



QUICK GUIDE TO LIGHTING DESIGN

Lumen method of calculation

The various unknowns in general illumination, such as footcandle levels, number of luminaires, etc., are determined by the lumen method. The method relates total light output in lumens from lamps to (1) the efficiency of the luminaire and (2) the efficiency of the room in utilizing the lumen output. Factors affecting efficiency of the room are room proportions, distance of luminaires from the work plane, and room surface reflectances:

$$\text{Average lumens reaching work plane} = \text{total initial lamp lumens} \times \text{CU} \times \text{MF}$$

$$\begin{aligned} \text{Average footcandles at work plane} &= \frac{\text{total initial lamp lumens} \times \text{CU} \times \text{MF}}{\text{area of room in sq ft}} \\ &= \text{total watts per sq ft} \times \text{overall lumens per watt} \times \text{CU} \times \text{MF} \end{aligned}$$

$$\text{Area per luminaire (sq ft)} = \frac{\text{initial lumens per lamp} \times \text{no. of lamps per luminaire} \times \text{CU} \times \text{MF}}{\text{average footcandle level desired}}$$

$$\text{Total watts per sq ft} = \frac{\text{average footcandle level desired}}{\text{overall lumens per watt} \times \text{CU} \times \text{MF}}$$

$$\text{Number of lamps} = \frac{\text{footcandles} \times \text{area}}{\text{lumens per lamp} \times \text{CU} \times \text{MF}}$$

$$\text{Number of luminaires} = \frac{\text{footcandles} \times \text{area}}{\text{lamps per luminaire} \times \text{lumens per lamp} \times \text{CU} \times \text{MF}}$$

CU = coefficient of utilization

MF = maintenance factor

$$\text{MF} = \text{LLD} \times \text{LDD}$$

where LLD = lamp lumen depreciation factor

LDD = luminaire dirt depreciation factor

IES zonal-cavity technique for calculating coefficients of utilization

Coefficients of utilization can be determined most accurately by the zonal-cavity technique:

Ceiling cavity ratio

$$\text{CCR} = \frac{5 \text{ hcc} (L + W)}{L \times W}$$

Room cavity ratio

$$\text{RCR} = \frac{5 \text{ hrc} (L + W)}{L \times W}$$

Floor cavity ratio

$$\text{FCR} = \frac{5 \text{ hfc} (L + W)}{L \times W}$$

where

hcc = distance in feet from luminaire to ceiling

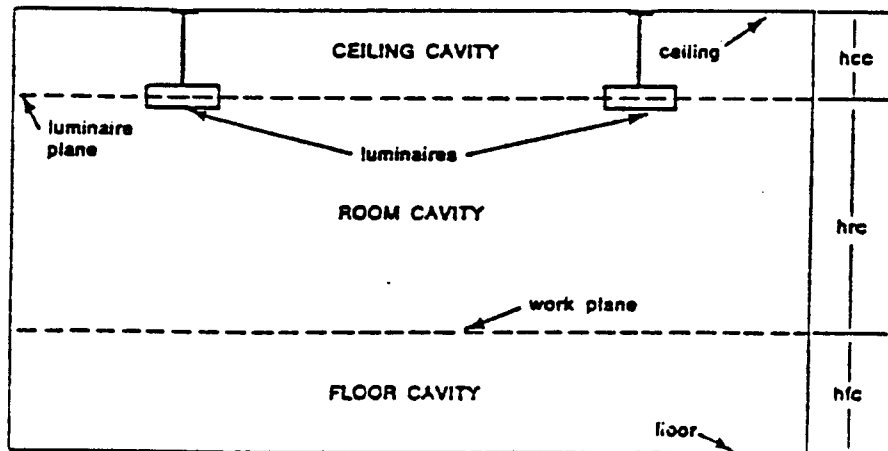
hrc = distance in feet from luminaire to work plane

hfc = distance in feet from work plane to floor

L = length of room in feet

W = width of room in feet

When cavity ratios are known, coefficients of utilization can be found in manufacturers' catalogs.



Basic cavity dimensions