



BSI Standards Publication

Energy performance of buildings - Ventilation for buildings

Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6

National foreword

This British Standard is the UK implementation of EN 16798-1:2019. It supersedes BS EN 15251:2007, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Ventilation for buildings, heating and hot water services.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

**Energy performance of buildings - Ventilation for buildings
- Part 1: Indoor environmental input parameters for
design and assessment of energy performance of buildings
addressing indoor air quality, thermal environment,
lighting and acoustics - Module M1-6**

Performance énergétique des bâtiments - Ventilation
des bâtiments - Partie 1 : Données d'entrées
d'ambiance intérieure pour la conception et
l'évaluation de la performance énergétique des
bâtiments couvrant la qualité de l'air intérieur,
l'ambiance thermique, l'éclairage et l'acoustique
(Module M1-6)

Energetische Bewertung von Gebäuden - Teil 1:
Eingangsparameter für das Innenraumklima zur
Auslegung und Bewertung der Energieeffizienz von
Gebäuden bezüglich Raumluftqualität, Temperatur,
Licht und Akustik - Module M1-6

This European Standard was approved by CEN on 23 December 2018.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 16798-1:2019) has been prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by November 2019, and conflicting national standards shall be withdrawn at the latest by November 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15251:2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Regarding the most significant technical changes that were made in this new edition, see the Introduction.

Concerning the various parts of EN 16798, see below.

This standard has been produced to meet the requirements of Directive 2010/31/EU (19 May 2010) on the energy performance of buildings (recast), referred to as “recast EPbd”.

EN 15251:2007 was produced to meet the requirements of Directive 2002/91/EC (16 December 2002) on energy performance of buildings referred to as “EPBD”.

For the convenience of Standards users CEN/TC 156, together with responsible Working Group Convenors, have prepared a simple table below relating, where appropriate, the relationship between the ‘EPBD’ and ‘recast EPBD’ standard numbers prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”.

EPBD EN Number	Recast EPBD EN Number	Title
EN 15251	EN 16798-1	<i>Energy performance of buildings — Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics — Module M1-6 (revision of EN 15251)</i>
N/A	CEN/TR 16798-2	<i>Energy performance of buildings — Part 2: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics — Module M1-6 — Technical report — Interpretation of the requirements in EN 16798-1</i>

EN 13779	EN 16798-3	<i>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) (revision of EN 13779)</i>
N/A	CEN/TR 16798-4	<i>Energy performance of buildings — Part 4: Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems — Technical report — Interpretation of the requirements in EN 16798-3</i>
EN 15241	EN 16798-5-1	<i>Energy performance of buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Ventilation for buildings - Calculation methods for energy requirements of ventilation and air conditioning systems — Part 5-1: Distribution and generation — method 1 (revision of EN 15241)</i>
EN 15241	EN 16798-5-2	<i>Energy performance of buildings - Ventilation for buildings - Part 5-2: Calculation methods for energy requirements of ventilation systems (Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8) - Method 2: Distribution and generation (revision of EN 15241)</i>
N/A	CEN/TR 16798-6	<i>Energy performance of buildings — Part 6: Ventilation for buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Calculation methods for energy requirements of ventilation and air conditioning systems — Technical report — Interpretation of the requirements in EN 16798-5-1 and EN 16798-5-2</i>
EN 15242	EN 16798-7	<i>Energy performance of buildings - Ventilation for buildings - Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration (Modules M5-5) (revision of EN 15242)</i>
N/A	CEN/TR 16798-8	<i>Energy performance of buildings - Ventilation for buildings - Part 8: Interpretation of the requirements in EN 16798-7 - Calculation methods for the determination of air flow rates in buildings including infiltration - (Module M5-5)</i>
EN 15243	EN 16798-9	<i>Energy performance of buildings — Part 9: Ventilation for buildings - Module M4-1, M4-4, M4-9 — Calculation methods for energy requirements — Calculation methods for energy requirements of cooling systems — General (revision of EN 15243)</i>

N/A	CEN/TR 16798-10	<i>Energy performance of buildings - Ventilation for buildings - Part 10: Interpretation of the requirements in EN 16798-9 - Calculation methods for energy requirements of cooling systems (Module M4-1, M4-4, M4-9) - General</i>
N/A	EN 16798-11	<i>Energy performance of buildings — Part 11: Module M4-3 — Calculation of the design cooling load</i>
N/A	EN 16798-13	<i>Energy performance of buildings — Part 13: Module M4-8 — Calculation of cooling systems — Generation</i>
N/A	CEN/TR 16798-14	<i>Energy performance of buildings — Part 14 : Module M4-8 — Calculation of cooling systems — Generation — Technical report — Interpretation of the requirements in EN 16798-13</i>
N/A	EN 16798-15	<i>Energy performance of buildings — Part 15: Module M4-7 — Calculation of cooling systems — Storage</i>
N/A	CEN/TR 16798-16	<i>Energy performance of buildings - Ventilation for buildings - Part 16: Interpretation of the requirements in EN 16798-15 - Calculation of cooling systems (Module M4-7) - Storage</i>
EN 15239 and EN 15240	EN 16798-17	<i>Energy performance of buildings — Part 17: Ventilation for buildings — Guidelines for inspection of ventilation and air conditioning systems, Module M4-11, M5-11, M6-11, M7-11</i>
N/A	CEN/TR 16798-18	<i>Energy performance of buildings — Part 18: Ventilation for buildings — Module M4-11, M5-11, M6-11, M7-11 — Guidelines for inspection of ventilation and air conditioning systems in EN 16798-17</i>

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom

Introduction

This European Standard is part of a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings, called “set of EPB standards”.

All EPB standards follow specific rules to ensure overall consistency, unambiguity and transparency.

All EPB standards provide a certain flexibility with regard to the methods, the required input data and references to other EPB standards, by the introduction of a normative template in Annex A and Annex B with informative default choices.

For the correct use of this standard a normative template is given in Annex A to specify these choices. Informative default choices are provided in Annex B.

The main target groups of this standard are all the users of the set of EPB standards (e.g. architects, engineers, regulators).

Use by or for regulators: In case the standard is used in the context of national or regional legal requirements, mandatory choices may be given at national or regional level for such specific applications. These choices (either the informative default choices from Annex B or choices adapted to national / regional needs, but in any case following the template of this Annex A) can be made available as national annex or as separate (e.g. legal) document (national data sheet).

NOTE So in this case:

- the regulators will **specify** the choices;
- the individual user will apply the standard to assess the energy performance of a building, and thereby **use** the choices made by the regulators.

Topics addressed in this standard can be subject to public regulation. Public regulation on the same topics can override the default values in Annex B of this standard. Public regulation on the same topics can even, for certain applications, override the use of this standard. Legal requirements and choices are in general not published in standards but in legal documents. In order to avoid double publications and difficult updating of double documents, a national annex may refer to the legal texts where national choices have been made by public authorities. Different national annexes or national data sheets are possible for different applications.

It is expected, if the default values, choices and references to other EPB standards in Annex B are not followed due to national regulations, policy or traditions, that:

- national or regional authorities prepare data sheets containing the choices and national or regional values, according to the model in Annex A. In this case the national annex (e.g. NA) refers to this text;
- or, by default, the national standards body will consider the possibility to add or include a national annex in agreement with the template of Annex A, in accordance to the legal documents that give national or regional values and choices.

Further target groups are parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

More information is provided in the Technical Report accompanying this standard (CEN/TR 16798-2 [7], under preparation).

The first edition of this standard was published in 2007 as EN 15251. The major change consisted in splitting up the standard in a normative Part 1 and a Technical Report as Part 2. Part 1 includes an Annex B with tables with default values and an Annex A with similar empty tables to be used for national values. Further technical changes are the introduction of a category IV, inclusion of daylight factor and occupant schedules.

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.

The present standard is a revision of EN 15251:2007. This standard specifies 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. The criteria in EN 15251 were, 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 standard.

The present standard 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 short and long term evaluation of the indoor environment. The present standard gives default criteria for design and energy calculations in an informative Annex B. A similar normative Annex A is included for specifying national criteria. The national Annex A may specify different criteria for design compared to criteria for energy calculation. The national annex may also specify different criteria for different building types (offices, schools, etc.).

The present standard does not require certain criteria to be used. This is up to national regulations or individual project specifications.

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.

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

This European Standard 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.

This European Standard 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 European Standard can also be used in national calculation methods. This standard sets criteria for the indoor environment based on existing standards and reports listed under normative references or in the bibliography.

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

Table 1 shows the relative position of this standard within the set of EPB standards in the context of the modular structure as set out in EN ISO 52000-1.

NOTE 1 In CEN 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 may cover more than one module and one module may 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 B.1.

Table 1 — Position of this standard within the EN EPB set of standards according to EN ISO 52000-1

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														
12	Ways to Express Indoor Comfort			12	BMS														
13	Outdoor Environment Conditions																		
14	Economic Calculation																		

2 Normative references

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

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

EN 12464-2, *Light and lighting - Lighting of work places - Part 2: Outdoor work places*

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

EN 12792, *Ventilation for buildings - Symbols, terminology and graphical symbols*

EN 16516, *Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air*

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)*

EN ISO 7345:2018, *Thermal performance of buildings and building components - Physical quantities and definitions (ISO 7345:2018)*

EN ISO 13731, *Ergonomics of the thermal environment - Vocabulary and symbols (ISO 13731)*

EN ISO 52000-1:2017, *Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures (ISO 52000-1:2017)*

NOTE 1 Default references to EPB standards other than EN ISO 52000-1 are identified by the EPB module code number and given in Annex A (normative template) and Annex B (informative default choice).

NOTE 2 Example of EPB module code number: M5-5, or M5-5.1 (if module M5-5 is subdivided), or M5-5/1 (if reference to a specific clause of the standard covering M5-5).

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:2018, EN ISO 52000-1, EN 12792, EN ISO 13731, the EN 12464 series, EN 12665 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE The terms of EN ISO 52000-1 that are indispensable for the understanding of the underlying standard are repeated here.

3.1 EPB standard

standard that complies with the requirements given in EN ISO 52000-1, CEN/TS 16628 and CEN/TS 16629

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

Note 1 to entry: For airing see B 3.2.4 in CEN/TR 16798-2:2019.

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 B.4.

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: Default criteria are listed in B.4.

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 B.4. Previous emissions (like tobacco smoke) may 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

θ_{rm-i}

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, chilled ceilings and beams 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 may 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 EN ISO 7726 [9] and FprCEN/TR 16798-2 [7].

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**room temperature**

Operative Temperature

3.25**ventilation**

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

3.26**ventilation rate**

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

3.27**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. A combination of mechanical and natural ventilation is possible (hybrid systems).

3.28**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 Clause 4 and EN ISO 52000-1:2017, Annex C and the specific symbols listed in Table 2 apply.

Table 2 — Symbols and units

Symbol	Quantity	Unit
d_o	indoor operative temperature	°C
b_e	outdoor temperature	°C
A_m	running mean outdoor air temperature	°C
θ_{rm-i}	running mean outdoor temperature	°C
θ_{ed-i}	daily mean outdoor temperature	°C
v_a	air speed	m/s
θ_f	floor surface temperature	°C
ΔCO_2	difference in CO ₂ concentration	ppm
$\Delta \theta_{pr}$	radiant temperature asymmetry	K
$\Delta \theta_a$	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_{totoz}	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
$C_{h,i}$	guideline value of the substance	µg /m ³
$C_{h,o}$	supply concentration of a pollutant at air intake	µg/l
ε_v	ventilation effectiveness	-
A	floor area	m ²
$L_{p,A}$	A-weighted sound pressure level	dB(A)
$L_{Aeq,nT}$	equivalent continuous sound pressure level	dB(A)
D	daylight factor	
$DC_{a,j}$	Daylight quotient of the Calculated area	j
$\overline{E}_m$	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 Clause 4 and EN ISO 52000-1:2017, Annex C and the specific abbreviations listed in Table 3 apply.

Table 3 — Abbreviations

Abbreviation	Term
ACH	Air change per hour, (h^{-1})
$D_{\text{Ca},j}$	Vertical facades Daylight factor
DR	Draught rate, %
DSNA	Roof lights 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

This document provides default indoor environmental criteria for the design of buildings, room conditioning systems and lighting systems (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. This 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 (Clause 7).

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

6.1 Introduction

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 in Clause 6 shall be used as input values for sizing of the systems as well as for design of buildings.

The present standard 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 4.

Table 4 — Categories of indoor environmental quality

Category	Level of expectation
IEQ _I	High
IEQ _{II}	Medium
IEQ _{III}	Moderate
IEQ _{IV}	Low
NOTE In the tables only the category numbers are used without the IEQ _x symbol.	

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

6.2 Thermal environment

6.2.1 Heated and/or mechanically cooled buildings

6.2.1.1 General

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 (EN ISO 7730), 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 6.2 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 where 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 B.2, Table B.2 and in FprCEN/TR 16798-2 [7].

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 2 Using one of the default methods described in FprCEN/TR 16798-2 [7], it can be described how often the conditions are out of the required range.

6.2.1.2 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 B.3 presents the most important local thermal discomfort criteria at three category levels.

NOTE For more background information see FprCEN/TR 16798-2 [7].

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 (6.2.1).

In buildings without mechanical cooling, the criteria for the thermal environment shall be specified using the method described in 6.2.1 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 may 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 B.2.2.

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 where the building design and the natural ventilation system are not adequate to meet the required temperature categories the design documents shall state that fact.

NOTE 3 Using one of the methods described in FprCEN/TR 16798-2 [7], 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 $> 25\text{ °C}$ increased air velocity can be used to reduce the adverse effects of increased air temperatures according to B.2.3.

6.3 Design for Indoor air quality (ventilation rates)

6.3.1 General

6.3.1.1 Introduction

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 B.3.

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

6.3.1.2 Source control

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

It is recommended to identify the main sources of pollutants and to eliminate or decrease them by ventilation.

NOTE 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 B.4.

6.3.1.3 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.

6.3.1.4 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 B.3 in FprCEN/TR 16798-2 [7]). Annex C includes default occupant schedules.

6.3.1.5 Building damage

Building damage shall be evaluated in order to see 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.

6.3.1.6 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 m² and l/s per occupant.

NOTE Default occupant schedules are given in Annex C.

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, LPB₁₋₃ (A.4) 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 (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):

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

where

- q_{tot} = total ventilation rate for the breathing zone, l/s
- n = design value for the number of the persons in the room,
- q_p = ventilation rate for occupancy per person, l/(s person)
- A_R = floor area, m²
- q_B = ventilation rate for emissions from building, l/(s·m²)

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

NOTE See B.3 for default values. The methods described in FprCEN/TR 16798-2 [7] 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 by Formula (2):

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

where

- Q_h is the ventilation rate required for dilution, in m^3 per second;
- G_h is the generation rate of the substance, in micrograms per second;
- $C_{h,i}$ is the guideline value of the substance, in micrograms per m^3 ;
- $C_{h,o}$ is the concentration of the substance of the supply air, in micrograms per m^3 ;
- ε_v is the ventilation effectiveness.

Default values for $C_{h,i}$ can be found in B.3.1.3 (for CO_2) and B.7 (other substances). Default values for ε_v (complete mixing is 1) can be found in EN 16798-3. $C_{h,i}$ and $C_{h,o}$ may also be expressed as $\text{ppm} \cdot 10^6$ (vol/vol). In this case the pollution load G_h shall 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 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 B.3 Table B.9. Threshold values for other sources are listed in B.7. Emission rates and outdoor concentrations for the substances considered shall be defined based on material testing or certification (see Table B.17) and local ambient air quality values.

NOTE FprCEN/TR 16798-2 [7] shows examples of pollutants generation and concentration, e.g. for CO_2 or water vapour, together with sample calculations. Calculations for non-steady-state are shown also.

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 (ach);
- design air flow rates by room and building type (q_{room}).

NOTE Default values for q_m^2 and q_p are presented in B.3.

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).

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 6.3.2.1.

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 B.3 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 B.3 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 B.10.

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 FprCEN/TR 16798-2 [7].

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 passing the air through a filter or similar device;