The quantities of light
Date: Venerdì, febbraio 15 @ 12:21:35 CET
Topic: Educational Lighting Site

There are four fundamental quantities to know:

1) Luminous flux: unit of measurement: lumen (lm), this unit of measurement indicates the quantity of light energy emitted in the time unit; a second away from a source. Light energy means, by convention, the energy emitted in the interval from 380 to 780 nanometers. For lamps, CIE rules establish that the measurement of the luminous flux emitted is to be measured after 100 hours of functioning.

2) Light intensity: unit of measurement: candela (cd): it indicates the quantity of luminous flux emitted by a source inside the solid angle in a given direction. A point light source emits a radiation with the same intensity in all directions, its luminous flux, then, propagates uniformly as if it were generated inside a sphere. Artificial light sources do not emit light uniformly in all spatial directions, the practical system to visualize the distribution of the light emitted by a source in space consists of representing luminous intensities, as if they were vectors applied in the same place, as rays radiating from the centre of a sphere. The catalogues of light devices often quote photometric curves, i.e. the sections of the photometric solid, on two main orthogonal planes intersected on the symmetry and rotation axis. The knowledge of photometric curves is very important because on its basis it is possible to verify if the chosen light device distributes the light in the required way.

3) Illumination: unit of measurement: lux (lx): it is the ratio between the luminous flux received by a surface and the same area. In other words, it indicates the quantity of light that hits a surface unit.

4) Luminance: unit of measurement: candela sq m (cd/sqm): it is the ratio between the light intensity emitted by a surface in a given direction and the apparent area of such surface. In practice it indicates the sensation of luminousness which is received by a primary or secondary light source. A primary source is a body that emits radiations directly; a secondary source is a body that reflects the radiations emitted by a primary source. It is important to have a clear idea of the difference between illumination and luminance, while the first quantity indicates the quantity of light emitted by a source that hits a given surface, the second indicates the sensation of luminousness that we receive from this surface; it means that on two surfaces, a white one and a black one, we can have the same illumination value, e.g. 500 lx, but the sensation of luminousness received and thus the luminance will be completely different in that those two surfaces reflect the light differently.

Lm/WLight intensityCandela cdIt represents the percentage of luminous flux of a light source in a specific direction. It serves to calculate light distribution. For lamps with an integrated reflector with a beamed luminous flux it is more practical than the luminous fluxIlluminationLux lxIt represents the luminous flux per m on an illuminated surface (1

lx= 1lm/m). Thanks to its extreme simplicity it is the most frequently used reference employed in lighting systems projectsLuminanceCd/sq m

Quantity	*Unit of measurement*	**Explanations and application**
Energy flux	***Watt W***	Electromagnetic radiating energy, generally represented as divided on the spectrum (according to the wavelength)
Visual sensibility	***V***	It defines which sections of the spectrum (ranges of wavelength) are perceived by the eye in the form of light
Luminous flux	***lumen lm***	It is the flux of energy perceived by the visual sensibility and it represents one of the most important properties of lamps: for this reason it is always indicated in the catalogues of lamps manufacturers
Light efficiency	***lm/W***	It is proportional to the performance of the transformation process of the electric power absorbed in the luminous flux, thus it is a continuous stimulus that results in lamps with an increased light efficiency and consequently with a lower energy consumption
Light intensity	***candela cd***	It represents the percentage of luminous flux of a light source in a specific direction. It serves to calculate light distribution. For lamps with an integrated reflector with a beamed luminous flux it is more practical than the luminous flux
Illumination	***lux lx***	It represents the luminous flux per m on an illuminated surface (1 lx= 1lm/m). Thanks to its extreme simplicity it is the most frequently used reference employed in lighting systems projects
Luminance	***cd/m***	It represents the luminosity of illuminated lamps and objects as it is perceived by the eye and it is the most important reference for an accurate design of lighting systems for work places where it is important to ensure an excellent vision

A one lux illumination is given by the luminous flux of one lumen that falls on a one square metre area - light quantifications and units of measurement