

- high performance insulation materials
- daylight compensation system
- efficient HVAC system
- solar PV
- CHP

General information:

- Project developer (designer):
 - Studio Cspe-Anshen Dyer – Studio Chiarugi Engineers
 - A6I Ingegneri Associati – CMZ – Studio Lombardini Engineering
- Location (address, Country of technology developer): Viale G. Pieraccini, Careggi (Florence, Italy)
- Project starting date (year): 2002
- Project status: completed in 2006

Summary of project:

The Meyer Children Hospital of Florence (Ospedale Pediatrico Meyer) is a children's hospital located in the suburbs of Florence, Italy. Founded in 1884 by Marquis Giovanni Meyer in memory of his wife Anna, the Hospital was one of the first Hospital institutions in Italy exclusively devoted to the problems of child health care from birth to adolescence. Currently, the Meyer Children Hospital occupies an area of 31,000 m², consisting of three storeys with 150 beds.

In 2002, the hospital was involved in the HOSPITALS initiative, financially supported by the European Commission under the 5th Framework Programme for RTD and demonstration on "Energy, Environmental and Sustainable Development - Part B: Energy program", aiming to reduce significantly the total energy demand in the hospital. An innovative energy efficient demonstration building has been implemented, an integrated energy design process has been followed from the first step of the initiative. The application of innovative energy efficient building concepts can be demonstrated in:

- good insulation of the building (building envelope and materials, wall insulation);
- integration of innovative daylight/lighting system (building orientation and form, windows and shading, and green roof);
- application of high efficient energy system (high efficient condensing-combi boilers and ventilation and cooling systems);
- the utilisation of renewable energy (the bioclimatic greenhouse is integrated by the installation of a photovoltaic plan).



The New Meyer Children Hospital of Florence

Description of project:

As we all know, hospitals represent a very significant typology in terms of energy consumption. However, preliminary analysis on the current hospitals buildings in Italy has shown that the existing healthcare buildings are characterised by excessive and non-efficient energy consumption due to bad building maintenance and obsolete equipments. Generally, the total energy cost for a hospital corresponds 10% of its total management cost. The actual hospital building design approach has not caught attention from Italian market operators, due to either the low sensibility and interest of the Public Administrations, or the national market lacking in innovative technological products.

The objectives of the Meyer Children Hospital pilot project were to reduce significantly the energy consumption and peak electricity demand of the hospital and, in the meantime, to obtain a considerable improvement of comfort and indoor conditions, through the application of energy efficiency measures. In fact, a reduction of the total energy demand by more than 60% was expected.

- Situation/opportunity for project implementation

Since the HOSPITALS initiative was aimed at demonstrating the exploitation of the significant reduction potential of the total energy demand within the European health care building sector, the Meyer Children Hospital of Florence as an idea candidate for introducing innovative energy efficient building concepts in healthcare sector.

Moreover, it is worth to remark that the success of the implementation of Meyer Children Hospital demonstration project is not only innovative in Italian healthcare sector but also highly replicable in other hospitals in Italy. The innovation of this project is the introduction of some specific innovative energy saving techniques for the actual standard in order to set a new energy, environmental and health standard for hospital buildings.

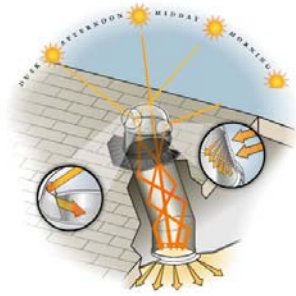


New Meyer Children's Hospital

- European demonstration project "HOSPITALS"

Innovative application

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- Technical description
- climate condition

located in the suburbs of Florence, the microclimate in the Meyer Children Hospital is the urban type, while the outdoor climate in this area is characterised by mild winter and dry, short, warm summer, with the ASHRAE heating degree days of 2060 Kd/a (Kelvin days per year).

- technical requirements of the buildings

The new building consists of two floors above ground and one underground, with a heating/cooling area of 21,600 m² corresponding a heating/cooling volume of 60,238 m³. Considering its function, the outdoor design temperatures for this building ranges from 10.6 to 40.2 °C, while 22 °C is considered as indoor temperature. The ventilation rate has been set at 35 air changes per hour. The design illumination levels shall be: 350 lux for patient rooms; 420 lux for offices, 280 lux for atrium and 150 lux for surrounding space.

- innovative building technologies

As mentioned above, various of innovative energy efficient building concepts have been applied in this pilot project, in particular,

- innovative daylighting systems: Sun pipes and light ducts. As the sun-pipes have an internal element that reflects the sunlight from outside to inside, the installation of these components on the terrace of corridors and halls, and in front of patient room windows permits the switch-off of the lamps in the corridors during the morning through the year. Since each patient room has two windows and one of them faces inside, through the adoption of sun-pipes those inside windows are also illuminated by sunlight.
- high performance building envelope and materials: improved wall insulation has been studied for the rooms directly exposed to external climatic conditions, finally, the walls built for the Hospital have 6 cm of thermal insulation materials, having a U value of 0.37 W/m²K. It is expected that the utilisation of high installation materials will permit to reduce 12% annual energy consumption for heating.



View of the terrace at the top of the hospital with sun-pipes and light ducts



Sun-pipes installed in front of patient rooms



Sun shading systems used for patient rooms and the greenhouse

- green roof: the realisation of a green roof is a outstanding feature of this demonstration project. Since the hospital is a place in which psychological aspects are very important for patients, the original idea was to create a green-roof terracing with gardens where people can walk, look at the landscape at the hills and enjoy the green of the park. Furthermore, the application of Green roof technologies will reduce the hospital buildings' environmental impact. High performance thermal insulation materials have been utilised also in this case, the green roof package studied for the Meyer Hospital reaches a U value of 0.79 W/m²K.
- windows and shading system: wooden-frame windows have been chosen by the project. Patient rooms are protected from direct sunlight through an overhanging structure. In order to reduce the visual impact of the building in the park, the shading system is covered externally with copper-plates and in wood as internal surface. A greenhouse has been built surrounding the buildings, which is shaded by internal white blinds adjustable through an automatic control system.
- heating and cooling systems: two high efficiency condensing combi gas boilers (106% efficiency) and radiant floor panels have been installed for supply space heating. The choice of radiant floor panels allows the hospital to reach a good thermal comfort level but with a low energy cost.



Heating system

The project aims at promoting and widespread disseminating EU innovative Research and Technology Development and Demonstration results, as well as eco-sustainability criteria in building sector, which include:

- energy efficient building materials, components and systems not yet introduced into the building market or in their first market phase;
- innovative applications of heating/cooling and power supply technologies, combined with the use of renewable energy sources, in building sector;
- best EU demonstration eco-building projects.

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For summer cooling, two electrical chillers will be used. Moreover, there is a third water/water type chiller; the heat generated from this last one is used for a domestic hot water generation.

- o ventilation: for saving cooling energy, both passive cooling and ventilation techniques are applied as much as possible, air-conditioning devices are used only where necessary. A sun space has been built as a buffer area for the building. The heated air generated in this space will be used to create solar draughts for providing a natural air flow through the building. Since the part of the buffer space is oriented to the South, during summer, it is partly openable to reduce overheating.
- o integration of renewable energies: a 31kWp of glass/glass PV system has been integrated in the Meyer hospital's greenhouse. The installation of this PV system was financed partially by the Italian Ministry of Environment (contribution was 75% of total PV cost). The Meyer's greenhouse is south-oriented, having unobstructed solar access to the main solar glazing of the structure to maximize the collection of winter sunshine. Furthermore, the PV installation integrated into building greenhouse provides the opportunity of combining energy production with other functions of the building envelope, such as shading, weather shielding and heat production.

Actually, the design objective of this greenhouse has taken into account not only energy and environmental aspects but also social impact: the primary objective was to create a pleasant and -socializing space, which is well integrated with the adjacent green surroundings.



The Meyer Hospital's greenhouse

- o natural gas cogeneration system for electricity and heat: a co-generation plant will be installed in the Meyer hospital, with power capacity of 7.5 MWe (ISO). Heat and electricity generated will cover partially the energy demand of the hospital complex.



The CHP plant installed in the Meyer Hospital

The electrical efficiency of the turbine - calculated as the ratio between energy power generated and heat supplied by the natural gas - equals to 29.9%; while its thermal efficiency - calculated as the ratio between heat output and heat input from methane combustion - reaches 40,5%. The obtainable annual energy saving will amount to around 4,400 Toe (Ton of oil equivalent).

Performance:

- o Energy data: the energy performance was designed to achieve a 40% reduction in consumed energy, however, the information reported here are derived from simulation, calculation and monitoring.

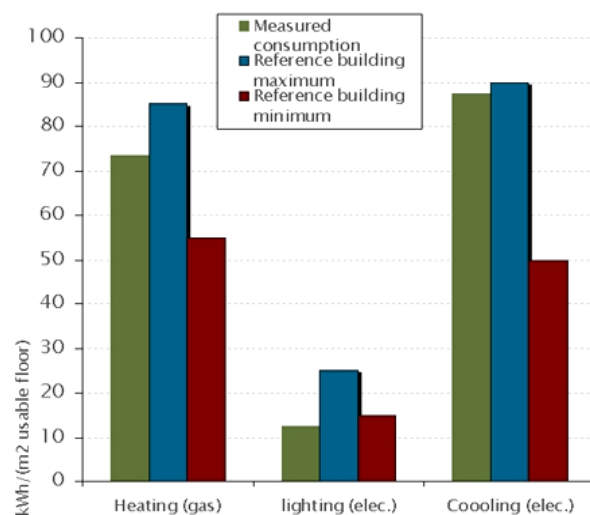
The high insulation materials applied in walls and the roof permit the achievement of an energy saving of 35% for heating and cooling. The annual-average heating demand is 73.4 kWh/m², while the annual-average cooling demand amounts to 87.3 kWh/m².

The annual energy consumption for hot water generation is 13% less than in a conventional Italian hospital. It is worth to underline that the co-generation plant has not been considered for energy performance because the installation of the plant shall be completed.

So far as energy consumption for lighting, with the installation of high efficient lamps, together with the adoption of sun-pipes and light ducts, the total annual electricity demand is only 12.3 kWh/m².

The table below summarises partially the obtained energy performance in comparison with conventional hospitals.

- o Economic data: the total cost of the project amounts to € 1,160,000, of which € 960,000 for the structure and € 200,000 for furnishing. The investment for CHP plant is not included in the total cost because its installation has still to be completed. As the installation of the CHP plant was not foreseen by the HOSPITALS initiative, the district where the Hospital is located will be in charge of the completion of the CHP plant.



Energy consumption

New Meyer Children's Hospital

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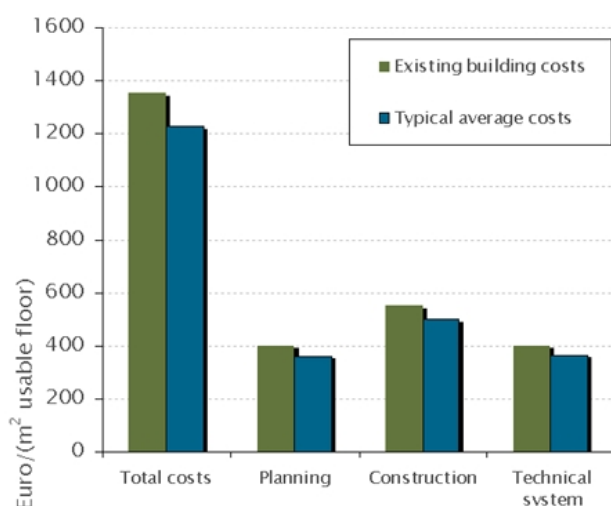
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Particularly, the total building costs (not including the land or lot) per m² usable floor area for Meyer Hospital demonstration project are shown in the following figure, in comparison with typical building construction costs.

Although the construction costs of the pilot project are higher than conventional buildings, due to the application of innovative energy saving measures, the higher initial investment will be paid back easily from energy saving, which will be obtainable through over the whole life of the project.

		Annual energy use in a conventional hospital	Annual energy use in Meyer Children hospital
heating, total	kWh/m²a	112,1	73,4
space heating	kWh/m ² a	97,2	60,5
DHW	kWh/m ² a	14,9	12,9
cooling	kWh/m²a	113,5	87,3
electricity, total	kWh/m²a	99,5	62,9
air pollution			
CO ₂	kg/m ² a	80,5	51,4
SO ₂	kg/m ² a	0,07	0,452
NO _x	g/m ² a	0,70	0,452

The implementation of the project was supported financially by the European Commission, the EU funding covered 35% of the eligible capital costs, which includes include planning, construction, commissioning, monitoring, evaluation as well as dissemination.



Financial chart of the construction of the new Meyer Children Hospital building

- o Environmental data (Carbon Dioxide emission reduced): since the yearly energy consumption in Children's Hospital has been substantially decreased, consequently Carbon Dioxide emission has been reduced significantly. The main air emissions are reported in the above-mentioned table. Comparing with conventional hospitals, the total CO₂ reduction amounts about 36%.

Information on project developer

The Owner/project partner of the present demonstration project is Meyer Children's Hospital.

Up to Now, thanks to the EU HOSPITALS initiative, the new Meyer Hospital is the first bio-climate hospital built in Italy.

Further information:

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