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Energy performance of buildings — Indoor environmental quality

Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings

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National foreword

This British Standard is the UK implementation of ISO 17772-1:2017.

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Energy performance of buildings — Indoor environmental quality —

Part 1: **Indoor environmental input parameters for the design and assessment of energy performance of buildings**

Performance énergétique des bâtiments — Qualité de l'environnement intérieur —

Partie 1: Paramètres d'entrée de l'environnement intérieur pour la conception et l'évaluation de la performance énergétique des bâtiments

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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. www.iso.org/directives

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This document was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*.

A list of all the parts in the ISO 17772 series can be found on the ISO website.

Introduction

Energy consumption of buildings depends significantly on the criteria used for the indoor environment (heating, cooling, ventilation and lighting) and building (including systems) design and operation. Indoor environment also affects health, productivity and comfort of the occupants. Recent studies have shown that costs of poor indoor environment for the employer, the building owner and for society, as a whole are often considerable higher than the cost of the energy used in the same building. It has also been shown that good indoor environmental quality can improve overall work and learning performance and reduce absenteeism. In addition uncomfortable occupants are likely to take actions to make themselves comfortable which may have energy implications. There is therefore a need for specifying criteria for the indoor environment for design and energy calculations for buildings and building service systems.

There exist other national and International Standards, and technical reports, which specify criteria for thermal comfort (ISO 7730[2]). These documents do specify different types and categories of criteria, which may have a significant influence on the energy demand. For the thermal environment criteria for the heating season (cold/winter) and cooling season (warm/summer) are listed. These criteria are, however, mainly for dimensioning of building, heating, cooling and ventilation systems. They may not be used directly for energy calculations and year-round evaluation of the indoor thermal environment. Studies have shown that occupant expectations in natural ventilated buildings may differ from conditioned buildings, which will be part of this document.

This document specifies how design criteria can be established and used for dimensioning of systems. It defines how to establish and define the main parameters to be used as input for building energy calculation and long term evaluation of the indoor environment. Finally this document identifies parameters to be used for monitoring and displaying of the indoor environment

Different categories of criteria may be used depending on type of building, type of occupants, type of climate and national differences. This document specifies several different categories of indoor environment which could be selected for the space to be conditioned. These different categories are intended to be used for design and may also be used to give an overall, yearly evaluation of the indoor environment by evaluating the percentage of time in each category. The designer may also select other categories using the principles from this document.

Table 1 shows the relative position of this document within the set of EPB standards in the context of the modular structure as set out in ISO 52000-1[15].

NOTE 1 In ISO/TR 52000-2 the same table can be found, with, for each module, the numbers of the relevant EPB standards and accompanying technical reports that are published or in preparation.

NOTE 2 The modules represent EPB standards, although one EPB standard can cover more than one module and one module can be covered by more than one EPB standard, for instance a simplified and a detailed method respectively. See also Clause 2 and Tables A.1 and H.1.

Table 1 — Position of this document within the EN EPB set of standards according to ISO 52001-1

Overarching		Building (as such)		Technical Building Systems										
	Descriptions		Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water	Lighting	Building automation and control	PV, wind, ..
sub1	M1	sub1	M2	sub1		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	1	General	1	General									
2	Common terms and definitions; symbols, units and subscripts	2	Building energy needs	2	Needs									
3	Applications	3	(Free) Indoor conditions without systems	3	Maximum load and power									
4	Ways to express energy performance	4	Ways to express energy performance	4	Ways to express energy performance									
5	Building functions and building boundaries	5	Heat transfer by transmission	5	Emission and control									
6	Building occupancy and operating conditions	6	Heat transfer by infiltration and ventilation	6	Distribution and control									
7	Aggregation of energy services and energy carriers	7	Internal heat gains	7	Storage and control									
8	Building partitioning	8	Solar heat gains	8	Generation and control									
9	Calculated energy performance	9	Building dynamics (thermal mass)	9	Load dispatching and operating conditions									
10	Measured energy performance	10	Measured energy performance	10	Measured energy performance									
11	Inspection	11	Inspection	11	Inspection									

Table 1 *(continued)*

Overarching			Building (as such)			Technical Building Systems										
	Descrip-tions			Descrip-tions			Descrip-tions	Heat-ing	Cool-ing	Ventila-tion	Humid-ifi cation	Dehumidifi-cation	Domes-tic hot water	Light-ing	Building automa-tion and control	PV, wind, ..
12	Ways to express indoor comfort					12	BMS									
13	Outdoor envi-ronment conditions															
14	Economic calculation															

Energy performance of buildings — Indoor environmental quality —

Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings

1 Scope

This document specifies requirements for indoor environmental parameters for thermal environment, indoor air quality, lighting and acoustics and specifies how to establish these parameters for building system design and energy performance calculations.

It includes design criteria for the local thermal discomfort factors, draught, radiant temperature asymmetry, vertical air temperature differences and floor surface temperature.

This document is applicable where the criteria for indoor environment are set by human occupancy and where the production or process does not have a major impact on indoor environment.

It also specifies occupancy schedules to be used in standard energy calculations and how different categories of criteria for the indoor environment can be used.

The criteria in this document can also be used in national calculation methods. This document sets criteria for the indoor environment based on existing standards and reports (listed in Clause 2 and the Bibliography).

The document does not specify design methods, but gives input parameters to the design of building envelope, heating, cooling, ventilation and lighting.

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 13731, *Ergonomics of the thermal environment — Vocabulary and symbols*

IEC 60050-845, *International electrotechnical vocabulary — Chapter 845: Lighting*

EN 16798-3, *Ventilation of non-residential buildings — Performance requirements for ventilation and room-conditioning systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13731 and IEC 60050-845, and the following 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
EPB standard
standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628[19] and CEN/TS 16629[20]

Note 1 to entry: These three basic EPB documents were developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480,), and support essential requirements of EU Directive 2010/31/EU on the energy performance of buildings (EPBD). Several EPB standards and related documents are developed or revised under the same mandate.

[SOURCE: ISO 52000-1:2017, 3.5.14]

3.2
adaptation, thermal
physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment in order to avoid or to limit thermal discomfort

Note 1 to entry: In naturally ventilated buildings these are often in response to changes in indoor environment induced by outdoor weather conditions.

3.3
adaptation
perceived air quality
sensory adaptation to perceived air quality (odour), which occurs during the first 15 min exposure to bio effluents

3.4
airing
intentional opening of windows, doors, vents, etc. for increasing the ventilation in a room

3.5
breathing zone
part of the occupied zone at the head level of the occupants

Note 1 to entry: Head level is 1,7 m standing, 1,1 m seated and 0,2 m for children on the floor

Note 2 to entry: For a definition of occupied zone see EN 16798–3.

3.6
building, very low-polluting
building where predominantly very low-emitting materials and furniture are used, activities with emission of pollutants are prohibited and no previous emitting sources (like tobacco smoke, from cleaning) were present

Note 1 to entry: Default criteria are listed in Annex H.

3.7
building, low-polluting
building where predominantly low emitting materials are used and materials and activities with emission of pollutants are limited

Note 1 to entry: Note to entry: Default criteria are listed in in Annex H.

3.8
building, non low-polluting
building where no effort has been done to select low-emitting materials and where activities with emission of pollutants are not limited or prohibited

Note 1 to entry: Default criteria are listed in Annex H. Previous emissions (like tobacco smoke) can have taken place.

3.9
cooling season
part of the year (usually summer) during which cooling is needed to keep the indoor temperature within specified levels, at least part of the day and in part of the rooms

Note 1 to entry: The length of the cooling season differs substantially from country to country and from region to region.

3.10
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

3.11
demand controlled ventilation
ventilation system where airflow rates are controlled automatically according to measured needs at room level

3.12
dehumidification
process of removing water vapour from air

3.13
outdoor temperature, daily mean
average of the hourly mean outdoor air temperature for one calendar day (24 h)

3.14
outdoor temperature
running mean
$\boldsymbol{\Theta}_{\mathbf{ed}}$
exponentially weighted running mean of the daily mean outdoor air temperature

3.15
heating season
part of the year during which heating is needed to keep the indoor temperature within specified levels, at least part of the day and in part of the rooms

Note 1 to entry: The length of the heating season differs substantially from country to country and from region to region.

3.16
humidification
process of adding water vapour to air to increase humidity

3.17
mechanical cooling
cooling of the indoor environment by mechanical means used to provide cooling of supply air

Note 1 to entry: This includes fan coil units, cooled surfaces, etc.

Note 2 to entry: Opening of windows during night and day time or mechanical supply of cold outdoor air is not regarded as mechanical cooling.

3.18
mechanical ventilation
ventilation system where air is supplied or extracted from the building or both by a fan using air terminal devices, ducts and roof/wall devices

3.19
natural ventilation
ventilation provided by thermal, wind, or diffusion effects through doors, windows, or other intentional devices in the building designed for ventilation

Note 1 to entry: Natural ventilation systems can be either manually or automatically controlled.

3.20
occupied hours
hours when the majority of the building or part of the building being considered is in its intended use

3.21
operative temperature
uniform temperature of an imaginary black enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment

Note 1 to entry: Further information is given in ISO 7726[1] and EN 16798-2[13].

3.22
optimal operative temperature
operative temperature that satisfies the greatest percentage of occupants at a given clothing and activity level in the current thermal environment

3.23
room conditioning system
system installed and used to keep comfortable conditions in a room within a defined range

Note 1 to entry: Air conditioning, chilled beams and radiant, surface heating and cooling systems are included.

3.24
ventilation
process of providing outdoor air by natural or mechanical means to a space or building

3.25
ventilation rate
magnitude of outdoor air flow to a room or building through the ventilation system or device

3.26
ventilation system
combination of appliances or building components designed to supply indoor spaces with outdoor air and/or to extract polluted indoor air

Note 1 to entry: A ventilation system can refer to mechanical, natural and hybrid ventilation systems.

Note 2 to entry: The ventilation system can consist of mechanical components (e.g. combination of air handling unit, ducts and terminal units). A ventilation system can also refer to natural ventilation systems making use of temperature differences and wind with facade grills in combination with mechanical exhaust (e.g. in corridors, toilets etc.). A combination of mechanical and natural ventilation is possible (hybrid systems).

3.27
design ventilation airflow rate
ventilation rate that the ventilation system is able to provide in design conditions (including boost, weather and loads)

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in ISO 52000-1:2017, Annex C and the following apply.

Symbol	Quantity	Unit
θ_o	indoor operative temperature	°C
θ_e	outdoor temperature	°C
Θ_{m}	running mean outdoor air temperature	°C
Θ_{o}	operative temperature, design and energy calculations	°C
$\Theta_{\mathrm{rm\text{-}i}}$	running mean outdoor temperature	°C
$\Theta_{\mathrm{ed\text{-}i}}$	daily mean outdoor temperature	°C
v_{a}	air speed (average / maximum)	m/s
Θ_{f}	floor surface temperature	°C
ΔCO_2	concentration	ppm
$\Delta\Theta_{\mathrm{pr}}$	radiant temperature asymmetry	K
$\Delta\Theta_{\mathrm{a}}$	vertical air temperature difference	K
α	constant for running mean calculations	
q_{tot}	total ventilation rate	l/s
q_{B}	ventilation rate for building materials	l/s(m^2)
q_{p}	ventilation rate for persons	l/s (per person)
$q_{\mathrm{tot,oz}}$	total ventilation rate in occupied zone	l/s(m^2), l/s(person)
n	number of persons	
q_{h}	ventilation rate required for dilution of pollutant	L/s
G_{h}	generation of a pollutant	μg/s
C_{h}	guideline value of a pollutant	μg/L
$C_{\mathrm{h,i}}$	guideline value of the substance	μg /m^3
$C_{\mathrm{h,o}}$	supply concentration of a pollutant at air intake	μg/L
ε_{v}	ventilation effectiveness	-
A	floor area	m^2
$L_{p,A}$	A-weighed sound pressure level	dB(A)
$L_{\mathrm{eq,\,nT,A}}$	equivalent continuous sound pressure level	dB(A)
D	daylight factor	
$DC_{\mathrm{a},j}$	daylight quotient of the calculated area	j
E_{m}	average maintained illuminance	lx
M	activity level	met
I_{cl}	assumed clothing level winter/summer	clo

4.2 Abbreviations

For the purposes of this document, the abbreviations given in ISO 52000-1:2017, Annex C and the following apply.

Abbreviation	Term
ACH	
DR	draught rate, %
DSNA	daylight quotient sunscreen not activated
IEQ	indoor environmental quality
IEQ_{cat}	indoor environmental quality category for design
$LPB_{1–3}$	low polluting building class
PD	percentage dissatisfied for local; thermal discomfort
PMV	predicted mean vote
PPD	predicted percentage of dissatisfied, %
RH	relative humidity
WHO	World Health Organization

5 Interactions with other standards

The present document provides default indoor environmental criteria for the design of buildings, room conditioning systems and lighting systems (see Clause 6). The thermal criteria (PMV or design indoor temperature in winter, design indoor temperature in summer) shall be used as bases for the definition of input for heating load calculations and cooling load calculations, sizing of equipment and energy calculations. Ventilation rates shall be used for design, sizing and energy calculations for ventilation systems. Lighting levels shall be used for design of lighting system including the use of day lighting. The present document shall provide default values for the indoor environment (like temperature, ventilation rate, illuminance) as input to the calculation of the energy demand (building energy demand), when the space is occupied (see Clause 7).

NOTE The categories are related to the level of expectations the occupants might have. A normal level would be “Medium”. A higher level might be selected for occupants with special needs (children, elderly, handicapped, etc.). A lower level does not provide any health risk but might decrease comfort.

6 Design input parameters for design of buildings and sizing of heating, cooling, ventilation and lighting systems

6.1 General

For design of buildings and sizing of technical building systems for heating, cooling, ventilation and lighting parameters and criteria shall be specified and documented. The criteria given in this clause shall be used as input values for sizing of the systems as well as for design of buildings.

The present document specifies, in informative annexes, default input values for use in cases where no national regulation is available. The default criteria are given for several categories. Design criteria for the indoor environment shall be documented together with the premises for use of the spaces.

Default input values are given for each of the different categories of indoor environmental quality. A short description of the categories is shown in Table 2.

Table 2 — Categories of indoor environmental quality

Category	Level of expectation
IEQ_I	High
IEQ_{II}	Medium
IEQ_{III}	Moderate
IEQ_{IV}	Low

NOTE The categories are related to the level of expectations the occupants might have. A normal level would be "Medium". A higher level might be selected for occupants with special needs (children, elderly, handicapped, etc.). A lower level will not provide any health risk but might decrease comfort.

6.2 Thermal environment

6.2.1 Heated and/or mechanically cooled buildings

For establishing design criteria the following procedure shall be used.

Criteria for the thermal environment in heated and/or mechanical cooled buildings shall be based on the thermal comfort indices PMV-PPD, with assumed typical levels of activity and typical values of thermal insulation for clothing (winter and summer). Based on the selected criteria a corresponding design operative temperature interval shall be established. The values for dimensioning of cooling systems shall be the upper values of the comfort range during cooling season (summer) and values for dimensioning of the heating system shall be the lower values of the comfort range.

The design criteria in this section shall be used for both design of buildings (dimensioning of windows, solar shading, building mass etc.) and HVAC systems.

Selection of the category is building, zone or room specific, and the needs of special occupant groups such as elderly people (low metabolic rate and impaired control of body temperature) shall be considered. For this group of people it is recommended to use category I requirements.

For buildings and spaces were the mechanical cooling capacity is not adequate to meet the required temperature categories, the design documents shall state that fact.

NOTE 1 Some default examples of recommended design indoor operative temperatures for heating and cooling, derived according to this principle, are presented in Table H.2 and in ISO/TR 17772-2[14].

NOTE 2 Instead of using operative temperature as the design criterion the PMV-PPD index can be used directly. In this way the effect of increased air velocity and effect of dynamic clothing insulation can be taken into account.

NOTE 3 Using one of the default methods described in ISO/TR 17772-2, it can be described how often the conditions are out of the required range.

6.2.1.1 Local thermal discomfort

Criteria for local thermal discomfort such as draught, radiant temperature asymmetry, vertical air temperature differences and floor surface temperatures shall also be taken into account when designing buildings and HVAC systems. Table H.3 presents the most important local thermal discomfort criteria at three category levels.

NOTE 1 For more background information see ISO/TR 17772-2.

6.2.2 Buildings without mechanical cooling

For the dimensioning of the heating system the same criteria as for mechanically, cooled and heated buildings shall be used (see 6.1.1).

In buildings without mechanical cooling, the criteria for the thermal environment shall be specified using the method described in 6.1.1 or using the adapted method that takes into account adaptation effects. This adaptive method only applies for occupants with sedentary activities without strict clothing policies where thermal conditions are regulated primarily by the occupants through opening and closing of elements in the building envelop (e.g. windows, ventilation flaps, roof lights, etc.). This method applies to office buildings and other buildings of similar type used mainly for human occupancy with mainly sedentary activities, where there is easy access to operable windows and occupants can freely adapt their clothing to the indoor and/or outdoor thermal conditions.

NOTE 1 The field studies behind the method were conducted in office buildings but the method can also apply in other spaces with similar individual possibilities for adaptation, e.g. in residential buildings.

NOTE 2 Default criteria for the indoor operative temperature in buildings without mechanical cooling systems are presented in H.2.

The upper limits shall be used to design buildings and passive thermal controls (e.g. orientation of glazing and solar shading, thermal building capacity, size and adjustability of operable windows etc.) to avoid overheating.

For buildings and spaces were the building design and the natural ventilation system is not adequate to meet the required temperature categories the design documents shall state that fact.

NOTE 3 Using one of the methods described in ISO/TR 17772-2, it can be described how often the conditions are out of the required range.

6.2.3 Increased air velocity

It shall be evaluated if increased air velocity (with or without personal control) can improve thermal comfort.

NOTE Under summer comfort conditions with indoor operative temperatures >25 °C increased air velocity can be used to reduce the adverse effects of increased air temperatures according to H.3.

6.3 Design for indoor air quality (ventilation rates)

6.3.1 General

Indoor air quality shall be controlled by the following means: source control, ventilation, and possible filtration and/or air cleaning.

Design ventilation airflow rates intended for sizing of the ventilation system shall be specified.

NOTE 1 Default ventilation airflow rates are presented in Annex B.

NOTE 2 During normal operation of the ventilation system, the ventilation flow rates can be different from the design ventilation flow rates.

6.3.1.1 Source control

The control of emission of non-human pollutants shall be the primary strategy for maintaining acceptable air quality.

NOTE 1 Once the main sources of pollutants are identified they can be eliminated or decreased by ventilation.

NOTE 2 The choice of building materials, surface preparation, maintenance and furniture has an impact on the non-human pollutant emission in rooms, spaces and buildings. The classification of this is shown in Annex C.

6.3.1.2 Ventilation

The design ventilation air flow rates shall be used for designing any type of ventilation system, including mechanical, natural and hybrid ventilation systems.

The design requirements for the ventilation air flow rates shall take into account the pollutant emissions rates left after source control with material selection, local exhaust and other means.

6.3.1.3 Time periods used for determining air flow rates

The methods described in Clause 6 assume that pollutants emissions are constant in each time period considered and lead to a constant ventilation air flow rate for each time period.

If occupation and pollutant loads vary in time, the designer shall specify the time periods considered for the calculation of the design ventilation air flow rates. These shall describe at least the assumed periods of occupancy and of non-occupancy.

NOTE Ventilation is also needed during non-occupied hours of the building to avoid accumulation of pollutant in indoor air or on surfaces, or ventilation can be started before occupancy (see ISO/TR 17772-2). Annex N includes default occupant schedules.

6.3.1.4 Building damage

Building damage shall be evaluated if the required ventilation rate for indoor air quality is high enough to avoid damaging condensation on surfaces, in the materials or in the structure. If not a higher ventilation rate shall be used as design value.

6.3.1.5 Design documentation

The design documentation shall state:

— which design method and if applicable which IEQ_{cat} is used for design;

— which pollutant sources have been identified and processes used to eliminate or decrease those sources;

— which method has been used to derive the specified design ventilation airflow rates and the applied occupancy schedules;

— design flow rates and the control range of ventilation in l/s per m^2 and l/s per occupant.

NOTE Default occupant schedules are given in Annex N.

6.3.2 Methods

6.3.2.1 General

Design parameters for indoor air quality shall be derived using one or more of the following methods:

— Method 1: Method based on perceived air quality;

— Method 2: Method using limit values for substance concentration;

— Method 3: Method based on predefined ventilation air flow rates.

NOTE Within each method, the designer can choose between different categories of indoor environmental quality and define which low pollutant building category, LPB_{1-3}, Annex C or Annex J is used.

6.3.2.2 Method 1 based on perceived air quality

The dilution required for reducing the health risk from a specific air pollutant shall be evaluated separately from the ventilation rates required to obtain a desired perceived air quality level (see Table 4). The highest of these ventilation rate values shall be used for design. If critical sources are identified for health, it shall be checked that they remain below the health threshold values (see 6.3.2.3).

The total ventilation rate for the breathing zone is found by combining the ventilation for people and building calculated from Formula (1):

$$q_{tot} = n \cdot q_p + A_R \cdot q_B \qquad (1)$$

where

q_{tot} is the total ventilation rate for the breathing zone, l/s;

n is the design value for the number of the persons in the room;

q_p is the ventilation rate for occupancy per person, l/(s·person);

A_R is the floor area, m^2;

q_B is the ventilation rate for emissions from building, l/(s·m^2).

The perceived air quality levels are defined by default for non-adapted persons in non-residential and adapted persons in residential buildings. In non-residential buildings, assuming adapted persons shall be justified.

NOTE See Annex B for default values. The methods described in ISO/TR 17772-2 can be used in special cases where adapted persons are considered. The resulting ventilation rates are assumed to be independent of seasons.

6.3.2.3 Method 2 using criteria for individual substances

The design ventilation rate required to dilute an individual substance shall be calculated using Formula (2):

$$Q_h = \frac{G_h}{C_{h,i} - C_{h,o}} \cdot \frac{1}{\varepsilon_v} \qquad (2)$$

where

Q_h is the ventilation rate required for dilution, in m^3/s;

G_h is the generation rate of the substance, in µg/s;

$C_{h,i}$ is the guideline value of the substance, in µg/m^3;

$C_{h,o}$ is the concentration of the substance of the supply air, in µg/m^3;

ε_v is the ventilation effectiveness.

NOTE 1 Default values for $C_{h,i}$ can be found in Annex B (for CO_2) and Annex F (other substances). Default values for ε_v (complete mixing is 1) can be found in EN 16798–3. $C_{h,i}$ and $C_{h,o}$ can also be expressed as ppm 10^6 (V/V). In this case the pollution load G_h needs to be expressed as l/s.

Formula (2) applies to steady-state conditions and the method requires that the supply air substance concentration is lower than the indoor concentration.

To calculate the design ventilation air flow rate from Formula (2), the most critical or relevant pollutant (or group of pollutants) shall be identified and the pollution load in the space shall be estimated.

When this method is used it is required that CO_2 representing the pollutant emission from people (bio effluents) shall be used as one of the substances.

Values depending on the category of indoor air are defined for CO_2 in Annex B. Threshold values for other sources are listed in Annex F. Emission rates and outdoor concentrations for the substances considered shall be defined based on material testing or certification (see Annex J) and local ambient air quality values.

NOTE 2 ISO/TR 17772-2 shows examples of pollutants generation and concentration (e.g. for CO_2 or water vapour, together with sample calculations) as well as calculations for non-steady-state.

6.3.2.4 Method 3 based on pre-defined ventilation air flow rates

This is a method to determine certain pre-defined minimum ventilation air flow rate estimated to meet requirements for both perceived air quality and health in the occupied zone.

The pre-defined ventilation air flow rates shall be expressed by one or more of the following parameters:

— total design ventilation for people and building components (q_{tot});

— design ventilation per unit floor area ($q_{m}{}^2$);

— design ventilation per person (q_p);

— design air change rates (a_{ch});

— design air flow rates by room and building type (q_{room}).

NOTE Default values for $q_{m}{}^2$ and q_p are presented in Annex I. Design opening areas (A_{tot}) can for residential buildings be considered as predefined air flow rates but need specific data on local climate and building characteristics (see EN 16798–7[43]).

6.3.3 Non-residential buildings

6.3.3.1 Applicable methods

For the design of ventilation systems and calculation of design heating and cooling loads, the design ventilation rate shall be specified based on national requirements, or when no national regulation is available, using one of the three methods described in 6.2.2.1.

6.3.3.2 Ventilation air flow rates during unoccupied periods

In case the ventilation is shut off, the operation time and ventilation air flow rate needed to limit the concentration of pollutants emitted by materials prior to occupation shall be determined.

NOTE 1 Annex I gives default values for the minimum ventilation air to be delivered prior to occupation.

In case the air flow rate is lowered, the air flow rate needed to limit the concentration of pollutants emitted by materials prior to occupation shall be determined.

NOTE 2 Annex I gives default values for the minimum ventilation air flow rate to be delivered to remove building emissions during un-occupied hours.

6.3.4 Residential buildings

6.3.4.1 Applicable methods

Design ventilation air flow rates shall be specified as an air change per hour for each room, and/or outdoor air supply per person and/or required extract rates (bathroom, toilets, and kitchens), given as an overall required air-change rate or design air flow rates by room and building type (q_{room}) and design opening areas.

NOTE Design opening areas (A_{tot}) for residential buildings can be considered as predefined air flow rates but need specific data on local climate and building characteristics (see EN 16798–7).

6.3.4.2 Ventilation air flow rates during non-occupied periods

If the ventilation rate is lowered when the building is not occupied, the air flow rate needed to limit the concentration of pollutants emitted by any sources (building and specific residential activities) shall be determined and applied.

NOTE Default values are listed in Table I.1.4.

6.3.5 Access to operable windows

It shall be possible to access operable elements in the building envelop (e.g. windows, ventilation flaps, sky lights) provided for the ventilation, to allow the building occupants to make ventilation and to provide contact to the outside. Alternatively a remote control e.g. by mechatronic drives or operating rods can be used.

NOTE For example, this applies to bedrooms and living rooms in dwellings and other buildings with rooms intended for sleep, e.g. elderly homes. It also applies in schools and child care facilities. Increased air flow rates can be determined according to EN 16798–7. For further guidance see ISO/TR 17772-2.

6.3.6 Filtration and air cleaning

The influence of the position of outdoor air intakes, filtration and air cleaning shall be considered. If filtration and air cleaning is used the following points shall be considered:

— reducing the amount of airborne pollutants (pollens, moulds, spores, particles, dust) from the outdoor air intake by circulating the air through a filter or similar device;

— circulating secondary air through a filter or other air cleaning technology to reduce the amount of pollutants in the indoor air;

— reduce the concentration of odours and gaseous contaminants by circulating the secondary air or recirculating the return air through a gas phase air cleaner.

NOTE Design guidelines on air cleaning and filtration are given in EN 16798–3 and ISO 16814[12]. How to partially substitute ventilation by air cleaning is described in ISO/TR 17772-2.

6.4 Humidity

The humidity criteria depend partly on the requirements for thermal comfort and indoor air quality and partly on the physical requirements of the building (condensation, mould growth etc.). For special buildings (museums, historical buildings, churches etc.) additional humidity requirements shall be taken into account. Humidification or dehumidification of room air is usually not required but, if used, excess humidification and dehumidification shall be avoided.

NOTE 1 Air-water systems might require dehumidification to prevent condensation.

NOTE 2 Default design values of indoor humidity for occupied spaces with dehumidification and humidification systems are given in I.2.

6.5 Lighting

6.5.1 General

To enable people to perform visual tasks efficiently and accurately, appropriate lighting shall be provided. The lighting criteria shall be selected according to the tasks and activities being undertaken and shall provide comfortable conditions for the occupants. The design illuminance levels shall be obtained by means of daylight, electric light or a combination of both.

The design of daylight openings (e.g. windows, rooflights, etc.) shall not cause visual discomfort due to glare or a loss of privacy. The heat load from lighting systems shall be taken into account when calculating the energy demand in non-residential buildings for heating and cooling.

NOTE Windows are to be the primary source of light during daylight hours. Windows also provide visual contact with the outside environment. For reasons of comfort and energy in most cases the use of daylight is preferred. This depends on factors like occupancy hours, autonomy (portion of occupancy time during which there is enough daylight), location of the building (latitude) and amount of daylight hours during summer and winter, etc. Some explanations of the effects of lighting on health are given in ISO/TR 17772-2.

6.5.2 Non-residential buildings

For work places the design level for the average maintained illumination E_m shall be specified.

NOTE Specifications for work places can be found in EN 12464–1[23] and for sports lighting in EN 12193[21]. For some visual tasks in buildings and spaces the required lighting criteria are presented in Table D.1. Emergency lighting is not within the scope of this document.

To ensure good daylight provision, the daylight penetration in the spaces meant for human occupancy shall be fulfilled.

NOTE EN 15193–1[30] provides details of occupancy periods and daylight availability and estimations. Default daylight criteria are given in Annex D.

6.5.3 Residential buildings

The design illuminance levels shall be obtained by means of daylight, electric light or a combination of both.

NOTE EN 15193–1 and CEN/TR 15193–2[18] provide details of occupancy periods and daylight availability and estimations. Default daylight criteria are given in B.4.

6.6 Noise

For the design of ventilation, heating and cooling systems the required sound levels shall be specified.

NOTE 1 Default values are listed in Annex E. The tables in Annex E are only based on noise due to building service equipment and not on outdoor noise. Often national requirements exist for noise from building service equipment inside or outside assuming windows are closed. Calculation methods and guidance for the evaluation of noise at the design stage are found in EN 12354–5[22].

The noise from building service systems might disturb the occupants and prevent or deteriorate the intended use of the space or building. The noise in a space shall be evaluated using A-weighted equivalent sound pressure level, normalized with respect to reverberation time ($L_{\text{Aeq,nT}}$) to take into account the sound absorption of the room.

NOTE 2 $L_{\text{Aeq,nT}}$ is defined in ISO 16032[11] and ISO 10052[5].

NOTE 3 Noise from the ventilation and air conditioning systems can also be used to mask the other sound sources and to improve the acoustic privacy.

The criteria shall be used to limit the sound pressure level due to mechanical equipment and to set sound insulation requirements for the noise from outside and adjacent rooms.

NOTE 4 The values recommended in Annex E can be exceeded for a short-term period if the occupants can control the operation of the equipment or the windows. Even in this case, the rise of the sound pressure level over the values in the Annex E is limited to between 5 dB (A) and 10 dB (A).

Ventilation shall not rely primarily on operable windows if the building is located in an area with a high outdoor noise level compared to the level to be achieved in the space inside the building.

7 Indoor environment parameters for energy calculation

7.1 General

The energy calculation criteria for the indoor environment shall be specified and documented. Special considerations shall be given to personalized heating, cooling, and ventilation systems.

NOTE 1 For personalized systems see ISO/TR 17772-2. If personalized systems are used different thermal and indoor air quality criteria can be used for those two zones.

Accepted exceedance of the criteria shall be specified.

NOTE 2 Default values for exceedance are listed in ISO/TR 17772-2.

7.2 Thermal environment

As the energy calculations can be performed on a seasonal, monthly or hourly basis the indoor environment is specified accordingly. Indoor operative temperature criteria for heating and for cooling shall be specified.

Assumptions regarding clothing level and activity level shall be listed separately.

NOTE For additional information on clothing see ISO 9920[4] and on activity see ISO 8996[3].

7.2.1 Seasonal and monthly calculations

For seasonal and monthly calculations of energy use for heating and cooling respectively, the same values of indoor operative temperatures as for designing (sizing) the heating and cooling systems shall be used (see 6.1).

7.2.2 Hourly calculations

The target value of the operative temperature shall be specified. If the cooling power is limited the excess indoor operative temperatures shall be estimated and evaluated. Assumptions related to allowable exceedance shall be described.

NOTE The indoor operative temperature could fluctuate within the range according to the energy saving features or control algorithm. Default values for the acceptable range of the indoor operative temperature for heating and cooling are presented in H.4. Methods for evaluating the excess operative temperature are given in ISO/TR 17772-2.

7.3 Indoor air quality and ventilation

7.3.1 General

The minimum ventilation rate to be used for energy calculations during operation time shall at least conform to the minimum rates as prescribed in Clause 6. To ensure good indoor air quality at the beginning of the occupancy, the ventilation shall start before the occupancy or a minimum ventilation rate shall be provided during unoccupied hours according to 6.3.3.2 for energy calculations.

In systems with variable air flow controlled by any criteria representing demand (e.g. timer, occupancy detection, change of pollution load) the variation of ventilation rate over time (which might vary between maximum and minimum depending on the occupancy and pollution load such as CO_2 or moisture generation) shall be taken into account in the energy calculations.

Ventilation air flow rates in naturally ventilated buildings shall be calculated based on building layout, location and weather conditions.

NOTE Natural ventilation rates can be calculated in accordance with EN 16798–7 or with dynamic thermal simulation tools.

In hybrid ventilation systems the air flow and resulting energy calculation is due to a combination of natural and mechanical means.

7.4 Humidity

The criteria used for room and central equipment design and sizing (see 6.1.3) shall also be used in energy calculations. Indoor air shall not be dehumidified to a lower relative humidity than the design values and not be humidified into higher relative humidity than the design values. Furthermore an upper limit for the absolute humidity shall be given. Unoccupied buildings shall not be humidified (with some exceptions such as museums) but might need to be dehumidified to prevent long term moisture damage.

7.5 Lighting

7.5.1 Non-residential buildings

The required illumination level shall be obtained by daylighting (according to the daylight availability), electric lighting or a combination of both. Energy for illumination is calculated only for the occupied hours based on the agreed occupancy profile.

NOTE The energy use for lighting systems is calculated in accordance with EN 15193–1. The quality of lighting can be evaluated in according to EN 12464–1 and EN 12193. Default occupancy profiles are given in Annex N.

7.5.2 Residential buildings

The lighting power required for a residential building shall be calculated by the summation of the power rating of each lamp installed in a room or area.

NOTE Energy use can be calculated in accordance with EN 15193–1. Guidance on the installed lighting power requirements is given in EN/TR 15193–2.

Annex A
(normative)

Recommended criteria for the thermal environment

This annex includes all national recommended criteria for the thermal environment.

A.1 Recommended categories for mechanically heated and cooled buildings

Assuming different criteria for the PPD-PMV (ISO 7730), different categories of the indoor environment are established. Recommended PPD-PMV ranges are given in Table A.1. At least one category shall be given. For the design and dimensioning further criteria for the thermal environment (draught, vertical air temperature differences, floor temperature, and radiant temperature asymmetry) shall be taken into account (see Table A.3).

Table A.1 — Recommended categories for the design of mechanically heated and cooled buildings

Category	**Thermal state of the body as a whole**	
	PPD %	Predicted mean vote
I		
II		
III		
IV		

Table A.2 presents design values for the indoor operative temperature in buildings that have heating systems in operation during the winter season and mechanical cooling systems during the summer season.

Assumed clothing thermal insulation level for winter and summer (clo-value) and activity level (met-value) shall be listed in Table A.2.

Table A.2 — Recommended design values of the indoor operative temperature in winter and summer for buildings with mechanical cooling systems

Type of building/ space	**Category**	**Operative temperature °C**	
		Minimum for heating (winter season)	Maximum for cooling (summer season)
Residential buildings, living spaces (bedrooms, living rooms etc.) Sedentary activity ~1,2 met	I		
	II		
	III		
	IV		
Residential buildings, other spaces (kitchens, storages etc.) Standing-walking activity ~1,5 met	I		
	II		
	III		
	IV		
NOTE Assumed relative humidity XX % and velocity XX m/s.			

Table A.2 *(continued)*

Type of building/ space	Category	Operative temperature °C	
		Minimum for heating (winter season)	Maximum for cooling (summer season)
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditorium, cafeteria, restaurants, class rooms, Sedentary activity ~1,2 met	I		
	II		
	III		
	IV		
Other	I		
	II		
	III		
	IV		
NOTE Assumed relative humidity XX % and velocity XX m/s.			

Table A.3 gives criteria for local thermal discomfort for design of buildings and HVAC systems. At least one category shall be listed. Only three categories are included as an IV category cannot be justified from existing data.

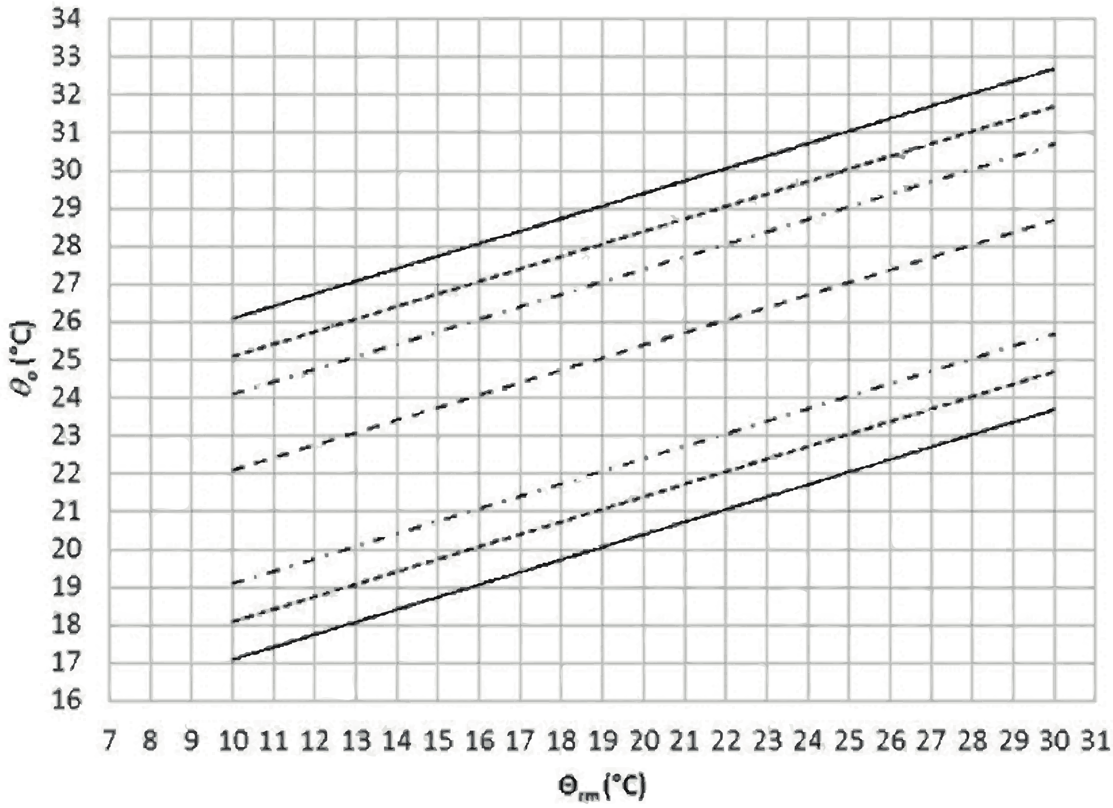
Table A.3 — Local thermal discomfort design criteria

	Draught			Vertical air temperature difference (head-ankle)		Range of floor surface temperature		Radiant temperature asymmetry				
		Maximum air velocity winter [m/s]	Maximum air velocity summer [m/s]		Temp. Difference [K]		Floor surface temperature range [°C]		Warm ceiling [K]	Cool wall [K]	Cool ceiling [K]	Warm wall [K]
Category I												
Category II												
Category III												

NOTE List any assumptions regarding the criteria.

A.2 Acceptable indoor temperatures of buildings without mechanical cooling systems

In Figure A.1 recommended indoor operative temperatures are presented for buildings without mechanical cooling systems. The limitation for this method shall be listed.



Key

Θ_{rm}	running mean outdoor temperature °C
θ_o	indoor operative temperature, °C
——— (solid line)	Cat. III upper limit
········ (dotted line)	Cat. II upper limit
— · — · (dash-dot line)	Cat. I upper limit
– – – – (dashed line)	Comfort temperature
— · — · (dash-dot line)	Cat. I lower limit
········ (dotted line)	Cat. II lower limit
——— (solid line)	Cat. III lower limit

Figure A.1 — Design values for the indoor operative temperature for buildings without mechanical cooling systems as a function of a weighted running mean of the outdoor temperature

The outdoor running mean temperature is calculated by means of Formula (A.1).

$$\Theta_{rm} = (1 - \alpha)\cdot\{ \Theta_{ed\,-1} + \alpha\cdot\Theta_{ed\,-2} + \alpha^2\, \Theta_{ed\,-3}.....\} \quad (A.1)$$

where

Θ_{rm} is the outdoor running mean temperature for the considered day (°C);

$\Theta_{rm\text{-}1}$ is the running mean outdoor air temperature for previous day;

α is the constant between 0 and 1 (recommended value is 0,8);

$\Theta_{ed\text{-}I}$ is the daily mean outdoor air temperature for the i^{th} previous day.

Include any assumptions for the use of Figure A.1.

A.3 Increased air velocity

Under summer comfort conditions with indoor operative temperatures > 25 °C artificially increased air velocity can be used to compensate for increased air temperatures in accordance with Table A.3 only if the increased air velocity is under personal control.

Table A.4 — Indoor operative temperature correction ($\Delta\Theta_o$) that can be applied when buildings are equipped with fans, personal systems that provide building occupants with personal control over air speed at workstation level

Average air speed (Va) 0,6 m/s	Average air speed (Va) 0,9 m/s	Average air speed (Va) 1,2 m/s

A.4 Recommended indoor temperatures for energy calculations

Table A.5 — Temperature ranges for hourly calculation of cooling and heating energy in 1–4 categories of indoor environment

Type of building or space	Category	Temperature range for heating °C	Temperature range for cooling °C
Residential buildings, living spaces (bedrooms, living rooms etc.)	I		
	II		
	III		
	IV		
Residential buildings, other spaces (kitchens, storages etc.)	I		
	II		
	III		
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditorium, cafeteria, restaurants, class rooms etc.)	I		
	II		
	III		
	IV		
NOTE Assumptions regarding clothing and activity shall be given.			

Table A.5 *(continued)*

Type of building or space	Category	Temperature range for heating °C	Temperature range for cooling °C
OTHER			
NOTE Assumptions regarding clothing and activity shall be given.			

Annex B
(normative)

Basis for the criteria for indoor air quality and ventilation rates

B.1 Design ventilation air flow rates for non-residential buildings

B.1.1 General

Due to health reasons the minimum airflow rate shall not be less than 4 l/s/person and the WHO Guideline values in Annex F shall be met. The air flow rates given in this annex are design ventilation air flow rates.

The air flow rates given in this annex assume complete mixing in the room (concentration of pollutants is equal in extract and in occupied zone). Ventilation rates shall be adjusted according to the ventilation effectiveness if the performance of air distribution differs from complete mixing in accordance with EN 16798-3[41].

B.1.2 Method 1: Method based on perceived air quality

The calculated design ventilation rate is from two components (a) ventilation to dilute/remove pollution from the occupants (bio effluents) and (b) ventilation to remove/dilute pollution from the building and systems. The ventilation for each category is the sum of these two components as illustrated with Formula (1).

The ventilation rates for occupants are presented for non-adapted.

The total ventilation rate depends on occupant density and building type. A building is by default a low-polluting building unless prior activity has resulted in pollution of the building (e.g. smoking). In this case, the building shall be regarded as non-low polluting. The category very low-polluting requires that the majority of building materials used for finishing the interior surfaces meet the national or international criteria of very low-polluting materials. How to define very low-polluting building materials is given in Annex C.

Values for occupants (q_P) only are listed in Table B.1.

Values for at least one category shall be listed.

Table B.1 — Design ventilation rates for non-adapted persons for diluting emissions (bio effluents) from people for different categories

Category		Airflow per non-adapted person l/(s·pers)
I		
II		
III		
IV		

The ventilation rates (q_B) for the building emissions are calculated according to Table B.2.

Table B.2 — Design ventilation rates for diluting emissions from buildings

Category	Very low polluting building l/(s m^2)	Low polluting building l/(s m^2)	Non low-polluting building l/(s m^2)
I			
II			
III			
IV			

Table B.3 — Example of design ventilation air flow rates for a single-person office of 10 m^2 in a low polluting building (un-adapted person)

Category	Low-polluting building l/(s·m^2)	Airflow per non-adapted person l/(s·person)	Total design ventilation air flow rate for the room		
			l/s	l/(s·person)	l/(s·m^2)
I					
II					
III					
IV					

B.1.3 Method 2: Method using limit values of substance concentration

The design ventilation rates are calculated based on a mass balance equation for the substance concentration in the space taking into account the outdoor concentration.

If CO_2 is used as a tracer of human occupancy, the default limit values are listed in Table B.4.

Table B.4 — Default design CO_2 concentrations above outdoor concentration assuming a standard CO_2 emission of 20 L/(h/person)

Category	Corresponding CO_2 concentration above outdoors in PPM for non-adapted persons
I	
II	
III	
IV	

B.1.4 Method 3: Method based on predefined air flow rates

The design ventilation air flow rates can be expressed as a required rate per person [l/(s per person)] as a required rate per m^2 floor area l/(s·m^2), as required air change rate, required total ventilation for either supply air flow or extract air flow rates or both.

Table B.5 — Default predefined design ventilation air flow rates for an office (un-adapted person)

Category	Total design ventilation air flow rate for the room l/(s per person) l/(s·m²)
I	
II	
III	
IV	

If design rates are given for both per person and per m² the highest total ventilation air flow rate should be used for design.

B.1.5 Design ventilation air flow rates for residential buildings

B.1.5.1 General

Predefined ventilation air flow rates can be given on a national level based on one or more of the following components:

— total air change rate for the dwelling;

— extract air flows for specific rooms;

— supply air flows for specific rooms.

B.1.5.2 Design supply air flow rates

Table B.6 gives the default values for the three criteria. It is assumed that air is supplied in living rooms and extracted from wet rooms.

Table B.6 — Criteria based on pre-defined supply ventilation air flow rates: total ventilation (1), supply air flow (2) and (3)

Category	Total ventilation including air infiltration (1)		Supply air flow per person (2)	Supply air flow based on perceived IAQ for adapted persons (3)	
	l/(s·m²)	ach	l/(s·person)	q_p l/s (per person)	q_B l/s(m²)
I					
II					
III					
IV					
NOTE The values assume that outdoor air is the primary source. Un-used outdoor air may be transferred from other rooms. These values may be converted to l/s/m² of floor area at national level depending on the average density of occupation of dwellings.					

Supply air flow for method 3 is based on Formula (1).

Table B.7 — Design ΔCO_2 concentrations in occupied rooms and in bedrooms

Category	Design ΔCO_2 concentration for occupied rooms (ppm above outdoors)	Design ΔCO_2 concentration for bedrooms (ppm above outdoors)
I		
II		
III		
IV		

B.1.5.3 Design extract air flow rates

This annex gives values for the design extract air flow rate based on air flow rates by room and building type (q_{room}) are given in Tables B.8 and B.9.

Table B.8 — Design air flow rates by room and building type (q_{room})

Number of main rooms in the dwelling	Design extract air flow rates in l/s				
	Kitchen	Bathroom or shower with or without toilets	Other wet room	Toilets	
				Single in dwelling	Multiple (2 or more in dwelling)
1					
2					
3					
4					
5 and more					

Table B.9 — Categories for predefined extract air flow rates

Category	Airflow rates defined in Table B.8 multiplied by
I	
II	
III	
IV	

Category 4 applies only if there is an additional range hood in the kitchen.

Table B.9 gives a methodology for defining default design opening areas for natural ventilation systems in dwelling. The opening areas shall be provided as supply/extract grilles, stack ducts, window grilles, or similar system.

Table B.10 — Default design opening areas for dwellings (values to be defined on national levels) — Values for bedrooms and living rooms may be given per m² floor area or as fixed values per room

	Extract Kitchen, bathrooms and toilets m^2	Supply Bedrooms and living rooms m^2
Default design opening area		

B.1.6 Ventilation air flow rate during unoccupied periods

B.1.6.1 Non-residential buildings

In case the ventilation is shut off, the minimum amount of air to be delivered prior to occupation shall be:

In case the ventilation is lowered, the total air flow rate for diluting emissions from building shall be:

B.1.6.2 Residential buildings

The total air flow rate needed to deal with building materials emissions shall be:

B.2 The recommended criteria for dimensioning of humidification and dehumidification

For buildings with no other humidity requirements than human occupancy (e.g. offices, schools and residential buildings), humidification or dehumidification is usually not needed.

Usually humidification or dehumidification is needed only in special buildings like museums, certain health care spaces, process control, paper industry etc.). If humidification or dehumidification is used the values in the Table B.11 is recommended as design values under design conditions.

Table B.11 — Example of recommended design criteria for the humidity in occupied spaces if humidification or dehumidification systems are installed

Type of building/space	Category	Design relative humidity for dehumidification %	Design relative humidity for humidification %
Spaces where humidity criteria are set by human occupancy (Special spaces such as museums, churches etc. might require other limits)	I		
	II		
	III		

It is recommended to limit the absolute humidity to 12 g/kg.

Annex C
(normative)

How to define low and very low polluting buildings

The building is low or very low polluting if the majority of the interior materials are low or very low emitting. Low and very low emitting materials are stone, glass, ceramics and non-treated metal, which are known to show no emissions into indoor air, and materials that show low or very low emissions when tested in a ventilated test chamber after 28 days in line with international testing standards, e.g. CEN/TS 16516 or ISO 16000-3, ISO 16000-6, ISO 16000-9, ISO 16000-11, with the results calculated for the European Reference Room as specified in CEN/TS 16516.

Table C.1 — Criteria for the different building types

SOURCE	Low emitting products for LPB2	Very low emitting products for LPB1
Total VOCs TVOC (as in CEN/TS 16516)		
Formaldehyde		
Any C1A or C1B classified carcinogenic VOC		
R value (as in CEN/TS 16516)		

The R value includes the pollutants with limit values that have been identified.

Compliance can be shown by presentation of a test report, issued by a testing laboratory conforming to ISO/IEC 17025 or by showing a valid attestation of compliance with any regulation or voluntary label that includes the above (or more stringent) limit values after 28 days storage in a ventilated test chamber (or earlier).

Annex D
(normative)

Examples of criteria for lighting

Table D.1 — Criteria for some buildings and spaces

Ref.	Type of area, task or activity	$\bar{E}_m$ lx
	Offices: writing, typing, reading, data processing Conference and meeting rooms	
	Educational buildings: classrooms, tutorial rooms, classroom for evening classes and adults education, auditorium, lecture halls	
	Educational premises: educational buildings, sports halls, gymnasiums, swimming pools	
	Others	

Table D.2 — Daylight availability classification as a function of the daylight factor $D_{Ca,j}$ of the raw building carcass opening and D_{SNA}

Vertical facades Daylight factor, $D_{Ca,j}$	Roof lights Daylight factor, D_{SNA}[a]	Classification of daylight availability
$D_{Ca,j} \geq 6$ %		
6 % > $D_{Ca,j} \geq 4$ %		
4 % > $D_{Ca,j} \geq 2$ %		
$D_{Ca,j} < 2$ %		

[a] Values of $D_{SNA} > 10$ % should be avoided due to danger of overheating

Annex E
(normative)

Indoor system noise criteria of some spaces and buildings

The values given in Table E.1 refer to noise due to building service systems inside the considered room.

Table E.1 — Design equivalent continuous sound level, $L_{Aeq,nT}$ [dB(A)] for continuous sources

Building	Type of space	Equivalent continuous sound level $L_{Aeq,nT}$ [dB(A)]		
		I	II	III
Residential	Living room			
	Bedrooms			
Places of assembly	Auditoriums			
	Libraries			
	Cinemas			
	Museums			
Commercial	Retail stores			
	Department stores, supermarkets			
Hospitals	Bedrooms			
	Wards			
	Operating theatres			
Hotels	Hotel rooms			
	Reception, lobbies			
Offices	Small offices			
	Landscaped offices			
	Conference rooms			
Restaurants	Cafeterias			
	Bars, dining rooms			
	Kitchens			
Schools	Classrooms			
	Gymnasiums			
Sport	Covered sport facilities			
General	Service rooms, corridors			
	Toilets			

Annex F
(normative)

Criteria for substances in indoor air

Table F.1, gives suggested guideline values for indoor and outdoor air pollutants.

Table F.1 — Guidelines values for indoor and outdoor air substances

Substance	Indoor air quality guidelines

In case of specific indoor pollution, ventilation rates shall be adapted to optimize the diluting effect of ventilation and additional air cleaning strategies can be considered.

Annex G
(normative)

Occupant schedules for energy calculations

	Parameter office, land-scaped	Value	Unit	Clause-table
Operation time	Hour at day, START		hours	assumed
	Hour at day, END		hours	assumed
	Breaks, inside range		hours	assumed
	days/week		days	
	hours/day		hours	
	hours/year		hours	calculated
Internal gains	Occupants		m^2/pers	assumed
	Occupants (Total)		W/m^2	Calculated
	Occupants (Dry)		W/m^2	calculated
	Appliances		W/m^2	assumed
	Lighting			
	Moisture production		g/(m^2, h)	calculated
	CO_2 production		l/(m^2, h)	calculated
Set points	Min T,op in unoccupied hours		°C	Assumed
	Max T,op in unoccupied hours		°C	assumed
	Min T,op, heating/winter		°C	7.2, Table B1.5
	Max T,op, cooling/summer		°C	7.2, Table B1.5
	Ventilation rate (min.)		l/(s m^2)	6.3.2.2,
	Max CO_2 concentration (above outdoor)		ppm	6.3.2.3
	Min. relative humidity		%	7.4, Table I.11
	Max. relative humidity		%	7.4, Table I.11
	Lighting, illuminance in working areas		lx	7.5, Table K.1
	Domestic hot water use			
Other				

h	**Diversity factor**			**Energy calculation**		
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

Annex H
(informative)

Default criteria for the thermal environment

This annex includes all default criteria for the thermal environment.

H.1 Default categories for mechanically heated and cooled buildings

Assuming different criteria for the PPD-PMV (ISO 7730) different categories of the indoor environment are established. Recommended PPD ranges are given in the Table H.1. For the design and dimensioning further criteria for the thermal environment (draught, vertical air temperature differences, floor temperature, and radiant temperature asymmetry) shall be taken into account (see Table H.3).

Table H.1 — Default categories for design of mechanical heated and cooled buildings

Category	Thermal state of the body as a whole	
	Predicted percentage of dissatisfied PPD %	Predicted mean vote PMV
I	< 6	−0,2 < PMV < + 0,2
II	< 10	−0,5 < PMV < + 0,5
III	< 15	−0,7 < PMV < + 0,7
IV	< 25	−1,0 < PMV < + 1,0

Table H.1 presents design values for the indoor operative temperature in buildings that have active heating systems in operation during winter season and active cooling systems during summer season.

Assumed clothing thermal insulation level for winter and summer (clo-value) and activity level (met-value) are listed in Table H.2. Note that the operative temperature limits shall be adjusted when clothing levels and/or activity levels are different from the values mentioned in the table.

Table H.2 — Default design values of the indoor operative temperature in winter and summer for buildings with mechanical cooling systems (for more examples see ISO/TR 17772-2)

Type of building/space	Category	Operative temperature °C	
		Minimum for heating (winter season), approximately 1,0 clo	**Maximum for cooling (summer season), approximately 0,5 clo**
Residential buildings, living spaces (bedrooms, living rooms, kitchens etc.) Sedentary activity ~1,2 met	I	21,0	25,5
	II	20,0	26,0
	III	18,0	27,0
	IV	16,0	28,0
NOTE A 50 % relative humidity level and low air velocity level (<0,1 m/s) is assumed.			

Table H.2 *(continued)*

Type of building/space	Category	Operative temperature °C	
		Minimum for heating (winter season), approximately 1,0 clo	**Maximum for cooling (summer season), approximately 0,5 clo**
Residential buildings, other spaces (utility rooms, storages etc.) Standing-walking activity ~1,5 met	I	18,0	
	II	16,0	
	III	14,0	
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditorium, cafeteria, restaurants, class rooms, Sedentary activity ~1,2 met	I	21,0	25,5
	II	20,0	26,0
	III	19,0	27,0
	IV	18,0	28,0
NOTE A 50 % relative humidity level and low air velocity level (<0,1 m/s) is assumed.			

Table H.3 gives default criteria for local thermal discomfort parameters for the three categories for design of buildings and HVAC systems.

Table H.3 — Local thermal discomfort design criteria

	Draught			**Vertical air temperature difference (head-ankle)**		**Range of floor temperature**		**Radiant temperature asymmetry**				
	DR (Draught Rate) [%]	**Maximum air velocity**[a] **winter** [m/s]	**summer** [m/s]	**PD** [%]	**Temp. Difference**[b] [K]	**PD** [%]	**Floor surface temperature range** [°C]	**PD** [%]	**Warm ceiling** [K]	**Cool wall** [K]	**Cool ceiling** [K]	**Warm wall** [K]
Category I	10	0,10	0,12 [c]	3	2	10	19 to 29	5	< 5	< 10	< 14	< 23
Category II	20	0,16	0,19 [c]	5	3	10	19 to 29	5	< 5	< 10	< 14	< 23
Category III	30	0,21	0,24 [c]	10	4	15	17 to 31	10	< 7	< 13	< 18	< 35

[a] Assuming an activity level of 1,2 met, a turbulence intensity of 40 % and an air temperature equal to the operative temperature of around 20 °C in winter and 23 °C in summer.

[b] Difference between 1,1 and 0,1 m above the floor.

[c] When the air temperature is above 25 °C higher maximum air speeds are allowed and often even preferred (draught becomes pleasurable breeze); but only under the condition that occupants have direct control over the air speed. See B1.3 for examples of operative temperature corrections.

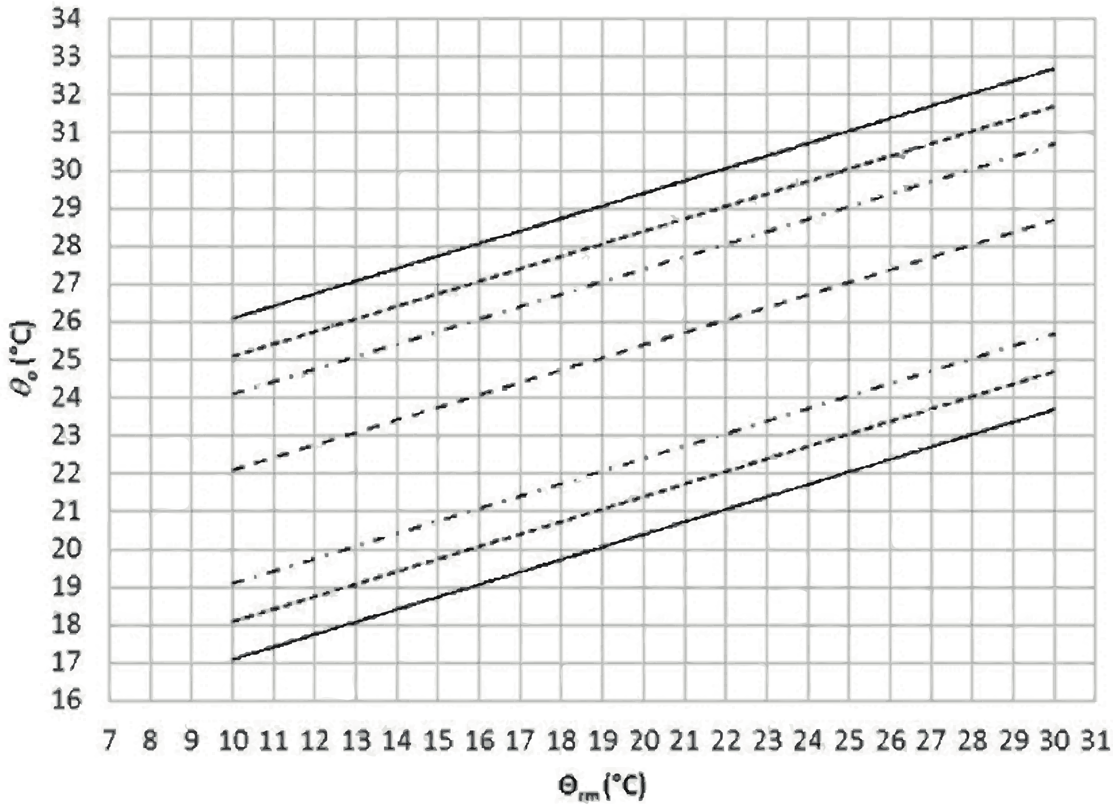
For more information, see ISO 7730 and ISO/TR 17772-2.

H.2 Default acceptable indoor temperatures for buildings without mechanical cooling systems

In Figure H.1 recommended ranges of indoor operative temperatures are presented for buildings without mechanical cooling systems as function of the outdoor running mean temperature, defined below. This alternative method only applies for office buildings and other buildings of similar type (e.g. residential buildings) used mainly for human occupancy with mainly sedentary activities, where there is easy access to operable windows and occupants can freely adapt their clothing to the indoor and/or outdoor thermal conditions, where thermal conditions are regulated primarily by the occupants through opening and closing of openings (windows) in the building envelope.

During the summer season and during the shoulder seasons (spring and autumn) so-called adaptive criteria (upper and lower temperature limits that change with the running mean outdoor temperature) shall be applied (see the cat. I, II and III upper and lower limits in Figure H.1).

During the winter season, the same temperature limits shall be applied as presented in H.1 for buildings with mechanical cooling systems (winter upper and lower limits are not presented in Figure H.1).



Key

Θ_{rm} running mean outdoor temperature °C

θ_o indoor operative temperature, °C

(solid line) Cat. III upper limit

(dotted line) Cat. II upper limit

(dash-dot line) Cat. I upper limit

(dashed line) Comfort temperature

(dash-dot line) Cat. I lower limit

(dotted line) Cat. II lower limit

(solid line) Cat. III lower limit

Figure H.1 — Default design values for the indoor operative temperature for buildings without mechanical cooling systems as a function of the exponentially-weighted running mean of the outdoor temperature

The outdoor running mean temperature is calculated by means of Formula (H.1).

$$\Theta_{rm} = (1- \alpha)\cdot\{ \Theta_{ed\,-1} + \alpha\cdot\Theta_{ed\,-2} + \alpha^2\, \Theta_{ed\,-3}.....\} \quad (H.1)$$

where

Θ_{rm} is the outdoor running mean temperature for the considered day (°C);

Θ_{ed-1} is the daily mean outdoor air temperature for previous day;

α is the constant between 0 and 1 (recommended value is 0,8);

Θ_{ed-i} is the daily mean outdoor air temperature for the *i-th* previous day.

The following approximate equation shall be used where records of daily running mean outdoor temperature are not available:

$$\Theta_{rm} = (\Theta_{ed\,-1} + 0{,}8\,\Theta_{ed\,-2} + 0{,}6\,\Theta_{ed\,-3} + 0{,}5\,\Theta_{ed\,-4} + 0{,}4\,\Theta_{ed\,-5} + 0{,}3\,\Theta_{ed\,-6} + 0{,}2\,\Theta_{ed\,-7})/3{,}8 \qquad \text{(H.2)}$$

The allowable indoor operative temperatures of Figure H.1 are plotted against the running mean outdoor temperature Θ_{rm}. This is defined as the exponentially weighted running mean of the daily outdoor temperature [see Formulae (H.1) and (H.2)].

The equations representing the lines in Figure H.1 are:

Category I upper limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 + 2$

lower limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 - 3$

Category II upper limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 + 3$

lower limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 - 4$

Category III upper limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 + 4$

lower limit: $\Theta_o = 0{,}33\ \Theta_{rm} + 18{,}8 - 5$

The dotted line in the middle refers to the optimal operative temperature. Formula (H.3) represents this line:

$$\Theta_c = 0{,}33\Theta_{rm} + 18{,}8 \qquad \text{(H.3)}$$

where

Θ_o is the indoor operative temperature, °C;

Θ_{rm} is the running mean outdoor temperature, °C;

Θ_c is the optimal operative temperature, °C.

The limits only apply when $10\ °C < \Theta_{rm} < 30\ °C$.

H.3 Increased air velocity

Under summer comfort conditions with indoor operative temperatures > 25 °C artificially increased air velocity can be used to compensate for increased air temperatures according to Table H.4 only if the increased air velocity is under personal control. The correction value depends on the air speed range of the appliance.

Table H.4 — Indoor operative temperature correction ($\Delta\Theta_o$) applicable for buildings equipped with fans or personal systems providing building occupants with personal control over air speed at occupant level

Average air speed, V_a **0,6 m/s**	**Average air speed, V_a** **0,9 m/s**	**Average air speed, V_a** **1,2 m/s**
1,2 °C	1,8 °C	2,2 °C
NOTE An air speed over 0,8 m/s moves the normal office paper from the desk.		

H.4 Default indoor temperatures for energy calculations

Table H.5 — Temperature ranges for hourly calculation of cooling and heating energy in three categories of indoor environment

Type of building or space	**Category**	**Temperature range for heating seasons, °C** **Clothing approximately 1,0 clo**	**Temperature range for cooling seasons, °C** **Clothing approximately 0,5 clo**
Residential buildings, living spaces (bedrooms, kitchens, living rooms etc.) Sedentary activity ~1,2 met	I	21,0 –25,0	23,5 - 25,5
	II	**20,0–25,0**	**23,0 - 26,0**
	III	18,0- 25,0	22,0 - 27,0
	IV	17,0–25,0	21,0 – 28,0
Residential buildings, other spaces (utility rooms, storages etc.) Standing-walking activity ~1,5 met	I	18,0–25,0	
	II	**16,0–25,0**	
	III	14,0–25,0	
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditoria, cafeteria, restaurants, class rooms) Sedentary activity ~1,2 met	I	21,0 – 23,0	23,5 - 25,5
	II	**20,0 – 24,0**	**23,0 - 26,0**
	III	19,0 – 25,0	22,0 - 27,0
	IV	17,0–25,0	21,0 – 28,0
NOTE During the between heating and cooling seasons (with Θ_{rm} between 10 °C and 15 °C) temperature limits that lie in between the winter and summer values may be used. Air velocity is assumed < 0,1 m/s and RH~40 % for heating season and 60 % for cooling season.			

The mean design operative temperature can vary from the values shown to take account of e.g. local custom or a desire for energy saving so long as the within-day variation from the design temperature is within the given range, and the occupants are given time and opportunity to adapt to the modified design temperature.

During between the heating and cooling seasons (with Θ_{rm} between around 10 °C and 15 °C), adjusted upper and lower temperature limits may be used that lie in between the winter and summer values mentioned in Table H.5.

Annex I
(informative)

Basis for the criteria for indoor air quality and ventilation rates

I.1 Default design ventilation air flow rates

I.1.1 General

Due to health reasons the total minimum airflow rate during occupancy expressed as l/s per person should never be below 4 l/s per person (see Table I.3) and the WHO Guideline values in Annex M is met. The default air flow rates given in this annex are design ventilation air flow rates.

The default air flow rates given in this annex assume complete mixing in the room (concentration of pollutants is equal in extract and in occupied zone). For non-residential buildings ventilation rates should be adjusted by the ventilation effectiveness in accordance with EN 16798-3 if the air distribution differs from complete mixing.

I.1.2 Method 1: method based on perceived air quality

The design ventilation rate is calculated from two components (a) ventilation to dilute/remove pollution from the occupants (bio effluents) and (b) ventilation to remove/dilute pollution from the building and systems. The ventilation for each category is the sum of these two components as illustrated with the Formula (1).

The ventilation rates for occupants are presented for non-adapted.

The total ventilation rate will then depend on occupancy density and building type. Examples of the total ventilation rates for non-industrial, non-residential buildings based on these values with default occupancy density are shown in ISO/TR 17772-2.

A building is a low-polluting building if the majority of building materials are low emitting and activity does not result in pollution of the building (e.g. smoking).

The category very low-polluting requires that the majority of building materials used for finishing the interior surfaces meet the national or international criteria of very low-polluting materials. An example of how to define very low-polluting building materials is given in Annex C.

Values for occupants (q_p) only are listed in Table I.1.

Table I.1 — Design ventilation rates for sedentary, adults, non-adapted persons for diluting emissions (bio effluents) from people for different categories

Category	Expected percentage dissatisfied	Airflow per non-adapted person l/(s per person)
I	15	10
II	20	7
III	30	4
IV	40	2,5

The ventilation rates (q_B) for the building emissions are given in Table I.2.

Table I.2 — Design ventilation rates for diluting emissions from different type of buildings

Category	Very low polluting building, LPB-1 l/(s m^2)	Low polluting building, LPB-2 l/(s m^2)	Non low-polluting building, LPB-3 l/(s m^2)
I	0,5	1,0	2,0
II	0,35	0,7	1,4
III	**0,2**	**0,4**	**0,8**
IV	0,15	0,3	0,6

Table I.3 — Example of default design ventilation air flow rates for a single-person office of 10 m^2 in a low polluting building (un-adapted person)

Category	Low-polluting building l/(s·m^2)	Airflow per non-adapted person l/(s per person)	Total design ventilation air flow rate for the room expressed in different ways		
			l/s	l/(s per person)	l/(s·m^2)
I	1,0	10	20	20	2
II	0,7	7	14	14	1,4
III	**0,4**	**4**	**8**	**8**	**0,8**
IV	0,3	2,5	5,5	5,5	0,55

Table I.3 shows the total ventilation rate is never lower than 4 l/s per person. The ventilation rate should always be higher than 4 l/s per person (minimum 4 l/s per person for human emissions and a part for building and activity related emissions).

I.1.3 Method 2: Method using limit values of substance concentration

The design ventilation rates are calculated based on a mass balance equation for the substance concentration in the space taking into account the outdoor concentration.

If CO_2 is used as a tracer of human occupancy, the default limit values are extracted from Table I.4. Further recommended criteria for the CO_2 calculation are included in ISO/TR 17772-2. The listed CO_2 values can also be used for demand controlled ventilation.

Table I.4 — Default design CO_2 concentrations above outdoor concentration assuming a standard CO_2 emission of 20 L/(h per person)

Category	Corresponding CO_2 concentration above outdoors in PPM for non-adapted persons
I	550 (10)
II	800 (7)
III	1350 (4)
IV	1350 (4)

I.1.4 Method 3: Method based on predefined ventilation flow rates

The design ventilation air flow rates can also be expressed as a required rate per person (l/(s per person)) or as a required rate per m^2 floor area (l/(s m^2).

Table I.5 — Default predefined design ventilation air flow rates for an office (un-adapted person)

Category	Total design ventilation air flow rate for the room	
	l/(s per person)	l/(s m^2)
I	20	2
II	14	1,4
III	8	0,8
IV	5,5	0,55

If design rates are given for both per person and per m^2 the higher ventilation air flow rate should be used for design.

The present example gives the same total ventilation as Method 1. Further examples are given in ISO/TR 17772-2.

I.1.5 Ventilation air flow rate during unoccupied periods

In case the ventilation is shut off, the minimum amount of air to be delivered prior to occupation is by default: 1 volume within 2 h of the zone to be ventilated.

In case the ventilation is lowered for un-occupied periods, the total air flow rate for diluting emissions from building should be minimum 0,15 l/s·m^2 of floor area in all rooms.

I.2 Default design ventilation air flow rates for residential buildings

Predefined ventilation air flow rates can be given based on one or more of the following components:

— total air change rate for the dwelling;

— extract air flows for specific rooms;

— supply air flows for specific rooms;

— design opening areas for natural ventilation.

Any of the criteria can be used in the design.

Both the total air flow rate for the entire dwelling and the extract air flow rate from wet rooms shall be calculated. Either one of the criteria can be used in the design.

I.2.1 Design supply air flow rates

Table I.6 gives the default values for the three criteria. It is assumed that air is supplied in living rooms and extracted from wet rooms.

Table I.6 — Criteria based on pre-defined supply ventilation air flow rates: Total ventilation (1), Supply air flow (2) and (3)

Category	Total ventilation including air infiltration (1)		Supply air flow per person (2)	Supply air flow based on perceived IAQ for adapted persons (3)	
	l/s,m^2	ach	l/s·per	q_p l/s (per person)	q_B l/s(m^2)
I	0,49	0,7	10	3,5	0,25
II	0,42	0,6	7	2,5	0,15
III	0,35	0,5	4	1,5	0,1
IV	0,23	0,4			

Supply air flow for Method 3 is based on Formula (1).

The values in Table I.6 assume that supply air is outdoor air, or unused air transferred from other rooms. These values may be converted to l/(s m^2) of floor area at national level depending on the average number of occupants in dwellings.

Table I.7 — Design CO_2 concentrations in occupied living rooms and bedrooms

Category	Design ΔCO_2 concentration for living rooms (ppm above outdoors)	Design ΔCO_2 concentration for bedrooms (ppm above outdoors)
I	550	380
II	800	550
III	1 350	950
IV	1 350	950

NOTE 1 The above values correspond to the equilibrium concentration when the air flow rate is 4, 7, 10 l/s per person for cat. I, II, III respectively and the CO_2 emission is 20 l /h per person and 13,6 l/h per person for living rooms and bedrooms respectively.

NOTE 2 For a 10 m^2 room (room height 2,5 m, 25 m^3) 4; 7 and 10 l/s per person correspond, with two persons in the room, to an air change rate of 1,2; 2,0 and 2,9 ACH.

I.2.2 Design extract air flow rates

This annex gives default values for the design extract air flow rate based on air flow rates by room and building type (q_{room}) given in Tables I.8 and I.9.

Table I.8 — Design air flow rates by room and building type (qroom)

Number of main rooms in the dwelling	Design extract air flow rates in l/s				
	Kitchen	Bathroom or shower with or without toilets	Other wet room	Toilets	
				Single in dwelling	Multiple (2 or more in dwelling)
1	20	10	10	10	10
2	25	10	10	10	10
3	30	15	10	10	10
4	35	15	10	15	10
5 and more	40	15	10	15	10

Table I.9 — Categories for predefined extract air flow rates

Category	Airflow rates defined in B 2.8 multi-plied by
I	1,4
II	1
III	0,7
IV	0,5

Category 4 applies only if there is an additional range hood in the kitchen.

I.2.3 Design opening areas for natural ventilation

Table I.10 gives a methodology for defining default design opening areas for natural ventilation systems in dwelling. The opening areas shall be provided as supply/extract grilles, stack ducts, window grilles, or similar system. When designing with design opening areas, the local climatic conditions should be taken into account.

Table I.10 — Default design opening areas for dwellings. Values for bedrooms and living rooms may be given per m² floor area or as fixed values per room

	Extract Kitchen, bathrooms and toilets cm²	Supply Bedrooms and living rooms cm²
Default design opening area	100 per room	60 per room

I.2.4 Design ventilation air flow rate during unoccupied periods

The total air flow rate needed to deal with building materials emissions and humidity reduction is between 0,1 and 0,15 l/(s·m²) of floor area, depending on the size and occupancy of the dwelling.

I.3 The recommended criteria for dimensioning of humidification and dehumidification

For buildings with no other humidity requirements than human occupancy (e.g. offices, schools and residential buildings), humidification or dehumidification is usually not needed.

Usually humidification or dehumidification is needed only in special buildings like museums, certain health care spaces, process control, paper industry etc.). If humidification or dehumidification is used the values in Table I.11 is recommended as design values under design conditions.

Table I.11 — Example of recommended design criteria for the humidity in occupied spaces if humidification or dehumidification systems are installed

Type of building/space	Category	Design relative humidity for dehumidification, %	Design relative humidity for humidification, %
Spaces where humidity criteria are set by human occupancy. (Special spaces, such as museums, churches etc. may require other limits)	I	50	30
	II	60	25
	III	70	20

Besides it is recommended to limit the absolute humidity to 12g/kg.

The recommended air flow rates in I.1 and I.2 may in very cold climate increase risk for too try air. In these cases, especially for IEQ category l and II is recommended to use humidity recovery. See ISO/TR 17772-2 for further guidance.

Annex J
(informative)

Example on how to define low and very low polluting buildings

The building is low or very low polluting if the majority of the interior materials are low or very low emitting. Low and very low emitting materials are stone, glass, ceramics and non-treated metal, which are known to show no emissions into indoor air, and materials that show low or very low emissions when tested in a ventilated test chamber after 28 days in line with international testing standards like CEN/TS 16516 or ISO 16000-3, ISO 16000-6, ISO 16000-9, ISO 16000-11, with the results calculated for the European Reference Room as specified in CEN/TS 16516.

Table J.1 — Criteria for the different building types

SOURCE	Low emitting products for low polluted buildings	Very low emitting products for very low polluted buildings
Total VOCs TVOC (as in CEN/TS 16516)	< 1,000 μg/m^3	< 300 μg/m^3
Formaldehyde	< 100 μg/m^3	< 30 μg/m^3
Any C1A or C1B classified carcinogenic VOC	< 5 μg/m^3	< 5 μg/m^3
R value (as in CEN/TS 16516)	< 1,0	< 1,0

The R value includes the pollutants with limit values that have been identified.

Compliance can be shown by presentation of a test report, issued by a testing laboratory conforming to ISO/IEC 17025 or by showing a valid attestation of compliance with any regulation or voluntary label that includes the above (or more stringent) limit values after 28 days storage in a ventilated test chamber (or earlier).

Annex K
(informative)

Examples of criteria for lighting

Table K.1 — Examples of criteria for some buildings and spaces according to EN 12464

Ref. no. acc. to EN 12464–1:2011	**Type of area, task or activity**	$\bar{E}_m$ **lx**
5.26.2 5.26.5	Offices - Writing, typing, reading, data processing, - Conference and meeting rooms	500
5.36.1–5.36.3	Educational buildings - Classrooms, tutorial rooms, Classroom for evening classes and adults education, Auditorium, lecture halls	500
5.36.24	Educational premises – Educational buildings - Sports halls, gymnasiums, swimming pools	300
NOTE Specific use of visual tasks not yet identified. For detailed design specific lighting standards like EN 12464-1 are needed.		

Table K.2 — Daylight availability classification as a function of the daylight factor $D_{Ca,j}$ of the raw building envelop opening and D_{SNA}

Vertical Facades **Daylight factor, $D_{Ca,j}$**	**Roof lights** **Daylight factor D_{SNA}**
$D_{Ca,j} \geq 6$ %	7 % < D_{SNA}[a]
6 % > $D_{Ca,j} \geq 4$ %	7 % > $D_{SNA} \geq 4$ %
4 % > $D_{Ca,j} \geq 2$ %	4 % > $D_{SNA} \geq 2$ %
$D_{Ca,j} < 2$ %	2 % > $D_{SNA} \geq 0$ %
[a] Values of D_{SNA} > 10 % should be avoided due to danger of overheating	

NOTE Besides the risk of overheating also the risk of glare needs to be evaluated with increased use of daylight (see ISO/TR 17772-2).

Annex L
(informative)

Indoor system noise criteria of some spaces and buildings

Table L.1 — Examples of design equivalent continuous sound level, $L_{Aeq,nT}$ [dB(A)] for continuous sources

Building	Type of space	Equivalent Continuous Sound Level $L_{Aeq,nT}$ [dB(A)]		
		I	II	III
Residential	Living room	≤ 30	≤ 35	≤ 40
	Bedrooms	≤ 25	≤ 30	≤ 35
Places of assembly	Auditoriums	≤ 24	≤ 28	≤ 32
	Libraries	≤ 25	≤ 30	≤ 35
	Cinemas	≤ 24	≤ 28	≤ 32
	Museums	≤ 28	≤ 32	≤ 36
Commercial	Retail stores	≤ 35	≤ 40	≤ 45
	Department stores, supermarkets	≤ 40	≤ 45	≤ 50
Hospitals	Bedrooms	≤ 25	≤ 30	≤ 35
	Wards	≤ 32	≤ 36	≤ 40
	Operating theatres	≤ 35	≤ 40	≤ 45
Hotels	Hotel rooms	≤ 25	≤ 30	≤ 35
	Reception, lobbies	≤ 30	≤ 35	≤ 40
Offices	Small offices	≤ 30	≤ 35	≤ 40
	Landscaped offices	≤ 35	≤ 40	≤ 45
	Conference rooms	≤ 30	≤ 35	≤ 40
Restaurants	Cafeterias	≤ 35	≤ 40	≤ 45
	Bars, dining rooms	≤ 32	≤ 36	≤ 40
	Kitchens	≤ 45	≤ 50	≤ 55
Schools	Classrooms	≤ 30	≤ 34	≤ 38
	Gymnasiums	≤ 35	≤ 40	≤ 45
Sport	Covered sport facilities	≤ 35	≤ 40	≤ 45
General	Service rooms, corridors	≤ 35	≤ 40	≤ 45
	Toilets	≤ 35	≤ 45	≤ 55

The values given in Table L.1 refer to sound generated inside the considered room by building service systems.

Further information in ISO/TR 17772-2.

Annex M
(informative)

WHO health-based criteria for indoor air

Table M.1, second column gives suggested guideline values for indoor and outdoor air pollutants as formulated by the WHO. For some pollutants no indoor air requirements have been defined yet by WHO. For those values only WHO outdoor requirements are presented, see the third column.

Table M.1 — WHO guideline values for indoor and outdoor air pollutants

Pollutant	WHO indoor air quality guidelines 2010	WHO air quality guidelines 2005
Benzene	No safe level can be determined	-
Carbon monoxide	15 min. mean: 100 mg/m^3 1 h mean: 35 mg/m^3 8h mean: 10 mg/m^3 24 h mean: 7 mg/m^3	-
Formaldehyde	30 min. mean: 100 µg/m^3	-
Naphthalene	Annual mean: 10 µg/m^3	-
Nitrogen dioxide	1 h mean: 200 µg/m^3 Annual mean: 20 µg/m^3	-
Polyaromatic Hydrocarbons (e.g. Benzo Pyrene A B[a]P)	No safe level can be determined	-
Radon	100 Bq/m^3 (sometimes 300 mg/m^3, country-specific)	-
Trichlorethylene	No safe level can be determined	-
Tetrachloroethylene	Annual mean: 250 µg/m^3	
Sulfure dioxide	-	10 min. mean: 500 µg/m^3 24 h mean: 20 µg/m^3
Ozone	-	8 h mean: 100 µg/m^3
Particulate matter PM 2,5	-	24 h mean: 25 µg/m^3 Annual mean: 10 µg/m^3
Particulate matter PM 10	-	24 h mean: 50 µg/m^3 Annual mean: 20 µg/m^3

WHO air quality guidelines values may be considered as a reference for indoor air quality when no other guidelines or national recommendations for indoor air quality value exist. Due to health effects confirmed at lower concentrations than current limit values and carcinogenic effect, the level of PAHs, particles, benzene should always be kept as low as possible.

In case of specific indoor pollution, ventilation rates shall be adapted to optimize the diluting effect of ventilation and additional air cleaning strategies can be considered.

Annex N
(informative)

Occupants schedules for energy calculations

If occupant schedules and internal loads are know these should be used for calculation of the energy performance.

The following default occupant schedules (see Annex C) are examples that can be used as input to calculations of energy use in a building, when a standard calculation is made and now specific values are available for a project.

The criteria used for room temperatures, ventilation, and humidity are based on IEQ building category LPB-1. Also for lighting the listed Lux-values are simplified. In a real space the lighting requirements vary from work place to work place depending on type of task.

The values in the tables cannot be used as standalone criteria and input values for design and energy calculations. This document as a whole should be used.

In the example below a reference is given to the clauses and tables in this document where the values come from.

	Parameter Office, landscaped	**Value**	**Unit**	
Operation time	Hour at day, START	7	hours	
	Hour at day, END	18	hours	
	Breaks, inside range	0	hours	
	days/week	5	days	
	hours/day	11	hours	
	hours/year	2 868	hours	
Internal gains	Occupants	17	m^2/s	assumed
	Occupants (Total)	7,0	W/m^2	calculated
	Occupants (Dry)	4,7	W/m^2	calculated
	Appliances	12	W/m^2	assumed
	Lighting			
	Moisture production	3,53	$g/(m^2, h)$	calculated
	CO_2 production	1,10	$l/(m^2, h)$	calculated

h	**Diversity factor**			**Energy calculation**		
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0

Setpoints	Min T,op in unoccupied hours	16	°C	Assumed
	Max T,op in unoccupied hours	32	°C	assumed
	Min T,op, heating/ winter	20	°C	7.2-B1.5
	Max T,op, cooling/ summer	26	°C	7.2-B1.5
	Ventilation rate (min.), Method 1	0,8	$l/(s\,m^2)$	6.3.2.2,
	Max CO_2 concentration (above outdoor)	450	ppm	6.3.2.3
	Min. relative humidity	25	%	7.4- B2.11
	Max. relative humidity	60	%	7.4- B2.11
	Lighting, illuminance in working areas	500	lx	7.5-B4.1
	Domestic hot water use			
Other				

8	0,2	0,2	0,2	0	0	0
9	0,6	0,6	0,6	0	0	0
10	0,6	0,6	0,6	0	0	0
11	0,7	0,7	0,7	0	0	0
12	0,7	0,7	0,7	0	0	0
13	0,4	0,4	0,4	0	0	0
14	0,6	0,6	0,6	0	0	0
15	0,7	0,7	0,7	0	0	0
16	0,7	0,7	0,7	0	0	0
17	0,6	0,6	0,6	0	0	0
18	0,2	0,2	0,2	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Annex O
(informative)

Occupants schedules for energy calculations

School classroom

Parameters and setpoints

	Parameter	Value	Unit
Operation time	Hour at day, START	8	hours
	Hour at day, END	17	hours
	Breaks, inside range	0	hours
	days/week	5	days
	hours/day	9	hours
	hours/year	2 346	hours
Internal gains	Occupants	5,4	m^2/pers
	Occupants (Total)	21,7	W/m^2
	Occupants (Dry)	13,8	W/m^2
	Appliances	8	W/m^2
	Lighting		
	Moisture production	11,11	g/(m^2, h)
	CO_2 production	3,46	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	3,8	l/(s m^2)
	Ventilation rate for CO_2 emission	1,84	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx
Other	Domestic hot water use	100	l / (m^2 year)
	Daycare, kindergarten		

Parameters and setpoints

h	Energy calculation					
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0,6	0,6	0,6	0	0	0
10	0,7	0,7	0,7	0	0	0
11	0,6	0,6	0,6	0	0	0
12	0,4	0,4	0,4	0	0	0
13	0,3	0,3	0,3	0	0	0
14	0,7	0,7	0,7	0	0	0
15	0,6	0,6	0,6	0	0	0
16	0,4	0,4	0,4	0	0	0
17	0,2	0,2	0,2	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Usage schedule

	Parameter	Value	Unit
Operation time	Hour at day, START	7	hours
	Hour at day, END	19	hours
	Breaks, inside range	0	hours
	days/week	5	days
	hours/day	12	hours
	hours/year	3 129	hours
Internal gains	Occupants	3,8	m^2/pers
	Occupants (Total)	33,3	W/m^2
	Occupants (Dry)	20,0	W/m^2
	Appliances	4	W/m^2
	Lighting		
	Moisture production	15,79	g/(m^2, h)
	CO_2 production	4,92	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	17,5	°C
	Max T,op	25,5	°C
	Ventilation rate (min.)	4,5	l/(s m^2)
	Ventilation rate for CO_2 emission	1,64	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx
Other	Domestic hot water use	100	l / (m^2 year)

	Energy calculation					
	Weekdays			Weekends		
h	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0,4	0,4	0,4	0	0	0
9	0,8	0,8	0,8	0	0	0
10	0,8	0,8	0,8	0	0	0
11	0,3	0,3	0,3	0	0	0
12	0,3	0,3	0,3	0	0	0
13	0,8	0,8	0,8	0	0	0
14	0,1	0,1	0,1	0	0	0
15	0,1	0,1	0,1	0	0	0
16	0,4	0,4	0,4	0	0	0
17	0,3	0,3	0,3	0	0	0
18	0,3	0,3	0,3	0	0	0
19	0,3	0,3	0,3	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Department store

Parameters and setpoints

Usage schedule

	Parameter	Value	Unit
Operation time	Hour at day, START	8	hours
	Hour at day, END	21	hours
	Breaks, inside range	0	hours
	days/week	7	days
	hours/day	13	hours
	hours/year	4 745	hours

	Energy calculation					
	Weekdays			Weekends		
h	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting

Internal gains	Occupants	17	m^2/pers
	Occupants (Total)	9,3	W/m^2
	Occupants (Dry)	4,5	W/m^2
	Appliances	1	W/m^2
	Lighting		
	Moisture production	3,53	g/(m^2, h)
	CO_2 production	1,10	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	16	°C
	Max T,op	25	°C
	Ventilation rate (min.)	2,2	l/(s m^2)
	Ventilation rate for CO_2 emission	0,53	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx
Other	Domestic hot water use	100	l / (m^2 year)

1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0,1	1	1	0,1	1	1
10	0,3	1	1	0,3	1	1
11	0,3	1	1	0,6	1	1
12	0,7	1	1	0,9	1	1
13	0,6	1	1	1	1	1
14	0,5	1	1	0,9	1	1
15	0,6	1	1	0,7	1	1
16	0,6	1	1	0,5	1	1
17	0,9	1	1	0,3	1	1
18	0,9	1	1	0,3	1	1
19	1	1	1	0,45	1	1
20	0,9	1	1	0,45	1	1
21	0,7	1	1	0,45	1	1
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Meeting room

Parameters and setpoints

	Parameter	Value	Unit
Operation time	Hour at day, START	7	hours
	Hour at day, END	18	hours
	Breaks, inside range	0	hours
	days/week	5	days
	hours/day	11	hours
	hours/year	2 868	hours
Internal gains	Occupants	2	m^2/pers
	Occupants (Total)	59,2	W/m^2
	Occupants (Dry)	40,1	W/m^2
	Appliances	12	W/m^2
	Lighting		
	Moisture production	30,00	g/(m^2, h)
	CO_2 production	9,35	l/(m^2, h)

Usage schedule

h	Energy calculation					
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0

Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	3,8	l/(s m^2)
	Ventilation rate for CO_2 emission	5,11	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx
Other	Domestic hot water use	100	l/(m^2 year)

8	0	0	0	0	0	0
9	0,5	0,5	0,5	0	0	0
10	0,8	0,8	0,8	0	0	0
11	0,9	0,9	0,9	0	0	0
12	0,8	0,8	0,8	0	0	0
13	0	0	0	0	0	0
14	0,7	0,7	0,7	0	0	0
15	0,8	0,8	0,8	0	0	0
16	0,8	0,8	0,8	0	0	0
17	0,7	0,7	0,7	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Office, Landscaped

Parameters and setpoints

	Parameter	**Value**	**Unit**
Operation time	Hour at day, START	7	hour
	Hour at day, END	18	hour
	Breaks, inside range	0	hours
	days/week	5	days
	hours/day	11	hours
	hours/year	2868	hours
Internal gains	Occupants	17	m^2/pers
	Occupants (Total)	7,0	W/m^2
	Occupants (Dry)	4,7	W/m^2
	Appliances	12	W/m^2
	Lighting		
	Moisture production	3,53	g/(m^2, h)
	CO_2 production	1,10	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	0,8	l/(s m^2)
	Ventilation rate for CO_2 emission	0,53	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx

Usage schedule

	Energy calculation					
	Weekdays			Weekends		
h	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0,2	0,2	0,2	0	0	0
9	0,6	0,6	0,6	0	0	0
10	0,6	0,6	0,6	0	0	0
11	0,7	0,7	0,7	0	0	0
12	0,7	0,7	0,7	0	0	0
13	0,4	0,4	0,4	0	0	0
14	0,6	0,6	0,6	0	0	0
15	0,7	0,7	0,7	0	0	0
16	0,7	0,7	0,7	0	0	0
17	0,6	0,6	0,6	0	0	0

Other	Domestic hot water use	100	l/(m² year)

18	0,2	0,2	0,2	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Office, single

Parameters and setpoints

	Parameter	Value	Unit
Operation time	Hour at day, START	7	hours
	Hour at day, END	18	hours
	Breaks, inside range	0	hours
	days/week	5	days
	hours/day	11	hours
	hours/year	2 868	hours
Internal gains	Occupants	10	m^2/pers
	Occupants (Total)	11,8	W/m^2
	Occupants (Dry)	8,0	W/m^2
	Appliances	12	W/m^2
	Lighting		
	Moisture production	6,00	g/(m^2, h)
	CO_2 production	1,87	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	1	l/(s m^2)
	Ventilation rate for CO_2 emission	0,96	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	500	lx
Other	Domestic hot water use	100	l/(m² year)

Usage schedule

h	Energy calculation					
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	1	1	1	0	0	0
11	1	1	1	0	0	0
12	1	1	1	0	0	0
13	0	0	0	0	0	0
14	1	1	1	0	0	0
15	1	1	1	0	0	0
16	1	1	1	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0

Restaurant

Parameters and setpoints

Usage schedule

	Parameter	Value	Unit
Operation time	Hour at day, START	6	hours
	Hour at day, END	24	hours
	Breaks, inside range	0	hours
	days/week	7	days
	hours/day	18	hours
	hours/year	6 570	hours
Internal gains	Occupants	6,1	m^2/pers
	Occupants (Total)	19,4	W/m^2
	Occupants (Dry)	13,2	W/m^2
	Appliances	4	W/m^2
	Lighting		
	Moisture production	9,84	g/(m^2, h)
	CO_2 production	3,07	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	16	°C
	Max T,op	25	°C
	Ventilation rate (min.)	5,2	l/(s m^2)
	Ventilation rate for CO_2 emission	1,62	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	300	lx
Other	Domestic hot water use	100	l/(m^2 year)

h	Energy calculation					
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0,1	0,13	0,3	0,1	0,13	0,3
8	0,4	0,15	0,3	0,4	0,15	0,3
9	0,4	0,18	0,55	0,4	0,18	0,55
10	0,4	0,21	0,55	0,4	0,21	0,55
11	0,2	0,26	0,75	0,2	0,26	0,75
12	0,5	0,29	0,75	0,5	0,29	0,75
13	0,8	0,27	0,75	0,8	0,27	0,75
14	0,7	0,25	0,75	0,7	0,25	0,75
15	0,4	0,23	0,75	0,4	0,23	0,75
16	0,2	0,23	0,75	0,2	0,23	0,75
17	0,25	0,26	0,7	0,25	0,26	0,7
18	0,5	0,26	0,75	0,5	0,26	0,75
19	0,8	0,24	0,75	0,8	0,24	0,75
20	0,8	0,22	0,75	0,8	0,22	0,75
21	0,8	0,2	0,75	0,8	0,2	0,75
22	0,5	0,18	0,75	0,5	0,18	0,75
23	0,35	0,09	0,5	0,35	0,09	0,5
24	0,2	0,03	0,3	0,2	0,03	0,3

Residential, apartment, retired

Parameters and setpoints

	Parameter	Value	Unit
Operation time	Hour at day, START	0	hour
	Hour at day, END	24	hour
	Breaks, inside range	0	hours
	days/week	7	days
	hours/day	24	hours
	hours/year	8760	hours
Internal gains	Occupants	28,3	m^2/pers
	Occupants (Total)	4,2	W/m^2
	Occupants (Dry)	2,8	W/m^2
	Appliances	3	W/m^2
	Lighting		
	Moisture production	2,12	g/(m^2, h)
	CO_2 production	0,66	l/(m^2, h)

Usage schedule

h	Energy calculation					
	Weekdays			Weekends		
	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	1	0,5	0	1	0,5	0
2	1	0,5	0	1	0,5	0
3	1	0,5	0	1	0,5	0
4	1	0,5	0	1	0,5	0
5	1	0,5	0	1	0,5	0
6	1	0,5	0	1	0,5	0
7	1	0,5	0,15	1	0,5	0,15

	Parameter	Value	Unit
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	0,5	l/(s m^2)
	Ventilation rate for CO_2 emission	0,28	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	0	lx
Other	Domestic hot water use	100	l/(m^2 year)

h	Weekdays Occupants	Weekdays Appliances	Weekdays Lighting	Weekends Occupants	Weekends Appliances	Weekends Lighting
8	1	0,7	0,15	1	0,7	0,15
9	1	0,7	0,15	1	0,7	0,15
10	1	0,5	0,15	1	0,5	0,15
11	1	0,5	0,05	1	0,5	0,05
12	1	0,6	0,05	1	0,6	0,05
13	1	0,6	0,05	1	0,6	0,05
14	1	0,6	0,05	1	0,6	0,05
15	1	0,6	0,05	1	0,6	0,05
16	1	0,5	0,05	1	0,5	0,05
17	1	0,5	0,2	1	0,5	0,2
18	1	0,7	0,2	1	0,7	0,2
19	1	0,7	0,2	1	0,7	0,2
20	1	0,8	0,2	1	0,8	0,2
21	1	0,8	0,2	1	0,8	0,2
22	1	0,8	0,2	1	0,8	0,2
23	1	0,6	0,15	1	0,6	0,15
24	1	0,6	0,15	1	0,6	0,15

Residential, apartment

Parameters and setpoints

	Parameter	Value	Unit
Operation time	Hour at day, START	0	hour
	Hour at day, END	24	hour
	Breaks, inside range	0	hours
	days/week	7	days
	hours/day	24	hours
	hours/year	8760	hours
Internal gains	Occupants	28,3	m^2/pers
	Occupants (Total)	4,2	W/m^2
	Occupants (Dry)	2,8	W/m^2
	Appliances	3	W/m^2
	Lighting		
	Moisture production	2,12	g/(m^2, h)
	CO_2 production	0,66	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	0,5	l/(s m^2)
	Ventilation rate for CO_2 emission	0,28	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	0	lx

Usage schedule

	Energy calculation					
	Weekdays			Weekends		
h	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	1	0,5	0	1	0,5	0
2	1	0,5	0	1	0,5	0
3	1	0,5	0	1	0,5	0
4	1	0,5	0	1	0,5	0
5	1	0,5	0	1	0,5	0
6	1	0,5	0	1	0,5	0
7	0,5	0,5	0,15	0,8	0,5	0,15
8	0,5	0,7	0,15	0,8	0,7	0,15
9	0,5	0,7	0,15	0,8	0,7	0,15
10	0,1	0,5	0,15	0,8	0,5	0,15
11	0,1	0,5	0,05	0,8	0,5	0,05
12	0,1	0,6	0,05	0,8	0,6	0,05
13	0,1	0,6	0,05	0,8	0,6	0,05
14	0,2	0,6	0,05	0,8	0,6	0,05
15	0,2	0,6	0,05	0,8	0,6	0,05
16	0,2	0,5	0,05	0,8	0,5	0,05
17	0,5	0,5	0,2	0,8	0,5	0,2

Other	Domestic hot water use	100	l / (m ^{2} year)

18	0,5	0,7	0,2	0,8	0,7	0,2
19	0,5	0,7	0,2	0,8	0,7	0,2
20	0,8	0,8	0,2	0,8	0,8	0,2
21	0,8	0,8	0,2	0,8	0,8	0,2
22	0,8	0,8	0,2	0,8	0,8	0,2
23	1	0,6	0,15	1	0,6	0,15
24	1	0,6	0,15	1	0,6	0,15

Residential, Detached house

Parameters and setpoints

	Parameter	**Value**	**Unit**
Operation time	Hour at day, START	0	hour
	Hour at day, END	24	hour
	Breaks, inside range	0	hours
	days/week	7	days
	hours/day	24	hours
	hours/year	8760	hours
Internal gains	Occupants	42,5	m^2/pers
	Occupants (Total)	2,8	W/m^2
	Occupants (Dry)	1,9	W/m^2
	Appliances	2,4	W/m^2
	Lighting		
	Moisture production	1,41	g/(m^2, h)
	CO_2 production	0,44	l/(m^2, h)
Setpoints	Min T,op in unoccupied hours	16	°C
	Max T,op in unoccupied hours	32	°C
	Min T,op	20	°C
	Max T,op	26	°C
	Ventilation rate (min.)	0,5	l/(s m^2)
	Ventilation rate for CO_2 emission	0,16	l/(s m^2)
	Max CO_2 concentration (above outdoor)	500	ppm
	Min. relative humidity	25	%
	Max. relative humidity	60	%
	Lighting, illuminance in working areas	0	lx
Other	Domestic hot water use	100	l / (m ^{2} year)

Usage schedule

	Energy calculation					
	Weekdays			Weekends		
h	Occupants	Appliances	Lighting	Occupants	Appliances	Lighting
1	1	0,5	0	1	0,5	0
2	1	0,5	0	1	0,5	0
3	1	0,5	0	1	0,5	0
4	1	0,5	0	1	0,5	0
5	1	0,5	0	1	0,5	0
6	1	0,5	0	1	0,5	0
7	0,5	0,5	0,15	0,8	0,5	0,15
8	0,5	0,7	0,15	0,8	0,7	0,15
9	0,5	0,7	0,15	0,8	0,7	0,15
10	0,1	0,5	0,15	0,8	0,5	0,15
11	0,1	0,5	0,05	0,8	0,5	0,05
12	0,1	0,6	0,05	0,8	0,6	0,05
13	0,1	0,6	0,05	0,8	0,6	0,05
14	0,2	0,6	0,05	0,8	0,6	0,05
15	0,2	0,6	0,05	0,8	0,6	0,05
16	0,2	0,5	0,05	0,8	0,5	0,05
17	0,5	0,5	0,2	0,8	0,5	0,2
18	0,5	0,7	0,2	0,8	0,7	0,2
19	0,5	0,7	0,2	0,8	0,7	0,2
20	0,8	0,8	0,2	0,8	0,8	0,2
21	0,8	0,8	0,2	0,8	0,8	0,2
22	0,8	0,8	0,2	0,8	0,8	0,2
23	1	0,6	0,15	1	0,6	0,15
24	1	0,6	0,15	1	0,6	0,15

Bibliography

[1] ISO 7726, *Ergonomics of the thermal environment — Instruments for measuring physical quantities*

[2] ISO 7730, *Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria*

[3] ISO 8996, *Ergonomics of the thermal environment — Determination of metabolic rate*

[4] ISO 9920, *Ergonomics of the thermal environment — Estimation of thermal insulation and water vapour resistance of a clothing ensemble*

[5] ISO 10052, *Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method*

[6] ISO 13790, *Energy performance of buildings — Calculation of energy use for space heating and cooling*

[7] ISO 13791, *Thermal performance of buildings — Calculation of internal temperatures of a room in summer without mechanical cooling — General criteria and validation procedures*

[8] ISO 13792, *Thermal performance of buildings — Calculation of internal temperatures of a room in summer without mechanical cooling — Simplified methods*

[9] ISO/TS 14415, *Ergonomics of the thermal environment — Application of international standards to people with special requirements*

[10] ISO 15927-4, *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 4: Hourly data for assessing the annual energy use for heating and cooling*

[11] ISO 16032, *Acoustics — Measurement of sound pressure level from service equipment in buildings — Engineering method*

[12] ISO 16814, *Building environment design — Indoor air quality — Methods of expressing the quality of indoor air for human occupancy*

[13] EN/TR 16798-2, *Energy performance of buildings — Ventilation for buildings — Guideline for using indoor environmental input parameters for the design and assessment of energy performance of buildings*

[14] ISO/TR 17772-2, *Energy performance of buildings — Overall energy performance assessment procedures — Part 2: Guideline for using indoor environmental input parameters for the design and assessment of energy performance of buildings*

[15] ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*

[16] ISO/TR 52000-2, *Energy performance of buildings — Overarching EPB assessment — Part 2: Explanation and justification of ISO 52000-1*

[17] CEN/TR 14788, *Ventilation for buildings — Design and dimensioning of residential ventilation systems*

[18] CEN/TR 15193-2, *Energy performance of buildings — Energy requirements for lighting — Part 2: Technical Report to EN 15193-1*

[19] CEN/TS 16628, *Energy performance of buildings — Basic principles for the set of EPB standards*

[20] CEN/TS 16629, *Energy performance of buildings — Detailed technical rules for the set of EPB standards*

[21] EN 12193, *Light and lighting — Sports lighting*

[22] EN 12354-5, *Building acoustics — Estimation of acoustic performance of building from the performance of elements — Sounds levels due to the service equipment*

[23] EN 12464-1, *Light and lighting — Lighting of work places — Indoor work places*

[24] EN 12599, *Ventilation for buildings — Test procedures and measurement methods to hand over air conditioning and ventilation systems*

[25] EN 12831, *Heating systems in buildings — Method for calculation of the design heat load*

[26] EN 13032-1, *Light and lighting — Measurement and presentation of photometric data of lamps and luminaries — Part 1: Measurement and file format*

[27] EN 13032-4, *Light and lighting — Measurement and presentation of photometric data of lamps and luminaires — Part 4: LED lamps, modules and luminaires*

[28] EN 13141 (all parts), *Ventilation for buildings — Performance testing of components/products for residential ventilation*

[29] EN 13142, *Ventilation for buildings — Components/products for residential ventilation — Required and optional performance characteristics*

[30] EN 15193-1, *Energy performance of buildings — Energy requirements for lighting — Part 1: Specifications, Module M9*

[31] EN 15217, *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings*

[32] EN 15239, *Ventilation for buildings — Energy performance of buildings —Guidelines for inspection of ventilation systems*

[33] EN 15240, *Ventilation for buildings — Energy performance of buildings — Guidelines for the inspection of air-conditioning systems*

[34] EN 15241, *Ventilation for buildings — Calculation methods for the energy losses due to ventilation and infiltration in buildings*

[35] EN 15242, *Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*

[36] EN 15243, *Ventilation for buildings —Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

[37] EN 15255, *Energy performance of buildings — Sensible room cooling load calculation – General criteria and validation procedures*

[38] EN 15265, *Energy performance of buildings — Calculation of energy needs for space heating and cooling using dynamic methods — General criteria and validation procedures*

[39] EN 15378, *Heating systems in buildings —Inspection of boilers and heating systems*

[40] EN 15665, *Ventilation for buildings — Determining performance criteria for residential ventilation systems*

[41] EN 16798–3, *Energy performance of buildings — Ventilation for buildings — Part 3: For non-residential buildings — Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)*

[42] EN 16798–7, *Energy performance of buildings — Ventilation for buildings —Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration (Module M5-5)*

[43] CR 1752:2001, *Ventilation for buildings — Design criteria for the indoor environment*

[44] CIE 69:1987, *Methods for characterizing illuminance meters and luminance meters: Performance, characteristics and specifications*

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