

1.7 BASIC DESIGN OF ILLUMINATION SCHEMES

Depending upon the requirements and the way of light reaching the surface, Lighting schemes are classified as follows,

- (i) Direct lighting
- (ii) Semidirect lighting
- (iii) Indirect lighting
- (iv) Semi – indirect lighting and
- (v) General lighting.

Direct lighting:

In the direct lighting system, the luminaries direct the 90 to 100% of the light output of the lamp towards downward (light falls just below the lamp). This scheme is more efficient but it suffers from hard shadows and glare. It is mainly used for industrial and general outdoor lighting.

Semidirect lighting scheme:

In semidirect lighting scheme, about 60 – 90% lamps luminous flux is made to fall downwards directly by using some reflectors and the rest of the light is used to illuminate the walls and ceiling. This type of light scheme is employed in rooms with high ceiling. This scheme will improve not only the brightness but also the efficiency.

Indirect lighting schemes:

In this lighting scheme, 90% of the light output from the lamp is directed upward to the ceiling and upper side of walls and reflected back to the working plane area. In such scheme, the ceiling acts as the lighting source and glare is reduced to minimum.

Semi – indirect lighting scheme.

In semi – indirect lighting scheme, the luminaries direct the light output of the lamp partially (10 to 30%) downward, but with a major portion of light output (70 to 90 %) upward. Glare will be completely eliminated with such type of lighting scheme. This scheme is widely preferred for indoor lighting decoration purpose.

General lighting scheme:

In this scheme, lamps made of diffusing glass are used which are nearly equal illumination in all directions. Mounting height of the source should be much above eye level to avoid glare. Lamp fittings of various lighting schemes are shown in Figure.

RESIDENTIAL LIGHTING

The light in home can be peaceful, comfortable, romantic and intimate or cheerful and festive. Light can turn strangers away and welcome friends inside. Options for lighting each room are as varied as the colours of paint and features of carpet selected. Rating of lamps for illuminating a lightly coloured drawing room of size 8m long, 3m wide 3.5 m high. Following data may be assumed:

- Required illumination level 100 lumens/m²
- Coefficient of utilisation on horizontal plane 0.5
- Type of lamps - standard fluorescent lamps: 40 W, 1600 W per lamp.

COMMERCIAL LIGHTING

In commercial shopping complex, each shop has a different image to convey and different product to sell. Each aspect of a shop should be carefully designed with its client or customers in mind. Shops also carry their own identity. Lighting supports a shop in its identity, shows off the shop's merchandise to its best advantage, serving as a true magnet, drawing customers into the shop and persuading them to buy. Recommended lamps for commercial buildings

- For general purpose lighting – Fluorescent Lamps
- For display lighting – LV Halogen Lamp
- For boarding & hoarding – Metal Halide Lamp
- For textile shops – Filament/LV Halogen Lamp

STREET LIGHTING

The main objectives of the street lighting are 1. to make the street more attractive, so that obstructions on the road is clearly visible to the drivers of vehicles, 2. to increase the community value of the street, 3. to clear the traffic easily in order to promote safety and convenience. The two basic principles are usually employed for the street lighting design are given below:

Diffusion principle:

In this method, light is directed downwards from the lamp by the suitably designed reflectors. The design of these reflectors is in such a way that they may reflect total light over the road surface uniformly as much as possible. The reflectors are made to have a cut off between 30° and 45°, so that the filament of the lamp is not visible except just

below the source, which results in eliminating glare. Illumination at any point on the road surface is calculated by applying inverse square law (or) point-by-point method.

Specular reflection principle:

The specular reflection principle enables a motorist to see an object about 30 m ahead. In this case, the reflectors are curved upwards, so that the light is thrown on the road at a very large angle of incidence. This can be explained with the help of Figure. An object resides over the road at 'P' in between the lamps S1, S2 and S3 the observer at 'Q' Thus, the object will appear immediately against the bright road surface due to the lamps at a longer distance. This method of lighting is only suitable for straight sections along the road. In this method, it is observed that the objects on the roadway can be seen by a smaller expenditure of power than by the diffusion method of lighting.

Illumination level:

Normally illumination required depends upon the class of street lighting installation. The illumination required for different areas of street lighting are given in table.

S. No.	Area	Illumination (lumens/m ²)
1	Road junction and important shopping centres	30
2	Poorly lighted sub-urban streets	4
3	Average well-lighted street	8-15

Mounting height: Normally spacing for the standard lamps is 50 m with a mounting height of 8m. Lamp posts should be fixed at the junctions of roads.

Types of lamps: Mercury vapor and sodium vapor discharge lamps are preferable for street lighting. Since, the overall cost of the installation of discharge lamps are less than the filament lamps and also the less power consumption for a given amount of power output.

S. No.	Area	Illumination (lumens/m ²)
1	Single side mounting	Not for straight roads Recommended for bends with radius less than 75H, H-height of mounting Mounting outside the bend
2	Opposite mounting	Superior to other three methods More number of lamps Uniform illumination on road surface Used for very wide roads
3	Staggered arrangement	Lamps on alternate columns on the opposite side of central strip Suitable and economical for road width of 15m between two foot oaths at extreme ends
4	Central mounting	A central lamp post has two lamps back to back Used for very wide roads May be supplemented by staggered or opposite arrangement

FACTORY LIGHTING

Industry (or) factory lighting must satisfy the following aspects.

1. The quality of work is to be improved
2. Accidents must be reduced.
3. The productivity of labour should be increased.

The above requirements can be met by the factory lighting only when the lighting schemes provides: (i) Adequate illumination on the working plane, (ii) Minimum glare, (iii) Clean and effective source fitting, and (iv) Uniform distribution of light over the working plane. The lamps used for factory lighting are fitted with specially designed reflectors and they can be easily cleaned.

- Industrial lighting fittings
- Standard reflectors
- Diffusing fittings
- Concentrating diffusing fittings
- Angle reflectors.

FLOOD LIGHTING

Flood lighting means flooding of large surfaces with light from powerful projectors. A special reflector and housing are employed in flood lighting in order to concentrate the light emitted from the lamp into a relatively narrow beam, which is known as flood lighting projector. It is employed to serve one or more of the following purposes.

1. Aesthetic flood lighting:

For enhancing beauty of building at night such as public places, ancient buildings and monuments, religious buildings on important festive occasions etc.

2. Industrial and commercial flood lighting

For illuminating railway yards, sports stadium, car parks, construction sites, quarries etc.

3. Advertising

They are used for illuminating showcases and advertisement boards and for the decoration of houses etc. The projectors of floodlighting schemes are classified into

- (a) Narrow beam projectors
- (b) Medium angle projectors
- (c) Wide angle projectors.

Flood Lighting Calculation

While calculating the number of projectors required for flood lightings, it is necessary to know the level of illumination required and it is depending on the type of building and the purpose of floodlighting. And also the type of projector and the selection of projector depend upon the beam size as well as the light output. The three steps of lighting calculations are,

Step 1 : Illumination level required

Step 2 : Type of projector

Step 3 : Number of projector

1. Illumination level required:

The Illumination level in lumens/m² required depends upon the type of building, the purpose of the flood lighting. The amount of conflicting light in the vicinity etc.

2. Type of projector:

Based on beam size, light output, the choice of projector is made. The beam size determines the area covered by the beam and the latter the illumination provided.

3. Number of projectors:

$$N = \frac{A \times E \times DF \times \text{Waste light factor}}{UF \times \text{Wastage of lamp} \times \text{Luminous efficiency of lamp}}$$