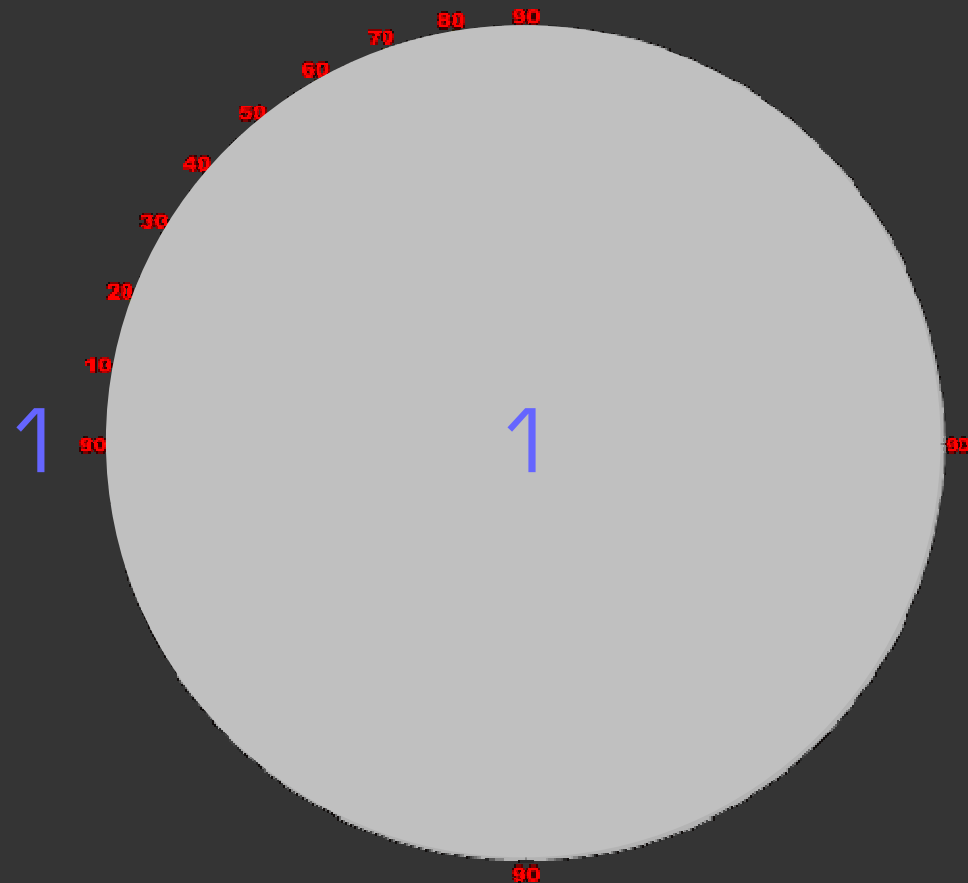


Sky models

► Overcast sky

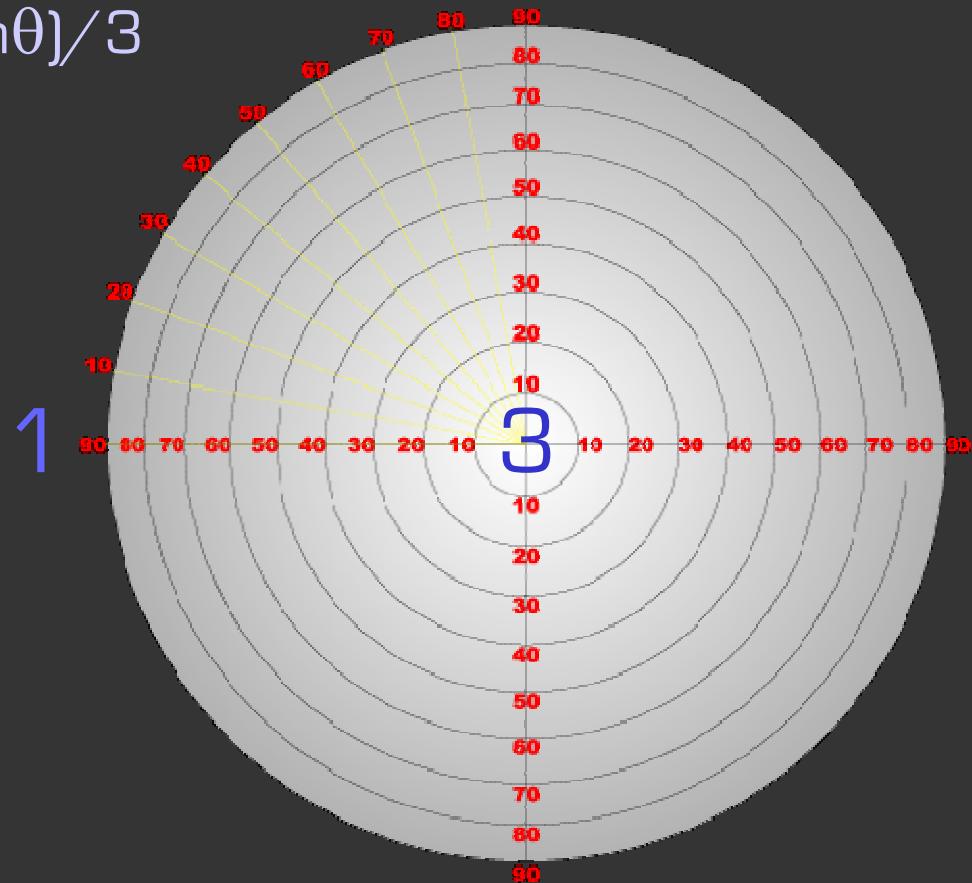
- 7'000 (winter) to 20'000 (summer) lux on ground
- uniform $L(\theta)=L_z$



Sky models

► Overcast sky

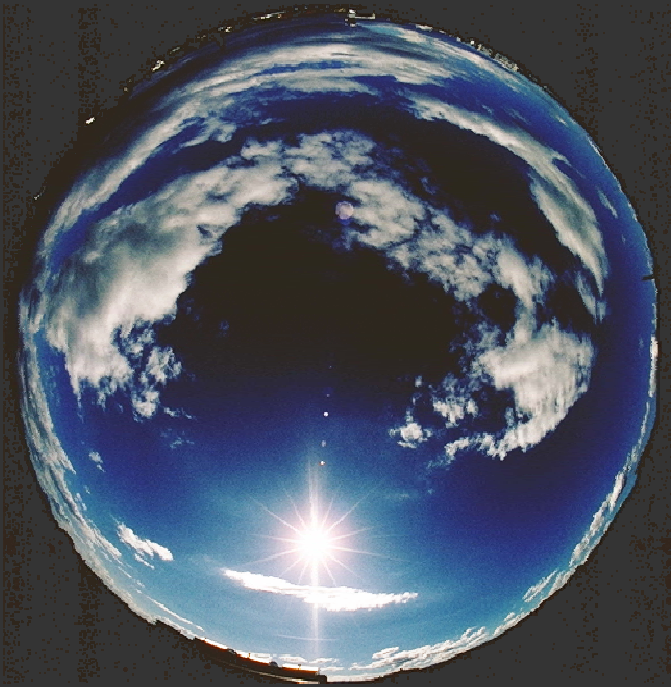
- 7'000 (winter) to 20'000 (summer) lux on ground
- CIE overcast $L(\theta) = L_z (1 + 2 \sin \theta) / 3$



Sky models

► Clear sky

- 30'000 (winter) to 100'000 (summer) lux on ground

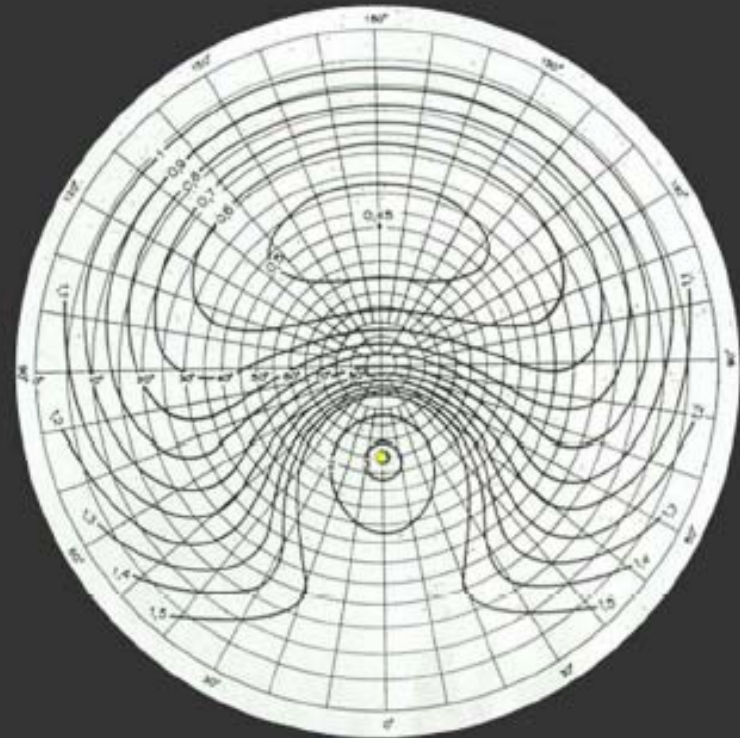
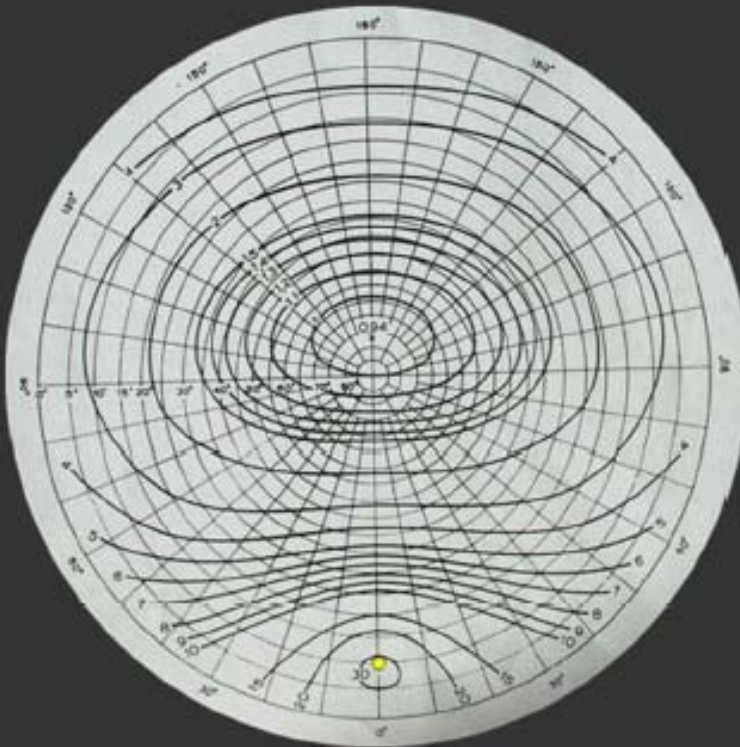


Sky models

► Clear sky

■ CIE clear sky model

L = fctn of zenith luminance and sun position



Sky models

► Clear sky

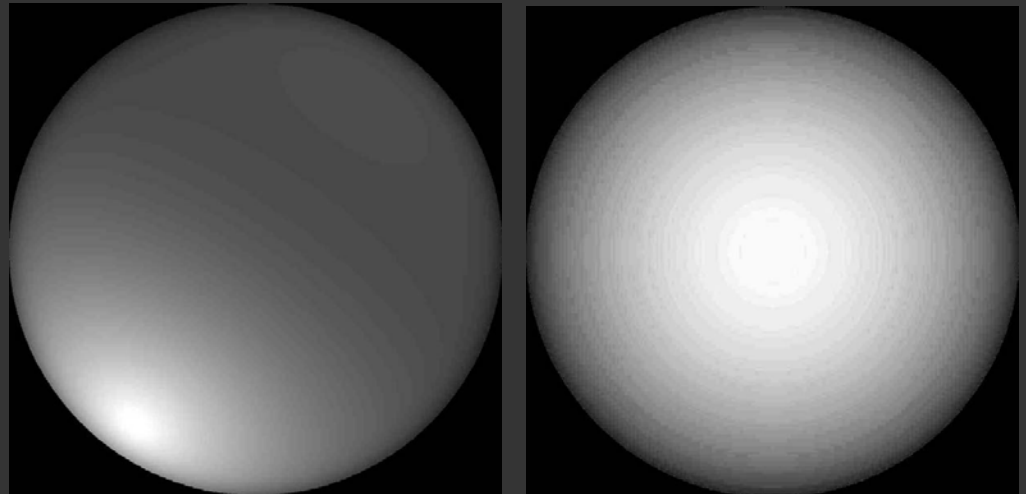
- CIE clear sky model

 - 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

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

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

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

- 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)

- ▶ $D [\%] = E_p / E_h = \text{sum of:}$
 - Direct (sky) component: SC

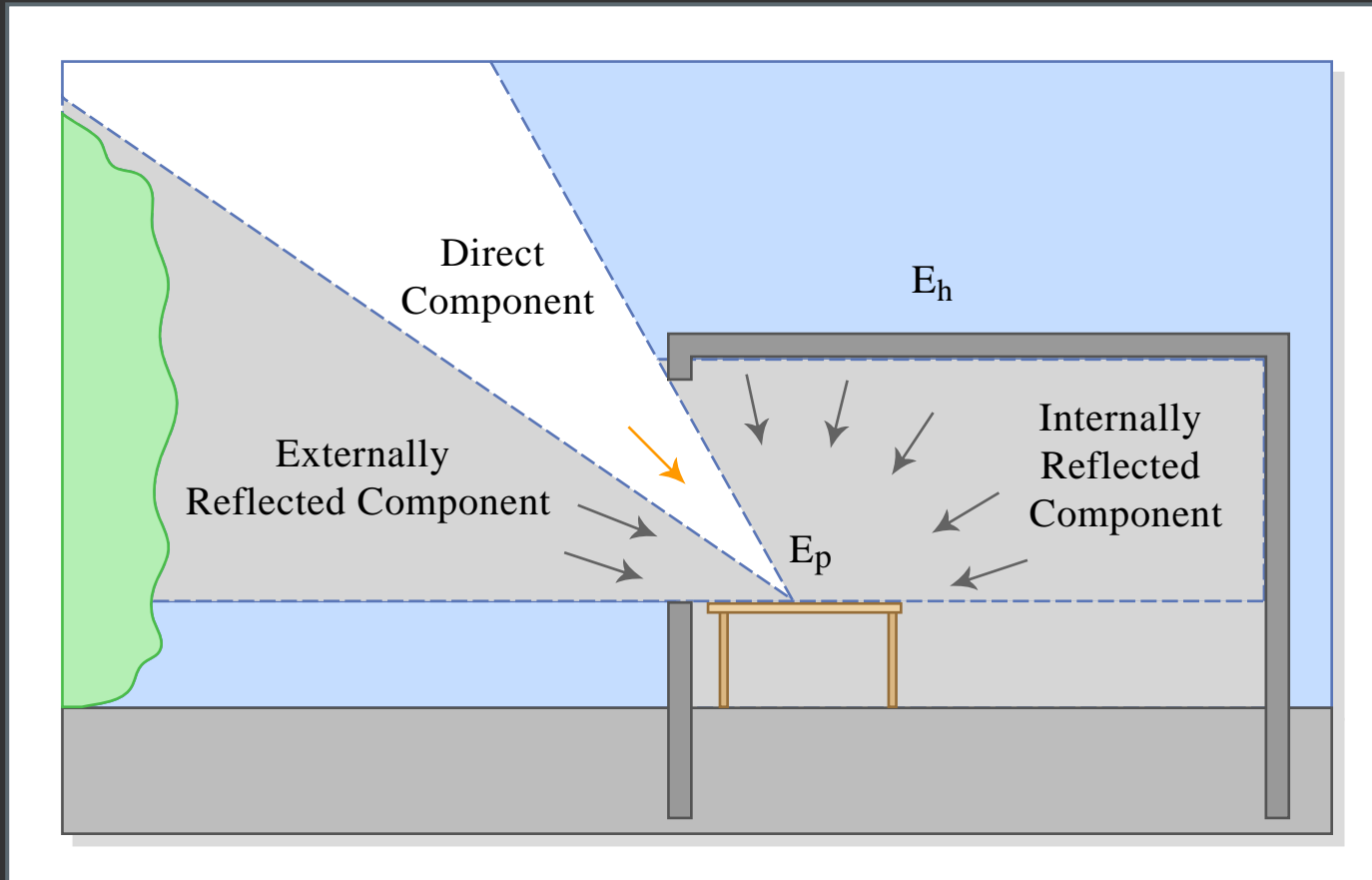
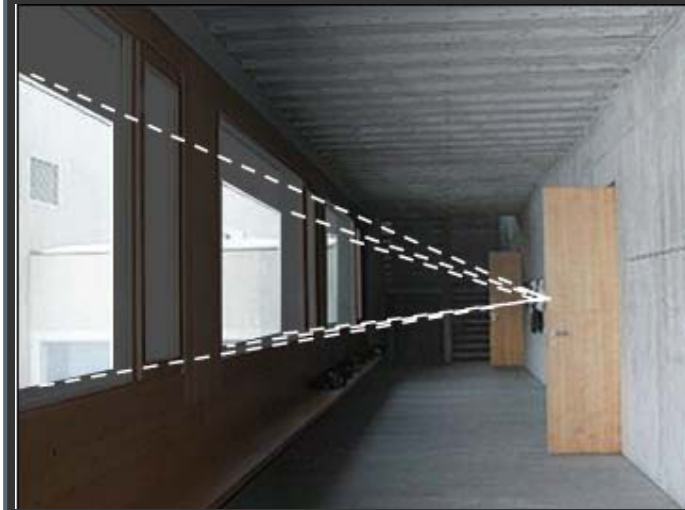
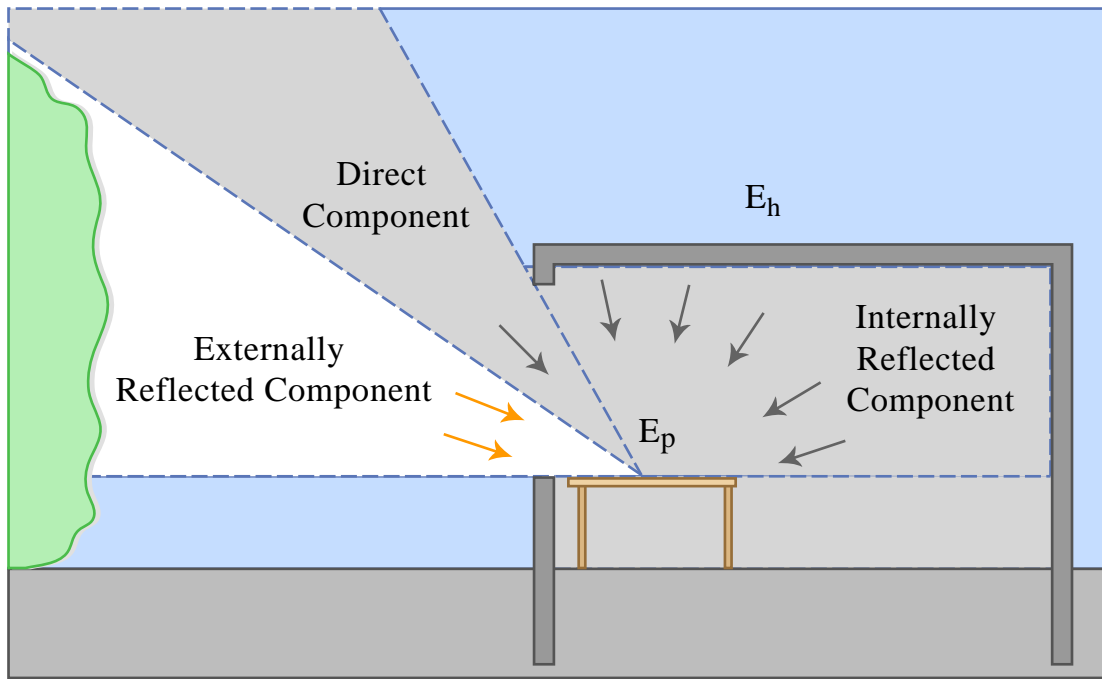


Figure by MIT OCW.

Daylighting protractor → lines of sight and correction factors

Split-flux method for Daylight Factor

- ▶ $D [\%] = E_p / E_h = \text{sum of:}$
 - Direct (sky) component: SC
 - Externally reflected component: ERC



Consider as sky component with different luminance

Figure by MIT OCW.

Split-flux method for Daylight Factor

- ▶ $D [\%] = E_p / E_h = \text{sum of:}$
 - Direct (sky) component: SC
 - Externally reflected component: ERC
 - Internally reflected component: IRC

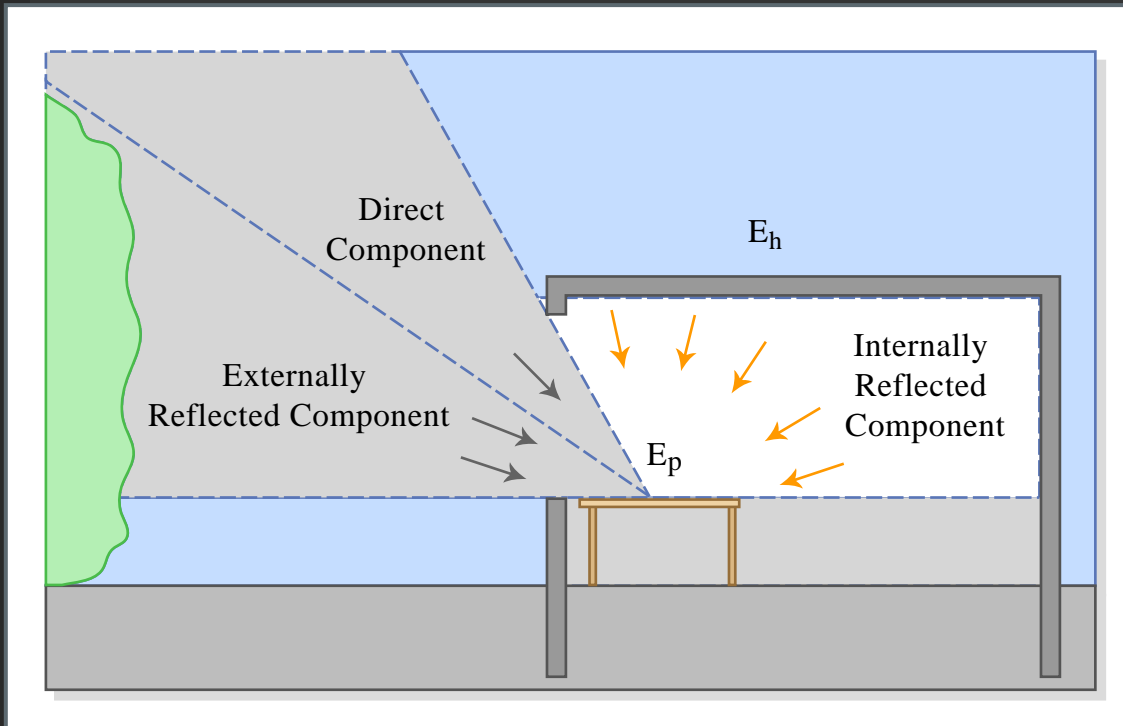
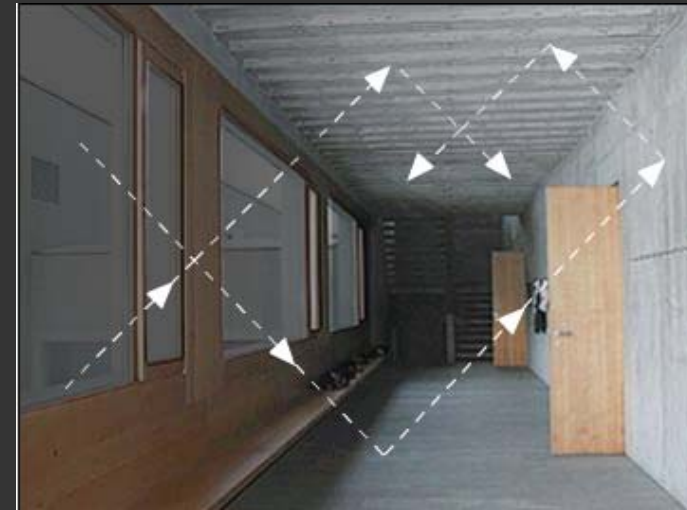


Figure by MIT OCW.



Use formula

$$\text{Average IRC} = \frac{0.85W}{A(1-\rho)} \times (C\rho_{sw} + 5\rho_{cw})$$