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Dnevna svetloba v stavbah

Daylight of buildings

Tageslicht in Gebäuden

L'éclairage naturel des bâtiments

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Daylight in buildings

L'éclairage naturel des bâtiments

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Contents

Page

European foreword

This document (EN 17037:2018) has been prepared by Technical Committee CEN/TC 169 “Light and Lighting”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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Introduction

Daylight should be a significant source of illumination for all spaces with daylight opening(s). Daylight is strongly favoured by building occupants as a way to adequately illuminate the indoor surfaces, and to save energy for electrical lighting.

Daylight can provide significant quantities of light indoors, with high colour rendering and variability, changing through the day and the seasons. Daylight openings provide views and connection to the outside and contribute to the psychological well-being of occupants. A daylight opening can also provide exposure to sunlight indoors, which is important, for example, in dwellings, hospital wards and nurseries. In a space, where activities comparable to reading, writing or using display devices are carried out, a shading device should be provided to reduce visual discomfort. The standard addresses daylighting performance over the year. Daylight should illuminate spaces during a significant fraction of the annual daylight hours over the year. Daylight provision depends firstly on the availability of daylight outside (i.e. the prevailing climate at the site) and, thereafter, the environment surrounding the building, the components immediate around the daylight opening and the configuration of the interior spaces.

This standard encourages building designers to assess and ensure successfully daylit spaces. It also allows building designers and developers to target ambitions with respect to daylighting, as well as addressing other issues related to daylight design, such as view out, protection against glare, and exposure to sunlight.

1 Scope

This document specifies elements for achieving, by means of natural light, an adequate subjective impression of lightness indoors, and for providing an adequate view out. In addition, recommendations for the duration of sunshine exposure within occupied rooms are given.

This document gives information on how to use daylighting to provide lighting within interiors, and how to limit glare. This document defines metrics used for the evaluation of daylighting conditions and gives principles of calculation and verification. These principles allow to address the issue of variability of daylight over the days and the year.

This document applies to all spaces that may be regularly occupied by people for extended periods except where daylighting is contrary to the nature and role of the actual work done.

The specification of lighting requirements for humans in indoor work places including visual tasks are given in EN 12464-1 and are not part of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12216, *Shutters, external blinds, internal blinds — Terminology, glossary and definitions*

EN 12464-1, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 12665:2018, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

EN 14501:2005, *Blinds and shutters — Thermal and visual comfort — Performance characteristics and classification*

ISO 15469:2004, *Spatial distribution of daylight — CIE standard general sky*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665:2018 and the following apply.

3.1
daylight
visible part of global solar radiation

Note 1 to entry: Also defined as part of global solar radiation capable of causing a visual sensation [CIE ILV 278].

[SOURCE: EN 12665:2018, 3.4.7, modified – note to entry added]

3.2
daylight factor
ratio of the illuminance at a point on a given plane due to the light received directly or indirectly from a sky of assumed or known luminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky, excluding the contribution of direct sunlight to both illuminances

Note 1 to entry: Glazing, dirt effects, etc. are included.

Note 2 to entry: When calculating the lighting of interiors, the contribution of direct sunlight needs to be considered separately.

Note 3 to entry: The term daylight factor is normally used when considering an overcast sky as sky type 1 or 16 in ISO 15469.

[SOURCE: EN 12665:2018, 3.4.8, CIE ILV 17-279, modified – note 3 to entry added]

3.3
daylight opening
any area in the building envelope that is capable of admitting daylight to an interior

3.4
daylight provision
level of illuminance achieved across a fraction of a reference plane for a fraction of daylight hours within a space

3.5
diffuse horizontal illuminance (from the sky)
illuminance produced by skylight on a horizontal surface on the Earth

[SOURCE: CIE ILV 17-302]

3.6
discomfort glare
glare that causes discomfort without necessarily impairing the vision of objects

[SOURCE: EN 12665:2018, 3.2.23, CIE ILV 17-333]

3.7
glare
condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or by extreme contrasts

[SOURCE: EN 12665:2018, 3.1.8, CIE ILV 17-492]

3.8
global horizontal illuminance
illuminance produced by daylight on a horizontal surface on the Earth

[SOURCE: CIE ILV 17-495]

3.9
no-ground line for view
divider between the part of the space from which the ground can be seen directly by a sitting person and the part from which it cannot

3.10
no-sky line for view
divider between the part of the space from which the sky can be seen directly by a sitting person and the part from which it cannot

3.11
obstruction
anything outside a building which prevents the direct view of part of the sky

[SOURCE: CIE ILV 17-834]

3.12
outside distance of view
distance from the inner surface of view opening to opposite major obstructions located in front of the opening

3.13
reference plane
plane in a space on which illuminances and/or daylight factors are calculated, specified or measured

3.14
reference point for view
position from which the view is assessed

3.15
skylight
part of sky radiation capable of causing a visual sensation

[SOURCE: CIE ILV 17-1194]

3.16
solar altitude
vertical angle between the line passing through the centre of the solar disc and the horizontal plane measured from the reference/observation point

3.17
solar azimuth
horizontal angle between vertical plane passing through the geographical north and vertical plane passing through the centre of the solar disc

Note 1 to entry: Solar azimuth is measured clockwise from due North from 0° to 360°

3.18
sunlight
part of direct solar radiation capable of causing a visual sensation

[SOURCE: CIE ILV 17-1281]

3.19
sunlight exposure
sum of the time (hours) (e.g. on a given day) within a given period during which the sun is above the actual horizon with a cloudless sky, which may be limited by permanent obstructions like mountains, buildings, etc.

3.20
utilized area
fraction of the space intended to be occupied

3.21
veiling reflections
specular reflections that appear on the object viewed and that partially or wholly obscure the details by reducing contrast

[SOURCE: EN 12665:2018, 3.2.24, CIE ILV 17-1396]

3.22
view
visual contact with the surrounding through an opening in the surface of a building, providing information about the surrounding landscape/cityscape, possibility to experience the weather changes and to follow the time over the day

3.23
view opening
any area in the building envelope admitting a view, including glazed walls, glazed doors, etc

4 Symbols and abbreviations

For the purposes of this document, the specific symbols listed in Table 1 apply.

Table 1 — Symbols and units

Symbol	Name of quantity	Unit
$A_{façade}$	Area of the façade	m^2
$A_{glazing}$	Area of the glazing	m^2
D	Daylight factor	%
DGP	Daylight glare probability	-
$DGP_{e<5\,\%}$	DGP-value, that is not exceeded in more than 5 % of the occupation time	-
DGP_s	Simplified DGP value	-
DGP_t	Threshold DGP value for a critical glare situation	-
D_T	Target daylight factor	%
D_{TM}	Minimum target daylight factor	%
D_w	Distance from daylight opening	m
ET	Equation of time	h
E_v	Vertical illuminance at eye level	lx ($lm \cdot m^{-2}$)

Symbol	Name of quantity	Unit
$E_{v,d}$	Diffuse horizontal illuminance (from the sky)	lx (lm·m^{-2})
$E_{v,d,med}$	Median diffuse horizontal skylight illuminance	lx (lm·m^{-2})
$E_{v,g}$	Global horizontal illuminance	lx (lm·m^{-2})
$E_{v,g,med}$	Median global horizontal daylight illuminance	lx (lm·m^{-2})
$F_{DGP,exceed}$	Fraction of reference usage time for which a threshold value DGP_t is exceeded	-
$F_{plane,\%}$	Fraction of the reference plane for target illuminance level	%
$F_{time,\%}$	Fraction of time for which a given value of illuminance is exceeded	%
f_{glaz}	Glazing fraction	%
i	Number of glare sources	-
J	J is the day number of the year (e.g. for 1st January, J = 1 and for 31st December, J = 365, February is taken to have 28 days)	-
LT	Local clock time	h
L_s	Luminance of glare source	cd/m^2
L_v	Sky luminance	cd/m^2
P	Position index	-
TST	True solar time	h
t_d	Daylight hours	h
t_{end}	Time when the duration of sunlight is ending by the obstruction or when the solar azimuth α_s reaches the end of the acceptance angle α_a	h
t_{start}	Time when the sun rays begin to reach reference point	h
α_a	Acceptance angle	degrees
α_{obs}	Angle of obstruction	degrees
α_s	Solar azimuth (measured clockwise from due North)	degrees
$\alpha_{wn,s}$	Azimuth angle of daylight opening normal, measured from South	degrees
γ_s	Solar altitude	degrees

Symbol	Name of quantity	Unit
$\gamma_{s,min}$	Minimum Solar altitude	degrees
Δ	Declination of the sun	degrees
Λ	Geographical longitude of the site East (+) or West (-) of Greenwich	degrees
λ_s	Longitude of standard meridian	degrees
$\tau_{glazing}$	Normal-hemispherical light transmittance of the glazing	-
$\tau_{v,n\text{-}dif}$	Normal-diffuse light transmittance	-
$\tau_{v,n\text{-}n}$	Normal-normal light transmittance	-
φ	Geographical latitude of the site	degrees
ω_s	Solid angle subtended by the glare source	sr
ω_η	The hour angle ω_η is counted from the meridian as positive towards the afternoon and negative towards the morning.	degrees

5 Assessment of daylight in interior spaces

5.1 Daylight Provision

5.1.1 General

Daylight can contribute significantly to the lighting needs of any type of building. This means that daylight openings should have appropriate areas to provide sufficient daylight throughout the year. Thus, the evaluation of daylight provision should make account of the availability of daylight at the site in addition to accounting for the properties of the space (e.g. external obstruction, glazing transmittance, thickness of walls and roofs, internal partition and surface reflectance, funitures).

5.1.2 Criteria for daylight provision

A space is considered to provide adequate daylight if a target illuminance level is achieved across a fraction of the reference plane within a space for at least half of the daylight hours.

In addition, for spaces with vertical or inclined daylight openings, a minimum target illuminance level is also to be achieved across the reference plane.

The reference plane of the space is located 0,85 m above the floor, unless otherwise specified. A small fraction of the reference plane may be disregarded to account for singularities.

Values for target illuminances, minimum target illuminances and fractions of reference plane are given in Table A.1.

5.1.3 Daylight Provision Calculation Methods

The following methods to assess daylight provision to the interior, using validated software, are possible:

Method 1) Calculation method using daylight factors on the reference plane. Annex A gives values for target daylight factors (D_T) and minimum target daylight factors (D_{TM}) to be achieved depending on the given site.

Method 2) Calculation method of illuminance levels on the reference plane using climatic data for the given site and an adequate time step. Annex A gives values for target illuminances and minimum target illuminances to be achieve.

Annex B describes recommendations for the daylight calculations using the two methods.

5.1.4 Verification of daylight provision

Verification of daylight provision can be determined using either an adequate software or on site measurements.

The procedure by software requires a representative model of the space together with the key parameters (such as any significant nearby obstructions, the assigned surface reflectance values and glazing transmissivity) that are a reasonable representation of those for the actual, completed building. This can be determined using either Method 1 or Method 2 described in 5.1.3.

On site, it can also be verified using illuminance meters, to measure the distribution of the daylight factor in the actual, completed building. It needs to be conducted at grid points of the reference plane (see B.2) Methods for verification are described in Annex B.

5.2 Assessment for view out

5.2.1 General

View to the outside provides visual connection with the surroundings to supply information about the local environment, weather changes and the time of day. This information can relieve the fatigue associated with long periods of being indoors. All occupants of a space should have the opportunity for the refreshment and relaxation afforded by a change of scene and focus. View to the outside should be assessed from selected reference points corresponding to where people are located within the utilized area.

A view is considered to comprise three distinct layers:

— a layer of sky;

— a layer of landscape;

— a layer of ground.

NOTE The ground layer can include information of activities. The landscape layer can be comprised of buildings, nature, and/or the horizon only.

From any specific reference point (Q), the view quality depends on:

— the size of the daylight opening(s);

— the width of the view (horizontal sight angle);

— the outside distance of view;

— the number of layers;

— the quality of the environmental information of the view.