POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE
Degree in Architecture
Honors theses

External shading devices to control daylight and solar heat gain. Performance analysis and design hypothesis
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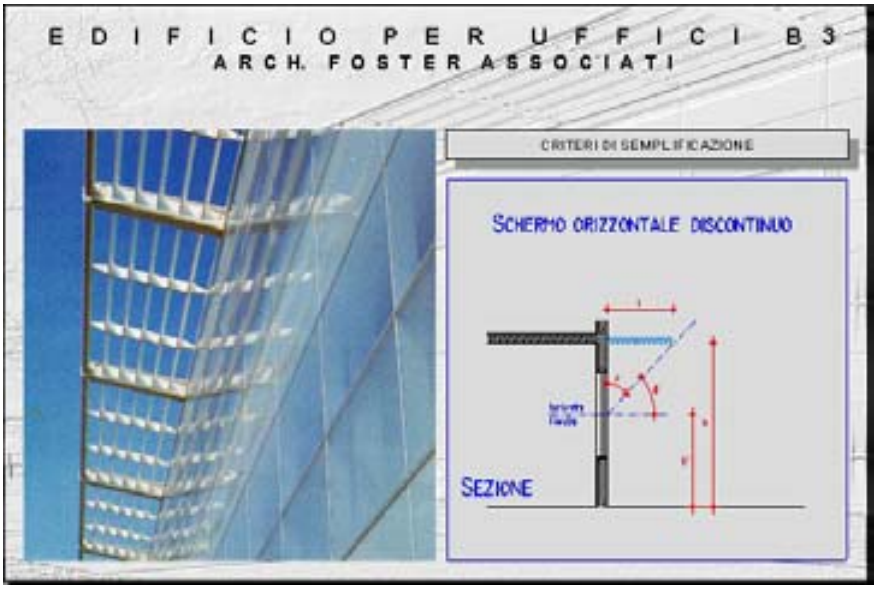
In the last years a new way to design buildings, known as *energy conscious design* developed. Buildings have to be designed so that their shape, their orientation and above all their envelope allow to assess comfort conditions with a minimum use of building services.

Within this topics the degree thesis was carried out: actually external shading devices plays a fundamental role into the light and solar radiation control.

The principal aim of this work is to analyse shading devices in order to provide useful indications to their design.

It was necessary, on the one hand, to classify the shading devices by their geometric characteristics, reducing them to four fundamental typology to represent, with a certain approximation, its architectural variety; on the other hand, to analyse their energy and luminous performance through the definition of synthetic parameters and calculation methodology.



Simplification criteria

For the energy performance evaluation, an automatic calculation program has been created. It is able to characterize the projected shadow of any shading device, for

any latitude and in any time, and then to determine the hourly shading factor, which is the synthetic parameter assumed as reference.

The adopted methodology has been compared with that used in the Italian standard UNI 10375 app.C; it was found a remarkable difference of the values and new corrected values for the city of Turin were proposed.

For the daylight evaluation, an existing office has been considered and the internal light distribution has been quantitatively and qualitatively estimated.

On the one hand, it has been pointed out the light distribution on the floor level by means of the daylight factors values, obtained by the Waldram diagram, and the influence of the screen reflection coefficient on the room light penetration has been analysed.

On the other hand, it has been estimated the light uniformity in the room through the ratio of maximum and mean values of daylight factors.

Finally it has been evaluated the shading devices energy and luminous performance, since the light and solar radiation control are often not separable.

The results coming from this integrated analysis have been put into design indications.

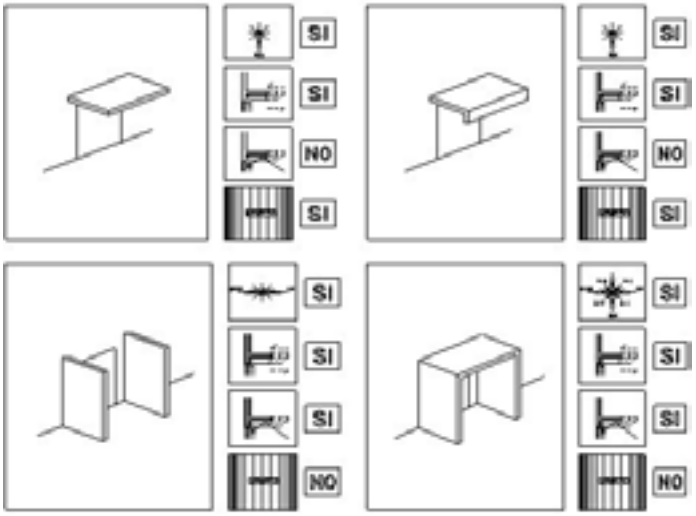
As far as the overhang is concerned, the best use is, as known, for south orientations, and the right depth must be carefully calculated. An increase of the depth means a bigger shadowed area and a diminution of the shading factor with a consequent decrease of the daylight factor, not balanced by external reflection of the screen. As a consequence it is not advisable to act on covering or coating material.

For overhang with vertical end projection, the reflection coefficient of the screen becomes more important: increasing the depth means an improvement of energy performance, connected to the projection dimension, which doesn’t coincide with a drastic decrease of the daylight factor, since the minor direct component is balanced by the external reflection.

For side fin and compound screen, the external reflection plays a primary role. Actually a side fin with increasing depth involves a bigger shadowed area but not minor daylight factors values.

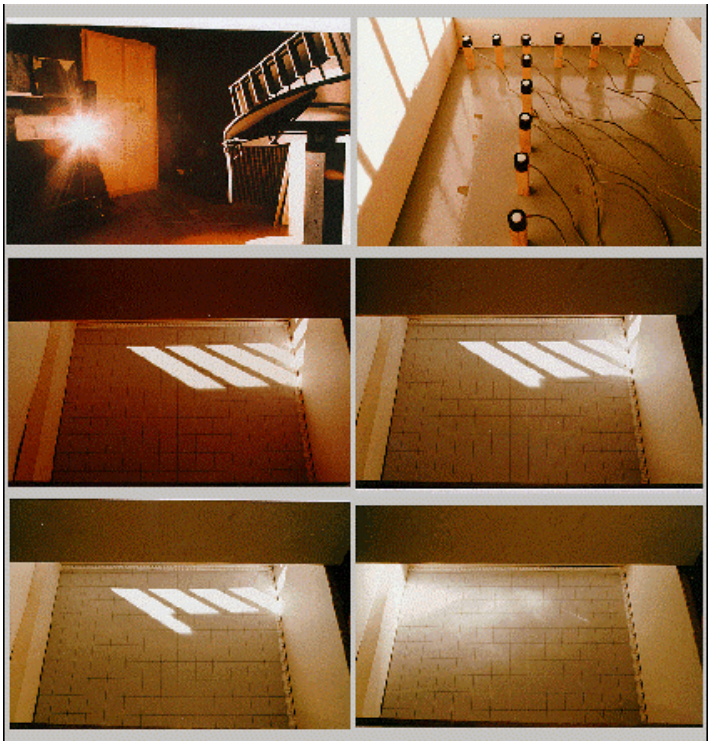
The external reflection of a compound screen engage importance straight better respect to direct component. Increasing his depth, is possible to maintain acceptable values of internal daylight factor acting chiefly on reflection characteristics.

It’s so advisable, for the last two type of screen, to take into account as design parameters the dimensions, the depth, the covering and colouring materials.



Design indications

The obtained results has been experimentally supported by a scale model and a solar machine, to perform the projected shadows in different time and period of the year and to evaluate the incidence of the shading devices reflection coefficient on the light penetration in the room.


The experimental apparatus and the projected shadows

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