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## Indian Standard

## GUIDE FOR

DAYLIGHTING OF BUILDINGS
(Second Revision)

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# Indian Standard GUIDE FOR DAYLIGHTING OF BUILDINGS (Second Revision) 

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# Indian Standard GUIDE FOR DAYLIGHTING OF BUILDINGS (Second Revision) 

## 0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 31 December 1975, after the draft finalized by the Functional Requirements in Buildings Sectional Committee had been approved by the Civil Engineering Division Council.
0.2 This standard was first published in 1963 and subsequently revised in 1968. The present revision is being taken up with a view to incorporate a number of modifications as decided by the Sectional Committee. The main modifications made in the second revision relate to the inclusion of some correction factors for external reflected components with respect to the mean angle of elevation of observation and calculation of the mean angle of obstruction in some examples given in Appendix B.
0.3 In view of lack of data in respect of optimum daylight illumination levels required for different visual tasks, illumination levels generally accepted in other countries were taken as the basis for design in the code at the time of its first publication. The code has been based on the data provided by Central Building Research Institute (CBRI) from the measurements over a period of years from 1962-67. It has been found that the basis of design should be the prevalent exterior daylight levels obtainable over the principal regions of India during the winter months. It is hoped that the Meteorological Department of India would undertake measurement of sky Juminance and illumination over the principal cities in India and when further data become available this code will again be suitably modified.
0.4 A series of codes have been prepared by ISI to cover the functional aspects of buildings, such as, structural safety, heat and sound insulation, acoustics and ventilation. This code is intended to serve as a convenient guide to the engineers, architects and builders in understanding the general principles and methods of daylighting of dwellings, offices and hospitals. It recommends the minimum illumination values to be achieved by adopting daylighting principles and gives general guidance for realising the values in practice.
0.4.1 Daylighting requirements inside factory buildings have been covered in IS : 6060-1971* and IS : 7942-1976 $\dagger$ deals in the daylighting of educational buildings.

[^1]0.5 The Sectional Committee responsible for the preparation of this standard has noted that influence of dusty conditions was an additional factor to be taken into account in daylighting in tropical regions, but in the abserice of definite data, this aspect has not been, provisionally, taken into account in laying down the recommendations made in the code.
0.6 In the preparation of this code, the Sectional Committee has particularly felt the need for hourly and daily record for daylight illumination and investigation regarding optimum levels of illumination for different visual tasks. The National Physical Laboratory, New Delhi is currently engaged in investigations relating to daylight illumination and the optimum illumination levels for different visual tasks and it is the intention of the Committee to review the provisions contained in this code when sufficient experimental and observational data becomes available.
0.7 Typical sky component curves given in this standard (see Fig. 2 to 4) are based on the equation developed by the Central Building Research Institute for the proposed typical design sky based on their work on several places in India, rather than providing the values of sky component at a point due to some standard windows, the committee thought that the curves shown will give a clue to the extent by which sky component values change as one recedes from the window. The sky component table enables one to predetermine the sky component from the clear sky at the design time.
0.8 Some general notes on daylighting of buildings are given in Appendix C with a view to providing some additional and useful information relevant to the recommendations made in this code.
0.9 The recommendations made in this code may not, however, meet all the situations that may arise in individual cases, and it may become necessary to deviate from the provisions of this code or suitably adapt them to meet such situations.
0.10 Taking into consideration the views of engineers, architects and the building inhabitants, the Sectional Committee has related it to the design procedure followed in this country in this field. The committee felt that for Indian conditions where in the plains the weather is clear except during the monsoon seasons when it gets cloudy for a while and since the number of days in a year, when the sky is overcast is only about 70, the adoption of the C.I.E. overcast sky was not relevant. The Committee felt that the work done by the Central Building Research Institute on the luminance pattern of clear skies in India were reasonably representative of the situations normally met with in practice and generally agreed to switchover to the clear design sky conditions as formulated by the CBRI. The Committee felt that further work on the skies in India necessitating modifications in this code may be taken up by interested institutions. Assistance has also been derived from the 'Principles of modern building, Vol I' prepared by the

Department of Scientific and Industrial Research (Building Research Station) published by Her Majesty's Stationery Office, London (1961).
0.11 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

1.1 This standard covers the general principles and methods of daylighting of dwellings, offices and hospitals. It recommends the minimum illumination values to be achieved by daylighting principles and gives general guidance for realizing the values in practice.

Note - For daylighting of factory buildings reference may be made to IS : 6060-1971 $\dagger$ and for educational buildings to IS: 7942-1976 $\ddagger$.

## 2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.
2.1 Altitude ( $\theta$ ) - The angular distance of any point of celestial sphere, measured from the horizon, on the great circle passing through the body and the zenith.
2.2 Avimuth $(\phi)$ - The angle measured between the meridians passing through the north point and the point in question (point $C$ in Fig. 1).
2.3 Brightness (Photometric Brightness or Luminance) - The luminous intensity of the surface per unit of projected area in a given direction as viewed from that direction.

Nore - The unit of measurement of brightness is candle per square centimetre.
2.4 Brightness Ratio or Contrast - The variations or contrast in brightness of the details of a visual task such as white print on blackboard.
2.5 Candela (Cd) - The SI unit of luminous intensity. Candela = 1 lumen per steradian.
2.6 Clear Design Sky - The distribution of luminance of such a sky is non-uniform; the horizon is brighter than the zenith and the brightness at an altitude $(\theta)$ in the region away from the sun, is given by the expression :

$$
B_{\theta}=B_{z} \operatorname{Cosec} \theta
$$

[^2]
## where

$\theta$ lies between $15^{\circ}$ and $90^{\circ}$,
$B_{\theta}=$ constant when $\theta$ lies between $0^{\circ}$ and $15^{\circ}$, and $\boldsymbol{B}_{\boldsymbol{z}}=$ brightness at zenith.


REFERENCES

$$
\begin{aligned}
& 0 \text { - Oberver's station } \\
& \text { C - Celestial body } \\
& \mathcal{Z} \text { - Zenith } \\
& \text { NA Nadir } \\
& \text { N - Geographical north }
\end{aligned}
$$

Fig. 1 Azimuth of a Celestial Body
2.7 Dayligint Factor - It is a measure of the total daylight illumination at a point on a given plane expressed as the ratio (or percentage) which the illumination at the point on the given plane bears to the simultaneous illumination on a horizontal plane due to a clear design sky at an exterior point open to the whole sky vault, direct sunlight excluded.
2.8 Dayliple Area - The superficial arca on the working plane illuminated to not less than a specified daylight factor, that is, the area within the relevant contour.
2.9 Daylifint Pemetratioat - The maximum distance which a given daylight factor contour penetrates into a room.
2.10 Ertermai Refocted Compoment (2lRC) - The ratio (or percentage) of that part of the daylight illumination at a point on a given plane which is received by direct refiection from external surfaces as compared to the
simultaneous exterior illumination on a horizontal plane from the entire hemisphere of an unobstructed clear design sky.
2.11 Illumination - At a point of surface the ratio of the luminous flux incident on an infinitesimal element of surface containing the point under consideration to the area of this element.

Nots - The unit of measurement of illumination is lux (one lumen per square metre).
2.12 Internal Reflected Component (IRC) - The ratio (or percentage) of that part of the daylight illumination at a point on a given plane which is received by direct reflection or inter-reflection from the internal surfaces as referred to the simultaneous exterior illumination on a horizontal plane due to the entire hemisphere of an unobstructed clear design sky.
2.13 Lumen (lnm) - SI unit of luminous flux. The luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform intensity of one candela.
2.14 Luminous Flux - That quantity characteristic of radiant flux which expresses its capacity to produce visual sensation evaluated according to the values of relative luminous efficiency for the light adapted eye.
2.15 North and South Poiats - The points in the respective directions where the meridian cuts the horizon.
2.16 Reveal - The side of an opening for a window.
2.17 Sky Composent (SC) - The ratio (or percentage) of that part of the daylight illumination at a point on a given plane which is received directly from the sky as compared to the simultaneous exterior illumination on a horizontal plane from the entire hemisphere of an unobstructed clear design sky.
2.18 Direct Solar mamination - The illumination from the sun with the light from the sky excluded.
2.19 Working Pase - A horizontal plane at a level at which work will normally be done. For the purpose of this code the working plane, unless specified otherwise, shall be assumed as the horizontal plane 75 cm from the floor (normal table top level) in houses, flats, offices, and hospital wards and 90 cm (normal work bench level) from hospital operation theatre.
2.20 Visual Field - The visual field in a binocular which includes an area approximately 120 degrees vertically and 160 degrees horizontally centering on the point to which the eyes are directed. The line joining the point of fixation and the centre of the pupil of eack eye is called its primary line of sight.
2.21 Comaral Fiedd - The area of circle round the point of fixation and
its diameter subtends an angle of about 2 degrees at the eye. Objects within this area are most critically seen both in their details and colour.
2.22 Peripheral Field - It is the rest of the visual field which enables the observer to be aware of the special framework surrounding the object seen.

Note - A central part of the peripheral field, subtending an angle of about 30 degrees on either side of the point of fixation, is chiefly involved in the perception of glare.

## 3. FACTORS AFFEGTING VISION

3.1 Seeing - It is funda:aentally governed by differences in brightness and colour in the objects seen. Good contrasts of colour and brightness are desirable, especially in the central 2-degree field. Better contrasts or brightness ratios outside tend to detract attention. The criterion of successful lighting, for optimum seeing comfort and efficiency, is to maintain the whole field bright and the central 2-degree field (containing the objects of attention) a little brighter and more contrasting.

### 3.2 Glare

3.2.1 Excessive contrast or abrupt and large changes in brightness produce the effect of glare. When glare is present the efficiency of vision is reduced and small details or subtle changes in tone cannot be perceived.
3.2.2 Glare may be :
a) direct glare due to light sources within field of vision,
b) reflected glare due to reflections from light sources or surfaces of excessive brightness, and
c) .veiling glare where the peripheral field is comparatively very bright.
3.2.3 An example of glare source in daylighting is the view of the bright sky through a window especially when the surrounding wall is comparatively dark or weakly illuminated. Glare can be minimized in this case either by shielding the open sky from direct sight by louvers, external hoods or deep reveals, or by cross lighting the surrounding wall to a comparable level. A gradual transition of brightness from one portion to the other within the field of vision always avoids or minimizes the glare discomfort.

## 4. SOURCES OF DAYLIGFTING

4.1 The primary source of light for daylighting is the sun. The light received by the earth from the sun consists of two parts, namely, direct solar illumination and sky radiation. For the purposes of the daylighting design, direct solar illumination shall not be considered and only sky radiation shall be taken as contributing to illumination of the building interiors during the day.

### 4.2 The relative amount of sky radiation depends on the position of the

sun defined by its altitude which in turn varies with the latitude of the locality, the day of the year and the time of the day, as indicated in Table 1.
4.3 The external available horizontal illumination which may be assumed for design purposes in this country, broadly covering Indian from north to south, may be taken 8000 lux. Since the design is based on the solar position of $15^{\circ}$ altitude the corresponding illumination from the design sky has been found to be nearly constant all over the country. However, the prevalent atmospheric haze which varies from place to place may nocessitate a 25 percent increase in the value of 8000 lux design illumination suggested in this code, where haze conditions prevail at design time.

## 5. DAYLIGHT FACTORS

### 5.1 General

5.1.1 The daylight intensity at any point inside a room is subject to severe and frequent fluctuations, but it is, however, found to bear a more or less constant ratio to the simultaneous external intensity when the sky is clear or overcast throughout. It has, therefore, become customary to express the intensity of daylight illumination inside a room at any point in any plane as a ratio or percentage of the simultaneous intensity in a horizontal plane at an outside point open to the entire sky vault. Direct sunlight, if any, is always excluded from both interior and exterior values of illumination.
5.1.2 The factor, as defined above, is independent of the absolute brightness of the sky but is dependent on its surface distribution.
5.1.3 The surface distribution for the brightness of the sky varies with the conditions of the sky. Large variation of sky luminance distribution in so far as clear skies are concerned do not exist since there is a general rise of daylight availability as the sun goes up in the sky. However, it has been found that the regions of the sky opposite the sun has generally less luminance and may, therefore, provide the basis for design. The design may be based on the clear sky with sun at $15^{\circ}$ altitude. The region of the sky directly opposite the sun will be design sky for side-lit windows and the corresponding 'sky' illumination will be known as the 'design exterior illumination' for computing the sky components indoor.

### 5.2 Components of Daylight Factor

5.2.1 Daylight factor (DF) is a measure of all the daylight reaching on an indoor reference point from the following sources:
a) The direct sky visible from the point,
b) External surfaces reflecting light directly to the point, and
c) Internal surfaces reflecting and inter-reflecting light to the point.
5.2.1.1 Each of the three components, when expressed as a ratio or percent of the simultaneous external illumination on the horizontal plane

TABLE 1 SOLAR ALTITUDES (TO THE NEAREST DEGREE) FOR INDIAN LATITUDES
(Clause 4.2)


Nots - Hours are by local solar time.
defines respectively the Sky Component (SC), the External Reflected Component (FRC) and the Internal Reflected Component (IRC).
5.2.2 The daylight factors on the horizontal plane only usually taken as the working plane in a room is generally horizontal; however, the factors in vertical planes should also be considered when specifying daylighting values for special cases, such as daylighting on classroom blackboards, pictures and paintings hung on walls.
5.2.3 Daylight factor is the sum of the individual components, namely, SC, ERC and IRC, separately determined (see 6.3.1).

### 5.3 Sky Components (SC)

5.3.1 Sky component for any size of window is computed by the use of the appropriate table of Appendix $A$ on the lines indicated in the worked examples in Appendix B.
5.3.2 The values, obtainable from the tables are for rectangular open unglazed windows, with no external obstructions. The values shall be corrected for the presence of window bars, for glazing and external obstructions, if any.
5.3.3 Corrections for window bars shall be made by multiplying the values read from tables in Appendix A by a factor equal to the ratio of the clear opening to the overall opening.
5.3.4 Correction for Glazing - Where windows are glazed, the sky components obtained from Appendix A shall be reduced by about 10 to 20 percent provided the panes are of clear glass tolerably clean. Where glass is of the frosted (ground) type, the sky components read from Appendix A may be reduced by about 15 to 30 percent. Higher indicated correction corresponds to larger windows and/or near reference points.
5.3.5 Correction for External Obstructions - There is no separate correction except that the values from tables in Appendix A shall be read only for the unobstructed portions of the window, by method indicated in Appendix B.
5.4 External Reflected Component (ERC) - The values of the sky component corresponding to the portion of the window obstructed by the external obstructions can be found by the use of methods described in Appendix B. These values when multiplied by the correction factors, corresponding to the mean elevation of obstruction from the point in question as given in Table 2, can be taken as the external reflected components for that points.
5.5 Internal Reflected Component (IRC) - The component of daylight factor contributed by reflection from the inside surfaces varies directly as the window area and inversely as the total area of internal surfaces, and depends on the reflection factors of the floor, wall and roof surfaces inside and of the ground outside. For rooms white washed on walls and ceiling and windows of normal sizes, the IRC will have a sizeable value even at

## TAELE 2 CORRECIION FACTORS POR ERC

(Clause 5.4)

| Mran Anols <br> of | Corasction <br> Factor |
| :---: | :---: |
| Elbvation |  |

points far away from the window. External obstructions, when present, will proportionally reduce the IRC. Where accurate values of IRC are desired, a precise method of evaluation of the same is given in B-4.

## 6. DAYLIGHTING REQUIREMENTS

6.1 Design External Mlumination - The daylight factor to be maintained in any internal environment shall be specified in relation to external illumination.

### 6.2 Illumination Levels Necessary for Different Visual Tasks -

 Illumination levels necessary for different visual tasks shall be assumed to be those given in IS : 3646 (Part II)-1966*. If the required amount of illumination is not achieved by daylighting only, it may have to be supplemented by artificial lighting.
### 6.3 Recommended Daylight Factor to be Maintained in Different Interiors

6.3.1 If design for daylighting based only on sky component values are recommended, as sky components are easily determinable, this will tend to make the daylighting more liberal; however, where more precise values are desired, account may be taken of ERC and IRG values given in 5.4 and 5.5.
6.3.2 Based on an assumed external design illumination level of 8000 lux (see 4.3) and the acceptable levels of minimum illumination necessary for different visual tasks (see 6.2), the daylight factors recommended for different locations are given in Table 3.

[^3]
## TAETE 3 RDCOMNENDED DAYTRGET PACTORS FOR

(Clauses 6.3.2 and 7.1.1)

| Loantion | Daybioht Pagron Pemciatt |
| :---: | :---: |
| Dwallings: |  |
| Kitchen | 2.5 |
| Living room | 0.625 |
| Study | 1.9 |
| Circulation | 0.313 |
| Schools: |  |
| Class-room | 1.9 |
| Lecture theatre | 2.0 to 2.5 |
| Study hall | 2.0 to 2.5 |
| Laboratory | 1.9 to 3.8 |
| Offices: |  |
| General | 1.9 |
| Drawing | $3.75$ |
| Enquiry | 0.625 to 1.9 |
| Hospilals: |  |
| General ward | 1.25 |
| Pathological laboratory | 2.5 to 3.75 |
| Libraries: |  |
| Stack room | 0.9 to 1.9 |
| Reading room | 1.9 to 3.75 |
| Counter area | 2.5 to 3.75 |
| Catalogue room | 1.9 to 2.5 |

Note - 100 lux is equal to a sky component of value 1.25 percent based on a 8000 lux design exterior illumination.
6.3.2.1 Daylight factor values for other external intensities (see 4.3) may be obtained by evaluation.

Example:
For external design illumination levels of 1000 lux the illumination of 100 lux will be $\frac{100 \times 100}{10000}=1$ percent daylight factor.
6.3.3 The recommended daylight levels should be ensured generally on the working plane at the following positions:
a) At a distance of 3 to 3.75 m from the window along the central line perpendicular to the window;
b) At the centre of the room if more appropriate; and
c) At fixed locations, such as school desks, blackboards, and office tables.
6.3.3.1 In selecting any one position for design purposes, due consideration should be given to the needs of the situation.
6.3.4 The daylight area of the prescribed daylight factor should not normally be less than half the total area of the room.
6.3.5 Supplementary artificial illumination may have to be provided :
a) against the possibility of the level of illumination falling below the specified values at such times when the outside illumination falls below the design value; and
b) where the fineness of visual task may demand a higher level of illumination at special locations, occasionally.
6.3.6 A few typical examples of cross-sectional vertical distribution of light for two sizes of windows at certain assumed sill levels are given in Fig. 2, 3 and 4.

## 7. WINDOW

### 7.1 Window Sizes

7.1.1 The width and height of the appropriate window shall be decided upon by referring to the tables in Appendix A corresponding to the daylight factor (see Table 3) and the chosen depth of penctration from among the three alternatives given in 6.3.3.


Fig. 2 Typical Sky Component Gurves on Vertical Crose Section Along the Central Line


Fig. 3 Typical Sky Component Curves on Vertical Cross Section Along the Central Line


[^4]
## is : 2440-1975

7.1.2 The tables, in general give a number of window sizes contributing to the recommended illumination. Economic and architectural consideration should decide the final choice.
7.1.3 Before referring to the tables in Appendix A for deciding upon a suitable window size, the daylight factor corresponding to the particular location shall be increased by appropriate factors if the window is to be glazed and/or is externally obstructed and/or is to be provided with window bars (see 5.3.4).

### 7.2 General Principles of Window Design to Afiord Good Daylighting

7.2.1 Generally, while taller windows give greater penetrations, broader windows give better distribution of light. It is preferable that some area of the sky at an altitude of 20 degrees to 25 degrees should light up the working plane.
7.2.2 But broader windows may also be equally or more efficient provided their sills are raised by 30 cm to 60 cm above the working plane. Such raised sills will not cut the outside view appreciably and afford in most situations, valuable wall space within easy reach, especially in schools and hospitals where it may be utilized to carry electric wiring, gas and water connections, etc.
7.2.3 For a given penetration, a number of small windows properly positioned along the same, adjacent or opposite walls will give better distribution of illumination than a single large window. The sky component at any point, due to a number of windows, can be easily determined from the corresponding sky component contour charts appropriately superimposed. The sum of the individual sky component for each window at the point gives the overall component due to all the windows. The same charts may also facilitate easy drawing of sky component contours due to multiple windows.
7.2.4 Unilateral lighting from side windows will in general be unsatisfactory if the effective depth of the room is more than two to two-and-a half times the distance from the floor to the top of the window.
7.2.5 Windows on two opposite sides will give greater uniformity of internal daylight illumination especially when the room is 7 m or more. across. They also minimize glare by illuminating the wall surrounding each of the opposing windows. Side windows on one side and clerestory windows on the opposite side may be provided where the situation so requires.
7.2.6 Crosslighting with windows on adjacent walls tends to increase the diffused lighting within a room.
7.2.7 Windows in deep reveals tend to minimize glare effects.
7.2.8 Windows shall be provided with CHAJJAHS, louvers, baffles or
other shading devices to exclude, as far as possible, direct sunlight entering the room. CHA7JAHS, louvers, etc, reduce the effective height of the windows for which due allowance shall be made. Broad and low windows are, in general, much easier to shade against sunlight entry. Direct sunlight when it enters increases the inside illumination very considerably. Glare will result if it falls on walls at low angles, more so than when it falls on floors especially when the floors are dark coloured or less reflective.
7.2.9 Light control media, such as translucent glass panes (opal or matt) surfaced by grinding, etching or sand blasting, configurated or corrugated glass, certain types of prismatic glass and glass blocks, are often used. They should be provided, either fixed or movable, outside or inside, especially in the upper portions of the window. The lower portions are usually left clear to afford desirable views. The chief purpose of such fixtures is to reflect part of the light on to the ceiling and thereby increase the diffuse lighting within, light up the farther areas in the room and thereby produce a more uniform illumination throughout. They will also prevent the window causing serious glare discomfort to the occupants but will provide some glare when illuminated by cirect sunlight.
7.2.10 Design should be such that in addition to direct illumination por vision should be made for diffuse lighting by internal reflecions and i:te:reflections. The design should be such that the Erightness ratio of tor 10 k to its immediate surroundings and distant areas in the roum shoud he as 10:3:1 and not exceeded.
7.2.11 To ensure a good level of diffused lighting, all interal sufaces should be light coloured and have good reflectance.

## 8. SITING OF BUILDINGS

8.1 Proper planning and layout of buildings can add appreciably to the daylight illumination inside.
8.2 Certain dispositions of building masses offer much les mutuad obstruction to daylight than others and hence have a significant relevance especially when intensive site planning is undertaken. The relative avadability of daylight in multistorey blocks of different relative orientations anc given in Table 4.
8.3 Where a number of similar building blocks is to be raica farly close to each other, it will be more advantageous to have aiternete blocks perpendicular to each other than all in a parallel formation.
8.4 Building heights and spacings are interdependent and can in general be adjusted to provide optimum daylighting advantage, for any density of building development, that is, for any ratio of floor area to the overall site area.

TABLE 4 RELATIVE AVAILABILITY OF DAYLIGHT ON THE WINDOW PLANE AT GROUND LEVEL IN A FOUR-STOREYED BUILDING BLOGKS (CLEAR DESIGN-SKY AS BASIS, DAYLIGHT AVAIILABILITY TAKEN AS UNITY ON AN UNOBSTRUCTED FACADF, VALUES ARE FOR THE CENTRE OF THE BLOCKS)
(Clause 8.2)

| Distance of | Infinitely Long | Parallel Blocks | Parallel Blocks |
| :---: | :---: | :---: | :---: |
| Separation | Parallel Blocks | Facing Each | Facting Gaps |
| Between |  | Other (Length $=$ | Between Oppostre |
| Blocks |  | $2 \times$ Height) | Blocks (Lirngth $=$ |
|  |  |  | $2 \times \mathrm{Height})$ |
| 0.5 Ht | $0 \cdot 15$ | $0 \cdot 15$ | 0.25 |
| 1.0 Ht | 0.30 | 0.32 | 0.38 |
| 1.5 Ht | 0.40 | 0.50 | 0.55 |
| 2.0 Ht | 0.50 | $0 \cdot 60$ | $0 \cdot 68$ |

APPENDIX A<br>(Clauses 5.3.1, 5.3.3, 5.3.4, 5.3.5, 7.1.1 and 7.1.3)

## SKY COMPONENT TABLES

## A-1. DESCRIPTION OF TABLES

A-1.1 There are three tables included in this Appendix:
Table 5 Percentage sky components on the horizontal plane due to a vertical window for the tropical design sky.
Table 6 Percentage sky components on the vertical plane/perpendicular to a vertical window for the tropical design sky.
Table 7 Percentage sky components on the vertical plane parallel to a vertical window for the tropical design sky.

A-1.2 All the tables are for an unglazed opening illuminated by the clear design sky.

A-1.3 The values tabulated are the components at a point $P$, distant $d$ from the opening on a line perpendicular to the plane of the opening through one of its lower corners. $l$ and $h$ are the width and height respectively of the rectangular opening (see Fig. 5).
table 5 pergentage sky components on the horizontal plane due to a vertical winow for tig troical design bey

| $\begin{gathered} \mu / d \alpha \\ 1 \\ \hline \end{gathered}$ | 0.1 | $0-2$ | 0.3 | 0.4 | $0-5$ | 0.6 | 0.7 | 0.8 | 0-9 | 1.0 | $1 \cdot 1$ | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 3.0 | 40 | 5.0 | 10.0 | INF |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.1 | 0.036 | 0.071 | 0.104 | 0.133 | 0.158 | 0.179 | 0.198 | 0.213 | 0.225 | 0.295 | 0.243 | 0.250 | 0-256 | 0-261 | 0.264 | 0.268 | 0.270 | $0-272$ | 0.274 | 0.276 | 0.284 | 0.286 | 0.287 | 0-288 | $0-288$ |
| 0.2 | 0-141 | 0-277 | 0.403 | 0.516 | $0-614$ | $0 \cdot 699$ | 0.770 | 0-829 | 0.878 | 0.918 | 0.950 | 0.977 | 0.999 | 1.018 | 1.089 | 1.046 | 1.056 | 1 -065 | 1.072 | 1.079 | 1.110 | 1.118 | $1 \cdot 122$ | 1-125 | 1.125 |
| 0.3 | 0.300 | 0.589 | 0.859 | 1.102 | 1.315 | 1.499 | 1.653 | 1.782 | 1.888 | 1.976 | 2.048 | 2.108 | 2.157 | 2.197 | 2.231 | 2.259 | 2.282 | 2.302 | 2.318 | 2.933 | 2.401 | 2.421 | 2.429 | 2.436 | 2.437 |
| 0.4 | 0.460 | 0.905 | 1.522 | 1.702 | 2.041 | 2.337 | 2.590 | 2.804 | 2.984 | 3.134 | 3-258 | 3.361 | 3446 | 3.516 | 3.574 | 3.623 | 3.664 | 3.699 | 9.728 | 9.753 | 3.873 | 3.909 | 3.922 | 3.935 | 3.937 |
| 0.5 | 0.604 | 1.189 | 1.741 | 2.247 | 2-700 | 3.099 | 3.444 | 3.740 | 3.992 | 4.204 | 4.583 | 4.533 | 4659 | 4.765 | 4853 | 4.928 | 4.990 | $5-043$ | 5.088 | $5 \cdot 126$ | 5.312 | 5.366 | 5.387 | 5.408 | 5.410 |
| 0.6 | 0.732 | 1.443 | $2 \cdot 114$ | 2.732 | 3.289 | 3.781 | 4-211 | 4.582 | 4.900 | 5.171 | 5.401 | 5.596 | 5-761 | 5-901 | 6.020 | 6.121 | 6.208 | 6-281 | 6.344 | 6-397 | 6.661 | 6.739 | 6.769 | 6.798 | 6.802 |
| 0.7 | 0.844 | 1.665 | $2 \cdot 441$ | 3. 159 | 3.808 | 4.385 | 4891 | 5.350 | 5-709 | 6.034 | 6.311 | 6.548 | 6.751 | 6.924 | 7.071 | 7.198 | 7.307 | 7.400 | 7.481 | 7.551 | 7.902 | 8.006 | 8.047 | 8.087 | 8.092 |
| 0.8 | 0.942 | 1.858 | 2.727 | 9.559 | 4262 | 4.914 | 5.488 | 5.989 | 6-423 | 6.798 | 7.119 | 7.995 | 7.632 | 7.836 | 8 -011 | 8.162 | 8.292 | 8.405 | 8 -502 | 8.587 | 9.029 | 9.164 | 9.217 | 9268 | 9276 |
| 0.9 | 1.026 | 2.025 | 2.974 | 3.855 | 4657 | 5.375 | 6.011 | 6.567 | 7.051 | 7.470 | 7.832 | 8.144 | $8 \cdot 413$ | 8.645 | 8.846 | 9.019 | 9170 | 9.301 | 9415 | 9.515 | 10-045 | 10-214 | 10-280 | 10.345 | 10.355 |
| 1.0 | 1.099 | 2.169 | 3.188 | 4.135 | 5.000 | 5.776 | 6.465 | 7.071 | 7.600 | 8.060 | 8.458 | 8.803 | 9.102 | 9.361 | 9.585 | 9780 | 9950 | 10.093 | 10-228 | 10.343 | 10.957 | 11.162 | 11.243 | 11.323 | 11.335 |
| 1.1 | 1.161 | 2.294 | 3.372 | 4.377 | $5 \cdot 296$ | 6.124 | 6.861 | 7.510 | 8.079 | 8.576 | 9.008 | 9.983 | 9.709 | 9.992 | 10.239 | 10-454 | 10.642 | 10-806 | 10.951 | 11.078 | 11.776 | 12.017 | 12.114 | 12.209 | 12.224 |
| 1.2 | 1.215 | 2.401 | 3.531 | 4586 | 5.553 | 6.425 | 7.204 | 7.893 | 8.498 | 9.027 | 9.489 | 9.892 | 10.243 | 10.549 | 10.816 | 11.050 | 11.254 | 11.434 | 11.593 | 11.732 | 12.509 | 12.786 | 12.900 | 13.013 | 13.050 |
| 1.3 | 1.262 | 2.493 | 3.668 | 4767 | 5.775 | 6.687 | 7.503 | 8.226 | 8.863 | 9.422 | 9.912 | 10.339 | 10.713 | 11.040 | 11.326 | 11.577 | 11.797 | 11.992 | 12.163 | 12.314 | 13.167 | 19.478 | 13.609 | 13.742 | 19.762 |
| 1.4 | 1.302 | 2.573 | 3.787 | 4.924 | 5.968 | 6.915 | 7.764 | 8.517 | $9-183$ | 9.769 | 10.283 | 10.733 | 11.127 | 11.473 | 11.777 | 12.044 | 12.279 | 12.487 | 12.670 | 12.833 | 13.758 | 14-102 | 14251 | 14.404 | 14-427 |
| 1.5 | 1.337 | 2.643 | 9.891 | 5.060 | 6.136 | 7.114 | 7.991 | 8.772 | 9464 | 10.073 | 10.609 | 11.080 | 11-493 | 11.857 | 12.176 | 12.458 | 12.707 | 12.927 | 13.122 | 13.295 | 14-289 | 14.666 | 14.832 | 15.006 | 15-083 |
| 1.6 | 1.367 | 2.703 | 3.981 | 5.179 | 6.283 | 7.287 | $8 \cdot 190$ | 8.996 | 9.710 | 10.341 | 10.897 | 11.386 | 11.817 | 12.196 | 12.531 | 12.826 | 13.088 | 13.319 | 13.525 | 13.708 | 14.768 | 15.176 | 15.359 | 15.555 | 15.585 |
| 1.7 | 1.394 | 2.756 | 4.060 | 5.283 | 6.412 | 7.440 | 8.366 | 9.192 | 9927 | 10.577 | 11.151 | 11.657 | 12.104 | 12.498 | 12.846 | 13.154 | 13-427 | 13-669 | 13.885 | 14078 | 15.199 | 15.638 | 15.838 | 16.056 | 16.091 |
| 1.8 | 1.417 | 2.803 | 4-129 | $5 \cdot 375$ | 6.526 | 7.574 | 8.520 | 9.366 | 10.119 | 10.786 | 11.376 | 11.898 | 12.359 | 12.766 | 13.127 | 13.446 | 13.730 | 13.983 | 14.208 | 14.409 | 15.590 | 16.058 | 16-274 | 16-516 | 16.554 |
| 1.9 | 1.438 | 2.884 | 4190 | 5.456 | 6.626 | 7.693 | 8.656 | 9.520 | 10-289 | 10.972 | 11.577 | 12.112 | 12.586 | 13.006 | 13.978 | 13.708 | 14.002 | 14-264 | $1+498$ | 14.707 | 15.944 | 16.441 | 16.673 | 16.937 | 16.980 |
| 2.0 | 1.456 | 2.880 | 4.244 | 5-527 | 6.714 | 7.798 | 8.778 | 9.656 | 10-440 | 11.137 | 11.755 | 12.303 | 12.789 | 13.220 | 13.603 | 13.943 | 14-246 | 14.516 | 14.758 | 14.975 | 16.265 | 16.790 | 17.037 | 17.525 | 17.972 |
| 2.0 | 1-559 | 3.087 | 4553 | 5.937 | 7.223 | 8.403 | 9.478 | 10-448 | 11.321 | 12.103 | 12-804 | 18-431 | 13.993 | 14-496 | 14.947 | 15-353 | 15.718 | 16.048 | 16.346 | 16.676 | 18.301 | 19.051 | 19.432 | 19.943 | 20.046 |
| 2.0 | 1.600 | 3.168 | 4.676 | 6.100 | 7.426 | 8.646 | 9.759 | 10.768 | 11.678 | 12.498 | 18.235 | 13-897 | 14-493 | 15-030 | 15.514 | 15.951 | 16.947 | 16.706 | 17.033 | 17.330 | 19.241 | 20.142 | 20.623 | 21.322 | 21-495 |
| 2.0 | 1.620 | $3 \cdot 208$ | 4735 | 6.179 | 7.525 | 8.765 | 9.897 | 10.925 | 11.854 | 12.693 | 13-448 | 14.128 | 14.742 | $15 \cdot 296$ | 15.798 | 16.252 | 16.664 | 17.040 | 17.382 | 17.695 | 19.740 | 20.740 | 21.293 | 22.148 | 22.993 |
| 2.0 | 1.648 | 3.263 | 4818 | 6.289 | 7.662 | 8.930 | 10.089 | 11.144 | 12.100 | 12.965 | 13.747 | 14454 | 15.094 | 15.674 | 16.201 | 16.681 | 17.118 | 17.518 | 17.885 | 18.222 | 20.491 | 21.681 | 22.390 | 23.676 | 24238 |
| INF | 1.657 | \$282 | 4.846 | 6.327 | 7.710 | . 8.986 | 10-155 | 11.220 | 12.186 | 13.060 | 13-851 | 14567 | 15-217 | 15.806 | 16.342 | 16.831 | 17.278 | 17.688 | 18.064 | 18.410 | 20.770 | 22.046 | 22.838 | 24.463 | 26.111 |

table 6 Plercentage sixy components on the vertical plane perpendicular to a vertical window for the tropical design sky (Clause A-1.1)

| $(1 / \alpha$ | 0.1 | 0.2 | 0.3 | 0.4 | 0-5 | 0-6 | 0.7 | 0.8 | 0.9 | 1.0 | $1 \cdot 1$ | 1.2 | 1.9 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 19 | $2 \cdot 0$ | 3.0 | 40 | $5 \cdot 0$ | 10.0 | INF |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.1 | 0.036 | 0.141 | 0.303 | 0.506 | 0.734 | 0.971 | $1 \cdot 207$ | 1.432 | 1.643 | 1.836 | 2.011 | 2-163 | 2-308 | $2 \cdot 433$ | 2.544 | 2.642 | $2 \cdot 730$ | 2.808 | $2 \cdot 878$ | $2 \cdot 970$ | 3.309 | 3.461 | 3.536 | 3.641 | 3-678 |
| 0.2 | 0.071 | 0-277 | 0.594 | 0.993 | 1.442 | 1.910 | 2.374 | 2.820 | 3.236 | 3.618 | 3.964 | 4276 | 4.554 | $4-802$ | 5.022 | 5.219 | 5.393 | 5.549 | 5.688 | 5.812 | 6547 | 6.850 | 7.000 | 7.211 | 7.284 |
| 0-3 | 0.103 | 0.401 | 0.863 | 1.445 | $2 \cdot 100$ | 2.793 | 3-475 | 4130 | 4.743 | 5.306 | 5.818 | 6-278 | 6.690 | 7.058 | 7.385 | 7.677 | 7.936 | 8.168 | 8.375 | 8.560 | 9.657 | 10.110 | 10.335 | 10.651 | 10.760 |
| 0.4 | 0.126 | 0.491 | 1.059 | 1.779 | $2 \cdot 597$ | 3.460 | 4.326 | 5.166 | 5.958 | 6.691 | 7.359 | 7.967 | 8.507 | 8.990 | 9.420 | 9.804 | 10.146 | 10-451 | 10.724 | 10.968 | 12.421 | 13.024 | 13.323 | 13.743 | 13.889 |
| 0.5 | 0.142 | 0.554 | 1.197 | 2.015 | 2.947 | 3.937 | 4.938 | 5.914 | 6-842 | 7.707 | 8.503 | 9.228 | 9.883 | 10-472 | 10.999 | 11.476 | 11.897 | 12.273 | 12.610 | 12.912 | 14.712 | 15.462 | 15.835 | 16.360 | 16.542 |
| 0.6 | 0.154 | 0.600 | 1.298 | 2.187 | 3.204 | 4.288 | 5.389 | 6.468 | 7.498 | 8.464 | 9.358 | 10.177 | 10.922 | 11.596 | 12-204 | 12.752 | 13.244 | 13.686 | 14084 | 14.441 | 16.583 | 17.478 | 17.924 | 18.552 | 18.771 |
| 0.7 | 0-162 | 0.634 | 1.372 | $2 \cdot 316$ | 3-397 | 4.552 | 5.729 | 6.887 | 7.997 | 9.042 | 10-013 | 10.907 | 11.723 | 12.465 | 13.138 | 13.746 | 14.296 | 14.793 | 15-241 | 15.616 | 12.111 | 19.148 | 19.665 | 20-397 | 20.653 |
| 0.8 | 0.169 | 0.660 | 1.429 | 2.413 | 3.543 | 4.754 | 5.990 | 7.209 | 8.382 | 9.490 | 10-523 | 11.476 | 12.350 | 13.147 | 13.873 | 14.531 | 15.129 | 15.670 | 16.161 | 16.606 | 19.361 | 20.538 | 21.127 | 21.961 | 22.253 |
| 0.9 | 0.174 | 0.680 | 1.472 | 2.487 | 3.655 | 4.909 | 6.192 | 7.460 | 8.683 | 9.841 | 10.924 | 11.926 | 12.847 | 13.690 | 14.459 | 15.159 | 15.796 | 16.375 | 16.902 | 17.381 | 20.386 | 21.701 | 22.360 | 23.297 | 23.625 |
| 1.0 | 0.178 | $0-695$ | 1.505 | 2.545 | 3.743 | 5.030 | 6.350 | 7.657 | 8.921 | 10.120 | 11.243 | 12.284 | 13.245 | 14.126 | 14.931 | 15.666 | 16.337 | 16.948 | 17.504 | 18.012 | 21-237 | 22.680 | 23.408 | 24.446 | 24.810 |
| 1.1 | 0.181 | 0.707 | 1.532 | 2.591 | 3.812 | 5.126 | 6.475 | 7.814 | 9.110 | 10.342 | 11.498 | 12.573 | 13.566 | 14478 | 15.314 | 16.079 | 16.778 | 17.416 | 17.999 | 18.531 | 21.946 | 23.508 | 24.303 | 25.441 | 25.841 |
| $1-2$ | 0.183 | 0.716 | 1.552 | 2.626 | 3.866 | 5.202 | 6.575 | 7.939 | 9.261 | 10.521 | 11.705 | 12.807 | 13.827 | 14.776 | $15 \cdot 628$ | 16.418 | 17.141 | 17.802 | 18.407 | 18.961 | 22.543 | 24.208 | 25.072 | 26.309 | 26.745 |
| 1.3 | 0.185 | 0.723 | 1.568 | 2.655 | 3.910 | $5 \cdot 263$ | 6.655 | 8.040 | 9.384 | 10.656 | 11-873 | 12.998 | 14.041 | $15 \cdot 003$ | 15-887 | 16-698 | 17.442 | 18.123 | 18.747 | 19.320 | 23.049 | 24-809 | 25.735 | 27.070 | 27.542 |
| 1.4 | 0.186 | 0.729 | 1.582 | 2.678 | 3.945 | 5-312 | 6.720 | 8.122 | 9.484 | 10.785 | 12.011 | 13.155 | 14-217 | 15.198 | 16.101 | 16.931 | 17.692 | 18.391 | 19.032 | 19.621 | 23.480 | 25.326 | 26.308 | 27.741 | 28-249 |
| 1.5 | 0.188 | 0.734 | 1.592 | 2.697 | 3.973 | 5.352 | 6.773 | 8.189 | 9566 | 10.883 | 12.124 | 13.285 | 14.364 | 15.361 | 16.280 | 17.125 | 17.902 | $18 \cdot 616$ | 19.272 | 19.875 | 23.850 | 25.772 | 26.808 | 28.336 | 28.880 |
| 1.6 | 0.189 | 0.738 | 1.601 | 2.712 | 3.996 | 5.385 | 6.816 | 8.244 | 9.634 | 10-963 | 12.219 | 13.394 | 14.486 | 15.497 | 16.430 | 17.289 | 18.079 | 18.806 | 19.475 | 20.090 | 24.169 | 26.161 | 27.245 | 28.866 | 29.445 |
| 1.7 | 0.189 | 0.741 | 1.608 | 2.724 | 4.016 | $5 \cdot 412$ | 6.852 | 8.290 | 9.690 | 11.031 | 12.298 | 13.484 | 14.589 | 15-611 | 16.556 | 17.427 | 18.229 | 18.968 | 19.648 | 20.274 | 24.444 | 26.501 | 27.629 | 29.340 | 29.955 |
| 1.8 | 0.190 | 0.744 | 1.614 | 2.735 | 4.032 | 5.434 | 6.882 | 8.328 | 9.737 | 11.087 | $12 \cdot 364$ | 13.561 | 14.675 | 15-708 | 16.663 | 17.545 | 18.357 | 19.105 | 19.795 | 20-331 | 24.684 | 26.799 | 27.969 | 29.765 | 30-416 |
| 1.9 | 0.191 | 0.746 | 1.619 | 2.743 | 4.045 | 5-453 | 6.908 | 8.360 | 9.777 | 11-135 | 12.420 | 13.625 | 14.749 | 15.791 | 16.755 | 17.645 | 18.466 | 19.224 | 19.922 | 20.567 | 24-893 | 27.062 | 28.270 | 30.149 | 30.835 |
| 2.0 | 0.191 | 0.748 | 1.623 | 2.751 | 4.056 | 5.469 | 6.929 | 8.387 | 9.811 | 11.175 | 12.468 | 13.630 | 14.811 | 15.861 | 16.833 | 17.731 | 18.560 | 19.325 | 20.031 | 20.634 | 25.077 | 27.294 | 28.537 | 30.496 | $31 \cdot 217$ |
| 3.0 | 0.193 | 0.756 | 1.642 | 2.785 | 4.109 | 5.544 | 7.030 | 8.517 | 9.972 | 11.371 | 12.699 | 13.950 | 15.120 | 16.211 | 17.224 | 18.164 | 19.036 | 19.844 | 20.594 | 21.289 | 26.082 | 28.619 | 30.108 | 32.676 | 33.742 |
| 4.0 | 0.194 | 0.759 | 1.648 | 2.794 | $4 \cdot 124$ | 5.566 | 7.058 | 8.554 | 10.018 | 11.427 | 12.767 | 14.029 | $15 \cdot 212$ | 16.316 | 17.343 | 18.298 | 19.185 | 20.008 | 20.772 | 21-483 | 26.439 | 29.128 | 30.745 | 33.687 | 35.064 |
| 5.0 | 0.194 | 0.760 | 1.650 | 2.798 | $4 \cdot 129$ | 5.574 | 7.069 | 8.568 | 10.036 | 11.449 | 12.793 | 14.060 | 15.248 | 16.357 | 17.390 | 18.351 | 19.243 | 20.073 | 20-844 | 21.562 | 26.592 | 29.359 | 31.049 | 34.232 | 35.872 |
| 10.0 | 0.194 | 0.761 | 1.652 | 2.801 | 4.135 | 5.581 | 7.080 | 8.582 | 10:053 | 11.470 | 12.818 | 14.090 | 15.283 | 16.398 | 17.436 | 18.403 | 19.302 | 20.138 | 20.917 | 21.641 | 26.758 | 29.624 | 31.419 | 35-049 | 37.513 |
| INF | 0.194 | 0.761 | 1.652 | 2.802 | 4.136 | 5.582 | 7.081 | 8.584 | 10.056 | 11.473 | 12.822 | 14.095 | 15.288 | 16.404 | 17.443 | 18.411 | 19.311 | 20.143 | 20.928 | 21.654 | 20.785 | 29.672 | 31-493 | 35-274 | 39.172 |

table 7 percentage sky components on the vertical plane parallel to a vertical window for the tropical design sky (Clause A-1.1)

| $1 / d \rightarrow$ | 0.1 | $0 \cdot 2$ | 0.3 | 0-4 | 0.5 | $0 \cdot 6$ | $0-7$ | 0.8 | 0.9 | 1.0 | 1.1 | 1-2 | 1-3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 3.0 | 4.0 | $5 \cdot 0$ | 10.0 | INF |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0.1 | 0.728 | 1.429 | 2.078 | 2.600 | 3.167 | 3.600 | 3.964 | $4 \cdot 265$ | 4.513 | 4.717 | 4.883 | 5.020 | $5 \cdot 132$ | 5.225 | 5.301 | 5.365 | 5.418 | 5.463 | 5.501 | 5.533 | 5.687 | 5.733 | 5.749 | 5.765 | 5.766 |
| 0.2 | 1.429 | 2.803 | 4.077 | 5-221 | 6.220 | 7.073 | 7.790 | 8.385 | 8.876 | 9.278 | 9609 | 9.830 | 10.103 | 10.286 | 10.439 | 10.565 | 10.671 | 10.760 | 10.835 | 10.899 | 11.207 | 11.296 | 11.330 | 11.362 | 11.365 |
| 0.3 | 2.068 | 4.061 | $5 \cdot 913$ | 7.530 | 9.040 | 10.285 | 11.337 | 12.212 | 12.934 | 13.528 | 14.016 | 14.417 | 14.747 | 15.020 | $15 \cdot 246$ | 15.434 | 15.591 | 15.724 | 15.836 | 15.931 | 16.390 | 16.523 | 16.574 | 16.623 | 16.627 |
| $0 \cdot 4$ | 2.529 | 4.970 | 7.249 | 9.312 | 11.133 | 12.707 | 14.042 | 15.164 | 16.097 | 16.870 | 17.507 | 18.025 | 18.458 | 18.816 | 19.113 | 19.360 | 19.568 | 19.742 | 19-890 | 20.015 | 20.624 | 20.801 | 20.868 | 20.933 | 20.939 |
| 0.5 | 2.852 | 5.608 | 8.186 | 10.529 | 12.606 | 14.410 | 15.952 | 17.256 | 18.350 | 19.262 | 20-021 | 20.652 | $21 \cdot 177$ | 21.613 | 21.978 | 22.275 | 22.530 | 22.746 | 22.923 | 23.082 | 23.836 | 24.056 | 24.140 | 24.222 | 24-229 |
| 0.6 | 3.086 | 6.070 | 8.867 | 11.415 | 13.681 | 15.656 | 17.353 | 18.793 | 20.008 | 21.027 | 21.879 | 22.592 | 23.189 | 23.689 | $24 \cdot 109$ | 24.462 | 24.761 | 25.014 | $25 \cdot 229$ | 25.412 | 26.299 | 26.561 | 25.662 | 26.759 | 26.768 |
| 0.7 | 3.259 | 6.413 | 9.373 | 12.074 | 14.482 | 16.588 | 18.402 | 19.949 | 21-257 | 22.359 | 23.285 | 24.063 | 24.716 | 25.267 | 25.731 | 26.124 | 26-458 | 26.742 | 26.984 | 27.192 | 28.214 | 28.517 | 28.634 | 28.748 | 28-758 |
| $0-8$ | 3-389 | 6.672 | 9.755 | 12-573 | 15.090 | 17.296 | 19.201 | 20.830 | 22.212 | 23.380 | 24.365 | 25195. | 25.895 | 26.486 | 26.987 | 27.412 | 27.775 | 28.004 | 28.350 | 28.578 | 29.720 | 30.065 | 30.198 | 30.327 | 90-399 |
| C.9 | 3.469 | 6.869 | 10.046 | 12.955 | 15.556 | 17.840 | 19.817 | 21.511 | 22.952 | 24.173 | 25.206 | 26.078 | 26.816 | 27.441 | 27.972 | 28.424 | 28.810 | 29.141 | 29.426 | 29.672 | 30.927 | 31.303 | 31-451 | 31.596 | 91.610 |
| 1.0 | 3.565 | 7.021 | 10-272 | 13.250 | $1{ }^{1917}$ | 18.263 | 20.297 | 22.043 | 23.531 | 24.795 | 25-866 | 26.773 | 27.542 | 28.196 | 28.752 | 29.226 | 29.633 | 29.982 | 30-283 | 30.544 | 31.889 | 32.302 | $32 \cdot 467$ | 32.627 | 32.643 |
| 1.1 | 3.625 | 7.139 | 10-447 | 13.481 | 16-200 | 18.594 | 20.674 | 22.462 | 23-989 | 25-288 | 26.391 | 27.326 | 28.121 | 28.798 | 29.375 | 29.869 | 30-293 | 30.658 | 30.973 | 31.246 | 32-670 | 33.117 | 33.297 | \$3.473 | 39-491 |
| $1-2$ | 3.672 | 7.233 | 10-586 | 13.663 | 16.423 | 18.857 | 20.973 | 22.795 | 24-353 | 25-681 | 26.810 | 27.770 | 28.587 | 29.283 | 29.878 | 30.388 | 30.826 | 31-201 | 31.532 | 31.816 | 33.309 | 33.796 | 33.981 | 34-173 | . $34-193$ |
| 1.3 | 3.709 | 7.307 | 10.696 | 13.807 | 16.602 | 19.067 | 21-213 | 23.062 | 24.646 | 25-998 | 27.148 | 28.128 | 28.963 | 29.676 | 30-286 | 30.810 | 31.261 | 31.651 | 31.989 | 32.283 | 33-836 | 34-350 | 34.550 | 34.756 | 34.779 |
| 1.4 | 3.739 | 7.966 | 10.784 | 13-924 | 16.745 | 19.296 | 21-06 | 29.278 | 24-804 | 26-255 | 27.424 | 28.420 | 29.271 | 29-998 | 30.621 | 31-157 | 31.618 | 32.018 | 32.365 | 32.667 | 34-274 | 34.813 | 35.035 | 35.247 | 35.271 |
| 1.5 | 3.763 | 7.414 | 10856 | 14.018 | 16.861 | 19.373 | 21.563 | 23.454 | 25.077 | 26-465 | 27.649 | 28.660 | 29.523 | 30-262 | 30.897 | 31.443 | 31.914 | 32.322 | 32.677 | 32-986 | 34.641 | 35.202 | 35.436 | $35 \cdot 663$ | 35.689 |
| 16 | 3.783 | 7.453 | 10.914 | 14.095 | 16.956 | 19.485 | 21.692 | 23.599 | 25-296 | 26-638 | 27.835 | 28.857 | 29.732 | 30-482 | 31-126 | 31.680 | 32.160 | 32.575 | 32.937 | 33.253 | 34.950 | 35.532 | 35.776 | 36.017 | 36.046 |
| 1.7 | 3.799 | 7.485 | 10.962 | 14-158 | 17.034 | 19.578 | 21-798 | 23.718 | 23.368 | 26.781 | 27.989 | 29.022 | 29.906 | 30.665 | 31.317 | 31.879 | 32.366 | 32-788 | 33.156 | 93.477 | 35-211 | 35.812 | 36.067 | 96-321 | 36-352 |
| 18 | 3.812 | 7.512 | 11.002 | 14.211 | 17.099 | 19.655 | 21.886 | 23.817 | 25.478 | 26.900 | 28.118 | 29.160 | 30.052 | 30.818 | 31.477 | 32.046 | 32.599 | \$2.967 | 39.340 | 39.666 | 35-435 | 36.052 | 36.316 | 36.584 | 36.617 |
| 1.9 | 3.824 | 7.594 | 11.035 | 14-254 | 17.153 | 19719 | 21.960 | 23.900 | 25.570 | 27.001 | 28.226 | 29.276 | 30-175 | 30-948 | 31.613 | 32-188 | 32.686. | 33-119 | 33.497 | 33.828 | 35-626 | 36.259 | 36.592 | 36.812 | 36.847 |
| 2.0 | 3-833 | 7.553 | 11.062 | 14-291 | 17.199 | 19.773 | 22-022 | 23-970 | 25-647 | 27.086 | 28.318 | 29.374 | 30-279 | 31.058 | 31.728 | 32.908 | 32-811 | 33-249 | 33.631 | 33-965 | 35-791 | 36.438 | 36.719 | 37.011 | 37.048 |
| 30 | 3-876 | 7.639 | 11.192 | 14.463 | 17-412 | 20.027 | 22.316 | 24.302 | 26.016 | 27.491 | 28.757 | 29846 | $30-783$ | 31.592 | 32.291 | 32.898 | 33.427 | 39.889 | 34-294 | $34 \cdot 651$ | 36-640 | 37.380 | 37.715 | $38 \cdot 107$ | 38.157 |
| 40 | 3-888 | 7.663 | 11.228 | 14.511 | 17-471 | 20-098 | 22.398 | 24-996 | 26-121 | 27.606 | 28-884 | 29.983 | 30-930 | 31.748 | 32.457 | 33.074 | 33-611 | 34.082 | 34-496 | 34-860 | 36.915 | 37.699 | 38.063 | 38.510 | 38.579 |
| 30 | 3-883 | 7.672 | 11.241 | 14.529 | 17.494 | 20-125 | 22.430 | 24-432 | 26-161 | 27.650 | 28.932 | 30.035 | 30-986 | 31.808 | 32.521 | 33.142 | 39.683 | 34157 | 34.574 | 34.945 | 37.028 | 37.834 | 38.214 | 38.696 | 38.781 |
| 100 | 3897 | 7.681 | 11.254 | 14.546 | 17.515 | 20-150 | 22-459 | 24.466 | 26-199 | 27.693 | 28.978 | 30-085 | 31.041 | 91.867 | 32.584 | 33.208 | 33.753 | 3+231 | 34.652 | 35.024 | 37.144 | 37.978 | 38.332 | 38.927 | 39.057 |
| nip | $3-688$ | 7602 | 11.256 | 14.548 | 17.518 | 20-154 | 22-464 | $24-471$ | 26-205 | 27-699 | 28.985 | 30-093 | 31-049 | 31.876 | 32.593 | 33-218 | 33.764 | 3+243 | 34.664 | 35-037 | 37.162 | 38-003 | $38 \cdot 411$ | $\mathbf{3 8 . 9 7 8}$ | 39.172 |

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Fig. 5
A-1.4 Sky components for different $h / d$ and $l / d$ values are tabulated, that is, for different sizes of windows and for different distances of the point $P$ from the window.

A-1.5 By suitable combination of the values obtained from the three tables, for a given point for a given window, the sky component in any plane $p$ issing through the point can be obtained.

> A P P E N D I X $\quad$ B
> $($ Clauses $5.3 .1,5.3 .5,5.4$ and 5.5$)$

## Caldulation of sky component

## B-1. METHODS OF USING THE TABLES IN APPENDIX A

B-1.1 Methods of using the tables in Appendix A to get the sky components at different points are explained with reference to specific examples. Since the working plane is usually horizontal, Table 5 alone will be generally used. Only in Example 12, both Tables 6 and 7 are utilized.

## B-2. EXAMPLES

## Example 1:

Point $P$ is 300 cm from the window on a perpendicular line passing through the centre of the sill. The width of the window is 180 cm and height 150 cm . Considering one half of the window (see Fig. 6):

$$
\begin{aligned}
l / d=90 / 300 & =0.3 \\
h / d=150 / 300 & =0.5
\end{aligned}
$$

The component as read from Table 5 is 1.74 percent. The component for the total window is $2 \times 1.74=3.48$ percent.


All dimensions in centimetres.
Fra. 6

## Example 2:

Point $P$ is 300 cm from the same window, the foot of the perpendicular $\mathcal{N}$ being on the sill 30 cm from one corner and 150 cm from the other (see Fig. 7).


All dimensions in centimetres.
Fig. 7
Part A,

$$
\begin{aligned}
& l / d=150 / 300=0.5 \\
& h / d=150 / 300=0.5 \\
& F_{a}=2.70 \text { percent (from Table 5) }
\end{aligned}
$$

Part B,

$$
\begin{aligned}
l / d & =30 / 300=0.1 \\
h / d & =150 / 300=0.5 \\
F_{b} & =0.604 \text { percent (from Table 5) } \\
F & =F_{a}+F_{b}=2.70+0.604=3.304
\end{aligned}
$$

## Example 3:

Point $P$ is 300 cm from the same window. Foot of the perpendicular $\mathcal{N}$ is 60 cm above the sill at the centre (see Fig. 8).


All dimensions in centimetres.
Fig. 8
The portion of the window below the horizontal line passing through $\mathcal{N}$ will be ineffective as no sky can be seen through that part.
For each half: effective $l / d=90 / 300=0.3$

$$
\text { effective } \begin{aligned}
h / d & =(150-60) / 300=0.3 \\
F_{1} & =0.859 \text { percent (from Table } 5) \\
F & =2 \times F_{1}=2 \times 0.859=1.718 \text { percent }
\end{aligned}
$$

Example 4:
Point $P$ is 300 cm from the same window. Foot of the perpendicular $\mathcal{N}$ is 60 cm below the sill at the centre (see Fig. 9).


All dimensions in centimetres.
Fig. 9
Consider the window extended up to $E F$
For portion NFBH

$$
\begin{aligned}
l d d & =90 / 300=0.3 \\
h / d & =60 / 300=0.2 \\
F_{1} & =0.403 \text { percent (from Table 5) }
\end{aligned}
$$

For portion NFCG

$$
\begin{aligned}
l / d & =90 / 300=0.3 \\
h / d & =(150+60) / 300=0.7 \\
F_{2} & =2.441 \text { percent (from Table 5) }
\end{aligned}
$$

For the portion HBCG

$$
F^{\prime}=F_{2}-F_{1}=2.441-0.403=2.038
$$

For the total window $A B C D$

$$
F=2 F^{\prime}=2 \times 2.038=4.076 \text { percent }
$$

## Example 5:

Point $P$ is 300 cm from the same window. Foot of the perpendicular $\mathcal{N}$ is 60 cm below the sill and 90 cm to the left of $A D$ (see Fig. 10).


All dimensions in centimetres.
Fio. 10
Consider $A B C D$ extended to $N B^{\prime} C D^{\prime}$

1) For $\mathcal{N B} \boldsymbol{B}^{\prime} \boldsymbol{D}^{\prime}$

$$
\begin{aligned}
& l / d=(180+90) / 300=0.9 \\
& h / d=(150+60) / 300=0.7 \\
& \left.F_{1}=5.709 \text { percent (from Table } 5\right)
\end{aligned}
$$

2) For $N A^{\prime} D D^{\prime}$

$$
\begin{aligned}
& l / d=90 / 300=0.3 \\
& h / d=(150+60) / 300=0.7 \\
& F_{3}=2.441 \text { percent (from Table 5) }
\end{aligned}
$$

3) For $N B^{\prime} B A^{\prime}$

$$
\begin{aligned}
l / d & =(180+90) / 300=0.9 \\
h / d & =60 / 300=0.2 \\
F_{z} & =0.878 \text { percent (from Table } 5 \text { ) }
\end{aligned}
$$

4) For $N A^{\prime} A A^{\prime \prime}$

$$
\begin{aligned}
l / d & =90 / 300=0.3 \\
h / d & =60 / 300=0.2 \\
F_{c} & =0.403 \text { percent (from Table } 5)
\end{aligned}
$$

Since

$$
\begin{aligned}
& A B C D=N B^{\prime} C D^{\prime}-N A^{\prime} D D^{\prime}-N B^{\prime} B A^{\prime \prime}+N A^{\prime} A A^{\prime \prime} \\
& \qquad \begin{aligned}
F & =F_{1}-F_{2}-F_{3}+F_{4} \\
& =5.709-2.441-0.878+0.403 \\
& =2.793 \text { percent }
\end{aligned}
\end{aligned}
$$

## Example 6:

Point $P$ is 300 cm from the same window, $\mathcal{N}$ falls above the lintel level. No sky can be seen from $P$ and, therefore, $F=0$.

## Exampli 7:

Point $P$ is 180 cm from the same window. $\mathcal{N}$ coincides with $A$ (sec Fig. 11).


All dimensions in centimetres.
Fig. 11

$$
\begin{aligned}
l / d & =180 / 180
\end{aligned}=1.0 \quad 1 . d=150 / 180=0.833
$$

Interpolation is necessary to get $F$ from the table
For $l / d=1.0$ and $h / d=0.9$

$$
F_{1}=7.470 \text { percent }
$$

For $l / d=1.0$ and $h / d=0.8$

$$
F_{2}=6.8 \text { percent }
$$

For $l / d=1.0$ and $h / d=0.833$

$$
\begin{aligned}
F & =6.8+\frac{1}{3}(7.47-6.8) \\
& =6.8+0.223 \\
& =7.023 \text { percent }
\end{aligned}
$$

## Example 8:

Point $P$ is 210 cm from the same window. $\mathcal{N}$ coincides with $A$.

$$
\begin{aligned}
l / d & =180 / 210=0.86 \\
h / d & =150 / 210=0.71
\end{aligned}
$$

$$
\text { For } l / d=0.8 \text { and } h / d=0.7, F_{1}=5.33 \text { percent (from Table } 5 \text { ) }
$$

$$
\text { For } l / d=0.8 \text { and } h / d=0.8, F_{2}=5.99 \text { percent (from Table 5) }
$$

$$
\text { For } l / d=0.8 \text { and } h / d=0.71, F^{\prime}=F_{1}+0.1\left(F_{2}-F_{1}\right)
$$

$$
=5.33+0.1 \times 0.66
$$

$$
=5.4 \text { percent approximately }
$$

For $l / d=0.9$ and $h / d=0.7, F_{3}=5.709$ percent (from Table 5) For $l / d=0.9$ and $h / d=0.8, F_{4}=6.423$ percent (from Table 5)
For $l / d=0.9$ and $h / d=0.71, F^{\prime \prime}=F_{3}+0.1\left(F_{4}-F_{9}\right)$
$=5.709+0.1 \times(6.423-5.709)$
$=5.709+0.1 \times 0.714$
$=5.7804$
$=5.78$ percent
For $\quad l / d=0.86$ and $h / d=0.71$

$$
\begin{aligned}
F & =F^{\prime}+0.6\left(F^{\prime \prime}-F^{\prime}\right) \\
& =5.40+0.6 \times 0.38 \\
& =5.628 \text { percent }
\end{aligned}
$$

## Example 9:

Point $P$ is in front of the window, below the sill and to the left. Depth of reveal 60 cm (see Fig. 12).


All dimensions in centimetres.
Fic. 12
$l^{\prime}$ and $h^{\prime}$, the apparent length and height of the opening, are first calculated geometrically and the table is used afterwards to get sky component by methods indicated earlier.

## Example 10:

Point $P$ is 300 cm from the same window. $\mathcal{N}$ coincides with $A$. Top or external obstruction is $E F 60 \mathrm{~cm}$ apparently above $A B$ as seen from $P$ (see Fig. 13).


All dimensions in centimetres.
Fig. 13
For $A B C D$

$$
\begin{aligned}
l / d & =180 / 300=0.6 \\
h / d & =150 / 300=0.5 \\
F_{1} & =3 \cdot 1 \text { percent (from Table } 5 \text { ) }
\end{aligned}
$$

For $A B F E$

$$
\begin{aligned}
l / d & =180 / 300=0.6 \\
h / d & =60 / 300=0.2 \\
F_{2} & =0.7 \text { percent (from Table 5) }
\end{aligned}
$$

For the unobstructed portion $E F C D$

$$
F=F_{1}-F_{2}=2.4 \text { percent }
$$

Mean angle of obstruction $\tan ^{-1} \frac{30}{300}=5^{\circ}$ approximately
From Table 2, corresponding correction factor $=0.086$
$E R C=F_{2} \times 0.086=0.7 \times 0.086=0.0602=0.06$ percent
Obstruction 20 percent of $F_{2}=0.7 / 5=0.14$ percent
Example 11:
Point $P$ is 300 cm from the same window. $\mathcal{N}$ coincides with $A$. External obstruction is $90 \mathrm{~cm} \times 90 \mathrm{~cm}$ as seen from $P$. The apparent obstruction is shown in the figure (see Fig. 14).
For $A B C D$

$$
\begin{aligned}
l / d & =180 / 300=0.6 \\
h / d & =150 / 300=0.5 \\
F_{1} & =3.1 \text { percent (from Table } 5 \text { ) }
\end{aligned}
$$



All dimensions in centimetres.
Fig. 14
For obstruction AEFG

$$
\begin{aligned}
l / d & =90 / 300=0.3 \\
h / d & =90 / 300=0.3 \\
F_{2} & =0.86 \text { percent (from Table 5) }
\end{aligned}
$$

For unobstructed portion $E B C D G F$

$$
F=F_{1}-F_{2}=2.24 \text { percent }
$$

Mean angle of obstruction $=\tan ^{-1} \frac{45}{1300}=8^{\circ}$ approximately
Correction factor $=0.086$
$E R C=0.86 \times 0.086=0.07396=0.074$ percent
Obstruction $1 / 5$ of $0.86=0.172$ percent
Example 12:
Same window. Vertical blackboard 300 cm from window parallel to the window plane. Sky component at centre required (see Fig. 15).




Fig. 15
Similar methods as described earlier should be used to find sky component $F_{1}$. But Table 6 should be used in this case.

If the plane of the blackboard is perpendicular to the window plane, Table 5 should be used to find the sky component $F_{2}$.

If the plane of the blackboard is inclined at an angle $\theta$ to the perpendicular direction :

$$
F=F_{\mathbf{1}} \operatorname{Sin} \theta+F_{\mathbf{z}} \operatorname{Cos} \theta
$$

Notr - In certain positions only a part of the window will be lighting the blackboard but the above examples indicate the method to follow in such or other complicated ituations.

## B-3. CENERAL INSTRUGIONS

B-3.1 For irregular obstructions like a row of trees parallel to the plane of the window, equivalent straight boundaries horizontal and vertical, may be drawn, and the methods indicated in Examples 10 and 11 can then be used.

B-3.2 For extremely irregular obstructions or obstructions not in a plane parallel to the window, diagrammatic methods, such as Waldrams diagrams will have to be employed.

B-3.3 For bay windows, dormer windows or corner windows the effective dimensions of window opening computed should be taken when using the tables to find the sky components.

## B-4. CALCULATION OF IRC

B-4.1 The internal reflected component is a variable quantity which varies from point to point in a room depending upon the interior finish. IRC value is maximum at the centre of the room and decreases elsewhere in all directions. For processing calculations of IRC at any given point of the room, special techniques have to be made out. The internal reflected component may be calculated by using the following formula :

$$
I R C=\frac{0.85 W}{A(1-R)}\left(C R_{f w}+10 R_{c \infty}\right)
$$

where
$W=$ window area;
$C=$ a constant of value 78 when there is no external obstruction but it has different values as shown in Table 8 when there are obstructions;
$R_{y w}=$ average reflection factor of the floor and those parts of the wall below the plane of the mid-height of the window (excluding the window wall);
$R_{\text {cw }}=$ average reflection factor of the ceiling and those parts of the wall above the plane of the mid-height of the window (excluding the window wall);
$A=$ area of all the surfaces in the room (ceiling walls, floor and windows) ; and
$R=$ the average reflection factor of all surfaces in the room (ceiling, walls, floor and windows) expressed as a decimal part of unity.

## TABLE 8 VALUES OF C

(Clause B-4.1)

| Angle of Obetruction | Sky + External Obstruction, $C$ | Angle or Obstruction | Sky + External Obstrucition, $C$ |
| :---: | :---: | :---: | :---: |
| (1) | (2) | (1) | (2) |
| Degree |  | Degrec |  |
| 5 | 68.9 | 55 | 15.8 |
| 15 | 50.6 | 65 | 12.9 |
| 25 | $36 \cdot 2$ | 75 | 11.1 |
| 35 | 26.7 | 85 | . 10.36 |
| 45 | 20.1 |  |  |

## B-4.1.1 Example:

Consider two rooms of dimensions :
Room $X=6 \mathrm{~m}(l) \times 5 \mathrm{~m}(w) \times 3 \mathrm{~m}(h t)$
Room $\boldsymbol{r}=3.7 \mathrm{~m} \times 3 \mathrm{~m} \times 3 \mathrm{~m}$
Let the window area be 15 percent of the floor area and be glazed
Window size in room $X=2.5 \mathrm{~m} \times 1.8 \mathrm{~m}$
Window size in room $Y=1.5 \mathrm{~m} \times 1.1 \mathrm{~m}$
The windows are on the $6 \mathrm{~m} \times 3 \mathrm{~m}$ side in room $X$ and $3.7 \mathrm{~m} \times 3 \mathrm{~m}$ side in room $X$, and the sill heights are 0.9 m from floor level.

Reflection coefficientsof walls and ceiling $\quad=70$ percent

Floor
Glazing
$=20$ percent
$=15$ percent

Value of $I R C$ in room $X$ :
a) Total interior area $=A=2(30+18+15)=126^{-} \mathrm{m}^{2}$
b) Average reflection factor of interior :

$$
R=\frac{61.5 \times 0.7+30 \times 0.7+30 \times 0.2+4.5 \times 0.15}{61.5+30+30+4.5}=0.56
$$

c) $1-R=0.44$
d) Mid-height of window is 1.83 m from floor, average reflection factor of room below 1.83 m level excluding the wall containing the window:

$$
R_{f 10}=\frac{29.28 \times 0.7+30 \times 0.2}{29.28+30}=0.45
$$

e) Average refiection factor of room above 1.83 m level excluding the wall çontaining the window:

$$
\begin{aligned}
& R_{\text {ow }}=\frac{18.72 \times 0.7+30 \times 0.7}{18.72+30}=0.7 \\
& \text { f) } I R C=\frac{0.85 \times 4.5}{126 \times 0.44}(78 \times 0.45+10 \times 0.7)=2.904
\end{aligned}
$$

Value of IRC in room $r$ :
a) Total interior area.

$$
\begin{aligned}
A & =2(3.7 \times 3+3.7 \times 3+3 \times 3) \\
& =62.4 \mathrm{~m}^{2}
\end{aligned}
$$

b) Average reflection fäctor

$$
R=\frac{38 \times 55 \times 0.7 \times 3 \times 0.7+3.7 \times 3 \times 0.2+1.5 \times 1.1 \times 0.15}{38.55+11.1+11.1+1.65}=0.596
$$

c) Mid-height of window from floor $=1.46 \mathrm{~m}$
d) Average reflection factor below 1.46 m level

$$
R_{f w}=\frac{3.7 \times 3 \times 0.7+1.54 \times 9.7 \times 0.7}{11.1+14.94}=0.48
$$

e) Average reflection factor above 1.46 m level

$$
R_{c v o}=\frac{3.7 \times 3 \times 0.7+1.54 \times 9.7 \times 0.7}{11.1+14.94}=0.7
$$

f) $I R C=\frac{0.85 \times 1.65}{62.4 \times 0.404}(78 \times 0.48+10 \times 0.7)=2.472$

## APPENDIX C

(Clause 0.8)

## GENERAL NOTE ON DAYLIGHTING OF BUILDING

C-1. The main aim of daylighting design is how to admit enough light for good visibility without setting up uncomfortable glare. No simple solution may be given as the sky varies so much in its brightness from hour to hour, and from season to season.
C-2. Different visual tasks need differing amounts of lights for the same visual efficiency. The correct amount of light for any task is determined by the following:
a) The characteristics of the task - size of significant detail, contrast of detail with background and how close it is to the eyes;
b) The sight of the worker-for example, oid people need more light;
c) The speed and accuracy necessary in the performance of work. If no errors are permissible, much more light is needed; and
d) The ease and comfort of working-long and sustained tasks must be done easily whereas workers can make a special effort for tasks of very short duration.
These factors have been made the subject of careful analysis as a result of which tables of necessary levels of illumination have been drawn up.
C-3. Levels of lighting determined analytically must be translated into levels of daylight and then into size of window opening or vice-versa for checking the size of window assumed for required levels of daylight.
C-4. One of the many important factors involved in the translation is the lightness of the room surface. The illumination level in a given room with a finite window will be higher when the walls are light coloured than when these are dark coloured. It is necessary, therefore, at an early stage to consider the colouring of the rooms of the building and not to leave this until later. Lighting is not merely a matter of window openings and quite half the eventual level of lighting may be dependent on the decorations in the room. Whatever may be the colour the occupants want to use, it is most desirable to maintain proper values of reflectance factors for ceiling, wall and floors so that the level of daylight illumination is maintained.

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[^5]
[^0]:    *Also represents The Institution of Engineers (India).

[^1]:    Code of practice for daylighting of factory buildings.
    $\dagger$ Code of practice for daylighting of educational buildings.

[^2]:    *Rules for rounding off numerical values (revised).
    $\dagger$ Code of practice for daylighting of factory buildings.
    $\ddagger$ Code of practice for daylighting of educational buildings.

[^3]:    *Code of practice for interior illumination: Part II Schedule for values of illumination and glare index.

[^4]:    Fig. 4 Typical Sky Component Curves on Vertical Cross Section Along the Central Line

[^5]:    -Salos Office In Bombay to at Novelty Chambers, Grant Road.Bombay 400007
    fBales Office In Calcufta is af $\mathrm{s}^{\text {S Chowinghee Approech, P O. Princep }}$ 41800Sreest, Calcutta 700072896820

