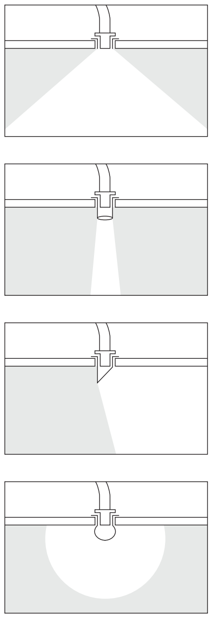
In addition to drawings and computeraided techniques the construction of models is a practical way of demonstrating a lighting installation and the lighting effects it creates. Similar to computer graphics, the model can be used for presentation and simulation purposes.

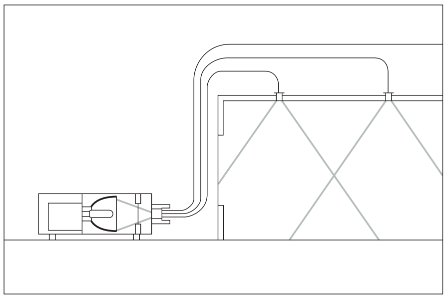
The clear advantage of models is that lighting effects are not only illustrated, but they can actually be shown and observed in all their complexity. The degree of accuracy of the simulation is only limited by the size and degree of accuracy of the proportions of the model. The most realistic simulations are made on mock-up models on a 1:1 scale.

The scale chosen for the model depends on the purpose of the test and the degree of accuracy the simulation is to present. Models made to scales of 1:100 or even 1:200 only allow observation of the daylight effect on the entire building, whereas with 1:20 to 1:10 models it is possible to observe detailed lighting effects in individual areas.

The most critical detail, especially on small-scale models, is generally the luminaire itself, because even small deviations have a direct effect on the lighting effect. There are similarly limits to the accuracy with which luminaires can be represented due to the dimensions of the light sources available. Through the application of optical fibres, which convey the light from an external light source to several luminaire models, a higher degree of accuracy is possible. When evaluating the effect of a specially developed luminaire or luminaires that are integrated into the architecture, it is advisable to create a mock-up of the luminaire, or of the specific architectural element on a 1:1 scale. This is usually possible without too great an expense, whereas it is only justified for entire rooms in the case of large-scale projects.

The use of models for daylight simulations is particularly widespread. In this case the problem of recreating luminaires to scale does not arise; sunlight and daylight are readily available if the model is taken outside. The alternative is an artificial sky and a sunlight simulator, which can be used to produce the required effect. In the case of daylight simulation in the open air, an instrument similar to a sundial is used to position the model to correspond to a specific geographical location at a specific time of day and year at a specific angle of incident sunlight. If sunlight simulation equipment is used, the sun is represented by a movable, artificial sun.
In both cases it is possible to carry out accurate observations of the effect of the light in and on the building on small-scale models and make constructive designs for solar protection and daylight control. Observations can be recorded using endoscope cameras, while micro video cameras allow the documentation of changes in the lighting conditions over the course of the day or year.
An artificial sky can be used to simulate lighting conditions under an overcast sky and also allows daylight factors to be measured (according to DIN 5034).





Fibre optic system used to simulate artificial lighting in models of interior spaces. The ends of the fibres represent the individual luminaires in the model. By using special constructions on the ends of the fibres different luminaire types can be simulated (wide and narrow-beam downlights, directional spotlights, wallwashers and exposed lamps).

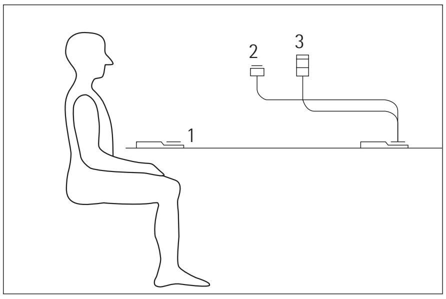
3.3.8 Measuring lighting installations

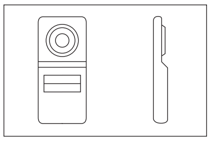
Measuring the lighting qualities of a lighting installation can serve a number of purposes. In the case of new installations measurements are taken to check that the planned values have been obtained. Measurements recorded on existing installations help the planner to decide what maintenance or renovation work is required. Measurements can also be taken during the planning process for the evulation and comparison of lighting concepts. The factors that are measured are initially illuminance and luminance. Other values, such as shadow formation or the contrast rendering factor (CRF) can be obtained using appropriate techniques.

To ensure that results of measurements taken are usable the measuring equipment must be of a suitably high quality. In the case of equipment for measuring illuminance this applies predominantly to the correct measurement of inclined incident light (cosine-corrected photometer) and the V (lambda) correction of the photometer.

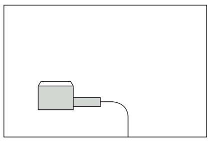
When measuring a lighting installation, a series of parameters have to be taken into account and documented in a report. This initially involves the recording of specific qualities of the environment, such as reflectance factors and colours of room surfaces, the time of day, the amount of daylight and the actual mains voltage. Features of the lighting installation are then recorded: the age of the installation, the lighting layout, the types of luminaires, the type and condition of the lamps and the overall condition of the installation. The type of measuring equipment and the class of accuracy of the measuring device has to be recorded.

To record illuminances for an entire space (in accordance with DIN 5035, Part 6) a floor plan is made of the space and has to include furniture. The arrangement of luminaires and the points at which measurements are to be taken are then entered. The measuring points are the central points on a 1-2 m grid, in the case of high rooms up to a 5 m grid. Measurements can also be taken at individual workplaces, in which case an overall tight measuring grid is created for the area. Horizontal illuminances are measured at the individual measuring points at the height of the working plane of 0.85 m or 0.2 m respectively, cylindrical illuminances for determining the formation of shadows on a 1.2 m plane of reference. Luminance measurements for calculating glare limitation are carried out at workplaces in offices at eye level (1.2 or 1.6 m).

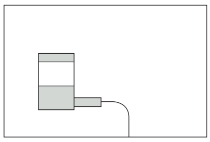




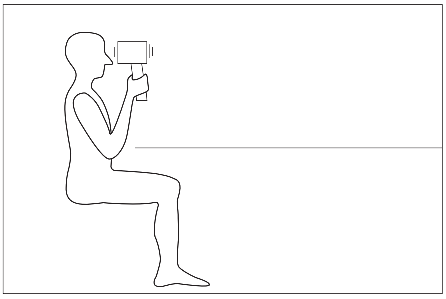
Measuring horizontal illuminance on the working plane using measuring equipment with an integral photo-cell (1).

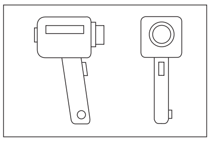


Measuring horizontal illuminance using measuring equipment with a separate photo-cell (2)

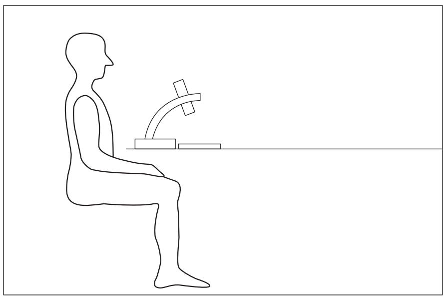


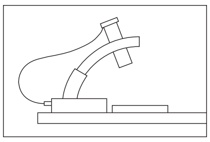
Measuring cylindrical illuminance using measuring equipment with a separate photo-cell (3)





Measuring the luminance of luminaires or room surfaces using measuring equipment with an integral view finder.





Measuring the contrast rendering factor (CRF) for the evaulation of reflected glare at workplaces on the basis of a standard reflection value.