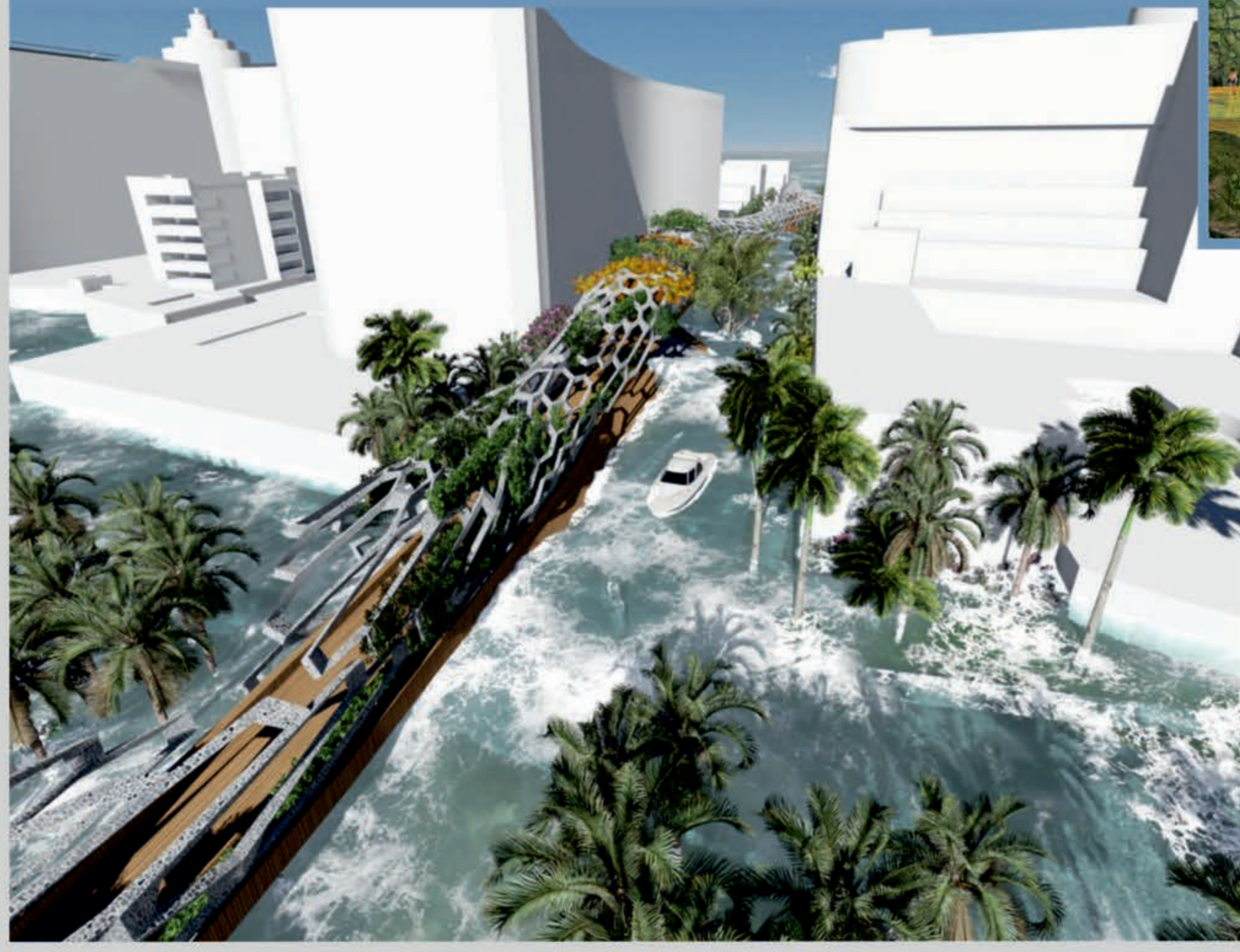
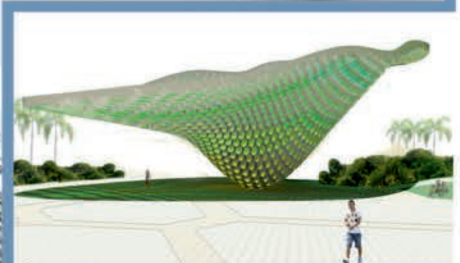
Climate Responsive Architecture

Climate change adaption and resource efficiency
Adattamento ai cambiamenti climatici ed efficienza delle risorse





Gianmichele PANARELLI
Clarissa DI TONNO
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Nuova serie di architettura
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MIAMI BEACH
D9 Carbon Neutral Hybrids for Miami Beach
Florida International University (FIU)
College of Architecture + The Arts
Miami Beach Urban Studios (MBUS)

The Present work has been developed at College of Architecture + The Art FIU (Florida International University) of Miami as part of activities the exchange of teaching and research with the Department INGEO of University G. d'Annunzio Chieti-Pescara. March-April 2015

FIU | Architecture + The Arts
Florida International University

UdA
Università degli Studi
G. d'Annunzio Chieti Pescara

GROUP OF WORK

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INTRODUCTION

Francesco Girasante

Research themes

Social Housing with particular reference to the experimentation and design innovation activities for eco systemic quality.
The policy framework for social housing has seen, especially in Europe, changed conditions of management interventions with absolute necessity of actions related to building restoration and environmental quality. Always intensely engaged, designers are now faced with complex processes because of national policies, the economic crisis and factors of industrial innovation. The request is identified in the awareness of an ongoing commitment to achieve quality objectives in terms of meeting the new demands of contemporary living in the reconfiguration of space and in terms of innovation in constructive strategies to meet the demands of energy saving and low environmental impact.

Technological and production "issues" related to the design of prefabricated light building systems for the space of the house and not only in relation to the requirements of flexibility, modifiability, self-sufficiency, upgradeability and self-constructability. The renewed design approach is characterized by the continuous testing of materials, products and techniques capable of achieving low- cost buildings, for industrial production, and equipped with a high environmental quality: a way to design the quality of space based mainly on assembly of dry and semi-finished components provided by industry. The project activity becomes a pretext for a reconsideration of the concept of assembly that can be taken as one of the reference paradigms of contemporary design. Within those construction methods in which the technological data is assumed by the designer as the founding of architectural form, we find a methodological and operational reference for the organization and management of the design and construction process, also works characterized by great technological complexity.

The research on these issues, developed by architects Gianmichele Panarelli and Clarissa Di Tonno in the working group coordinated by me at the Engineering and Geology Department of "G. D'Annunzio" University, part of a broader debate on the contribution that technology culture is able to give to the architecture project formation and the role of technology, product and /or process, within the dynamics of production of interventions.
In April 2015, for the second consecutive year, at the College of Architecture of the FIU (Florida International University) in Miami there was a period of intense study (divided into workshops, communications, research) and debate with working group of Prof Thomas Spiegelhalter. It was an opportunity to compare the studies produced during the research and presented for scientific contributions to conferences and days of work with the results obtained by the group of Prof. Spiegelhalter.
Through the comparison is intended to develop operational strategies that can foreshadow a comprehensive set of responses to the changed system performance requirements, with the definition of new design approaches, new methods of procedure, new design processes, new attitudes towards environmental issues.
The material of study was collected by architects Panarelli and Di Tonno and reread in light of new experiences: meaningful verification of the issues in depth through the methodology of the Climate Responsive Architecture adopted by Prof. Thomas Spiegelhalter, and design thinking developed with students of FIU.

SECTION 1 — LECTURES AND RESEARCH IN MIAMI

RESEARCH TOPICS - CLIMATE RESPONSIVE ARCHITECTURE APPROACH
SOCIAL HOUSING AND URBAN REGENERATION
INNOVATIVE PROJECTS AND EXPERIMENTAL TECHNOLOGIES

Gianmichele Panarelli

TRADITIONAL BUILDINGS INNOVATIVE AND EXPERIMENTAL SYSTEMS

Clarissa Di Tonno

RESEARCH TOPICS
CLIMATE RESPONSIVE ARCHITECTURE APPROACH

Gianmichele Panarelli

Topics

The thread that interconnects the research activities carried out for several years trying to rebuild the complex articulation of positions and research on issues of Social Housing in reference to technological innovation and experimentation building.

We have tried to identify a new cultural horizon, starting reflections on innovation as a function of other emerging issues within the culture of the project and the transformation of contemporary social and structural: innovation and environment, innovation and heritage building is not fine , innovation and building tradition, innovation and transfer, innovation and temporary space, innovation and environmental responsibility, innovation and social housing.

An important area of work has been occupied by reflection on technological innovation relative to our condition as designers: innovation in this sense cannot be read narrowly as technical innovation, which is the basis of technological and scientific progress that characterizes so strongly in our time, but as cultural dimension that can contribute to building a mental attitude and really innovative design. The term innovation was intended to capture that process of evolution in which may be framed the potential of the creative imagination that offers new perspectives in the field of knowledge and resources not yet explored. Innovation is understood, not as self-referential theme or as a pretext instrumental to propose new expressive techniques but as critical method and key to tie the technology of our time can to concrete opportunities for design and research; all it legitimized by the technological culture.

The formal results of recent architecture on which they are carried out experimental activities are not always in line with the efforts of designers and this is evident in particle mode, the interface artifact external environment. In the “line” border called casing, skin, especially in regard to the necessary performance requirements of the building you are projected research generation.

Appears useful for a reconstruction of the most interesting experiences retrace some highlights in which schools best designers have worked on some fundamental themes of building linked to the question of technical architecture and its relationship with the data form and function.

A simple comparison between two experimental programs, INA House Program in Italy and Case Study House in the United States, developed the same historical period end approximately 50 years, show the different results also linked to different cultural and industrial contexts.

Introduction

In the framework of exchange and collaboration (started in 2014), for didactic and research activities in the College of Architecture of the FIU (Florida International University, group coordinated by Prof. Thomas Spiegelhalter and the Department INGEO (University G. d’Annunzio University of Chieti - Pescara, group coordinated by Prof. Francesco Girasante) in the period April - May 2015 we were guests, for lectures and activities to teaching support, at course of prof. Spiegelhalter.

Objective of this publication is to illustrate the work developed at MBUS from mixed working group (INGEO - MBUS). To begin with a few words on the structure that hosted us, the College of Architecture + The Arts of the FIU (Florida International University) of Miami, Florida. The College of Architecture + The Arts engages our local and global communities by deploying the power of architecture + the arts to create, innovate, and inspire solutions to social, economic, and environmental problems. Offering 9 graduate and 8 undergraduate degrees within 7 academic departments, our more than 2,500 majors have the unique experience working with our award-winning faculty, in nationally ranked programs, in the heart of Miami one of the country’s most vibrant, diverse, and creative cities! In particular, Miami Beach Urban Studios. Mission: The Miami Beach Urban Studios build upon the mission of the College build upon the vision of the College of Architecture + The Arts by utilizing the innovation, community engagement, and expertise afforded by its participating faculty members, facilities, and location to be at the forefront of teaching, research, and service in art, design, performance, and communication. The Miami Beach Urban Studios offers undergraduate and graduate students a unique opportunity to study in one of the most vibrant, artistic urban centers in the world for one semester, while gaining valuable professional experience at design firms, and by working with innovative public, private, and non-profit arts organizations throughout the city. Located in the iconic Art Deco 420 Lincoln Road building, the Miami Beach Urban Studios give students and faculty access to Miami Beach's burgeoning arts and design culture. The Urban Studios provide expansive space for design and fine arts students, practice and performance spaces for music and theatre students as well expansive gallery/exhibition spaces and classroom space for use by the entire College. The location is an ideal base for the study in arts, design and performance, for museum and gallery visits, and for exposure to the wealth of arts organizations located in Miami Beach. The Miami Beach Urban Studios offer a full roster of courses enriched by Miami Beach's unique artistic, historical, and cultural resources and by the extensive network of noted professionals, artists and performers who serve as visiting critics and mentors.

Activity at MBUS

During the period of activity in MBUS have been developed activities of support in teaching, course of prof. Thomas Spiegelhalter and during the same course have been presented two lectures in the context of "Climate responsive architecture approach": *Social Housing and Urban Regeneration; Innovative projects and experimental system*.

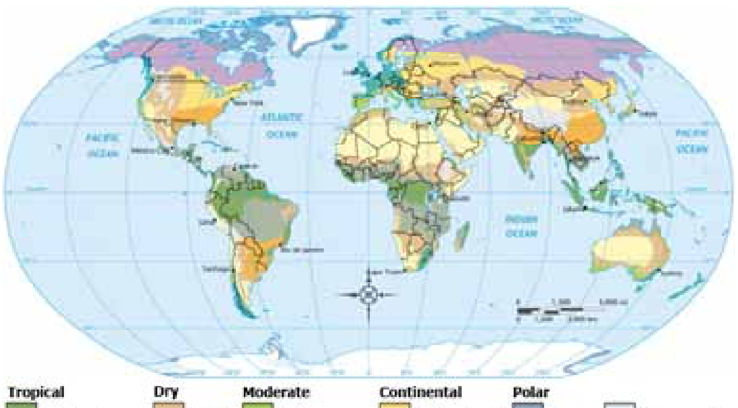
It was also presented an ongoing research: *Traditional Buildings. Innovative and experimental systems.*

Climate responsive achitecture

Basic principles

Climate-responsive architecture can be defined as architecture aimed at achieving occupant thermal and visual comfort with little or no recourse to nonrenewable energy sources by incorporating the elements of the local climate effectively (Yannas, 2003). This refers therefore to architecture that reduces the negative impact on the environment & sustains the ecosystem of which it is a part. Udyavar (2006) identifies the main paradigms of Climate Sensitive Architecture as: (a) Energy Efficient Design (b) Preservation of Natural Ecosystems (c) Use of Renewable Energy (d) Water Resource Management (e) Use of Eco-friendly materials (f) Ecological Landscape Design (g) Solid Waste Management and Healthy Indoor Environment.

Traditional architecture exhibits variety of building design suited to the respective climatic conditions.



For the architect, the process of acquiring and maintaining the knowledge and proficiency needed to create and sustain an environmentally-responsive architecture can be very tasking. Yannas argues that this requires the architect to have motivation, dedication and a considerable amount of time.
Such designers fail at the first hurdle to incorporate what Ehrenkrantz (1992) identifies as user needs and aspirations which include provision of environmental control and comfort among others. In practical terms climate-responsive architecture should result in structures that are planned and constructed to accommodate weather-related factors such as heavy precipitation, snow loads and temperature extremes. The Practical Approach. Having established that design with climate is essentially driven by planning a proper projection, a practical approach is to carry out a stage-by-stage phased approach to design schemes. Haruna (2006) describes architecture as being successful if it acts well and does the thing it is required to do.
If this success is to be achieved, a staged approach (referred to as Stages 1 and 2) is suggested and it involves investigation/evaluation and synthetic application of design responses.

STAGE 1: Investigation & Evaluation

Clearly, any analysis carried out will give specific results depending on the factors determined by local conditions. The deductions from the information in Stage 1 should guide the architect subsequently.

STAGE 2: Synthetic Application

This involves the application of various measures to deal with the problems identified by the analysis and evaluation process. Basically this means taking measures to address Passive Cooling, Orientation, Shading, Insulation, Thermal Mass, Passive Solar Heating and Renewable Energy.

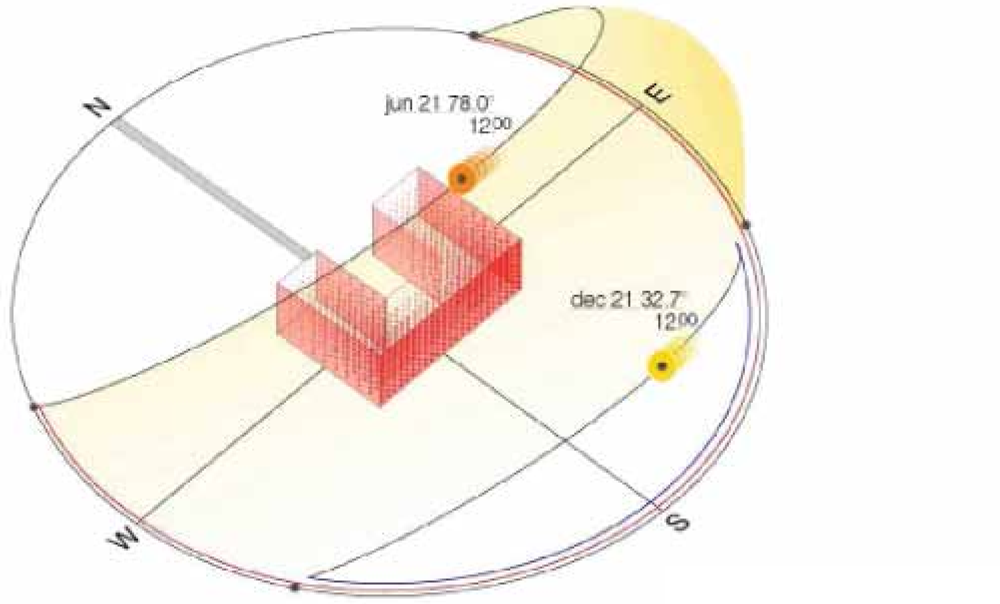
Building form

Building form together with plan geometry, building orientation, surface to volume ratio, mass, service and natural ventilation are fundamental elements for the design choices included in its climatic context. Any building design for warm climatic conditions would attempt to exclude any of the above major heat loads arising due to the prevailing ambient temperature and the intensity of solar radiation. The passive techniques in practice. Maximum solar radiation is interrupted by the roof (horizontal surface) followed by the east and west walls and then the north wall during the summer period, when the south oriented wall receives minimum radiation. It is therefore desirable that the building is oriented with the longest walls facing north and south, so that only short walls face east and west. Thus only the smallest wall areas are exposed to intense morning and evening sun. The buildings in a cluster can be spaced such that they shade each other mutually. The amount and effectiveness of the shading, however, depends on the type of building clusters.
We considered the climate in which we operate prevalently, Mediterranean.

Mild Mid-Latitude

1. Use passive solar design with insulated thermal mass.
2. Maximize cross ventilation
3.Evaporative cooling or ceiling fans should be used if required.
4. Consider convective (stack) ventilation, which vents rising hot air while drawing in cooler air.
5. Site home for solar access and exposure to cooling breezes. Shade all east and west glass in summer.
6. Install reflective insulation to keep out heat in summer
7.Use bulk insulation in ceilings and walls.
8. Build screened, shaded summer outdoor living areas that allow winter sun penetration.

A building's plan geometry can be studied into consideration the short side, long side, floor plan, orientation and climatic condition.
Martin and March (1972) have classified building clusters into three basic types, i.e., pavilions, streets



Building form in climatic context

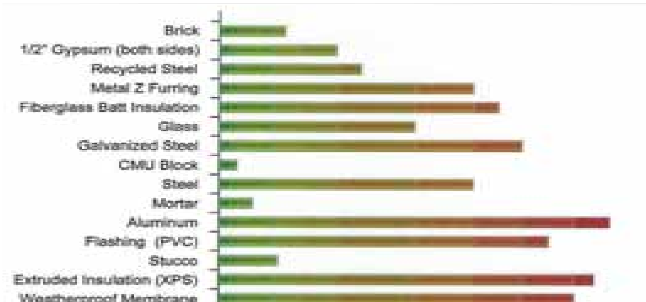
Building envelopes

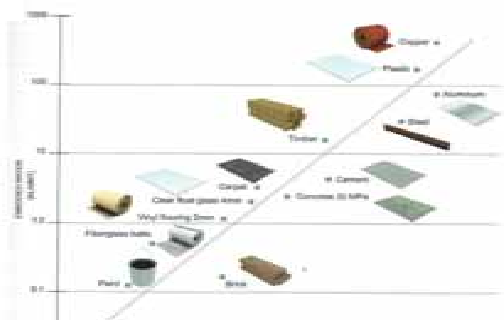
Building envelope is the interface of the building with the exterior surroundings determining the exterior appearance but mainly plays the role of regulating the thermal exchange, exactly how the skin of the body. The proper selection of walls, roof and floor system (materials and technological systems in general) are important components of energy saving strategy. The use of material for construction building causes consequences for the impact which follows in the environment.

Environmental impact

The real knowledge of the thermal properties of materials is fundamental in the design choices for different buildings with different uses, and in the different climatic and environmental contexts. Reducing the energy envelope loss is critical. Thermal transmittance and thermal resistance are the two most important proprieties for understanding the conductive performance of building materials.

- *embodied energy:* embodied energy is the amount of energy used to extract, produce and distribute a material to the location of use.
- *embodied water:* The amount of water used to manufactured and deliver materials to their final destination is called embodied water.
- *carbon footprint:* carbon footprint refers to amount of carbon dioxide and other greenhouse gas emission associated with an activity, a process or a product.





embodied energy of building materials

Material thermal properties

Designing efficient building envelopes requires an understanding of the thermal performance of utilized materials. Most important properties of building materials are:
Thermal resistance (R-value), Thermal transmittance (U-value),Thermal Conductivity, Thermal bridging and air leakage, Solar heat gain coefficient and shading coefficient.

Enclosure materials

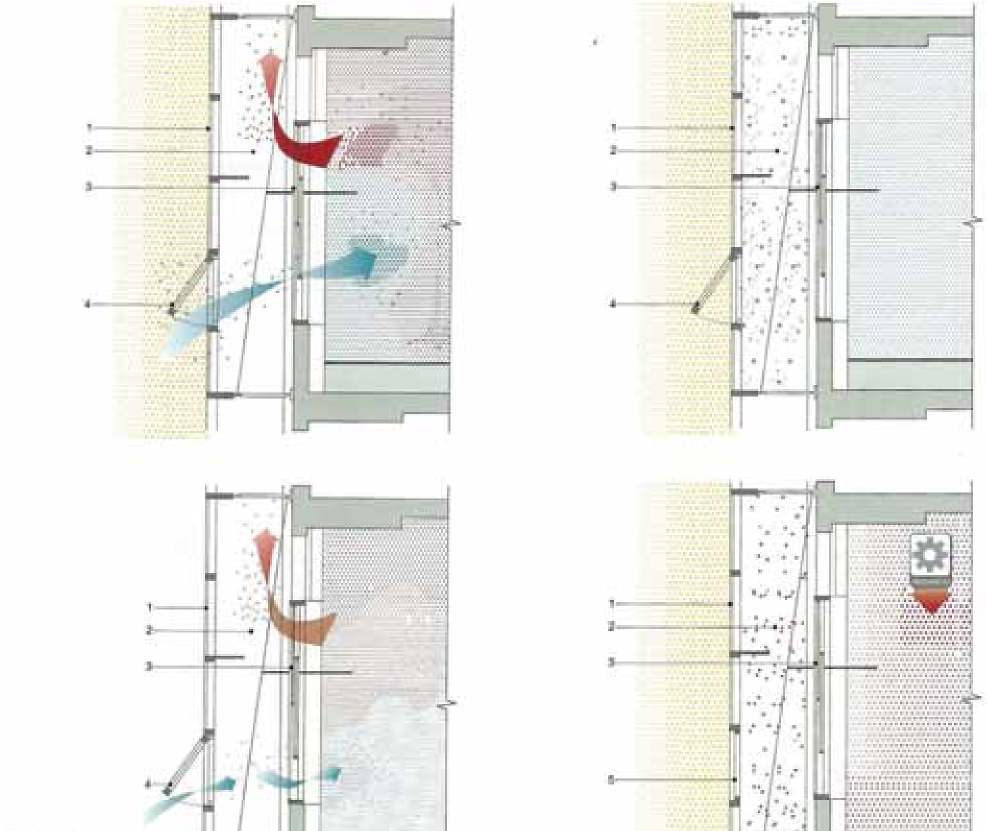
Enclosure serve for a multitude functions as thermal comfort, natural lighting, air movement, humidity control,sound insulation, fire and water resistance. The selection of materials that can best integrate the different functions is a substantial step. Among the major materials used are:
Wood, masonry products, reinforced concrete, metals, glass, composites.

Insulation materials

The insulation of a building envelope consist of many layers of materials which can organic (cork, mineral fiber, cotton, etc) or inorganic (polyurethane, polystyrene), remember:
Rigid insulation, structural insulated panels, vacuum insulation panels, synthetic insulation, sound insulation, other insulation materials.

Thermal materials

Building materials with significant mass such as concrete can act ad thermal storage areas in climates where there is a significant difference between the day and nighttime temperatures. Between the most used, although in the course of experimentation.



Wall System

Design and technology in exterior walls foresee the use of diverse materials. The wall system can be designed as a monolithic or a multi-layered system, the commonly used wall types are:

- Cavity wall; Glass Curtain wall; CMU Wall; Concrete Wall; Metal Venner Wall; Precast concrete Wall; Stone Panel Wall.

Climate Responsive Facades

The Climate Responsive Facades plays a critical role in the thermal behavior and the overall building's energy consumption. These facade system have the potential to capture, filter, and redirect daylight, provide natural ventilation and control solar radiation with important consequences on the building's energy performance. Some at this facade are: Double skin facades; Horizontal shading devices; Photo-voltaic external building walls.

Climate Control

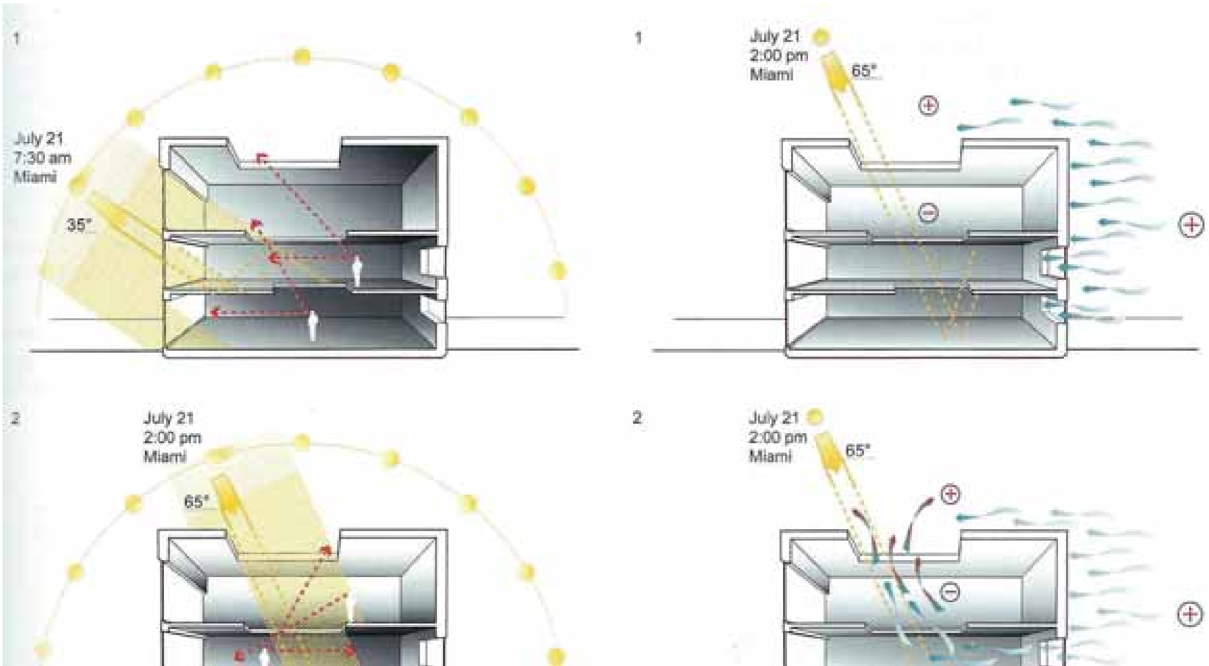
Designing resource-efficient building with active, passive or hybrid systems of achieving comfort requires understanding of the climate, site condition, building occupancy types and availability of energy resource.

Concept

Climate: Heating degree days; Cooling degree days.
Building occupancy. Loads: Building thermal and electrical loads; Occupancy types.
Psychrometrics/Thermal comfort: Human body; Psychrometric chart; Thermal comfort standards.
Heat forms: Latent heat; Sensible heat.
Heat Flow: Conduction; Radiation; Convention.

Carbon Neutral Design

Carbon-neutral design or carbon neutrality is a general term referring to a building achieving zero net energy consumption and zero carbon emission. In this category we find:
Sustainable buildings; Low energy buildings; Zero fossil energy buildings;Plus energy buildings.



Passive System

Natural system
A passive approach to building design takes advantage of natural systems to ventilate, daylight, heat or cool buildings thus eliminated the requirement for active mechanical system and fossil fuel-based energy consumption. Elements of the system are: Sun; Light; Air/Wind; Landscape.

Solar heating
Direct Heat; Indirect Heat; Isolated Heat.

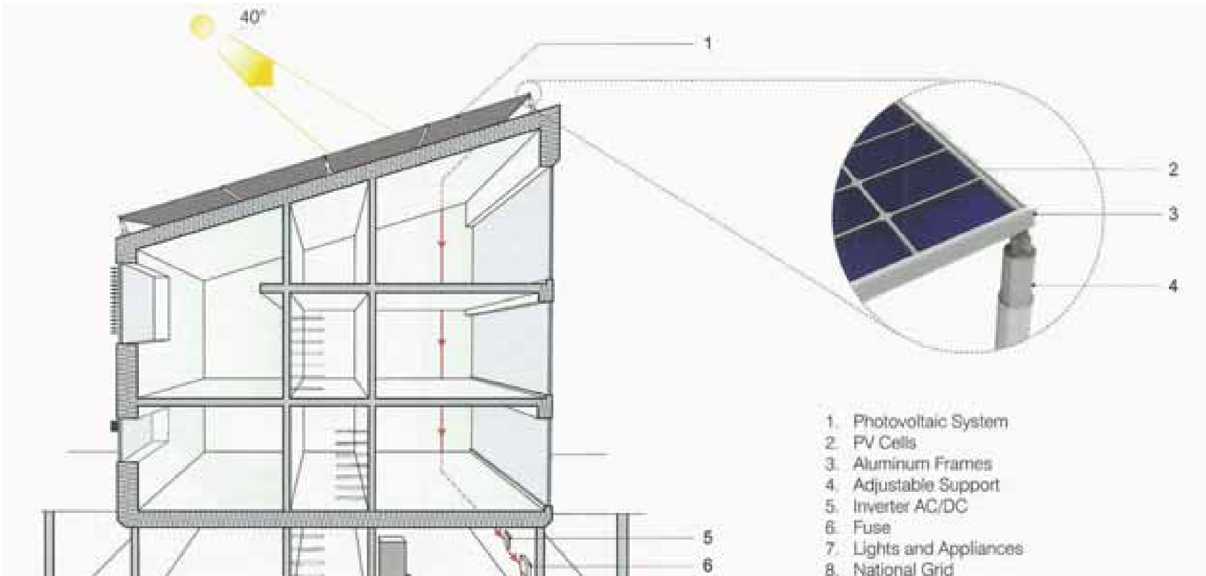
Passive cooling
Natural cross ventilation; Stack ventilation; Thermal mass cooling-with night ventilation; Evaporative cooling.

Encapsulated phase change material
PCM Thermal storage; Organic PCM; Inorganic PCM.

Active System

Space conditioning
Space conditioning involves the processes of heating, cooling and ventilation for indoor air quality, humidity control and thermal comfort. Elements of the system are: Thermal loads; Cooling; Heating; Ventilating.

Distribution medium: Refrigerant system; All air System; All water system; Air water system; Thermo active building system.
Chillers: Chilled water - air conditioning system; Cooling towers.
Evaporative cooling: Direct evaporative cooling; Indirect evaporative cooling; Two stage direct and indirect evaporative cooler.
Mechanical heating: Solar assisted gas boiler; Basement furnace; Heating coil; Heat pump.
District heating and cooling: District heating system; Combined heat and power.
Ventilation: Air handling unit; Package unit system.
Heat energy recovery systems: Heat recovery ventilator; Energy recovery ventilator.
Distribution and terminal system: Single duct/single zone system; Single duct variable air volume system; Double duct system in cooling mode; Under floor distribution system; Fan coil unit; Induction system; Fan coil with supplementary air; Radiant panels with supplementary air.



Renewable Energy

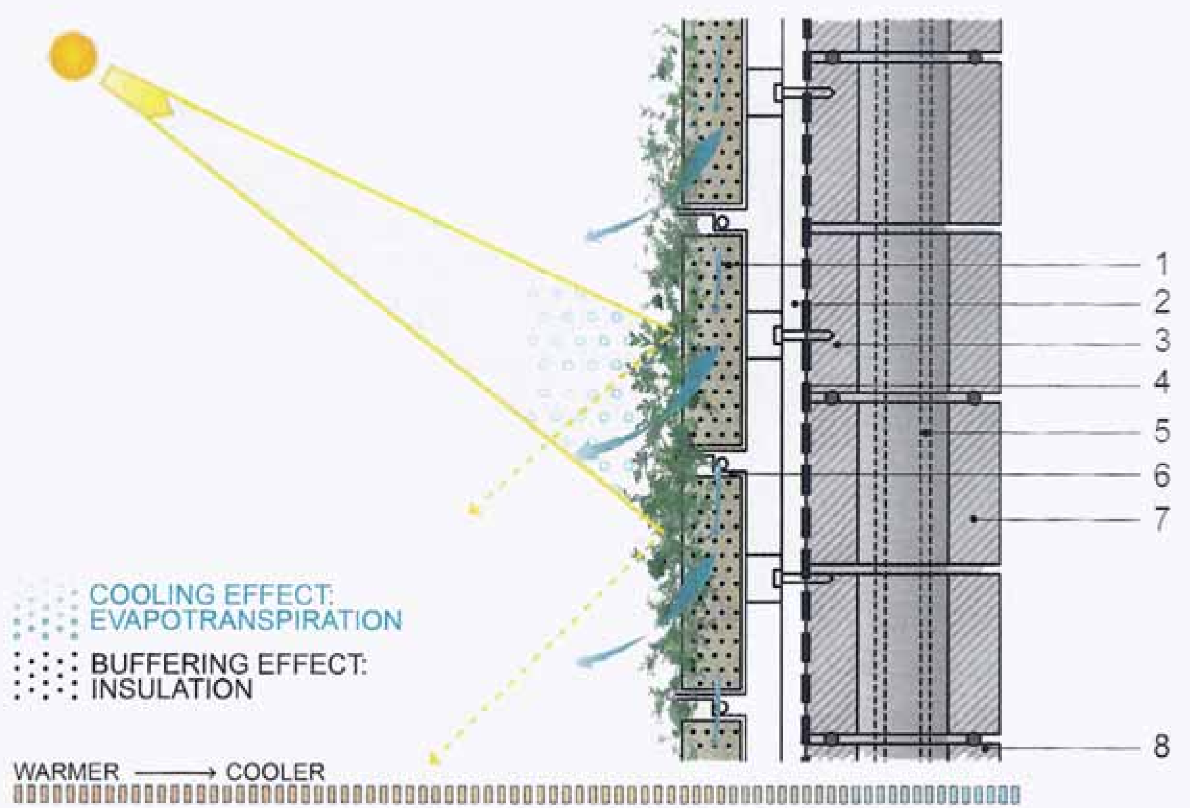
Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy resources are constantly replenishing themselves. In various forms include:
Solar Energy; Photo voltaic System; Wind Energy; Geothermal Energy.

Landscape

Shading by trees and vegetation is a very effective method of cooling the ambient hot air and protecting the building from solar radiation. The solar radiation absorbed by the leaves is mainly utilized for photosynthesis and evaporative heat losses. A part of the solar radiation is stored as heat by the fluids in the plants or trees. The best place to plant shady trees is to be decided by observing which windows admit the most sunshine during peak hours in a single day in the hottest months. Usually east and west oriented windows and walls receive about 50% more sunshine than the north and south oriented windows/walls. Trees should be planted at positions determined by lines from the centres of the windows on the west or east walls toward the position of the sun at the designated hour and date. On the south side only deciduous trees should be planted.

Thermal Efficiency
- Solar heat moderation
- Thermal insulation

Hydrological efficiency
- Water Conservation
- Runoff mitigation and pollution control
- Wastewater management



1. Modular Panels with Planting Medium
2. Stainless Steel Frame
5. Vertical Reinforcement Bars
6. Irrigation Drip Line

SOCIAL HOUSING AND URBAN REGENERATION

Gianmichele Panarelli

This writing is aimed at illustrating the path that has been taken for about 20 years by the laboratory (now called Riutility-lab, coordinated by Gianmichele Panarelli and Rocco Cerino) in the branch of housing interventions (in particular social housing) and in urban regeneration interventions (in physical, social and economic terms) in a Public - Private partnership approach constantly looking for new models of management of interventions. For a better comprehension of the basic idea of the Riutility-lab is fundamental to recall some important moments of housing policies in Italy, also with reference to the European scene.

In Italy we can distinguish two important periods in the housing management policies:
- the years which go from 1900 to around 1990, in which the State had the responsibility for managing housing policies;
- the years from 1990 to present day (2015), in which each Region has implemented its housing policy as a result of the mandate received by the Italian state.

Introduction

Since the late nineteenth century housing policies in Italy have had a great tradition of supporting the economic and social development, such as all forms of cooperatives (the employees of the same company, such as the State Railways) founded in order to build up houses.
The first law on housing was issued by the Italian Government in 1903 (called Law Luzzatti).
The promulgation of this law had the purpose to help to solve the housing problem not only for low-income families, but also for the classes whose social ladder and income were not placed in the lower rungs.

Housing Policies In Italy Between 1900 and 1990 From The Rural To The Urban System

In February 1920 the District Garbatella was founded in Rome in an architectural and cultural climate based on the English model of the “garden city”, characterized by a good connection to the city center and single- family houses with a private entrance, gardens and green cultivable areas.
In the construction, a building development plan based on the experimentation of the “fast house” was implemented in the years between 1923 and 1927. This typology could be visually associated to the garden house but, unlike the British model, it was built with very economical materials and a considerable speed of execution; ornamental elements were marginal and green spaces were no longer private gardens but shared areas. In those years political changes contributed to start some major urban interventions (such as the demolition of the historic fabric of the city adjacent to the cathedral of San Pietro) having made necessary the use of buildings in Garbatella for those who had lost their house.
After World War II Italy had to face a tough period of rebirth. On 24 February 1949 the Italian Parliament approved a bill, proposed by the Minister of Labour Amintore Fanfani, which was aimed at increasing working-class employment; so the plan Ina-House, a massive residential reconstruction plan, was carried out.

Garbatella District
Roma (1921)

After World War II Italy had to face a tough period of rebirth. On 24 February 1949 the Italian Parliament approved a bill, proposed by the Minister of Labour Amintore Fanfani, which was aimed at increasing working-class employment; so the plan Ina-House, a massive residential reconstruction plan, was carried out.
The plan INA CASA has been an important field of social and architectural experimentation in a country, which had never worked in an actual territorial unit perspective. The deep differences between the north of Italy (with large industrialized areas) and the south (with strong agricultural vocation and characteristics) led some the best designers to operate in completely different contexts. The fourteen years of activity of INA CASA (established in 1949) have been the occasion for Italian urban culture to experiment prewar European models (Alberto Rossi, 1960).
The achievements of the first seven years have been subdivided into two major trends.
- The first one is that of neo rationalism which is linked to the European experiences, in particular in Germany in the Thirties, where we can perceive a current that exasperates, through orthogonality, the purist abstract-figurative component of the international style, and preserves the typological components of housing. Some examples are the Harrar district in Milan and the Barra district in Naples.
- The second trend is that of the organic stream, where the influences of Scandinavian cities and the experience of the English garden cities, together with the findings of Italian details linked to the medieval architecture and the Mediterranean spontaneous architecture, represent the ingredients of “Neorealism”. Some examples are the Tiburtino of Quaroni and Ridolfi in Rome and the Falchera of Astengo and Renacco in Turin, which are part of this trend that has contributed to make the unity of the neighborhood and of the district the myth of the urban culture of the Fifties.
In the following seven years, the architectural research of INA CASA moved on other fronts and focused on new urban experiments. In this period, the self-sufficient district policy strengthened, because it had