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Protractors for Daylight Control in Town Planning

Abstract

There is a need for adequate daylight control in town planning. This paper presents protractors for determining the reduction in the sky illumination on a facade on account of neighbouring buildings. These protractors are based on precise equations of sky components for the clear design sky in India. It is proposed that daylight control should be such as to provide at least 26 percent of the sky component on the facade containing windows for daylighting. Such a control will ensure daylight to all buildings and enable adequate design of windows with proper allowance for building development in the neighbourhood.

Introduction

Daylight availability on the facades of existing buildings, as influenced by other buildings in the vicinity, has been regarded as a good town planning control for ensuring certain sky visibility and daylight to the occupants of existing buildings. Methods such as the Waldram diagram[1] and daylight indicators[2] have been used for this purpose. The former requires all the obstructions to be projected on the diagram and the latter involves use of too many indicators for different cases, which is time consuming. The sky component protractor on the other hand is a simple method of determining the obstructions to the visible sky and estimating available daylight. Sky component protractors for estimating sky illumination on building facades are described here for clear design sky[3] conditions in India.

Protractors for Illumination on Facades

The sky component at a point on a given plane is the percentage ratio of the sky illumination at that given point, and design sky illumination on a horizontal plane due to an unobstructed sky. The equations[4] of sky components have been derived for a clear design sky in India and the precise values[5] of sky components have been computed with the help of an IBM 1620 computer. These values have been utilized in making protractors (Figs 1 & 2) for facades oriented parallel and perpendicular to given facades. The protractors have been made for use on a layout plan with the base line parallel to the obstructing building facades. The H/D circles represent the ratio of obstruction and its distance from the reference facade. The percentage sky component contours are marked on the protractors with values shown on the circumference.

Method of Using Protractors

On the layout plan a reference point may be chosen on a facade somewhere at the centre of the layout which will show the maximum reduction of sky illumination due to neighbouring buildings. The boundries of parallel and perpendicular facades visible from the reference point are joined to it through straight lines. Relevant protractors for the parallel or perpendicular facades is used with its centre at the reference point and base parallel to the obstructing facades. The sky component values are noted at the intersections of the relevant H/D circle and the lines joining the reference point with the ends of a parallel or perpendicular facade on the relevant protractor. The difference of the two values gives the reduction of the sky component due to an obstructing facade. The sum total of the difference gives the total reduction of the sky component due to all the neighbouring buildings on the layout.

Example

Given a layout of six storey blocks of size 12mx 9mx 18m with a separation between blocks in a row as 12m and distance between two rows as 18m, it is required to determine the reduction of sky illumination on the facade of a block on the ground floor.

Solution

Draw sight lines BP, AP and DP, CP from the reference point P to the parallel facades on one side of

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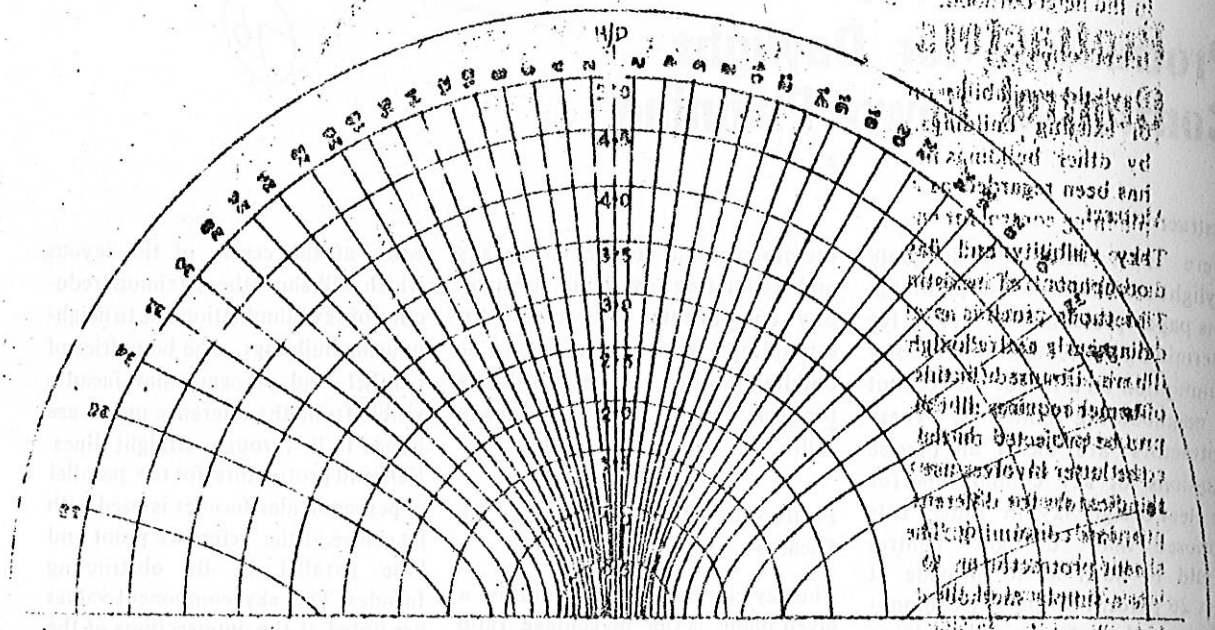

Figure 1

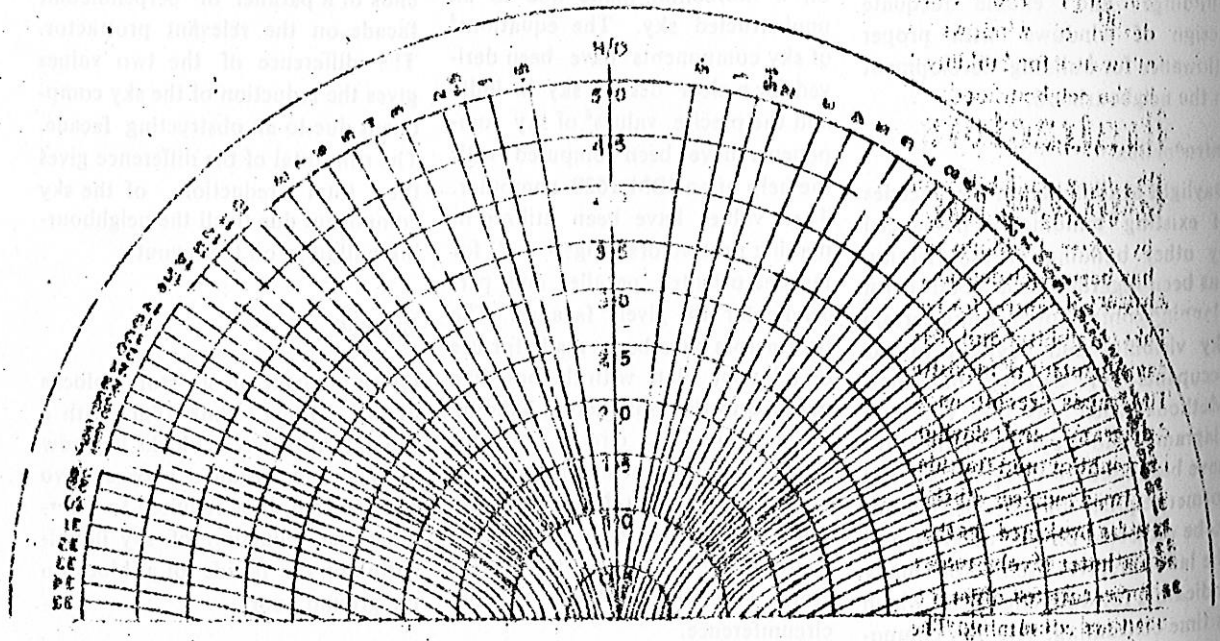

Figure 2

the point P (Fig. 3). Assuming the reference point near ground level, the ratio of height of parallel facades and their normal distance from P is H/D=18/18=1.0. Placing the protractor for parallel facades with its centre at P and base parallel to the facades, the sky component values along BP, AP and DP, CP at H/D circle of value 1.0 are 26, 12 and 31, 29. The differences (26−12=14) and (31−29=2) are the reduction of sky component due to facades AB and CD. Considering similar reductions due to parallel

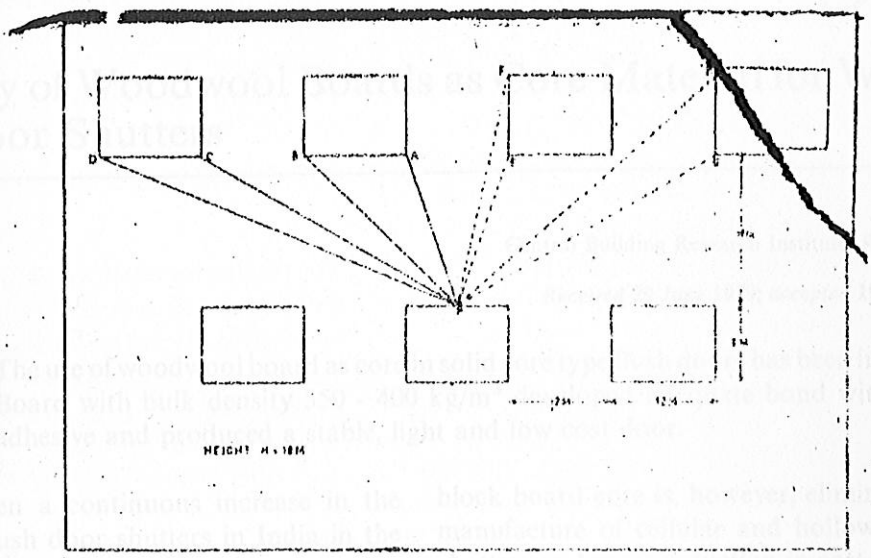

Figure 3

facades on the other side of the reference point the reduction will be 2×(14+2)=32.

For perpendicular facades EF and GK the normal distance from the point P is 6M and 33M respectively. Placing the protractor in perpendicular facades with the centre at P and base parallel to EF or GK, read the values of sky component at the intersection of H/D circle of value 18/6=3.0 for EP and FP and at H/D circle of value 18/30=0.6 (near 0.5) for KP and CP. The reductions are (29—26=3) and (8—5=3) respectively. Therefore the reduction to the sky component due to perpendicular facades on both sides is 2× (3+3)=12. Thus total reduction of sky component due to both parallel and perpedicular facades is 32+12=44%. Hence the net sky component at P is 78—44=34% where 78 is the unobstructed value. Further reduction due to distant blocks may be neglected.

Discussion

A limit to the reduction of sky illumination on a facade due to neighbouring buildings forms a suitable criterion for the visibility of the sky for natural illumination of a building. Considering the possibility of designing windows for admitting adequate daylight indoors the reduction factor for the sky illumination on a facade should not exceed 2/3. The sky component on an unobstructed facade being 78 percent for the clear design sky in India, a reduction factor of 2/3 implies that the net sky component on a facade should exceed 26 percent. If the building development at a given place is controlled in terms of the limiting facade sky illumination, it is possible to design windows for providing adequate daylighting indoors and saving energy on artificial lighting. The precise methods of calculating daylight and designing windows[5-7] are available in various publications as well as in the Indian Standard Code[8] of practice for daylighting. Careful consideration of daylight control in town planning will enable adequate daylighting design and ensure daylight to all buildings so that nobody is deprived of daylight as a result of construction of new buildings in the neighbourhood.

Acknowledgement

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