Electric lighting

- Light emission
  - incandescence vs. luminescence
- Lamp types
  - Incandescent (classic, halogen)
  - Discharge (fluorescent tubes)
  - Electrodeless (induction-based)

8 Natural light

7 Low pressure sodium

6 High pressure sodium

5 Mercury vapor

4 Fluorescence

3 Metal halide

2 Halogen

1 Classic incandescent

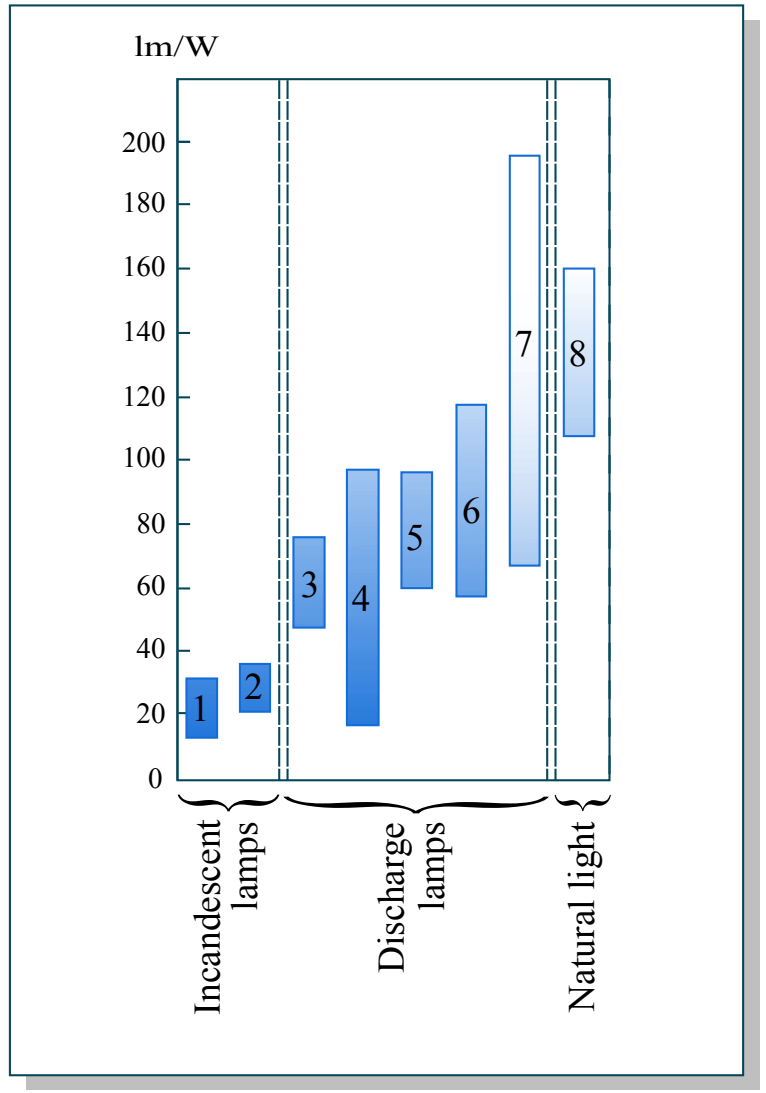


Figure by MIT OCW.

Electric lighting

- Incandescent lamps (color °T = 2500 °K)
  - Classic incandescence
    - 15 to 500 W
    - 6 to 17 lm/W

Electric lighting

- Incandescent lamps (color °T = 2500 °K)
  - Classic incandescence
  - Halogen incandescence
    - 25 to 2000 W
    - 10 to 22 lm/W

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
    - 18, 36 or 58 W
    - 53 to 89 lm/W
    - color °T between 3000 and 6000 °K
    - poor to pretty good color rendering

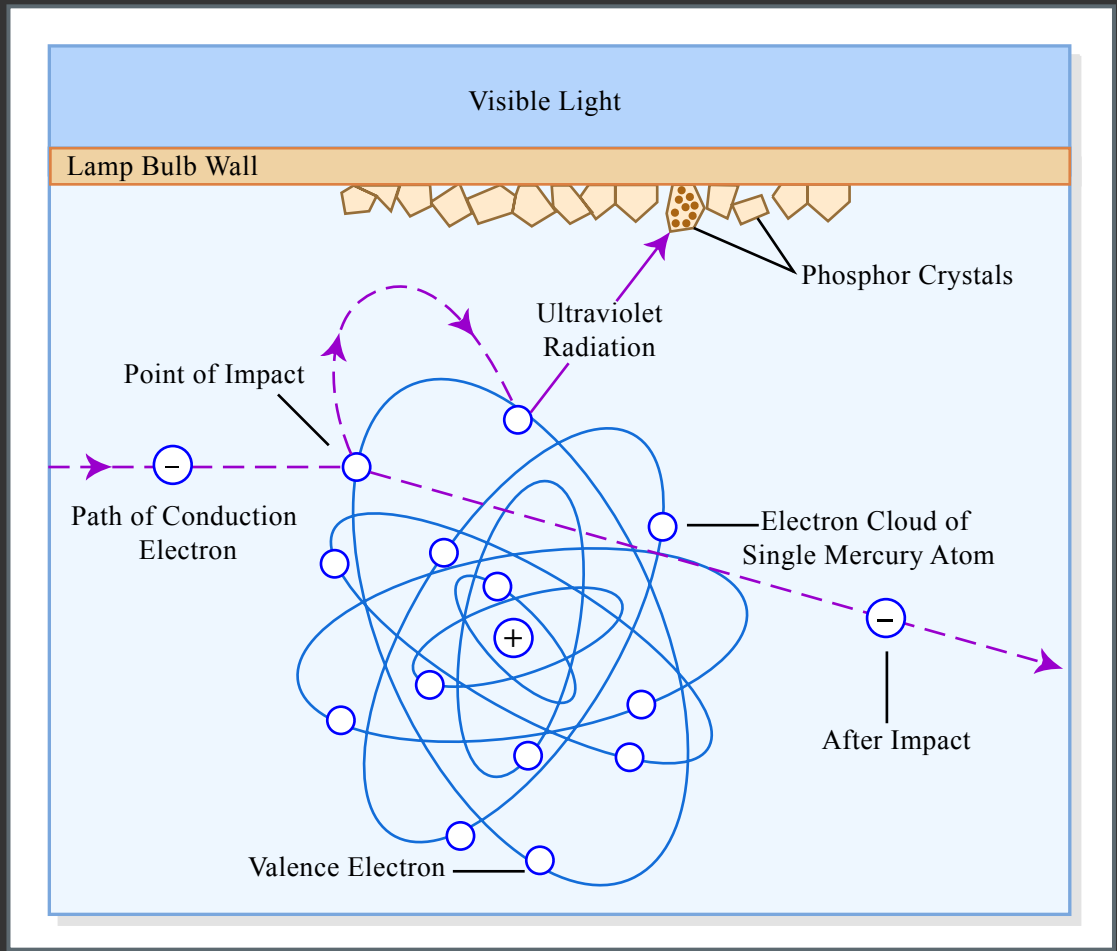


Figure by MIT OCW.

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
  - Compact fluorescents
    - 3 to 23 W
    - 33 to 65 lm/W
    - 3000 to 3500 °K
    - pretty good color rendering

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
  - Compact fluorescents
  - Metal halides
    - 40 to 150 W for HQI, 250 to 3500 W for HQI-T
    - 85 lm/W for HQI, 80 to 91 lm/W for HQI-T
    - 3500 to 4000 °K for HQI, 3000 °K for HQI-T
    - pretty good color rendering for both

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
  - Compact fluorescents
  - Metal halides
  - Mercury vapor
    - 50 to 1000 W
    - 35 to 60 lm/W
    - 3000 °K
    - pretty good color rendering

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
  - Compact fluorescents
  - Metal halides
  - Mercury vapor
  - Sodium
    - High pressure: 50-1000 W, 70-130 lm/W, 3000 °K, poor to fair color °T

Electric lighting

- Incandescent lamps
- Discharge lamps
  - Fluorescent tubes
  - Compact fluorescents
  - Metal halides
  - Mercury vapor
  - Sodium
    - High pressure: 50-1000 W, 70-130 lm/W, 3000 °K, poor to fair color °T
    - Low pressure: 18-185 W, 100-200 lm/W, no color rendering (one λ)

Electric lighting

- Incandescent lamps
- Discharge lamps
- Induction lamps (electrodeless)
  - EM induction → discharge
    - 70 to 150 W
    - 65 lm/W
    - 3000 °K
    - pretty good color rendering

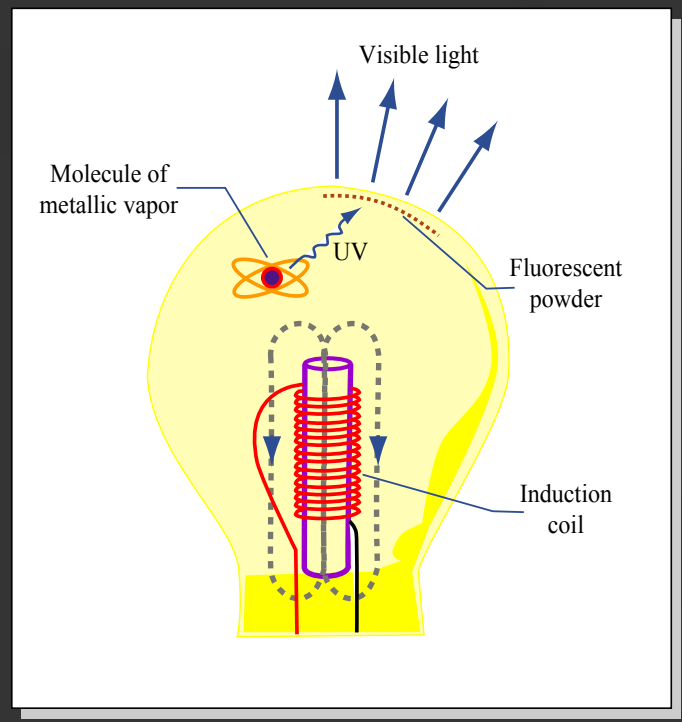


Figure by MIT OCW.

Electric lighting

- Kinds of luminaires
  - point sources
    - central / axial symmetry

  vs.

  - linear sources
    - transverse symmetry
    - longitudinal symmetry

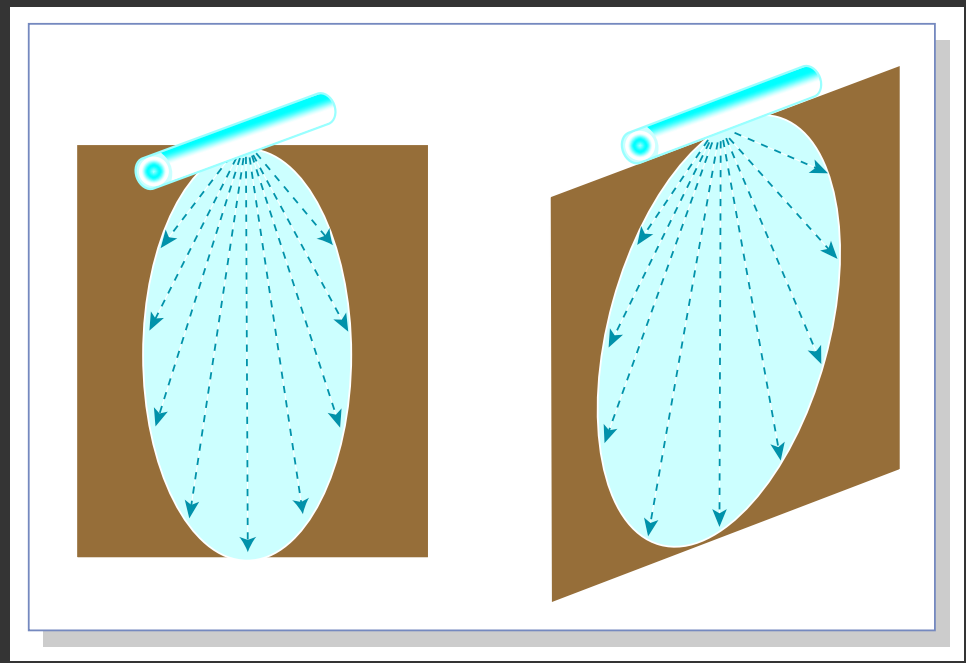


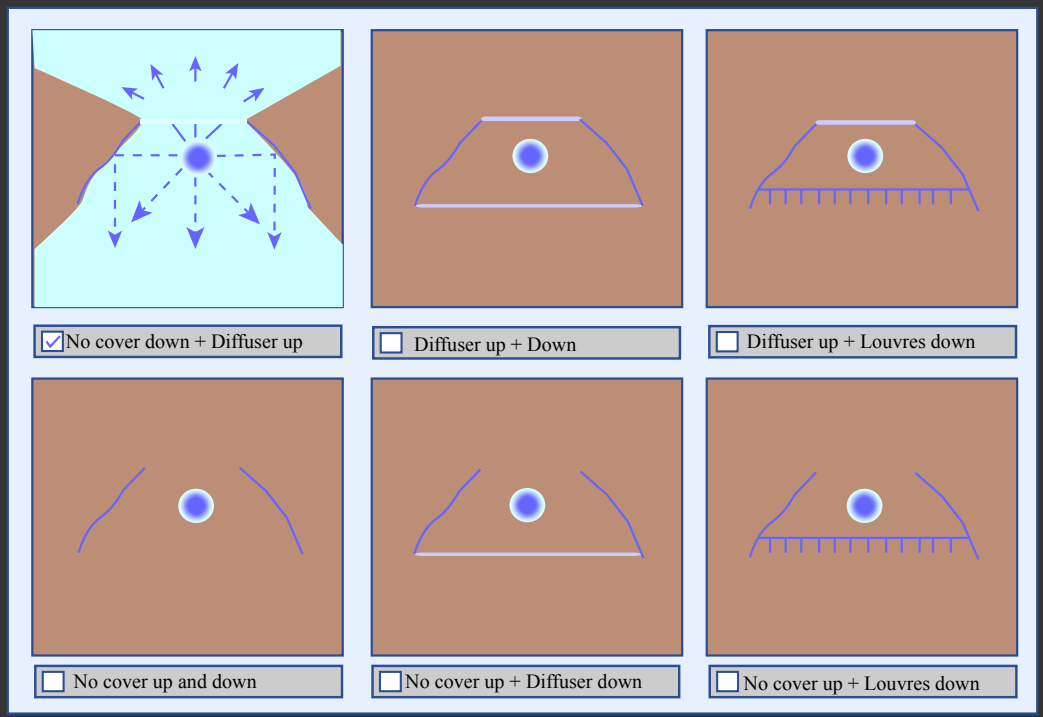
Figure by MIT OCW.

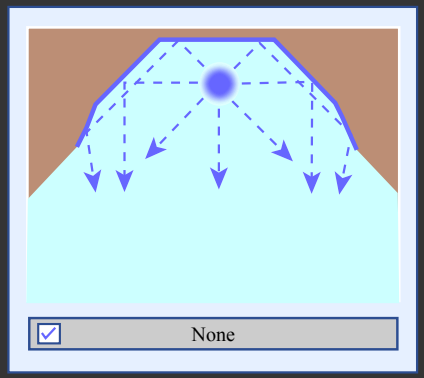
Electric lighting

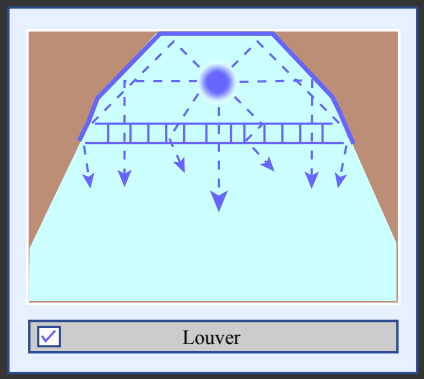
- Kinds of luminaires
  - Direct extensive
  - Direct intensive
  - Indirect
  - Direct indirect
  - Asymmetrical

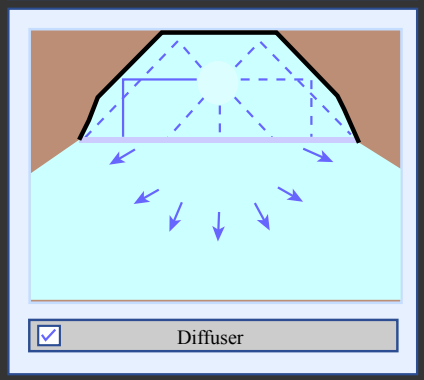
Electric lighting

- Optics and Reflectors for control
  - emitted flux
  - distribution









Figures by MIT OCW.

Electric lighting

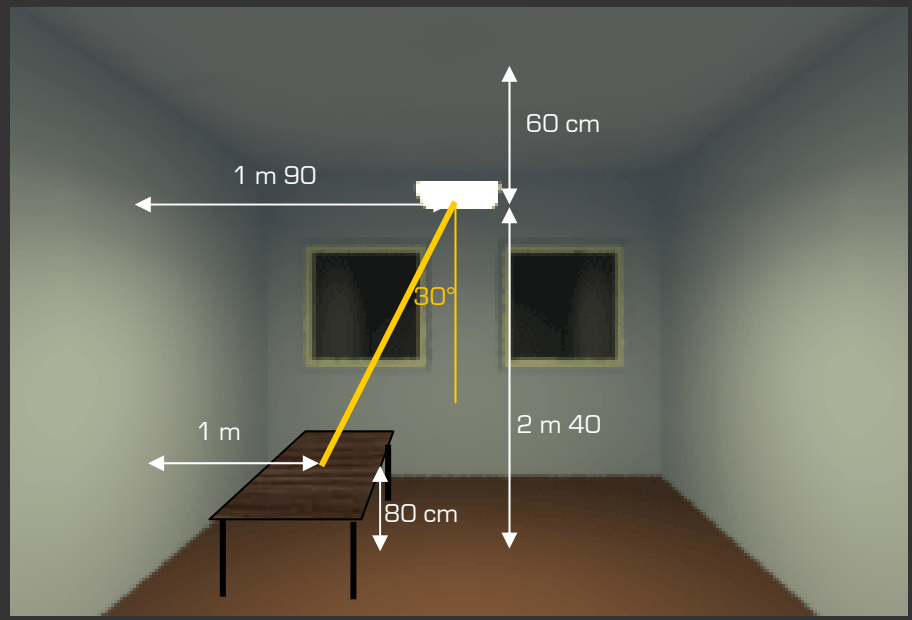
- Catalog information
  - Light Output Ratio (LOR)
  - Glare control (based on various glare or visual comfort metrics)
  - Light intensity distribution (LID)
- Variants and others
  - illuminance maps at given distance
  - coefficients of utilization
  - luminances, lumens by zone...

Electric lighting

- Intensity distributions
  - IES 01
  - IES12
  - IES 06
  - IES 15
  - IES 02

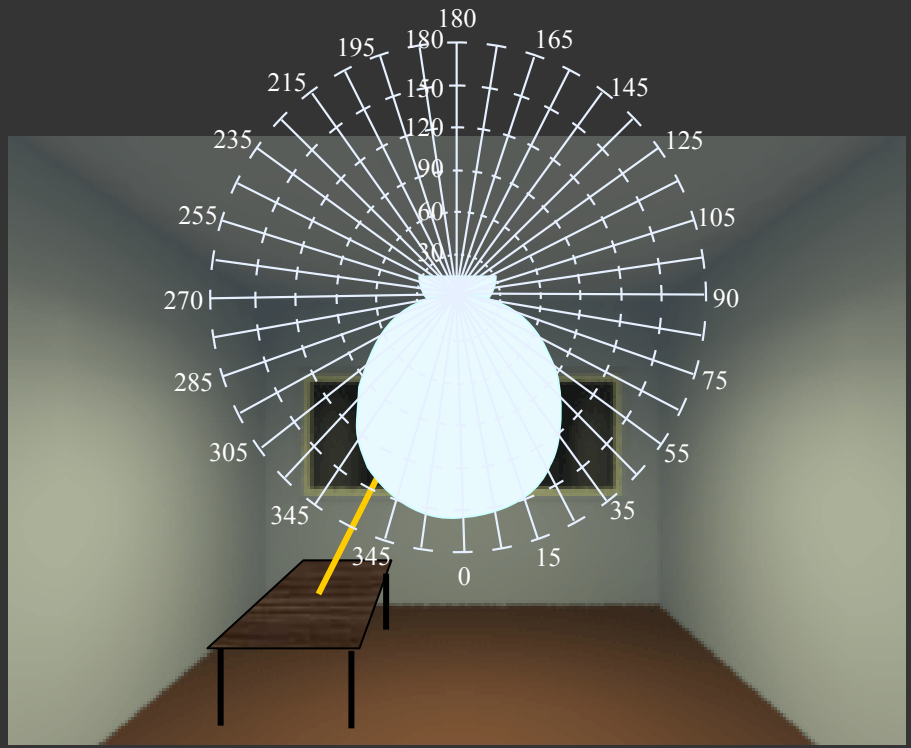
Electric lighting

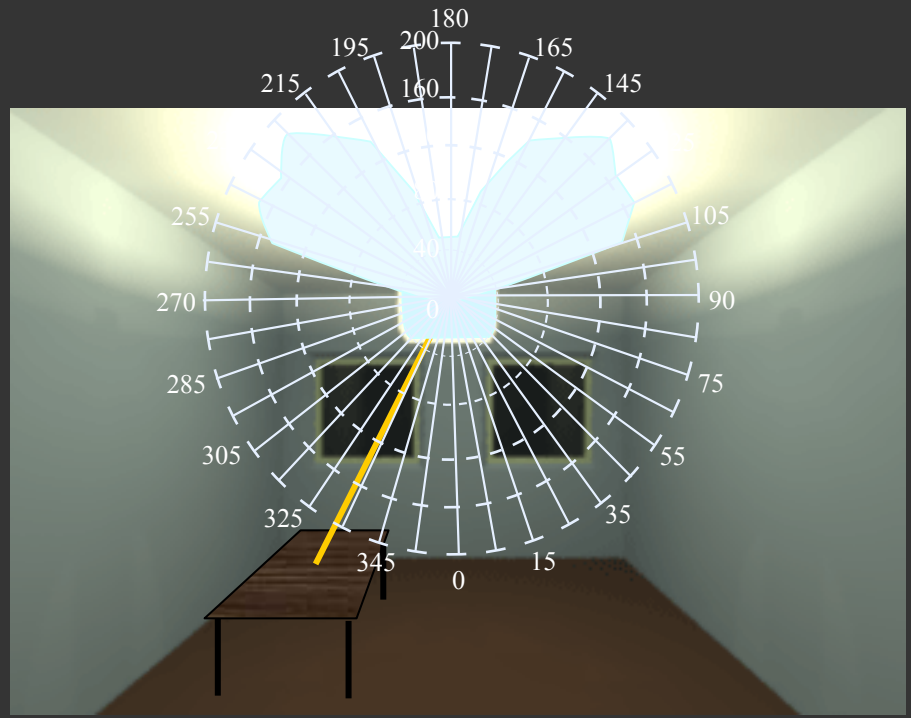
- Intensity distributions
  - Which luminaire should I choose to illuminate my desk efficiently?



Electric lighting

- Intensity distributions
  - Which of these luminaires should I choose to optimize my desk's illumination?

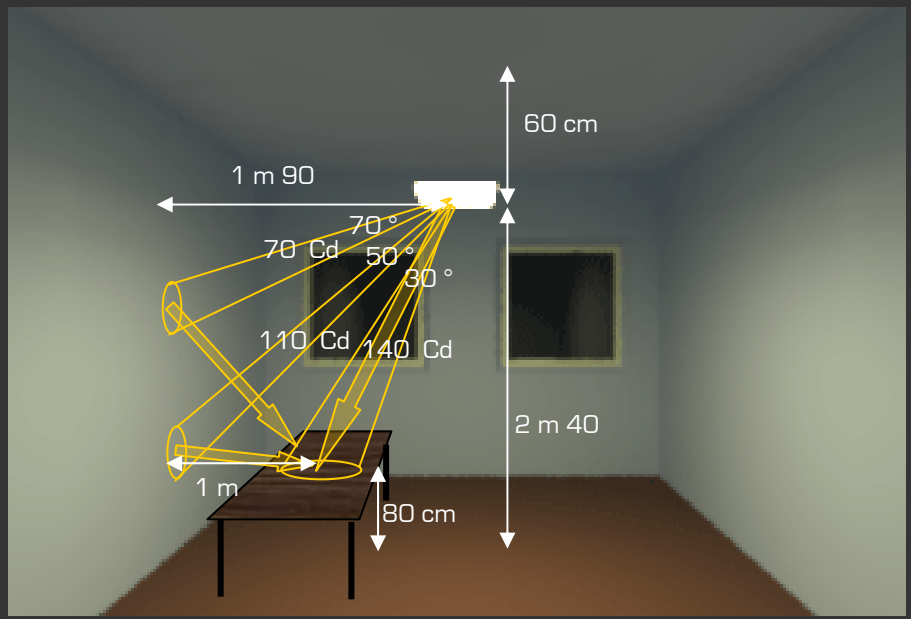


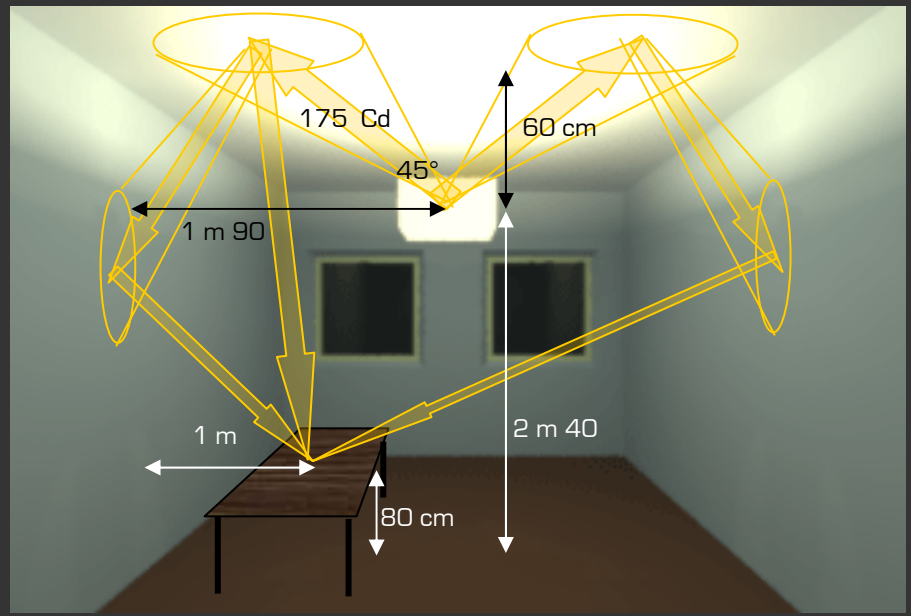


Figures by MIT OCW.

Electric lighting

- Intensity distributions
  - Which of these luminaires should I choose to optimize my desk's illumination?





Electric lighting

Coefficients of utilization (CU): Lumen method

- Objective: calculate average illuminance $\bar{E}_{workplane}$ = total Φ_{wp} / A_{wp}
- CU definition: % of lamp lumens reaching workplane

→ $\bar{E}_{workplane}$ = (Nb luminaires) x (Lumens per luminaire) x CU x LLF / $A_{workplane}$

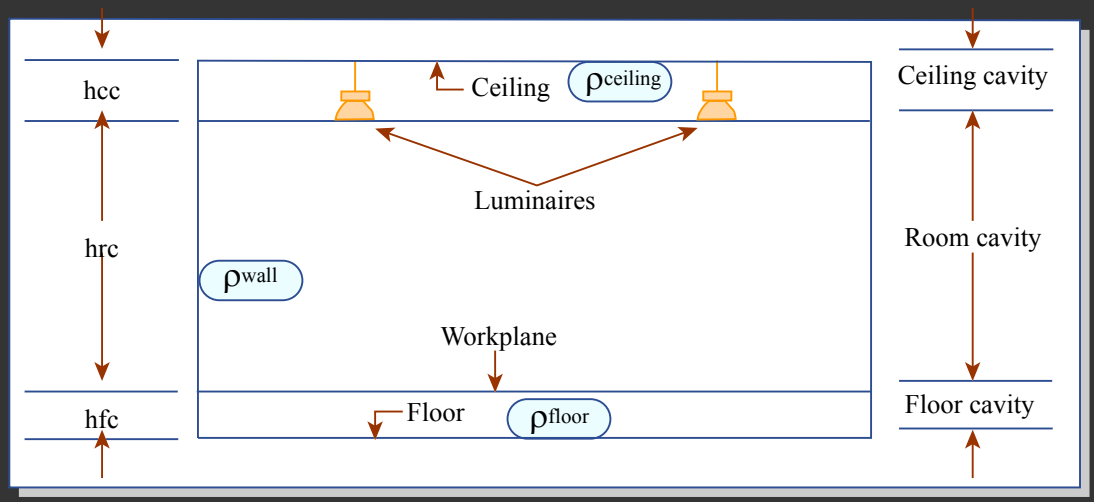


Figure by MIT OCW.

Electric lighting

- Efficiency of a lighting installation
  - lighting equipment used
  - lighting installation design
  - electric lighting use

Electric lighting

- Reading relevant to lecture topics:
  - "Heating Cooling Lighting" by Lechner: Chap 14
  - "IESNA Lighting Handbook" (9th Ed.): Chap 6-7 + Chap 9
  - "Introduction to Architectural Science " by Szokolay: § 2.5