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Contemporary Heritage Lexicon

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Cristiana Bartolomei · Alfonso Ippolito ·
Simone Helena Tanoue Vizioli
Editors

Contemporary Heritage Lexicon


Volume 2

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Editors

Cristiana Bartolomei
Department of Architecture
University of Bologna
Bologna, Italy

Alfonso Ippolito
DSDRA
Sapienza University of Rome
Rome, Italy

Simone Helena Tanoue Vizioli 
Architecture and Urbanism Institute
Universidade de São Paulo
São Paulo, Brazil

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Preface

About our time today:

[...] La mémoire est la vie, toujours portée par des groupes vivants et à ce titre, elle est en évolution permanente, ouverte à la dialectique du souvenir et de l'amnésie, inconsciente de ses déformations successives, vulnérable à toutes les utilisations et manipulations, susceptible de longues latences et de soudaines revitalisations [...]. Parce qu'elle est affective et magique, la mémoire ne s'accommode que des détails qui la confortent; elle se nourrit de souvenirs flous, télescopants, gloubaux ou flottants, particuliers ou symboliques, sensible à tous les transferts, écrans, censure ou projections (NORA, 1984, p. XIX).¹

Through a spectrum of different approaches, this publication proposes to explore the contemporary lexicon of cultural heritage in architecture, engineering, and related areas in ample and significant ways. They are presented as a contribution to preserving the past (re)thinking about the present and designing the future. This compendium contains texts by authors from seven countries: Argentina, Brazil, Spain, Italy, Iran, Portugal, and the UK in which they share their perspectives on heritage and its specificities.

From a multidisciplinary perspective, the publication seeks to unravel the complex relationships between creativity, technology, and sustainability within the context of cultural heritage. The book does not limit itself to tangible heritage but also explores aspects of intangible heritage, promoting a holistic understanding of the influences that shape cultural legacy. The collection offers a wide variety of texts, including detailed analyses of iconic historical works and exploration of the work of contemporary architects. In addition to these thematic axes, the publication covers research on the latest technologies, parametrization, digital modeling, augmented virtual reality, simulation, and artificial intelligence. Innovative concepts such as circular economy, circular design, and contemporary circular heritage emerge, further expanding the scope of discussion.

Cultural heritage, more than just a mere collection of artifacts, serves as a repository of knowledge, where perception and cognition of space foster a sense of

¹ NORA, Pierre. Entre Mémoire et Histoire. La problématique des lieux. In: **Les lieux de mémoire**. I La République, Paris, Gallimard, 1984. p. XVII–XLII.

identity and belonging within communities, ensuring the transmission of cultural values, traditions, and memories to future generations.

This publication aims to examine the various facets of preserving this heritage, considering the innovations provided by technological advancements and the commitment to documentation, including the initiative of the Ministry of Cultural Heritage (MiC) with the project “Italian Architecture of the Second Half of the 20th Century,” featuring an online platform for researchers and non-specialists.

Following the timeline of history, in Antiquity and the Middle Ages, materiality and form were predominant in building construction. In the subsequent phase, during the industrial and post-industrial eras, the debate on form persisted, now enriched by studies and practices related to new structures and materials. From the modern era onwards, attention intensified on geometry and construction processes, emphasizing the fundamental triad—structure, form, and function. In the contemporary scenario, we are experiencing revelatory moments of technology in design and construction processes; the construction dimension and the conceptual sphere manifest their presence. This impact is visible in mathematical applications using algorithms and software and in the ongoing debate on introducing artificial intelligence in architecture and engineering.

Contemporary architecture, in this 21st century, manifests a dynamic interaction between tradition and innovation, between past and future. In this context, the publication retrieves historical memory from the perspective of current reflections, including the study of the restoration of the Monastery of the Four Crowned Martyrs in Rome and the Church of Santa Maria Goretti in Mormanno (Italy). Several texts anchor their references to the transition between modern and contemporary architecture, as evidenced by the analysis of the bus station in Alicante (Spain). Others revisit postmodern architecture, highlighting the works of Paolo Portoghesi and Vittorio Gregotti (Marbella Swimming Pool, Spain) and the contributions of Rem Koolhaas (Casa da Música, Portugal). A phenomenological perspective also examines the works of Eduardo Souto de Moura.

Rapid technological progress has significantly impacted contemporary architectural practices, from using advanced parametric modeling tools to metaverse simulation. 3D printing and robotic construction technologies are revolutionizing our perception of architectural design and what we can achieve through digital fabrication. In addition to these topics, chapters explore the potential of augmented virtual realities applied in heritage documentation and education.

With the addition of laser scanning technology, HBIM (Heritage Building Information Modeling) revisits the importance of the analog model and significantly contributes to the documentation process, thereby enhancing the understanding and preservation of heritage. Digital models also play an essential role in documenting the ephemeral architectures of world fairs, as demonstrated by the Palermo Mediterranean Fair of 1950 and the Milan Triennale.

The texts contained in this publication cover various applications of HBIM, including the integration of BIM and Geographic Information System (GIS) in cultural heritage management, emphasizing the importance of interoperability between these two systems, as shown in the study of the University Religious Center

(URC) in Los Angeles. Another HBIM approach is present in the study of Luciana Natoli's projects, which can materialize concepts that the designer has never graphically represented. In the digital age, the modeling tools available in the most advanced graphic programs allow for creating continuous, fragmented, amorphous, organic, and topological forms. In this lexicon of contemporary architecture, parametric architecture assumes a prominent role, as demonstrated by analyzing works such as *The Broad* in Los Angeles, USA, and form research processes.

Texts that explore new digital mapping technologies, including studies on the Palazzo Cassa di Risparmi by Luigi Vagnetti in Livorno, emphasize the importance of such advancements. In this case, a digital survey followed by a critical redesign of the facades reveals significant variations in the composition of these structures along the square. Also noteworthy is the 3D digital mapping of the Venice Farm Chapel by Decio Tozzi, an expressive example of contemporary architecture in Brazil, and the study of the sports pavilion in Bastia Umbria, which discusses the transdisciplinary nature of representation provided by BIM.

The texts cover different scales, from the object to the building to urban interventions, as in the case of *Tactical Urbanism* in urban centers and the debate on skyscrapers that mark the landscape and development of Italian coastal cities. Some researchers apply new technologies to conduct specific studies, such as analyzing contemporary gates, railings, and bell towers, as exemplified in the case of *Loggetta* (Italy), or researching lifeguard towers on the coast of Miami (USA).

Other texts explore material, language, and geometry in facade design, as evidenced by research on facade masonry for the restoration of the Solimene Factory and the study of facade grids in the works of architects from Alberti and Terragni to the present day, with works by Herzog and de Meuron, Carlos Scarpa, and Aldo Rossi among the many presents in the texts. Architects and scholars also discuss the role of ornaments in contemporary architecture in the *Expressive Constructions*. Still, about facades, there are essays on compositional aspects related to kinetic and programmed art and applications of algorithmic modeling capable of generating thousands of possibilities for ornamental or decorative motifs.

In the context of technologies, the discussion ranges from the cognitive potential of freehand drawing and the creative limits of using AutoCAD to the creation of digital architectures for virtual experiences aimed at formulating hypotheses about heritage and providing digital immersion in historical spaces, as highlighted in the text on the architectural heritage of Rio de Janeiro. Isola Comacina's villas use 3D digital modeling, BIM, and Virtual Reality (VR) to present their information, which they can share via VR and web VR.

This publication also examines the field of Artificial Intelligence (AI) in architecture, exploring its role in optimizing work times and decision-making processes and generating various variations in design and materials. An important example is the study that uses an AI model to identify contemporary architecture in terms of morphology, stylistic features, and strategic aspects. This approach adds algorithmic capabilities to aesthetic requirements and the designer's role. In the electronic and digital age, the mathematical and numerical instrumentation of various software programs has served as a basis for innovative forms, triggering debates

between digital architecture and reality. The metaverse plays a significant role in understanding works and projects, as highlighted in the text on this *modus operandi*, as well as in the imaginative vertical cities conceived by Henri Ciriani.

Sustainability, the use of recycled materials, energy efficiency, and the conscious use of natural resources are also part of the lexicon of this collection. In this context, the study of Saint Paul Hospital stands out, which adopts a regenerative architecture approach that goes beyond mere sustainability, creating spaces that minimize negative impacts and actively contribute to the revitalization and regeneration of the environment. Additionally, this compilation comprises examinations and dialogues concerning the core tenets of the circular economy and its impact on shaping the current architectural discourse. This remodeling occurs through the implementation of construction processes that aim for complete waste elimination and the integration of carbon assessment, fostering a more conscious and sustainable approach to both building design and execution. Urban green areas studies include cities like Milan and the Citylife region, which showcase urban solutions designed by renowned contemporary architects such as Isozaki, Libeskind, and Zaha Hadid.

Advanced artificial intelligence algorithms mediate both the world of fashion and architectural materials, highlighting the multidisciplinary nature of this publication's approach. The publication presents studies exploring different materials and technologies in the design of iconic chairs, as well as visualizing the Rubik's Cube through digital models and designs. In the same artistic spectrum, themes related to urban art are addressed, such as the Recoleta Cultural Center in Buenos Aires, designed by Clorindo Testa, and a reflection on contemporary artistic interventions on the facades of historical centers in cities like Rome, Bologna, and Milan.

Sharing the richness and diversity of the themes in this publication and promoting a broader understanding will catalyze the construction of critical reflections and visionary proposals for heritage, architecture, and engineering in the 21st century. Interdisciplinary dialogue and exploration of technological frontiers are essential to guide innovation and shape a more sustainable, aesthetically enriching, and culturally relevant architectural future.

Due to the high number of contributions, the publication consists of two volumes.

Bologna, Italy
Rome, Italy
São Paulo, Brazil

Cristiana Bartolomei
Alfonso Ippolito
Simone Helena Tanoue Vizioli

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Digital Patterns: Textures and Geometries of Contemporary Façades



Giorgio Buratti and Luca Armellino

Abstract The continuous period of information technology growth, in synergy with new Digital fabrication techniques of building components, has reopened the debate on the architectural façade's role as a site of cultural production. The free forms of ornament are no longer antithetical to the building's constructive structure, but thanks to the study of complex patterns, they are designed and produced according to the same logic and with the same tools. The old opposition between structure and ornament is thus overcome, opening a range of new possibilities for interaction between function and decoration, volume and surface, supporting structure and building skin. Beginning with a historical analysis, this paper provides a systematically structured account of the evolution of the façade's role in contemporary international architecture's modern design.

Keywords Architectural languages · Algorithmic modelling · Pattern design · Façade design

1 Introduction

In the design process, drawing has always preceded construction activity. It constitutes a moment of organising ideas, managing resources, and forecasting results, which is made possible by using dedicated tools. The increased level of computer literacy that has characterised the turn of the millennium has forced designers and researchers to investigate the processes underlying daily computer use. This interest has led to the advent of a new phase of computer-aided design that has freed designers from the traditional modelling software constraints, which bring them to choose from predefined sets of formal possibilities that are subsequently assembled. The new approach envisages the generation of form through the drafting of algorithms, promoting a line of research in which morphology is not defined a priori but derives from a refinement process of conceptual, communicative and structural instances

G. Buratti (✉) · L. Armellino
Design Department, Politecnico Di Milano, Milan, Italy
e-mail: giorgio.buratti@polimi.it

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that leads to the result that best meets the expectations formulated at the outset. It is now possible to formally articulate repetitive, complex structures characterised by considerable morphological freedom that bring the study of patterns, understood as a conceptual and operational tool, back into vogue. There was thus a renewed interest in the principles of tectonics, ornament and decoration and, more generally, in pattern design, which had been absent from the architectural debate since Post Modern experience attempted to correct the excessive abstraction of the Modern Movement by promoting serial and modular constructions that allowed design flexibility and took more remarkable account of social needs. At the turn of the millennium, a new generation of designers moved from the deconstructivism of organic forms to an architectural current that does not derive building morphology from archetypal simplifications but from emerging relational structures capable of transferring to architectural characteristics typical of living systems such as adaptation, transformation and self-organisation. One of the research fields in which this investigation is particularly intense is the building envelope, perhaps the architectural element most directly related to the building's communicative functions. When standard features such as cornices, pediments and pilasters, entablatures, tympanums and portals become technically superfluous, the façade embodies the semiological role previously entrusted to the language of architectural iconographies. The digitisation of production processes, thanks to machinery capable of constructing the designed object in its whole or parts starting from its digital model, has endowed designers with new geometric or surface finishing possibilities, making the envelope the primary site of architectural expression.

Through analysing the facades' history and a series of case studies, the paper delves into the role of drawing in the configuration process of the external envelope, emphasising the relationship between digital technology and formal solutions. In particular, the study of the pattern, assumed in its meaning of an underlying structure, visible and invisible simultaneously, capable of articulating the logical elements necessary for the design elaboration, will be explored.

2 Material, Language and Geometry in Facade Design

Any representation results from conscious action aimed at describing or communicating events, artefacts or concepts, which uses a system of signs capable of returning meaning and significance according to a specific code. The code may depend on cultural development or historical–geographical context, but always with the function of extrapolating the meaning of entities and then referring by signification to reality itself. If a linguistic system can be applied to an organised set of symbols, in that case, the artefacts derived from the design process, as sign systems, can also be identified as language and analysed through semiological tools [1].

In the case of the designed work, signification also occurs through drawing, characterised by a dual nature where representation becomes an analogy of reality capable of explicating different values and meanings. Indeed, in any design, as much as it

is an operational process based on logic and reason, meaning is mediated through expressive forms that respond to visual and communicative needs. It follows that objects and architectures intentionally perpetuate semantic forms over time, which respond to a precise iconological code based on the articulated interweaving of function, morphology, and materials. Beginning with Vitruvius' *De Architectura*, there have been numerous historical attempts to systematise between these levels. While considering that even the organisation of space implicitly leads to meaning, implied or evident, in the specifics of the Vitruvian triad, the communicative function pertains to *venustas* [2]. This category best expresses the aesthetic values that lead back to the representativeness of architecture.

Therefore, the external configuration of the building plays a fundamental role in “telling” the architecture, declining specific languages following the theoretical formulations of the time. The exterior surface is the element through which architecture manifests itself, constituting its face in referring to the very etymology of the word (from the Latin *facies*), expressing its signifying component. According to Vitruvius, the facades of temples and public buildings fulfil their representative function through the precise proportional rules established by the system of classical orders, defining a method that is accepted, revisited and interpreted in the Renaissance as the starting point for the formulation of a language where the parts and elements articulate the overall design, giving it balance and harmony. The requirements of formal/compositional and constructive order are placed in the foreground, with them the need to pursue beauty, understood as the intellectual structure of relationships and proportions that govern ornament.

In the following Baroque period, orders and proportions are reinterpreted to emphasise the elements' plasticity, giving the façade the role of a scenic scenery. Movement of the masses, *chiaroscuro* contrasts, spectacularity and drama spring from a design strongly directed toward a dynamic perception of space.

The rise of neoclassical rationalism will consider these styles unreasonable because of a new ideal of beauty that surpasses natural elements, seen as imperfect. Amid the Industrial Revolution, the new conception is consistent with the Enlightenment context of the period. By assimilating traditional architectural bodies to constructive elements, facades are reduced to static elements, often characterised by considerable monumentality, especially in the later eclectic works. The neoclassical style describes a very long historical period but is distinguished by little capacity for evolution. From the point of view of composition, throughout the nineteenth century, there was increased philological attention to the use of historical forms and a richer and more expressive decorative language, which remains essentially classicist.

However, some essential reflections on the communicative and symbolic functions of facades by German theorists Carl Bötticher and Gottfried Semper are from these years. In 1840, Bötticher formulated the first distinction between what he called the “*kernform*,” or the basic structural features of architecture, and the “*kunstform*,” which represents the expressive qualities [3]. In the same period, Gottfried Semper published *Four Elements of Architecture* [4], in which he listed the “fundamental” elements of the built—the hearth, the roof, the enclosure and the mound—along with the four procedural categories of textile, ceramics, carpentry and masonry. In

interpreting the “Primitive Hut,” Semper establishes a distinction between the role of the structure, which defines and orders the interior space, separating it from what is outside, and the role of the covering as a site of exchange with the community (Fig. 1). For Semper, the ornamentation of the surface, expressed through the procedural articulations of his four technical operations, has always been linked to the cultural and material context in which the work is produced. The meaning of the four procedural acts relates intrinsically and circularly to the individuals by whom and for whom the surface is made. Facades are interfaces between individuals and communities, communicating with the outside world through techniques of symbolic expression.

In the early twentieth century, the very nature of the façade underwent further debate under the influence of abstract art movements such as Cubism, which supplanted the more representational art forms prevalent in the late 1800s. Fascination with new technologies, stemming mainly from automobile, aircraft, and ship-building innovations, promoted the so-called progressive spirit that saw excess style, decoration, or ornamentation as unnecessary waste when not shameful or criminal.

The modernist *zeitgeist* endorses research through technology and the study of space, as opposed to symbolism and stylistic eclecticism. The debate over surfaces, including material conditions of assembly and representation as a site of cultural expression, is at the epicentre of this rupture: the modernist facade becomes an abstraction, unadorned and representative of the progress of the modern era. Throughout the twentieth century, the objective nature of modernist detail was expressed by analytic drawing conventions such as axonometry and other oblique

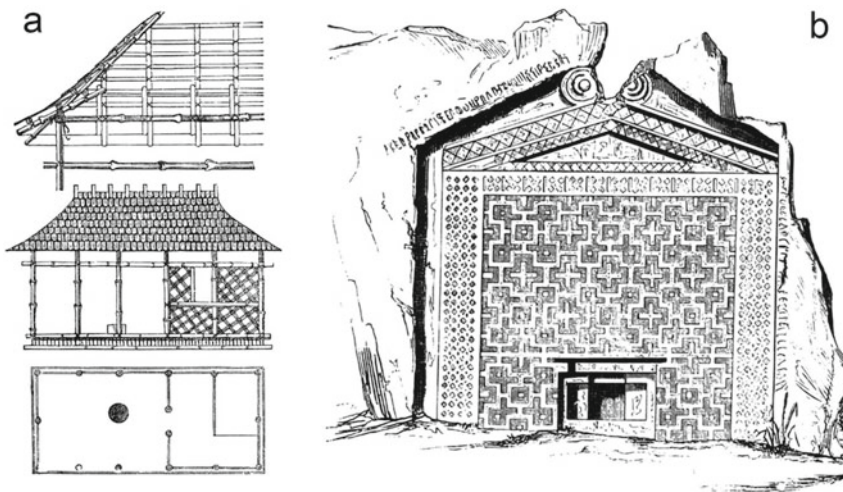


Fig. 1 a Primitive hut and Tomb of Mida (b), from *The four elements of architecture*, Gottfried Semper, 1851

projection techniques, which overcome the presence of an observer subject historically codified in architectural drawing by Renaissance perspective. Studying techniques specific to the medium helps untether architecture from the vicissitudes of popular culture and representational or expressive content design. The Modern Movement cleans up the stylistic remnants of previous centuries, focusing on spatial distribution to establish motifs disciplining principles of modern architecture, but at the expense of expressive and representational techniques that had historically formed the interface between architecture, context, and users.

In the 1960s, this disconnect led to a significant attempt at rebalancing by the Post-Modern current. The introduction of linguistic theory as a framework for exploring the meaning of architecture via its syntactic and semantic dimensions led Robert Venturi and Denise Scott Brown to study the potential of the vernacular and scenic architecture that characterises the Las Vegas Strip. This road, well known as the Las Vegas Strip, is a street between the municipalities of Paradise and Winchester, suburbs of Las Vegas, Nevada, known for having the largest concentration of larger hotels and casinos in the world. By confronting the pure abstraction of early twentieth-century architecture, Venturi and Scott-Brown's work overbearingly reaffirms the role of the façade as an expressive site, restoring the symbolic and expressive capacities of the architectural façade and re-legitimizing a revival of ornament and decoration as a legitimate disciplinary technique (Fig. 2). These arguments influenced the debate on architecture in the following years, evolving throughout the 1970 and 1980s into various approaches. Although architectural Postmodernism stalled but handily, with its claims of cultural engagement but its failure to produce radical change because of relying on images and symbols from the past, rather than attempting to extract new meanings for contemporary users, it laid the groundwork for a new vision of the built environment and architectural space. The influence on future trends, although these did not necessarily follow its principles, such as Deconstructivism or Blob architectures, can be framed in the search for new languages that seek to liberate form, no longer conditioned by past concepts of order, alignment and symmetry, but through unconventional articulated morphology, contrasting juxtapositions, and highly plastic materials. And it is precisely to control this morphological complexity, or because of it, that a new logic emerges, based on information technology evolution that promotes a further period of innovation: the Digital Design age.

3 Pattern, Software and Digital Fabrication

In the 1990s, with the spread of digital drawing technologies in design schools and professional practice, the design community witnessed the rapid development of formally complex architectural visions. In contrast to Semperian tectonics principles, which focus on material and production characteristics, new morphologies are obtained from digital surfaces devoid of volume and thickness, free from gravitas, and capable of remarkable formal properties.

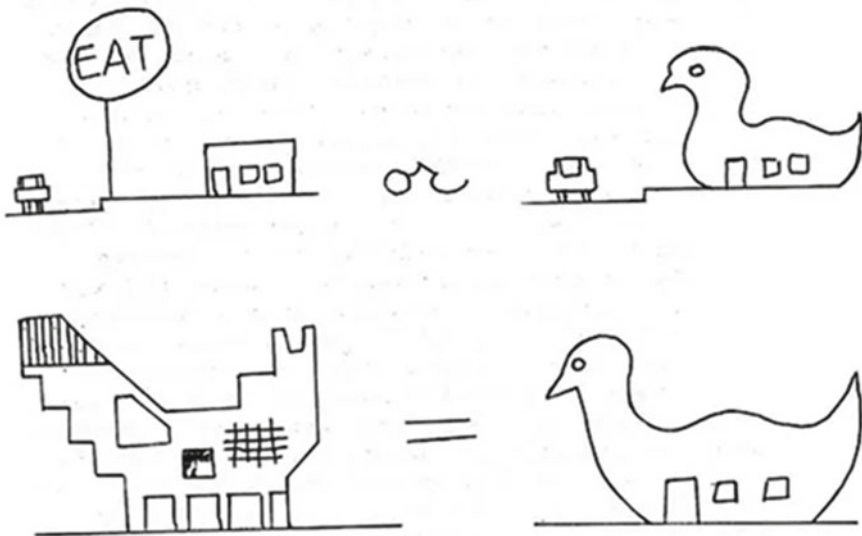
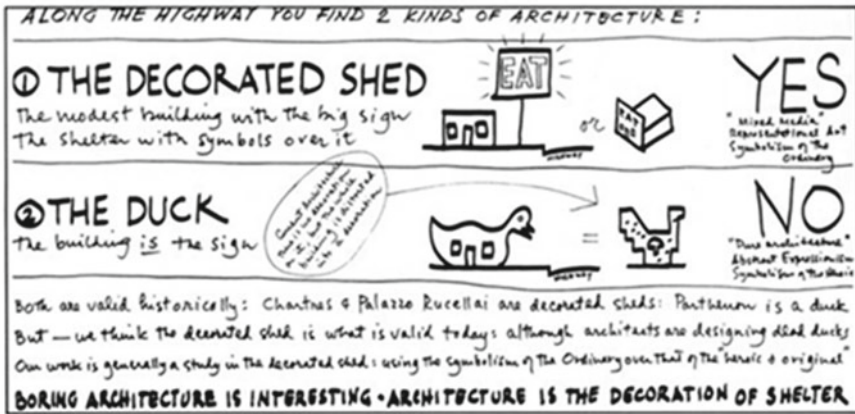


Fig. 2 A building as a sign, Venturi R., Scott Brown D. and Izenour S., Learning from Las Vegas, 1972

However, by the end of the decade, a series of rough translations from the virtual to the real world highlights the difficulties of making such complex shapes, characterised by seamless curvatures that make their fabrication complex. The introduction of Computer Numeric Controlled (CNC) fabrication technologies in the late 1990s solved the problem thanks to machines capable of building the designed object, globally or by parts, from its digital model. The new technology promotes panelling, a method to discretise complex surfaces into smaller components that can be constructed and combined into larger assemblies, achieving the sinuous continuity

of the virtual equivalent. This process is known as Digital Fabrication and requires no interpretation other than that of the designer, as the file is prepared at full scale and fabricated without the involvement of intermediaries, offering unprecedented control over full-scale manufacturing processes and providing access to a wide range of precise technical operations and material applications. This intense technological and material exploration has realigned the virtual with the real, unifying several once-scanned design moments such as drawing, dimensioning, and construction [5].

Technology is strategically harnessed to coordinate geometry, material and performance (structural, decorative, symbolic). There is a move away from smooth, continuous topologies in favour of composite and more articulated facades, evolved through patterns that incorporate technical and expressive functions and manage levels of complexity hitherto impossible to attack. The design defines an ordered repetition of a set of forms; it is an abstract device capable of describing and organising the relationships among the components of a system and determining its essential characteristics [6]. Its repetitive and redundant nature allows for gradual variations, making it capable of adapting and responding to changing conditions. Its distinctive network organisation dissolves the boundaries between seemingly separate aspects, integrating them into a structure that allows them to interact. The essential properties of the pattern depend on the relationship between the entities and do not belong to any of the individual parts. These properties are lost if the system is dissected, materially or theoretically, into isolated elements. The digitisation of the design process helps to manage the relationship between relationships and processes by making the form interact with the conditionals of the physical and production context. Still, in itself, more is needed to integrate the cultural characteristics or social aspects that are essential to the achievement of formal coherence. Pattern is the conceptual tool of the new era, capable of producing the interaction and integration between different levels of design [7].

Indeed, the abundance of patterns in today's facades is symptomatic of recent construction innovations: increasingly efficient building cladding systems and stronger, thinner and lighter materials organised in inexpensive modules. At the same time, thousands of differentiated patterns can be generated in no time thanks to algorithmic modelling applications. The definition of algorithms in the generation of the form is inseparable from the systematisation of the design: fundamental is not so much the knowledge of the programming language, an algorithmic process can do without the use of the computer, but *forma mentis* capable of deducing and analysing the steps leading to the result. Knowledge of geometry should not be confused, as is often the case, with the computational tool. Managing thousands of data related to a problem and optimising them according to any criteria is a job that the computer does effectively. However, the computer cannot establish the generation rules; the designer must formulate these. Among thousands of possibilities, we see the return of the natural and/or expressive organisations of ornament and the focus of the communicative plane of the surface. The following examples reaffirm the centrality of the façade as a site of cultural expression and engagement, capable of claiming the expressive potential of architecture: from reflections on the relationship with society

to interpretations of the exchange with the natural environment to the deployment of solutions that reflect the themes of contemporary culture.

4 New Digital Patterns

The following projects present different formal solutions based on the relationship between material articulation and meanings expressed by the façade. Although no accurate taxonomy exists, each of these examples identifies recognisable approaches.

Hild und K Architekten's design of a family house in Aggstall is based on conventional construction techniques reinterpreted through the introduction of patterns and formal motifs. This strategy is most in line with current discussions of ornament in an attempt to establish a symbiosis between the material conditions of architecture born of necessity (e.g., structure and function) and those driven by different aesthetic and formal qualities. This combinatorial act unifies the functional and ornamental capacities of the surface into a new, unique but dualistic entity, echoing Louis Sullivan's assertion that a "*decorated structure, harmoniously conceived, well-considered, cannot be stripped of its system of ornament obviously benefit from this sympathy, without destroying its individuality*" [8]. The façade of the family home is designed to simulate in a novel way the *chiaroscuro* patterns that distinguish traditional dwellings in this region of Germany (Fig. 3). This particular pattern is traditionally used in the area as a decorative element for utensils and clothing and lends itself well to the peculiar constructive use of bricks. These parallelepiped elements of regular shape and size promote better bonding through mortar, which increases cohesion between the pieces, making the structure monolithic. Used on sight, they create a pattern identified by the texture of the joints and the relationship among the sides of the brick. This modular element subordinates compositional possibilities in texture and plastic articulation. The pattern is imposed on the piece's modularity that provides the uniformity of the surface signs in a recognisable repeated module as a logical consequence of the face constant dimensions. It is thus possible to repropose a traditional ornamental pattern through the alternation of light and shadow created by the different arrangement of the same piece protrusion without resorting to other forms and materials. Evoking Semper's claim for vestigial indices of technique and materiality derived from construction procedures, Aggstall's house appropriates and interprets the fleeting effects of light on the walls of the Bavarian country house as a repetitive pattern that, in turn, affects the material organisation of the wall itself. The second approach involves the materialisation of images, establishing a new tension between the narrative and representational qualities of figuration and its ability to be used as an architectural element. This approach is particularly evident in the work of Herzog & de Meuron who, since the late 1980s, have deepened the application of figural images and motifs to building facades and interior walls. Some of H & deM's best-known works are based on serial repetition and abstraction of a pre-existing image to introduce new material sensibilities into the work. In the De Young Museum, San Francisco (Fig. 4), the idea of surrounding vegetation is transferred and

adapted through numerically controlled machining to the copper cladding through a process of disfiguration that transforms the image into a new entity. At the time, this mosaic algorithmic process was emerging but was undeveloped in using perforated and embossed metal. The architects worked with Zahner, a company that produces highly crafted architectural metalwork, whose engineers and software specialists developed a dedicated system called ZIRA (Zahner Interpretive Relational Algorithm), which would allow unique perforation and patterned dimples, variably sized and placed throughout the exterior. ZIRA technology was developed to streamline a complex series of holes in the copper, allowing engineers to run chosen imagery through the algorithmic system and translate it, by robotic process, to the thousands of copper plates. This included nearly 8000 unique facade panels—the collective whole which formed light patterns as seen through trees. There are approximately 1,500,000 bumps on the surface, with four levels of bumps that go in and four levels that come out. These bumps, along with the flat plane, result in nine different levels of surface texture.

Architects originally called for a light golden-hued appearance for the Museum. However, as the intentions evolved, a desire for the Museum to blend and emerge from its forested surroundings like an ancient indigenous structure. Understanding how copper alloys transform over time and the integrity and durability of the material was critical to the selection process. The cladding was thus designed so that over the decades, the copper facade and roof would transition from bright golden red to dark brown, finally blending in with the landscape's dark green.

The precise control enabled by the digital fabrication helped it simulate the effect of light caused by foliage and optimise the building's thermal performance by controlling the environmental conditions resulting from its oceanfront location. The third approach is surface discretisation, the one closest to traditional tectonic principles in using more or less heterogeneous components to achieve large-scale coverages. Rather than repetition, the patterns used with this method are based on variation, using tiles of different shapes and sizes that recombine into a result more significant than the sum of the parts. The facade design of the Liberal Arts and Science College in Doha, Qatar, by Arata Isozaki & i-net + Cat, is a typical example of a discretised surface that responds to climatic and cultural needs at different levels. Responding to the extreme sunlight and hot humid weather, the entire building is wrapped by a secondary skin, double roof and double wall. The intense sunlight is reflected and diffused between the two layers, bringing into the space soft bright light (Fig. 5). The double wall is constructed from GRC panels, offset 1 m of the inner wall. The chosen decorative motif harks back to the quasi-periodic structures found in recent times in some classical motifs of Islamic art, which anticipate Penrose's findings [9], allowing a planar surface to be covered randomly with only three tiles. The quasi-crystal pattern is applied to the panel, and each panel is suspended by a stainless-steel cable 50 mm apart from its adjacent panels. This process reduces the heat load of the building as well as adds aesthetical value. The façade reveals itself differently throughout the day concerning the sunlight movement: the inner side of GRC panels are yellow, and the reflecting sunlight between the two walls projects the colour onto the inner wall. The same decorative motif, used as separating



Fig. 3 House in Aggstall, Aggstall, Germany. Design Hild und K. Architekten. Dappled lighting effects on the surface mimic similar qualities seen on local buildings' irregular plaster-rendered masonry façades

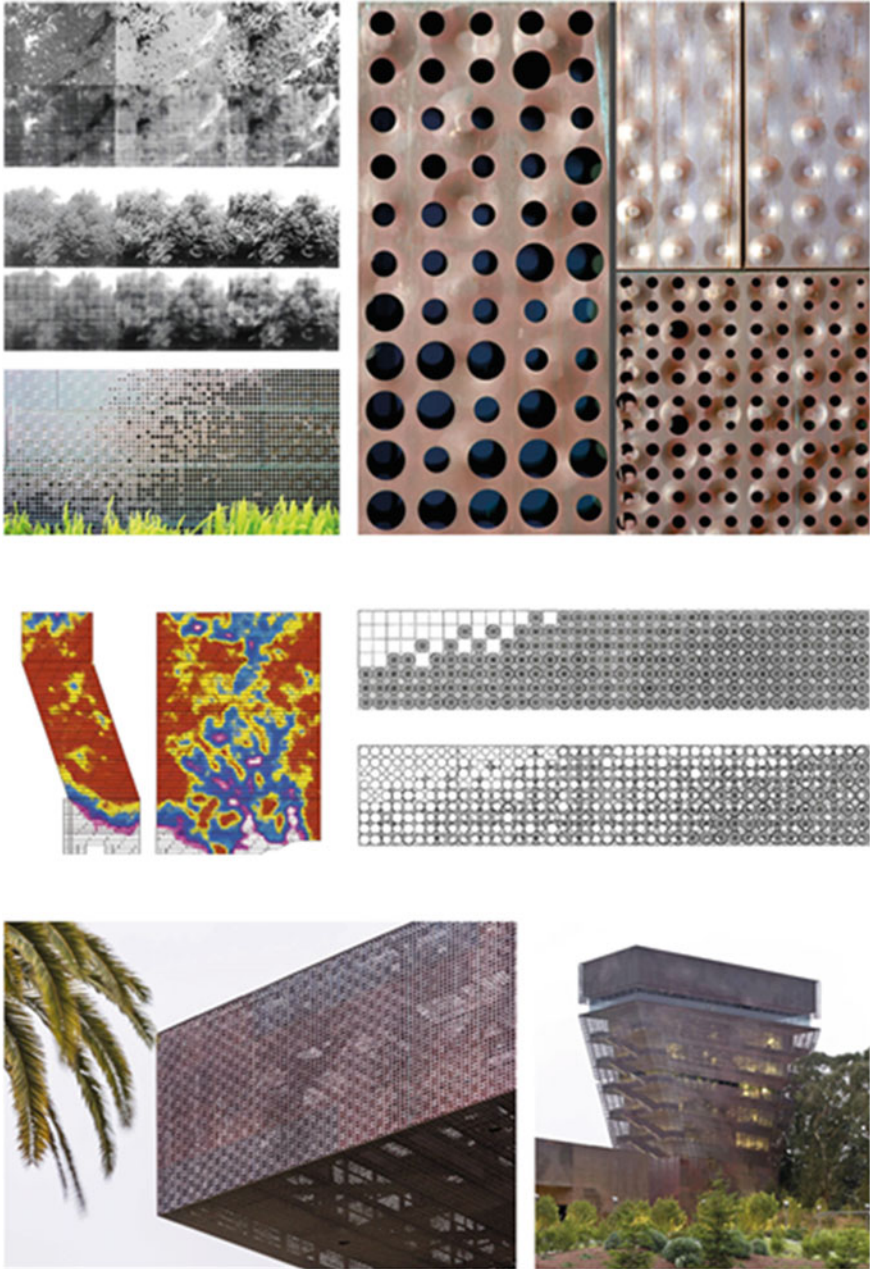


Fig. 4 De Young Museum, San Francisco, USA. Design Herzog & de Meuron. Abstracted photographs of tree canopies were superimposed onto each tower elevation to replicate the effect of light flickering through a canopy of leaves. Light apertures- circular perforations in the sheet metal—are different in diameter and spaced to allow building thermic regulation

grids, characterises the interiors, unifying light control with the formal languages typical of the region.

The fourth and final approach involves the visual and immaterial function of the facade, with no connection to the underlying geometry, used as mere support. The graphic logic of these projects needs to be more specific to semantic content and disinterested in production techniques, focusing on the immediate effects of representation. Involvement in these projects is manifested through the production of atmospheres and moods, as exemplified by the work of the design collective *Splitterwerk*, which, since the mid-1990s, has built its practice around the desire to engage the viewer through projects close to performance art. Focusing neither on formal manipulations of volume nor material organisations of the surface, *Splitterwerk*'s ideas emphasise ambiguity through patterns that use colour and marks to distort perception. Thus, in the *Frog Queen* (Fig. 6) in Graz, Austria, the pixelated surface of the architecture is designed to mystify the form and volume of the building itself. Although from a distance, the different panels appear to be coloured in shades of grey, they have imprinted images of gears and mechanical mechanisms, the production activity of the client. Even the essential elements of architecture, such as doors and windows, disappear, absorbed by the aesthetic motif of the facade.

5 Conclusions

The architectural façade has been a source of disciplinary discussion and critique for a century and a half: from Semper's expressive cladding through the purity of the modernist wall, from the billboards of Venturi and Scott Brown to the sinuous plasticity and complex articulation of contemporary façades. The continuous and unstoppable evolution of the computer tool has contributed to various themes and possibilities for entering the conceptual framework, from the figures and embellishments of ornament to the symbols and narratives of decoration to the performative effects of material assemblages. A century after Adolf Loos's critique of ornament [10], it is possible to return to questioning the nature and role of language as a central rather than peripheral condition of design practice. To speak of meanings seems contradictory in today's context of increasingly efficient products and services of high-performance materials to Building Information Modeling (BIM). Still, without denying these innovations' disciplinary or professional contributions, the search for figuration has become an equally important aspect of today's architectural culture.

In today's scenario, abundant ornamental or decorative patterns would seem inconsequential to recent technological innovations. These range from efficient covering systems, organised in lightweight, cost-effective modules that are increasingly high performing, to algorithmic modelling applications capable of quickly generating minimal differences among thousands of possibilities, making pattern selection, not to mention pattern recognition, an increasingly daunting task. So, with so many patterns available, the question is not which ornament to choose but rather why.

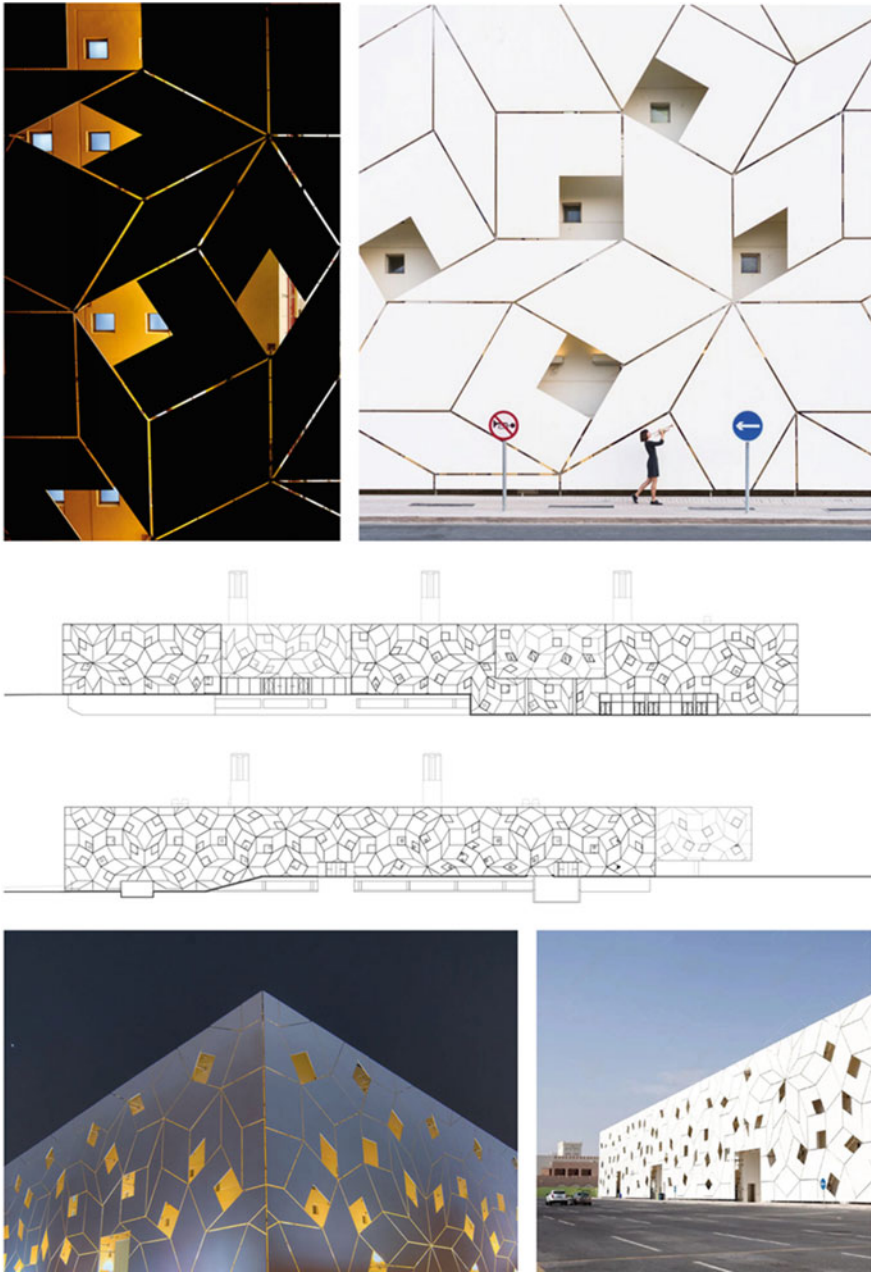


Fig. 5 Liberal Arts & Science Building, Doha, Qatar. Design Arata Isozaki & i-net + Cat. The design of the two-layer structure responds to the extreme climate; a secondary skin of GRC panels wraps the entire building. An aperiodic pattern evokes the mosaic-like layout of a typical Islamic city

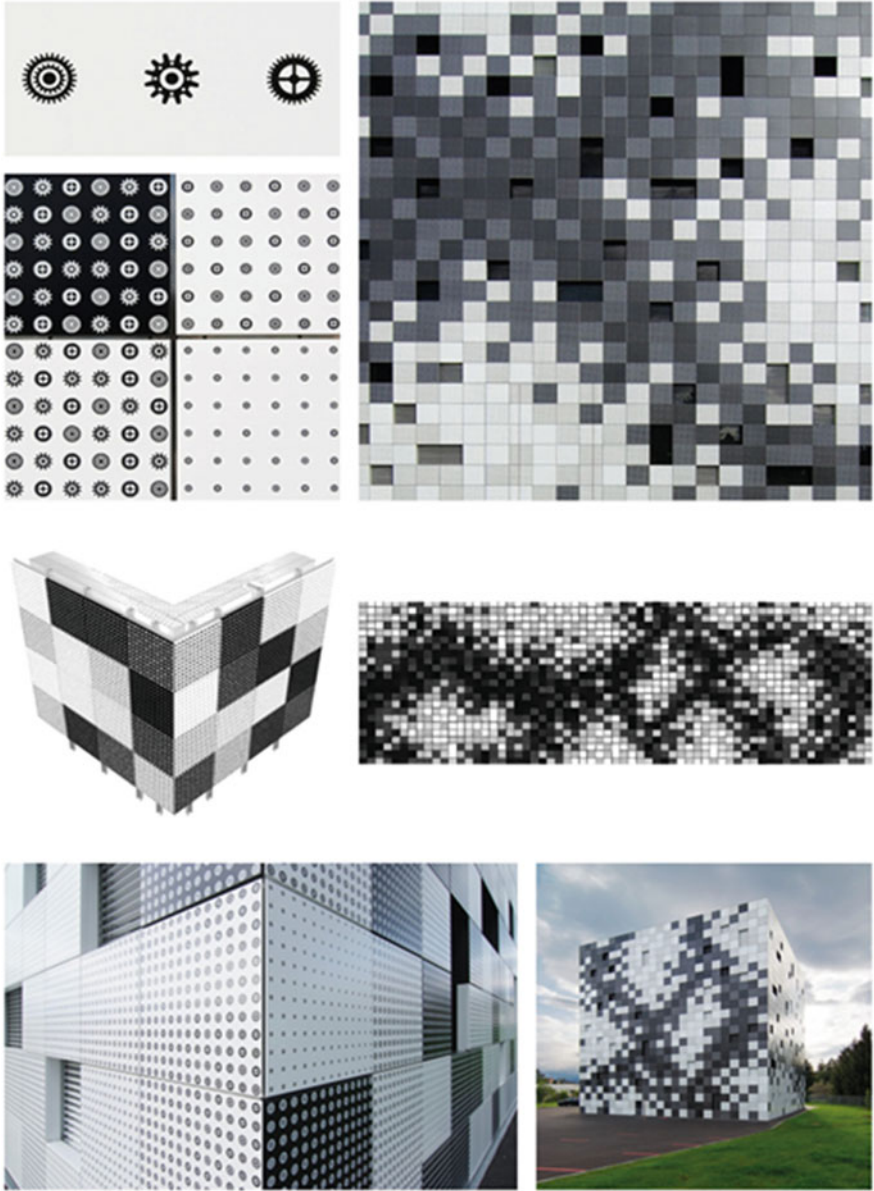


Fig. 6 Frog Queen, Graz, Austria. Design Splitterwerk. The multi-tone pixelated graphic visually dissolves the crisp edges of the building volume. The silk-screened figures are gear wheels of the precision work inside the building

To answer this question, this paper has examined a heterogeneous group of projects and practices that depart from the historical experiences analysed in the first paragraph. The projects considered can be grouped according to the combination of matter and significance, the intrinsic conditions of ornament or decoration that the surface coordinates. It is thus possible to derive four approaches defined as “integration, materialisation, contradiction, and disinterest” [11].

For example, Hild und K Architekten’s Aggstell house brick shell design establishes a symbiosis between structure, function and the aesthetic and formal qualities that bring together brick assemblage and the domestic shelter’s textile nature. This strategy of “integration” seems to recall Sempere’s claims for vestigial indices of technique and materiality derived from construction procedures, developing the connection between the building’s tectonic nature and the cultural language of textiles and tools.

The second approach involves the “materialisation” of images that establish a tension between the narrative and representational figuration qualities and its ability to be instrumentalised as an architectural element. Herzog & de Meuron’s work for the De Young Museum in San Francisco translates the image of the greenery through the palette of materials and workings that cover the building. The representative qualities of the image are neutralised; the original figure is reconstituted as an intensive material texture that contributes to the effects of spatial depth.

The third approach to the relationship between meaning and material composition can be defined as “contradiction.” Referring to Venturi’s experience, which articulated the surface on the basis of signification rather than material determinism, architects working along these lines reintroduce relevant expressions of popular culture into architecture. Thus, in Arata Isozaki & i-NET + Cat’s Liberal Arts and Science Building, the cultural narrative is the basis for reinterpreting a typical Islamic city, an assemblage of small housing units with patios. The space of this building is organised by “Summer Patios” (interior atriums) and “Winter Patios” (exterior courtyards) located consecutively, resulting in a mosaic pattern. A series of significant figurative elements overlapping to compose the building envelope also recalls the geometric pattern culture of abstraction and innovation typical of Islamic art.

“Disinterest” is the fourth and final approach referring to designs in which surface articulation is graphic and immaterial, unrelated to the underlying architecture. Indifferent to the legibility project and production technicalities, these projects focus on the immediate effects of graphical content. The work of the Graz-based design collective Splitterwerk builds its poetics by focusing neither on formal manipulations of volume nor on surface material organisations but by emphasising image over detail. Thus, in the Frog Queen in Graz, Austria, the pixelated surface of the architecture is designed to mystify the form and volume of the building itself.

The return to expressive techniques is a means that denotes a desire to connect with a broader audience, which only sometimes responds to abstract forms and theoretical spaces. The symbolic aspect has arguably become intrinsic to the materiality of contemporary architecture, while the physical composition and production of building surfaces continue to influence the scale and nature of the cultural effects of architecture. With the aid of computation, novel forms, materials or constructional

methods evolved, allowing new possibilities to realise a built structure. In all the proposed examples, the design included digital aids to create new Digital Tectonics [12]. This last is not the mere inclusion of technology in architecture or an updating of a traditional term, but it is a way of thinking about architecture that considers the building as a system and evaluates the building qualities linked to emotional, psychological and aesthetical aspects. By intersecting these components, a new “complex order” [11] emerges that sees the deepening of facade qualities as an essential theme for the discipline’s vitality.

In developing this paper, Giorgio Buratti wrote all the chapters, while Luca Armellino integrated the chapters Intro and Conclusion and drew part of the illustration.

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