

General lighting and differentiated lighting: general lighting provided by a regular arrangement of louvred luminaires and downlights. Both components can be switched and dimmed separately to produce a timed differentiation (above). Spatial differentiation is achieved by the arrangement of wall-washers and the grouping of downlights (below).

3.3.2.5 Direct or indirect lighting

The decision whether to plan direct or indirect lighting affects the proportion of directed or diffuse lighting in the space significantly. This decision results in a lighting concept which, in the case of indirect lighting, is designed to produce diffuse general lighting, whereas a direct lighting concept may comprise both direct and diffuse light and both general and accent lighting.

Indirect lighting provides the advantage that it produces very uniform, soft light and creates an open appearance due to the bright room surfaces. Problems arising from direct and reflected glare do not occur, making indirect lighting an ideal solution for critical visual tasks, such as work at VDTs.

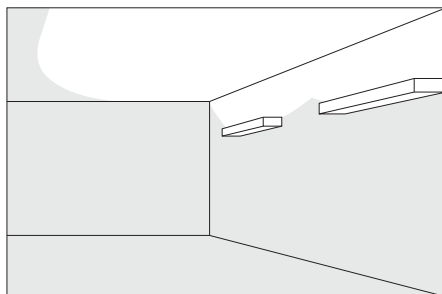
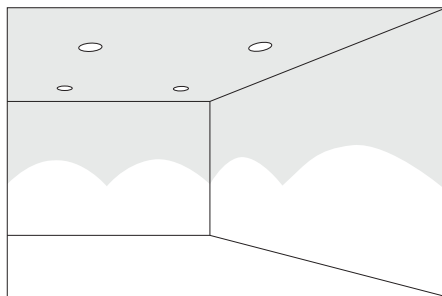
It should be noted, however, that indirect lighting alone produces very poor modelling and spatial differentiation. In addition, there is no accentuation of the architecture or the illuminated objects. The result may be a flat and monotonous environment.

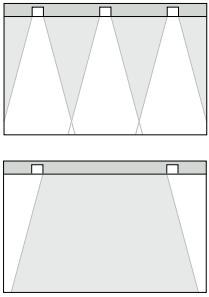
Indirect lighting is achieved by the light from a primary light source being reflected by a substantially greater, mostly diffuse reflecting surface, which in turn adopts the character of a large-scale secondary reflector luminaire. The reflecting surface may be the architecture itself: the light may be directed onto the ceiling, the walls or even onto the floor, from where it is reflected into the room. There is an increase in the number of so-called secondary reflector luminaires which are being developed. They consist of a primary light source with its own reflector system and a larger secondary reflector. This design allows improved optical control of the emitted light.

Direct lighting, mostly using louvred luminaires, can also be used to produce general lighting with a predominant diffuse component. It may well also have a component of directed light. This gives rise to distinctly different lighting qualities, above all considerably enhanced modelling and more clearly defined surface structures.

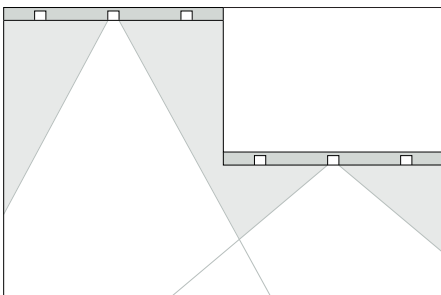
A lighting design concept based on direct lighting means that individual areas within the space can be purposefully lit from almost any location. This allows a greater degree of freedom when designing the luminaire layout.

Direct and indirect lighting: direct lighting using downlights (above), indirect lighting using wall-mounted ceiling washlights (below).





Horizontal and vertical lighting: the same luminaire layout can be used for downlights for horizontal lighting as well as for wall-washers for vertical lighting.



Horizontal general lighting from different ceiling heights: as a rule, narrow-beam luminaires are used for high ceilings and wide-beam luminaires for low ceilings to ensure that the light beams overlap.

### 3.3.2.6 Horizontal and vertical lighting

In contrast to the decision to opt for an integral or additive lighting installation, or for a static or variable concept, the extreme forms of exclusively horizontal or vertical lighting are hardly significant in practice: a portion of the missing form of lighting is almost always automatically produced through the reflections on room surfaces and illuminated objects. In spite of this interdependence the character of a lighting installation is predominantly determined by the emphasis laid on either horizontal or vertical lighting.

The primary decision to provide horizontal lighting is frequently in line with the decision to plan functional, user-oriented light. This is especially true in the case of lighting for workplaces, where the lighting is predominantly designed as uniform lighting for horizontal visual tasks. In such cases vertical lighting components are predominantly produced by the diffuse light that is reflected by the horizontal illuminated surfaces.

The decision to plan vertical lighting may also be related to the task to fulfil functional requirements, especially in the case of the lighting of vertical visual tasks, e.g. the reading of wall charts or the viewing of paintings. However, vertical lighting frequently aims to present and create a visual environment; in contrast to horizontal, purely functional lighting, vertical lighting is intended to emphasise the characteristic features and dominant elements in the visual environment. This applies first and foremost to architecture, whose structures can be clearly portrayed by purposefully illuminating the walls, as well as to the accentuation and modelling of objects in the space. Vertical lighting is also essential in order to facilitate communication, to ensure people's facial expressions are not concealed by the heavy shadows produced by single-component horizontal lighting.

### 3.3.2.7 Lighting working areas and floors

One of the most common lighting tasks is the illumination of horizontal surfaces. This category includes the majority of lighting tasks regulated by standards for workplaces and circulation areas. This may be the lighting of the working plane (0.85 m above the floor) or the lighting of the floor itself (reference plane 0.2 m above the floor).

The illumination of these planes can be effected by direct light, and a large number of luminaires are available for this task. A variety of lighting effects can be achieved depending on the choice of luminaires. Louvred luminaires or light structures for fluorescent lamps produce uniform general lighting, which is primarily required for workplaces. Conversely,

by using downlights, especially those designed for incandescent lamps, directed light can be produced that accentuates the qualities of materials more intensely and produces greater differentiation in the lighting of a space; this can be used effectively for the illumination of prestigious spaces and for display lighting. A combination of both luminaire types is possible to create spatially differentiated lighting or to increase the portion of directed light in general.

The illumination of horizontal surfaces can also be provided using indirect light. In this case the walls, or preferably the ceiling, are illuminated to produce uniform, diffuse ambient lighting using these surfaces to reflect the light. Indirect light consists of vertical components to provide a bright atmosphere in the space and horizontal components for the actual lighting of the working area or floor. This can be used for the lighting of corridors, for example, to create a spacious impression in spite of low illuminances. Indirect lighting is glare-free, which makes it especially suitable for lighting visual tasks that can be easily undermined by disturbing reflected glare, e.g. at workstations. If more modelling is required to enhance the three-dimensional quality of illuminated objects or to accentuate architectural features indirect lighting can be supplemented by directed lighting, which provides the required accentuation. In some cases very little modelling is required, which means that indirect lighting provides an optimum solution. It should be noted that energy consumption for an indirect lighting installation may be up to three times higher than that for a direct lighting system due to restricted reflection factors.

In future, a combination of direct and indirect lighting will gain in significance as opposed to exclusively direct or indirect lighting, in which case the indirect component will provide general lighting with a high degree of visual comfort, and the direct component accent lighting for the working area and inherent visual tasks.

Besides the combination of direct and indirect luminaires, either as individual luminaires or as integral luminaires in light structures, secondary luminaires can also be used. They emit both direct and indirect light and allow optical control of both.