DAYLIGHT IN THE BUILDING

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Summary

14% of the energy consumption in Europe (19% globally) belongs to lighting. A possible energy savings of 60%of this amount could be realized with quality light management and use of daylight.

Daylight intensity changes during the day, year, according to the weather etc. As the exterior condition vary, it is difficult to control the proper illumination level indoor. Maximize the positive and block the negative effects of daylight and sunlight in the building and functional coordination with artificial lighting are the issue.

Keywords: daylight, energy efficiency, luminance, glare

1 Different aspects of day lighting in the interior space

Proper illumination level, energy demands on the artificial lighting, need of the optical contact to the surrounding, the art effect of light changing during the day as well as the potential to create extraordinary effect and bring new quality to the whole building could be seen as reasons to open the building envelope and bring a lot of daylight inside.

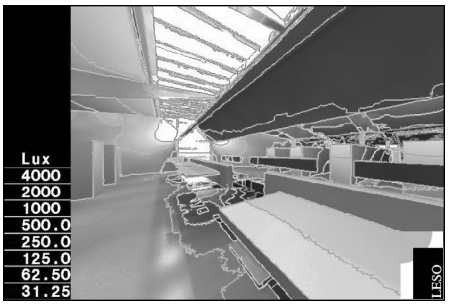

Fig. 1 Measurement of the illuminance in the room [5]

Fig. 2 Fisheye projection – analyses of luminance, glare, etc on the work space, Inanici [2]

Without the strategy at the early design stage, uncontrolled light flux from exterior could cause sun glare, the outsized use of the glass in the façade increase thermal losses in winter and the risk of summer overheating of the room. It might cause malfunction of the whole system. The responsible design of the habitable building has to be aware of all these consequences and deal with these ambivalences while using the daylight in the interior.

2 Modern solutions, proposal for future

To create quality interior conditions, many concepts were developed. From the eletronic control units operating the traditional system of blinds to the modern facade with special electrochromic glass technologies, systems of light guides, optical-fibre cables and many others. These are possible methods to bring the quality daylight inside the building.

2.1 Venetian blinds, external awning etc.

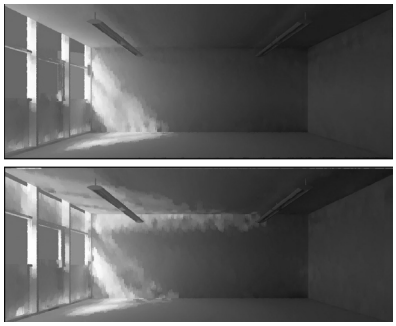

Fig. 3 Effect on light distribution – without and with use of Venetian blinds

Fig. 4 External awning

Popular way how to control the light entering the interior are Venetian blinds, external awning etc (put aside the internal blinds with very limited thermal effect). In modern concept are usually equipped with electronic sensor, remote control etc. While the system adjusts itself according to outside conditions, occupants are often disturbed with noise and small, but noticeable, changes of illuminance. The request for the stabile light conditions and no disruption often come to a decision to close these blinds all day long and use the artificial lighting 100% of time.

2.2 Shape of the façade, double layer ceiling

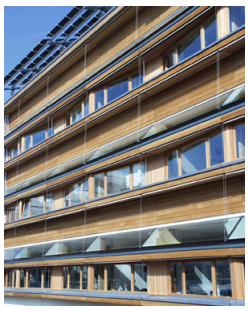

Fig. 5 Solar façade – photo [5]

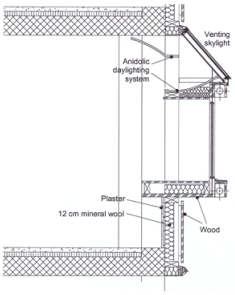

Fig. 6 Solar façade – section [5]

Efficient way to control the light entering the room is to create the building already with some system to control the amount and quality of daylight entering the space. This could mean to shape façade according to the sun position in different time of the year or to set up double layer ceiling with reflective surface to lead the light deeper in the room.

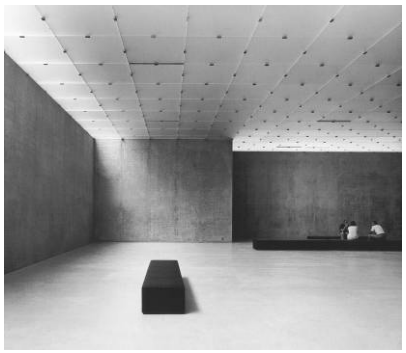

Fig. 7 Zumthor: Kunsthaus Bregenz

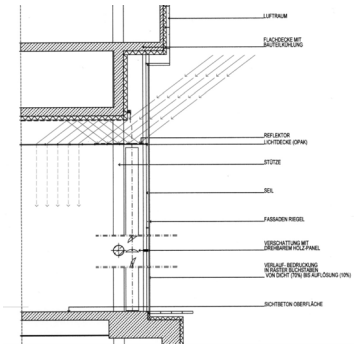

Fig. 8 Kramm&Strigl: Light-ceiling of new library for Leipzig, Germany [4]

2.3 Skylight, light guides, light tunnels

Use of the skylights and light tunnels provide the light in the central part of the building. These distribute the daylight more equally through the space and block the sunlight from the room at the same time. This makes the interior space light conditions very comfortable. But still, as these are built-in solutions with no reaction to the exterior conditions, we are usually not able to control the light flux entering the room.

Fig. 9 Light tunnel

Fig. 10 Ross Lovegrove: light tunnel, Red Dot Award for design[3]

2.4 Light guides, electrochromic glass

Recently, new technologies are being tested, such as electrochromic glass, light guides, optical-fibre cables etc. After proper optimization could these create new possibility of daylight use in the interior, with control over the thermal effect and glare and no disruption to the occupants.

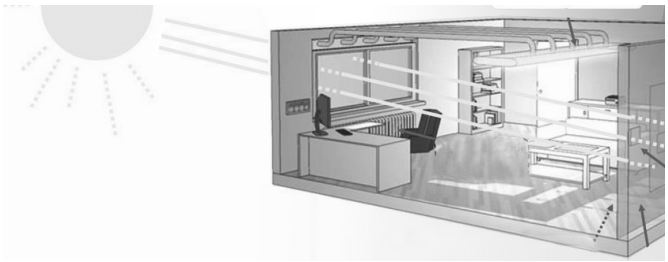

Fig. 11 Light guides in the room – Clear-Up project [6]

3 Conclusion

Light, and especially daylight, is one of the crucial aspects by achieving high quality interior conditions.

The good conceptual solution of the building plays the main role in its functionality. In the early design stage functional and affordable design could be found. Later only limited number of costly solutions is usually available.

Measurements, analyzes and optimisation of daylight systems could help to use positives of daylight and minimize its negative affects to create high quality interior space.

Acknowledgment

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