POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE
Degree in Architecture
Honors theses

Energy saving bioclimatic techniques, applied to the plan of a school building in a mountain zone

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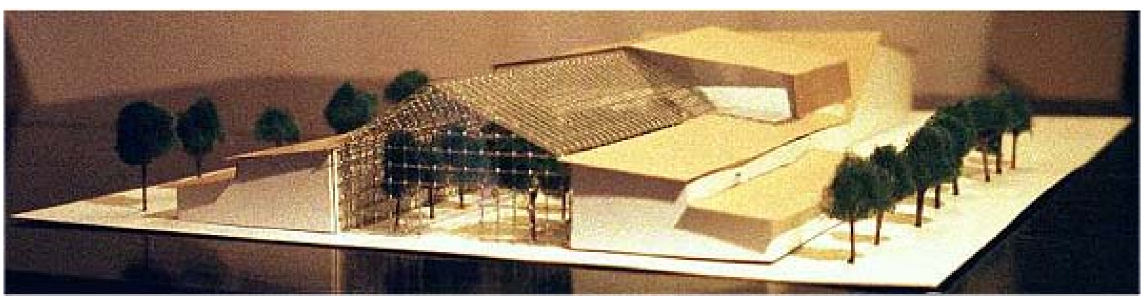
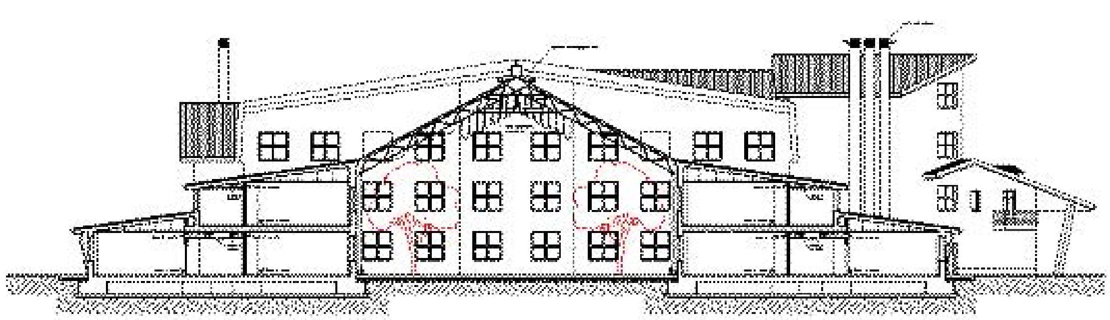
The modern built environment is in many cases a system *which generates a waste of resources*, undervaluing that the availability of primary energetic resources is not unlimited.

Therefore it is necessary to limit energy consumption, also with a careful examination, study and observation of our natural environment, by planning and building structures that offer, if not a complete independence from energetic sources of fossil origin, at least reduced comsumptions ; architecture should be considered a system able to manage and optimize the inflow and outflow of resources, *a self regulating* organism as regards to the external enviroment, that is to say, creating and realizing a *bioclimatic architecture.*

We have tested some tecniques of *bioclimatic architecture* by planning some *retrofitting interventions* for a school building in Oulx (To), already designed in accordance with the most recent Italian energy saving laws (L.373/76, L.308/82, L.10/91) .



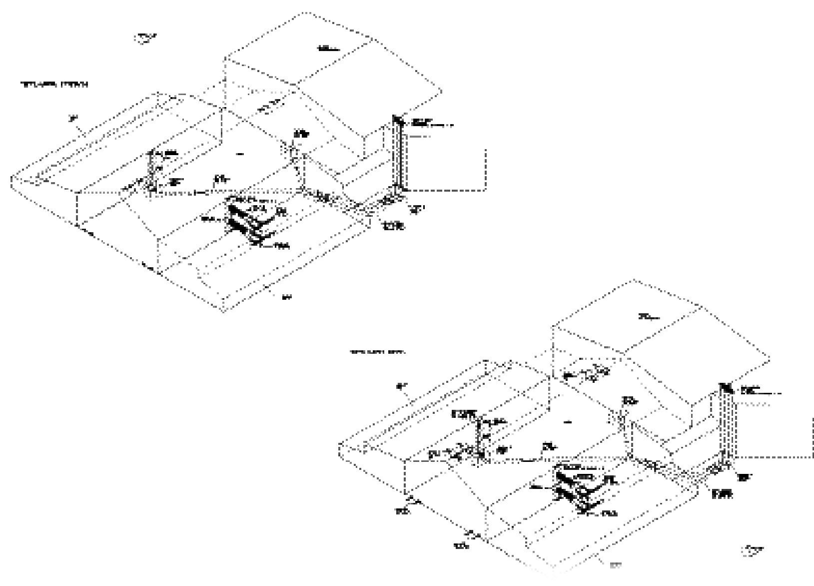
Model and cross section of the school in Oulx



Following these statements, our attention was focused on two aspects :

- in winter, exploitation of free solar contributions and their control in the summer ;
- exploitation of the ground thermic mass to obtain a contribution to the heating and cooling processes through the creation of a series of underground pipes and the realization of a ground-to-air heat exchanger.

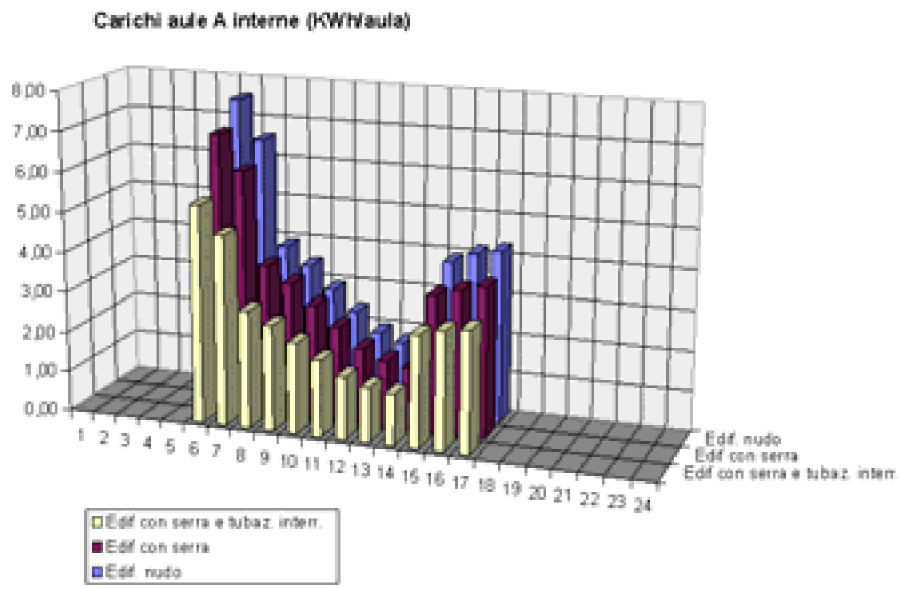
With reference to the first aspect, a glass-house has been conceived, which closes the yard between the offices and laboratories building and the classrooms building, offering all year round a wide and covered multipurpose space.
With reference to the second point, we started from the finding that in the most part of climatic regions the ground mass underneath a building can be a natural source of energy at an almost even temperature.
From the processing of the climatic data of our location (Oulx), we found out that the ground temperature should range between + 8 / + 9,5 °C (compared to the external air temperatures of +30°C in the summer and -20°C in winter) ; thanks to the ground to air thermic exchange, the above temperatures can give the air-heating system air inflow at a temperature that will restrain the need of additional exogenous energy.



Ventilation flows layout

The summer and winter air conditioning of the school building has been planned with an hybrid passive system which completes the air-heating plant (a system based on radiators and forced ventilation) and is composed by :
Air intercepting towers made of stainless steel ; air intake can be obtained by a coaxial fan, moved by an electric engine or by wind pressure.
Underground pipes at a depth between 2 and 3 meters, which form the ground-to-air heat exchanger; they have a gradient of 2 - 3 % to allow the outflow of possible condensation.

<u>Vertical ducts</u> that join the underground pipes and the air-handling units, with valves for the outflow regulation towards the single units or the glass-house.
<u>Glass-house</u> a metal and glass structure with sliding shading curtains and vents to obtain the "chimney effect".
<u>Inspection chambers</u> to ease the ducts maintenance and cleaning.
From the simulations of the thermic performances of the original building and the *bioclimatic building* (both obtained with a software program), we can assess that the bioclimatic building offers significant energy savings in winter (around 15-25%) and in the summer the cooling for the entire building (glass-house included) can be obtained without exogenous energy .



Comparative graphs of the loads obtained from the simulations

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