Calculation of heat need for heating and cooling

(EN ISO 13790:2008)
Slovak Republic

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EN ISO 13790 - very complex standard

- ***more methods***
- ***a lot of inputs from other CEN standards***

Problem of standards

(not only EN ISO 13790:2008)

Difficult to produce one CEN standard to be appropriate for software developers or national experts
and at the same time for individual experts, certifiers.

Software developers, national experts need:

all possible options, also detailed,
calculation procedures and indexes appropriate for computer algorithms

Individual certifiers-experts:

(Experience from trainings)

feel unhappy and complain: too long, too complicated, too many possibilities, too many indexes ... in reality do not use directly the standard

Possible solutions for countries:

- **copying the relevant parts as national standard (?)**
- **national annexes + user friendly software**

  (**SK** - more appropriate way for common methodology, less expensive for small countries)

National decisions for set the calculation procedures for certification were taken with regard to:

- find the right balance between
  - cost effectiveness
  - accuracy
  - quality
  - reproducibility

- **the skills and abilities of certifiers-independent experts** (certification concerns huge amount of buildings, lack of experts - poor quality of certificates)

In case of national simplifications should be considered that for the buildings of better quality and some new building technical systems some aspects neglected in the past become more important (heat gains, dynamic parameters, …, hourly calculation, simulation)

Calculated energy rating

Slovakia : Calculated energy rating

- all building types,
- new, existing.

- based on CEN standards
- Decree refers directly to CEN standards (translated)
- EN ISO 13790:2008 - **for heat need calculation**
- National Annex to EN ISO 13790 with some specifications and national input data

- **A lot of choices on the expert-certifier**

Calculated energy rating

Important role

Slovak Chamber of Civil Engineers

+ *Ministry of Construction and Regional Development*

responsible for the training of experts:

- *training, lessons (in cooperation with TSUS + STU)*
- *exams for experts*

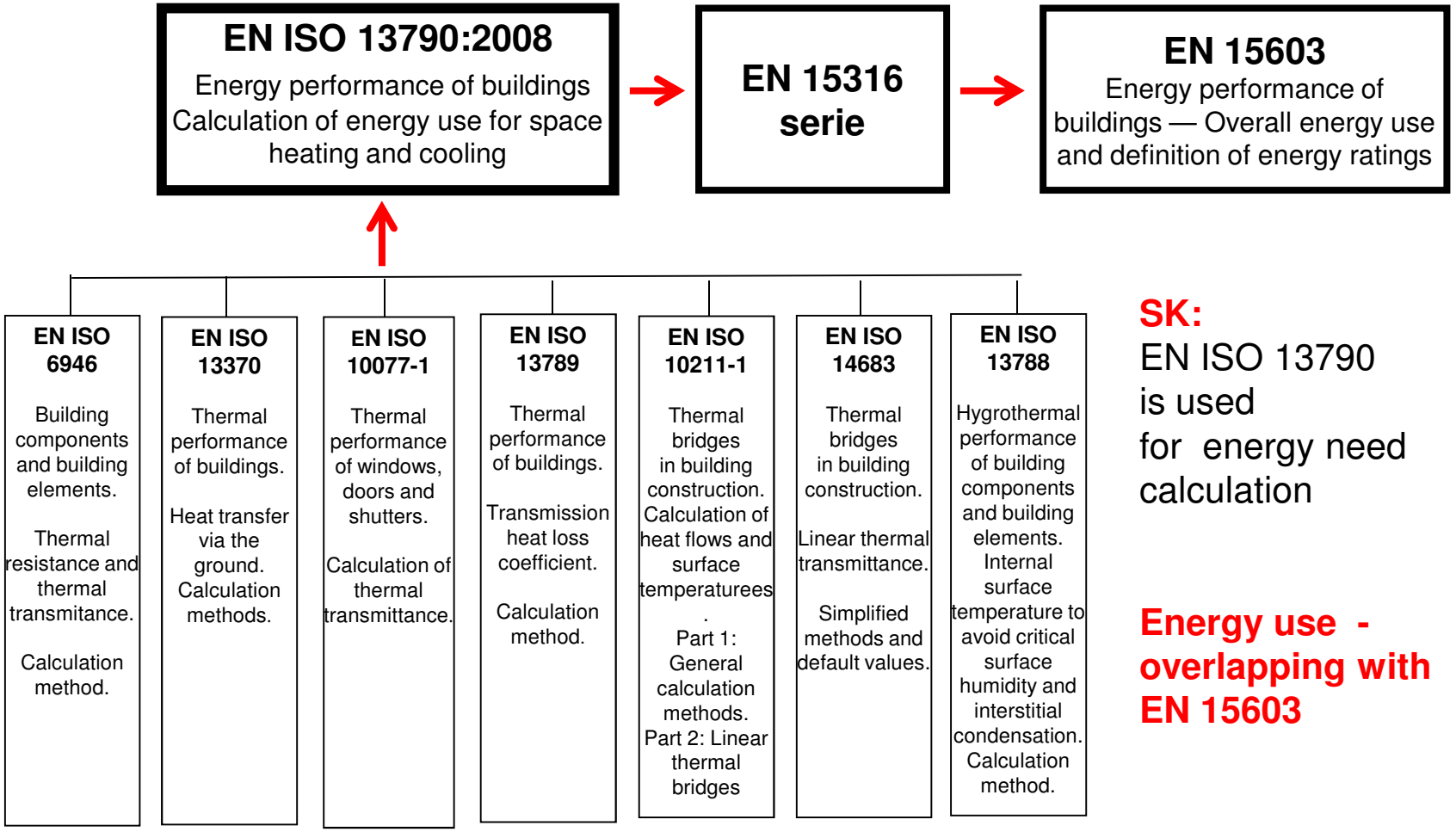
Ministry of Construction and Regional Development

issued a guidebook for experts:

- *General framework for methodology*
- *Calculation procedures with detailed explanation and examples*
- *National input data*
- *Often used instead of standard*

Calculated energy rating

All relevant CEN EPBD standards are implemented and translated



SK:
EN ISO 13790
is used
for energy need
calculation

Energy use - overlapping with EN 15603

Calculated energy rating

Energy certificate

calculated energy rating for

standard use + **standard climate conditions**

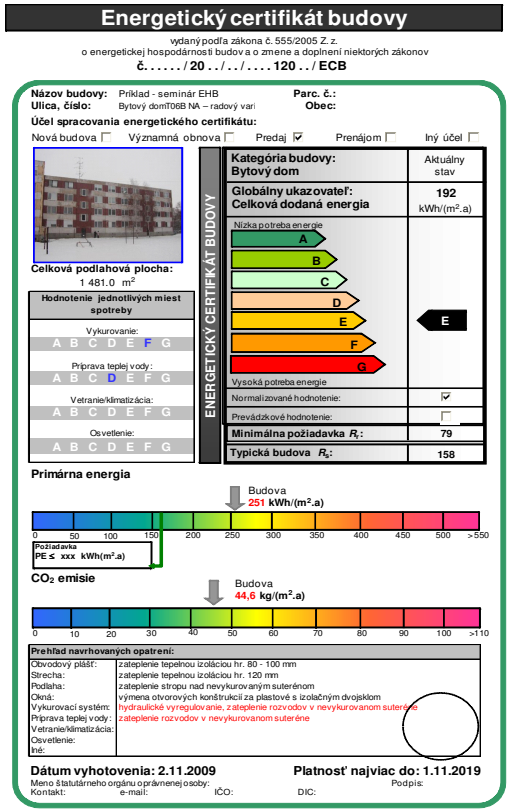
Global indicator - **Total delivered energy**

(sum of heating, DHW, air-conditioning, lighting

– also separate scale for each

– requirement to achieve class “B”)

- PE, CO_2 reported in certificate



Standard use and climate for heating and cooling energy need are defined in the Decree:

- Seasonal degree days
- Monthly, seasonal average external temperature
- Monthly, seasonal period duration
- Monthly, seasonal solar radiation

Content of the National Annex:

- ***Units***
- ***Calculation method***
- ***Boundary and thermal zones***
- ***Length of the heating season***
- ***Simplifications in calculation***
- ***National input data***
  - ***"b" temperature adjustment factor***
  - ***building thermal characteristics***
  - ***thermal bridges***
  - ***average air change rate calculation***
  - ***internal heat gains***
  - ***internal temperature***
  - ***climate data***
  - ***solar irradiance***

Units (EN ISO 13790 … energy in MJ, SK … kWh)

Calculation methods:

quasi-steady-state methods for heat need calculation

- ✓ residential buildings - seasonal method, only heating
- ✓ non-residential buildings - monthly method for heating and cooling

- hourly dynamic method or simulation methods are not explicitly restricted (but no hourly data for standard climate, standard use are available)

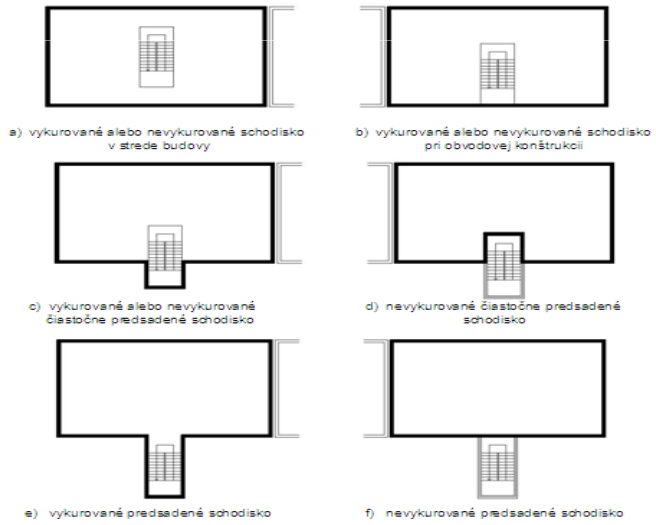
Definition of the boundary of the building

- type of dimensions

SK - external dimensions

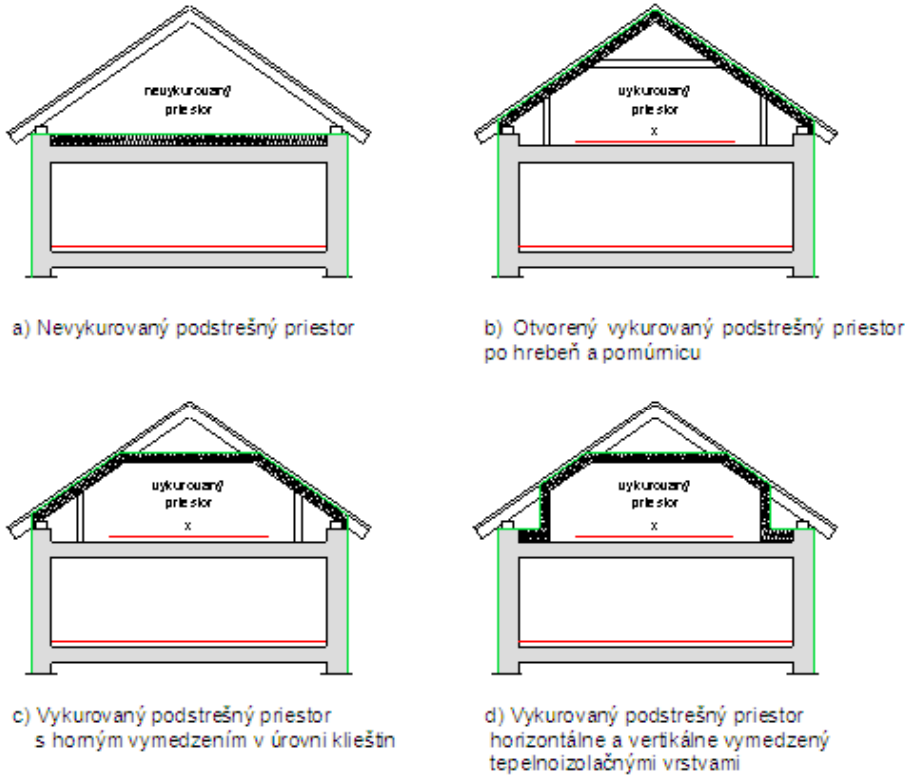
- floor area, volume

STN EN ISO 13790/NP



Obrázok NA.1 – Určenie podlahovej plochy podlažia so zohľadnením riešenia schodiska

STN EN ISO 13790/NA



a) Nevykurovaný podstrešný priestor

b) Otvorený vykurovaný podstrešný priestor po hrebeň a pomúrnicu

c) Vykurovaný podstrešný priestor s horným vymedzením v úrovni klieštin

d) Vykurovaný podstrešný priestor horizontálne a vertikálne vymedzený tepelnoizolačnými vrstvami

ohraničenie obalových konštrukcií na určenie obostavaného objemu

Obrázok NA.5 - Ohraničenie obostavaného objemu pri šikmej streche

Zdola je obostavaný objem ohraničený vonkajšou plochou zateplenia stropnej konštrukcie nad nevykurovaným suterénom alebo vstupným podlažím do budovy podľa obrázku NA.6.

Definition of the zones

Thermal zones

- Criteria for single zone or multi-zone calculation – Art. 6.3.2.
- set-point temperature for single zone calculation - area-weighted average (according to Art. 6.3.3.1.1)

SK - for certification – standard set-point temperatures per building type in Decree

Multi–zone calculation for zones with:

- different heating system,
- different use

Definition of the zones

Residential buildings – single zone calculation
(small unheated parts e.g. staircases – neglected)

Buildings with mixed use
(more than 10% of floor area for different use)
– always multi-zone calculation

SK - simplification for multi-zone calculation:
-adiabatic boundaries between the zones
without the thermal coupling
(if the purpose is a calculation of the whole building)

Input data in National Annex:

- values for temperature adjustment factors "b"
- Reference to the source of building thermal characteristics
- way of thermal bridges consideration (detailed calculation, simplified values ΔU W/(m^2.K))
- internal temperatures for different spaces (rooms, classes, gymnasium,..)
- internal gains (simplified standard values for 3 building types can be used – family houses, apartment buildings, public buildings)

National Annex EN ISO 13790:2008

Energy performance of buildings Calculation of energy use for space heating and cooling

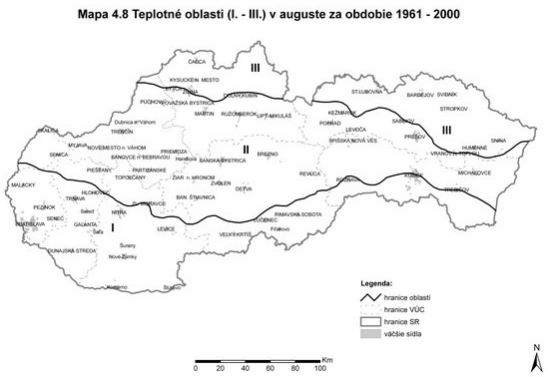
Climate data – for tailored energy rating

(data useful for **measured energy rating**)

Average monthly external temperature (also max, min) for all localities in Slovak Republic)

Regression from the measurements from 1961 – 2000 issued by Slovak Hydrometeorology Institute

zones I. II. III. - **maps of zones different for each month**



Month / zone	I	II	III
Január	y = - 0,004x - 1,1	y = - 0,004x - 1,8	y = - 0,004x - 2,5
Február	y = - 0,005x + 1,3	y = - 0,005x + 0,6	y = - 0,005x - 0,1
Marec	y = - 0,006x + 6,2	y = - 0,006x + 5,3	y = - 0,006x + 4,4
Apríl	y = - 0,007x + 11,7	y = - 0,007x + 11,1	y = - 0,007x + 10,4
Máj	y = - 0,007x + 16,6	y = - 0,007x + 16,0	y = - 0,007x + 15,4
Jún	y = - 0,0075x + 19,7	y = - 0,0075x + 19,1	y = - 0,0075x + 18,5
Júl	y = - 0,0075x + 21,4	y = - 0,0075x + 20,7	y = - 0,0075x + 20,0
August	y = - 0,0075x + 20,8	y = - 0,0075x + 20,1	y = - 0,0075x + 19,4
September	y = - 0,0065x + 16,3	y = - 0,0065x + 15,7	y = - 0,0065x + 16,0
Október	y = - 0,005x + 10,7	y = - 0,005x + 10,2	y = - 0,005x + 9,6
November	y = - 0,0045x + 5,1	y = - 0,0045x + 4,7	y = - 0,0045x + 4,2
December	y = - 0,0045x + 0,5	y = - 0,0045x + 0,1	y = - 0,0045x - 0,5

***y* – monthly average external temperature – in dependence on x – altitude**

Zones for calculation of solar radiation for particular locality

Coefficients for re-calculation of the monthly sum of solar radiation for different orientations (S, W, E, N) and slopes 30°, 60°, 90° for 3 zones in kWh/m²

?
Questions
Decisions at national level

EN ISO 13790:2008

Energy performance of buildings Calculation of energy use for space heating and cooling

? ***Art. 7.3.2***: Multiple steps to account for interaction between building and system – calculation in two or more steps

1. Step - calculation of heat need – without dissipated heat from the heating/cooling system → calculation of dissipated heat →
2. Step - final calculation of heat need

Can be decided at national level

SK – simplified approach - calculation in two or more steps is not required.
Recovered system thermal losses are not in the internal gains, but subtracted from the energy use per technical building system
(reason: assessed by 2 independent experts - for building and heating systems)

The better building quality, the holistic approach is more important !

? *Art. 13. Indoor conditions - Intermittent heating*

13.2.1. Continuous and quasi-continuous heating or cooling mode

Quasi-continuous if:

- the set-point temperature variations between normal-reduced periods < 3 K

and/or

- the time constant of the building **< 0**.2 **x** the duration of the shortest reduced heating/cooling period → used time average of set-point temperatures

SK: for standard building operation
the time average set-point temperatures are given **per building type** in Decree (inertia is not considered)
(e.g. for office buildings … 18,5℃, schools …. 18,4 ℃,..)

Buildings of higher inertia and difference between normal-reduced temperature ...

Intermittent heating and cooling

correction for intermittency (Art. 13.2.2)

– heating $Q_{H,nd} = Q_{H,nd,interm} = \alpha_{H,red} \cdot Q_{H,nd,cont}$

– cooling $Q_{C,nd} = Q_{C,nd,interm} = \alpha_{C,red} \cdot Q_{C,nd,cont}$

$Q_{H,nd,cont}$, $Q_{C,nd,cont}$, - energy need for continuous heating/cooling

$\alpha_{H,red}$, $\alpha_{C,red}$ - reduction factor for intermittent heating/cooling

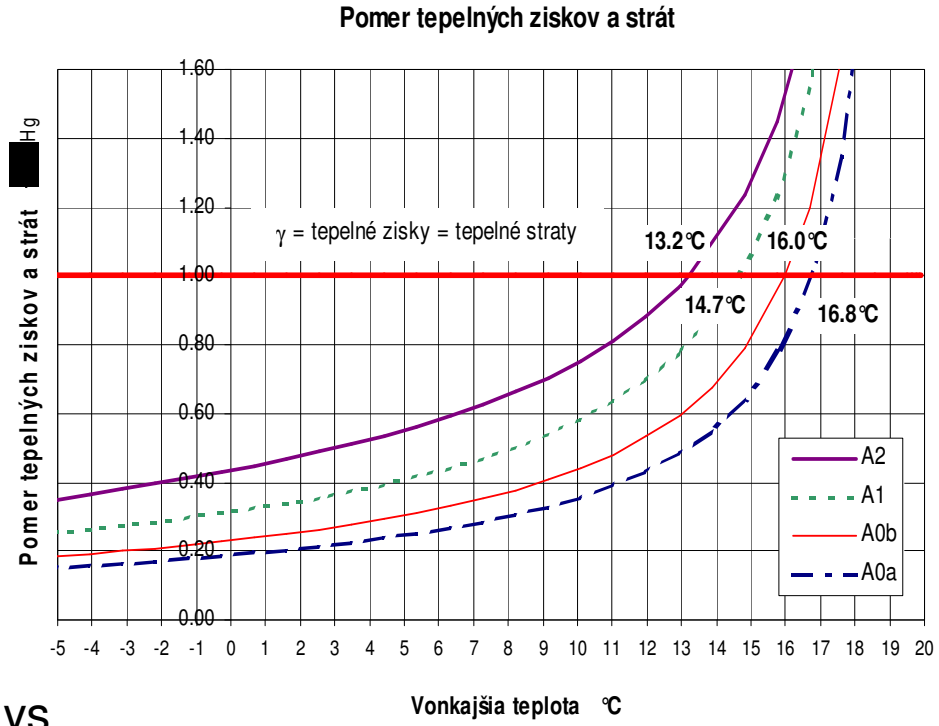
Simplification of standard
***against* previous version, set-back temperature is not important**

? Length of the heating season

Should be set according to Annex I.3.6.3 for a geographical zone and typical buildings

SK: Study of apartment buildings – fixed length of heating season calculated (I.3.6.2)

The limit daily average external temperature - difference 1-5 ℃ between the buildings of poor and good quality



SK – for certification
fixed length of heating season = 212 days

? *Art. 11. Solar heat gains*

11.3.2. Heat flow by solar gains per building element

$$\Phi_{\mathrm{sol},k} = F_{\mathrm{sh,ob},k} A_{\mathrm{sol},k} I_{\mathrm{sol},k} - F_{\mathrm{r},k} \Phi_{\mathrm{r},k}$$

Extra heat flow due to thermal radiation to the sky included in solar heat gain

SK - for certification:
Heating – ignores extra heat transfer by radiation to the sky
in combination with
ignoring solar heat gains of opaque elements
(important only for dark, poorly insulated surfaces, large areas facing the sky)

Extra heat flow due to thermal radiation

SK – for certification:

Cooling – can be calculated
(on expert) – more detailed calculation better value

- solar heat absorbed by opaque elements is calculated

In Slovak climate small effect:

- **heat flow due to thermal radiation to the sky - small part**
- (about 0,05 kWh/m^2 for cooling season) **in new building energy balance**

- **Effective collecting area of opaque building elements – more important** (5-20% of total effective collecting area)

? *Art. 11. Solar heat gains*

11.2.1. Heat flow from solar heat source in the adjacent unconditioned space (11.3.6, E.2)

SK - for certification:

Unheated sunspace – should be considered for heating and cooling

For other adjacent unconditioned spaces – solar gains ignored for heating but considered for cooling

The better building quality, heat gains are more important !

? *Art. 12 Dynamic parameters:*

SK:

- **Seasonal method** - residential buildings
  gain utilization factor not need to be calculated
  can be used fixed $\eta = 0.95$
  (Study: OK for old buildings, for new buildings should be calculated)

- **Monthly method -** non-residential buildings
  gain utilization factor calculated

  (building time constant - no national values for internal heat capacity
  - default values from EN ISO 13790 are used
  (problem ambiguous explanation in clause G.7)

Thank you for your attention

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