

POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture (Environment and Land)
Honors theses

Integration between natural and artificial light, potential and limit on energy conservation

by Francesca Massa

Tutor: Valentina Serra

Co-tutor: Anna Pellegrino

Daylight is one of the defining elements in architecture both in aesthetic and functional terms. Since the beginning of the twentieth-century, despite the progressive diffusion of electric energy, it has continued to be the main source used to light (in daytime) both residential and public buildings.

It lost this function starting from the middle of the 20th-century, when a larger diffusion and availability of low cost electric energy determined a more and more pronounced exclusion from the planning sphere of buildings. Actually it is thought that a wide use of *artificial light* could allow to achieve more flexible results and enable a more disengaged technical elaboration, free from the position and the size of windows.

The results of this approach has been a design more and more dependent on artificial sources of energy, in accordance with a philosophy based on the replacement of daylight (constantly exposed to variations in intensity and direction, so difficult to control) with a source of light able to guarantee constant levels of lighting in occupied areas.

The energy crisis in the seventies made reconsider the wide potential offered by the use of *daylight*, causing it to be progressively used again both as a lighting source and an architectonic element. Its changeable and dynamic nature is seen as a quality rather than a defect, because daylight is able to satisfy the biological needs of human beings in relation to the natural rhythm that changes during the day.

Exploiting at most the natural availability of daylight coming from outside also means to reduce energy consumptions in buildings. The problem of **energy conservation** has become more and more important over the years, especially with reference to the primary sources from which energy is obtained, generally polluting and near to exhaustion.

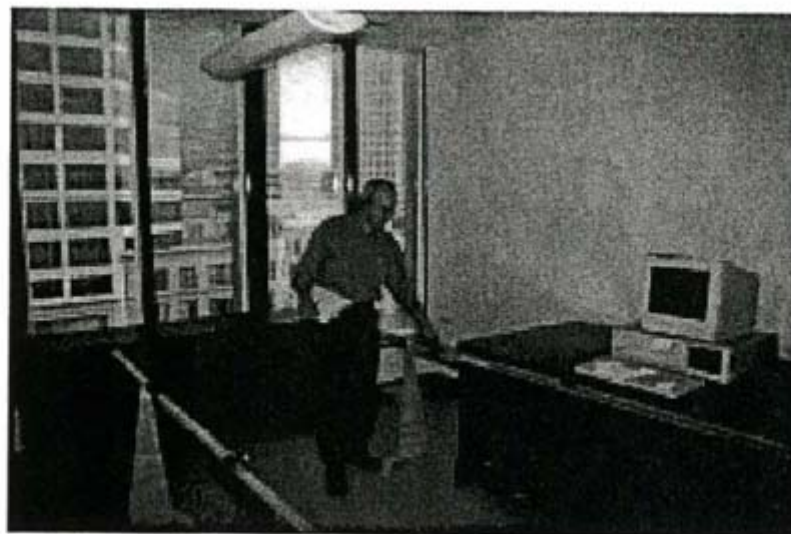
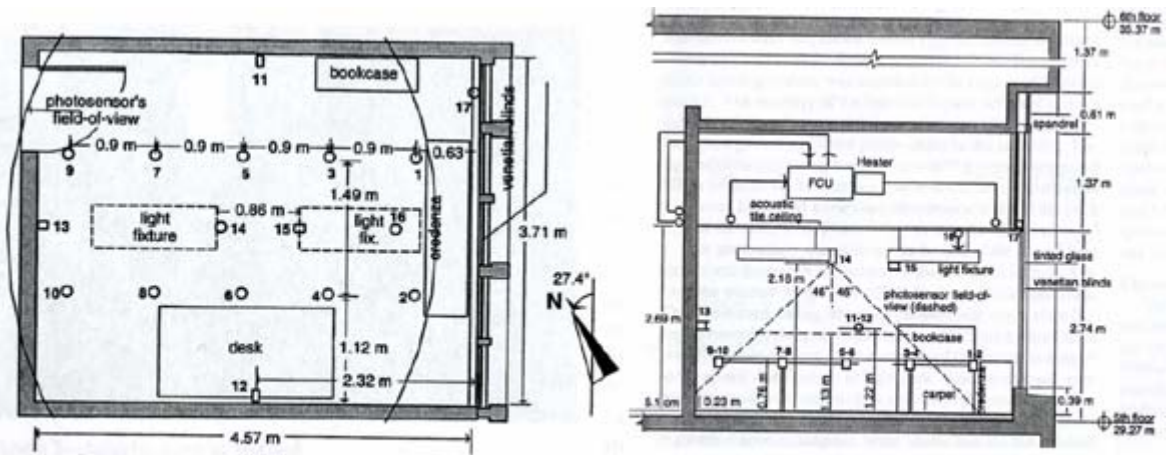
Technical and technological progress has led the lighting technique research towards the development of more and more advanced systems, which can even modulate their own performance acting on luminous intensity produced by artificial sources, in connection with the availability of natural light in a space.

The lighting technique discipline is now in a phase of study and experimentation of possible devices for **integration between natural and artificial light**. The main objectives are:

- possibility, through the use of suitable instruments, of reproducing the dynamics of sunlight during the day;
- check of light intensity provided by artificial sources in relation with the availability of natural light;
- maximum exploitation of daylight, rightly shielded or modulated in order to create always the most comfortable conditions for users;
- choice of techniques and systems able to combine all the elements to maximize the result;
- energy conservation and longer life for sources;
- achievement of the best and highly advanced comfort performance inside a close space in connection with its use.

Going through the most significant steps of this research area, this analysis is composed of three main sections.

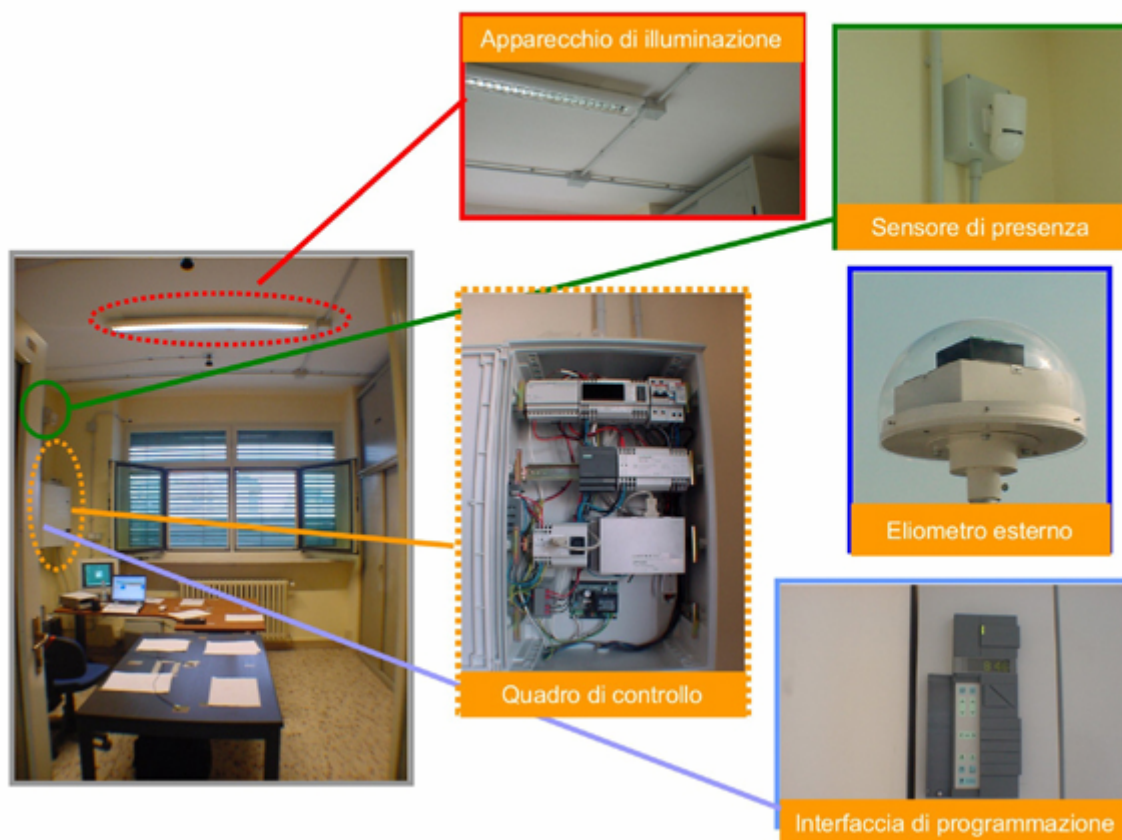
The objective is to study and to test the **potential and limit** coming from a project of integration between the natural and artificial light components. To succeed in producing concrete considerations and valuations, about ten case studies have been analyzed and tested. They have been promoted and carried out in some of the more technologically advanced countries in the world and then published on international magazines.



Planimetric arrangement of electric devices in a case study in California

In an even more direct and practical way, the last section of the paper reports a short experimental analysis on a research plan recently set up at the Politecnico di Turin, Energetics department. The study tested the working of the last operative control system produced at *Zumtobel*, called *LUXMATE Professional*. In this case too, the aim was the definition of energy conservation potential achievable with this kind of systems.

Descrizione del sistema



Components of the LUXMATE system and their location

For further information, e-mail:
Francesca Massa: massa.francy@libero.it