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RENEWABLE ENERGY

ADVANCED BIOCLIMATIC ARCHITECTURE FOR BUILDINGS

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ABSTRACT

The town-planning guide for the areas of the high speed rail station of Florence, is finalised at the synthesis of a comprehensive strategic design of the overall objectives bring out by the town-planning scheme of the city. The new bioclimatic strategies realised for the new buildings involved natural lighting systems, roof developed such green areas, passive solar glazed facades, passive natural ventilation, underground design strategies.

INTRODUCTION

The town-planning guide defines, in fact the informer features of the urban reorganisation of the whole areas included between the S. Maria Novella Rail Station and the expected New high speed Rail Station, or directly invested from the localisation of this one, such as the Belfiore area and the ex-Macelli area, also neighbouring such as the Cinema and theatre Apollo, the complex of Business Palace and Congress and Fortezza da Basso Palace, customs offices and head office of Industrial Association, the Mazzoni Central Thermal, the Fiat-Belfiore area, the ex-livestock Market, the east strip along the rail level.

The actual rail complex, together with the Strozzi Avenue and Belfiore Avenue, are negatively distinguished for the insufficient relational integration with the town, even though the extraordinary urban value of the Central Station of S. Maria Novella.

OBJECTIVES

The objectives of the town-planning guide aim to assure the connection and the design-urban role of the new high speed rail station with the urban district, in prevision of the consequent deep change and in respect of the urban infrastructures of the city. The objectives tried also to realise the integrated relation with the Station of S. Maria Novella. The soundness key of the urban planning is in fact the reorganisation of the system of the actual Central Rail Station, actually organised on the unique relationship with the Historical centre of Florence with an unidirectional entrance façade, subjected to the tendency risk of a growing and a functional congestion.
The Central Rail Station integration with the new high speed Rail Station is organised with an organic system of structures/ equipment's/ functions in a logic sequence, determined trough the territory, and determined trough a partial functional and access distribution with their localisation and directions such as *urban exchangers*, reinforced by the increase infrastructures and services of the district.
The overcoming of the split and barrier effect determined by the actual structured Central Rail Station respect on the crossed urban sector, it is realised for the new system, under the two general objectives of the urban connection North- South and of the urban permeable East-West.

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METHODOLOGY OF APPROACH

The new methodological and design approach for the buildings foreseen in the urban planning is finalised at the internal temperature fluctuation control, for an high insulation control, an high thermal mass performance for the absorption and transfer processes, trough ventilation ducts inside floors and roofs, collected at the solar captio systems with the relative control disposals.
The possibility to use daily differences of temperature, allows during the summer to refresh the building, dissipating heat with nocturnal natural ventilation, and in winter extend the daily effect of solar radiation accumulation and solar internal accumulation, exceeding, thanks at the thermal mass inertia, also during the cloudy days, trough and automatic management of the technological systems used in the buildings for the maximum use of the system potentiality.
Also the aspect of the natural ventilation is individuated such as fundamental for the sustainable approach strategy of the new buildings, finalised at the reduction and use of the artificial climatic systems, with the guarantee to giv in all the rooms an acceptable internal comfort in the varies seasons, it is foreseen many openings are controlled automatically in the way to be able to guarantee natural ventilation.
The new high speed rail station is developed with a long green roof, with many glazed surfaces in the perimeter, the winding roof surfaces allows to enclose many openings ducts to allows natural ventilation, the ducts are solar chimneys: vertical ducts whose ends is warmed by sun with the green house effect, and the creation of an ascendant column of air "chimney effect" able to accelerate air exchanges inside the premises.
These elements have also the function of lighting systems to converge natural light from the roof inside the building.
The use of natural vegetation like a roofing system put this building between the major existing "green building"

Belfiore/Redi buildings high speed rail station and surrounding urban areas and Existing buildings

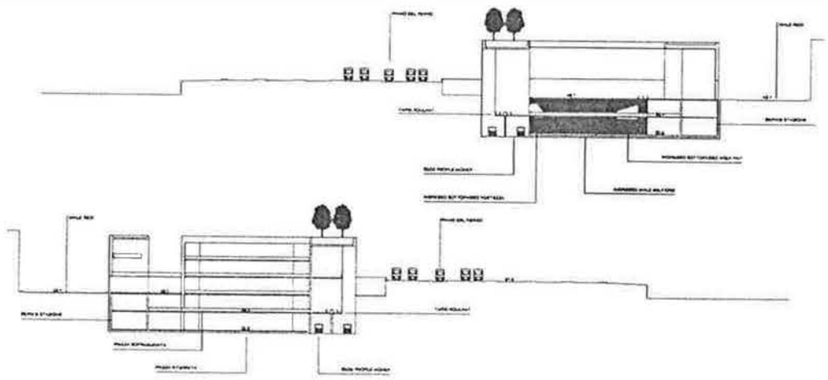
In function of their energy balance the new buildings, have to be considered like controlled with automatic systems able to operate to obtain the optimal sustainable form of energy for the environment Solar energy systems will be used in the more appropriate way, for lighting systems, photovoltaic systems and thermal, trough systems strictly integrated in the urban masterplan.
The choice of a big roof garden, of more than 15.000 square meters, constitute the more relevant aspect of the all Guide Masterplan: it is the major realisation of roof park, to give to the city a pedestrian area equipped in the green, and contributes at the improvement of environmental microclimate (evaporation and air humidify, syntheses of chlorophyll, oxygenate, reduction of the overheating due at the thermal radiation on an pave horizontal surface, visual and comfort aspects).
From a bioclimatic point of view, in relation to the energy balance of the lower volume, the collocation of a layer of vegetable earth and a grass and bush surface over the cover roof, constitute a powerful instrument of thermal insulation, that in winter reduce drastically thermal losses from the horizontal surface and in summer avoid the overheating due to the solar radiation.
These actions of containment of the energy exchanges, in conjunction to the other strategies for the vertical walls, will allows to reduce of more than the 70% the energy consumption in winter and in summer and the confront of a traditional building, and meliorate the internal conditions trough a temperature stabilisation due to the project and not to the building systems.
Also for the existing buildings comprises in the Masterplan Guide is foreseen that in occasion of the refunctionalism intervention, rehabilitation and extraordinary maintenance, can be consider the energy aspect, with the objective to limit the need, meliorate environmental quality and reduce CO_2 emission in a urban contest densely built-up area.
The intervention finalised at the energy rehabilitation of existing buildings represent an aspect of particular interest for our country, where building activity is prevalent concentrated on the reuse of the existing.
Those prescription that goes beyond the minimum limits fixed by 10/91 Law finalised at the achievement of the UE standards and of the Italian Government in the recent Kyoto vertex and it will be insert with a specific actuate rule inside at the next Municipality Energy Masterplan with different parameters for the central areas, the strategic zones and for the surrounding interested zones.

The underground areas in the Guide Masterplan

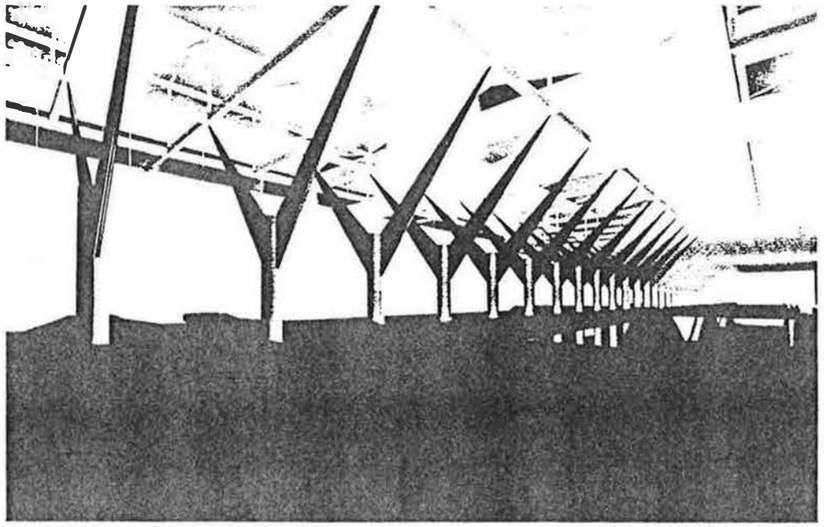
- The high speed trains platforms are placed below 20 meters under the actual earth level and constitutes the central part of a big underground area of about 18.000 square meters (450x38) which communicate with the outside (beside with the rail galleries) trough the correspondent volumes to the actual buildings, for about 500 square meters and trough specific openings for ventilation and lighting along the route.
- An underground pedestrian route long 300 meters is equipped with tapis roulant and connect, at the height of less 12 meters, the great gallery of platforms a the main entrance central atrium (at the height of less 7 meters), this area is developed inside the multi-storey building in the area Belfiore Redi.
- Two pedestrian underground passages distributes from the central atrium of the station (at the level of less 7 meter): one underpass the viale Redi connecting pavements of via B Marcello and the FIAT building, and the other underpass the viale Belfiore until achieve the old central thermal Mazzoni in the Ghiacciaie street.
- A commercial gallery equipped with about 100 meters connect the square at the ground floor of the old central thermal Mazzoni at the People Mover stop in front of the Fortezza da Basso, passing trough the rail raise
- The pedestrian passage from the People Mover stop to the park inside the Fortezza Building, underpass the Medici walls to go back up in a large open air amphitheatre in front of the actual restoration school.
- Underpass street of the viale Strozzi for about 70 meters in front of the ancient walls, to allow the pedestrian continuity between the historical centre and the Fortress. It have to allows an equipped bus stop and the other public services which will pass from the Viale Strozzi and the go back up from the two sides.
- Underpass of the viale Belfiore for about 180 meters in front of the hight speed rail station to divide the traffic currents at the crossing with the il viale Redi, via B. Marcello e via G. Monaco.
- Underpass close at the new hydraulic section along the Mugnone torrent, between the extension of the viale Milton e il viale Redi, under the rail crossing for about 200 meters. The length of this tunnel need a particular study of lighting to eliminate the possible risk of visual intrusions in the passage of the external light into the gallery and vice versa.
- Underpass to allows the traffic from and for the Romito street

General guide lines for Lighting and ventilation strategies

The environmental evaluation of the characteristics of an underground areas have to be based on a check trough specialised for natural lighting and ventilation control software.
Natural lighting should allow the daily vision in all the public underground zones also without artificial light, guarantying a minimum security value.
The natural ventilation will be able to achieve a reduced air exchange (almost of one hourly volume) also without mechanical ventilation.



It will be verify the evacuation of eventual smokes or accidental steam without interfere with people ebb.
The possibility to transfer natural light in the underground areas, have to allow for what is possible the perception of the time passing trough and external lighting variation, and the integration with artificial lighting.
The use of natural lighting constitutes an example of the integration of the varies systems and varies strategies in the solar architecture and it will become a determinant factor in the architecture characterisation, particularly in the public buildings.
Consequent to this approach, the lighting problem is represent by the introduction of new technologies which tries to diffuse the exceeded lighting rather than simply avoid the use.
The use of advanced technologies allows to quantify the light directional in a uniform way and eliminate same negative aspects such as dazzle effect or the excessive overheating. The dimensioning of the glazed surfaces and their composition, the type of the openings, distribution of the light inside the building and it's integration with artificial light are design choices, whose performance control can't return to successive phases.
The integration between artificial and natural fonts in the lighting field have had a great development with the evolution of the electronic systems in the sector of the lighting level revelation and light characteristics , and fo the artificial lighting control.
This integration allow to actuate a gradual substitution between the two systems in the way to reduce the disconnection and contain energy consumption.
From a technical point of view the natural light diffusion inside the underground areas is obtained with varies reflective systems, natural (in particular for the diffused light) than controlled (dynamic) for a reflection of the direct solar radiation to reach great distances from the external element of caption.
Also the disposal materials are enriched of new experiences (lighting ducts, reflecting films, optic fibres, Fresnel lenses) and prevision instruments and control to allow an effective evaluation of the proposed design solutions.
The emerging part of these lighting systems, which constitutes the caption light system, and it will be integrate in the external structure or create an integration with the external structures while the transferring ducts could be used also lake ventilation channel or for other compatible functions (service areas, security exits, smokes evacuation channels, ecc...)



The varies underground zones present in the masterplan presents spatial characteristics very different between each other, and also the natural lighting systems of these areas could be different to give specific integrated specifications integrated in the design solutions.
In particular in the area of the train arrival, where the air exchange with the surface is bigger, we can verify the condition of "cold well", for the go back up of the air the cold one that is more heavy and is stabilised in low level, where are the train waiting people
The possibility to contrast and reduce this phenomena could be study from the point of view of the air exchange with the outside (automatic systems), than intervention of the comfort conditions in the waiting areas (floors, radiating walls, solar gains heating, division of the areas with laminated sheet warm air systems, etc..)

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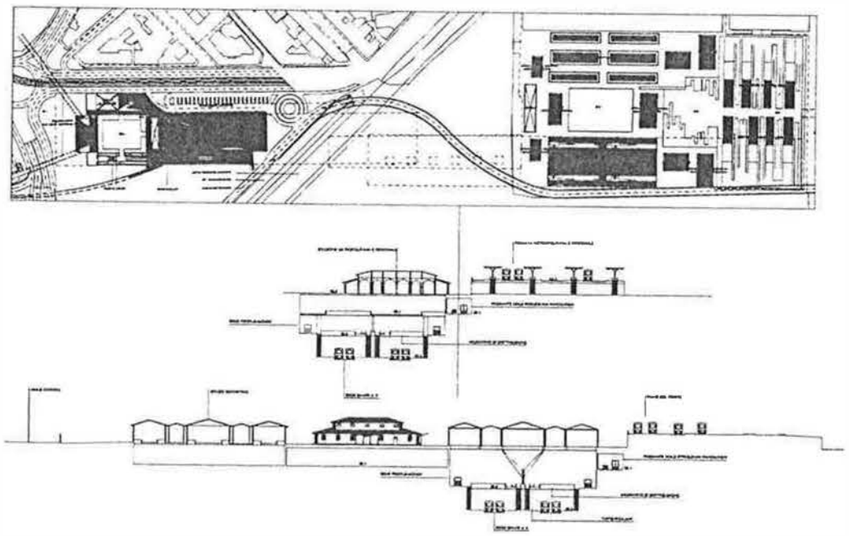

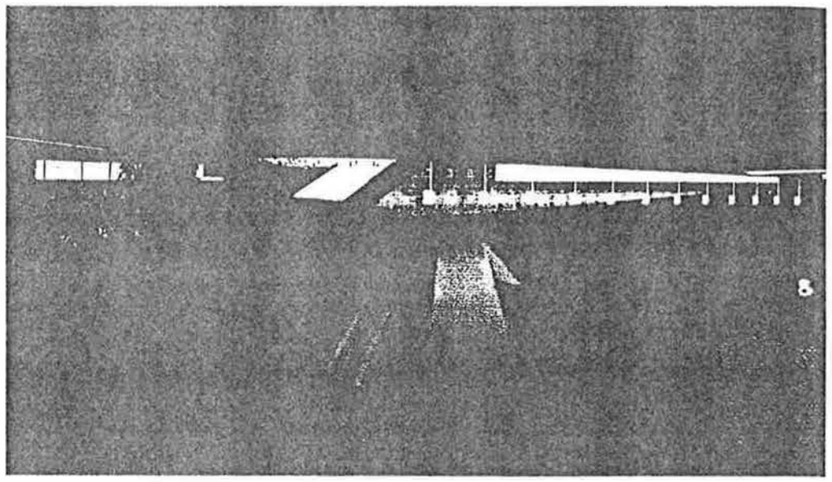

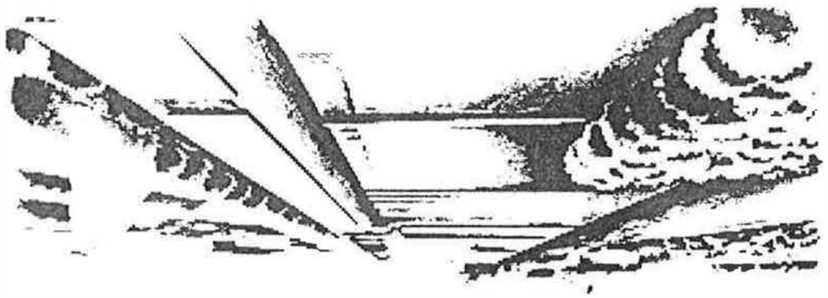

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SIMULTANEOUS APPLICATION OF DIFFERENT NATURAL COOLING TECHNOLOGIES TO AN EXPERIMENTAL BUILDING

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ABSTRACT

In terms of performance, natural cooling technologies have always been studied by experimentation of single techniques. In order to obtain an improvement in global performance, particularly with regard to comfort, an investigation of the combined utilization of several techniques for the same location has been carried out. This paper gives the results of a series of experiments in which several techniques of natural cooling were applied simultaneously in an experimental building.

KEYWORDS

Natural cooling; ground cooling; controlled ventilation

INTRODUCTION

An experimental building, constructed by a group of researchers of DITEC – Politecnico di Milano, proved to be a valid test-bench for the application of various low energy consumption cooling techniques.

The results of some of the most interesting experiments have already been the subject of various publications (Solaini et al., 1994, 1995, 1996) in which the results obtained for each individual test were described. The techniques adopted were oriented towards different types of plants that could really be applied in existing buildings. The classic natural cooling techniques of controlled mechanical ventilation and ground cooling were experimented in particular, the ground cooling system being obtained by water-ground heat exchangers with various geometrical arrangements (vertical pipes and horizontal pipes) positioned at various dephts.

The results of the experiments demonstrated that each of the techniques examined produced different performance characteristics as a function of the ambiental conditions (external temperature, solar radiation, temperature of the ground etc.).

In the summer of 1997, measurement campaigns were carried out in the experimental building, each lasting a week on average, which permitted a comparison of direct performance (the building has two monitored test rooms, with the same characteristics) and an evaluation of the combined effects of the application of several cooling techniques in the same test room.

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