

Light, noise and radiation

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The requirements of good lighting

- **Sufficiency:** An illumination of 15-20 foot-candles (1 foot candle = 10.76 Lux) is basic minimum for satisfactory vision
- **Distribution:** Should be uniform, having same intensity
- **Absence of glare:** Glare is excessive contrast i.e. automobile headlight
- **Absence of sharp shadows**
- **Steadiness:** The source of light should be constant.
- **Colour of light:** Should be soothing for eye
- **Surroundings:** Ceilings and roofs should have reflection factor of 80%; walls 50-60%; furniture 30-40%; floor 15-20%

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Measurement of light

Description	Quantity measured name	Recommended unit	Other units
Brightness of point source	Luminous intensity	Candela	Candle power
Flow of light	Luminous flux	Lumen	
Amount of light reaching surface	Illumination or illuminance	Lux	Foot candle Lumen/cm ²
Amount of light re-emitted by surface	Brightness or luminance	Lambert	Foot lambert Candles/cm ²

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Lighting standards

Visual task	Recommended illumination (lux)
Casual reading	100
General office work	400
Fine assembly	900
Very severe task	1300-2000
Watch making	2000-3000

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Natural lighting

- Natural lighting is derived partly from the **visible sky and partly from reflection**.
- **Suggestion for improving daylight illumination:**
 - **Orientation of the building:** Whenever possible should be oriented north or south for uniform illumination.
 - **Removal of obstructions**
 - **Windows**
 - **Interior of the rooms:** Ceiling should be white; upper portion of the walls light-tinted and lower portions darker for eye-comfort.

Artificial lighting

- **There are 5 systems of artificial lighting:**
 - **Direct lighting:** 99-100% light is directed towards working area
 - **Semi-direct lighting:** 10-40% light is directed upward (ceiling)
 - **Indirect lighting:** 90-100% light is projected towards ceiling and wall
 - **Semi-indirect lighting:** 60-90% light is projected upward
 - **Direct-indirect lighting:** Light is equally distributed
- **Methods of artificial illumination:**
 - **Filament lamps:** Widely used. Tungsten filament emits light.
 - **Fluorescent lamps:** Glass tube filled with mercury vapour.

Health effects of lighting

❑ Beneficial effects:

- Required for proper vision and precision of object
- Used as treatment for neonatal jaundice
- Stimulates oxidation processes for natural purification and decomposition of waste or excreta
- Laser is used for academic, decorative and high-tech simulations
- Infra-red rays are used for sterilization and heating process
- UV ray produce vitamin-D on human skin
- UV-A also causes tanning of human body

Health effects of lighting

❑ Harmful effects:

- Poor lighting can cause eye strain, headache, lacrimation, eye fatigue, miner's nystagmus
- Excess light can cause eye strain, inflammation of cornea and premature cataract
- Glare can also cause eye strain, accidents, reduced critical vision
- LASER causes erythema, skin ageing, photosensitivity and skin cancer, also causes eye burns
- Infrared rays can cause burns, cataract, inflammation of eyelids
- UV rays can cause inflammation of cornea, conjunctiva, pain and running eye and 'arc eye' found in welding workers.
- UV rays also cause skin cancer

Noise

- Noise is often defined as “unwanted sound”, but this definition is subjective because one man’s sound may be another man’s noise.
- A better definition of noise is- “**wrong sound, in the wrong place, at the wrong time**”.
- Noise has two important properties:
 - a. Loudness or intensity:** The loudness is measured in decibels (dB)
 - b. Frequency:** It is measured in Hertz (Hz)

Sources of noise

- **Industrial noise:** mining, tunneling, quarrying, heavy engineering, textile machine, welding works etc.
- **Transportation:** automobiles- bus, truck, motor vehicles, railway tract, aircrafts
- **Construction equipment**
- **Domestic:** amplified music

Acceptable noise levels

Residential	Bed room	25 dB
	Living room	40 dB
Commercial	Office	35-45 dB
	Conference room	40-45 dB
	Restaurants	40-60 dB
Industrial	Workshop	40-60 dB
	Laboratory	40-50 dB
Educational	Classroom	30-40 dB
	Library	35-40 dB
Hospitals	Wards	20-35 dB

Effects of noise exposure

□ Auditory effects:

- **Auditory fatigue:** It appears at 90 dB region and greatest at 4000 Hz
- **Deafness:** Continuous or repeated exposure to 100 dB causes permanent hearing loss. Exposure to noise above 160 dB may rupture tympanic membrane and cause permanent hearing loss.

□ Non-auditory effects:

- Interference with speech
- Annoyance
- Efficiency
- Psychological change
- Besides affecting health, noise is also a significant factor for economic losses.

Control of noise

- **Careful planning of cities:**
 - ✓ Division of the city into zones with separation of industrial and transportation areas
 - ✓ Separation of residential areas from main streets by means of green belts
 - ✓ Widening of main street to reduce the level of noise penetration into dwellings
- **Control of vehicles**
- **Improvement of acoustic insulation of buildings**
- **Industries and railways:**
 - Control of noise at source of industries if possible.
- **Protection of exposed persons**
- **Legislation**
- **Education**

Sources of radiation

- ☐ **Natural**
 1. **Cosmic rays**
 2. **Environmental**
 - Terrestrial
 - Atmospheric
 3. **Internal**
 - Potassium-40
 - Carbon-14
- ☐ **Man-made**
 1. **Medical and dental:** X-rays, radioisotopes
 2. **Occupational exposure**
 3. **Nuclear:** radioactive fall-out
 4. **Miscellaneous:** Radioactive devices i.e. TV, mobile, tablets, dial watch, isotope tagged products, luminous markers

Types of radiation

- ☐ **Ionizing radiation:**
 - ❖ **Electromagnetic radiations**
 - X-rays, Gamma rays
 - ❖ **Corpuscular radiations**
 - Alpha particles, Beta particles, Protons
- ☐ **Non-ionizing radiation:**
 - UV radiation, visible light, infrared radiation, microwave radiation and radio frequency radiation

Radiation units

- ☐ **The activity of a radioactive material:**
 - Becquerel (Bq)
 - Curie (Ci)
- ☐ **The potency of radiation:**
 - Rontgen or Coulomb per kilogram (C/Kg): Unit of exposure
 - Rad or Gray (Gy): Unit of absorbed dose
 - Rem or Sievert (Sv): Product of absorbed dose and modifying factors

Biological effect of radiation

☐ Somatic: a. Immediate

- Radiation sickness
- Acute radiation syndrome

b. Delayed

- Leukemia
- Carcinogenesis
- Foetal developmental anomalies
- Shortening of life

☐ Genetic: a. Chromosomal mutations

b. Point mutations

Prevention of radiation exposure

☐ Prevention of internal irradiation:

- Notification
- Advance approval for specified activities
- Specification of dose limits and emissions for exposed persons
- Classification of work places depending on risk and exposed person
- Introduction of control measures and monitoring
- Introduction of competent practitioners for the specialized task of monitoring, evaluation and control
- Critical assessment of new plants and projects
- Centralization of calibration, dosimetry and records
- Medical surveillance of exposed persons

Prevention of radiation exposure

☐ Prevention of external irradiation:

- Avoidance of unnecessary X-ray examination
- Adequate control and surveillance of X-ray installations
- Improvement in technique
- Improved leadings for dose reduction shield, distance and time
- Administration control:
 - ✓ Work task planning and management
 - ✓ Posting regulatory and cautionary warning signs
 - ✓ Training of the stakeholders
 - ✓ Monitoring and surveillance
 - ✓ Regular working hour
 - ✓ Recreation and holidays
- **Effective personal protective measures are- wearing lead apron, rubber apron, using film badge or dosimeter.**

Dosimeter

- A **dosimeter** is a device used to **measure the amount of ionizing radiation** absorbed by a person or object.
- It's essentially a **radiation "measuring tool"** that helps quantify the amount of radiation exposure over a period of time, particularly in situations where individuals are exposed to radiation in their **work environment or during medical procedures.**



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