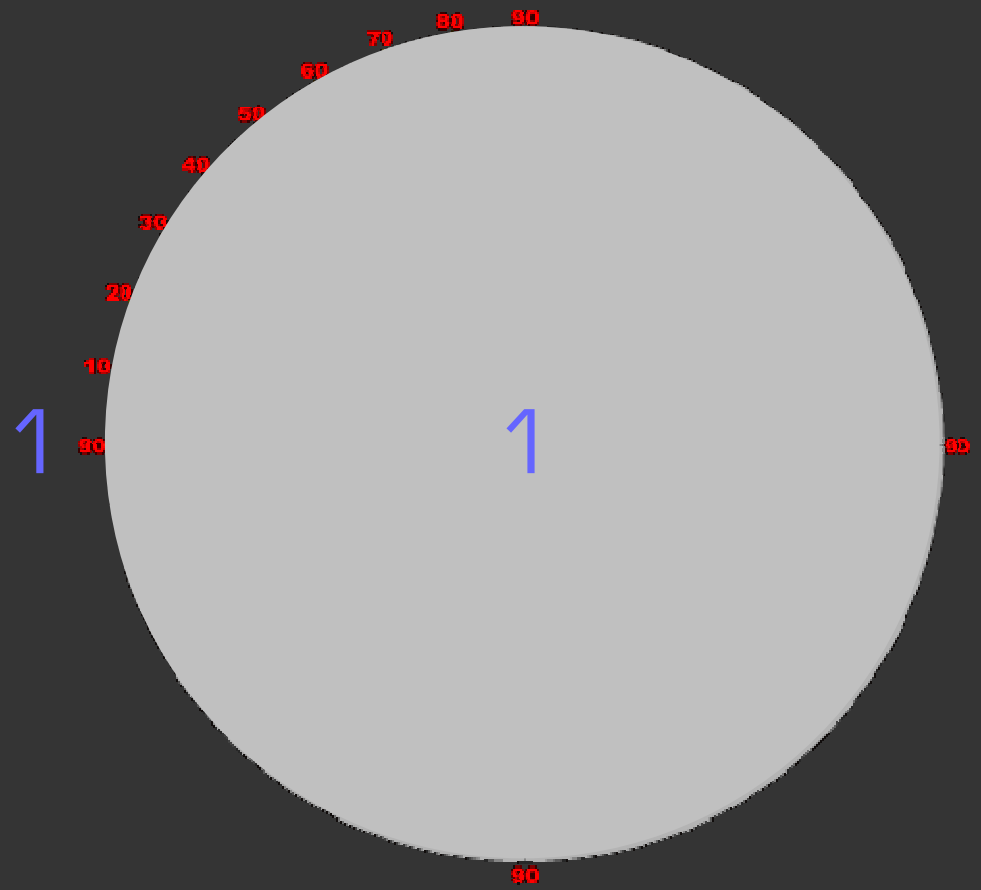
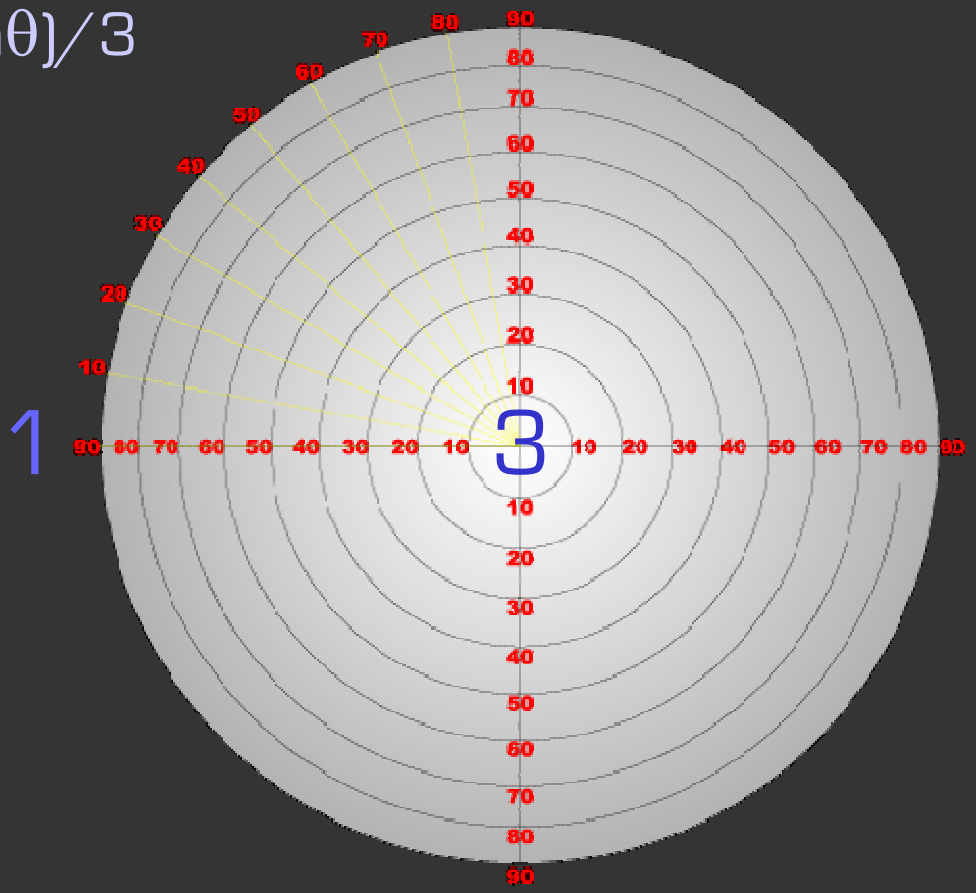
Sky models

- Overcast sky
  - 7’000 (winter) to 20’000 (summer) lux on ground
  - uniform $L(\theta)=L_z$



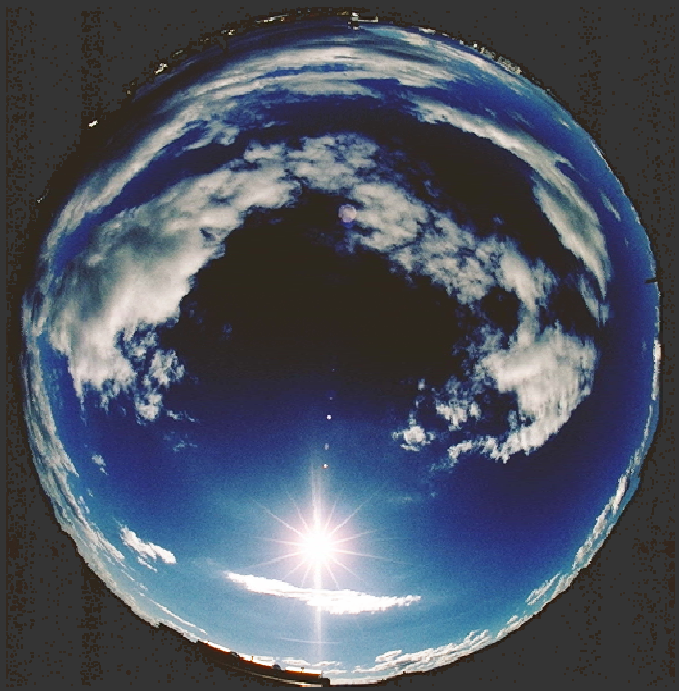
Sky models

- Overcast sky
  - 7'000 (winter) to 20'000 (summer) lux on ground
  - CIE overcast $L(\theta)=L_z(1+2\sin\theta)/3$



Sky models

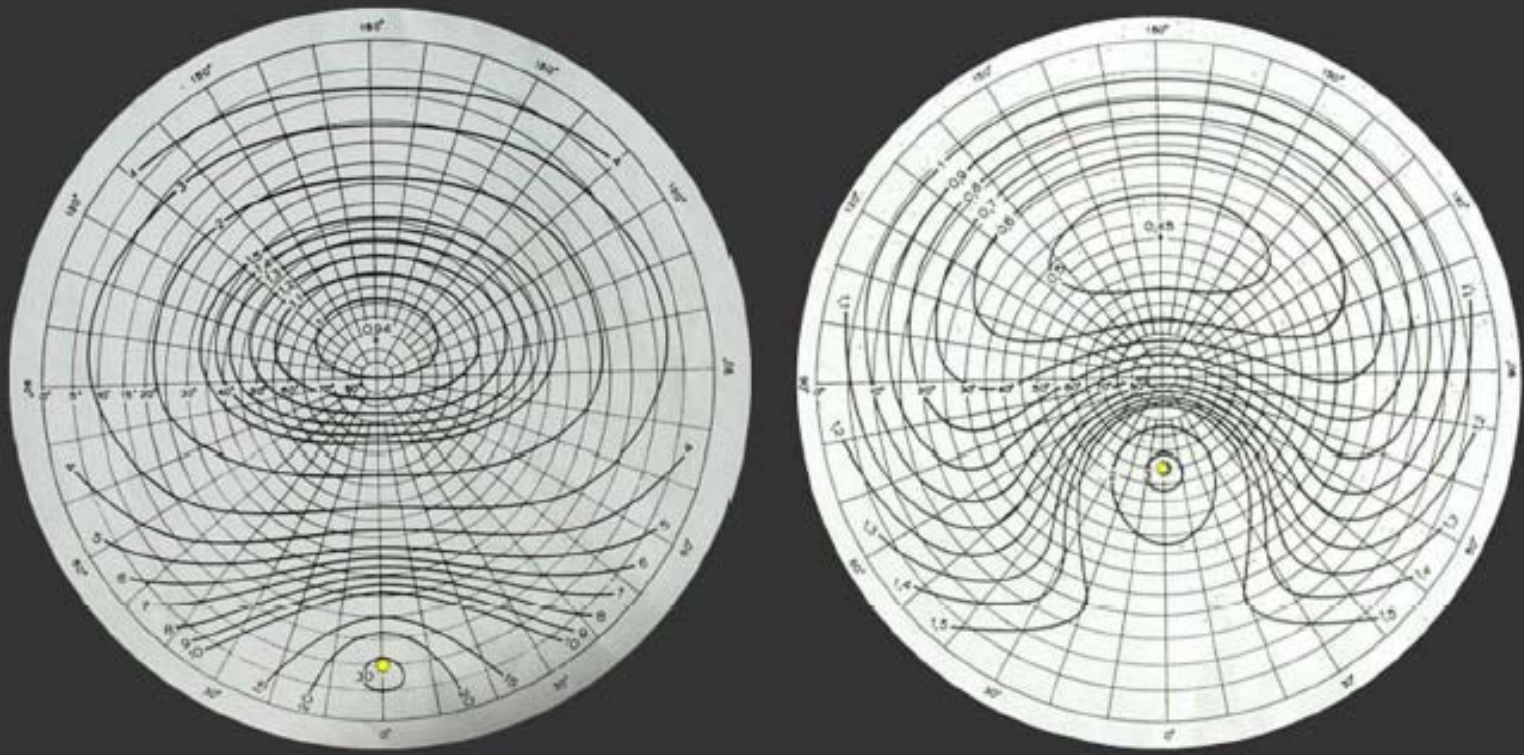
- Clear sky
  - 30’000 (winter) to 100’000 (summer) lux on ground



Sky models

- Clear sky
  - CIE clear sky model

    L = fction of zenith luminance and sun position



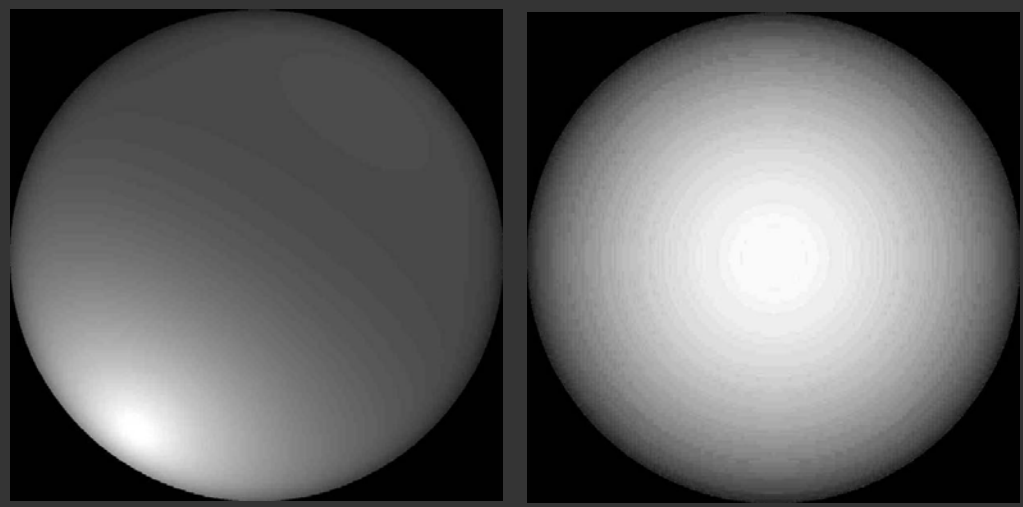
Sky models

- Clear sky
  - CIE clear sky model

    L = fction of zenith luminance and sun position
  - Perez All Weather sky model (generalization of CIE clear sky)

    L = fction of zenith luminance, sun position, dew point and 5 coefficients

  ➔ L fully defined if diffuse and direct irradiance are known



Ex. for overcast: Perez vs. CIE

Average Daylight Factor calculation

- Empirical formula

$$DF_{average} = \frac{\sum(W \cdot \tau \cdot \theta \cdot m)}{A(1 - R_2)}$$

where

W = Area of each window (m^2),

τ = Transmittance of each glazing material

θ = Vertical angle of sky as seen from centre of each window

m = Maintenance factor based on angle of glazing and cleanliness (0.5 – 0.9),

A = Total internal surface area of space, including walls, floors, ceilings & windows (m^2)

R_2 = Area weighted average reflectance of all surfaces making up A

(use 0.1 as reflectance for glass).

LEED Green Building Rating System

- Daylighting credits
  - § 8.1 = Daylight 75% of spaces with DF > 2% (1 credit)
  - § 8.2 = View for 90% of occupied spaces (2 credits)
- Estimation using spreadsheet

$$\text{DF}\ [\%] = \frac{\text{Window Area [sf]}}{\text{Floor Area [sf]}} \times \text{Window Geometry} \times \frac{\text{Actual } T_{vis}}{\text{Min} T_{vis}} \times \text{Window Height Factor}$$

  - Chart for
    - Geometry Factor
    - Min T_{vis}
    - Height factor
- No information about glare, overheating...

Split-flux method for Daylight Factor

UK Building Research Establishment (BRE)

- D [%] = E_P / E_h = sum of:
  - Direct (sky) component: SC

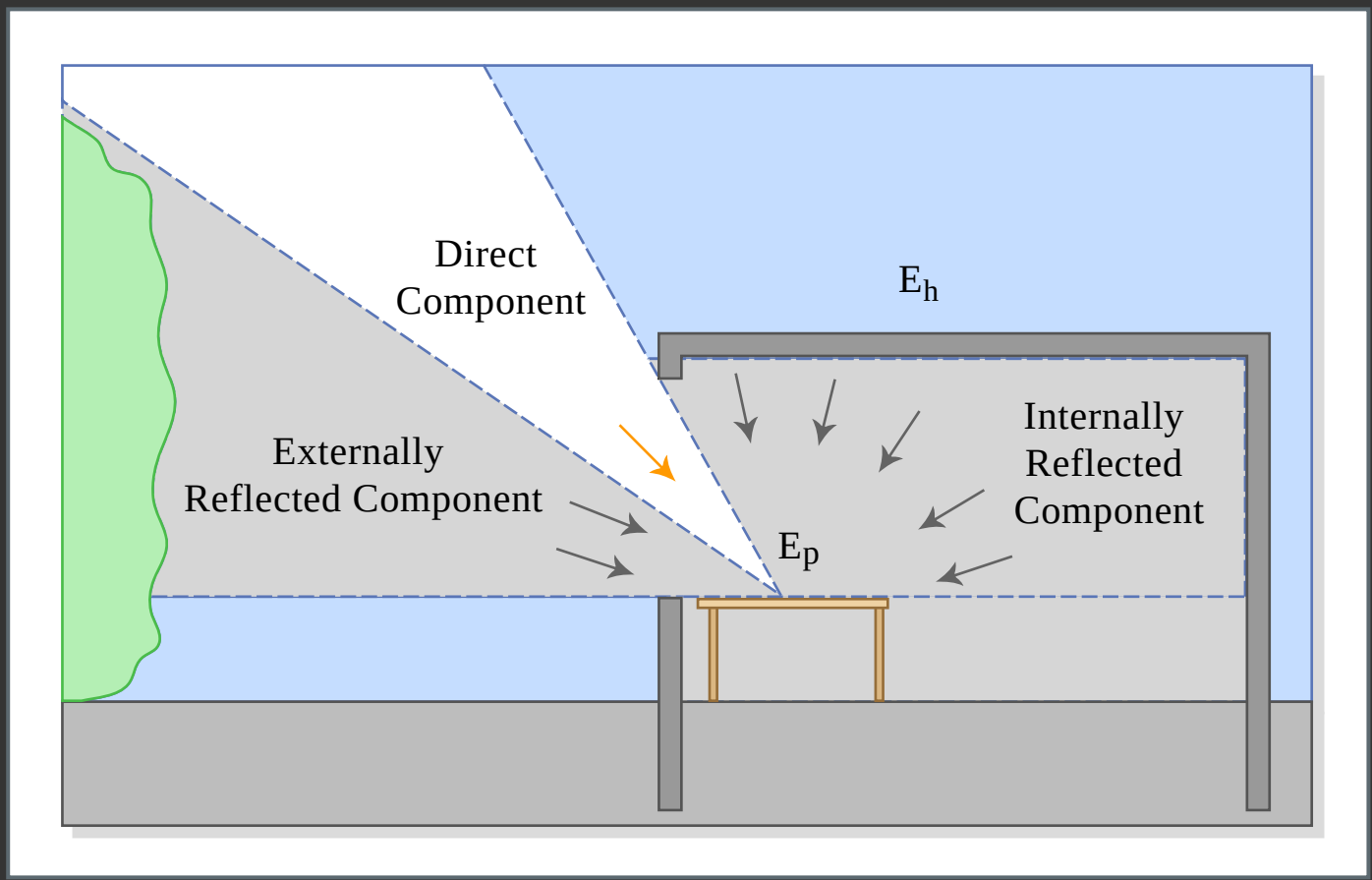


Figure by MIT OCW.

Daylighting protractor → lines of sight and correction factors

Split-flux method for Daylight Factor

- D [%] = E_P / E_h = sum of:
  - Direct (sky) component: SC
  - Externally reflected component: ERC

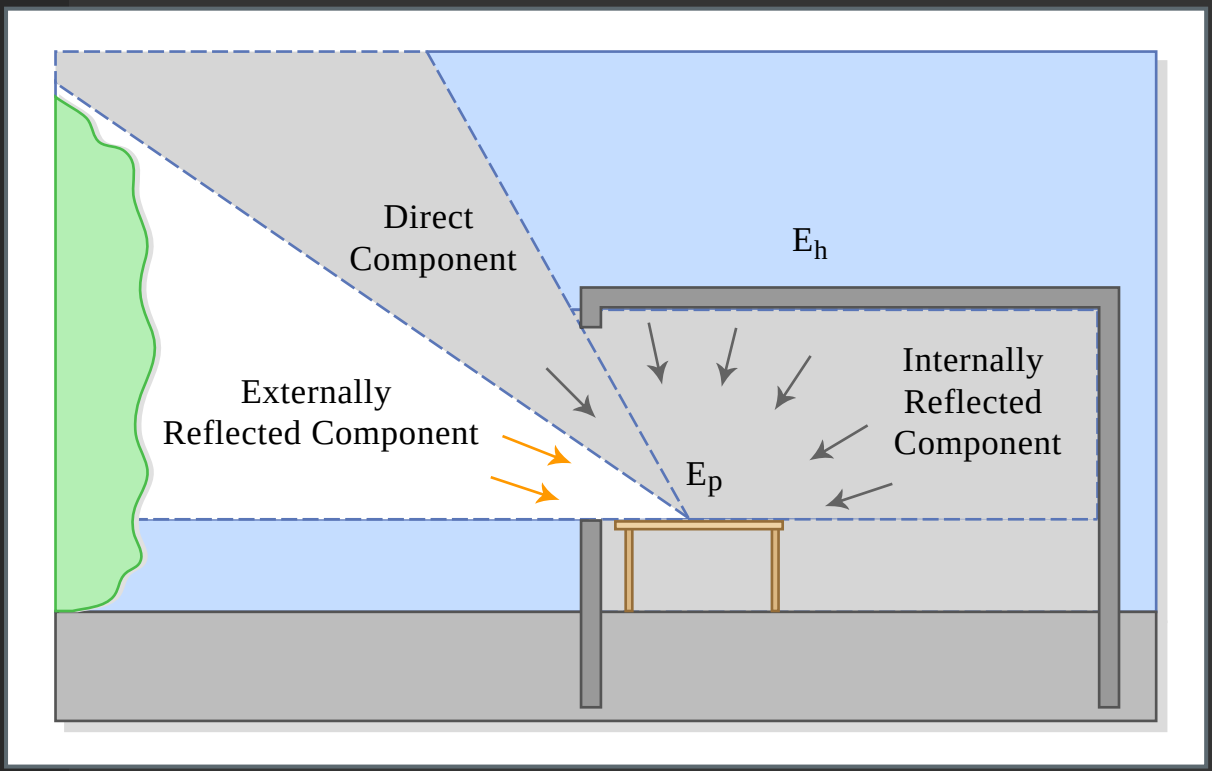
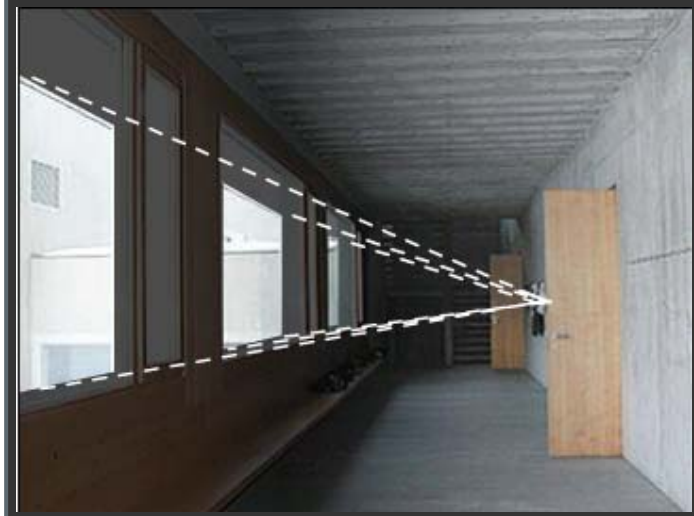


Figure by MIT OCW.



Consider as sky component with different luminance

Split-flux method for Daylight Factor

- D [%] = E_P / E_h = sum of:
  - Direct (sky) component: SC
  - Externally reflected component: ERC
  - Internally reflected component: IRC

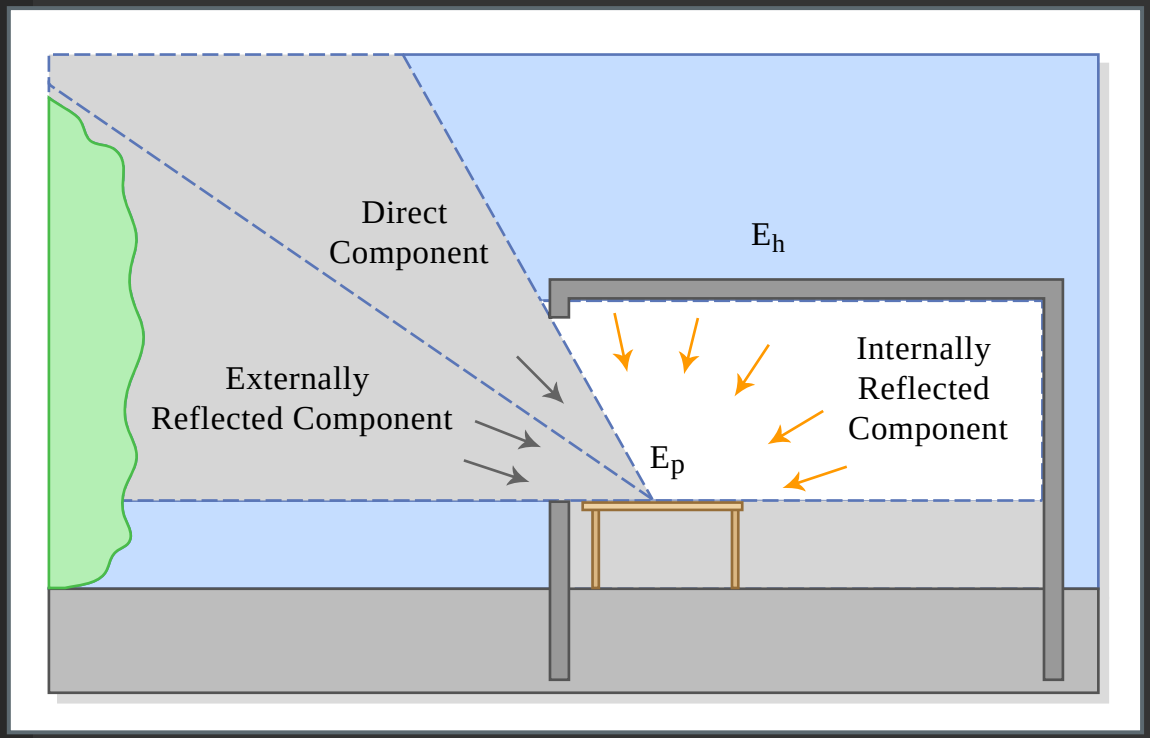
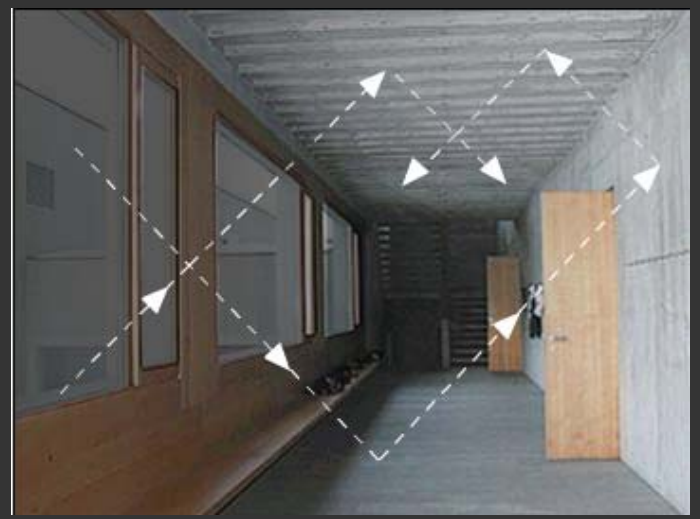


Figure by MIT OCW.



Use formula $Average\,IRC = \frac{0.85W}{A(1-\rho)} \times (C\,\rho_{fw} + 5\,\rho_{cw})$