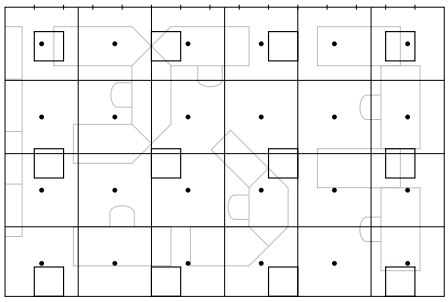
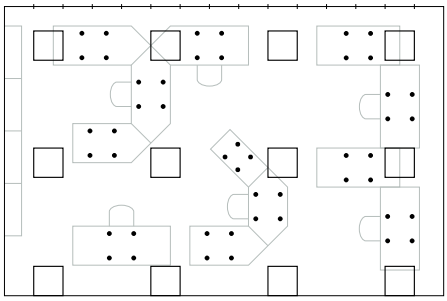
$$\bar{E} = \frac{1}{n} \cdot \sum_{1}^{n} E_x$$

$$g = \frac{E_{min}}{\bar{E}}$$

Formula for calculating the average illuminance $\bar{E}$ from a measuring grid with n measuring points and the measured values E_x. Calculating the uniformity g of a lighting installation from the lowest value E_{min} and the average illuminance $\bar{E}$.



Measuring illuminances on the working plane in empty or open furnished spaces is made according to a regular grid of 1 to 2 metres.



Measuring points for the measurement of illuminances at workplaces.

3.3.9 Maintenance

The maintenance of a lighting installation generally comprises lamp replacement and the cleaning of the luminaires, and possibly also re-adjustment or realignment of spotlights and movable luminaires.

The main objective of maintenance is to ensure that the planned illuminance is maintained, i.e. to limit the unavoidable reduction of luminous flux of a lighting installation. The reasons for the reduction in luminous flux may be defective lamps and the gradual loss of luminous flux by the lamps or a decrease in light output due to soiling of the reflectors or attachments. In order to avoid a reduction in luminous flux and illuminance below a given level all lamps must be replaced and luminaires cleaned at regular intervals. It is practical to effect both maintenance procedures at the same time, since time and technical equipment, such as lifting trucks and cleaning equipment, are essential costly factors in maintenance.

By stipulating a light loss factor when planning the lighting, the intervals at which maintenance is to be carried out can be controlled. By keeping light loss factors low the lighting level will initially be higher and the period during which luminous flux is gradually reduced to below the critical value extended. Using the light loss factor, lamp replacement and the cleaning of luminaires can be timed to take place simultaneously. In dusty environments, for example, a low light loss factor can be stipulated (e.g. 0.6 instead of the customary 0.8) to extend the intervals between the cleaning of the luminaires and co-ordinate them with the service life of the lamps.

It is advisable to have an adequate supply of the required lamp types, both for regular and individual lamp replacement. This will ensure that only lamps of the same power, luminous colour and with the same technical qualities will be used in the lighting installation. In the case of specific lamp types, e.g. halogen lamps for mains voltage, the products supplied by different manufacturers deviate so greatly from one another that uniform lighting effects can only be obtained if the luminaires are all equipped with the same brand.

Besides quantative issues there are a number of qualitative aspects that may be decisive for maintenance. When one lamp fails in a geometric arrangement of downlights, or in a continous row of luminaires, it may have little effect on the overall illuminance in the space, but the interruption in a pattern of bright luminaires may be visually disturbing. This also applies to the effects created by the luminaires; a missing beam of light in a series along one wall is just as disturbing as an abrupt drop in luminance due to a defective wallwasher. It is therefore more practical in this case not to wait until the regular lamp replacement is due, but to replace the defective lamp immediately. The adjustment of luminaires is also classified as maintenance in the interest of the qualitative aspects of the lighting installation. In the field of display lighting luminaires frequently have to be realigned to emphasise specific areas to accommodate the layout of a new arrangement, or the repositioning of stands, shelves or showcases in retail spaces.

The task of the lighting designer is to draw up a maintenance plan that meets the requirements of the given situation and to provide the necessary information for the maintenance staff. The maintenance plan should enable the operator to service the installation at regular intervals, checking whether the technical requirements are being met and the lighting is performing as planned.