ALTA SCUOLA
POLITECNICA
POLITECNICO DI MILANO | POLITECNICO DI TORINO

PROJECT / 9TH

CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI TORINO

Partnership with public and private institutions, network between territories, supporting to innovation and research are main objectives for the Torino Chamber of Commerce which promotes the economic development and the local businesses growth.
The Chamber offers a wide range of services to more than 231,000 companies working in the province and listed in the public Register of Enterprises: training, technological innovation, collection and distribution of information, fostering of business relations at home and abroad, creation of services and financing of projects designed to assist new businesses, promotion and organization of events, access to financing, information and consultancy for companies involved in foreign trade.
A particular attention is dedicated to the different levels of education, from professional courses to post-university Masters, with a special focus on high education systems and international training, which represent a significant tool for the attractiveness and worldwide relations, together with the solidity of the industrial fabric, the pro-business mood of the public administration, the quality of life in a creative, cultural and artistic context.
This is the reason why the Torino Chamber of Commerce, years ago, decided to cooperate with the ASP, the advanced international Faculty, founded by Politecnico di Torino and Politecnico di Milano, to enhance links between the two cities.
Italian Chambers of Commerce work to build local area networks between research centers and enterprises, individual enterprises, institutions, territories and cities, as well as technological networks.
Torino, Milan and Genoa Chambers of Commerce support the development of North-western macroeconomic region by means of projects.
Figures are significant: north-western Italy (Piemonte, Lombardia, Val d'Aosta and Liguria) is one of the European biggest areas, with a population that nearly amounts to 16 million people and 1.583,000 enterprises. It is an integrated territory that can proudly compete with the other European polycentric regions.
The North-western region needs economical and infrastructural actions but also stronger cultural relations, focusing in particular on art, education and organization of international events, as Milano Expo 2015.
In addition Torino Chamber of commerce will host the 9° World Chambers Congress in June 2015. The Congress is the only global event gathering Chambers' chief executives and businessmen worldwide to exchange best practice, to widen network and develop projects to support SMEs. A new challenge for the Torino Chamber of commerce and for the city itself.

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Summary

PIA_A

Playing Architecture,
a prototype of a smart public building

Project 1

Playing Architecture

PIA_A

Playing Architecture, a prototype of a smart public building

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Siemens Spa

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Claudia Tesei
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Project description

Smart buildings are the basic cells of the smart cities, they are the architectures with high technological level that allows cities to evolve with a clever and connected infrastructural grid. This is the concept that moved the ASP team to prototype a small building, a clinic to give basic health care in a quartet, sustainable and energy independent. The idea that guided the insertion of these small buildings in developing countries' slums (the case study is New Delhi) is guarantee a low distance from all the points of the area. In fact having high accessibility in terms of time and space is crucial in a crowded area where people move by foot or by bike and physical obstacles for cars are everywhere. In this way a mother will be able to give birth in adequate conditions, children will be cared for injuries, elder people will receive assistance without moving so much.
The building produces the energy to satisfy its own requirements using rotating photovoltaic panels and thanks to the yearly insolation trend has a surplus for the great part of the year. This energy will be used to provide additional services to the population, as purification of water or small charge access points easily usable by the open porch. Energy is considered as a starting point to improve social conditions, is generated locally by buildings that become small power plants, fully sustainable by using solar energy and eliminating the pollution. In the future this could be a direction to reduce the environmental impact and the pollution of big regional power plants, through a grid of small production unit able to provide energy in capillary way with a low impact also for the esthetic point of view.
Another crucial aspect of the project is the construction process of the building, in fact is quite completely prefabricated in a central place of the studied area to make easier and fast the following assembly phase in the locations of the clinics, inspired by an IKEA logic of macro-object. The packaging project is thought to be adaptable to the transportation constraints of the case study. In New Delhi the elements are produced and packaged in boxes suitable for small jeeps, the biggest way to access the tight and chaotic streets of the slums. The building is made also of local materials and involves local producers in the developing process of the area.
In conclusion the project is thought to answer the innovation challenges to

develop the smart cities, focusing on the extension of this concept to not already developed areas. Smart buildings as our prototype will have a key role in the future evolution of a world ready to face great environmental and energetic issues.

Tasks and skills

Architecture:
Matteo Novarino, the group architect, managed the general organization of the building, merging together the work of the other specialists in the group, harmonizing all the elements in the overall prototype. He worked in tight collaboration with the structural and energetic engineers in order to evaluate all the different alternatives, giving also feedbacks on other members' decisions, evaluating their consequences on the overall system and their integration in the general prototype.
Structure:
As structural engineers, Marina Canala and Claudia Tesei concentrated on the design of the clinic structure, always interacting with the other project aspects(energy and architecture) in order to optimize the structural element sizing. Their most courageous choice has been the adoption of bamboo as structural material, intended to provide a more sustainable and cost effective solution.
Energy Supply:
Federico Minoli and Gianluigi Ferrari are energy engineers and took care of the requirements of the building for what concerns electricity and thermal supply. The implementation of an innovative photovoltaic tracking is their answer, but the integration of the energy system with sustainable architecture and structure is another key element they used to create a smart building.
New Delhi Case Study:
As an Urban Planner and Sociologist, Rachel Izland focused on the case study, applying the project to a real world context and optimizing the social aspects.

Abstract

The challenging goal of the project is designing infrastructures to provide fundamental services in developing countries, in complex situations such as slums or bidonvilles, inserting buildings able to produce energy where it is needed without transportation. The practical idea is to implement several small, prefabricated clinics to have a fast, cheap and sustainable solution but also be able to provide health care for a long period and offer a starting point for local development.
From the structural and architectural point of view, we try to respect local construction tradition, energy issues and structural requirements. To do so we compare different solutions for each building element (envelope, roof, openings, structure etc.) in order to give different possible configurations and features suitable for different situations all over the world. By doing so we give our stakeholders the possibility to choose among different features in order to make the building suitable for different situations all over the world. After the comparison, we have focused our case study in New Delhi, deepening the solutions that are more suitable for our location, according to their availability and respect for the context.
The other main requirement is sustainability, which means satisfying all the energy needs with green energy (considering that slums do not have electricity). To reduce the energy demand we use passive cooling strategies together with high insulation and we implemented an innovative photovoltaic system. It consist in an automatic azimuth tracking of the panels, obtained using turntables originally thought for cars exhibition, because innovation is not only inventing something new, but especially considering and combining technologies from a different and constructive point of view. The continuous interconnections between our disciplines during the design allowed to create a coherent concept, with a global implementation model but also a local approach in the development of the particular solutions for the case study.

Understanding the problem

Our project started with the conception of a sustainable public building, such as a school or a medical clinic, that could provide a stimulus to the surrounding community. The building was intended to provide essential resources to the population, such as technological resources, electricity, special services and also job opportunities related to its realization. In this way, the building could act as a catalyst for the further development of the neighborhood.

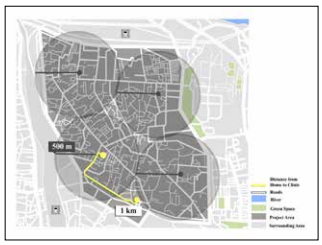


Figure 1: Clinics position and walking distance

Figure 2: a street in Delhi

The specific case study location in New Delhi, India, was selected for a variety of reasons, primarily involving environmental and economic conditions. For instance, India is sufficiently developed in order to provide access to local materials and industries that can be used to develop the essential elements of the project, such as steel, bamboo, and cladding materials. Special consideration was also given to the proposed function of the building. A medical clinic was chosen as opposed to a school because of the high-tech nature of our building makes it is more suitable and cost effective as a clinic. Moreover, the basic health care is a tricky issue and one of the first requirements to achieve a real development of India.
The specific slum chosen for the case study is an area in New Delhi of 6 km2 ,located near the center of the city, bordered by the railway tracks. The slums are a primary choice for the location of the clinics because of the high density of the living conditions and the lack of hygiene services, meaning that this population has a need for the kind of basic healthcare that our clinics are designed to provide.
The project stakeholders include local governments, humanitarian aid organizations, environmental organizations, architecture and technology companies.

Exploring the opportunities

A fundamental challenge in the project was the desire to design a geo-

graphically versatile building while at the same time minimizing the transportation of materials. These two desires were in some ways contradictory, since the need for geographical versatility suggested a prefabricated design that would be manufactured off site, while the desire to minimize the transportation of materials suggested the use of a highly customized design using local materials. Although our research into existing solutions found projects that either focused entirely on local materials and construction techniques, or projects that employed a standardized, prefabricated design, we did not find an existing solution that resolved both issues. As regards the structural aspects of the clinic, this contradiction has been faced evaluating the possibility of adopting usual materials, as reinforced concrete or steel, and local ones with a high availability in India as bamboo or a combination of them.

Another important aspect of the project was the development of an energy production system able to combine high output and economical feasibility. The goal of sustainability and the possible absence of grid connection made us opt for solar panels. The process involved optimizing the tracking possibilities in order to maximize the energy output in the most efficient way. In this direction several configurations were investigated using the simulator PVSyst, to understand the gain in energy production and compare it to the additional costs.

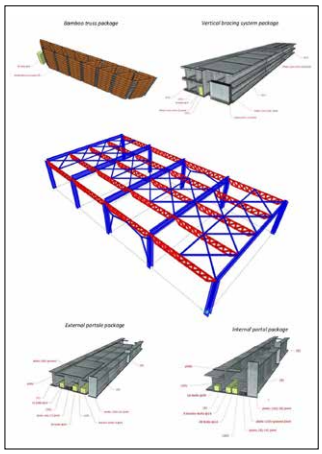
Generating a solution

We have attempted to develop a combined solution using a partially standardized and prefabricated design, while at the same time allowing customizable elements for every case study.

In this sense, as regards the disposition of the structural elements, flexibility has been assured by proposing the possibility of choice between different materials. Although the principal structure, composed of 5 portals, is realized entirely with steel profiles, for the secondary structure the opportunity of adopting a traditional material for Delhi like bamboo, arranged in truss beams, is offered as alternative of steel simple beam-sections. Although both the materials are locally available in India, the mixed bamboo-steel solution has been found preferable under several points of view: bamboo adoption not only allows both to cut costs and to satisfy better the environmental sustainability requirement; combined with an high tech way of assembling culms, it is also expected to encourage improvements in the local building culture towards safer construction techniques. In addition, a complete packaging of all the members, divided according to their specific function in the structure, is provided, aiming at both assuring the transportation feasibility in the narrow slum streets (maximum length for a single component of 4m) and making simpler the assembly itself for not specialized manpower.

The possibility to make small changes to the general prototype makes our prototype not only a smart building, but a customizable set, using “ikea” slang, which can be used in very different situations with small changes, cutting costs thanks to pre-cast constructive systems and use of local materials.

Figure 3: overall structure and details



We then focused on the New Delhi case study. We did so after a general evaluation which took into account different aspects, from economical and qualitative to energetic and constructive ones. We decided to use coconut fiber for insulation, a locally produced material which is therefore very cheap and easy to find. We then adopted corrugated metal sheets to clad our building, a cheap and easy to substitute material which allows us to face different problems related to durability in difficult areas such as slums. In order to improve the energetic behavior of our prototype we use natural ventilation strategies, first of all putting windows on the roof, decision which allows us to exploit a better natural air circulation inside the building and, at the same time, overcoming the problem of light in a very crowded area. Of course these strategies are not sufficient to satisfy the energy demand of our building, that’s why we carefully evaluated a series of active strategies to provide enough energy without the need of grid-connection.

Figure 4: cross-section of the clinic

Thus the original idea of a public building acting as a social stimulus developed further into the concept of a diffused power plant. The diffused power plant concept involves high-energy producing buildings, keeping energy production inside the city and reducing the need for energy transport, creating in a practical way the concept of smart city.

In this perspective, the energy supply concept is producing an high amount of energy in a small area, to guarantee high reliability and standards of health assistance. The simulations revealed that two interesting configurations to deepen are the seasonal manual tracking, which is simple and involve manpower only twice a year, and the automatic azimuth tracking that has performance (up to +27.8% of yearly energy compared with the fixed solutions) very close to the expensive full tracking. To make the automatic azimuth tracking simple and cheap, we thought to use rotating platform originally intended for cars exhibition. Their features can match our requirements and we hope that more in-depth analysis could be a natural follow-up of the project for stakeholders interested in this cross-industry combination of technologies.

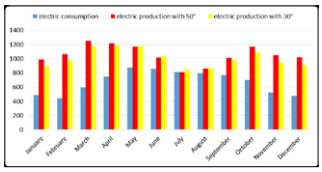


Figure 5: Energy consumption and production with different tilt angles

The idea has been implemented for our case study, considering the electric medical devices and the lighting to understand the consumption of the clinic. Moreover, there’s an heat pump to convert electric energy produced by sun in heating and cooling. This phase has been developed together with the choice of envelope characteristics to find a composition of materials and layer with good thermal properties. The final solution provides considerable energy surplus for the great part of the year; purification of water and free wi-fi are proposed as possible additional services for population.

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