

PROGRAMS FOR SIMULATION DAYLIGHT LIGHTING AND THEIR USE IN PRACTISE

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Summary

Lighting status of an interior and effect of lighting on humans and their eyes does not depend solely on the amount of light, but also on other factors (spatial distribution of light, the dynamics of changes of lighting with time etc.). The design must maintain good lighting quality in case of sunny, cloudy and overcast sky, and also in case of direct illumination by the Solar. To maintain good lighting quality, sufficient lighting level does not suffice; it is also necessary to maintain good lighting quality.

Keywords: Daylight, programs

1 Evaluation of daylight lighting

1.1 Quantitative criterion

To evaluate illuminance from quality point of view, daylight factors D [%] is used; it expresses the ratio of interior illuminance E [lx] at the point at working plane relative to illuminance E_H [lx] outdoors from the standard unobstructed sky.

$$D = \frac{E}{E_H} \cdot 100 \text{ [%]} \quad (1)$$

Resulting daylight factor composes of the sky component, the externally reflected component from exterior obstacle, and the internally reflected component from interior surfaces.

$$D = D_s + D_e + D_i \quad (2)$$

Sizing of windows must allow sufficient lighting of the room. Windows in one perimeter wall sometimes does not suffice; use of lighting from multiple directions may improve lighting of the room; sometimes, roof lighting may be added as long as the position of room within the building allows it. It is necessary to assess the quality of lighting, e.g. in some cases, lighting from opposite windows may actually worsen the situation.

1.2 Qualitative criteria

Qualitative criteria express the quality of interior lighting; they include uniformity, flux distribution, brightness distribution in one's field of vision, prevention of dazzle, and color finish of interior surfaces. Provision of sufficient light intensity does not guarantee visual comfort at all.

- Uniformity of daylight lighting
- Dazzle

2.3 Eurodial

Very simple program for preliminary evaluation during design of building with relation to exterior lighting, artificial lighting, and proposal of NWSE orientation for the purpose of heating technology design. It provides first impression of thermal characteristics of a room. (E.g. the number of days when AC will have to be switched on, or blinds activated, or a ledge over a window installed because of excess Solar irradiation).

2.4 Radiance (Ecotect-Dr. A. J. Marsh, IES)

A program simulating not only lighting situation, but also thermal-technical. Radiance method can be categorized as a generalized raytracing method. [5] This method takes all areas as ideal diffusion primary or secondary light sources or a combination thereof. Advantages of his method include simple implementation of visualization and calculation algorithm, as the surface illuminance is being calculated regardless of the direction of viewing of the scene being visualized. When changing this direction, there is no need to recalculate (on the contrary to classical raytracing), which improves the performance tremendously, especially when animating walk-throughs in architectonic CAD etc. This program evaluates daylight illuminance and also brightness contrast in an interior and when combined with IES, it is possible to evaluate thermal behaviour as well, and ECOTECT program allows to simulate solar irradiance and to perform acoustical calculations.

2.5 Practical experience with programs

The interior depicted below has special lighting system, including glazed façade and inclined lighting tube with “pills”, which is designed and installed to allow early morning and evening sunlight, while preventing excess thermal load at the noon.



Figs. 3, 4 Design of hall and meeting area [4]

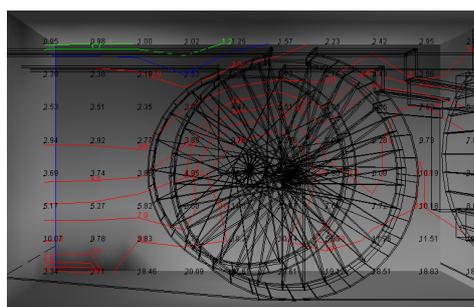
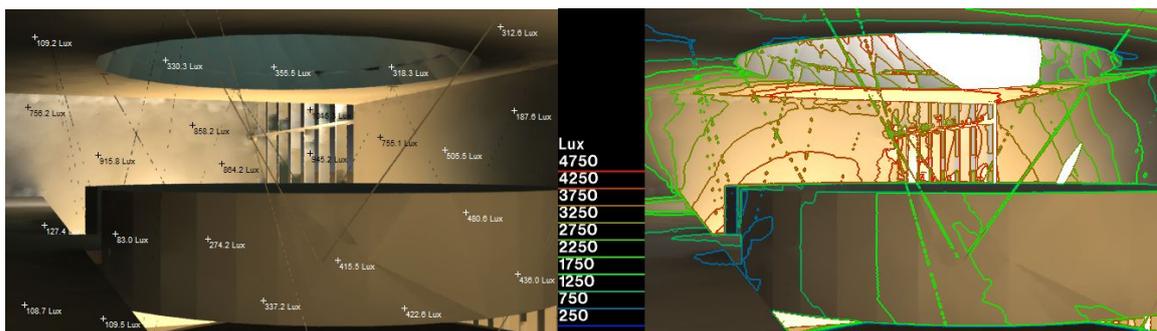


Fig. 5 Wdls sample output Daylight Factor (hall from fig 3 and 4)



Figs. 6, 7 Ecotect sample output Illuminance image [lx] (21.december 12:00, 21. June 9:00)

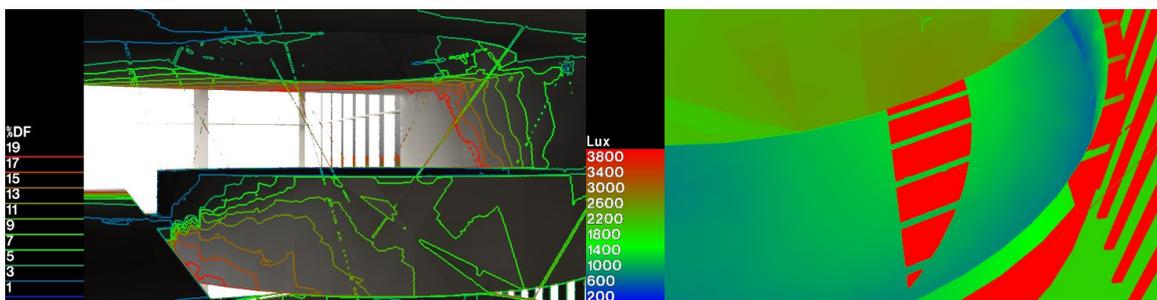


Fig. 8 sample output Daylight factor[%]

Fig. 9 21.june 17.00 - Illuminance image [lx]

3 Conclusions

Daylight may be utilized in many different ways - architects and light technicians must ensure that resulting light effects are suitable from quality and quantity point of view. To assess this, we may use calculation programs. Different methods of light reflection or directing of sunlight should be used to solve the needs for lighting of complex interiors, even if the situation and resulting solution may seem complicated.

References

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