

Illumination/Lighting : Part II

Lumens Method of Lighting Calculation

Calculates average illuminance on working planes to determine the number of luminaires needed for specific lighting levels, typically used for interior lighting.

Interior Lighting Formula:

$$MMI = \frac{N \times n \times \phi \times LLF \times CU}{A}$$

Where:

- **MMI** = Maintained average illuminance (lux or fc) over horizontal surface or Min. maintained illumination level
- **N** = Number of luminaires required
- **n** = Number of lamps in each luminaire
- ϕ = Lamp's original luminous flux
- **LLF** = Light loss factor
- **CU** = Co-efficient of utilization
- **A** = Area of the horizontal plane.

Outdoor Lighting Formula:

$$N = \frac{MMI \times A}{n \times \phi \times LLF \times CU}$$

Where:

- **MMI** = Maintained average illuminance (lux or fc) over horizontal surface or Min. maintained illumination level
- **N** = Number of luminaires required
- **n** = Number of lamps in each luminaire
- ϕ = Lamp's original luminous flux
- **LLF** = Light loss factor
- **CU** = Co-efficient of utilization
- **A** = Area of the horizontal plane.

OR

- **A** = Roadway Width x Spacing (For outdoor application such as roadway lighting)

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Light Loss Factor (LLF)

- **Description:** Ratio of illuminance at time ttt to initial illuminance, accounting for decreases due to factors like lamp lumen factor, luminaire maintenance, and room surface maintenance.
- **Details:** Typical LLF value is 0.85, previously known as the maintenance factor, and includes components like ballast factor, ambient temperature factor, and dirt depreciation factor.

Coefficient of Utilization (CU)

- **Description:** Proportion of emitted luminous flux that reaches the working plane, influenced by factors such as room proportions, reflection, and mounting height.
- **Examples:** Direct fixture/downlight CU = 0.85, Indirect fixture CU = 50%, Spot/Accent CU = 95%, Ambient CU = 75%.

Initial Illumination Level (II)

- Initial illumination level required for the luminaires can be calculated using following formula:

$$II = \frac{MMI}{CU \times LDD \times LLD}$$

Luminous flux (ϕ)

- Luminous flux produced by the luminaires can be calculated using following formula:

$$\phi = \frac{II \times W \times L}{CU}$$