(Provisional)

MYANMAR NATIONAL BUILDING CODE 2012

PART 5A

BUILDING SERVICES

(LIGHTING)

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MYANMAR NATIONAL BUILDING CODE

PART 5A BUILDING SERVICES

Lighting

5A.1 SCOPE

This Section covers requirements and methods for lighting of buildings.

5A.2 TERMINOLOGY

5A.2.0 For the purpose of this Section, the following definitions shall apply.

5A.2.1 Lighting

5A.2.1.1 *Altitude (θ)* — The angular distance of any point of celestial sphere, measured from the horizon, on the great circle passing through the body and the zenith *(see* Figure 1).

5A.2.1.2 *Azimuth (Ø)* — The angle measured between meridians passing through the north point and the point in question (point C in Figure 1).

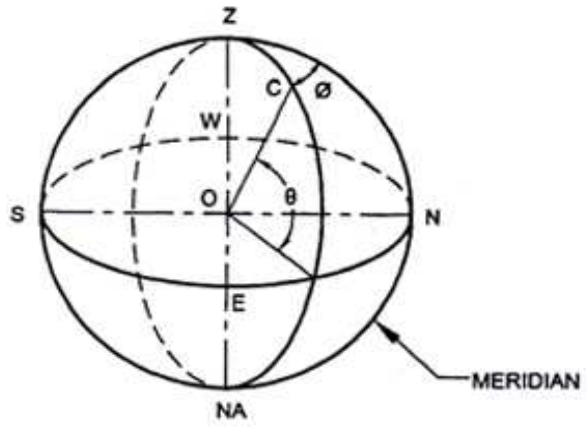

Figure 1: Altitude and Azimuth of a Celestial Body

REFERENCES

O	-	Observer's station	S	-	Geographical south
C	-	Celestial body	E	-	Geographical east
Z	-	Zenith	W	-	Geographical west
NA	-	Nadir	N	-	Geographical north

5A.2.1.3 *Brightness Ratio or Contrast* — The variations or contrast in brightness of the details of a visual task, such as white print on blackboard.

5A.2.1.4 *Candela (cd*) —The SI unit of luminous intensity.

Candela = 1 lumen per steradian

5A.2.1.5 *Central Field* — The area of circle round the point of fixation and its diameter, subtending an angle of about 2° at the eye. Objects within this area are most critically seen in both their details and colour**.**

5A.2.1.6 *Clear Design Sky* **—** The distribution of luminance of such a sky is non-uniform; the horizon is brighter than the zenith, and when L_z is the brightness at zenith, the brightness at an altitude (θ) in the region away from the sun, is given by the expression:

$$L_\theta = L_z \operatorname{cosec} \theta$$

When θ lies between 15° and 90°, and L_θ is constant when θ lies between 0° and 15°.

5A.2.1.7 *Colour Rendering Index (CRI)* — Measure of the degree to which the psychophysical colour of an object illuminated by the test illuminant conforms to that of the same object illuminated by the reference illuminant, suitable allowance having been made for the state of chromatic adaptation.

5A.2.1.8 *Correlated Colour Temperature (CCT) (Unit: K)* — The temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions.

5A.2.1.9 *Daylight Area* — The superficial area on the working plane illuminated to not less than a specified daylight factor, that is, the area within the relevant contour.

5A.2.1.10 *Daylight Factor* — The measure of total daylight illuminance at a point on a given plane expressed as the ratio (or percentage) which the illuminance at the point on the given plane bears to the simultaneous illuminance on a horizontal plane due to clear design sky at an exterior point open to the whole sky vault, direct sunlight being excluded.

5A.2.1.11 *Daylight Penetration* — The maximum distance to which a given daylight factor contour penetrates into a room.

5A.2.1.12 *Direct Solar Illuminance* — The illuminance from the sun without taking into account the light from the sky.

5A.2.1.13 *External Reflected Component (ERC)* — The ratio (or percentage) of that part of the daylight illuminance at a point on a given plane which is received by direct reflection from external surfaces as compared to the simultaneous exterior illuminance on a horizontal plane from the entire hemisphere of an unobstructed clear design sky.

5A.2.1.14 *Glare* **—** A condition of vision in which there is discomfort or a reduction in the ability to see significant objects or both due to an unsuitable distribution or range of luminance or due to extreme contrasts in space and time.

5A.2.1.15 *Illuminance*— At a point on a surface, the ratio of the luminous flux incident on an infinitesimal element of the surface containing the point under consideration to the area of the element.

NOTE — The unit of illuminance (the measurement of illumination) is lux which is 1 lumen per square metre.

5A.2.1.16 *Internal Reflected Component (IRC)* — The ratio (or percentage) of that part of the daylight illuminance at a point in a given plane which is received by direct reflection or inter-reflection from the internal surfaces as compared to the simultaneous exterior illuminance on a horizontal plane due to the entire hemisphere of an unobstructed clear design sky.

5A.2.1.17 *Light Output Ratio (LOR) or Efficiency (η)* — The ratio of the luminous flux emitted from the luminaire to that emitted from the lamp(s) (nominal luminous flux). It is expressed in percent.

5A.2.1.18 *Lumen (lm)* — 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.

5A.2.1.19 *Luminance (At a point of a Surface in a Given Direction) (Brightness)* — The quotient of the luminous intensity in the given direction of an infinitesimal element of the surface containing the point under consideration by the orthogonally projected area of the element on a plane perpendicular to the given direction. The unit is candela per square meter (cd/m^2).

5A.2.1.20 *Luminous Flux (Ø)*—The 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:

(a) *Effective luminous flux* ($Ø_n$) — Total luminous flux which reaches the working plane.

(b) *Nominal luminous flux* ($Ø_0$)— Total luminous flux of the light sources in the interior.

5A.2.1.21 *Maintenance Factor (d*) — The ratio of the average illuminance on the working plane after a certain period of use of a lighting installation to the average illuminance obtained under the same conditions for a new installation.

5A.2.1.22 *Meridian* — It is the great circle passing through the zenith and nadir for a given point of observation.

5A.2.1.23 *North and South Points* — The point in the respective directions where the meridian cuts the horizon.

5A.2.1.24 *Orientation of Buildings* — In the case of non- square buildings, orientation refers to the direction of the normal to the long axis. For example, if the length of the building is east-west, its orientation is north- south.

5A.2.1.25 *Peripheral Field* — It is the rest of the visual field which enables the observer to be aware of the spatial framework surrounding the object seen.

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

5A.2.1.26 *Reflected Glare* — The variety of ill effects on visual efficiency and comfort produced by unwanted reflections in and around the task area.

5A.2.1.27 *Reflection Factor (Reflectance*) — The ratio of the luminous flux reflected by a body (with or without diffusion) to the flux it receives. Some symbols used for reflection factor are:

r_c = Reflection factor of ceiling.

r_w = Reflection factor of parts of the wall between the working surface and the luminaires.

r_f = Reflection factor of floor.

5A.2.1.28 *Reveal*—The side of an opening for a window.

5A.2.1.29 *Room Index (k_r)* — An index relating to the shape of a rectangular interior, according to the formula:

$$k_r = \frac{L.W}{(L+W)\,H_m}$$

where L and W are the length and width respectively of the interior, and H_m is the mounting height, that is, height of the fittings above the working plane.

NOTES

1 For rooms where the length exceeds 5 times the width, L shall be taken as L = 5W.

2 If the reflection factor of the upper stretch of the walls is less than half the reflection factor of the ceiling, for indirect or for the greater part of indirect lighting, the value H_m is measured between the ceiling and the working plane.

5A.2.1.30 *Sky Component (SC)*—The ratio (or percentage) of that part of the daylight illuminance at a point on a given plane which is received directly from the sky as compared to the simultaneous exterior illuminance on a horizontal plane from the entire hemisphere of an unobstructed clear design sky.

5A.2.1.31 *Solar Load* — The amount of heat received into a building due to solar radiation which is affected by orientation, materials of construction and reflection of external finishes and colour.

5A.2.1.32 *Utilization Factor (Coefficient of Utilizaiton) ( )* — The ratio of the total luminous flux which reaches the working plane (effective luminous flux, $Ø_n$) to the total luminous flux of the light sources in the interior (nominal luminous flux, $Ø_0$).

5A.2.1.33 *Visual Field*—The visual field in the binocular which includes an area approximately 120° vertically and 160° 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 each eye is called its primary line of sight.

5A.2.1.34 *Working Plane* — A horizontal plane at a level at which work will normally be done *(see* **5A.3.1.3.3** and **5A.3..1.3.4**),

5A.3 LIGHTING

5A.3.1 Principles of Lighting

5A.3.1.1 *Aims of Good Lighting*

Good lighting is necessary for all buildings and has three primary aims. The first aim is to promote work and other activities carried out within the building; the second aim is to promote the safety of the people using the building; and the third aim is to create, in conjunction with the structure and decoration, a pleasing environment conducive to interest of the occupants and a sense of their well-being.

5A.3.1.1.1 *Realization of these aims involves:*

a) careful planning of the brightness and colour pattern within both the working areas and the surroundings so that attention is drawn naturally to the important

areas, detail is seen quickly and accurately and the room is free from any sense of gloom or monotony *(see* **5A.3.1.3**);

b) using directional lighting where appropriate to assist perception of task detail and to give good modeling;

c) controlling direct and reflected glare from light sources to eliminate visual discomfort;

d) in artificial lighting installations, minimizing flicker from certain types of lamps and paying attention to the colour rendering properties of the light;

e) correlating lighting throughout the building to prevent excessive differences between adjacent areas so as to reduce the risk of accidents; and

f) installation of emergency lighting systems, where necessary.

***5A*.3.1.2** *Planning the Brightness Pattern*

The brightness pattern seen within an interior may be considered as composed of three main parts — the task itself, immediate background of the task and the general surroundings of walls, ceiling, floor, equipment and furnishings.

5A.3.1.2.1 In occupations where the visual demands are small, the levels of illumination derived from a criterion of visual performance alone may be too low to satisfy the other requirements. For such situations, therefore, illuminance recommendations are based on standards of welfare, safety and amenity judged appropriate to the occupations; they are also sufficient to give these tasks brightness which ensured that the visual performance exceeds the specified minimum. Unless there are special circumstances associated with the occupation, it is recommended that the illuminance of all working areas within a building should generally be 150 lux, even though the visual demands of the occupation might be satisfied by lower values.

5A.3.1.2.2 Where work takes place over the whole utilizable area of room, the illumination over that area should be reasonably uniform and it is recommended that the uniformity ratio (minimum illuminance divided by average illuminance levels) should be not less than 0.7 for the working area.

5A.3.1.2.3 When the task brightness appropriate to an occupation has been determined, the brightness of the other parts of the room should be planned to give a proper emphasis to visual comfort and interest.

A general guide for the brightness relationship within the normal field of vision should be as follows:

(a) For high task brightness (above 100 cd/m^2)	Maximum
1) Between the visual task and the adjacent areas like table tops	3 to 1
2) Between the visual task and the remote areas of the room	l0 to l

(b) For low and medium task brightness (below 100 cd/m^2): The task should be brighter than both the background and the surroundings; the lower the task brightness, the less critical is the relationship.

5A.3.1.3 *Recommended Values of Illuminance*

Table 1 gives recommended values of illuminance commensurate with the general standards of lighting described in this section and related to many occupations and buildings; These are valid under most of the conditions whether the illumination is by daylighting, artificial lighting or a combination of the two. The great variety of visual tasks makes it impossible to list them all and those given should be regarded as representing types of task.

5A.3.1.3.1 The different locations and tasks are grouped within the following four sections:

a) Industrial buildings and process;

b) Offices, schools and public buildings;

c) Surgeries and hospitals; and

d) Hotels, restaurants, shops and homes.

5A.3.1.3.2 The illumination levels recommended in Table 1 are those to be maintained at all time on the task. As circumstances may be significantly different for different interiors used for the same application or for different conditions for the same kind of activity, a range of illuminances is recommended for each type of interior or activity instead of a single value of illuminance. Each range consists of three successive steps of the recommended scale of illuminances. For working interiors the middle value of each range represents the recommended service illuminance that would be used unless one or more of the factors mentioned below apply.

5A.3.1.3.2.1 The higher value of the range should be used when**:**

a) unusually low reflectances or contrasts are present in the task;

b) errors are costly to rectify;

c) visual work is critical;

d) accuracy or higher productivity is of great importance; and

e) the visual capacity of the worker makes it necessary.

5A.3.1.3.2.2 The lower value of the range may be used when:

a) reflectances or contrast are unusually high;

b) speed and accuracy is not important; and

c) the task is executed only occasionally.

5A.3.1.3.3 Where a visual task is required to be carried out throughout an interior, general illumination level to the recommended value on the working plane is necessary; where the precise height and location of the task are not known or cannot be easily specified, the recommended value is that on horizontal plane 850 mm above floor level.

NOTE — For an industrial task, working plane for the purpose of general illumination levels is that on a work place which is generally 750 mm above the floor level. For certain purposes, such as viewing the objects of arts, the illumination levels recommended are for the vertical plane at which the art pieces are placed.

5A.3.1.3.4 Where the task is localized, the recommended value is that for the task only; it need not, and sometimes should not, be the general level of illumination used throughout the interior. Some processes, such as industrial inspection process, call for lighting of specialized design, in which case the level of illumination is only one of the several factors to be taken into account.

5A.3.1.4 *Glare*

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 scene cannot be perceived. It may be

a) direct glare due to light sources within the 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.

5A.3.1.4.1 An example of glare sources in day lighting is the view of the bright sky through a window or skylight, especially when the surrounding wall or ceiling 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, curtains or other shading devices or by cross lighting the surroundings 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.

5A.3.1.5 *Lighting for Movement about a Building*

Most buildings are complexes of working areas and other areas, such as passages, corridors, stairways, lobbies and entrances. The lighting of all these areas should be properly correlated to give safe movement within the building at all times.

5A.3.1.5.1 *Corridors, passages and stairways*

Accidents may result if people leave a well-lighted working area and pass immediately into corridors or on to stairways where the lighting is inadequate, as the time needed for adaptation to the lower level may be too long to permit obstacles or the threads of stairs to be seen sufficiently quickly.

Table 1: Recommended Values of Illuminance

*(Clauses **5A.3.1.3, 5A.3.1.3.2, 5A.3.3.2** and **5A.3.3.2.1)***

SI No.	Type of Interior or Activity	Range of Service Illuminance in Lux	Quality Class of Direct Glare Limitation	Remarks
(1)	(2)	(3)	(4)	(5)
1	**AGRICULTURE AND HORTICULTURE**			
1.1	Inspection of Farm Product where Colour is Important	300-500-750	1	Local lighting may be appropriate
	Other Important Tasks	200-300-500	2	Local lighting may be appropriate
1.2	Farm Workshops			
1.2.1	General	50-100-150	3	
1.2.2	Workbench or machine	200-300-500	2	Local or portable lighting may be appropriate
1.3	Milk Premises	50-100-150	3	
1.4	Sick Animal Pets, Calf Nurseries	30-50-100	3	
1.5	Other Firm and Horticultural Buildings	20-30-50	3	
2	**COAL MINING (SURFACE BUILDINGS)**			
2.1	Coal Preparation Plant			
2.1.1	Walkways, floors under conveyors	30-50-100	3	
2.1.2	Wagon loading, bunkers	30-50-100	3	
2.1.3	Elevators, chute transfer pits, wash box area	50-100-150	3	
2.1.4	Drum filters, screen, rotating shafts	100-150-200	3	
2.1.5	Picking belts	150-200-300	3	Directional and colour properties of lighting may be important for easy recognition of coal and rock
2.2	Lamp Rooms			
2.2.1	Repair section	200-300-500	2	
2.2.2	Other areas	100-150-200	3	
2.3	Weight Cabins, Fan Houses	100-150-200	3	
2.4	Winding Houses	100-150-200	3	
3	**ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION**			
3.1	General Plant			
3.1.1	Turbine houses (operating floor)	150-200-300	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
3.1.2	Boiler and turbine house basements	50-100-150	3	
3.1.3	Boiler houses, platforms, areas around burners	50-100-150	3	
3.1.4	Switch rooms, meter rooms, oil plant rooms, HV substations (indoor)	100-150-200	2	
3.1.5	Control rooms	200-300-500	1	Localized lighting of control display and the control desks may be appropriate
3.1.6	Relay and telecommunication rooms	200-300-500	2	
3.1.7	Diesel generator rooms, compressor rooms	100-150-200	3	
3.1.8	Pump houses, water treatment plant houses	100-150-200	3	
3.1.9	Battery rooms, chargers, rectifiers	50-100-150	3	
3.1.10	Precipitator chambers, platforms, etc	50-100-150	3	
3.1.11	Cable tunnels and basements, circulating water culverts and screen chambers, storage tanks (indoor), operating areas and filling points at outdoor tanks	30-50-100	3	
3.2	Coal Plant			
3.2.1	Conveyors, gantries, junction towers, unloading hoppers, ash handling plants, settling pits, dust hoppers outlets	50-100-150	3	
3.2.2	Other areas where operators may be in attendance	100-150-200	3	
3.3	Nuclear Plants			
	Gas circulation bays, reactor area, boiler platform, reactor charges and discharge face	100-150-200	2	
4	**METAL MANUFACTURE**			
4.1	Iron Making			
4.1.1	Sinter plant:			
	Plant floor	150-200-300	3	
	mixer drum, fan house, screen houses, coolers transfer stations	100-150-200	3	
4.1.2	Furnaces, cupola:			
	General	100-150-200	3	
	Control platforms	200-300-500	2	Local Lighting may be appropriate
	Conveyor galleries, walkways	30-50-100	3	
4.2	Steel Making			
4.2.1	Electric melting shops	150-200-300	3	
4.2.2	Basic oxygen steel making plants			

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
4.2.2.1	General	100-150-200	3	
4.2.2.2	Convertor floor, teeming bay	150-200-300	3	
4.2.2.3	Control platforms	200-300-500	2	Local Lighting may be appropriate
4.2.2.4	Scrap bays	100-150-200	3	
4.3	Metal Forming and Treatment			
4.3.1	Ingot stripping, soaking pits, annealing and heat treatment bays ,acid recovery plant Picking and cleaning bays, roughing mills, cold mills, finishing mills, tinning and galvanizing lines, cut up and rewind lines	150-200-300	3	
4.3.2	General	100-150-200	3	
4.3.3	Control platforms	200-300-500	2	Local Lighting may be appropriate
4.3.4	Wire mills, product finishing, steel inspection and treatment	200-300-500	3	
4.3.5	Plate/strip inspection	300-500-700	2	
4.3.6	Inspection of tin plate, stainless steel, etc;	-	-	Special lighting to reveal faults in the specular surface of the material will be
4.4	Foundries			
4.4.1	Automatic Plant			
4.4.1.1	Without manual operation	30-50-100	3	
4.4.1.2	With occasional manual operation	100-150-200	3	
4.4.1.3	With continuous manual operation	150-200-300	3	
4.4.1.4	Control room	200-300-500	1	Localized lighting of the control display and the control desks may be appropriate
4.4.1.5	Control platforms	200-300-500	2	
4.4.2	Non-automatic plants			
4.4.2.1	Charging floor, pouring, shaking out, cleaning, grinding fettling	200-300-500	3	
4.4.2.2	Rough moulding, rough core making	200-300-500	3	
4.4.2.3	Fine moulding, fine core making	300-500-750	2	
4.4.2.4	Inspection	300-500-750	2	
4.5	Forges (Severe vibration is likely to occur)			
4.5.1	General	200-300-500	2	
4.5.2	Inspection	300-500-750	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
5	**CERAMICS**			
5.1	Concrete products			
	Mixing, casting, cleaning	150-200-300	3	
5.2	Potteries			
5.2.1	Grinding, moulding, pressing, cleaning, trimming, glazing, firing	200-300-500	3	
5.2.2	Enamelling, colouring	500-750-1000	1	
5.3	Glass Works			
5.3.1	Furnace rooms, bending ,annealing	100-150-200	3	
5.3.2	Mixing rooms, forming, cutting, grinding polishing, toughening	200-300-500	3	
5.3.3	Beveling, decorative cutting, etching, silvering	300-500-750	2	
5.3.4	Inspection	300-500-750	2	
6	**CHEMICALS**			
6.1	Petroleum, Chemical and Petrochemical Works			
6.1.1	Exterior walkways, platforms, stairs and ladders	30-50-100	3	
6.1.2	Exterior pump and valve areas	50-100-150	3	
6.1.3	Pump and compressor houses	100-150-200	3	
6.1.4	Process plant with remote control	30-50-100	3	
6.1.5	Process plant requiring occasional manual intervention	50-100-150	3	
6.1.6	Permanently occupied work stations in process plant	150-200-300	3	
6.1.7	Control rooms for process plant	200-300-500	1	
6.2	Pharmaceutia l Manufacturer and Fine Chemicals Manufacturer			
6.2.1	Pharmaceutical manufacturer Grinding, granulating, mixing, drying, tableting, sterilizing, washing, preparation of solutions, filling, capping, wrapping, hardening	300-500-750	2	
6.2.2	Fine chemical manufacture			
6.2.2.1	Exterior walkways, platforms, stairs and ladders	30-50-100	3	
6.2.2.2	Process plant	50-100-150	3	
6.2.2.3	Fine chemical finishing	300-500-750	2	
6.2.2.4	Inspection	300-500-750	1	Local lighting may be appropriate
6.3	Soap Manufacture			
6.3.1	General area	200-300-500	2	
6.3.2	Automatic processes	100-200-300	2	
6.3.3	Control panels	200-300-500	1	Local lighting may be appropriate
6.3.4	Machines	200-300-500	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
6.4	Paint Works			
6.4.1	General	200-300-500	2	
6.4.2	Automatic processes	150-200-300	2	
6.4.3	Control panels	200-300-500	2	
6.4.4	Special batch mixing	500-750-1000	2	
6.4.5	Colour matching	750-1000-1500	1	
7	**MECHANICAL ENGINEERING**			
7.1	Structural Steel Fabrication			
7.1.1	General	200-300-500	3	
7.1.2	Marking off	300-500-750	3	Local lighting may be appropriate
7.2	Sheet Metal Works			
7.2.1	Pressing, punching, shearing, stamping, spinning, folding	300-500-750	2	
7.2.2	Bench work, scribing, inspection	500-750-1000	2	
7.3	Machine and Tool Shops			
7.3.1	Rough bench and machine work	200-300-500	3	
7.3.2	Medium bench and machine work	300-500-750	2	
7.3.3	Fine bench and machine work	500-750-1000	2	
7.3.4	Gauge rooms	750-1000-1500	1	Optical aids may be required
7.4	Die Sinking Shops			
7.4.1	General	300-500-750	2	
7.4.2	Fine work	1000-1500-2000	1	Flexible local lighting is desirable
7.5	Welding and Soldering Shops			
7.5.1	Gas and arc welding, rough spot welding	200-300-500	3	
7.5.2	Medium soldering, brazing, spot welding	300-500-750	3	
7.5.3	Fine soldering, fine spot welding	750-1000-1500	2	Local lighting is desirable
7.6	Assembly Shops			
7.6.1	Rough work for example, frame and heavy machine assembly	200-300-500	3	The lighting of vertical surface may be important
7.6.2	Medium work, for example, engine assembly, vehicle body assembly	300-500-750	2	
7.6.3	Fine work, for example, office machinery assembly	500-750-1000	1	Localized lighting may be useful
7.6.4	Very fine work, for example, instrument assembly	750-1000-1500	1	Local lighting and optical aids are desirable
7.6.5	Minute work, for example, watch making	1000-1500-2000	1	Local lighting and optical aids are desirable

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
7.7	Inspection and Testing Shops			
7.7.1	Coarse work, for example, using go/no-go gauges, inspection of large sub-assemblies	300-500-750	2	Local or localized lighting may be appropriate
7.7.2	Medium work, for example, inspection of painted surfaces	500-750-1000	1	Local or localized lighting may be appropriate
7.7.3	Fine work, for example, using calibrated scales, inspection of precision mechanisms	750-1000-1500	1	Local or localized lighting may be appropriate
7.7.4	Very fine work, for example, inspection of small intricate parts	1000-1500-2000	1	Local lighting and optical aids are desirable
7.7.5	Minute work, for example, inspection of very small instruments	2000	1	Local lighting and optical aids are desirable
7.8	Paints Shops and Spray Booths			
7.8.1	Dipping, rough spraying	200-300-500	3	
7.8.2	Preparation, ordinary painting, spraying and finishing	200-500-750	2	
7.8.3	Fine painting, spraying and finishing	500-750-1000	2	
7.8.4	Inspection, re-touching and matching	750-1000-1500	2	
7.9	Plating Shops			
7.9.1	Vats and baths	200-300-500	3	
7.9.2	Buffing, polishing burnishing	300-500-750	2	
7.9.3	Final buffing and polishing	500-750-1000	2	
7.9.4	Inspection	-	-	Special light to reveal fault in the surface of the material will be required
8	**ELECTRICAL AND ELECTRONIC ENGINEERING**			
8.1	Electrical Equipment Manufacture			
8.1.1	Manufacture of cables and insulated wires, winding, varnishing and immersion of coils, assembly of large machines, simple assembly work	200-300-500	3	
8.1.2	Medium assembly, for example, telephones, small motors	300-500-750	3	Local lighting may be appropriate
8.1.3	Assembly of precision components, for example, telecommunication equipment, adjustment, inspection and calibration	750-1000-1500	1	Local lighting is desirable. Optical aids may be useful
8.1.4	Assembly of high precision parts	1000-1500-2000	1	Local lighting is desirable. Optical aids may be useful
8.2	Electronic Equipment Manufacture			
8.2.1	Printed circuit board			
8.2.1.1	Silk screening	300-500-750	1	Local lighting may be appropriate
8.2.1.2	Hand insertion of components, soldering	500-750-1000	1	Local lighting may be appropriate

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
8.2.1.3	Inspection	750-1000-1500	1	A large, low luminance luminaire overhead ensures specular reflection conditions which are helpful for inspection of printed circuits
8.2.1.4	Assembly of wiring harness, cleating harness, testing and calibration	500-750-1000	1	Local lighting may be appropriate
8.2.1.5	Chassis assembly	750-1000-1500	1	Local lighting may be appropriate
8.2.2	Inspection and testing			
8.2.2.1	Soak test	150-200-300	2	
8.2.2.2	Safety and functional tests	200-300-500	2	
9	**FOOD, DRINK AND TOBACCO**			
9.1	Slaughter Houses			
9.1.1	General	200-300-500	3	
9.1.2	Inspection	300-500-750	2	
9.2	Canning, Preserving and Freezing			
9.2.1	Grading and sorting of raw materials	500-750-1000	2	Lamp of colour rendering group 1A or 1B will be required, if colour judgement is required
9.2.2	Preparation	300-500-750	3	
9.2.3	Canned and bottled goods			
9.2.3.1	Retorts	200-300-500	3	
9.2.3.2	Automatic processes	150-200-300	3	
9.2.3.3	Labelling and packaging	200-300-500	3	
9.2.4	Frozen foods			
9.2.4.1	Process area	200-300-500	3	
9.2.4.2	Packaging and storage	200-300-500	3	
9.3	Bottling, Brewing and Distilling			
9.3.1	Keg washing and handling, bottle washing	150-200-300	3	
9.3.2	Keg inspection	200-300-500	3	
9.3.3	Bottle inspection	-	-	Special lighting will
9.3.4	Process areas	200-300-500	3	
9.3.5	Bottle filling	500-750-1000	3	
9.4	Edible Oils and Fats Processing			
9.4.1	Refining and blending	200-300-500	3	
9.4.2	Production	300-500-750	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
9.5	Mills-Milling, Filtering and Packing	200-300-500	3	
9.6	Bakeries			
9.6.1	General	200-300-500	2	
9.6.2	Hand decorating, icing	300-500-750	2	
9.7	Chocolate and Confectionery Manufacture			
9.7.1	General	200-300-500	3	
9.7.2	Automatic processes	150-200-300	3	
9.7.3	Hand decoration, inspection, wrapping and packing	300-500-750	2	If accurate colour judgements are required, lamps of colour rendering group 1A or 1B are used
9.8	Tobacco Processing	300-500-750	2	
9.8.1	Material preparation, making and packing	500-750-1000	2	
9.8.2	Hand processes			
10	**TEXTILES**			
10.1	Fibre Preparation			
10.1.1	Bale breaking, washing	200-300-500	3	
10.1.2	Stock dyeing, tinting	200-300-500	3	
10.2	Yarn Manufacture			
10.2.1	Spinning, roving, winding, etc	300-500-750	2	
10.2.2	Healding (drawing in)	750-1000-750	2	
10.3	Fabric Production			
10.3.1	Knitting	300-500-750	2	
10.3.2.	Weaving			
10.3.2.1	Jute and hemp	200-300-500	2	
10.3.2.2	Heavy woolens	300-500-750	1	
10.3.2.3	Medium worsteds, fine woolens, cottons	500-750-1000	1	
10.3.2.4	Fine worsteds, fine linens, synthetics	750-1000-1500	1	
10.3.2.5	Mending	1000-1500-2000	1	
10.3.2.6	Inspection	1000-1500-2000	1	
10.4	Fabric Finishing			
10.4.1	Dyeing	200-300-500	3	
10.4.2	Calendaring, chemical treatment, etc	300-500-750	2	
10.4.3	Inspection			

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
10.4.3.1	'Grey' cloth	750-1000-1500	1	
10.4.3.2	Final	1000-1500-2000	1	
10.5	Carpet Manufacture			
10.5.1	Winding, beaming	200-300-500	3	
10.5.2	Setting pattern, turfing cropping, trimming, fringing, latexing and latex drying	300-500-750	2	
10.5.3	Designing, weaving, mending	500-750-1000	2	
10.5.4	Inspection			
10.5.4.1	General	750-1000-1500	1	Local lighting may be appropriate
10.5.4.2	Peace dyeing	500-750-1000	1	Local lighting may be appropriate
11	**LEATHER INDUSTRY**			
11.1	Leather Manufacture			
11.1.1	Cleaning, tanning and stretching, vats, cutting, fleshing, stuffing	200-300-500	3	
11.1.2	Finishing, scarfing	300-500-750	2	
11.2	Leather Working			
11.2.1	General	200-300-500	3	
11.2.2	Pressing, glazing	300-500-750	2	
11.2.3	Cutting, splitting, scarfing, sewing	500-750-1000	2	Directional lighting may be useful.
11.2.4	Grading, matching		2	Local lighting may be appropriate
12	**CLOTHING AND FOOTWEAR**			
12.1	Clothing Manufacture			
12.1.1	Preparation of cloth	200-300-500	2	
12.1.2	Cutting	500-750-1000	1	
12.1.3	Matching	500-750-1000	1	
12.1.4	Sewing	750-1000-1500	1	
12.1.5	Pressing	300-500-750	2	
12.1.6	Inspection	1000-1500-2000	1	Local lighting may be appropriate
12.1.7	Hand tailoring	1000-1500-2000	1	Local lighting may be appropriate
12.2	Hosiery and Knitwear Manufacture			
12.2.1	Flat bed knitting machines	300-500-750	2	
12.2.2	Circular knitting machines	500-750-1000	2	
12.2.3	Lockstitch and over locking machine	750-1000-1500	1	
12.2.4	Linking or running on	750-1000-1500	1	
12.2.5	Mending, hand finishing	1000-1500-3000	-	Local lighting may be appropriate

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
12.2.6	Inspection	1000-1500-2000	2	Local lighting may be appropriate
12.3	Glove Manufacture			
12.3.1	Sorting and grading	500-750-1000	1	
12.3.2	Pressing, knitting, cutting	300-500-750	2	
12.3.3	Sewing	500-750-1000	2	
12.3.4	Inspection	1000-1500-2000	-	Local lighting may be appropriate
12.4.1	Stiffening, braiding, refining, forming, sizing, pounding ,ironing	200-300-500	2	**12.4.1**
12.4.2	Cleaning, flanging, finishing	300-500-750	2	
12.4.3	Sewing	500-750-1000	2	
12.4.4	Inspection	1000-1500-2000	-	Local lighting may be appropriate
12.5	Boot and Shoe Manufacture			
12.5.1	Leather and synthetics			
12.5.2	Sorting and grading	750-1000-1500	1	
12.5.3	Clicking, closing	750-1000-1500	2	Local or localized lighting may be appropriate
12.5.4	Preparatory operations	750-1000-1500	2	Local or localized lighting may be appropriate
12.5.5	Cutting tables and pressure	1000-1500-2000	1	Local or localized lighting may be appropriate
12.5.6	Bottom stock preparation, lasting, bottoming finishing, shoe rooms	750-1000-1500	1	Local or localized lighting may be appropriate
12.5.7	Rubber			
12.5.7.1	Washing, compounding, coating, drying, varnishing, vulcanizing, calendaring, cutting	200-300-500	3	
12.5.7.2	Lining, making and finishing	300-500-750	2	
13	**TIMBER AND FURNITURE**			
13.1	Sawmills			
13.1.1	General	150-200-300	3	
13.1.2	Head saw	300-500-750	2	Localized lighting may be appropriate
13.1.3	Grading	500-750-1000	2	Directional lighting may be useful
13.2	Woodwork Shops			
13.2.1	Rough sawing, bench work	200-300-500	2	
13.2.2	Sizing, planning, sanding, medium machining and bench work	300-500-750	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
13.2.3	Fine bench and machine work, fine sanding, finishing	500-750-1000	2	Localized lighting may be appropriate
13.3	Furniture Manufacture			
13.3.1	Raw material stores	50-100-150	3	
13.3.2	Finished goods stores	100-150-200	3	
13.3.3	Wood matching and assembly, rough sawing, cutting	200-300-500	2	
13.3.4	Machining, sanding and assembly, polishing	300-500-750	2	Localized lighting may be appropriate
13.3.5	Tool room	300-500-750	2	
13.3.6	Spray booths			
13.3.6.1	Colour finishing	300-500-750	2	
13.3.6.2	Clear finishing	200-300-500	2	
13.3.7	Cabinet making			
13.3.7.1	Veneer sorting and grading	750-1000-1500	1	
13.3.7.2	Marquetry, pressing, patching and fitting	300-500-750	1	
13.3.7.3	Final inspection	500-750-1000	1	Special lighting will be required
13.4	Upholstery Manufacture			
13.4.1	Cloth inspection	1000-1500-2000	1	Special lighting will be required
13.4.2	Filling, covering	300-500-750	2	
13.4.3	Slipping, cutting, sewing	500-750-1000	2	
13.4.4	Mattress making			
13.4.5	Assembly	300-500-750	2	
13.4.6	Tape edging	750-1000-1500	2	Local lighting may be appropriate
14	**PAPER AND PRINTING**			
14.1	Paper Mills			
14.1.1	Pulp mills, preparation plants	200-300-500	3	
14.1.2	Paper and board making			
14.1.2.1	General	200-300-500	3	
14.1.2.2	Automatic process	150-200-300	3	Supplementary lighting may be necessary for maintenance work
14.1.2.3	Inspection, sorting	300-500-750	1	
14.1.3	Paper converting processes			
14.1.3.1	General	200-300-500	3	
14.1.3.2	Associated printing	300-500-750	2	
14.2	Printing Works -			
14.2.1	Type foundries			
14.2.1.1	Matrix making, dressing type, hand and machine coating	200-300-500	3	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
14.2.1.2	Front assembly, sorting	500-750-1000	2	
14.2.2	Composing rooms	-		
14.2.2.1	Hand composing, imposition and distribution	500-750-1000	1	
14.2.2.2	Hot metal keyboard	500-750-1000	1	
14.2.2.3	Hot metal casting	200-300-500	2	
14.2.2.4	Photo composing keyboard or setters	300-500-750	1	
14.2.2.5	Paste up	500-750-1000	1	
14.2.2.6	Illuminated tables-general lighting	200-300-500	-	Dimming may be required
14.2.2.7	Proof presses	300-500-750	2	
14.2.2.8	Proof reading	500-750-1000	1	
14.2.3	Graphic reproduction			
14.2.3.1	General	300-500-750	2	
14.2.3.2	Precision proofing, retouching, etching	750-1000-1500	1	Local lighting may be appropriate
14.2.3.3	Colour reproduction and inspection	750-1000-1500	1	
14.2.4	Printing machine room			
14.2.4.1	Presses	300-500-750	2	
14.2.4.2	Premake ready	300-500-750	2	
14.2.4.3	Printed sheet inspection	750-1000-1500	1	
14.2.5	Binding			
14.2.5.1	Folding, pasting, punching and stitching	300-500-750	2	
14.2.5.2	Cutting, assembling, embossing	500-750-1000	2	
15	**PLASTIC AND RUBBER**			
15.1	Plastic Products			
15.1.1	Automatic plant			
15.1.1.1	Without manual control	30-50-100	3	
15.1.1.2	With occasional manual control	50-100-150	3	
15.1.1.3	With continuous manual control	200-300-500	3	
15.1.1.4	Control rooms	200-300-500	1	
15.1.1.5	Control platforms	200-300-500	2	
15.1.2	Non-automatic plant			
15.1.2.1	Mixing, calendaring, extrusion, injection, compression and blow moulding, sheet fabrication	200-300-500	3	
15.1.2.2	Trimming, cutting, polishing, cementing	300-500-750	2	
15.1.2.3	Printing, inspection	750-1000-1500	1	
15.2	Rubber Products			
15.2.1	Stock preparation — plasticizing, milling	150-200-300	3	
15.2.2	Calendaring, fabric preparation, stock-cutting	300-500-750	3	
15.2.3	Extruding, moulding	300-500-750	2	
15.2.4	Inspection	750-1000-1500	-	
16	**DISTRIBUTION AND STORAGE**			

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
16.1	Work Stores	100-150-200	3	Avoid glare to drivers of vehicles approaching the loading bay
16.1.1	Unpacking, sorting	150-200-300	3	bay Avoid glare to drivers of vehicles approaching the loading bay
16.1.2	Large item storage	50-100-150	3	Avoid glare to drivers of vehicles approaching the loading bay
16.1.3	Small item rack storage	200-300-500	3	Avoid glare to drivers of vehicles approaching the loading bay
16.1.4	Issue counter, records, storeman's desk	300-500-750	2	Local or localized lighting may be appropriate
16.2	Warehouses and Bulk Stores			
16.2.1	Storage of goods where indentification requires only limited preparation of detail	50-100-150	3	
16.2.2	Storage of goods where indentificiation requires perception of details	100-150-200	3	
16.2.3	Automatic high bay rack stores			
16.2.3.1	Gangway	20	-	
16.2.3.2	Control station	150-200-300	3	
16.2.3.3	Packing and dispatch	200-300-500	3	
16.2.3.4	Loading bays	100-150-200	3	Avoid glare to drivers of vehicles approaching the loading bay
16.3	Cold Stores			
16.3.1	General	200-300-500	3	
16.3.2	Breakdown, make-up and dispatch	200-300-500	3	
16.3.3	Loading bays	100-150-200	3	Avoid glare to drivers of vehicles approaching the loading bay
17	**COMMERCE**			
17.1	Offices			
17.1.1	General offices	300-500-750	1	
17.1.2	Deep plan general offices	500-750-1000	1	
17.1.3	Computer work stations	300-500-750	1	
17.1.4	Conference rooms, executive offices	300-500-750	1	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
17.1.5	Computer and data preparation rooms	300-500-750	1	
17.1.6	Filing rooms	200-300-500	1	
17.2	Drawing Offices			
17.2.1	General	300-500-750	1	
17.2.2	Drawing boards	500-750-1000	1	
17.2.3	Computer aided design and drafting	-	-	Special lighting is required
17.2.4	Print rooms	200-300-500	1	
17.3	Banks and Building Societies			
17.3.1	Counter, office area	300-500-750	1	
17.3.2	Public area	200-300-500	1	
18	**SERVICES**			
18.1	Garages			
18.1.1	Interior parking areas	20-30-50	3	
18.1.2	General repairs, servicing, washing, polishing	200-300-500	2	
18.1.3	Workbench	300-500-750	1	Local or localized lighting may be appropriate
18.1.4	Spray booths	300-500-750	1	
18.1.5	External apron			
18.1.5.1	General	30-50-100	-	Care should be taken to avoid glare to drivers and Neighbouring residents
18.1.5.2	Pump area (retail sales)	200-300-500	-	See ‘ Retailing
18.2	Appliance servicing			
18.2.1	Workshop			
18.2.1.1	General	200-300-500	2	
18.2.1.2	Workbench	300-500-750	2	Localized lighting may be appropriate
18.2.1.3	Counter	200-300-500	2	Localized lighting may be Appropriate
18.2.1.4	Stores	200-300-500	3	
18.3	Laundries			
18.3.1	Commercial laundries			
18.3.2	Receiving, sorting, washing, drying, ironing, despatch, dry-cleaning, bulk machine work	200-300-500	3	
18.3.3	Head ironing, pressing, mending, spotting, inspection	300-500-750	3	
18.3.4	Launderettes	200-300-500	3	
18.4	Sewage Treatment Works			
18.4.1	Walkways	30-50-100	3	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
18.4.2	Process areas	50-100-150	3	
19	**RETAILING**			
19.1	Small Shops with Counters	300-500-750	1	The service illuminance should be provided on the horizontal plane of the counter. Where wall displays are used, a similar illuminance on the walls is desirable
19.2	Small Self-Service Shops with Island Displays	300-500-750	1	
19.3	Super Markets, Hyper-Markets			
19.3.1	General	300-500-750	2	
19.3.2	Checkout	300-500-750	2	
19.3.3	Showroom for large objects, for example, cars, furniture	300-500-750	1	
19.3.4	Shopping precincts and arcades	100-150-200	2	
20	**PLACES OF PUBLIC ASSEMBLY**			
20.1	Public Rooms, Village Halls, Worship Halls	200-300-500	1	
20.2	Concert Halls, Cinemas and Theatres			
20.2.1	Foyer	150-200-300	-	
20.2.2	Booking office	200-300-500	-	Local or localized lighting may be appropriate
20.2.3	Auditorium	50-100-150	-	Dimming facilities will be necessary. Special lighting of the aisles is desirable
20.2.4	Dressing rooms	200-300-500	-	Special mirror lighting for make-up may be required
20.2.5	Projection room	100-150-200	-	
20.3	Churches			
20.3.1	Body of church	100-150-200	2	
20.3.2	Pulpit, lectern	200-300-500	2	Use local lighting
20.3.3	Choir stalls	200-300-500	2	Local lighting may be appropriate
20.3.4	Alter, communion table, chancel	100-150-200	2	Additional lighting to provide emphasis is desirable
20.3.5	Vestries	100-150-200	2	
20.3.6	Organ	200-300-500	-	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
20.4	Hospitals			
20.4.1	Anaesthetic rooms			
20.4.1.1	General	200-300-500	-	
20.4.1.2	Local	750-1000-1500	-	
20.4.2	Consulting areas			
20.4.2.1	General	200-300-500	-	
20.4.2.2	Examination	750-1000-1500	-	
20.4.3	Corridors			
20.4.3.1	General	100-150-200	-	
20.4.4	Ward corridors		-	
20.4.4.1	Day, screened from bays	150-200-300	-	
20.4.4.2	Day, open to natural light	150-200-300 (total)		
20.4.4.3	Morning/Evening	100-150-200	-	
20.4.4.4	Night	5-10	-	
20.4.5	Cubicles			
20.4.5.1	General	200-300-500	-	
20.4.5.2	Treatment	750-1000-1500	-	
20.4.6	Examination			
20.4.6.1	General	200-300-500	-	
20.4.6.2	Local inspection	750-1000-1500	-	
20.4.7	Intensive therapy			
20.4.7.1	Bad head	30-50	-	
20.4.7.2	Circulation between bed ends	50-100-150	-	
20.4.7.3	Observation	200-300-500	-	
20.4.7.4	Local observation	750-1000-1500	-	
20.4.7.5	Staff base (day)	200-300-500	-	
20.4.7.6	Staff base (night)	30	-	
20.4.8	Laboratories			
20.4.8.1	General	200-300-500	-	
20.4.8.2	Examination	300-500-750	-	
20.4.9	Nurses' stations			
20.4.9.1	Morning/day/evening	200-300-500	-	
20.4.9.2	Night desks	30	-	
20.4.9.3	Night, medical trolleys	50-100-150	-	
20.4.10	Operating theatres			
20.4.10.1	General	300-500-750	-	
20.4.10.2	Local	10000 to 50000	-	Special operating lights are used
20.4.11	Pathology departments			
20.4.11.1	General	200-300-500	-	
20.4.11.2	Examination	300-500-750	-	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
20.4.11.3	Pharmacies	200-300-500	-	
20.4.11.4	Reception/enquiry	200-300-500	-	
20.4.11.5	Recovery rooms	200-300-500	-	
20.4.12	Ward-circulation			
20.4.12.1	Day	50-100-150	-	
20.4.12.2	Morning/Evening	50-100-150	-	
20.4.12.3	Night	3-5	-	
20.4.13	Ward-bed head			
20.4.13.1	Morning/Evening	30-50		
20.4.13.2	Reading	100-150-200		
20.4.14	Night			
20.4.14.1	Adult	0.1-1		
20.4.14.2	Pediatric	1		
20.4.14.3	Psychiatric	1-5		
20.4.14.4	Watch	5		
20.4.15	X-Ray areas			
20.4.15.1	General	150-200-300		
20.4.15.2	Diagnostic	150-200-300		
20.4.15.3	Operative	200-300-500		
20.4.15.4	Process dark room	50		
20.4.16	Surgeries			
20.4.16.1	General	200-300-500	-	
20.4.16.2	Waiting rooms	100-150-200	-	
20.4.17	Dental surgeries			
20.4.17.1	Chair	Special lighting	-	
20.4.17.2	Laboratories	300-500-750	-	
20.4.18	Consulting rooms			
20.4.18.1	General	200-300-500	-	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
20.4.18.2	Desk	300-500-750	-	
20.4.18.3	Examination couch	300-500-750	-	
20.4.18.4	Ophthalmic wall and near-vision charts	300-500-750	-	
20.5	Hotels			
20.5.1	Entrance halls	50-100-150		
20.5.2	Reception, cashier's and porters' desks	200-300-500		Localized lighting may be appropriate
20.5.3	Bars, coffee base, dining rooms, grill rooms, restaurants, lounges	50-200		The lighting should be designed to create an appropriate atmosphere
20.5.4	Cloak rooms, baggage rooms	50-100-150	3	
20.5.5	Bed rooms	30-50-100	-	Supplementary local lighting at the bed head, writing table should be provided
20.5.6	Bathroom	50-100-150		Supplementary local lighting near the mirror is desirable
20.5.7	Food preparation and stores, cellars, lifts and corridors	-	-	
20.6	Libraries			
20.6.1	Lending library			
20.6.1.1	General	200-300-500	1	
20.6.1.2	Counters	300-500-750	1	Localized lighting may be appropriate
20.6.1.3	Bookshelves	100-150-200	2	The service illuminance should be provided on the vertical face at the bottom of the bookshelves.
20.6.1.4	Reading rooms	200-300-500	1	
20.6.1.5	Reading tables	200-300-500	1	Localized lighting may be appropriate
20.6.2	Catalogues			
20.6.2.1	Card	100-150-200	2	
20.6.2.2	Microfiche/Visual display units	100-150-200	2	
20.6.3	Reference libraries			
20.6.3.1	General	200-300-500	1	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
20.6.3.2	Counters	300-500-750	1	Localized lighting may be appropriate
20.6.3.3	Bookshelves	100-150-200	2	The service illuminance should be provided on the vertical face at the bottom of the bookshelves.
20.6.3.4	Study tables, carrels	300-500-750	1	
20.6.3.5	Map room	200-300-500	1	
20.6.4	Display and exhibition areas			
20.6.4.1	Exhibits insensitive to light	200-300-500	-	
20.6.4.2	Exhibit sensitive to light, for example, pictures, prints, rare books in archives	50 to 150	-	
20.6.5	Library workrooms			
20.6.5.1	Book repair and binding	300-500-750	2	
20.6.5.2	Catalogue and sorting	300-500-720	2	
20.6.5.3	Remote book stores	100-150-200	3	
20.7	Museums and Art Galleries			
20.7.1	Exhibits insensitive to light	200-300-500	-	
20.7.2	Light sensitive exhibits, for example, oil and temper paints, undyed leather, bone, ivory, wood, etc	150	-	This is a maximum illuminance to be provided on the principal plane of the exhibit
20.7.3	Extremely light sensitive exhibits, for example, textiles, water colours, prints and drawings, skins, botanical specimens, etc	50	-	This is the maximum illuminance to be provided on the principal plane of the object
20.7.4	Conservation studies and workshops	300-500-750	1	
20.8	Sports Facilities			
	Multi-purpose sports halls	300-750	-	This lighting system should be sufficiently flexible to provide lighting suitable for the variety of sports and activities that take place in sports halls. Higher illuminance of 1000-2000 lux would be required for television coverage

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
21	**EDUCATION**			
21.1	Assembly Halls			
21.1.1	General	200-300-500	3	
21.1.2	Platform and stage	-	-	Special lighting to provide emphasis and to facilitate the use of the platform/ stage is desirable
21.2	Teaching Spaces			
	General	200-300-500	1	
21.3	Lecture Theatres			
21.3.1	General	200-300-500	1	
21.3.2	Demonstration benches	300-500-750	1	Localized lighting may be appropriate
21.4	Seminar Rooms	300-500-750	1	
21.5	Art Rooms	300-500-750	1	
21.6	Needlework Rooms	300-500-750	1	
21.7	Laboratories	300-500-750	1	
21.8	Libraries	200-300-500	1	
21.9	Music Rooms	200-300-500	1	
21.10	Sports Halls	200-300-500	1	
21.11	Workshops	200-300-500	1	
22	**TRANSPORT**			
22.1	Airports			
22.1.1	Ticket counters, checking desks, and information desks	300-500-750	2	Localized lighting may be appropriate
22.1.2	Departure lounges, other waiting areas	150-200-300	2	
22.1.3	Baggage reclaim	150-200-300	2	
22.1.4	Baggage handling	50-100-150	2	
22.1.5	Customs and immigration halls	300-500-750	2	
22.1.6	Concourse	150-200-300	2	
22.2	Railway Stations			
22.2.1	Ticket office	300-500-750	2	Localized lighting may be appropriate
22.2.2	Information office	300-500-750	2	Localized lighting over the counter may be appropriate
22.2.3	Parcels office, left			
22.2.4	Luggage office			
22.2.4.1	General	50-100-150	2	
22.2.4.2	Counter	150-200-300	2	
22.2.5	Waiting rooms	150-200-300	2	
22.2.6	Concourse	150-200-300	2	
22.2.7	Time table	150-200-300	2	Localized lighting may be appropriate
22.2.8	Ticket barriers	150-200-300	2	Localized lighting may be appropriate

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
22.2.9	Platforms (covered)	30-50-100	2	Care should be taken to light and mark the edge of the platform clearly
22.2.10	Platforms (open)	20	-	Care should be taken to light and mark the edge of the platform clearly
22.3	Coach Stations			
22.3.1	Ticket offices	300-500-750	2	Localized lighting over the counter may be appropriate
22.3.2	Information offices	300-500-750	2	Localized lighting over the counter may be appropriate
22.3.3	Left luggage office			
22.3.3.1	General	50-100-150	3	
22.3.3.2	Counter	150-200-300	3	Localized lighting is appropriate
22.3.4	Waiting rooms	150-200-300	2	
22.3.5	Concourse	150-200-300	2	
22.3.6	Time tables	150-200-300	2	Localized lighting is appropriate
22.3.7	Loading areas	100-150-200	3	
23	**GENERAL BUILDING AREAS**			
23.1	Entrance			
23.1.1	Entrance halls, lobbies, waiting rooms	150-200-300	2	
23.1.2	Enquiry desks	300-500-750	2	Localized lighting may be appropriate
23.1.3	Gatehouses	150-200-300	2	
23.2	Circulation Areas			
23.2.1	Lifts	50-100-150	-	
23.2.2	Corridors, passageways, stairs	50-100-150	2	
23.2.3	Escalators, travellators	100-150-200	-	
23.3	Medical and First Aid Centre			
23.3.1	Consulting rooms, treatment rooms	300-500-750	1	
23.3.2	Rest rooms	100-150-200	1	
23.3.3	Medical stores	100-150-200	2	
23.4	Staff Rooms			
23.4.1	Changing, locker and cleaners rooms, cloakrooms, lavatories	50-100-150	-	
23.4.2	Rest room	100-150-200	1	
23.5	Staff Restaurants			
23.5.1	Canteens, cafeterias, dining rooms, mess rooms	150-200-300	2	

Table 1- *Continued*

(1)	(2)	(3)	(4)	(5)
23.5.2	Servery, vegetable preparation, washing-up area	200-300-500	2	
23.5.3	Food preparation and cooking	300-500-750	2	
23.5.4	Food stores, cellars	100-150-200	2	
23.6	Communications			
23.6.1	Switchboard rooms	200-300-500	2	
23.6.2	Telephone apparatus rooms	100-150-200	2	
23.6.3	Telex room, post room	300-500-750	2	
23.6.4	Reprographic room	200-300-500	2	
23.7	Building Services			
23.7.1	Boiler houses			
23.7.1.1	General	50-100-150	3	
23.7.1.2	Boiler front	100-150-200	3	
23.7.1.3	Boiler control room	200-300-500	2	Localized lighting of the control display and the control desk may be appropriate
23.7.1.4	Control rooms	200-300-500	2	Localized lighting of the control display and the control desk may be appropriate
23.7.1.5	Mechanical plant room	100-150-200	2	
23.7.1.6	Electrical power supply and distribution rooms	100-150-200	2	
23.7.1.7	Store rooms	50-100-150	3	
23.8	Car Parks			
23.8.1	Covered car parks			
23.8.1.1	Floors	5-20	-	
23.8.1.2	Ramps and corners	30	-	
23.8.1.3	Entrances and exits	50-100-150	-	
23.8.1.4	Control booths	150-200-300		
23.8.1.5	Outdoor car parks	5-20		

For the same reason, it is desirable that the illumination level of rooms which open off a working area should be fairly high even though the rooms may be used only occasionally**.**

It is important, when lighting stairways, to prevent disability from glare caused by direct sight of bright sources to emphasize the edges of the treads and to avoid confusing shadows. The same precautions should be taken in the lighting of cat-walks and stairways on outdoor industrial plants.

5A.3.1.5.2 Entrances

The problems of correctly grading the lighting within a building to allow adequate time for adaptation when passing from one area to another area are particularly acute at building entrances. These are given below:

a) By day, people entering a building will be adapted to the very high levels of brightness usually present outdoors and there is risk of accident if entrance areas, particularly any steps, are poorly lighted. This problem may often be overcome

by arranging windows to give adequate natural lighting at the immediate entrance, grading to lower levels further inside the entrance area. Where this cannot be done, supplementary artificial lighting should be installed to raise the level of illumination to an appropriate value.

b) At night it is desirable to light entrance halls and lobbies so that the illumination level reduces towards the exit and so that no bright fittings are in the line of sight of people leaving the building. Any entrance steps to the building should be well-lighted by correctly screened fittings.

5A.3.1.6 For detailed information regarding principles of good lighting, reference may be made to standard practice [(1) IS 3646].

5A.3.2 Artificial Lighting

5A.3.2.1 Artificial lighting may have to be provided

a) where the recommended illumination levels have to be obtained by artificial lighting only,

b) to supplement daylighting when the level of illumination falls below the recommended

value, and

c) where visual task may demand a higher level of illumination.

5A.3.2.2 *Artificial Lighting Design for Interiors*

For general lighting purposes, the recommended practice is to design for a level of illumination on the working plane on the basis of the recommended levels for visual tasks given in Table 1 by a method called 'Lumen method'. In order to make the necessary detailed calculations concerning the type and quantity of lighting equipment necessary, advance information on the surface reflectances of walls, ceilings and floors is required. Similarly, calculations concerning the brightness ratio in the interior call for details of the interior decor and furnishing. Stepwise guidance regarding designing the interior lighting systems for a building using the 'Lumen method' is given in **5A.3.2.2.1** to **5A.3.2.2.4.**

5A.3.2.2.1 *Determination of the illumination level*

Recommended value of illumination shall be taken from Table 1, depending upon the type of work to be carried out in the location in question and the visual tasks involved.

5A.3.2.2.2 *Selection of the light sources and luminous*

The selection of light sources and luminaires depends on the choice of lighting system, namely, general lighting, directional lighting and localized or local lighting.

5A.3.2.2.3 *Determination of the luminous flux*

a) The luminous flux ($Ø$) reaching the working plane depends upon the following:

1) lumen output of the lamps,

2) type of luminaire,

3) proportion of the room (room index) (k_r),

4) reflectance of internal surfaces of the room,

5) depreciation in the lumen output of the lamps after burning their rated life, and

6) depreciation due to dirt collection on luminous and room surface**.**

b) *Coefficient of Utilization or Utilization Factor*

1) The compilation of tables for the utilization factor requires a considerable amount of calculations, especially if these tables have to cover a wide range of lighting practices. For every luminaire, the exact light distribution has to be measured in the laboratory and their efficiencies have to be calculated and measured exactly. These measurements comprise:

(i) the luminous flux radiated by the luminaires directly to the measuring surface,

(ii) the luminous flux reflected and re- reflected by the ceiling and the walls to the measuring surface, and

(iii) the inter-reflections between the ceiling and wall which result in the measuring surface receiving additional luminous flux.

All these measurements have to be made for different reflection factors of the ceiling and the walls for all necessary room indices. These tables have also to indicate the maintenance factor to be taken for the luminous flux depreciation throughout the life of an installation due to ageing of the lamp and owing to the deposition of dirt on the lamps and luminaires and room surfaces.

2) The values of the reflection factor of the ceiling and of the wall are as follows:

White and very light colours	0.7
Light colours	0.5
Middle tints	0.3
Dark colours	0.1

For the walls, taking into account the influence of the windows without curtains, shelves, almirahs and doors with different colours, etc, should be estimated,

c) Calculation for determining the luminous flux

$$E_{av} = \frac{\phi}{A}$$

or, $$\varphi = \frac{E_{av} A}{\mu}$$ for new condition

and $$\varphi = \frac{E_{av} A}{\mu d}$$ for working condition

where

ϕ = Total luminous flux of the light sources installed in the room in lumens;

E_{av} = Average illumination level required on the working plane in lux;

A = Area of the working plane in m^2;

= the utilization factor in new conditions; and

d = maintenance factor.

In practice, it is easier to calculate straightaway the number of lamps or luminaires from:

$$N_{\text{lamp}} = \frac{E_{av}\ A}{\mu\ d\ \phi_{\text{lamp}}}$$

$$N_{\text{luminaires}} = \frac{E_{av}\ A}{\mu\ d\ \phi_{\text{luminaires}}}$$

where

ϕ_{lamp} = Luminous flux of each lamp in lumens,

$\phi_{\text{luminaires}}$ = Luminous flux of each luminaire in lumens,

N_{lamp} = Total number of lamps, and

$N_{\text{luminaires}}$ = Total number of luminaires

5A.3.2.2.4 *Arrangement of the luminaires*

This is done to achieve better uniformly distributed illumination. The location of the luminaires has an important effect on the utilization factor.

a) In general, luminaires are spaced 'a' metre apart in either direction, while the distance of the end luminaire from the wall is ' ½*a*' metre. The distance '*a*' is more or less equal to the mounting height *'H_m'* between the luminaire and the working plane. The utilization factor tables are calculated for this arrangement of luminaires.

b) For small rooms where the room index (k_r) is less than 1, the distance '*a*' should always be less than H_m since otherwise luminaires cannot be properly located. In most cases of such rooms, four or two luminaires are placed for good general lighting. If, however, in such rooms only one luminaire is installed in the middle, higher utilization factors are obtained, but the uniformity of distribution is poor. For such cases, references should be made to the additional tables for k_r = 0.6 to 1.25 for luminaires located centrally.

5A.3.2.3 *Artificial Lighting to Supplement Day lighting*

5A.3.2.3.1 The need for general supplementary artificial lighting arises due to diminution of daylighting beyond design hours, that is, for solar altitude below 15° or when dark cloudy conditions occur.

5A.3.2.3.2 The need may also arise for providing artificial lighting during the day in the innermost parts of the building which cannot be adequately provided with daylighting, or when the outside windows are not of adequate size or when there are unavoidable external obstructions to the incoming day lighting.

5A.3.2.3.3 The need for supplementary lighting during the day arises, particularly when the daylighting on the working plane falls below 100 lux and the surrounding luminance drops below 19 cd/m² .

5A.3.2.3.4 The requirement of supplementary artificial lighting increases with the *decrease* in day lighting availability. Therefore, conditions near sunset or sunrise or equivalent conditions due to clouds or obstructions, etc, represent the worst conditions when the supplementary lighting is most needed.

5A.3.2.3.5 The requirement of supplementary artificial lighting when day lighting availability becomes poor may be determined from Fig. 2 for an assumed ceiling height of 3.0 m, depending upon floor area, fenestration percentage and room surface reflectance.

Cool daylight fluorescent tubes are recommended with semi-direct luminaires. To ensure a good distribution of illumination, the mounting height should be between 1.5 m and 2.0 m above the work plane for a separation of 2.0 m to 3.0 m between the luminaires. Also the number of lamps should preferably be more in the rear half of the room than in the vicinity of windows. The following steps may be followed for using Fig. 2 for determining the number of fluorescent tubes required for supplementary day lighting.

a) Determine fenestration percentage of the floor area, that is,

$$\frac{Window\ Area}{Floor\ Area} \times 100$$

b) In Figure 2, refer to the curve corresponding to the percent fenestration determined above and the set of reflectances of ceiling, walls and floor actually provided.

c) For the referred curve of Figure 2 read, along the ordinate, the number of 40 W fluorescent tubes required, corresponding to the given floor area on the abscissa.

5A.3.2.4 For detailed information on the design aspects and principles of artificial lighting, reference may be made to standard practice [(1) IS 3646].

5A.3.2.5 For specific requirements for lighting of special occupancies and areas, reference may be made to Standard practice [(2) IS 1944].

5A.3.2.6 Electrical installation aspect for artificial lighting shall be in accordance with Part 5B 'Building Services, Electrical and Allied Installations'.

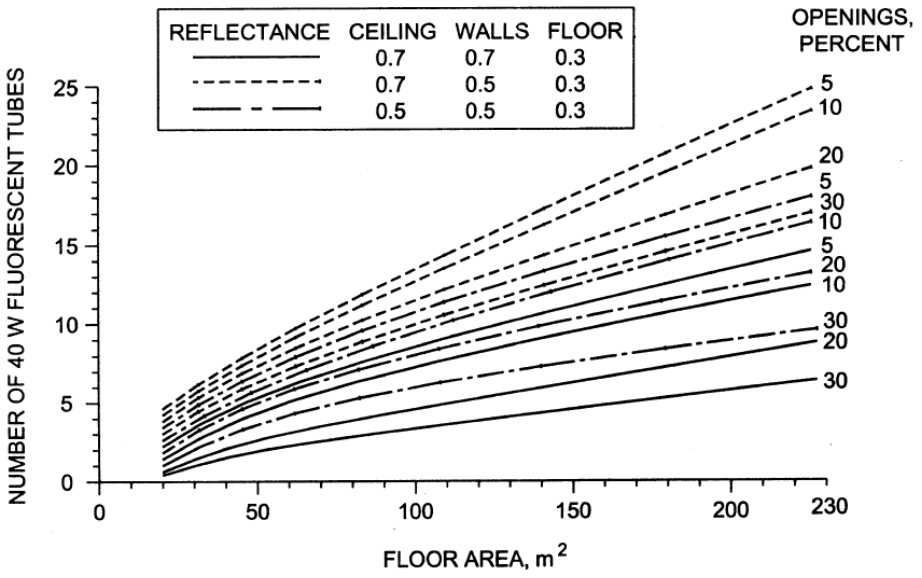

Figure 2: Supplementary Artificial Lighting for 40W Fluorescent Tubes

5A.3.3 Energy Conservation in Lighting

5A.3.3.1 A substantial portion of the energy consumed on lighting may be saved by utilization of daylight and rational design of supplementary artificial lights.

5A.3.3.2 Daytime use of artificial lights may be minimized by proper design of windows for adequate daylight indoors.

5A.3.3.3 Fenestration expressed as percentage of floor area required for satisfactory visual performance of a few tasks for different separation to height *(S/H)* ratio of external obstructions such as opposite buildings may be obtained from the design nomograph (Figure 3). The obstructions at a distance of three times their height or more *(S/H*> 3) from a window facade are not significant and a window facing such an obstruction may be regarded as a case of unobstructed window.

5A.3.3.3.1 The nomograph consists of horizontal lines indicating fenestration percentage of floor area and vertical lines indicating the separation to height ratio of external obstructions such as opposite buildings. Any vertical line for separation to height ratio other than already shown in the nomograph (1.0,2.0 and 3.0) may be drawn by designer, if required. For cases where there is no obstruction, the ordinate corresponding to the value 3.0 may be used. The value of percentage fenestration and separation to height ratio are marked on left hand ordinate and abscissa respectively. The illumination levels are marked on the right hand ordinate. The values given within brackets are the illumination levels on the work plane at centre and rear of the room. The wattage of fluorescent tubes required per square metre of the floor area for different illumination levels is shown on each curve.

5A.3.3.3.2 Following assumptions have been made in the construction of the nomograph:

a) An average interior finish with ceiling white, walls off white and floor grey has been assumed.

b) Ceiling height of 3 m and room depths up to 10 m and floor area between 30 m^2 and 50 m^2 have been assumed. For floor area beyond 50 m^2 and less than 30 m^2, the values of percent fenestration as well as wattage per m^2 should be multiplied by a factor of 0.85 and 1.15 respectively.

c) It is assumed that windows are of metallic sashes with louvers of width up to 600 mm or a *CHHAJJA* (balcony projection) at ceiling level of width up to 2.0 m. For wooden sashes, the window area should be increased by a factor of about 1.1.

d) Luminaires emanating more light in the downward direction than upward direction (such as reflectors with or without diffusing plastics) and mounted at a height of 1.5 m to 2.0 m above the work plane have been considered.

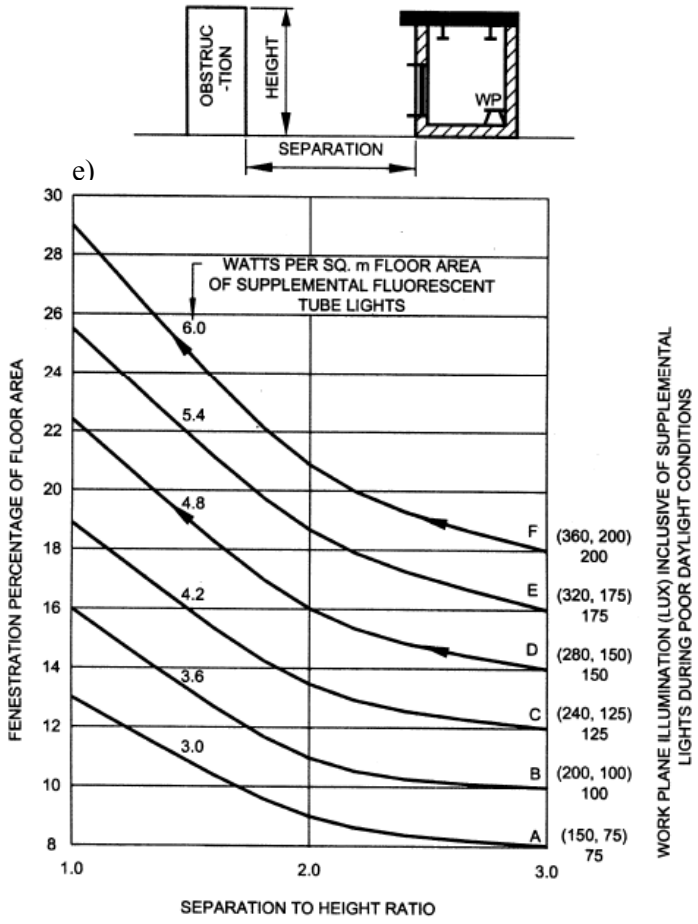

Figure 3: Nomograph for Daylighting and Suplemental Lighting Design of Building

5A.3.3.3.3 *Method of use*

The following steps shall be followed for the use of nomograph:

a) *Step 1* — Decide the desired illumination level depending upon the task illumination requirement in the proposed room and read the value of watts per square metre on the curve corresponding to the required illumination level.

b) *Step 2* — Fix the vertical line corresponding to the given separation to height ratio of opposite buildings on the abscissa. From the point of intersection of this vertical line and the above curve move along horizontal, and read the value of fenestration percent on the left hand ordinate.

c) *Step 3* — If the floor area is greater than 50 m^2 and less than 30 m^2, the value of watts per square metre as well as fenestration percent may be easily determined for adequate day lighting and supplemental artificial lighting for design purposes. However, if the fenestration provided is less than the required value, the wattage of supplementary artificial lights should be increased proportionately to make up for the deficiency of natural illumination.

5A.3.3.4 For good distribution of day light on the working plane in a room, window height, window width and height of sill should be chosen in accordance with the following recommendations**:**

a) In office buildings windows of height 1.2 m or more in the center of a bay with sill level at 1.0 to 1.2 m above floor and in residential buildings windows of height 1.0 m to 1.1 m with sill height as 0.9 m to 0.7 m above floor are recommended for good distribution of daylight indoors. Window width can accordingly be adjusted depending upon the required fenestration percentage of the floor area.

b) If the room depth is more than 10 m, windows should be provided on opposite sides for bilateral lighting.

c) It is desirable to have a white finish for ceiling and off white (light colour) to white for walls. There is about 7 percent improvement in lighting levels in changing the finish of walls from moderate to white.

5A.3.3.5 For good distribution and integration of daylight with artificial lights the following guidelines are recommended**:**

a) Employ cool daylight fluorescent tubes for supplementary artificial lighting.

b) Distribute luminaries with a separation of 2 m to 3 m in each bay of 3 m to 4 m width.

c) Provide more supplementary lights such as twin tube luminaries in work areas where daylight is expected to be poor for example in the rear region of a room having single window and in the central region of a room having windows on opposite walls. In the vicinity of windows only single tube luminaries should be provided.

5A.3.3.6 *Artificial Lighting*

Energy conservation in lighting is affected by reducing wastage and using energy effective lamps and luminaires without sacrificing lighting quality. Measures to be followed comprise utilization of daylight, energy effective artificial lighting design by providing required illumination where needed, turning off artificial lights when not needed, maintaining lighter finishes of ceiling, walls and furnishings, and implementing periodic schedule for cleaning of luminaires and group replacement of lamps at suitable intervals. Choice of light sources with higher luminous efficacy and luminaires with appropriate light distribution is the most effective means of energy saving in lighting. However, choice of light sources also depends on the other lighting quality parameters like colour rendering index and colour temperature or appearance. For example, high pressure sodium vapour lamps, which have very high luminous efficacy, are not suitable for commercial interiors because of poor colour rendering index and colour appearance, but are highly desirable in heavy industries. Also the choice of light sources depends on the mounting height in the interiors. For example, fluorescent lamps are not preferred for mounting beyond 7 m height, when high pressure gas discharge lamps are preferred because of better optical control due to their compact size.

5A.3.3.6.1 *Efficient artificial light sources and luminaires*

Luminous efficacy of some of the lamps used in lighting of buildings are given in **Table 2** along with average life in burning hours, Colour Rendering Index and Colour Temperature.

Table 2: Luminous Efficacy, Life, CRI and CCT of Light Sources

*(Clause **5A.3.4.6.1**)*

SI No.	**Light Source**	**Efficacy** lm/W	**Average Life** h	**CRI**	**CCT**
(1)	(2)	(3)	(4)	(5)	(6)
i)	Incandescent Lamps GLS 25 W-1 000W	8-18	1 000	100	2 800
ii)	Tungsten halogen incandescent lamps Mains-voltage types: Low-voltage types with reflector have lower wattages	10% higher than comparable GLS lamp	2 000	100	2 800-3 200
iii)	Fluorescent Lamps (FTL) a) Standard Lamps 38 mm (T12) 20W-65 W 26mm (T8) 18W-58W Cool daylight Warm white b) Tri-Phosper lamps 38mm (T12) 20W-65W 26mm (T8) 18W-58W	 61 67 88-104	 5 000 5 000 12 000-18 000	 72 77 85-95	 6 500 3 500 2 700-6 500
iv)	Compact Fluorescent Lamps (CFL) 5W-25W	40-80	8 000	Similar to FTL	
v)	High pressure mercury vapour lamps 80W-400W	36-60	5 000	45	4 000
vi)	Blended __ Light Lamps MLL 100W-500W	11-26	5 000	61	3 600
vii)	High Pressure Sodium Vapour Lamps 50W-1 000W	69-130	10 000-15 000	23	2 000
viii)	Metal halide lamps 35W-2 000W	69-83	10 000	68-92	3 000-5 600

NOTES

1 The table includes lamps and wattages currently in use in buildings in India.

2 Luminous efficacy varies with the wattage of the lamp.

3 Average life values are from available Indian Standards. Where Indian Standard is not available, values given are only indicative.

4 CRI and CCT values are only indicative.

5 For exact values, it is advisable to contact manufacturers.

Following recommendations may be followed in the choice of light sources for different locations:

a) For supplementary artificial lighting of work area in office building care should be taken to use fluorescent lamps, which match with colour temperature of the daylight.

b) For residential buildings fluorescent lamps and/or CFLs of proper CRI and CCT are recommended to match with the colours and interior design of the room.

c) For commercial interiors, depending on the mounting heights and interior design, fluorescent lamps, CFLs and low wattage metal halide lamps are recommended. For highlighting the displays in show windows, hotels, etc, low wattage tubular or dichroic reflector type halogen lamps can be used.

d) For industrial lighting, depending on the mounting height and colour consideration fluorescent lamps, high pressure mercury vapour lamps or high pressure sodium vapour lamps are recommended.

5A.3.3.6.2 For the same lumen output, it is possible to save 75 to 80 percent energy if GLS lamps are replaced with CFL and 65 to 70 percent if replaced with fluorescent lamps. Similar energy effective solutions are to be chosen for every application area.

Similarly with white fluorescent tubes recommended for corridors and staircases, the electrical consumption reduces to 1/4.5 of the energy consumption with incandescent lamps.

5A.3.3.6.3 Efficient luminaire also plays an important role for energy conservation in lighting. The choice of a luminaire should be such that it is efficient not only initially but also throughout its life. Following luminaries are recommended for different locations:

a) For offices semi-direct type of luminaries are recommended so that both the work plane illumination and surround luminance can be effectively enhanced.

b) For corridors and staircases direct type of luminaries with wide spread of light distributions are recommended.

c) In residential buildings, bare fluorescent tubes are recommended. Wherever the incandescent lamps are employed, they should be provided white enamelled conical reflectors at an inclination of about45° from vertical.

d) High efficacy lamps are to be used in the lighting fixture wherever as possible or a minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps as according to IECC 2012.

LIST OF STANDARDS

The following list records those standards which are acceptable as 'standard practice' and 'accepted standards' in the fulfillment of the requirements of the Code. The latest version of a standard shall be adopted at the time of enforcement of the Code. The standards listed may be used by the Authority as a guide in conformance with the requirements of the referred clauses in the Code.

	IS No.	Title
(1)	IS 3646 (Part 1): 1992	Code of practice for interior illumination: Part 1 General requirements and recommendations for building interiors *(first revision)*
(2)	1944	Code of practice for lighting of public thoroughfares: Parts 1 and 2 For main and secondary roads (Group A and B) *(first revision)*
	2672 : 1966	Code of practice for library lighting
	4347 : 1967	Code of practice for hospital lighting
	6665 : 1972	Code of practice for industrial lighting
	10894 : 1984	Code of practice for lighting educational institutions
	10947 : 1984	Code of practice for lighting for ports and harbours
	SP 32 : 1986	Handbook on functional requirements of industrial buildings (lighting and ventilation)
	SP 41 : 1987	Handbook on functional requirements of buildings other than industrial buildings

References may be made to the following publications for the common personal protective equipment and tools used.

[01] International Building Code 2009 (SECTION 1205 - LIGHTING)

[02] International Energy Conservation Code 2009

[03] ASHRAE hand book-Fundamentals 2009 (SECTION 15 - FENESTRATION)

[04] International Energy Conservation Code 2012

Provisions given in India National Lighting Code (under Preparation) may also be referred.