



SLOVENSKI STANDARD
oSIST prEN 17037:2016
01-september-2016

Dnevna svetloba v stavbah

Daylight of buildings

Tageslicht in Gebäuden

L'éclairage naturel des bâtiments

Ta slovenski standard je istoveten z: prEN 17037

<https://standards.iteh.ai/catalog/standards/sist/6fd9e65f-c3ba-4cda-a69c-dcbd8b7dce8d/sist-en-17037-2019>

ICS:

91.160.01 Razsvetljava na splošno Lighting in general

oSIST prEN 17037:2016

en,fr,de

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 17037

July 2016

ICS 91.160.01

English Version

Daylight of buildings

Tageslicht in Gebäuden

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prEN 17037:2016 (E)

European foreword

This document (prEN 17037:2016) has been prepared by Technical Committee CEN/TC 169 “Light and lighting”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

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Introduction

Whenever possible, daylight should be the significant source of illumination for all spaces with windows and rooflights. Daylight is strongly favoured by building occupants to adequately illuminate the indoor surfaces, and save energy for electrical lighting.

Daylight can provide large quantities of light indoor, with great spectral quality and variability changing through the day and seasons. Windows and rooflights provide also view and information to the outside and contribute to the psychological well-being of occupants. Windows and rooflights can also provide exposure to sunlight indoor, which is important in e.g. dwellings, hospitals and nurseries. In working interiors, solar protection should be provided where sunlight could cause visual discomfort or overheating. The standard addresses performance over the seasons, during a whole year. Daylight should light 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, and the window components and the configuration of the interior spaces.

This standard encourages building designers to assess and ensure successfully daylighted spaces. It also allow all professionals related the fenestration industry to define their ambitions in relation to daylighting of buildings. It should also help building developers to define minimum performance of their buildings with respect to daylighting, addressing also some qualitative issues such as minimum view out, minimum protection against glare, and minimum exposure to sunlight.

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1 Scope

This European Standard specifies minimum recommendations 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 habitable and occupied rooms are given. This standard gives information on how to use daylighting to provide lighting within interiors, and how to limit glare. This standard defines metrics used for the evaluation of daylighting conditions and gives methods of calculation and verification.

This standard 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 standard.

The specification of calculation procedures and metrics related to the energy performance of buildings are given in EN 15193 and are not part of this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12665:2011, *Light and lighting - Basic terms and criteria for specifying lighting requirements*

EN 12464-1:2011, *Light and lighting - Lighting of work places - Part 1: Indoor work places*

prEN 15193-1:2015, *Energy performance of buildings — Module M9 — Energy requirements for lighting — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665:2011 and the following specific definitions apply.

3.1

daylight

visible part of global solar radiation

[SOURCE: EN 12665:2011, 3.4.7]

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

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

[SOURCE: EN 12665:2011, 3.4.8, CIE ILV 17-279]

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 text of the definition.

3.3

rooflight

daylight opening on the roof or on a horizontal surface of a building

[SOURCE: EN 12665:2011, 3.5.69, CIE ILV 17-1119]

3.4

window

daylight opening on a vertical or nearly vertical area of a room envelope

[SOURCE: EN 12665:2011, 3.5.94, CIE ILV 17-1436]

3.5

target daylight factor

daylight factor value that needs to be achieved across a specified fraction of a given area (i.e. sensor points across a grid) in order to satisfy the criterion for daylight provision

3.6

minimum target daylight factor

minimum daylight factor allowed for a given area (i.e. sensor point) in order to satisfy the criterion for daylight provision over the entire space

3.7

work place

place intended to house work stations on the premises of the undertaking and/or establishment and any other place within the area of undertaking and/or establishment to which the worker has access in the course of his employment

[SOURCE: EN 12665:2011, 3.5.95, CIE ILV 17-1439]

Note 1 to entry Adapted from 89/654/EEC.

prEN 17037:2016 (E)**3.8****task area**

area within which the visual task is carried out

[SOURCE: EN 12665:2011, 3.5.77]

Note 1 to entry Also defined as partial area in the work place in which the visual task is carried out [CIE ILV 17-1300].

3.9**work area**

part of room or zone in the room containing work places

3.10**median diffuse horizontal skylight illuminance**

illuminance produced by skylight on a horizontal surface on the Earth achieved for half of the daylight hours (2 190 hours) in the year

3.11**diffuse horizontal illuminance (from the sky)**

illuminance produced by skylight on a horizontal surface on the Earth

[SOURCE: CIE ILV 17-302]

3.12**median global horizontal daylight illuminance**

illuminance produced by daylight on a horizontal surface on the Earth achieved for half of the daylight hours (2 190 hours) in the year

3.13**global horizontal illuminance**

illuminance produced by daylight on a horizontal surface on the Earth

[SOURCE: CIE ILV 17-302]

3.14**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 12665:2011, 3.1.8, ILV 17-492]

3.15**discomfort glare**

glare that causes discomfort without necessarily impairing the vision of objects

[SOURCE: EN 12665:2011, 3.2.23, CIE ILV 17-333]

3.16**veiling reflections**

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

[SOURCE: EN 12665:2011, 3.2.24, CIE ILV 17-1396]

3.17**uniformity**

ratio of minimum illuminance (luminance) to average illuminance (luminance) on (of) a surface

[SOURCE: EN 12665:2011, 3.2.20]

3.18**daylighting**

lighting for which daylight is the light source

[SOURCE: CIE ILV 17-285]

3.19**daylight opening**

area, glazed or unglazed, that is capable of admitting daylight to an interior

[SOURCE: CIE ILV 17-284]

3.20**sunlight**

part of direct solar radiation capable of causing a visual sensation

3.21**solar altitude**

angle between the a line passing through the centre of the solar disc and a given point of the horizontal plane on the earth's surface

3.22**solar azimuth**

horizontal angle between a vertical plane passing through the centre of the solar disc and the vertical north-south plane

Note 1 to entry Solar azimuth is measured clockwise from due North.

3.23**declination of the sun**

angle between the centre of the sun and the celestial equator; it is a function of the day of the year

3.24**equation of time**

difference between True Solar Time (TST) and the Local Clock Time (LT), because of the fluctuations in the length of the solar day according to the day of year

3.25**potential duration of sunlight**

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 mountains, buildings, trees, etc

3.26**occupied room**

room which is intended or is suitable for human occupation for more than a brief duration

Note 1 to entry The term "occupied room" includes habitable rooms, work rooms and the other rooms defined below.

prEN 17037:2016 (E)**3.27****habitable room**

occupied room in a dwelling such as a living room, bedroom, study, children's playroom, or an occupied room in a facility whose purpose is comparable to living

Note 1 to entry Rooms which function as living spaces, such as common rooms or lounges in senior citizen's homes, boarding schools or child care centers are also considered as habitable rooms. This does not include, however, rooms which are primarily used for sleeping, such as accommodations in a hotel, etc.

Note 2 to entry Kitchens, halls and other areas which are not occupied for a long period are not considered as habitable rooms even if they are equipped with spaces for eating, resting or working.

3.28**work room**

room which is permanently equipped with workplaces within a building

3.29**view**

contact with the (exterior to the building) 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

3.30**view window**

daylight opening in the surface of a building which provides a view, including glassed walls, glassed doors, rooflights etc

3.31**work plane**

reference surface defined as the plane at which work is normally done

[SOURCE: IEC 60050-845:1987/CIE 17:1987; 845-09-50]

3.32**obstruction**

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

[SOURCE: CIE ILV 17-834]

3.33**reference plane**

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

Note 1 to entry: For work places, the reference plane is the work plane

3.34**maintained illuminance**

value of minimum illuminance to maintain on the reference plane, at the place in and the conditions specified in EN 12464-1:2011

3.35**fraction of the reference plane with adequate daylighting**

fraction of the plane where an illuminance value will be obtained with daylighting, for a specific fraction of the time over the year

3.36**angle of obstruction**

angular height above the horizontal plane of the top of an obstruction (building, vegetation, mountain etc.) measured from the centre of the glazed area of the window, perpendicular to the plane of the window

3.37**fraction of time for which a given value of illuminance is exceeded**

this fraction of time is within the daylight hours (maximum 4 380 hours per year)

3.38**daylight hours**

total number of hours per year (4 380 hours) between sunrise and sunset. This is an arbitrary definition, since daylight can be available at low level however, for a duration depending on the latitude, outside the time between sunrise and sunset

3.39**no-sky line for view**

no-sky line for view is a divider between the part of the space from which the sky can be seen directly by a sitting person (eyelevel 1,20 m) and the part from which it cannot

3.40**no-ground line for view**

no-ground line for view is a divider between the part of the space from which the ground can be seen directly by a sitting person (eyelevel 1,20 m) and the part from which it cannot

3.41**utilized area**

space which occupants will tend to use for a significant period

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4 Symbols and abbreviations

4.1 Symbols

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

Table 1 — Symbols and units

| Symbol | Name of quantity | Unit |
|------------------|--|--------------------------------------|
| D | Daylight factor | % |
| D_T | Target daylight factor | % |
| D_{TM} | Minimum target daylight factor | % |
| $E_{v,d,med}$ | Median diffuse horizontal skylight illuminance | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| $E_{v,g,med}$ | Median global horizontal daylight illuminance | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| $E_{v,d}$ | Diffuse horizontal illuminance (from the sky) | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| $E_{v,g}$ | Global horizontal illuminance | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| U_o | Uniformity | - |
| γ_s | Solar altitude | Degrees |
| $\gamma_{s,min}$ | Minimum Sun altitude | Degrees |
| α_s | Solar azimuth (measured clockwise from due North) | Degrees |
| $\alpha_{wn,s}$ | Azimuth angle of window normal, measured from South | Degrees |
| α_a | Acceptance angle | Degrees |
| α_{obs} | Angle of obstruction | Degrees |
| δ | Declination of the sun | Degrees |
| TST | True solar time | h |
| LT | Local clock time | h |
| ET | Equation of time | h |
| λ | Geographical longitude of the site East (+) or West (-) of Greenwich | degrees |
| λ_s | Longitude of standard meridian | degrees |
| J | J is the day number of the year (e.g. for 1st January, J = 1 and for 31st December, J = 365, February is take to have 28 days) | - |
| ω | The hour angle ω is counted from the meridian as positive towards the afternoon and negative towards the morning. | h |
| φ | Geographical latitude of the site | degrees |
| t_{start} | Time when the sun rays begin to reach reference point | hours |

| Symbol | Name of quantity | Unit |
|------------------|--|--------------------------------------|
| t_{end} | Time when the sun is ending by the obstruction or is finalised by the time when the sun height γ_s reaches the solar azimuth angle α | hours |
| E_m | Maintained illuminance | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| $F_{plane,\%}$ | Fraction of the reference plane with adequate daylighting | % |
| $F_{time,\%}$ | Fraction of time for which a given value of illuminance is exceeded | % |
| t_d | Daylight hours | h |
| DGP | Daylight glare probability | - |
| E_v | Vertical illuminance at eye level | lx ($\text{lm}\cdot\text{m}^{-2}$) |
| L_s | Luminance of glare source | cd/m^2 |
| L_v | Sky luminance | cd/m^2 |
| P | Position index | - |
| ω_s | Solid angle subtended by the glare source | - |
| i | Number of glare sources | - |
| DGP_t | Threshold value for a critical glare situation | - |
| $F_{DGP,exceed}$ | Fraction of reference usage time for which a threshold value DGP_t is exceeded | - |
| f_{glaz} | Glazing fraction | % |
| $A_{glazing}$ | Area of the glazing | m^2 |
| A_{facade} | Area of the facade | m^2 |

5 Assessment of daylight

5.1 Minimum daylight provision

5.1.1 General

This standard proposes that daylight should contribute significantly to the lighting requirements of any type of building. This means that façade windows and rooflights should have sufficient areas to provide enough 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 etc.).

A space is considered to provide minimum daylight provision if a minimum target illuminance level is achieved across a percentage of the relevant area of the space for a least 50 % of the daylit hours. The percentage of the relevant area of the space changes if daylight in a space is received predominantly from façade windows or from rooflight.