# SIMPLIFIED CALCULATION OF DAYLIGHTING IN OBSTRUCTED SITES

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## INTRODUCTION

Daylighting of buildings is to a certain extent determined by urbanistic design of building-up, by shaping and disposal solution of buildings. The fundamental decision on these factors is to be done at early stages of the design process. The existing simple tools of daylighting convenient for design process at early stages take into consideration the variability of external room obstructions to a small extent. Set of nomographic charts being created at the Slovak Technical University in Bratislava (Czechoslovakia) try to overcome this shortage.

## CHARACTERISTIC OF NOMOGRAPHIC CHARTS

Luminous efficacy of window is determined by many factors, by distribution of sky luminance in space angle of window, by luminance of surrounding building-up and terrain, by the position of window in room, by the window construction and lining, by the window shapes and by the illuminated interior, by the kind of glazing material and its dirt factor, by reflection factors of inside interior surface. Interconnection of introduced factors influencing the quantitative and qualitative luminous environment aspects in room causes difficulties in finding a simple and at the same time a sufficiently universal and exact method of daylighting evaluation. It is possible to construct tools with required utility qualities determined to common daylighting types and standardized boundary conditions. In the typical building-up of a dwelling complex in Czechoslovakia there arise several basic types of rooms obstruction caused by surrounding buildings - Figure 1. The preliminary design and the evaluation of room daylighting with unilateral side lighting obstructed by one or two objects at different distances from each other, which are approximately parallel to room window, can be done by nomographic charts - Figure 2.

The standard CIE overcast sky, reflection factors of ceiling having value 0.7, of walls being 0.5, of floor being 0.2, of obstructed obstacles being 0.3, of terrain being 0.2 are supposed at constructing of graphic tools. The area of glazing is symmetric with room axis, the lower border begins 1 meter above the floor and the transmission factor of glazing in normal direction is 0.84. Daylight aperture is only filled up with completely pure glazing (2 sheets) in wall having the same thickness as glazing. The height of room is considered to be 2.7 m. The influence of non transparent parts of daylight aperture, the glazing pollution, the thickness of lining and the deviations from the standardized input data are corrected by correction factors. The result correction factor "k" is the product of all correction factors. The angles of obstructed obstacles $\alpha,\beta$ come out from the point laying on the outside facade in room axis and in the level of its floor. The obstacles gap has not to deviate from the room axis too much (max. 25 degrees). The graphic tools are used for the solution of two basic types of tasks:

- determining the maximal room depth, in which there is reached the required illumination and approximate determination of light distribution in room at designed window and obstruction
- determining such an obstruction extent of a new building
- up, which preserves sufficient daylighting in existing room.

## EXAMPLE

By means of nomographic chart in Figure 2, it is necessary to find out the depth of room $d_{max}$ in which the value of daylight factor DF would be 0.7%. The proportion w/r is 0.6 ("w" - window width,

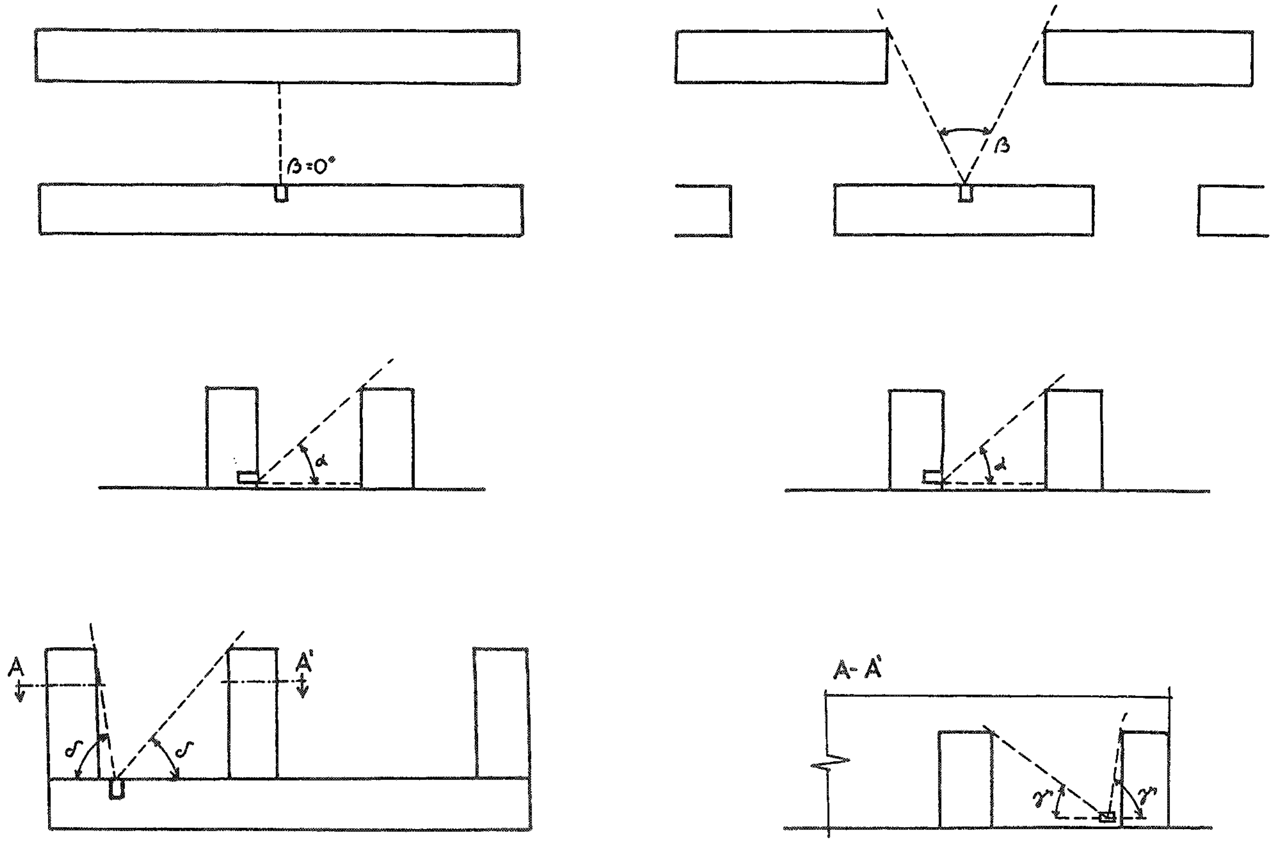
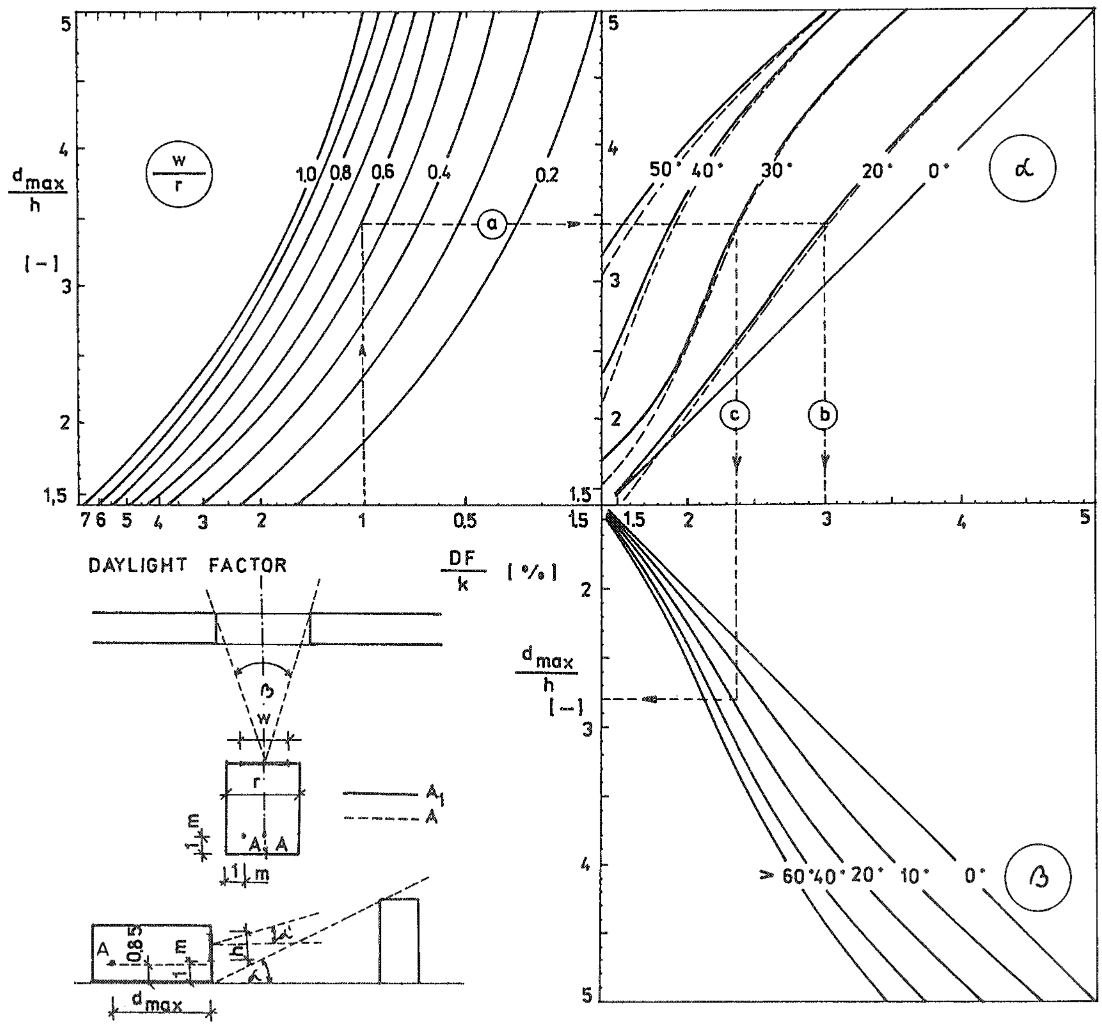



*Figure 1.*

"r" - room width), the height of daylight aperture is h = 1.5 m, the share of glazing surface on aperture surface is 0.8, dirt factor of glazing is 0.87. The room is suitable to other standardized conditions of graphic tool.

**Solution**

1. Correction factor k = 0.8 x 0.87 = 0.696
2. Daylight factor for pure glazing DF′ = DF/k = 0.7/0.696 = 1 %
3. From the point of vertical line DF′ = 1 % with curve w/r = 0.6, there will be taken away on the scale $d_{max}/h$ (line "a") the value about 3.4 meaning, that $d_{max}$ = 3.4 x h = 3.4 x 1.5 = 5.1 m
4. At window obstruction by a continuous parallel obstacle with $\alpha$ = 20°, $d_{max}$ will be (line "b") 3 x 1.5 = 4.5 m and the obstacles being determined by angles $\alpha$ = 30° and $\beta$ = 20° (line "c") $d_{max}$ = 2.8 x h = 2.8 x 1.5 = 4.2 m.



d max / h
[ – ]
w / r
1,0
0,8
0,6
0,4
0,2
a
50°
40°
30°
20°
0°
α
c
b
DAYLIGHT FACTOR
DF / k [ % ]
β
w
r
A1
A
1 m
1 m
0,85
E
h
dmax
> 60°
40°
20°
10°
0°
β


*Figure 2.*