INTERNATIONAL STANDARD

ISO 13789

Second edition
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Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method

Performance thermique des bâtiments — Coefficients de transfert thermique par transmission et par renouvellement d'air — Méthode de calcul

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 13789 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*.

This second edition cancels and replaces the first edition (ISO 13789:1999) which has been technically revised.

A summary of the principal changes is given below.

— The title has been replaced by "…Transmission and ventilation heat transfer coefficients — …" This is because a ventilation coefficient has been added (see Clause 5) and "loss" is replaced by "transfer" to allow for cases of cooling.

— Consequential changes have also been made in the Introduction, Scope and elsewhere throughout this International Standard.

— In Clause 2, reference is to "ISO" rather than to "EN ISO" where applicable. ISO 10077-2 has been added.

— In 4.3, the text has been clarified and Note 1 added.

— 4.4 and 4.5 have been amended to say that heat transfer to/from unheated spaces via the ground is disregarded.

— Clause 5 This is a new clause, taken unchanged from 7.3 of ISO 13790. The intention is that 7.3 of ISO 13790 should be deleted when that International Standard is revised and replaced by a reference to ISO 13789.

— Annex C is a new annex, taken unchanged from Annex G of ISO 13790. The intention is that Annex G of ISO 13790 should be deleted when that International Standard is revised.

Introduction

The aims of this International Standard are

a) to clarify the international market through the harmonized definition of intrinsic characteristics of buildings;

b) to help in judging compliance with regulations;

c) to provide input data for calculation of annual energy use for heating or cooling buildings.

The result of the calculations can be used as input for calculation of annual energy use and heating or cooling load of buildings, for expressing the thermal transmission and/or ventilation characteristics of a building or for judging compliance with specifications expressed in terms of transmission and/or ventilation heat transfer coefficients.

This International Standard 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.

Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method

1 Scope

This International Standard specifies a method and provides conventions for the calculation of the steady-state transmission and ventilation heat transfer coefficients of whole buildings and parts of buildings. It is applicable both to heat loss (internal temperature higher than external temperature) and to heat gain (internal temperature lower than external temperature). For the purpose of this International Standard, the heated or cooled space is assumed to be at uniform temperature.

Annex A provides a steady-state method to calculate the temperature in unconditioned spaces adjacent to conditioned spaces.

2 Normative references

The following referenced documents are indispensable for the application 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 6946[1)], *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

ISO 7345, *Thermal insulation — Physical quantities and definitions*

ISO 10077-1, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General*

ISO 10077-2, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 2: Numerical method for frames*

ISO 10211[2)], *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

ISO 13370[3)], *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

ISO 14683[4)], *Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values*

EN 15242[5)], *Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*

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1) To be published (revision of ISO 6946:1996).

2) To be published (revision of ISO 10211-1:1995 and ISO 10211-2:2001).

3) To be published (revision of ISO 13370:1998).

4) To be published (revision of ISO 14683:1999).

5) To be published.

3 Terms and definitions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 7345 and the following apply.

3.1.1
heated space
room or enclosure that, for the purposes of a calculation, is assumed to be heated to a given set-point temperature or set point temperatures

3.1.2
cooled space
room or enclosure that, for the purposes of a calculation, is assumed to be cooled to a given set-point temperature or set-point temperatures

3.1.3
conditioned space
heated and/or cooled space

NOTE The heated and/or cooled spaces are used to define the thermal envelope.

3.1.4
unconditioned space
room or enclosure which is not part of a conditioned space

3.1.5
heat transfer coefficient
heat flow rate divided by temperature difference between two environments; specifically used for heat transfer coefficient by transmission or ventilation

3.1.6
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

NOTE By convention, if the heat is transferred between a conditioned space and the external environment, the sign is positive if the heat flow is from the space to outside (heat loss).

3.1.7
ventilation heat transfer coefficient
heat flow rate due to air entering a conditioned space either by infiltration or ventilation, divided by the temperature difference between the internal air and the supply air temperature

NOTE The supply temperature for infiltration is equal to the external temperature.

3.1.8
building heat transfer coefficient
sum of transmission and ventilation heat transfer coefficients

3.1.9
internal dimension
dimension measured from wall to wall and floor to ceiling inside a room of a building

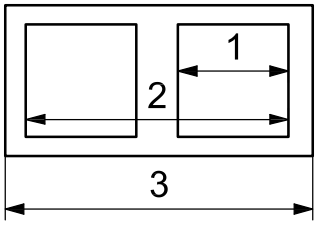
NOTE See Figure 1.

3.1.10
overall internal dimension
dimension measured on the interior of a building, ignoring internal partitions

NOTE See Figure 1.

3.1.11
external dimension
dimension measured on the exterior of a building

NOTE See Figure 1.



Key
1 internal dimension
2 overall internal dimension
3 external dimension

Figure 1 — Dimension systems

3.2 Symbols and units

Symbol	Quantity	Unit
A	Area	m^2
b	Adjustment factor for heat transfer coefficient	—
c_p	Specific heat capacity of air at constant pressure	Wh/(kg·K)
H	Heat transfer coefficient	W/K
U	Thermal transmittance	$W/(m^2 \cdot K)$
$\dot{V}$	Volumetric air flow rate	m^3/h
l	Length	m
n	Air change rate	h^{-1}
ρ	Density	kg/m^3
Ψ	Linear thermal transmittance	W/(m·K)
χ	Point thermal transmittance	W/K

4 Transmission heat transfer coefficient

4.1 Basic equation

The transmission heat transfer coefficient, H_T, is calculated according to Equation (1):

$$H_T = H_D + H_g + H_U + H_A \quad (1)$$

where

H_D is the direct heat transfer coefficient between the heated or cooled space and the exterior through the building envelope, defined by Equation (2), in W/K;

H_g is the steady-state ground heat transfer coefficient defined in 4.4, in W/K;

H_U is the transmission heat transfer coefficient through unconditioned spaces defined in Equation (5), in W/K;

H_A is the transmission heat transfer coefficient to adjacent buildings, determined according to Clause 7, in W/K.

ISO 10211 gives a general procedure for the calculation of the total thermal coupling coefficient of the complete envelope or any part of it, including ground heat transfer. Where no unconditioned space is involved, the total thermal coupling coefficient corresponds to the transmission heat transfer coefficient as defined in this International Standard.

NOTE In some applications the heat transfer via the ground is treated in terms of a constant part related to the annual average temperature difference and a varying part related to the monthly variations of internal and external temperature difference.

4.2 Boundaries of conditioned space

Before calculation, the conditioned space of the building under consideration shall be clearly defined. The building elements considered in the calculations are the boundaries of the spaces that are heated or cooled (directly or indirectly).

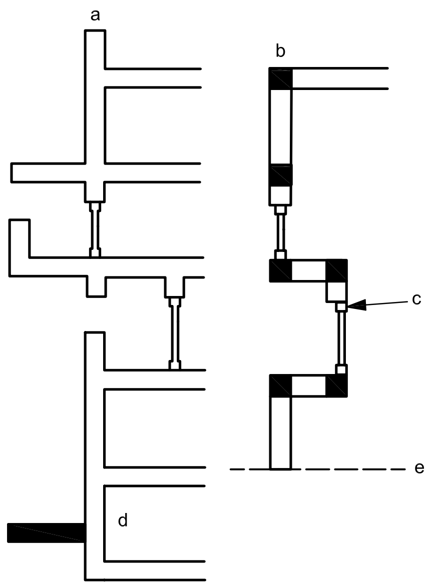
The building envelope above ground is modelled by plane and beam-shaped elements as shown on Figure 2.

Boundaries between the “underground” part, involving heat transmission through the ground, and the “above-ground” part of the building, having direct heat transfer to the external environment or to unconditioned spaces, are, according to ISO 13370,

— for buildings with slab-on-ground floors, suspended floors and unheated basements: the level of the internal surface of the ground floor (excluding any floor coverings such as carpets);

— for buildings with a heated basement: the external ground level.

Annex B provides information on the effect of using various types of dimensions when dividing the envelope into elements.



Key

flat envelope elements: ISO 6946 is applicable

windows and doors, with their frames: ISO 10077-1 and ISO 10077-2 are applicable

potential thermal bridges: ISO 14683 or ISO 10211 are applicable

a Reality.

b Model.

c Window/wall junctions that are also potential thermal bridges.

d Unheated.

e Application limit of ISO 13370.

Figure 2 — Modelling the building envelope by plane and beam-shaped components

If calculations are performed for parts of buildings, the boundaries of these parts shall be clearly defined, so that the sum of the transmission heat transfer coefficients of all parts equals that of the building.

4.3 Direct transmission between internal and external environments

The transmission heat transfer coefficient through the building elements separating the conditioned space and the external air is calculated either directly by numerical methods according to ISO 10211 or according to Equation (2):

$$H_{\mathrm{D}} = \sum_i A_i U_i + \sum_k l_k \Psi_k + \sum_j \chi_j \qquad (2)$$