INTERNATIONAL STANDARD

ISO 14683

Third edition
2017-06

Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values

Ponts thermiques dans les bâtiments — Coefficient linéique de transmission thermique — Méthodes simplifiées et valeurs par défaut

Reference number
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Foreword

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

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

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

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

ISO 14683 was prepared by ISO Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 89, *Thermal performance of buildings and building components,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 14683:2007), which has been technically revised.

The changes in the third edition are mostly editorial. The document has been re-drafted according to CEN/TS 16629:2014.

Introduction

This document is part of a series aimed at the international harmonization of the methodology for assessing the energy performance of buildings. Throughout, this series is referred to as a “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 document, a normative template is given in Annex A to specify these choices. Informative default choices are provided in Annex B.

The main target groups for this document are architects, engineers and regulators.

Use by or for regulators: In case the document 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 Annex A) can be made available as national annex or as separate (e.g. legal) document (national data sheet).

NOTE 1 So in this case:

— the regulators will specify the choices;

— the individual user will apply the document to assess the energy performance of a building, and thereby use the choices made by the regulators.

Topics addressed in this document can be subject to public regulation. Public regulation on the same topics can override the default values in Annex B. Public regulation on the same topics can even, for certain applications, override the use of this document. 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 a national annex (e.g. NA) is recommended, containing a reference to these data sheets;

— 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 (ISO/TR 52019-2) accompanying this document.

The subset of EPB standards prepared under the responsibility of ISO/TC 163/SC 2 cover *inter alia*:

— calculation procedures on the overall energy use and energy performance of buildings;

— calculation procedures on the internal temperature in buildings (e.g. in case of no space heating or cooling);

— indicators for partial EPB requirements related to thermal energy balance and fabric features;

— calculation methods covering the performance and thermal, hygrothermal, solar and visual characteristics of specific parts of the building and specific building elements and components, such as opaque envelope elements, ground floor, windows and facades.

ISO/TC 163/SC 2 cooperates with other technical committees for the details on appliances, technical building systems, indoor environment, etc.

This document provides the means (in part) to assess the contribution that building products and services make to energy conservation and to the overall energy performance of buildings.

This document deals with methods for assessing thermal bridges, which give rise to changes in heat flow rates and surface temperatures compared with those of the unbridged structure. These heat flow rates and temperatures can be precisely determined by numerical calculation in accordance with ISO 10211. However, for linear thermal bridges, it is often convenient to use simplified methods or tabulated values to obtain an estimate of their linear thermal transmittance.

The effect of repeating thermal bridges which are part of an otherwise uniform building element, such as wall ties penetrating a thermal insulation layer or mortar joints in lightweight blockwork, needs to be included in the calculation of the thermal transmittance of the building element concerned, in accordance with ISO 6946.

Although not covered by this document, thermal bridges can also give rise to low internal surface temperatures, with an associated risk of surface condensation or mould growth.

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.

NOTE 2 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 3 The modules represent EPB standards, although one EPB standard could cover more than one module and one module could 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 document (*in casu* M2–5) within the modular structure of the set of EPB standards

	Overarching		Building (as such)		Technical building systems										
Sub module	**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic hot water**	**Lighting**	**Building automation and control**	**PV, wind, ..**
sub1		**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
1	General		General		General									
2	Common terms and definitions; symbols, units and subscripts		Building energy needs		Needs								[a]	
3	Applications		(Free) Indoor conditions without systems		Maximum load and power									
4	Ways to express energy performance		Ways to express energy performance		Ways to express energy performance									
5	Building categories and building boundaries		Heat transfer by transmission	ISO 14683	Emission and control									
6	Building occupancy and operating conditions		Heat transfer by infiltration and ventilation		Distribution and control									
7	Aggregation of energy services and energy carriers		Internal heat gains		Storage and control									
8	Building zoning		Solar heat gains		Generation and control									
9	Calculated energy performance		Building dynamics (thermal mass)		Load dispatching and operating conditions									

[a] The shaded modules are not applicable.

Table 1 *(continued)*

	Overarching		Building (as such)		Technical building systems									
Sub module	**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic hot water**	**Lighting**	**Building automation and control**	**PV, wind, ..**
sub1		**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
10	Measured energy performance		Measured energy performance		Measured energy performance									
11	Inspection		Inspection		Inspection									
12	Ways to express indoor comfort				BMS									
13	External environment conditions													
14	Economic calculation													

[a] The shaded modules are not applicable.

Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values

1 Scope

This document deals with simplified methods for determining heat flows through linear thermal bridges which occur at junctions of building elements.

This document specifies requirements relating to thermal bridge catalogues and manual calculation methods.

Default values of linear thermal transmittance are given in Annex C.

NOTE Table 1 in the Introduction 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.

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 7345, *Thermal insulation — Physical quantities and definitions*

ISO 10211, *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

ISO 13370, *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

ISO 13789, *Energy performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method*

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

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

EXAMPLE 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).

NOTE 2 In this document, there are no choices in references to other EPB standards. NOTE 1 and the EXAMPLE above are kept to maintain uniformity between all EPB standards.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345 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 https://www.iso.org/obp/

3.1
linear thermal bridge
thermal bridge with a uniform cross section along one of the three orthogonal axes

3.2
point thermal bridge
localized thermal bridge whose influence can be represented by a point thermal transmittance

3.3
linear thermal transmittance
heat flow rate in the steady-state divided by length and by the temperature difference between the environments on either side of a thermal bridge

Note 1 to entry: The linear thermal transmittance is a quantity describing the influence of a linear thermal bridge on the total heat flow through the building envelope.

3.4
point thermal transmittance
heat flow rate in the steady-state divided by the temperature difference between the environments on either side of a thermal bridge

Note 1 to entry: The point thermal transmittance is a quantity describing the influence of a point thermal bridge on the total heat flow through the building envelope.

3.5
transmission heat transfer coefficient
heat flow rate due to thermal transmission through the fabric of a building, divided by the difference between the environment temperatures on either side of the construction

3.6
EPB standard
standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628[4] and CEN/TS 16629[5]

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 and support essential requirements of EU Directive 2010/31/EU on the energy performance of buildings. Several EPB standards and related documents are developed or revised under the same mandate.

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

4 Symbols and subscripts

4.1 Symbols

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

Symbol	Quantity	Unit
A	area	m^2
b	width	m
d	thickness	m
H	heat transfer coefficient	W/K
l	length	m
R	thermal resistance	$m^2 \cdot K/W$
U	thermal transmittance	$W/(m^2 \cdot K)$
θ	temperature	°C
λ	design thermal conductivity	$W/(m \cdot K)$

Symbol	Quantity	Unit
Φ	heat flow rate	W
Ψ	linear thermal transmittance	W/(m·K)
χ	point thermal transmittance	W/K

4.2 Subscripts

For the purposes of this document, the subscripts given in ISO 52000-1 and the following apply.

Subscript	Definition
a	adjacent
d	direct
e	external
g	ground
int	internal
oi	overall internal
se	external surface
si	internal surface
tr	transmission
u	unconditioned spaces

5 Description of the method

5.1 Output

The output of this document are linear and point thermal transmittances of thermal bridges.

5.2 General description

This document describes the method of calculation of linear and point thermal transmittance and provides default values.

5.3 Influence of thermal bridges on overall heat transfer

5.3.1 Transmission heat transfer coefficient

Between internal and external environments with temperatures θ_{int} and θ_e respectively, the transmission heat flow rate through the building envelope, Φ, is calculated using Formula (1):

$$\Phi = H_{tr} \cdot \left(\theta_{int} - \theta_e\right) \tag{1}$$

The transmission heat transfer coefficient, H_{tr}, is calculated using Formula (2):

$$H_{tr} = H_d + H_g + H_u + H_a \tag{2}$$

where

H_d is the direct heat transfer coefficient through the building envelope defined by Formula (3);

H_g is the ground heat transfer coefficient calculated in accordance with ISO 13370;

H_u is the heat transfer coefficient through unconditioned spaces calculated in accordance with ISO 13789;

H_a is the heat transfer coefficient to adjacent buildings calculated in accordance with ISO 13789.

5.3.2 Linear thermal transmittance

The calculation of the transmission heat transfer coefficient includes the contribution due to thermal bridges, according to Formula (3):

$$H_d = \sum_i A_i \cdot U_i + \sum_k l_k \cdot \Psi_k + \sum_j \chi_j \tag{3}$$

where

H_d is the direct heat transfer coefficient, in W/K;

A_i is the area of element i of the building envelope, in m^2;

U_i is the thermal transmittance of element i of the building envelope, in W/(m^2·K);

l_k is the length of linear thermal bridge k, in m;

Ψ_k is the linear thermal transmittance of linear thermal bridge k, in W/(m·K);

χ_j is the point thermal transmittance of the point thermal bridge j, in W/K.

The influence of point thermal bridges (insofar as they result from the intersection of linear thermal bridges) can often be neglected and so the correction term involving point thermal bridges can be omitted from Formula (3). If, however, there are significant point thermal bridges, then the point thermal transmittances should be calculated in accordance with ISO 10211.

Linear thermal bridges are generally liable to occur at the following locations in a building envelope:

— at junctions between external elements (corners of walls, wall to roof, wall to floor);

— at junctions of internal walls with external walls and roofs;

— at junctions of intermediate floors with external walls;

— at columns in external walls (if not allowed for in the U-value of the wall);

— around windows and doors.

5.3.3 Internal and external dimensions

There are three dimension systems commonly in use:

— internal dimensions, measured between the finished internal faces of each room in a building (thus excluding the thickness of internal partitions);

— overall internal dimensions, measured between the finished internal faces of the external elements of the building (thus including the thickness of internal partitions);

— external dimensions, measured between the finished external faces of the external elements of the building.

Any of these dimension systems may be used, provided that the system chosen is used consistently for all parts of the building construction. Linear thermal transmittance values depend on the system used, i.e. on the areas used for one-dimensional heat flow in $\sum_i A_i \cdot U_i$ in Formula (3), but the total transmission coefficient, H_{tr}, is the same provided that all thermal bridges are taken into account.

6 Methods for determination of linear thermal transmittance

6.1 Output data

The output data are listed in Table 2.

Table 2 — Output of the methods

Description	Unit	Destination module (Table 1)	Validity interval	Varying
linear thermal transmittance of linear thermal bridge *k*	W/(m·K)	M 2–5	—	No
point thermal transmittance of the point thermal bridge *j*	W/K	M 2–5	>0	No

6.2 Calculation time intervals

The input, the method and the output data are for steady-state conditions and assumed to be independent of actual conditions, such as indoor temperature or effect of wind or solar radiation.

6.3 Input data

Tables 3, 4 and 5 list identifiers for input data required for the calculation.

Table 3 — Identifiers for geometric characteristics

Name	Symbol	Unit	Value	Range	Origin	Varying
area of building envelope element *i*	A_i	m^2	—	>0		No
length of linear thermal bridge *k*	l_k	m	—	>0		No

Table 4 — Identifiers for dwelling boundary conditions

Name	Symbol	Unit	Value	Range	Origin	Varying
indoor environment temperature in the building under consideration	θ_{int}	°C	—	0...50		Yes
external temperature	θ_{ext}	°C	—	−50...50		Yes

Table 5 — Identifiers for thermal characteristics of dwelling fabric

Name	Symbol	Unit	Value	Range	Origin	Varying
thermal transmittance of element *i*	U_i	W/(m²·K)	—	>0	ISO 6946	No
linear thermal transmittance of thermal bridge *k*	Ψ_k	W/(m·K)	—	—	ISO 10211	No
point thermal transmittance of the point thermal bridge *j*	χ_j	W/K	—	>0	ISO 10211	No

Table 5 *(continued)*

Name	Symbol	Unit	Value	Range	Origin	Varying
annual average heat transfer coefficient to adjacent buildings	H_a	W/K	—	>0	ISO 13789	No
annual average ground heat transfer coefficient	H_g	W/K	—	>0	ISO 13370	No
transmission heat transfer coefficient through unconditioned spaces	H_u	W/K	—	>0	ISO 13789	No

6.4 Available methods and expected accuracy

When selecting a particular method, its accuracy should reflect the accuracy required in calculating the overall heat transfer, taking into account the lengths of the linear thermal bridges. Possible methods for determining Ψ include numerical calculations (typical accuracy ± 5 %), thermal bridge catalogues (typical accuracy ± 20 %), manual calculations (typical accuracy ± 20 %), and default values (typical accuracy 0 % to 50 %). The methods are discussed further in 6.5 to 6.7.

Where the details are not yet designed, but the size and main form of the building is defined, such that the areas of the different elements of the building envelope such as roofs, walls and floors are known, only a rough estimate of the contributions of thermal bridges to the overall heat loss can be made.

When sufficient information is available, more accurate values of Ψ for each of the linear thermal bridges can be obtained by comparing the particular detail with the best fitting example from a thermal bridge catalogue and using that value of Ψ. Manual calculation methods can also be used at this stage.

When full details are known, all the methods to determine Ψ may be used, including numerical calculations which give the most precise value for Ψ.

6.5 Numerical calculations

Linear thermal transmittance, Ψ, and point thermal transmittance, χ, shall be calculated in accordance with ISO 10211.

Any calculation of linear thermal transmittance shall state the system of dimensions on which it is based.

6.6 Thermal bridge catalogues

Examples of building details in thermal bridge catalogues have essentially fixed parameters (e.g. fixed dimensions and materials) and so are less flexible than calculations. In general, the examples given in a catalogue do not exactly match the actual detail being considered, and so applying the value of Ψ specified in the catalogue to an actual detail introduces an uncertainty. Nevertheless, the value of Ψ from the catalogue may be used, provided that both dimensions and thermal properties of the catalogue example are either similar to those of the detail being considered or are such that they are thermally less favourable than that of the detail being considered.

The numerical calculations on which the linear thermal transmittance values given in the catalogue are based shall be carried out in accordance with ISO 10211. The catalogue shall also provide the following information:

a) clear guidance on how values of Ψ are to be derived from the values given in the catalogue;

b) dimensions of the detail and thermal transmittance values of thermally homogeneous parts of the detail;

c) the internal and external surface resistances used for the calculation of the values given in the catalogue.

NOTE 1 When thermal bridge details are not yet fully designed, printed catalogues provide useful examples for the designer. However, more flexible catalogues using database systems can be used, where the exact dimensions and materials can be varied: the accuracy is then comparable to that of a numerical calculation.

NOTE 2 Preferably, the catalogue provides information on how the linear thermal transmittance for a given detail is affected by changes in the thermal conductivities and/or dimensions of the building components that comprise the thermal bridge. This can be done by tabulating coefficients that relate the change in linear thermal transmittance to the change in thermal conductivity and/or dimension.

Catalogues can also contain values of point thermal transmittance.

A template for specifying allowable catalogues is given in Table A.2.

6.7 Manual calculation methods

A manual calculation method shall provide the following information:

a) types of constructional details which apply;

b) dimensional limits for which the method is valid;

c) limits to the thermal conductivity of materials applied;

d) values of surface resistance to be used;

e) an estimate of accuracy (e.g. the maximum error).

NOTE Various manual calculation methods exist which are intended for use in calculations performed on hand-held calculators or by simple computer software. However, a general indication of accuracy for these methods cannot be given because most manual calculation methods apply only to a specific type of thermal bridge (e.g. constructions with sheet metal). Thus, over the specified range of application, a particular manual calculation can be very accurate, but outside that range it can be very inaccurate.

A template for specifying allowable methods is given in Table A.3.

7 Default values of linear thermal transmittance

Tables of default values of linear thermal transmittance may be prepared in accordance with the rules given in this document. Such tables shall give clear indications of the applicability of the values they contain and shall be based on calculations that do not underestimate the effect of the thermal bridges.

Table C.2 provides default values, calculated for parameters representing worst-case situations. These values are to be used in the absence of more specific data for the thermal bridges concerned. It is recommended that Table C.2 is extended or replaced, where appropriate, on a national basis, in order to cover constructional details typically used.

Annex A
(normative)

Input and method selection data sheet — Template

A.1 General

The template in Annex A of this document shall be used to specify the choices between methods, the required input data and references to other documents.

NOTE 1 Following this template is not enough to guarantee consistency of data.

NOTE 2 Informative default choices are provided in Annex B. Alternative values and choices can be imposed by national/regional regulations. If the default values and choices of Annex B are not adopted because of the national/regional regulations, policies or national traditions, it is expected that:

— national or regional authorities prepare data sheets containing the national or regional values and choices, in line with the template in Annex A; or

— by default, the national standards body will add or include a national annex (Annex NA) to this document, in line with the template in Annex A, giving national or regional values and choices in accordance with their legal documents.

NOTE 3 The template in Annex A is applicable to different applications (e.g., the design of a new building, certification of a new building, renovation of an existing building and certification of an existing building) and for different types of buildings (e.g., small or simple buildings and large or complex buildings). A distinction in values and choices for different applications or building types could be made:

— by adding columns or rows (one for each application), if the template allows;

— by including more than one version of a table (one for each application), numbered consecutively as a, b, c, ... For example: Table NA.3a, Table NA.3b;

— by developing different national/regional data sheets for the same standard. In case of a national annex to the standard these will be consecutively numbered (Annex NA, Annex NB, Annex NC, ...).

NOTE 4 In the section “Introduction” of a national/regional data sheet information can be added, for example about the applicable national/regional regulations.

NOTE 5 For certain input values to be acquired by the user, a data sheet following the template of Annex A, could contain a reference to national procedures for assessing the needed input data. For instance, reference to a national assessment protocol comprising decision trees, tables and pre-calculations.

The shaded fields in the tables are part of the template and consequently not open for input.

A.2 References

The references, identified by the module code number, are given in Table A.1.

Table A.1 — References

Reference	Reference document[a]	
	Number	Title
Mx-y[b]	...	...
	...	...

[a] If a reference comprises more than one document, the references may be differentiated.

[b] In this document, there are no choices in references to other EPB standards. The table is kept to maintain uniformity between all EPB standards.

A.3 Selection of methods

In this document, there is no need to specify choices in methods. A.3 is kept to maintain uniformity between all EPB standards.

A.4 Thermal bridge catalogues

Table A.2 — Thermal bridge catalogues (see 6.6)

Item	Choice
Thermal bridge catalogues	List catalogues with any applicability restrictions

A.5 Manual methods for thermal bridges

Table A.3 — Manual method (see 6.7)

Item	Choice
Manual methods	List methods, stating applicability and any restrictions

Annex B
(informative)

Input and method selection data sheet — Default choices

B.1 General

The template in Annex A of this document shall be used to specify the choices between methods, the required input data and references to other documents.

NOTE 1 Following this template is not enough to guarantee consistency of data.

NOTE 2 Informative default choices are provided in Annex B. Alternative values and choices can be imposed by national/regional regulations. If the default values and choices of Annex B are not adopted because of the national/regional regulations, policies or national traditions, it is expected that:

— national or regional authorities prepare data sheets containing the national or regional values and choices, in line with the template in Annex A; or

— by default, the national standards body will add or include a national annex (Annex NA) to this document, in line with the template in Annex A, giving national or regional values and choices in accordance with their legal documents.

NOTE 3 The template in Annex A is applicable to different applications (e.g., the design of a new building, certification of a new building, renovation of an existing building and certification of an existing building) and for different types of buildings (e.g., small or simple buildings and large or complex buildings). A distinction in values and choices for different applications or building types could be made:

— by adding columns or rows (one for each application), if the template allows;

— by including more than one version of a table (one for each application), numbered consecutively as a, b, c, ... For example: Table NA.3a, Table NA.3b;

— by developing different national/regional data sheets for the same standard. In case of a national annex to the standard these will be consecutively numbered (Annex NA, Annex NB, Annex NC, ...).

NOTE 4 In the section "Introduction" of a national/regional data sheet information can be added, for example about the applicable national/regional regulations.

NOTE 5 For certain input values to be acquired by the user, a data sheet following the template of Annex A, could contain a reference to national procedures for assessing the needed input data. For instance, reference to a national assessment protocol comprising decision trees, tables and pre-calculations.

The shaded fields in the tables are part of the template and consequently not open for input.

B.1 References

The references, identified by the module code number, are given in Table B.1.

Table B.1 — References

Reference	Reference document[a]	
	Number	Title
Mx-y[b]	...	...
	...	...

[a] If a reference comprises more than one document, the references may be differentiated.

[b] In this document, there are no choices in references to other EPB standards. The table is kept to maintain uniformity between all EPB standards.

B.2 Selection of methods

In this document, there is no need to specify choices in methods. B.3 is kept to maintain uniformity between all EPB standards.

B.3 Thermal bridge catalogues

Table B.2 — Thermal bridge catalogues (see 6.6)

Item	Choice
Thermal bridge catalogues	No default; should be assigned on a national basis

B.4 Manual methods for thermal bridges

Table B.3 — Manual method (see 6.7)

Item	Choice
Manual methods	No default; should be assigned on a national basis

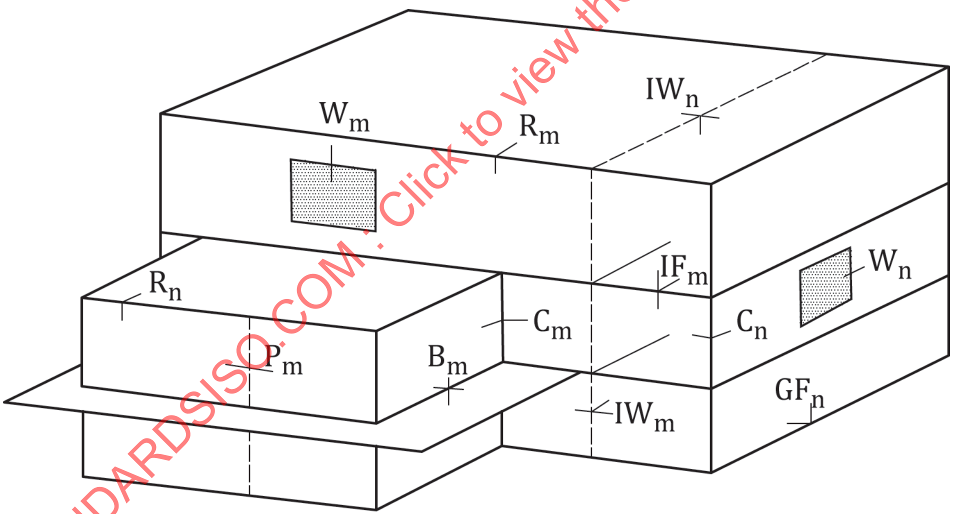
Annex C
(normative)

Default values of linear thermal transmittance

Table C.2 gives default values of Ψ for a range of commonly occurring types of two-dimensional thermal bridge, calculated using the data given in Table C.1. They are to be used when the actual value of Ψ is unknown, either when there are no details available for the particular thermal bridge, or where a rough value for Ψ is adequate for the accuracy required in the assessment of overall heat transfer. In Figure C.1, the notations R, B, C, GF, IF, IW, P and W refer to the location of the thermal bridge.

NOTE These default values of Ψ are based on two-dimensional numerical modelling in accordance with ISO 10211. They generally represent the maximum effects of thermal bridging. Default values are valid only for consideration of heat transfer, and not for consideration of critical surface temperature to avoid surface condensation.

Figure C.1 shows typical locations of these common types of two-dimensional thermal bridge. The capital letters against each thermal bridge denote the type of thermal bridge and the suffix denotes the specific thermal bridge, e.g. IW_n denotes one thermal bridge at the junction of the external envelope with an internal wall and IW_m denotes another different thermal bridge of the same type. The potential thermal bridges in a specific building design can be identified by reference to Figure C.1 and the appropriate default value of linear thermal transmittance assigned to each using Table C.2.



Key

B_m, C_m, C_n, GF_n, IF_m, IW_m, IW_n, P_m, R_m, R_n, W_m, W_n locations of the thermal bridge

Figure C.1 — Sketch of a building showing the location and type of commonly-occurring thermal bridges according to the scheme given in Table C.2

Table C.2 shows details of thermal bridges grouped by type and with four locations of the principal insulating layer (i.e. the layer with the highest thermal resistance). The principal insulating layer can be located

a) at the outside of,

b) in the middle of,

c) at the inside of, or

d) all the way through

the non-bridged part of the particular building element. Case d) refers to where the building element is of lightweight masonry construction or is a timber frame wall.

For each thermal bridge type and location of the principal insulating layer, Table C.2 gives an outline sketch of each detail and values of Ψ, rounded to the nearest 0,05 W/(m·K), based on the three systems of measuring building dimensions listed in 5.3.3:

— Ψ_i based on internal dimensions;

— Ψ_{oi} based on overall internal dimensions;

— Ψ_e based on external dimensions.

In the case of external dimensions, the measurements are to the bottom of the floor slab, or to the bottom of the insulation (if below the floor slab).

The default values of Ψ in Table C.2 are based on two-dimensional numerical calculations using the parameters in Table C.1.

Table C.1 — Parameters used to calculate the data in Table C.2

For all details:		R_{si} = 0,13 m²·K/W R_{se} = 0,04 m²·K/W
For external walls: For internal walls:		d = 300 mm d = 200 mm
For walls with an insulation layer:	— thermal transmittance — thermal resistance of insulation layer	U = 0,343 W/(m²·K) R = 2,5 m² K/W
For lightweight walls:		U = 0,375 W/(m²·K)
For ground floors:	— floor slab — thermal conductivity of ground — thermal resistance of insulation layer	d = 200 mm λ = 2,0 W/(m·K) R = 2,5 m²·K/W
For intermediate floors:		d = 200 mm λ = 2,0 W/(m·K)
For roofs:	— thermal transmittance — thermal resistance of insulation layer	U = 0,365 W/(m²·K) R = 2,5 m²·K/W
For the frames in openings:		d = 60 mm
For columns:		d = 300 mm λ = 2,0 W/(m·K).
B1, B2, B3, B4: the length of projection of the balcony does not affect the calculated value. IF6, IF8: insulation of thermal resistance 1,25 m²·K/W above and below the slab. GF9 to GF16: Calculated using 2 boundary temperatures (temperature below floor equal to external temperature). W1 to W12: window frame not included in geometrical model; calculations done with adiabatic boundary where window frame is shown.		

These parameters have been chosen so as to obtain default values of Ψ which are near to the maximum which is likely to occur in practice and are, thus, cautious overestimates of the thermal bridging effects, i.e. they will not underestimate the heat transfer through these thermal bridges.

Table C.2 — Default values of linear thermal transmittance

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

Wall	Lightweight wall (including lightweight masonry and timber frame walls)	Insulating layer	Slab/pillar	Window frame

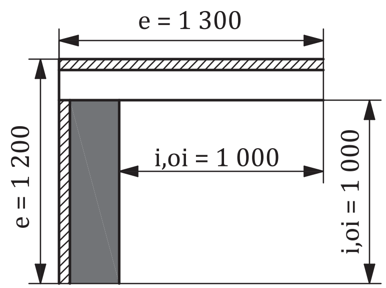
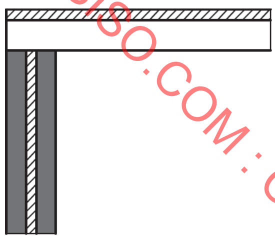
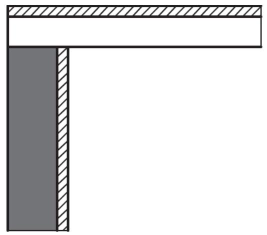
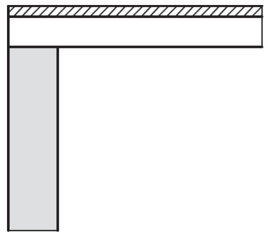
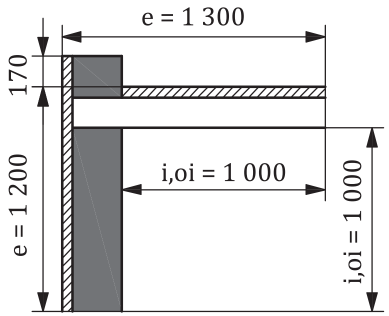
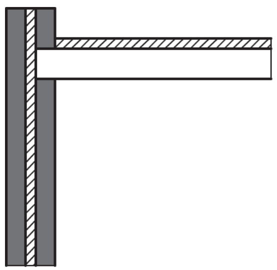
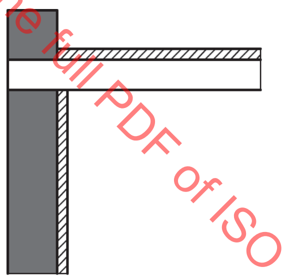
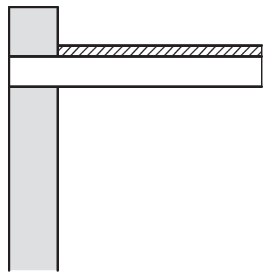
Roofs			
 **R1** $\Psi_e = 0,55$ $\Psi_{oi} = 0,75$ $\Psi_i = 0,75$	 **R2** $\Psi_e = 0,50$ $\Psi_{oi} = 0,75$ $\Psi_i = 0,75$	 **R3** $\Psi_e = 0,40$ $\Psi_{oi} = 0,75$ $\Psi_i = 0,75$	 **R4** $\Psi_e = 0,40$ $\Psi_{oi} = 0,65$ $\Psi_i = 0,65$
 **R5** $\Psi_e = 0,60$ $\Psi_{oi} = 0,80$ $\Psi_i = 0,80$	 **R6** $\Psi_e = 0,50$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,70$	 **R7** $\Psi_e = 0,65$ $\Psi_{oi} = 0,85$ $\Psi_i = 0,85$	 **R8** $\Psi_e = 0,45$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,70$

Table C.2 — (*continued*)

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

■	Wall	□	Lightweight wall (including lightweight masonry and timber frame walls)	▨	Insulating layer	□	Slab/pillar	⊠	Window frame

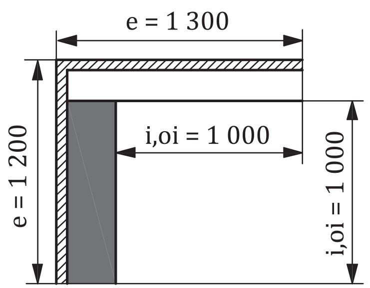
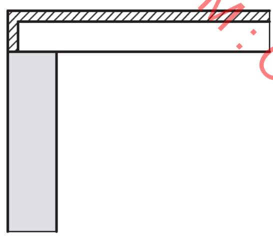
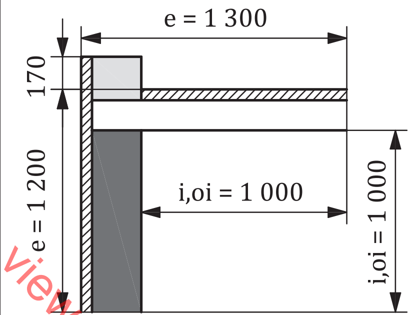
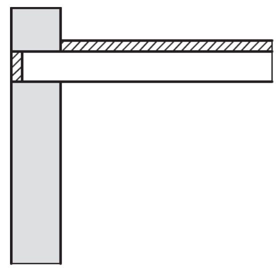
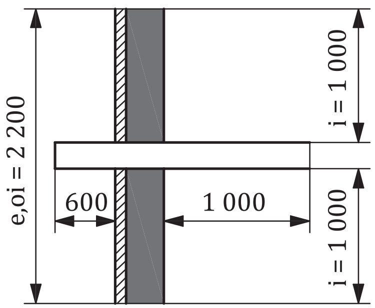
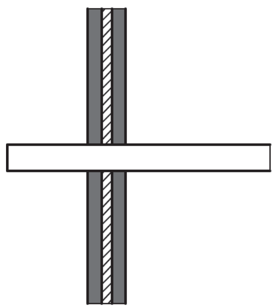
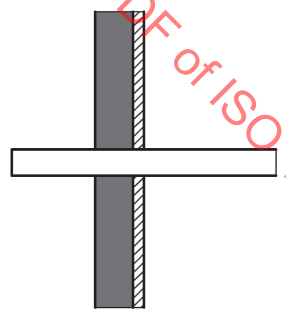
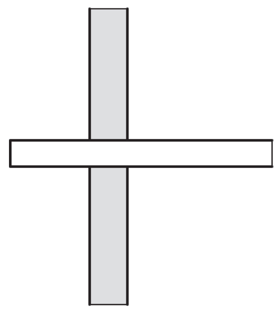
Roofs (continued)			
			
R9 $\Psi_e = -0,05$ $\Psi_{oi} = 0,15$ $\Psi_i = 0,15$	**R10** $\Psi_e = 0,00$ $\Psi_{oi} = 0,20$ $\Psi_i = 0,20$	**R11** $\Psi_e = 0,05$ $\Psi_{oi} = 0,25$ $\Psi_i = 0,25$	**R12** $\Psi_e = 0,15$ $\Psi_{oi} = 0,40$ $\Psi_i = 0,40$
Balconies			
			
B1 $\Psi_e = 0,95$ $\Psi_{oi} = 0,95$ $\Psi_i = 1,05$	**B2** $\Psi_e = 0,95$ $\Psi_{oi} = 0,95$ $\Psi_i = 1,05$	**B3** $\Psi_e = 0,90$ $\Psi_{oi} = 0,90$ $\Psi_i = 1,00$	**B4** $\Psi_e = 0,70$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,80$

Table C.2 — (*continued*)

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

Wall	Lightweight wall (including lightweight masonry and timber frame walls)	Insulating layer	Slab/pillar	☒ Window frame

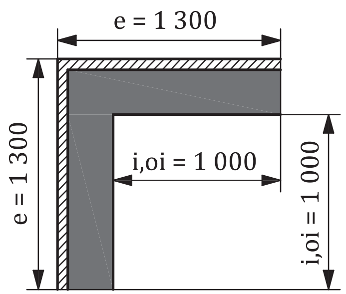
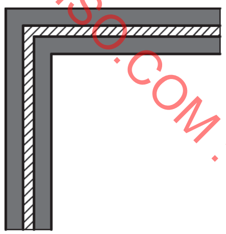
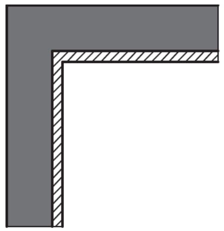
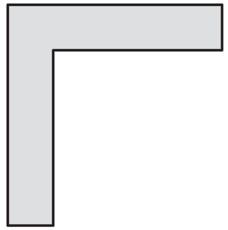
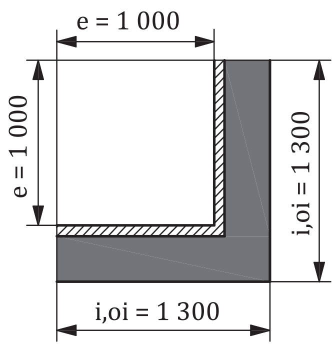
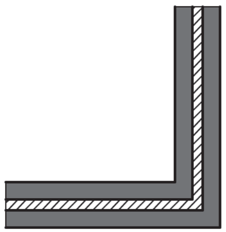
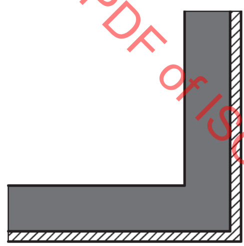
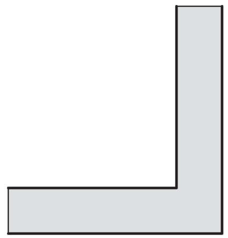
Corners			
 **C1** $\Psi_e = -0,05$ $\Psi_{oi} = 0,15$ $\Psi_i = 0,15$	 **C2** $\Psi_e = -0,10$ $\Psi_{oi} = 0,10$ $\Psi_i = 0,10$	 **C3** $\Psi_e = -0,20$ $\Psi_{oi} = 0,05$ $\Psi_i = 0,05$	 **C4** $\Psi_e = -0,15$ $\Psi_{oi} = 0,10$ $\Psi_i = 0,10$
 **C5** $\Psi_e = 0,05$ $\Psi_{oi} = -0,15$ $\Psi_i = -0,15$	 **C6** $\Psi_e = 0,15$ $\Psi_{oi} = -0,10$ $\Psi_i = -0,10$	 **C7** $\Psi_e = 0,15$ $\Psi_{oi} = -0,05$ $\Psi_i = -0,05$	 **C8** $\Psi_e = 0,10$ $\Psi_{oi} = -0,10$ $\Psi_i = -0,10$

Table C.2 — (*continued*)

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

Wall	Lightweight wall (including lightweight masonry and timber frame walls)	Insulating layer	Slab/pillar	⊠ Window frame

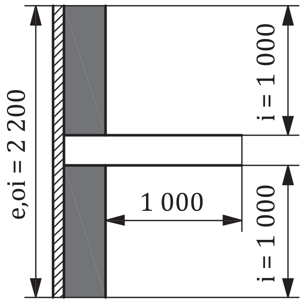
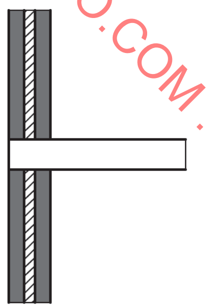
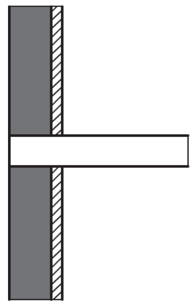
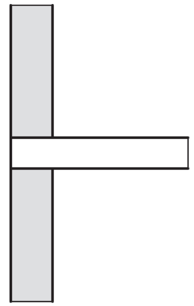
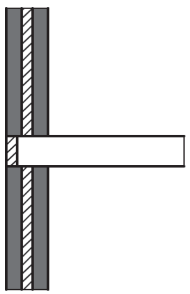
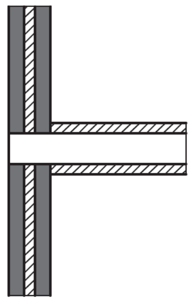
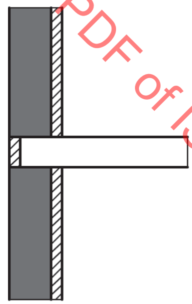
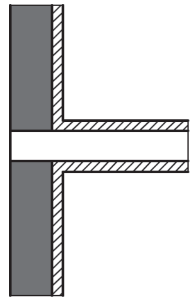
Intermediate floors			
			
IF1 $\Psi_e = 0,00$ $\Psi_{oi} = 0,00$ $\Psi_i = 0,10$	**IF2** $\Psi_e = 0,95$ $\Psi_{oi} = 0,95$ $\Psi_i = 1,05$	**IF3** $\Psi_e = 0,90$ $\Psi_{oi} = 0,90$ $\Psi_i = 1,00$	**IF4** $\Psi_e = 0,70$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,80$
			
IF5 $\Psi_e = 0,60$ $\Psi_{oi} = 0,60$ $\Psi_i = 0,65$	**IF6** $\Psi_e = 0,90$ $\Psi_{oi} = 0,90$ $\Psi_i = 1,00$	**IF7** $\Psi_e = 0,70$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,80$	**IF8** $\Psi_e = 0,45$ $\Psi_{oi} = 0,45$ $\Psi_i = 0,60$

Table C.2 — (*continued*)

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

Wall	Lightweight wall (including lightweight masonry and timber frame walls)	Insulating layer	Slab/pillar	Window frame

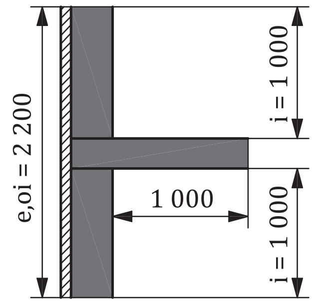
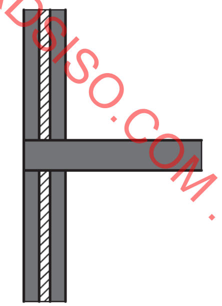
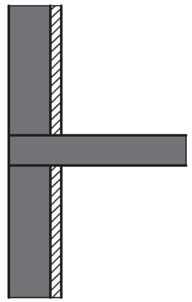
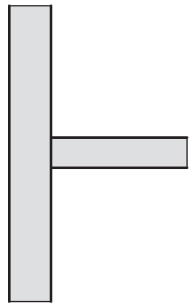
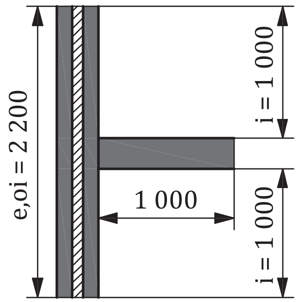
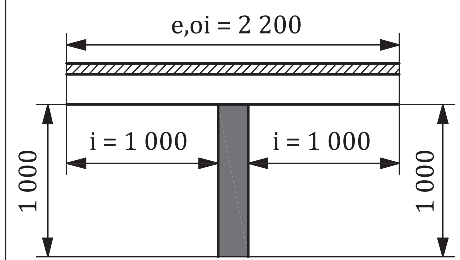
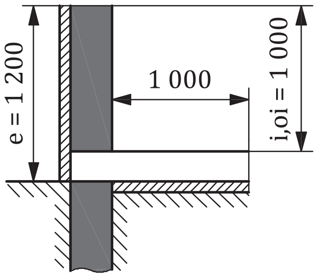
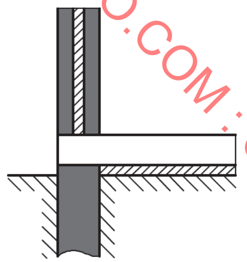
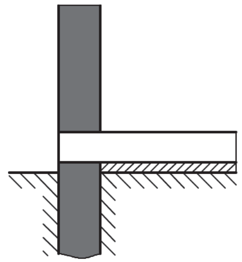
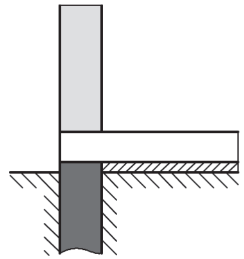
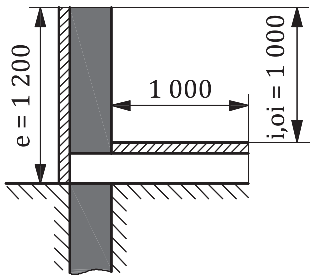
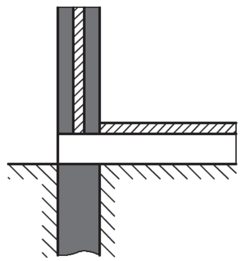
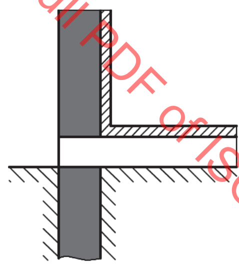
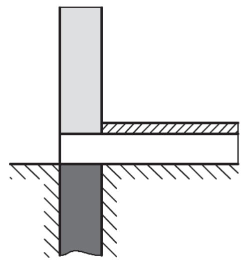
Internal walls			
 **IW1** $\Psi_e = 0{,}00$ $\Psi_{oi} = 0{,}00$ $\Psi_i = 0{,}10$	 **IW2** $\Psi_e = 0{,}95$ $\Psi_{oi} = 0{,}95$ $\Psi_i = 1{,}05$	 **IW3** $\Psi_e = 0{,}90$ $\Psi_{oi} = 0{,}90$ $\Psi_i = 1{,}00$	 **IW4** $\Psi_e = 0{,}00$ $\Psi_{oi} = 0{,}00$ $\Psi_i = 0{,}10$
 **IW5** $\Psi_e = 0{,}00$ $\Psi_{oi} = 0{,}00$ $\Psi_i = 0{,}10$	 **IW6** $\Psi_e = 0{,}00$ $\Psi_{oi} = 0{,}00$ $\Psi_i = 0{,}10$		

Table C.2 — (*continued*)

Dimensions in millimetres

Linear thermal transmittance in W/(m·K)

■	Wall	□	Lightweight wall (including lightweight masonry and timber frame walls)	▨	Insulating layer	□	Slab/pillar	⊠	Window frame

Slab-on-ground floors			
			
GF1 $\Psi_e = 0,65$ $\Psi_{oi} = 0,80$ $\Psi_i = 0,80$	**GF2** $\Psi_e = 0,60$ $\Psi_{oi} = 0,75$ $\Psi_i = 0,75$	**GF3** $\Psi_e = 0,55$ $\Psi_{oi} = 0,70$ $\Psi_i = 0,70$	**GF4** $\Psi_e = 0,50$ $\Psi_{oi} = 0,65$ $\Psi_i = 0,65$
			
GF5 $\Psi_e = 0,60$ $\Psi_{oi} = 0,75$ $\Psi_i = 0,75$	**GF6** $\Psi_e = 0,45$ $\Psi_{oi} = 0,60$ $\Psi_i = 0,60$	**GF7** $\Psi_e = -0,05$ $\Psi_{oi} = 0,10$ $\Psi_i = 0,10$	**GF8** $\Psi_e = 0,05$ $\Psi_{oi} = 0,20$ $\Psi_i = 0,20$