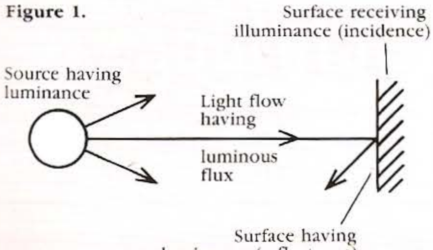
More technical information, help and advice. That was the clear message sent back by our readers in response to our survey. But how to accomplish this when the knowledge and experience of our readers ranges from student to experienced professional designers, engineers and technicians? And where interests vary from Theatre to Television, Motion Picture and Architectural Lighting. Our solution is to include a regular technical background feature to augment the reports of lighting applications and news of new equipment — and where better to begin, than with light itself.

THE MEANING OF LIGHT

THE LANGUAGE OF LIGHT

Lighting, regarded by some as an intriguing blend of art and science, possesses its own vocabulary, used to describe the lighting system shown in Fig.1.

Figure 1.



The terms most commonly employed can be summarised as follows.

- **Luminous Flux** is the output of a bare lamp, measured in lumens.
- **Luminous Intensity** is the output of the luminaire measured in candelas.
- Dividing the candela output by the square of the distance in metres gives the **illuminance.**
- **Illuminance** is the amount of light falling on a subject measured in Lux.
- **Luminance** is the amount of light reflected or brightness of the subject surface measured in candelas per square metre.

The light that a source emits is termed its **luminous flux** and is measured in **Lumens.** A lumen is defined such that a point source of light, of one candela intensity, radiating uniformly in all directions emits 4π lumens. Section 6 of *The Strandbook* reveals a staggering range of lamp lumen 'packages' from a modest 5000 lumens, for a 300W M38, to a massive 1,100,000 lumens, for a 12kW HMI! This figure, for an individual lamp is the total output measured by integrating or summing the luminous flux output over all directions emitted.

Lamps are used in housings referred to as luminaires. A luminaire is an assembly providing mechanical support and electrical connection to the lamp and incorporates a means of controlling the light emitted by the lamp. It will also comply with appropriate standards for electrical safety. Whilst the output of a luminaire may have any area, simplifications become available if it is small enough such that it can be treated as a **point source** and thus it may be considered to have a single luminous intensity for each direction.

A luminaire at a distance of several metres can usually be considered a point source of light. Thus calculations on luminaire output may be simply made (using only distance and intensity) provided that the distance is at least ten times the source size. Calibration of luminaire intensity is normally made at a distance of 10 metres.

If we now direct our source towards a surface, then the luminous flux (light) causes a certain amount of **illumination** of that surface, termed **illuminance**. The illuminance caused by 1 lumen uniformly on 1 square metre is defined as **1 Lux** in the SI system*, alternatively **1 Foot-candles** for 1 lumen falling on 1 square foot.

If we refer to the luminaire sections of *The Strandbook* we find figures of illuminance quoted at selected distances from the luminaire. We will also note that illuminance reduces in proportion to the square of the distance from the source to the surface; generally referred to as the inverse square law.

For fixed lighting installations recommended illuminances for a wide variety of applications are published by professional bodies such as the CIBSE in Britain or the IES in America, and are appropriate to particular visual tasks or work place situations being lit.

Whilst a certain amount of light may be incident on a surface its brightness, known as **luminance**, is dependent on the proportion of light reflected, governed by that surface's **reflectance**. Reflectance can range from 0 (perfect black) to 1 (perfect white).

A **Reflectance Factor** is commonly employed when evaluating contributions of light reflected from walls, ceiling and floors in addition to direct light, when calculating illuminance at the **working plane**. Most surfaces may be considered matt such that their luminance is independent of the angle of viewing. Surfaces with specular properties will preferentially reflect light, a phenomenon utilised in reflector design in luminaires.

**SI is the International Systems of Unit of Measurement.*

**The Strandbook offer — see page 15.*

TERMS, DEFINITIONS AND CONVERSIONS

The lamp is a source of light whose 'brightness' is known as **luminous intensity**, once more familiarly measured in candle power, but now in **Candelas** (cd). Whilst an ideal light source would radiate evenly in all directions, when the light source cannot be considered as an homogeneous whole, then its intensity is described appropriate to the area under consideration. Thus the term **Luminance** is introduced as the intensity per unit area of a body's surface and is measured in **Candelas per square metre** (cd/m^2) or old units such as **Foot-Lamberts**.

Luminous Intensity: The unit of measurement is given by the luminous intensity of a plane, black body surface of 1 square centimetre area heated to 2045°K — the solidification point of platinum — which is defined to have an intensity of 60 candelas.

Luminous Flux: A **Lumen** is the luminous flux emitted by a uniform point source of 1 candela intensity in 1 steradian. A steradian is the solid angle subtended at the centre of a sphere of unit radius by one square unit area on the surface. The total luminous flux thus emitted by the source is 4π lumens.

Illuminance: The illuminance caused by 1 lumen on 1 square metre is defined as 1 **Lux.**

Luminance: $\text{Luminance (cd/m}^2) = \dfrac{\text{Illuminance (lux)} \times \text{Reflectance}}{\pi}$

Lux: $= \dfrac{\text{Candelas}}{\text{Distance}^2\ (\text{m})}$ Foot Candles $= \dfrac{\text{Candelas}}{\text{Distance}^2\ (\text{ft})}$

Inverse Square Law: If a luminaire gives an illuminance of L1 Lux at distance D1 metres, then it will give illuminance L2 at distance D2, (assuming linear beam divergence).

Thus $L2 = L1 \times \dfrac{D1^2}{D2^2}$

Conversion Factors (SI Units to Imperial).

1 candela per sq. metre (cd/m^2) = 0.2919 Foot-Lamberts (fl)

1 candela per sq. metre (cd/m^2) = π Apostilb (asb).

1 Lux = 0.0929 Foot candles (fc).

Thus Lux = 10.76 × Foot-candles and Foot-candles = 0.0929 × Lux.