

**SLOVENSKI STANDARD
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Načrtovanje notranjega okolja v stavbah - Vgrajeni sevalni ogrevalni in hladilni sistemi - 4. del: Dimenzioniranje in izračun zmogljivosti dinamičnega ogrevanja in hlajenja toplotno-aktivnih delov stavbe (TABS) (ISO 11855-4:2021)

Building environment design - Embedded radiant heating and cooling systems - Part 4: Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS) (ISO 11855-4:2021)

Umweltgerechte Gebäudeplanung - Flächenintegrierte Strahlheizungs- und -kühlsysteme - Teil 4: Auslegung und Berechnung der dynamischen Wärme- und Kühlleistung für thermoaktive Bauteilsysteme (TABS) (ISO 11855-4:2021)

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Conception de l'environnement des bâtiments - Systèmes intégrés de chauffage et de refroidissement par rayonnement - Partie 4: Dimensionnement et calculs relatifs au chauffage adiabatique et à la puissance frigorifique pour systèmes d'éléments de construction thermoactifs (TABS) (ISO 11855-4:2021)

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91.140.10	Sistemi centralnega ogrevanja	Central heating systems
91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning systems

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Building environment design - Embedded radiant heating and cooling systems - Part 4: Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS) (ISO 11855-4:2021)

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This European Standard was approved by CEN on 29 July 2021.

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Contents	Page
European foreword.....	3

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[SIST EN ISO 11855-4:2021](https://standards.iteh.ai/catalog/standards/sist/9d7ddc76-14d4-44b4-a27b-4237c179e56f/sist-en-iso-11855-4-2021)
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European foreword

This document (EN ISO 11855-4:2021) has been prepared by Technical Committee ISO/TC 205 "Building environment design" in collaboration with Technical Committee CEN/TC 228 "Heating systems and water based cooling systems in buildings" the secretariat of which is held by DIN.

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 March 2022, and conflicting national standards shall be withdrawn at the latest by March 2022.

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.

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The text of ISO 11855-4:2021 has been approved by CEN as EN ISO 11855-4:2021 without any modification.

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2021-08

**Building environment design —
Embedded radiant heating and cooling
systems —**

Part 4:

**Dimensioning and calculation of the
dynamic heating and cooling capacity
of Thermo Active Building Systems
(TABS)**

*Conception de l'environnement des bâtiments — Systèmes intégrés de
chauffage et de refroidissement par rayonnement —*

*Partie 4: Dimensionnement et calculs relatifs au chauffage
adiabatique et à la puissance frigorifique pour systèmes d'éléments de
construction thermoactifs (TABS)*

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols	1
5 The concept of thermally active building surfaces (TABS)	4
6 Calculation methods	10
6.1 General.....	10
6.2 Rough sizing method.....	13
6.3 Simplified sizing by diagrams.....	13
6.4 Simplified model based on FDM.....	19
6.4.1 Cooling system.....	20
6.4.2 Hydraulic circuit and slab.....	20
6.4.3 Room.....	22
6.4.4 Limits of the method.....	24
6.5 Dynamic building simulation programs.....	25
7 Effects of acoustic ceiling units on the cooling performance of TABS	25
8 Input for computer simulations of energy performance	25
Annex A (informative) Simplified diagrams	27
Annex B (normative) Calculation method	33
Annex C (informative) Tutorial guide for assessing the model	44
Annex D (informative) Computer program	47
Bibliography	58

ISO 11855-4:2021(E)

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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 228, *Heating systems and water based cooling systems in buildings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11855-4:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

- editorial corrections;
- picture redraws;
- updated Bibliography;
- improved wording.

A list of all parts in the ISO 11855 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The radiant heating and cooling system consists of heat emitting/absorbing, heat supply, distribution, and control systems. The ISO 11855 series deals with the embedded surface heating and cooling system that directly controls heat exchange within the space. It does not include the system equipment itself, such as heat source, distribution system and controller.

The ISO 11855 series addresses an embedded system that is integrated with the building structure. Therefore, the panel system with open air gap, which is not integrated with the building structure, is not covered by this series.

The ISO 11855 series is applicable to water-based embedded surface heating and cooling systems in buildings. The ISO 11855 series is applied to systems using not only water but also other fluids or electricity as a heating or cooling medium. The ISO 11855 series is not applicable for testing of systems. The methods do not apply to heated or chilled ceiling panels or beams.

The object of the ISO 11855 series is to provide criteria to effectively design embedded systems. To do this, it presents comfort criteria for the space served by embedded systems, heat output calculation, dimensioning, dynamic analysis, installation, control method of embedded systems, and input parameters for the energy calculations.

The ISO 11855 series consists of the following parts, under the general title *Building environment design — Embedded radiant heating and cooling systems*:

- Part 1: *Definitions, symbols, and comfort criteria*
- Part 2: *Determination of the design heating and cooling capacity*
- Part 3: *Design and dimensioning*
- Part 4: *Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS)*
- Part 5: *Installation*
- Part 6: *Control*
- Part 7: *Input parameters for the energy calculation*

ISO 11855-1 specifies the comfort criteria which should be considered in designing embedded radiant heating and cooling systems, since the main objective of the radiant heating and cooling system is to satisfy thermal comfort of the occupants. ISO 11855-2 provides steady-state calculation methods for determination of the heating and cooling capacity. ISO 11855-3 specifies design and dimensioning methods of radiant heating and cooling systems to ensure the heating and cooling capacity. ISO 11855-4, this document, provides a dimensioning and calculation method to design Thermo Active Building Systems (TABS) for energy saving purposes, since radiant heating and cooling systems can reduce energy consumption and heat source size by using renewable energy. ISO 11855-5 addresses the installation process for the system to operate as intended. ISO 11855-6 shows a proper control method of the radiant heating and cooling systems to ensure the maximum performance which was intended in the design stage when the system is actually being operated in a building. ISO 11855-7 presents a calculation method for input parameters to ISO 52031.

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Building environment design — Embedded radiant heating and cooling systems —

Part 4:

Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS)

1 Scope

This document allows the calculation of peak cooling capacity of Thermo Active Building Systems (TABS), based on heat gains, such as solar gains, internal heat gains, and ventilation, and the calculation of the cooling power demand on the water side, to be used to size the cooling system, as regards the chiller size, fluid flow rate, etc.

This document defines a detailed method aimed at the calculation of heating and cooling capacity in non-steady state conditions.

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 11855-1, *Building environment design — Embedded radiant heating and cooling systems — Part 1: Definitions, symbols, and comfort criteria*

ISO 11855-2, *Building environment design — Embedded radiant heating and cooling systems — Part 2: Determination of the design heating and cooling capacity*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11855-1 apply.

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

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

4 Symbols

For the purposes of this document, the symbols in [Table 1](#) apply.

Table 1 — Symbols

Symbol	Unit	Quantity
A_F	m ²	Area of the heating/cooling surface area
A_W	m ²	Total area of internal vertical walls (i.e. vertical walls, external façades excluded)
C	J/(m ² ·K)	Specific thermal capacity of the thermal node under consideration

Table 1 (continued)

Symbol	Unit	Quantity
C_W	J/(m ² ·K)	Average specific thermal capacity of the internal walls
c_j	J/(kg·K)	Specific heat of the material constituting the j -th layer of the slab
c_{Wa}	J/(kg·K)	Specific heat of water
d_a	m	External diameter of the pipe
E_{Day}	kWh/m ²	Specific daily energy gains
f_{rm}^h	-	Running mode (1 when the system is running; 0 when the system is switched off) in the h -th hour
f_s	-	Design safety factor
$F_{v F-C}$	-	View factor between the floor and the ceiling
$F_{v F-EW}$	-	View factor between the floor and the external walls
$F_{v F-W}$	-	View factor between the floor and the internal walls
h_{A-C}	W/(m ² ·K)	Convective heat transfer coefficient between the air and the ceiling
h_{A-F}	W/(m ² ·K)	Convective heat transfer coefficient between the air and the floor
h_{A-W}	W/(m ² ·K)	Convective heat transfer coefficient between the air and the internal walls
h_{F-C}	W/(m ² ·K)	Radiant heat transfer coefficient between the floor and the ceiling
h_{F-W}	W/(m ² ·K)	Radiant heat transfer coefficient between the floor and the internal walls
H_A	W/K	Heat transfer coefficient between the thermal node under consideration and the air thermal node ("A")
H_C	W/K	Heat transfer coefficient between the thermal node under consideration and the ceiling surface thermal node ("C")
H_{Cct}	W/K	Heat transfer coefficient between the thermal node under consideration and the circuit
H_{CondDn}	W/K	Heat transfer coefficient between the thermal node under consideration and the next one
H_{CondUp}	W/K	Heat transfer coefficient between the thermal node under consideration and the previous one
H_{Conv}	-	Fraction of internal convective heat gains acting on the thermal node under consideration
H_F	W/K	Heat transfer coefficient between the thermal node under consideration and the floor surface thermal node ("F")
H_i	W/K	Coefficient connected to the inertia contribution at the thermal node under consideration
H_{IWS}	W/K	Heat transfer coefficient between the thermal node under consideration and the internal wall surface thermal node ("IWS")
H_{Rad}	-	Fraction of total radiant heat gains impinging on the thermal node under consideration
h_t	W/(m ² ·K)	Total heat transfer coefficient (convection + radiation) between surface and space
J	-	Number of layers constituting the slab as a whole
J_1	-	Number of layers constituting the upper part of the slab
J_2	-	Number of layers constituting the lower part of the slab
L_R	m	Length of installed pipes
$\dot{m}_{H,sp}$	kg/(m ² ·s)	Specific water flow in the circuit, calculated on the area covered by the circuit
m_j	-	Number of partitions of the j -th layer of the slab
n	-	Actual number of iteration in iterative calculations
n_h	h	Number of operation hours of the circuit
n_{Max}	-	Maximum number of iterations allowed in iterative calculations

Table 1 (continued)

Symbol	Unit	Quantity
$P_{Cct}^{Max,h}$	W	Maximum cooling power reserved to the circuit under consideration in the h -th hour
$P_{Cct,Spec}^{Max}$	W/m ²	Maximum specific cooling power (per floor square metre)
q_i	W/m ²	Inward specific heat flux
q_u	W/m ²	Outward specific heat flux
Q_C^h	W	Heat flux impinging on the ceiling surface ("C") in the h -th hour
Q_{Cct}^h	W	Heat flux extracted by the circuit in the h -th hour
Q_{Conv}^h	W	Total convective heat gains in the h -th hour
Q_F^h	W	Heat flux impinging on the floor surface ("F") in the h -th hour
$Q_{IntConv}^h$	W	Internal convective heat gains in the h -th hour
Q_{IntRad}^h	W	Internal radiant heat gains in the h -th hour
Q_{IWS}^h	W	Heat flux impinging on the internal wall surface ("IWS") in the h -th hour
$Q_{PrimAir}^h$	W	Primary air convective heat gains in the h -th hour
Q_{Rad}^h	W	Total radiant heat gains in the h -th hour
Q_{Sun}^h	W	Solar heat gains in the room in the h -th hour
Q_{Transm}^h	W	Transmission heat gains in the h -th hour
Q_W	W/m ²	Average specific cooling power
R	(m ² ·K)/W	Generic thermal resistance
$R_{Add C}$	(m ² ·K)/W	Additional thermal resistance covering the lower side of the slab
$R_{Add F}$	(m ² ·K)/W	Additional thermal resistance covering the upper side of the slab
R_{int}	(m ² ·K)/W	Internal thermal resistance of the slab conductive region
$R_{L,p}$	(m ² ·K)/W	Conduction thermal resistance connecting the p -th thermal node with the boundary of the (p+1)-th thermal node
R_r	(m ² ·K)/W	Pipe thickness thermal resistance
R_t	(m ² ·K)/W	Circuit total thermal resistance
$R_{U,p}$	(m ² ·K)/W	Conduction thermal resistance connecting the p -th thermal node with the boundary of the (p-1)-th thermal node
R_W	(m ² ·K)/W	Wall surface thermal resistance
R_{Wa}	(m ² ·K)/W	Water flow thermal resistance
R_x	(m ² ·K)/W	Pipe level thermal resistance
R_z	(m ² ·K)/W	Convection thermal resistance at the pipe inner side
s_r	m	Pipe wall thickness
s_1	M	Thickness of the upper part of the slab
s_2	m	Thickness of the lower part of the slab
W	m	Pipe spacing
δ_j	m	Thickness of the j -th layer of the slab
$\Delta\theta$	K	Generic temperature difference