

Module

4

Lighting Application

Lesson

19

Lighting Applications

## Instructional Objectives

- List various lighting applications
- Understand the need to integrate lighting with other applications
- Classify Industrial Lighting
- Classify Office Lighting
- List requirements of lighting for Educational Institutions, Auditoria, Hospitals, Hotels and restaurants

## Lighting Applications

This lesson presents various issues pertaining to lighting applications. First area of application is Industrial. Here Wide range of visual tasks are involved compared to schools or offices. Involves Extremely small to very large objects. The objects or areas could be Dark or light with Flat or contoured surfaces. In industrial environs the tasks are graded according to degree of fineness. Less critical tasks require low level/quality of light Finer work requires high level with minimum glare. General lighting is usually supplemented by specific lighting. Lighting is dictated by Nature of work, Shape of the space and ceiling structure

Thus lighting in Industry is Classified as:

- single storey without skylight
- multi storey
- single storey with sky light
- high bay

Single storey without sky light, specially in Work shops or factories floor to ceiling height is kept around 3m or 5 m or 7 m.

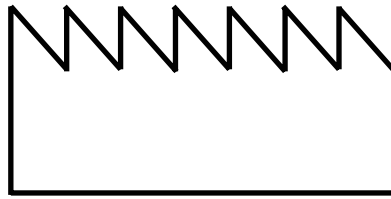
Fluorescent lamps are used up to a mounting height of 5m arranged in Continuous or broken rows. They may be mounted directly on ceiling or suspended.

When Mounting height  $h_m > 5m$ , usually discharge lamps with reflector luminaires are employed separation distance  $S < 1.5h_m$ . Usually line of luminaires is mounted perpendicular to work benches. Normally trunking systems containing wires enables efficacy of illumination.

## Multistorey

Usually Smooth white ceilings with height in the range  $2.8m < h < 3.5m$ . Here Roof acts as extended reflector. They use Tubular fluorescent lamps in continuous or broken rows. The lighting is Integrated with a/c system.

## Single storey with skylight



**Fig. 1 Typical Single storey with Sky light**

When using Lantern roof uses saw toothed roof, to allow more of day light Employs Reflector type luminaires in a row perpendicular to work bench.

In High bays, where ceiling height  $h > 7\text{m}$ , light sources need to be mounted higher. This facilitates avoiding obstruction to guide rails of cranes and tall machinery. Here, Dispersive narrow beam reflector luminaires fitted with metal halide or high pressure sodium vapour lamps that are color corrected are used.

## Special Tasks in Industrial Environment

Best way of assessing Visual requirement is known by doing it one self. Lighting design should Create necessary contrast between the details to be distinguished against the background. If general lighting does not meet these requirements then additional aids such as Illuminated magnifying glass, Stroboscopic lighting for viewing objects in motion or Monochromatic light in glass and ceramic manufacture.

## Office lighting

As regards office lighting they can be categorized as General offices, Private offices, Conference rooms. Here usually Limited well defined visual task are involved. Typically there are Horizontal work planes at  $0.75 - 0.85\text{m}$  from the floor. Typical Ceiling heights are  $2.8 - 3\text{m}$ .

## Illuminance

Recommended Illuminance levels in Small offices are  $500 - 750\text{ lx}$  on the task and in Large office  $750 - 1000\text{ lx}$  on the task. General lighting at least equal to 50% of task illuminance with a minimum of  $400\text{ lx}$  is recommended.

## Luminances

Recommended luminance values for Walls is  $50 - 150\text{ Cd/m}^2$ , for Ceiling  $100 - 200\text{ Cd/m}^2$  and for Tasks / Task area  $100 - 300\text{ Cd/m}^2$ . Color appearance should be agreeable. All this easily obtained using Day light fluorescent lamps with louvers and diffusers.

## General offices

They usually have Moderate to large area where work planes are not fixed. Such areas Ceiling mounted / recessed luminaries are arranged in a regular pattern. Lighting is suitably combined with air handling systems. This may be using false ceiling or suspended ceiling, hence luminaries should be well ventilated. Since large areas are involved energy saving by localized lighting by having appropriate controls for switching keeping lighting recommendations in mind.

It must be mentioned that Visual display units need special care such that Windows / sources do not reflect on the screen. Typically recommended levels are 400 lx for light screen and 700 lx for dark screen. Similarly for private office and conference rooms. As Drawing offices involve precision work a min. of 1000 lx is recommended

In Educational Institutions where Writing, reading & reading black board are main tasks, Levels for Office lighting with additional lighting for blackboards are sufficient. Recommended levels for Class room are 300 – 500 lx, for Handcrafts room – 500 – 1000 lx, for Laboratories – 500 – 1000 lx. Optics laboratories need special lighting as dictated for the experiments in optics. On chalk boards or Blackboard, level should be 300 – 500 lx (vertical). In Auditoria (during projection) 50–150 lx otherwise 300–500 lx. Needless to mention that in auditoria Reading writing require 500 lx. Care is to be taken to prevent glare. There is a need to provide Dimmers to vary the lighting level. There should be additional Local lighting on the blackboard. For proper functioning Centralized controls are required. The Control panel should be easily accessible to Lecturer at the rostrum. Table I lists the recommended levels for shops and stores.

## Shops and Stores

**Table I**

<b>Interiors</b>	<b>large shopping centers lx</b>	<b>Other areas lx</b>
General lighting	500 – 750	300 – 500
Local lighting	1500 – 3000	750 – 1500
Show case/windows		
General lighting	1000 – 2000	500 – 1000
Local lighting	5000 – 10000	3000 – 5000

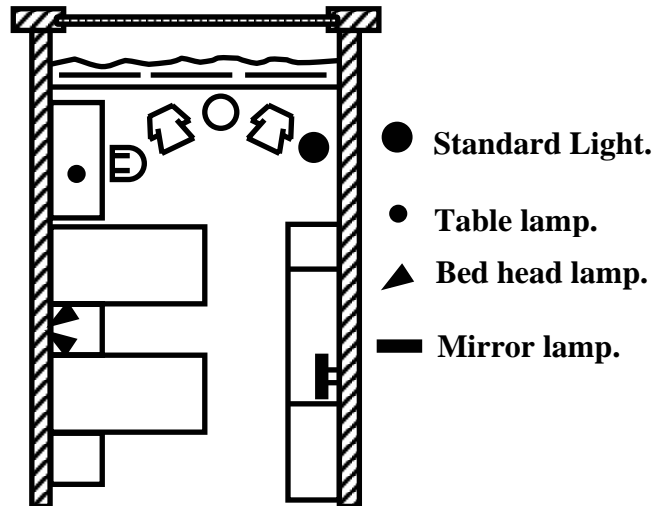
Show case in a store must be lit such that it brings out special features of the product. Hardware can use diffused fluorescent lamps. Jewellery best lit by incandescent lamps.

## Hotels / Restaurants

In hotels and restaurants lighting must take care of Approach roads / car parks / main entrance. They are lit by Columns – 30cm to 12m high. They are termed post top Lanterns.  $E_H = 10$  lx. canopy  $E_H = 100$  lx. Entrance halls, foyers attention is to be drawn to reception. Desk Hence increase illuminance around reception. Lighting system should be Flexible. In restaurants Fluorescent lamps around the perimeter of dining area with local lighting at tables (lowered at night times). This needs Dimming and partial switching.  $E_{av} = 100$  lx is recommended. No doubt at Cash desk, higher level of 300 lx is preferred.

In Corridors and stairs, when having Long corridors without any daylight Fluorescent lamps are preferred with Day time Illuminance of 150 lx and Night time Illuminance of 75 lx. In addition hotels must have all night pilot lighting and provisions for Emergency lighting

In Bed Rooms or Guest rooms provisions must be there for General lighting, Reading lamp at the table Bed head reading lamp in wall brackets mounted high. Mirrors should be lit by Fluorescent lamps right above or on either side.



**Fig. 2 Arrangement in a typical Guest Room in a Hotel**

## Hospitals

Lighting in hospitals is from the view of Patients, Technicians and Doctors. In this application Color rendering is important. Changes in color may misdiagnose a disease and effect psychology. Radiation is employed for treatment interference free.

In Patients room General lighting recommended is 100–200 lx and Local lighting recommended is 100 – 300 lx. Luminance  $350 \text{ cd/m}^2$  Examination lighting level should be 1000 lx. Night light should at least be 0.5 lx. Night observation light suggested is 5 – 20 lx. Recommended levels for Corridors during day are 200 – 300 lx. and nights is 5 – 10 lx.

Lights recommended for Exam rooms are 4000°K fluorescent lamps with 500 – 1000 lx. Theaters should have shadow free lighting. ICU and X Ray rooms should have at least 10 – 30lx.

Before, we close this lesson some types of luminaries employed are illustrated. Figures 1 to 4 show various types of luminaries that may be used for various types of lamps shown in Fig.5



**Fig. 1 Typical Decorative Surface mounting Consumer Luminaires**



**Fig. 2 Typical Consumer Luminaires for Fluorescent Lamps surface mountable**



**Fig. 3 Typical decorative Downlighters using CFL which can be recessed in ceiling**



**Fig. 4 Typical Commercial Luminaires using CFLs suitable for recessed mounting**



**Fig. 5 Typical Spectrum of Lamps**

## Lecture Summary

- Industrial lighting is dictated by:
  - nature of work
  - shape of space
  - ceiling structures
- Industrial lighting can be classified as:
  - single storey without skylight
  - multistorey
  - single storey with skylight
  - high bay light
- Additional lighting are used if general lighting doesn't meet requirements viz. illuminated magnifying glass, stroboscopic lighting, monochromatic light etc.
- Fluorescent lamps with louvres & diffusers are preferred for office lighting
- Vertical illumination becomes necessary for blackboards in educational institutions
- In hospitals lighting is done according to convenience of patients, technicians & doctors. Operation theatres need shadow free lighting. ICU & X-ray rooms have low luminance levels.



- In shops, restaurants & other commercial places, local & color lighting is employed to highlight a particular place / product

## Tutorial Questions

- When do you need stroboscopic lighting?
- What care should be taken for auditorium lighting?
- How should the line of luminaires be mounted in industries & why?

## Answer to Questions of previous lecture

- What do you mean by surface reflectance of 7751 & 751?
  - 7751 has surface reflectance of ceiling = 0.7, frieze = 0.7, walls = 0.5 & work plane = 0.1
  - 751 has surface reflectance of ceiling = 0.7, negligible for frieze, walls = 0.5 & work plane = 0.1

- What are isolux diagrams?

Isolux diagrams are used for calculation of illuminance & luminance levels

- What do you mean by frieze?

It is the wall area above the luminaire plane i.e. the plane at which luminaires are located

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