SLOVENSKI STANDARD
SIST EN 15265:2007

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Energijske značilnosti stavb - Računanje porabljene energije za segrevanje in hlajenje prostora z dinamično metodo - Splošna merila in validacija postopka

Energy performance of buildings - Calculation of energy needs for space heating and cooling using dynamic methods - General criteria and validation procedures

Wärmetechnisches Verhalten von Gebäuden - Berechnung des Heiz- und Kühlenergieverbrauchs - Allgemeine Kriterien und Validierungsverfahren

Performance thermiques des bâtiments - Calcul des besoins d'énergie pour le chauffage et le refroidissement des locaux - Critères généraux et procédures de validation

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Energy performance of buildings - Calculation of energy needs for space heating and cooling using dynamic methods - General criteria and validation procedures

Performance thermique des bâtiments - Calcul des besoins d'énergie pour le chauffage et le refroidissement des locaux - Critères généraux et procédures de validation

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Foreword

This document (EN 15265:2007) has been prepared by 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of an identical text or by endorsement, at the latest by February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings (EPBD). It forms part of a series of standards aimed at European harmonisation of the methodology for the calculation of the energy performance of buildings. An overview of the whole set of standards is given in prCEN/TR 15615.

Attention is drawn to the need for observance of EU Directives transposed into national legal requirements. Existing national regulations (with or without reference to national standards) may restrict for the time being the implementation of this European Standard.

This European Standard is one of a series of standards on general criteria and validation procedures for transient calculation methods for the design and the evaluation of the thermal and energy performance of buildings and building components. No existing European Standard is superseded.

The target audience of this European Standard are software developers of building simulation tools and policy makers in the building regulation sector. The standard specifies the boundary conditions and the simplifications needed to reach calculation results for the building part which are comparable.

It needs to be emphasized that there exist more sophisticated energy simulation methods and procedures including interactions with the heating, cooling, ventilating and lighting systems which may be used for the design and optimization process of a building without being necessarily covered by existing European Standards.

This European 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.

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

Introduction

This European Standard defines assumptions, boundary conditions and a procedure for the validation of dynamic calculation methods for the calculation of the annual energy need for space heating and cooling of a building or a part of it.

This way, the same dynamic method used for calculating design heating and cooling loads can provide also the cooling and heating needs necessary to estimate annual energy requirements.

The series of European Standards, giving general criteria and validation procedures for the building part of energy simulation models for the different calculation subjects, are listed below.

European Standard	Subject
EN ISO 13791 EN ISO 13792	Temperature calculations (air and operative)
EN 15255	Load calculations (sensible cooling)
EN 15265	Energy need calculations (heating and cooling)

1 Scope

This European Standard specifies a set of assumptions, requirements and validation tests for procedures used for the calculation of the annual energy needs for space heating and cooling of a room in a building where the calculations are done with a time step of one hour or less.

This European Standard does not impose any specific numerical technique for the calculation of the room heating or cooling need and the internal temperatures of a room.

The purpose of this European Standard is to validate calculation methods used to:

— assess the energy performance of each room of a building;

— provide energy data to be used as interface with system performance analysis (heating, cooling, ventilating, lighting, domestic hot water etc).

The validation procedure is used to check the energy need for space heating and cooling based on a transient sensible heat balance model, taking into account:

— the external surface heat balance;

— the conduction through the building envelope;

— the thermal capacities of external and internal structures;

— the internal surface heat balance;

— the air heat balance;

— the heat balance solution method.

All other aspects are given either by prescribed boundary conditions or by input data and are not part of the model validation. It is assumed, that for all these other matters e.g. embedded heating and cooling systems, prescriptive models have to be used according to existing European Standards.

The system performance analysis and moisture balance are not within the scope of this European Standard.

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.

EN 15241, *Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings*

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

EN ISO 7345:1995, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

prEN ISO 10211, *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations (ISO/DIS 10211:2005)*

prEN ISO 13370, *Thermal performance of buildings — Heat transfer via the ground — Calculation methods (ISO/DIS 13370:2005)*

prEN ISO 13790, *Energy performance of buildings — Calculation of energy use for space heating and cooling (ISO/DIS 13790:2005)*

prEN ISO 14683, *Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values (ISO/DIS 14683:2005)*

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995 and the following apply.

3.1.1
energy need for heating or cooling
heat to be delivered to or extracted from a conditioned space to maintain the intended temperature conditions during a given period of time

NOTE 1 The energy need is calculated and cannot easily be measured.

NOTE 2 The energy need can include additional heat transfer resulting from non-uniform temperature distribution and non-ideal temperature control, if they are taken into account by increasing (decreasing) the effective temperature for heating (cooling) and not included in the heat transfer due to the heating (cooling) system.

3.1.2
energy use for space heating or cooling or domestic hot water
energy input to the heating, cooling or hot water system to satisfy the energy need for heating, cooling (including dehumidification) or hot water respectively

NOTE If the technical building system serves several purposes (e.g. heating and domestic hot water) it can be difficult to split the energy use into that used for each purpose. It can be indicated as a combined quantity (e.g. energy need for space heating and domestic hot water).

3.1.3
envelope element
element of a building fabric delimited by two parallel surfaces, separating the room under consideration from the outdoor climate or another space

3.1.4
internal air temperature
temperature of the room air

3.1.5
internal environment
closed space delimited from the external environment or adjacent spaces by a building fabric component

3.1.6
internal surface temperature
temperature of the internal surface of each room element

3.1.7
mean radiant temperature
uniform surface temperature of an enclosure in which an occupant would exchange the same amount of radiant heat as in the actual non-uniform enclosure

3.1.8
operative temperature
uniform temperature of an enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment

NOTE As approximation, the operative temperature is calculated as mean value of the air temperature and the mean radiant temperature.

3.1.9
room air
air of the internal environment

3.2 Symbols and units

Principal symbols used are listed below, other symbols are defined where they are used within the standard.

Symbol	Quantity	Unit
A	area	m^2
c_p	specific heat capacity	J/(kg·K)
d	layer thickness	m
f_{df}	solar distribution factor	-
f_{lf}	solar loss factor	-
f_{sa}	solar to air factor	-
g	total solar energy transmittance	-
h	surface heat transfer coefficient	$W/(m^2·K)$
Q	quantity of heat or energy	kWh
R	thermal resistance	$m^2·K/W$
U	thermal transmittance under steady state	$W/(m^2·K)$
α	solar energy absorptance	-
ε	total hemispherical emissivity	-
θ	Celsius temperature	°C
λ	thermal conductivity	W/(m·K)
ρ	density	kg/m^3
ρ_e	solar energy reflectance	-
τ_e	direct solar energy transmittance	-
Φ	heat flow rate	W

Subscripts

a	air	ic	internal cavity
c	convection	r	radiation
e	external	op	operative
ec	external cavity	se	external surface
i	internal	si	internal surface

4 Procedures

The hourly heating and cooling needs of the building are calculated for the whole year based on climatic data, building characteristics using applicable standards listed in prEN ISO 13790 and national data for internal heat gains. The validation tests given in Clause 8 are limited to the thermal energy to be delivered to or extracted from the premises for heating and cooling only and therefore exclude the linkage to the energy system parts illustrated in Figure 1.

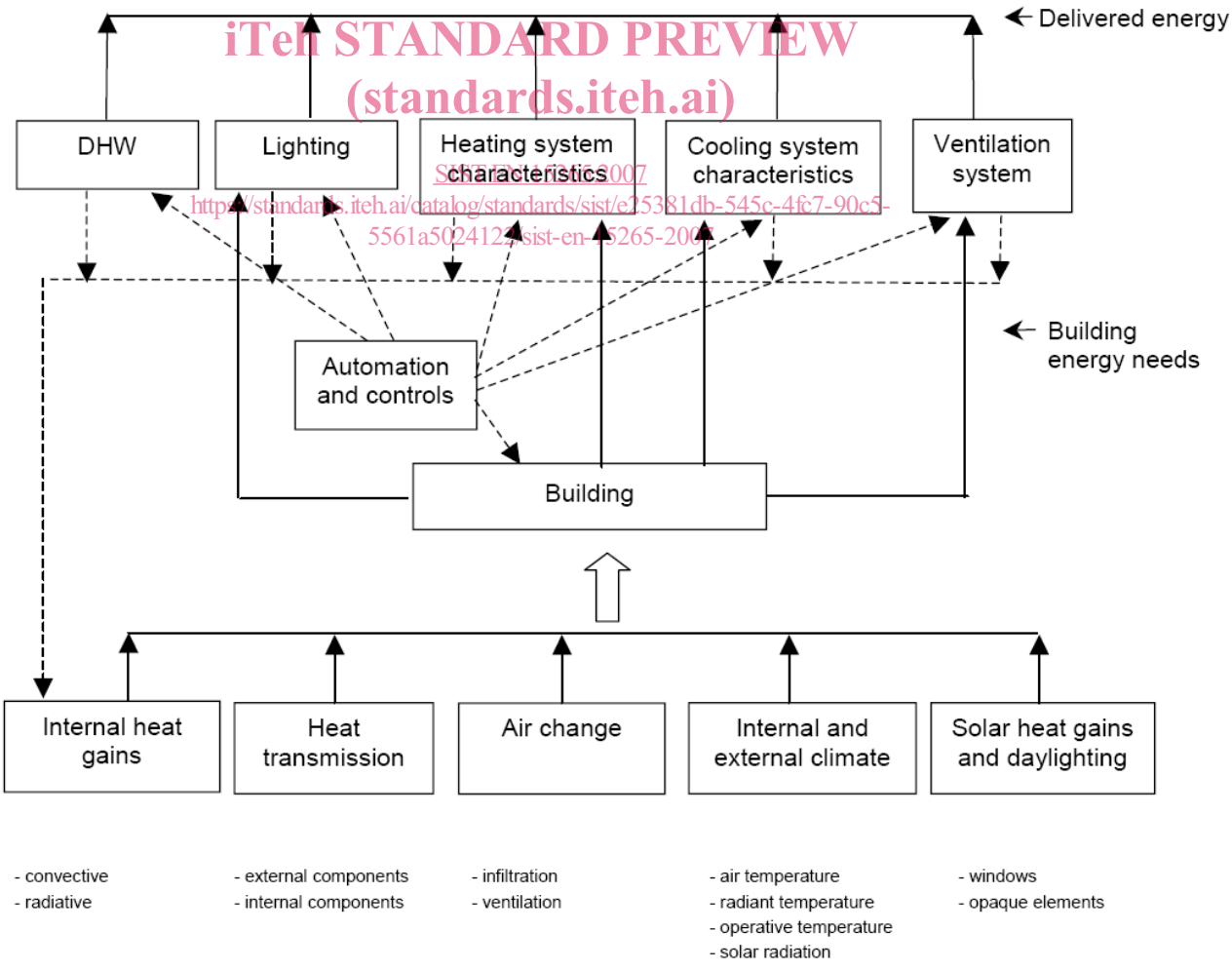

Figure 1 — Energy flows

5 Basic assumptions

The following basic assumptions shall be considered as minimum requirements for dynamic calculation methods being validated according to this European Standard:

— the room is considered a closed space delimited by enclosure elements;

— the air temperature is uniform throughout the room;

— the thermophysical properties of all materials are constant and isotropic;

— the convective heat transfer coefficients are fixed;

— the heat conduction through each room element is one-dimensional and their surfaces are considered isothermal;

— thermal bridges are represented either as linear heat loss elements with no thermal inertia according to prEN ISO 14683 or as equivalent one-dimensional building elements with thermal mass and thermal characteristics derived by steady state calculations according to prEN ISO 10211;

— the distribution of the solar radiation on the internal surfaces of the components of the zone is fixed;

— the distribution of the radiative part of heat flow to or from internal sources is uniform over the inside surfaces of the room elements;

— the long-wave radiative and the convective heat transfers at the internal surface of each component are treated separately;

— the angular dependence of solar transmission properties of glazing is accounted for based on manufacturers information, or alternatively a constant reduction factor of 0,9 has to be used;

— movable shading and external shading are taken into account according to prEN ISO 13790;

— the heat transfer through the ground floor (including floor-wall connections) shall be treated according to the dynamic calculation procedure given in prEN ISO 13370.

NOTE This list is not necessarily exhaustive, depending on the building features and applications.

6 Data requirement

6.1 General

For evaluating the energy needs of the building, the following information is required:

— the hourly climatic data of the location for a complete reference year;

— the descriptors of the building envelope components including thermal bridges (area and geometry, orientation, exposure, boundary conditions, thermophysical parameters, solar optical properties of windows systems and external shading according to prEN ISO 13790);

— the hourly profiles of the internal temperature set-point;

— the hourly profiles of the ventilation and infiltration rate;

— the hourly profile of the convective and radiative heat flows due to lighting, occupants, internal equipment and appliances;

— the characteristics of the thermal system (convective or radiative) and maximum heating and cooling capacity.

6.2 Climatic data

For a location with a given latitude and longitude the following hourly climatic data are required:

— external air temperature;

— the intensity of solar radiation (direct normal and diffuse horizontal);

— the external radiant temperature (sky and surroundings);

— the ground albedo.

NOTE External air moisture content and wind velocity are not directly needed here but might be required for evaluating the infiltration rate and the system behaviour.

The climatic data set used for the validation tests in this European Standard is given in Annex A.

6.3 Surface heat transfer coefficients

The following values shall be used:

a) convective surface heat transfer coefficients:

— external surface $h_{c,e}$ = 17,5 W/(m^2·K);

— internal surface of no-heating or no-cooling component $h_{c,i}$ = 2,5 W/(m^2·K);

— internal surface of cooling or heating component:

— vertical: $h_{c,i}$ = 2,5 W/(m^2·K);

— horizontal (heat flow upwards) $h_{c,i}$ = 5,0 W/(m^2·K);

— horizontal (heat flow downwards) $h_{c,i}$ = 0,7 W/(m^2·K);

b) long-wave radiative heat transfer coefficients (to sky and surroundings):

— internal surface $h_{lr,i}$ = 5,5 W/(m^2·K);

— external surface $h_{lr,e}$ = 5,5 W/(m^2·K).

NOTE Given values are typical for high emissivity ε = 0,9 and T_m = 300 K. For low emissivity surfaces, guidance can be found in Annex A of prEN ISO 6946.

6.4 Solar distribution

Solar to air factor f_{sa}

The solar to air factor, f_{sa}, is the fraction of the radiation entering through a glazing which is immediately delivered as a heat flow to the internal air. This fraction depends on the presence of internal elements with very low thermal capacity as carpets, furniture, etc. It is assumed to be time independent and it should be defined on a national basis: alternatively the value of f_{sa} = 0,1 may be used.

Solar loss factor f_{lf}

The solar loss factor, f_{lf}, is the fraction of the solar radiation entering through a glazing which is reflected back outside. It depends on the geometrical characteristics and solar properties of the glazing system, the exposure of the window, the solar angles and the room geometry. It is assumed to be time independent. Values of f_{lf} should be defined on a national basis: alternatively the solar loss factor may be neglected (f_{lf} = 0).

Solar distribution factor f_{df}

The heat flow rate due to the solar radiation entering through a glazing is absorbed by the internal surface of each room element. According to the assumptions of Clause 5, the distribution of the solar radiation is time independent. The distribution factor is defined, for each surface, as the fraction of the solar shortwave radiation absorbed by that surface.

For the purposes of this European Standard, the distribution factors shall be calculated using the expessions in Table 1 as a function the area of the envelope elements.

Table 1 — Solar distribution factors f_{df}

Floor	Vertical walls	Ceiling	Window
A_f / A_t	A_{wa} / A_t	A_c / A_t	0

A_f is the floor area;

A_{wa} is the sum of all vertical wall areas except windows;

A_c is the ceiling area;

A_t is the total area except window; $A_t = A_f + A_{wa} + A_c$.

6.5 Air ventilation and air infiltration

6.5.1 General

External air in the form of infiltration and ventilation provides a special type of load which is imposed on the conditioned space or the system. Ventilation is supplied to meet air purity and odour standards, while infiltration arises from controlled or uncontrolled leakage around doors and windows or through walls.

6.5.2 Infiltration

Infiltration is caused by a greater air pressure on the exterior of the building than on the interior. The quantity of the infiltrated air depends on the pressure difference; the number, the length and the width of the perimeter gaps of windows and doors; and the nature of the flow in the cracks or gaps.

6.5.3 Ventilation

Ventilation air is introduced for human occupancy. In air conditioning systems air ventilation may be provided directly from outside (external air ventilation) or by handling central air. For ventilation air directly from the outside the inlet temperature is equal to the external air temperature. For air treated in a central system the inlet temperature shall be fixed according to the characteristics of the system according to EN 15241 and EN 15242.

6.6 Internal load

For calculation of the internal loads the input data should include the convective and radiative portion of heat flow from lighting, people, internal equipment. The convective portion of the energy emanating from the internal sources affects the air temperature immediately. The radiative portion affects the operative temperature after it has been absorbed by walls, floor and furniture and has warmed them to a temperature that is higher than the air temperature. This absorbed energy stored by the structure contributes to the space heating or cooling load after a time lag.

6.7 Internal design temperature

The internal design temperature in general is represented by the air temperature as the system control maintains the internal air temperature within the limit imposed by the thermostat and the maximum load capacity of the system. For systems controls maintaining operative temperature, the internal design temperature shall be the operative temperature.

6.8 Heating and cooling system device

6.8.1 General

The following heating and cooling systems are considered:

— convective device;

— surface device;

— both convective device and surface device.

6.8.2 Convective device

Convective devices are emitting devices with negligible radiative effect (i.e. fan coil or air inlet). In this situation the room heating or cooling load is represented by the heating or cooling flow rate to be provided to or removed from the space for maintaining the prescribed internal conditions defined by the system control. If the heating or cooling is provided by an air mass flow rate $\dot{m}_{\mathrm{a}}$ at the prescribed inlet temperature θ_{il}, the room heating or cooling load is related to the air mass characteristics as follows:

$$\Phi_{\mathrm{c}} = \dot{m}_{\mathrm{a}}\, c_p\, (\theta_{\mathrm{il}} - \theta_{\mathrm{a,i}}) \qquad (1)$$

where

$\dot{m}_{\mathrm{a}}$ is the air mass flow rate;

c_p is the specific heat capacity of the air;

θ_{il} is the air inlet temperature of the convective device;

$\theta_{\mathrm{a,i}}$ is the room air temperature.

6.8.3 Cooling or heating surface device

With a cooling and/or heating surface device the heat flow is provided to or removed from the space by the surface of the device by convection and radiation. In this case the heating or cooling load is the total heat flow rate to be provided or removed by the surface of the heated or cooled element (comprising heat exchange with adjacent internal and external environments and stored heat variation) in order to maintain the prescribed internal conditions.

The room load, positive for heating and negative for cooling, is then given by:

$$\Phi_L = \Phi_b + \Phi_{lr,i} + \Phi_{c,i} + \Phi_{sr,i} \quad (2)$$

where

Φ_b is the heat flow rate backwards (it can be by conduction if the emitter is directly connected with the envelope, or by convection and long-wave radiation if the heating or cooling element is a suspended surface);

$\Phi_{lr,i}$ is the heat flow rate by long-wave radiation;

$\Phi_{c,i}$ is the heat flow rate by convection to the internal air;

$\Phi_{sr,i}$ is the heat flow rate due to the short-wave radiation absorbed by the surface.

7 Report of the calculation

7.1 General

The calculation report shall include the input data and the result of the calculation.

7.2 Input data

For evaluating hourly energy requirements of the building with a room by room calculation, the following information is required:

a) the hourly climatic data of the location over a complete reference year;

b) the descriptors of the envelope elements (area, exposure, boundary conditions, thermophysical parameters, solar factor);

c) the schedule of the internal temperature set-point (air or operative temperature);

d) the hourly profile of the ventilation and infiltration rates;

e) the scheduled values of the convective and radiative heat flows due to lighting, occupants, internal equipment, appliances;

f) the characteristics of the thermal system (convective and/or radiative) and maximum heating and cooling capacity.