POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE 2
Degree in Architecture
Honors theses

Innovative systems for lowest energy consumption building
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The work wants to investigate the performance improvement of the building envelopes and environmental systems by their rational use.
The aim doesn't want to define the best sustainable architecture solution (meant as saving energy capability) but it wants to sift out the trade technological systems by an energy view.
A careful inquiry has been done about the technological building systems on the market; these systems refer both traditional and advance envelopes and environmental technologies.

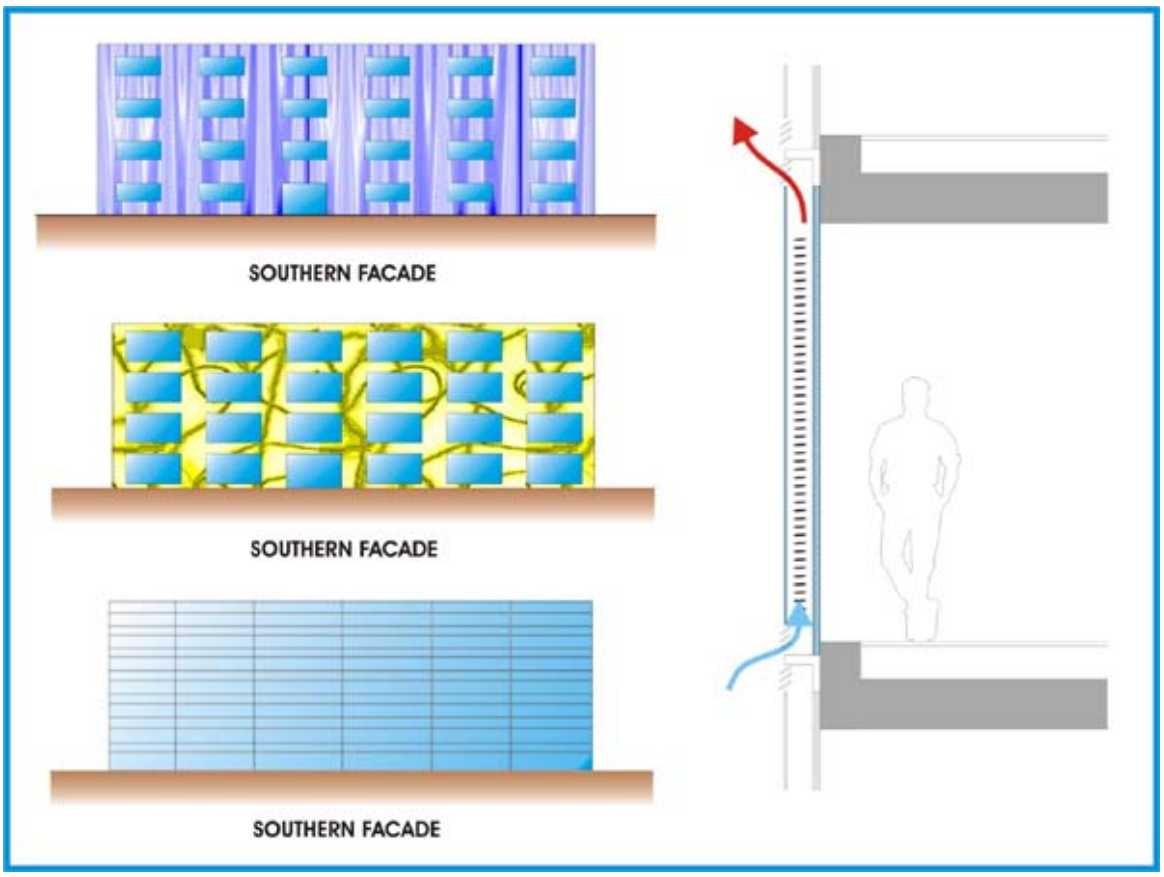
Some report cards have been draft to know and value the system energy abilities and their possible integration in order to reach the best energy performances.
Each technological systems answers to several energy-saving strategies settled by considering building as a thermodynamic system in which there are energy exchanges between inside and outside building envelope.

The study of the technologies refers to their application in a model office building; the choice of a tertiary fabric is motivated by its considerable possibility to employ advanced technologies
(such as double skin façade and building-integrated photovoltaic systems); moreover the summer-thermal comfort demand is now a requirement that cannot be disregarded.
Several envelope and environmental system configurations have been considered and for each of them an energy simulation has been made in three different climatic zones: Milan, Rome and Palermo.
The simulation has been carried out by DOE-2 program, developed by U.S. Department of Energy, that can appraise the building energy performance, by referring to electric and natural-gas consumption, in order to obtain thermal and lighting comfort:

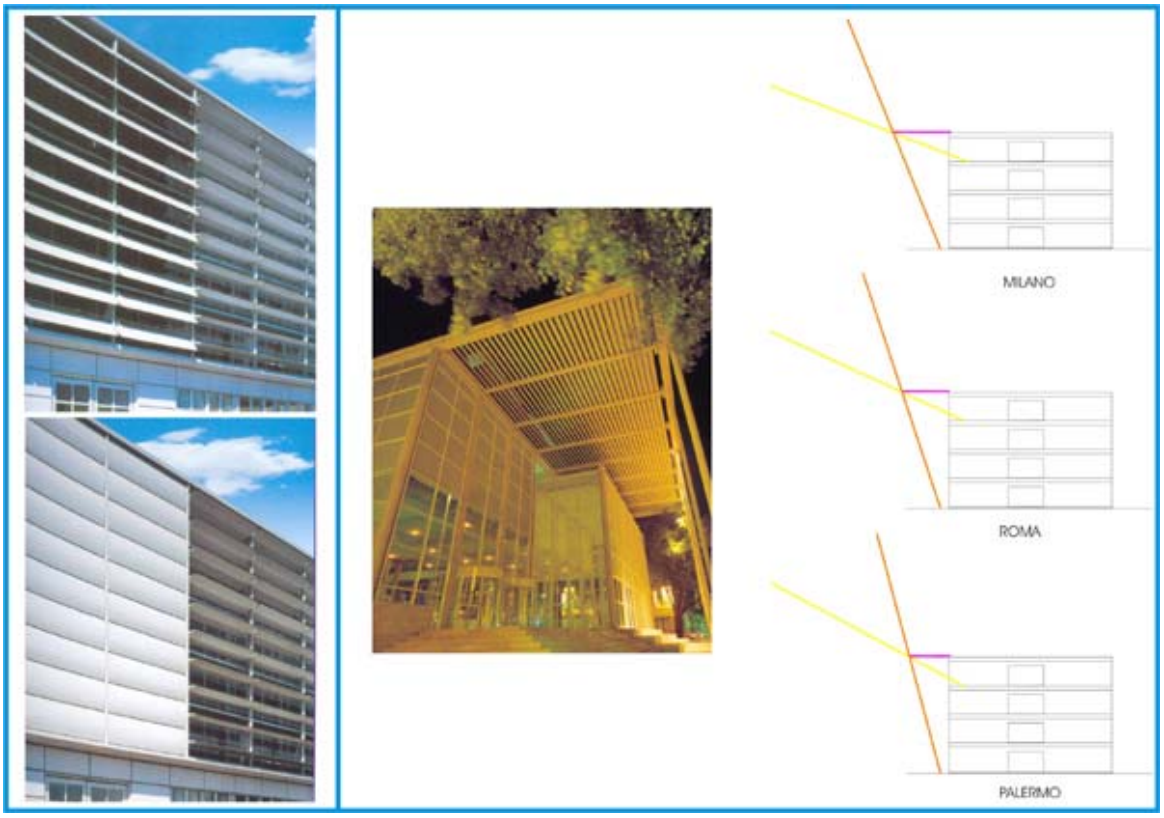
- indoor temperature of 20 [°C] during cold season;
- indoor temperature of 26 [°C] during hot season;
- indoor lighting level of 500 [lux] (office job).

The software simulator regards all the energy loads required by the indoor building activities (cooling and heating demand , artificial light, equipments) and the internal heat capacitance of the fabric, giving considerable completeness to the simulation output data.

The envelope configurations refer the same environmental system: gas furnace and compressor chiller with fan coil units.
The configurations differ in exterior wall composition (wall with a central cavity or naturally ventilated façade) and in window-to-wall surface area ratio (from the lowest window surface -defined by the ordinance – to fully transparent envelop).
For each building configurations particular actions have been individualized: thermal insulation increase, pane energetic feature variations and double skin façade.

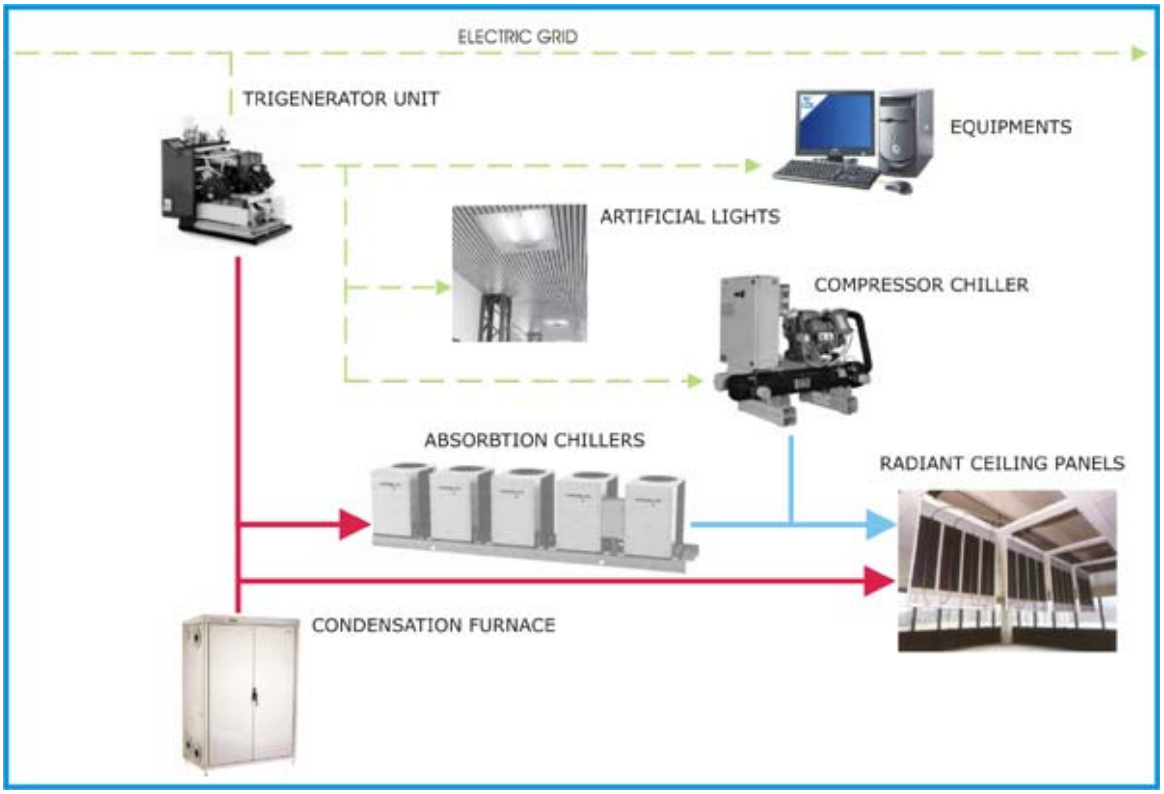


In the totally glazing solution it has been simulated fixed external solar shadings and motorised ones (computer controlled when solar irradiation exceeds a pre-established value) alongside the South exposure.



The second part of the simulation work foresees the study of different environmental system configurations, applied on the lowest and fully glazing envelope typologies:

- utilization of condensation furnaces, compressor chillers and radiant ceiling panels;
- the same above with a cogeneration unit to produce electrical energy;
- the same above, with absorption chillers to build a trigeneration system.



In the end a building-integrated photovoltaic façade has been regarded; the energy so produced forms the 10 % of the total electric energy request.

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