Artificial lighting

- it is not a natural component of the environment, it does not fully meet the physiological needs of the visual analyzer
- the development of the visual system from photosensitive spots in primitive animals to the visual analyzer of humans took place under conditions of regular (day, night) and irregular (weather) alternating intensity and quality (spectral composition) of lighting
- artificial light sources that are currently available cannot completely replace the quality of daylight. Despite significant technical progress, artificial lighting mostly lacks the dynamics of daylight and its spectral composition is usually less favorable for humans
- for a long-term stay, artificial lighting cannot be considered completely equivalent to daylight
- with the help of experiments in which the visual activity was the search for numbers in a continuous text, it was proven that, even with constant lighting, under otherwise identical conditions, visual performance is significantly higher in daylight than in artificial lighting
- with artificial lighting, a faster onset of fatigue, a greater increase in the number of errors and a longer latency time of the movement reaction to the light signal were observed

Measurement and evaluation of artificial lighting

- the invariance of artificial lighting makes it possible to measure illuminance in absolute units of lux. Daylight must be completely excluded during the measurement (perfect blackout, measurement at night)
- we choose our own measurement according to specific conditions, such as measurement of an empty room (at the control points of the comparison plane given by the relevant technical standard), or measurement in an equipped room (at the control points of the visual task)
- based on the measurements, in addition to the average illuminance value E p and the minimum value E min , we also determine the uniformity of artificial lighting r:

$$r = \frac{E_{min}}{E_P}$$

  - according to the type of visual activity, the standard distinguishes lighting categories A, B, C, D (with progressively lower demands on visual activity)
  - in categories A, B and C, the decisive criterion is visual performance before visual comfort, in category D, on the other hand, visual comfort precedes requirements for visual performance
  - requirements for visual performance are determined according to the characteristics of the activities and according to the contrast of colors and brightness of the critical detail and its surroundings (the critical detail is the size of the smallest necessarily distinguishable detail necessary for the considered visual performance)
  - Regardless of visual activity, the standard specifies the smallest permissible values of average illuminance E p and uniformity r for overall illumination according to the length of stay of people in the room (the following table):

Minimum values of illuminance and uniformity

Lenght of stay	Illumination	Uniformity
Occasional stay	20	0.1
Short-term stay category B, C	100	0.4
Permanent stay category B, C	200	0.65
Permanent stay category B, C without daylight	300	0.65

- A visual overview of artificial lighting can be obtained by supplementing the room plan with measured values, isolines for illuminance - **isoluxes**, which are defined analogously to isophotos of daylight

Additional requirements for artificial lighting

- simultaneous local (local) lighting and general lighting are called combined artificial lighting
- the intensity of the local lighting should be in a suitable proportion to the intensity of the general lighting. E.g. in healthcare facilities, when local lighting with an intensity of 1,000 lx is used, the overall lighting intensity should be at least 100 lx.
- ČSN 36 0082 gives the still satisfactory ratios for the intensities of both types of lighting (ČSN originally stood for Czechoslovak State Standards – today it stands for Czech Technical Standard)
- most used artificial lighting sources do not have a continuous spectrum of emitted radiation, this will be reflected in the reduced quality of color rendering.
- the resulting impression of a person exposed to artificial lighting also depends on the appearance of the color of the light source, or the color of the surrounding reflective surfaces, which is characterized by the so-called chromaticity temperature Tc.
- the chromaticity temperature indicates the temperature of the body in Kelvin, which emits a characteristic frequency given precisely by its temperature

- the human eye is not equally sensitive to all colors, the greatest sensitivity is found for yellow-green colors, for other colors the lighting intensity must be proportionally increased according to the changing sensitivity of the eye .
- the following table shows the dependence of color appearance on chromaticity temperature:

Color appearance according to chromaticity temperature

Chromaticity temperature T_c [K]	Color appearance	Color of light
> 5 000	cold	blue-white
3 000 – 5 000	neutral	white
< 3 000	warm	yellow

- a person's long-term experience leads to the fact that he subconsciously associates high values of lighting intensity with bright summer midday light with a high chromatic temperature (blue-white color)
- for low lighting intensity values, it rather expects lower chromatic temperatures (reddish, firelight)
- if at a given chromaticity temperature (light color) the lighting is to have a natural and pleasant effect, the lighting intensity must respect these facts, i.e. for high demands on lighting intensity, we choose sources with a high chromatic temperature (fluorescent lamps, discharge lamps), for lower demands, on the contrary, sources with a lower chromatic temperature (bulbs)
- disregarding these requirements creates a subjective feeling of over-lighting or under-lighting even with an objectively appropriate lighting intensity
- the chromaticity temperature and spectral composition of the emitted light has an effect on the presentation of the colors of the observed objects
- to evaluate the color quality of light, the general **color rendering index Ra** is used , which is calculated from the perception of eight selected test colors
- this index takes on values from 100 for very high requirements to 20 for very low requirements for color perception
- for accurate color comparison, it is therefore necessary to choose light sources with approximately the following parameters: T c =6,500 K, R a >=90, E p =1,000 lx

Note: ČSN 36 0082 is invalid from 1.11.2001 and replaced by ČSN EN 12464-1.

Links

Related articles

- Daylighting
- Visible light
- Color of fabrics

Source

- BENCKO, Vladimír. *Hygiena : Učební texty k seminářům a praktickým cvičením.* 2. přepracované a doplněné edition. Praha : Karolinum, 2002. 205 pp. pp. 126 – 128. ISBN 80-7184-551-5.