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Building environment design — Indoor environment — Daylight opening design for sustainability principles in visual environment

Conception des bâtiments — Espace intérieur — Conception des prises du jour pour les principes de durabilité dans l'environnement visuel

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Contents

Page

Foreword ..... **v**

Introduction ..... **vi**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Fundamentals **4**
4.1 General 4
4.2 General principles of sustainability 5
4.3 Project information 5
4.4 Framework of generation and verification 5
4.5 Framework of documentation at approval 6
4.6 Harmonization of architectural and daylight opening design 6

5 Design elements of daylight openings **6**
5.1 General 6
5.2 Matrix of aspects of daylight opening design 7
5.3 Daylight opening ratio to the wall area 8
5.4 Daylight opening ratio to the floor area 8
5.5 Levels of indoor daylight and the extent of sunlight 8
5.6 Quality of views to exterior 8
5.7 Daylight control systems in the building 9

6 Design process of daylight openings **9**
6.1 General 9
6.2 Stage I — Formulation of project definition 9
6.2.1 Project definition 9
6.2.2 Output — Document I 10
6.2.3 Evaluation I 10
6.2.4 Output — Approval of document I 10
6.2.5 Iteration 10
6.3 Stage II – Schematic design 10
6.3.1 General 10
6.3.2 Input 10
6.3.3 Output 11
6.3.4 Evaluation II 11
6.3.5 Approval of document II 11
6.4 Stage III – Detailed design 11
6.4.1 General 11
6.4.2 Input 11
6.4.3 Output – Document IIIa 12
6.4.4 Analysis 12
6.4.5 Output – Document IIIb 12
6.4.6 Evaluation III 13
6.4.7 Approval of documents IIIa and IIIb 13
6.4.8 Iteration into detail design 13
6.5 Stage IV – Final design 13
6.5.1 General 13
6.5.2 Commissioning documents 14
6.5.3 Cost estimation 14
6.5.4 Output: the final documents 14

Annex A (normative) **Flow diagram of the design process** **16**

Annex B (informative) **Basic architectural forms of the daylight opening** **17**

Annex C (informative) **Matrix of aspects of daylight opening design** **19**

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Annex D (informative) **Matrix of output required to satisfy daylight opening design** **23**
Bibliography **26**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

ISO 16813 provides general principles for the design of the indoor environment for buildings. The design process for the indoor visual environment is provided by ISO 16817 to ensure required visual comfort, good physiological effects of light and building energy performance and sustainability.

This document provides design team members with a design process for daylight openings under the umbrella of ISO 16813 and ISO 16817. Receiving daylight is a fundamental human need. It is essential to ensure favourable daylight environments in buildings. Daylight opening design is an indispensable element of building design. This document is targeted at habitable rooms in all buildings to ensure sufficient, quality daylight.

For this document, both windows and rooflights are deemed daylight openings. The size and position of the daylight openings affect the amount of daylight entering a room as well as the view from the daylight opening. An appropriate sizing of the daylight opening ensures a necessary level of daylight and an impression of spaciousness. However, large daylight openings can require more control of daylight in terms of visual and thermal environments. Qualities of daylight admitted through the daylight opening vary depending on the direction in which the daylight opening faces.

This document:

— provides a framework for taking into consideration various parameters and criteria in daylight opening design;

— is intended for use by design teams (architects and engineers), building clients, contractors, government officials and academics;

— is aimed at assisting these groups in designing daylight openings in the process of building design;

— incorporates sustainability considerations into the design of indoor visual environments.

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Building environment design — Indoor environment — Daylight opening design for sustainability principles in visual environment

1 Scope

This document provides a design process for daylight openings in order to ensure the principle of sustainability in the indoor visual environment. The design process for daylight openings includes the consideration of:

— sunshine duration in the building interiors;

— daylight opening ratio to the wall area of a habitable room;

— daylight opening ratio to the floor area of a habitable room;

— appropriate levels of indoor daylight based on human visual needs and the extent of sunlight;

— daylight control systems in the building;

— thermal comfort, thermal gains and energy efficiency.

This document is applicable to building environment design for new buildings and the retrofit of existing buildings.

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.

ISO 8995-1, *Lighting of work places — Part 1: Indoor*

ISO 16817:2017, *Building environment design — Indoor environment — Design process for the visual environment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
commissioning
sequence of events that ensure the building and the *technical building systems* (3.16) are functioning in accordance with the design parameters for the building lifetime

[SOURCE: ISO 16813:2006, 3.7 modified — The word “HVAC” has been replaced with “technical building”.]

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3.2
daylight
part of global solar radiation capable of causing a visual sensation

[SOURCE: CIE S 017/E:2011, 17-278]

3.3
daylight opening
area, glazed or unglazed, that is capable of admitting *daylight* (3.2) to an interior

Note 1 to entry: Basic architectural forms of the daylight opening are illustrated in Annex B.

[SOURCE: CIE S 017/E:2011, 17-284, modified — Note 1 to entry has been added.]

3.4
daylight opening ratio
daylight opening ratio to the floor area
daylight opening ratio to the wall area of a habitable room
ratio of the daylight opening area to the corresponding floor or wall area of a habitable room

Note 1 to entry: "Window-to-wall ratio (WWR)" is defined as "ratio of the fenestration area to the gross exterior wall area" in ISO 16818:2008, 3.249[2].

3.5
design team
group of people who are responsible for building design

Note 1 to entry: The design team can consist of an architect, an interior designer, a lighting designer, a landscape designer, engineers in electrical engineering, illuminating engineering, HVAC systems, structural engineering and construction management and other specialists.

3.6
direct solar radiation
part of extra-terrestrial solar radiation which, as a collimated beam, reaches the earth's surface after selective attenuation by the atmosphere

Note 1 to entry: The quantity measured is the direct solar irradiance, expressed in $W \cdot m^{-2}$.

[SOURCE: ISO 9846:1993, 3.6, modified — The last sentence in the original definition has been changed to Note 1 to entry.]

3.7
habitable room
room that is continuously used for living, working, meeting, amusement and other purposes similar thereto

[SOURCE: ISO 18523-2:2018, 3.1.7]

3.8
possible sunshine duration
possible sunshine duration at a particular location
sum of the time intervals within a given time period during which the sun is above the real horizon

Note 1 to entry: The possible sunshine duration can be obscured by mountains, buildings, trees, etc.

[SOURCE: CIE S 017/E:2011, 17-972, modified — The last sentence in the original definition has been changed to Note 1 to entry.]

3.9
relative sunshine duration
ratio of *sunshine duration* (3.14) to *possible sunshine duration* (3.8) within the same time period

Note 1 to entry: The unit is 1.

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[SOURCE: CIE S 017/E:2011, 17-1086]

3.10
rooflight
skylight, US
daylight opening (3.3) in a flat roof or low-pitched roof, intended primarily for lighting and consisting of a frame and glazing

Note 1 to entry: In the US, there is a homograph for the term “skylight”. See 3.11.

[SOURCE: ISO 6707-1:2017, 3.3.3.13, modified — The words "construction for closing an" have been deleted and “daylight” has been added.]

3.11
roof window
skylight, US
daylight opening (3.3) in the plane of a pitched roof, which admits light and which can provide ventilation

Note 1 to entry: In the US, there is a homograph for the term “skylight”. See 3.10.

[SOURCE: ISO 6707-1:2017, 3.3.3.14, modified — The words "construction for closing an" have been deleted and “daylight” has been added.]

3.12
spaciousness
spatial largeness and extensiveness, especially inside a building

3.13
sunlight
part of *direct solar radiation* (3.6) capable of causing a visual sensation

[SOURCE: CIE S 017/E:2011, 17-1281]

3.14
sunshine duration
sum of time intervals within a given time period (hour, day, month, year) during which the irradiance from *direct solar radiation* (3.6) on a plane normal to the sun direction is equal to or greater than 120 $W \cdot m^{-2}$

[SOURCE: CIE S 017/E:2011, 17-1282]

3.15
sustainability
maintenance of ecosystem components and functions for future generations, to address economic efficiency, social issues and environmental preservation

[SOURCE: ISO 16813:2006, 3.27]

3.16
technical building system
technical equipment for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting, building automation and control and electricity production

Note 1 to entry: A technical building system can refer to one or to several building services (e.g., heating, cooling, lighting and domestic hot water).

Note 2 to entry: A technical building system is composed of different sub-systems.

Note 3 to entry: Electricity production can include cogeneration, wind power and photovoltaic systems.

[SOURCE: ISO 52000-1:2017, 3.3.13, modified — The word “lighting” has been added in Note 1 to entry.]

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3.17
visual comfort
occupant satisfaction which the indoor visual environment, described in terms of illumination level, glare, visibility, reflection, quality view and psychological and physiological content with natural and artificial illumination

[SOURCE: ISO 16813:2006, 3.29, modified — The words “quality view” have been added.]

3.18
window
daylight opening (3.3) on a vertical or nearly vertical area of a room envelope

[SOURCE: CIE S 017/E:2011, 17-1436]

4 Fundamentals

4.1 General

Daylight opening design is a part of designing the indoor visual environment in the process of designing a building. It shall be appropriately included in the integrated design process provided by ISO 16817 in order to achieve the quality indoor visual environment. Daylight openings influence not only the visual environment but also the thermal, acoustical and air environments in buildings. An integrated multidisciplinary approach by a design team has important implications for daylight opening design. The integrated design process ensures an efficient and effective design to obtain the specified quality and performance level of safety, health, comfort and energy efficiency in buildings. ISO 16813 provides a flow diagram of the design process. The design process for daylight openings shall follow this process, as shown in Annex A. Daylight opening design shall be started at the initial stage of building design. Daylight can provide large quantities of light indoors, with great spectral quality and variability changing though the day and seasons. Windows provide a view and information about the outside and contribute to the psychological wellbeing of occupants. Windows, rooflights and roof windows can also provide exposure to sunlight indoors, which is important in e.g. dwellings, hospitals and nurseries. However, windows can give rise to glare. Careful consideration should be given to window screens, glazing materials and the reflectance of interior surfaces.

Exposure to sunlight is an important criterion because sufficient exposure to sunlight contributes to human health and a sense of wellbeing; but some rooms have to avoid receiving sunlight for their functionality. Besides, sunlight often causes glare directly or indirectly. It is of consequence in workplaces. Adequate sunlight controls should be provided to avoid visual discomfort as well as an overheating problem.

A certain level of the sunshine duration should be ensured in a habitable room for wellbeing[3,4]. Regional characteristics of direct solar radiation are expressed by the possible sunshine duration and the relative sunshine duration. In high-latitude regions, it is difficult to receive sufficient direct solar radiation in winter. In equatorial regions, south- and north-facing façades receive less direct solar radiation, whereas east- and west-facing façades receive more during a day. Direct solar radiation incident on the building exterior should be considered at the early stages of design. Incorrect decisions about the geometrical shape of the building can prevent the admission of sunlight into rooms.

The performance of daylight openings is influenced by site characteristics. Large obstructions can have an impact both on the amount of light reaching daylight openings and on the daylight distribution within rooms, and subsequently on the indoor visual environment. The building shall be planned so that building interiors will be illuminated by daylight in accordance with need for satisfactory performance of visual tasks. One or more habitable rooms should receive sunlight except where unavoidable circumstances are produced by the surrounding conditions of the site.

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