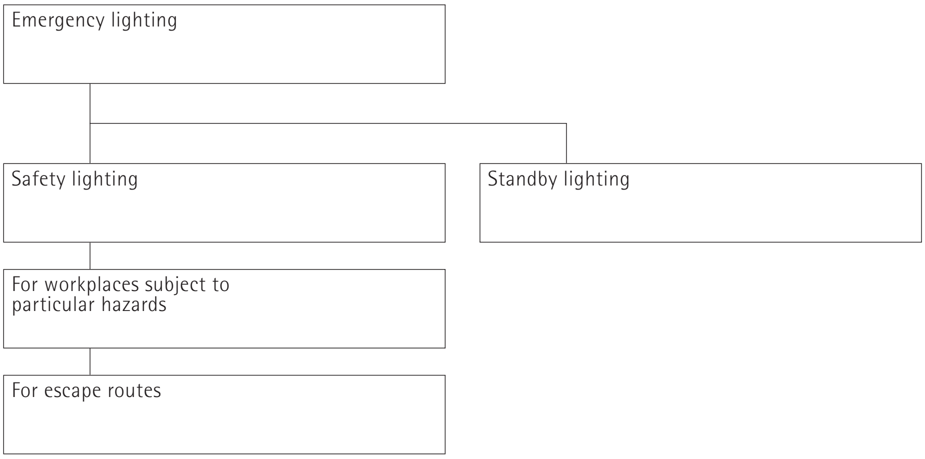


Safety lighting

Safety lighting allows people to leave rooms and buildings (safety lighting for escape routes), or to complete activities and leave rooms with workplaces that are exposed to hazards.

Regulations laid down in ASR 7/4 DIN 5035, Part 5, DIN 57108, VDE 0108.

Standby lighting

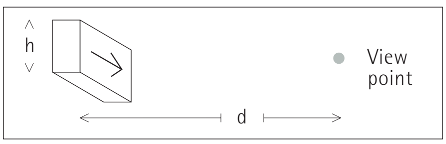
Standby lighting (usually 10 % of the rated illuminance) takes over from the artificial lighting to maintain continued operation for a defined period of time, used to limit damage and loss of production, in particular.

Regulations laid down in DIN 5035, Part 5.

Safety lighting	
Workplaces exposed to hazards	Escape routes
$E_{min} = 0.1\ E_n$ at least 15 lx E_n acc. to DIN 5035, Part 2	$E_{min} \geq 1$ lx (0.2 m above floor level) $\frac{E_{min}}{E_{max}} \geq \frac{1}{40}$
$\Delta t \leq 0.5$ s	$\Delta t \leq 15$ s (workplaces) $\Delta t \leq 1$s (meeting places, business premises)
$\Delta t \geq 1$ min, at least for the period people are subjected to danger	t = 1h (workplaces) t = 3h (meeting places, business premises)

Requirements to be met by safety lighting in workplaces exposed to hazards: minimum illuminance Emin, changeover time Δt and operating time t.

Requirements to be met by safety lighting for escape routes: minimum illuminance E_{min}, uniformity E_{min}/E_{max}, change-over time Δt and operating time t.



Min. height h of emergency exit signs in escape routes in accordance with maximum viewing distance d (acc. to DIN 4844).

Emergency exit sign, backlit

$h = \frac{d}{200}$

Illuminated emergency exit sign

$h = \frac{d}{100}$

the overall lighting is far too bright for all the other activities which will occur in the area.

There is no doubt that quantitative lighting design concepts of this kind are successful within the framework of the task that has been set, as explained above. There is a proven correlation between the quality of the light and visual performance; this corresponds to the definable effect which the quality of the lighting has on efficiency and safety at the workplace.

It is therefore justified to maintain that the standard lighting conditions recommended for a technical office must be different from those for a warehouse. But when consideration is given to the lighting required for working areas with different or changing activities the limits of quantitative lighting design concepts soon become apparent. If the task is to light a drawing board and a CAD workstation, for example – nowadays a frequent constellation – it soon becomes clear that the high illuminance level required for the drawing board is disturbing to the person working at the computer, indeed that the vertical light component required for work at the drawing board may make it impossible to work at the computer.

More light is therefore not always necessarily better light. Similarly, it is impossible to put other lighting qualities into any kind of basic order of importance – the measures taken to limit direct glare may not work at all to limit reflected glare; the light required to be able to read small print might be unbearable for reading texts printed on glossy paper. The frequently encountered idea that an overall illuminance level of 2000 lux with optimum glare limitation and colour rendering will be the end of complaints from office staff, is based on what can only be described as inadmissible simplification. Optimum lighting of different workplaces cannot be effected by raising the overall "quantity" or brightness of the light, but only by orienting the planning towards the requirements of the individual areas, in other words, by relaxing the requirement for lighting to be uniform.

As can be readily appreciated, the limits of quantitative lighting design soon become apparent in the actual field of application it was intended for, the lighting of workplaces. Questionable though it is, this kind of lighting philosophy is widespread and is generally adopted as the standard for architectural lighting. On closer investigation it is apparent that quantitative lighting design is based on an extremely simplified perception model. Our entire environment is reduced to the term "visual task"; all architectural considerations, the information content and aesthetic quality of the visual environment are disregarded. The same applies to the definition of the perceiving person, who is effectively considered to be a walking camera – the only aspect that is taken into account is the physiology of our vision; the psychology of perception is disregarded altogether.

Design concepts based on these principles, which only serve to ensure safety and a sound working economy, and ignore any other requirements the perceiving person may have of his visual environment, can lead to problems at the workplace. Outside the working environment the user would inevitably find such lighting inadequate; the lighting solution will remain clearly inferior to the feasible possibilities.

3.1.2 Luminance-based design

A quantitative lighting design concept that is oriented primarily towards providing a recommended illuminance level, lacks the criteria to develop a concept that goes beyond the requirements that would ensure productivity and safety to meet the needs of the architecture and the persons using the architectural space.

In response to this problem a new kind of lighting philosophy is developed, as represented in Waldram's "designed appearance" and Bartenbach's "stable perception" models, for example. The aim of this approach is a process that not only provides adequate lighting for visual tasks but is also able to describe and plan the optical effect of an entire space.

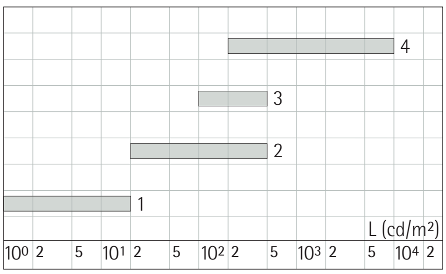
To be able to plan the visual effect of an environment the central reference quantity has to be changed. Instead of illuminance, which describes only the technical performance of a lighting installation, it is luminance that becomes the basic criteria – a dimension that arises from the correlation of light and lit environment, thereby forming the basis for human perception. Changing the central quantity to luminance means that brightness and contrast ratios can be established for the entire perceived space, be it between visual task and background, between individual objects or between objects and their surroundings.

This change of criteria does not make much difference to the lighting of visual tasks at the workplace, since the effect of different contrast ratios on visual performance are known and have been taken into consideration according to the degree of difficulty defined for the specific visual tasks. This does not apply for the lighting effect in the entire space. Considering luminance levels in this way means that brightness ratios produced by a lighting installation in correlation with the architecture and the illuminated objects can be ascertained and lighting concepts developed based on the distribution of brightness.
Designing concepts based on luminance levels is therefore not so much a question of simply changing reference criteria, but more of expanding the design analysis to the entire space. Whereas up to now an overall illuminance level was planned for the whole space based on the visual requirements for the most complicated visual task, the approach now is to plan luminance levels for all areas of a visual environment.

This means that it is now possible to differentiate between the various visual tasks performed in a space, to define room zones where the lighting is adjusted to the specific activities carried out in these areas. At this stage it is possible to refer to the standards and recommendations laid down for quantitative lighting design when planning the lighting for the individual visual tasks.

Design concepts based on luminance levels are, however, not confined to ascertaining spatial zones, which in turn would only lead to splitting a space up into a series of conventionally lit areas. The main feature of this kind of planning is that it is not directed towards the lighting for visual tasks, but towards the brightness ratio between the visual tasks and their respective surroundings, the balance of all luminances within one zone. This presumes that the lighting for one zone only allows optimum "stable" perception when the luminance contrasts do not exceed, or fall below, certain values. The aim is to create a constellation within which the visual task forms the brightest area in the environment, thereby holding the attention of the viewer. The luminance level of the surroundings should therefore be lower so as not to distract the person's view, but remain within a defined range of contrast. The permissible scale of contrasts is a result of the state of adaptation of the eye while perceiving the visual task – in a "stable" environment the eye retains a constant state of adaptation, whereas an "instable" environment leads to continuous, tiring adaptation through too low or too high background luminances.

When planning a "stable" spatial situation with controlled luminance distribution it is no longer possible to base concepts on a standardised lighting installation. Just as luminance is a result of the correlation of the illuminance and reflectance of the surfaces, the lighting installation and the material qualities must be planned together when designing concepts based on luminance levels. The required luminance contrasts cannot only be achieved by varying the lighting, but also by determining surrounding colours. The most prominent example is the lighting for the Museum of Art in Berne, where the especially intense and bright appearance of the paintings on display is not achieved by increased illuminance levels, but through the grey colour of the walls. In this situation the paintings have a higher luminance than the relatively dark surrounding area, which makes their



Ranges of typical luminances L in interior spaces: luminances outside working spaces (1), luminances of room surfaces (2), luminances of visual tasks at the workplace (3), tolerance luminances of luminaires (4).