Lighting Schemes

Different lighting schemes may be classified as**:**

(i) Direct lighting

(ii) Indirect lighting

(iii) Semi-direct lighting

(iv) Semi-indirect lighting

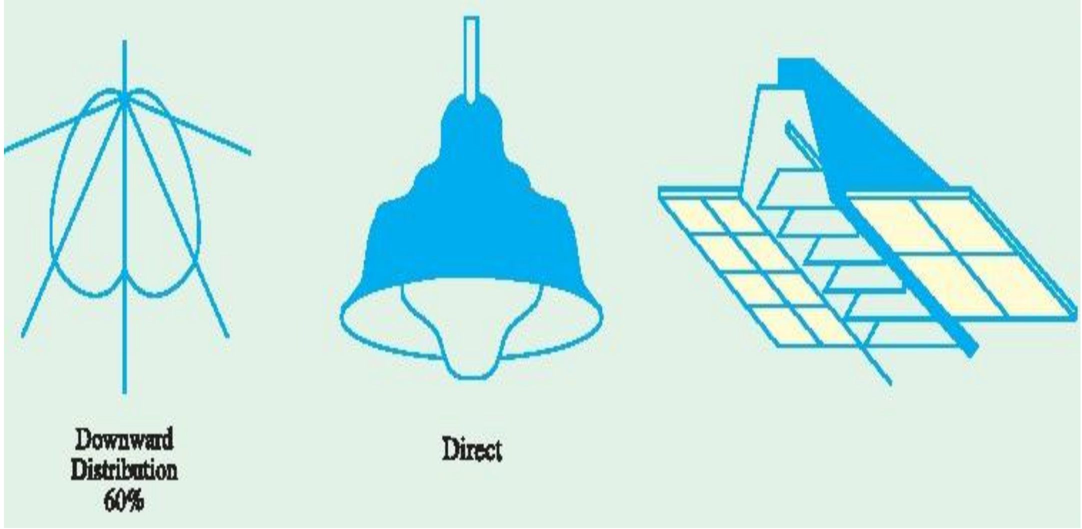
(v) General diffusing systems

Direct Lighting

As the name indicates, in the form of lighting, the light from the source falls directly on the object or the surface to be illuminated (Fig. below).

With the help of shades and globes and reflectors of various types, most of the light is directed in the lower hemisphere and also the brilliant source of light is kept out of the direct line of vision.

Direct illumination by lamps in suitable reflectors can be supplemented by standard or bracket lamps on desk or by additional pendant fittings over counters.



Direct Lighting

The fundamental point worth remembering is planning any lighting installation is that sufficient and sufficiently uniform lighting is to be provided at the working or reading plane.

For this purpose, lamps of suitable size have to be so located and furnished with such fittings as to give correct degree and distribution of illumination at the required place.

Moreover, it is important to keep the lamps and fittings clean otherwise the decrease in effective illumination due to dirty bulbs or reflectors may amount to 15 to 25% in offices and domestic lighting and more in industrial areas as a result of a few weeks neglect.

Direct lighting, though most efficient, is liable to cause glare and hard shadows

Indirect Lighting

In this form of lighting, light does not reach the surface directly from the source but indirectly by diffuse reflection (Fig. below).

The lamps are either placed behind a cornice or in suspended ***opaque*** bowls.

In both cases, a silvered reflector which is corrugated for eliminating striations is placed beneath the lamp.

In this way, maximum light is thrown upwards on the ceiling from which it is distributed all over the room by diffuse reflection.

Even gradation of light on the ceiling is secured by careful adjustment of the position and the number of lamps.

In the cornice and bowl system of lighting, bowl fittings are generally suspended about three-fourths the height of the room and in the case of cornice lighting, a frieze of curved profile aids in throwing the light out into the room to be illuminated.

Since in indirect lighting whole of the light on the working plane is received by diffuse reflection, it is important to keep the fittings clean.

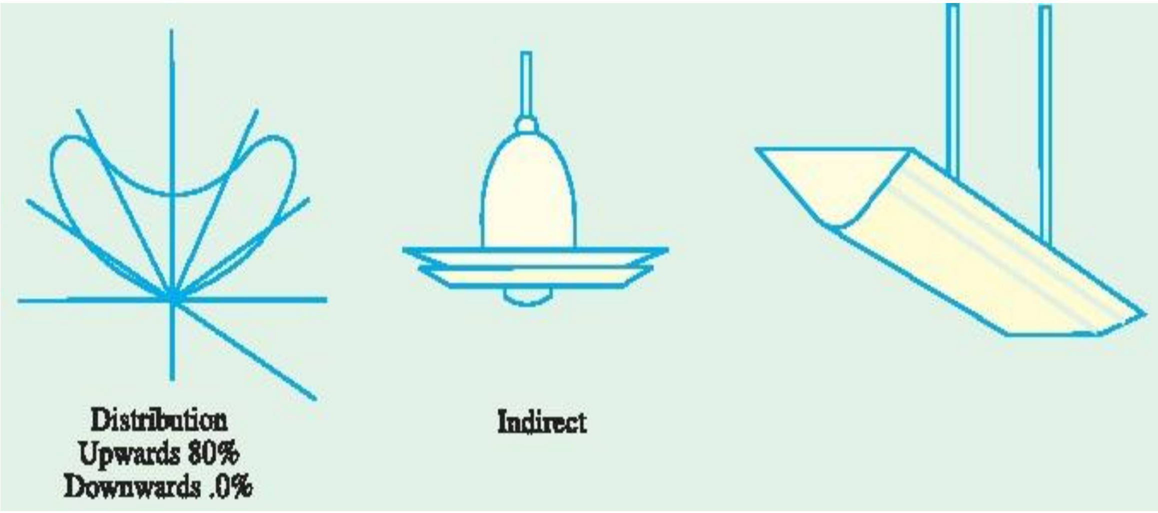
Indirect Lighting

One of the main characteristics of indirect lighting is that it provides shadow-less illumination which is very useful for drawing offices, composing rooms and in workshops especially where large machines and other obstructions would cast troublesome shadows if direct lighting were used.

However, many people find purely indirect lighting flat and monotonous and even depressive.

Most of the users demand 50 to 100% more light at their working plane by indirect lighting than with direct lighting.

However, for appreciating relief, a certain proportion of direct lighting is essential.



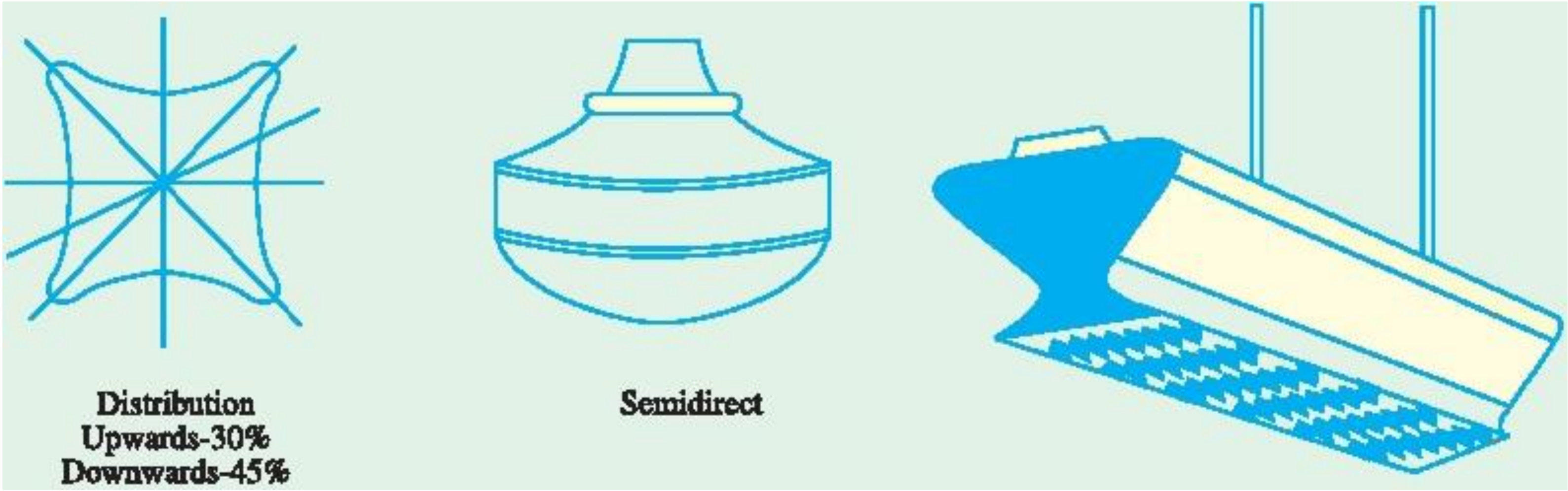
Semi-direct Lighting

utilizes luminaries which send most of the light downwards directly on the working plane but a considerable amount reaches the ceilings and walls also.

The division is usually 30% upwards and 45% downwards.

Such a system is best suited to rooms with high ceilings where a high level of uniformly-distributed illumination is desirable.

Glare in such units is avoided by using diffusing globes which not only improve the brightness towards the eye level but improve the efficiency of the system with reference to the working plane.

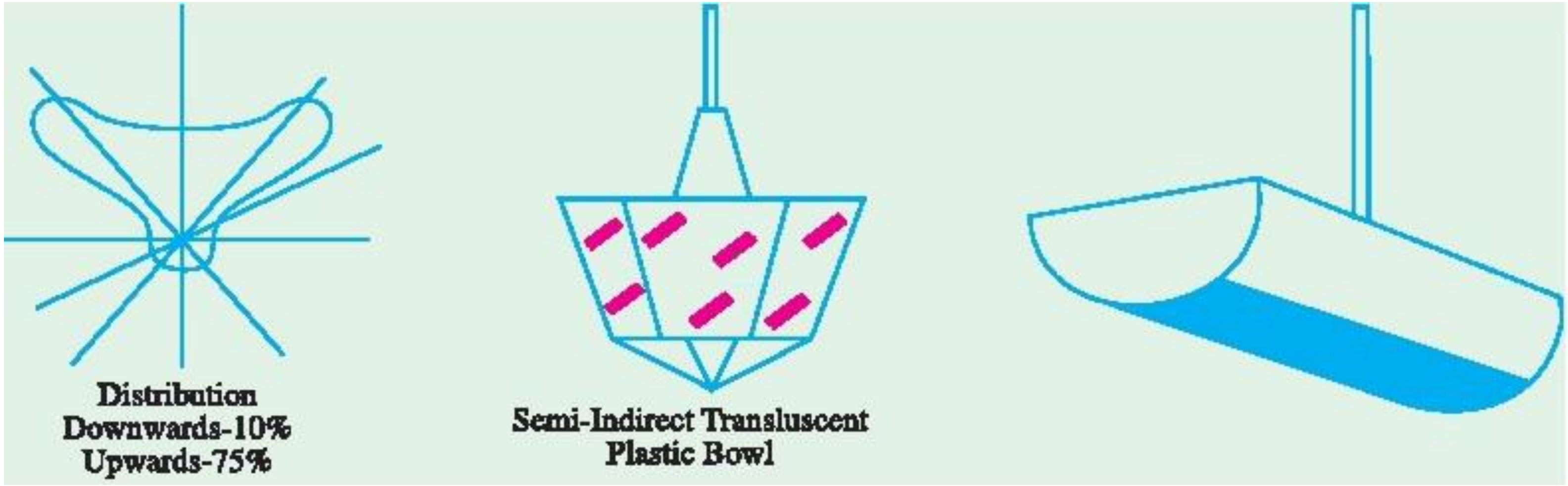


Semi-indirect Lighting

In this system which is, in fact, a compromise between the first two systems, the light is partly received by diffuse reflection and partly direct from the source (Fig.).

Such a system, therefore, eliminates the objections of indirect lighting mentioned above. Instead of using opaque bowls with reflectors, translucent bowls without reflector are used.

Most of the light is, as before, directed upwards to the ceiling for diffuse reflection and the rest reaches the working plane directly except for some absorption by the bowl.



Floodlighting

'flooding' of large surfaces with the help of light from powerful projectors. Flooding is employed
for the following purposes:

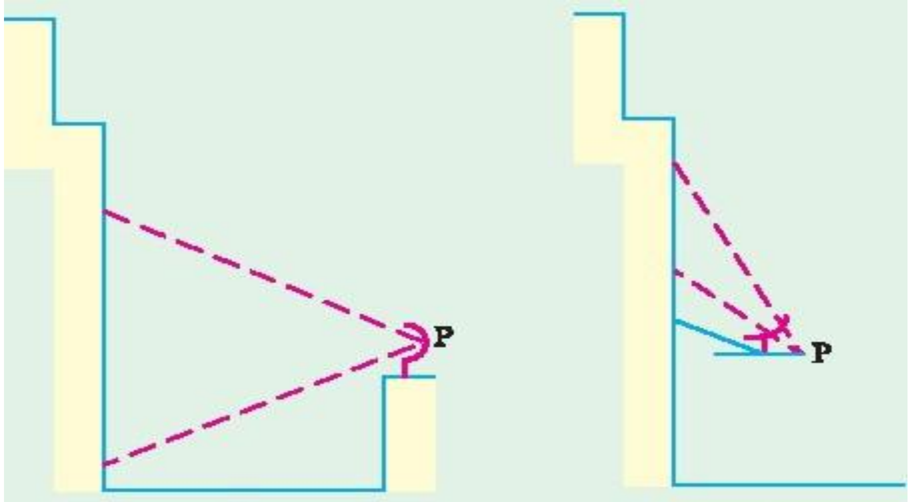
1. For aesthetic purposes as for enhancing the beauty of a building by night *i.e. flood lighting of*
ancient monuments, religious buildings on important festive occassions etc.

2. For advertising purposes *i.e. flood lighting, huge hoardings and commercial buildings.*

3. For industrial and commercial purposes as in the case of railway yards, sports stadiums and
quarries etc.

Usually, floodlight projectors having suitable reflectors fitted with standard 250-, 500-, or 1,000- watt gas-filled tungsten lamps, are employed. One of the two typical floodlight installations often used is as shown in Fig. (*a). The projector is kept 15 m* to 30 m away from the surface to be floodlighted and provides approximately parallel beam having beam spread of 25° to 30°.

Fig. (*b) shows the case* when the projector cannot be located away from the building. In that case, an asymmetric reflector is used which directs more intense light towards the top of the building.



(*a*) (*b*)

The total luminous flux required to floodlight a building can be found from the relation,□□ = *EA/*□□ *p.*

However, in the case of flood-lighting, one more factor has to be taken into account. That factor is known as waste-light factor (*W). It is so because when several projectors are used, there is bound to be* a certain amount of overlap and also because some light would fall beyond the edges of the area to be illuminated. These two factors are taken into account by multiplying the theoretical value of the flux required by a waste-light factor which has a value of nearly 1.2 for regular surfaces and about 1.5 for irregular objects like statues etc. Hence, the formula for calculation of total flux required for Floodlighting purposes is ,

$$\varnothing = \frac{E \times A \times W}{\eta \times p}$$

Definitions

9) Mean horizontal spherical candle power (M.H.S.C.P.)

It is the mean of candle powers in all directions above or below the horizontal plane passing through the source of light. (usually lower part)

$$\text{M.H.S.C.P.} = \frac{\text{Total flux emitted in hemisphere}}{2\pi}$$

Definitions

10)Lamp efficiency

It is the ratio of the output i.e luminous flux in lumens to the electrical power input in watts

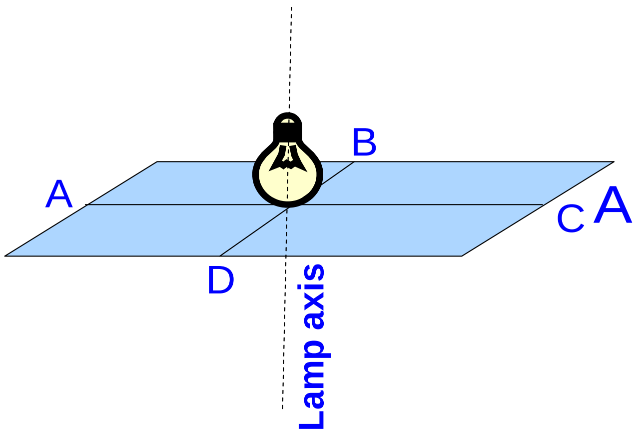
$$\text{Lamp efficiency} = \frac{\text{Luminous flux}}{\text{Electric power}} \quad \text{Lumen/watt}$$

Definitions

11.Polar Curves

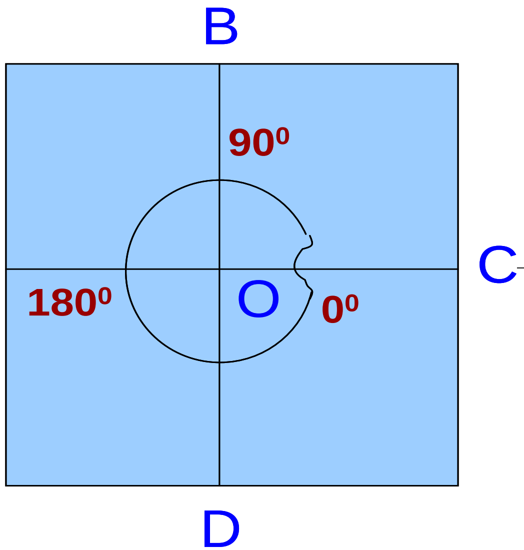
- The luminous intensity or candle power is not uniform in all directions, due to its unsymmetrical shape and design
- It is essential to know exactly how the light is distributed and is usually given in the form of polar curves
- Polar curve is defined as a graph representing the light distribution of a lamp (luminous intensity) in a horizontal or vertical plane

Polar Curves



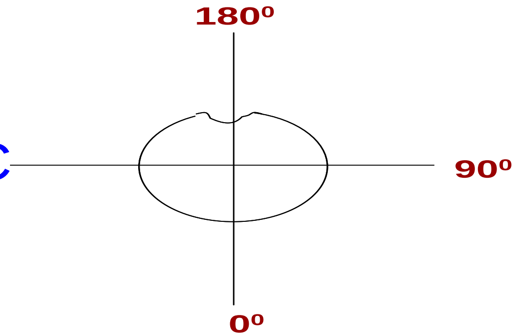
Lamp and horizontal plane

Fig.4a



On horizontal plane

Fig.4b



On vertical plane

Fig.4c

Horizontal Polar Curves

- Fig 4a shows an incandescent lamp. If the luminous intensity is measured in a horizontal plane about a vertical axis, a curve is plotted between luminous intensity and the angular position as shown in Fig 4b

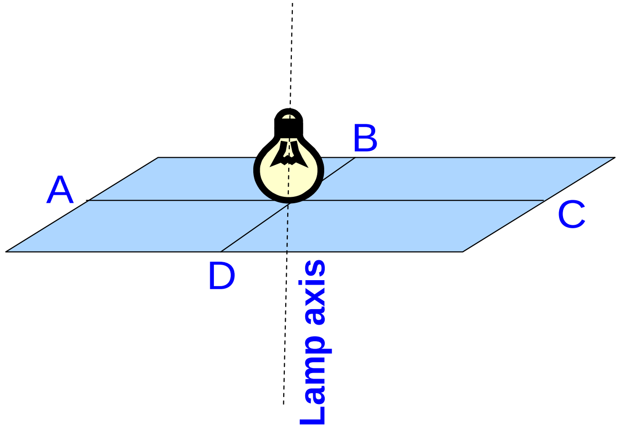


Fig.4a

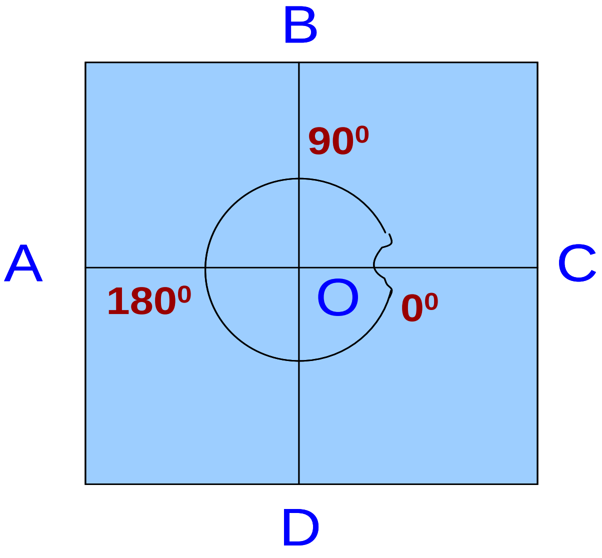


Fig.4b

Horizontal Polar Curves

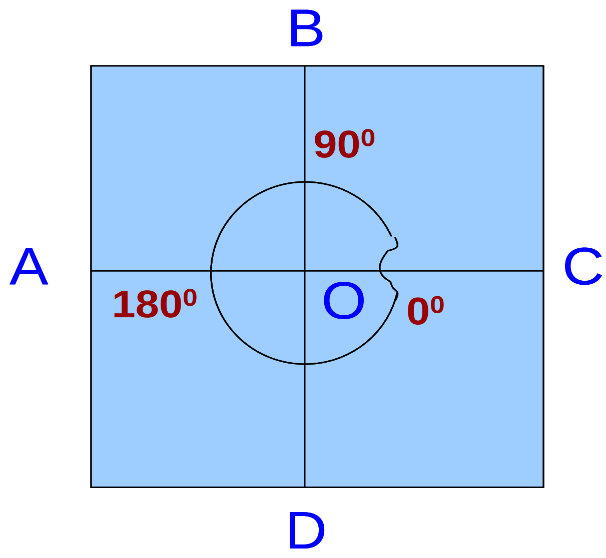


Fig.4b

The drop in luminous intensity along OC at 0^0 of horizontal polar curve is due to break in the filament where the current enters and leaves

Vertical Polar Curves

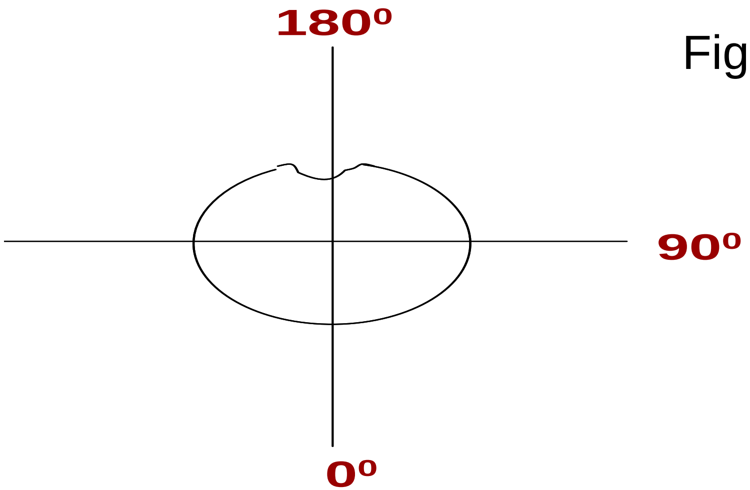


Fig.4c

On vertical plane

- If the luminous intensity is measured in a vertical plane at various angles, a polar curve in a vertical plane is obtained
- The drop or depression in luminous intensity at 180^0 of vertical polar curve is due to the position of the lamp holder

Summary

So far we have discussed about

- Units of Wave Length
- Definitions of
    - Plane angle
    - Solid angle
    - Luminous flux
    - Luminous intensity
    - Illumination
    - Brightness

Contd…

Definitions of

- M.H.C.P
- M.S.C.P
- M.H.S.C.P
- Lamp efficiency
- Polar Curves

Quiz

1Q. Lux is the unit of

A) Illumination

B) Flux

C) Luminous intensity

D) Solid angle

Quiz

2Q. The unit of lamp efficiency is

A) C.P./Watt

B) Watts/ Lumen

C) Lumens/Watt

D) Lumens / Steradian

Quiz

3Q. One radian is equal to________ degrees.

A) $180/2\pi$

B) $360/\pi$

C) $\pi/180$

D) $180/\pi$

Quiz

4Q. The largest solid angle subtended is _____steradian.

A) π

B) 4π

C) π/4

D) 1/π

Frequently Asked Questions

1) Define a) Plane angle and b) Solid angle
2) Define Luminous flux and intensity
3) Define Illumination and Luminous efficiency
4) Define M.H.C.P., M.S.C.P. and M.H.S.C.P
5) Draw and explain the vertical and horizontal polar curves

THANK YOU