SLOVENSKI STANDARD
SIST EN ISO 13370:2008

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SIST EN ISO 13370:1999

Toplotne karakteristike stavb - Prenos toplote skozi zemljo - Raļ unske metode (ISO 13370:2007)

Thermal performance of buildings - Heat transfer via the ground - Calculation methods (ISO 13370:2007

Wärmetechnisches Verhalten von Gebäuden - Wärmeübertragung über das Erdreich - Berechnungsverfahren (ISO 13370:2007)

Performance thermique des bâtiments - Transfert de chaleur par le sol - Méthodes de calcul (ISO 13370:2007)

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91.120.10	Toplotna izolacija stavb	Thermal insulation

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English Version

Thermal performance of buildings - Heat transfer via the ground - Calculation methods (ISO 13370:2007)

Performance thermique des bâtiments - Transfert de chaleur par le sol - Méthodes de calcul (ISO 13370:2007)

Wärmetechnisches Verhalten von Gebäuden - Wärmeübertragung über das Erdreich - Berechnungsverfahren (ISO 13370:2007)

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Foreword

This document (EN ISO 13370:2007) has been prepared by Technical Committee ISO/TC 163 "Thermal performance and energy use in the built environment" in collaboration with Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS.

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of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

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The text of ISO 13370:2007 has been approved by CEN as a EN ISO 13370:2007 without any modification.

INTERNATIONAL STANDARD

ISO 13370

Second edition
2007-12-15

Thermal performance of buildings — Heat transfer via the ground — Calculation methods

Performance thermique des bâtiments — Transfert de chaleur par le sol — Méthodes de calcul

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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.

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ISO 13370 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 13370:1998), which has been technically revised.

The following principal changes have been made to the first edition:

— Clause 4 contains a revised text to clarify the intention of the initial part of the former Annex A; the rest of the former Annex A is now contained in ISO 10211;

— 7.2 no longer contains a table of linear thermal transmittances: it is now recognized, as with other thermal bridging, that the wall/floor junction often needs to be calculated;

— 9.1 provides an alternative formula for well-insulated floors;

— 9.2 provides clarification for low-emissivity surfaces;

— Annex A contains formulae for cooling applications;

— Annex B has incorporated minor revisions to the text for edge-insulated floors;

— Annex D has been revised;

— Annex F (formerly Annex C) has been changed to informative status.

Introduction

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.

In contrast with ISO 6946, which gives the method of calculation of the thermal transmittance of building elements in contact with the external air, this International Standard deals with elements in thermal contact with the ground. The division between these two International Standards is at the level of the inside floor surface for slab-on-ground floors, suspended floors and unheated basements, and at the level of the external ground surface for heated basements. In general, a term to allow for a thermal bridge associated with the wall/floor junction is included when assessing the total heat loss from a building using methods such as ISO 13789.

The calculation of heat transfer through the ground can be done by numerical calculations, which also allow analysis of thermal bridges, including wall/floor junctions, for assessment of minimum internal surface temperatures.

In this International Standard, methods are provided which take account of the three-dimensional nature of the heat flow in the ground below buildings.

Thermal transmittances of floors give useful comparative values of the insulation properties of different floor constructions, and are used in building regulations in some countries for the limitation of heat losses through floors.

Thermal transmittance, although defined for steady-state conditions, also relates average heat flow to average temperature difference. In the case of walls and roofs exposed to the external air, there are daily periodic variations in heat flow into and out of storage related to daily temperature variations, but this averages out, and the daily average heat loss can be found from the thermal transmittance and daily average inside-to-outside temperature difference. For floors and basement walls in contact with the ground, however, the large thermal inertia of the ground results in periodic heat flows related to the annual cycle of internal and external temperatures. The steady-state heat flow is often a good approximation to the average heat flow over the heating season.

In addition to the steady-state part, a detailed assessment of floor losses is obtained from annual periodic heat transfer coefficients related to the thermal capacity of the soil, as well as its thermal conductivity, together with the amplitude of annual variations in monthly mean temperature.

Annex D provides a method for incorporating heat transfers to and from the ground into calculations undertaken at short time steps (e.g. one hour).

Worked examples illustrating the use of the methods in this International Standard are given in Annex K.

Thermal performance of buildings — Heat transfer via the ground — Calculation methods

1 Scope

This International Standard provides methods of calculation of heat transfer coefficients and heat flow rates for building elements in thermal contact with the ground, including slab-on-ground floors, suspended floors and basements. It applies to building elements, or parts of them, below a horizontal plane in the bounding walls of the building situated

— for slab-on-ground floors, suspended floors and unheated basements, at the level of the inside floor surface;

NOTE In some cases, external dimension systems define the boundary at the lower surface of the floor slab.

— for heated basements, at the level of the external ground surface.

This International Standard includes calculation of the steady-state part of the heat transfer (the annual average rate of heat flow) and the part due to annual periodic variations in temperature (the seasonal variations of the heat flow rate about the annual average). These seasonal variations are obtained on a monthly basis and, except for the application to dynamic simulation programmes in Annex D, this International Standard does not apply to shorter periods of time.

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, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

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

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

ISO 10456, *Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values*

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

3 Terms, definitions, symbols and units

3.1 Terms and definitions

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

3.1.1
slab on ground
floor construction directly on the ground over its whole area

3.1.2
suspended floor
floor construction in which the lowest floor is held off the ground, resulting in an air void between the floor and the ground

NOTE This air void, also called underfloor space or crawl space, may be ventilated or unventilated, and does not form part of the habitable space.

3.1.3
basement
usable part of a building that is situated partly or entirely below ground level

NOTE This space may be heated or unheated.

3.1.4
equivalent thickness
⟨thermal resistance⟩ thickness of ground (having the thermal conductivity of the actual ground) which has the same thermal resistance as the element under consideration

3.1.5
steady-state heat transfer coefficient
steady-state heat flow divided by temperature difference between internal and external environments

3.1.6
internal periodic heat transfer coefficient
amplitude of periodic heat flow divided by amplitude of internal temperature variation over an annual cycle

3.1.7
external periodic heat transfer coefficient
amplitude of periodic heat flow divided by amplitude of external temperature over an annual cycle

3.1.8
characteristic dimension of floor
area of floor divided by half the perimeter of floor

3.1.9
phase difference
period of time between the maximum or minimum of a cyclic temperature and the consequential maximum or minimum heat flow rate

3.2 Symbols and units

The following is a list of the principal symbols used. Other symbols are defined where they are used within the text.

Symbol	Quantity	Unit
A	area of floor	m^2
B'	characteristic dimension of floor	m
c	specific heat capacity of unfrozen ground	J/(kg·K)
d_g	total equivalent thickness – ground below suspended floor	m
d_t	total equivalent thickness – slab-on-ground floor	m
d_w	total equivalent thickness – basement wall	m
H_g	steady-state ground heat transfer coefficient	W/K
h	height of floor surface above outside ground level	m
P	exposed perimeter of floor	m
Q	quantity of heat	J
R	thermal resistance	m^2·K/W
R_f	thermal resistance of floor construction	m^2·K/W
R_{si}	internal surface resistance	m^2·K/W
R_{se}	external surface resistance	m^2·K/W
U	thermal transmittance between internal and external environments	W/(m^2·K)
U_{bf}	thermal transmittance of basement floor	W/(m^2·K)
U_{bw}	thermal transmittance of basement walls	W/(m^2·K)
U'	effective thermal transmittance for whole basement	W/(m^2·K)
w	thickness of external walls	m
z	depth of basement floor below ground level	m
Φ	heat flow rate	W
λ	thermal conductivity of unfrozen ground	W/(m·K)
ρ	density of unfrozen ground	kg/m^3
θ	temperature	°C
Ψ_g	linear thermal transmittance associated with wall/floor junction	W/(m·K)
$\Psi_{g,e}$	linear thermal transmittance associated with edge insulation	W/(m·K)

4 Methods of calculation

Heat transfer via the ground is characterized by:

— heat flow related to the area of the floor, depending on the construction of the floor;

— heat flow related to the perimeter of the floor, depending on thermal bridging at the edge of the floor;

— annual periodic heat flow, also related to the perimeter of the floor, resulting from the thermal inertia of the ground.