

SOLAR AND DAYLIGHT RIGHTS IN CONCEPT OF PERFORMANCE BASED BUILDINGS



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Summary

The daylight and direct solar availability in the urban environment is considered as an essential input data for design. There are many forms of control of daylight and direct solar access in buildings and open spaces among them. The control forms can be principally divided in two categories: simplified prescription and performance based methods. The paper discusses the present performance based criteria of solar and daylight rights in Slovakia, calculation techniques and their limitations in practice.

Keywords: Solar rights, daylight rights, urban planning

1 Introduction

A settlement planning is one of key aspects of sustainability. In spite of many initiatives and concepts called ecological building design, climatic building design, sustainable architecture, green architecture, biological design, etc. real processes lead to high urban density of many towns over the world. The sustainable city is sometimes described as high-density and compact in shape, which can reduce the consumption of natural resources. On the other hand increasing of urban density reduces solar and daylight access, mainly in low stories of surrounding buildings. High-rise living in large cities requires new morphological patterns and new criteria and evaluation methods.

In this paper, the relevance of daylighting and insolation (direct solar access) to urban design is discussed, identifying areas of special considerations.

2 Daylight and human health

Light influences the daily rhythms and well-being of humans in a physiological, psychological and biological way. Lately discovered non-visual (circadian) photoreceptors [1] are able to regulate natural body clock, and multiple body functions and performance. The broad literature shows that high lighting levels are the prime requirement for healthy

indoor environment. Daylight, including high intensities and natural dynamics, is an important and cost effective light source for healthy lighting. Availability of enough daylight on human retina prevents “fatigue”, bad “sleep quality”, and suchlike disorders. A large part of the population in developed countries is spending most time inside buildings. This fact strengthens arguments for assurance of diffuse daylight and direct sunlight in habitable interior spaces.

3 Performance based solar and daylight rights in Slovakia

A performance based design is an urban and building design that is based on a set of dedicated performance requirements and that can be evaluated on the basis of performance indicators.

Many European countries or cities have traditional planning regulations that indirectly affect daylight access in neighbouring buildings. Typical high limit of urban canyon is ratio 1:1, i.e. high of facades is equal to the distances of the buildings in the street. There are many other prescriptions (building coverage ratios, minimum and maximum height restrictions, building setback requirements...), but they usually not guarantee enough direct solar and diffuse daylight in interior space.

The radiation field at a given site is particularly sensitive to surrounding buildings. Rule of thumb for dimensioning windows in dwellings which is still used in several countries (area of window/area of room floor is for example 1/8) guarantees satisfactory daylighting only in situation without external obstruction – see **Fig. 1, 2** and **3**. Common external obstruction defined by angle of obstruction 36° decreases Daylight Factor in the middle of the depth of analysed residential room to one third of the value without external obstruction. In many European city centres the Daylight Factors in habitable interior spaces are below actual normalised values. And state of the art in urbanism has tendency to worsen availability of daylight and direct solar radiation in buildings. Actual performance based solar and daylight rights in Slovakia want to reach urban utopia – all new sunlit dwellings and all habitable rooms with enough daylight.

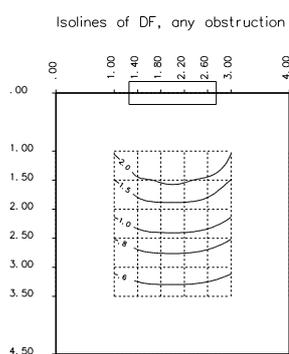


Fig. 1 Isolines of Daylight Factor in dwelling room – any external obstruction, value of DF in reference points 0,92 % (satisfy criterion according [2])

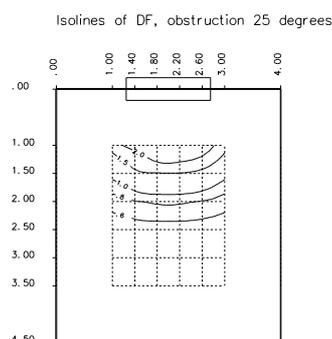


Fig. 2 Isolines of Daylight Factor in dwelling room – external obstruction 25°, value of DF in reference points 0,55 %

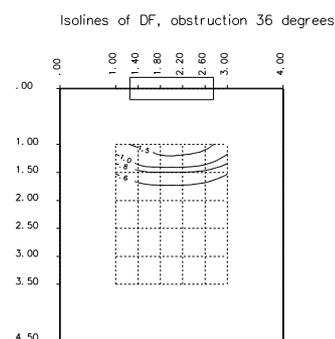


Fig. 3 Isolines of Daylight Factor in dwelling room – external obstruction 36°, value of DF in reference points 0,32 %

3.1 Criteria of solar access rights in Slovakia

In temperate latitudes need for sunshine is met mainly in dwellings. According to the Slovak building standard [2] which is incorporated into law all flats must admit enough time of solar access. The expression "enough time" means more than 1.5 hour every day during the period between 1st March and 13th October for one third of living floor area. The time of solar access (insolation) is related to the point on glazing 1.2 m above the floor level at the centre of the vertical opening (horizontally). The time of insolation is accounted under several conditions, such as (I) only astronomically possible time of insolation is considered when solar altitude is 5 degrees above the horizon; (II) the vertical opening area is greater than 1/10 of floor area of living room; (III) the angle between horizontal projection of a solar ray and the normal of vertical openings is less then 65°, (IV) since the year 2005 solar access is applied only for obstructions above 18°.

As a consequence, the shape of a new building is adjusted so to avoid excessive shading of the surrounding flats (minimum one third of their living area) during the period between March 1 and October 13. There are no exact criteria for solar access rights for undeveloped lots and for active solar systems in Slovakia.

The transparent sun-on-reference-point indicators and many other sun path diagrams or computer programs (even adapted CAD programs) can be applied for solar access computation.

3.2 Daylight rights in Slovakia

The main features of present daylight rights according [3] and related law are:

(I) only the sky light from CIE (Commission Internationale de l'Eclairage) Standard Overcast Sky on vertical external surfaces of windows or on reference points is taken into consideration, (II) own obstructions of a window or a reference point are not taken into account in calculations of daylight/skylight right (or only in defined amount), (III) the shape and dimensions of new development are defined by equivalent obstruction angle α_e . For classrooms $\alpha_e = 20^\circ$, max. 25° , for common interiors in housing estates $\alpha_e = 25^\circ$, max. 30° are used. The maximal equivalent obstruction angles in cities are $\alpha_e = 36^\circ$ and in historic city centres $\alpha_e = 42^\circ$ when it is approved by local government. On sloping sites to these values can be added maximum 5° .

The same criteria of daylight access rights are valid for undeveloped lots or proposed buildings.

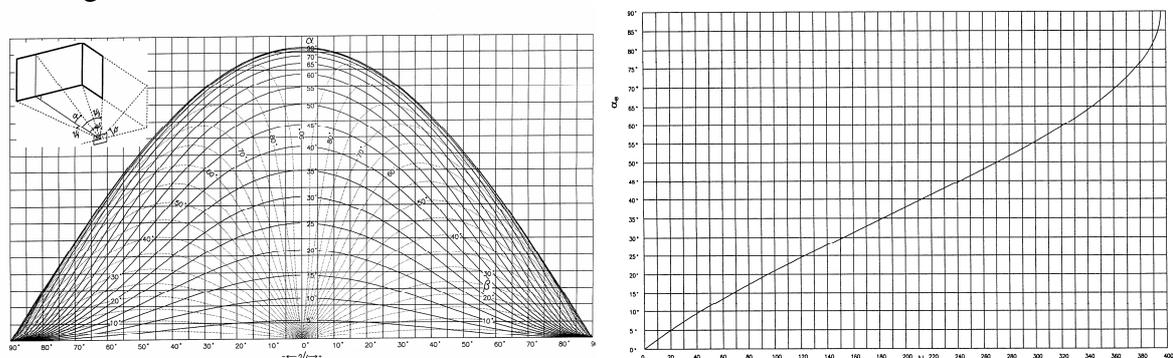


Fig. 4 Modified Waldram diagram for calculation of number of obstructed grid elements N (left); diagram for determining equivalent obstruction angle α_e (right)

The equivalent obstruction angles can be calculated graphically by the modified Waldram diagram (see **Fig. 4** left) and by diagram in **Fig. 4** right.

Using the **Fig. 4** one can determine the equivalent obstruction angle for any complex obstruction. The basic approach is to plot all the obstructions on the diagram in **Fig. 4** left, to sum the number of obstructed grid elements N , and from **Fig. 4** right to find out equivalent obstruction angle α_e .

4 Applications of solar and daylight rights

All new buildings, superstructures, and other improvements had to establish solar and daylight access rights for all existing neighbouring flats and habitable rooms. As a consequence, these rights involved serious restrictions to prospective new development. Many conflicts among the neighbouring property owners happened, mainly after the revolution in 1989. Before were used relatively strict urban prescriptions and owner law was weakened. Nowadays, in some parts of settlements in Slovakia is new zoning regulation; in some is valid old zoning regulation, and in many parts solar and daylight rights are the main mean of regulation. Applications of solar and daylight rights in existing urban patterns is relatively simple task. In these situations the adjoining neighbouring windows and urban proportions are known. When building heights are not limited and most of urban rules are not mandatory, then arise serious problems because existing solar and daylight rights don't create clear system for urban land use (gaps among buildings, building lines, etc.). Developers prefer a maximum occupation rate (building footprint area/building lot area) and a maximum building coefficient (total floor area/building area). In such situations any sense of harmony is lost; a compromise based preferably on solar and daylight rights is hardly attainable. Tall buildings infringe solar and daylight rights in broad neighbourhood – see **Fig. 5** and **6**. Normally solar and daylight rights protect building owners against overshadowing by newly constructed or extended neighbouring buildings. How to apply solar and daylight rights in urban infrastructure before urbanisation occurs is still open question.

Planning permission does not override a legal right to sun and daylight.



Fig. 5 Tall buildings – what are the minimum distances between them?



Fig. 6 Tall buildings diminish sky light availability even in faraway existing buildings

5 Conclusions

Natural light can't be forgotten tradition in urban design. It relates to the humanity of the building. Daylight and solar rights principally belong to human rights. Practical use of these rights needs to be balanced in correspondence with other environmental, social, cultural, economic and many another objectives of the settlements. Mainly high-rise building is challenging urban sustainability.

This article was carried out partly within the frame of the research project VEGA No. 1/3324/06 supported by the Scientific Grant Agency of Ministry of Education of Slovak Republic. This support is gratefully appreciated.

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