

Thermal performance of buildings — Calculation of energy use for space heating

The European Standard EN ISO 13790:2004 has the status of a
British Standard

ICS 91.140.10

National foreword

This British Standard is the official English language version of EN ISO 13790:2004.

The UK participation in its preparation was entrusted by Technical Committee B/540, Energy performance of materials, components and buildings, to Subcommittee B/540/1, European standards for thermal insulation, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2004

Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, pages 2 to 63 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

© BSI 30 June 2004

ISBN 0 580 43985 2

English version

Thermal performance of buildings - Calculation of energy use for space heating (ISO 13790:2004)

Performance thermique des bâtiments - Calcul des besoins d'énergie pour le chauffage des locaux (ISO 13790:2004)

Wärmetechnisches Verhalten von Gebäuden - Berechnung des Heizenergiebedarfs (ISO 13790:2004)

This European Standard was approved by CEN on 8 September 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword	3
Introduction	4
1 Scope	4
2 Normative references	5
3 Terms and definitions	5
4 Symbols and abbreviations	9
5 Outline of the calculation procedure and required data.....	11
6 Intermittent heating	15
7 Heat loss (single zone calculation).....	16
8 Heat gains.....	19
9 Heat use.....	21
10 Annual heat use of the building.....	24
11 Energy for space heating	24
12 Report.....	25
Annex A (normative) Application to existing buildings	27
Annex B (normative) Multi-zone calculation method	28
Annex C (normative) Intermittent heating – Calculation of adjusted internal temperature.....	29
Annex D (normative) Calculation with holiday period.....	37
Annex E (normative) Heat loss of special envelope elements	38
Annex F (normative) Solar gains of special elements.....	42
Annex G (informative) Ventilation airflow rates	49
Annex H (informative) Data for solar gains.....	53
Annex I (informative) Calculation of heat use for each heating mode.....	57
Annex J (informative) Accuracy of the method.....	59
Annex K (informative) Conventional input data	60
Annex ZA (informative) Normative references to international publications with their corresponding European publications.....	62
Bibliography	63

Foreword

This document EN ISO 13790:2004 has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS, in collaboration with Technical Committee ISO/TC 163, "Thermal performance and energy use in the built environment", sub-committee 2, "Calculation methods".

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 December 2004, and conflicting national standards shall be withdrawn at the latest by December 2004.

Annexes A to F are normative. Annexes G to K are informative.

This document includes a Bibliography.

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

Introduction

This standard is one of a series of calculation methods for the design and evaluation of thermal performance of buildings and building components.

The calculation method presented in this standard is based on an energy balance taking account of internal and external temperature variations and, through a utilisation factor, of the dynamic effect of internal and solar gains.

This method can be used for the following applications:

- 1) judging compliance with regulations expressed in terms of energy targets;
- 2) comparing the energy performance of various design alternatives for a planned building;
- 3) displaying a conventional level of energy performance of existing buildings;
- 4) assessing the effect of possible energy conservation measures on an existing building, by calculation of the energy use with and without the energy conservation measure;
- 5) predicting future energy resource needs on a national or international scale, by calculating the energy uses of several buildings representative of the building stock.

Reference can be made to other International Standards or to national documents for input data and detailed calculation procedures not provided by this standard. In particular, this applies to the calculation of the efficiency or the heat loss of the heating systems.

Unlike EN 832, whose scope is restricted to residential buildings, this standard can be applied to both residential and non-residential buildings. The most important changes in EN ISO 13790 compared to EN 832:1998, "*Thermal performance of buildings - Calculation of energy use for heating - Residential buildings*", are:

1. Ventilation rates are calculated according to standards prepared by CEN/TC 156;
2. Clause 11 has been made simpler, and energy use is calculated from heat use according to existing International Standards or, by default, to national documents;
3. A normative method has been included to calculate the effect of intermittence.
4. New input data have been included for non-residential buildings, in particular for utilisation factors.

For all these reasons, calculation using EN ISO 13790 gives results that may slightly differ from those obtained with EN 832.

1 Scope

This standard gives a simplified calculation method for assessment of the annual energy use for space heating of a residential or a non-residential building, or a part of it, which will be referred to as "the building".

It does not apply to buildings with air conditioning systems likely to provide space cooling during the heating season.

This method includes the calculation of:

1. the heat losses of the building when heated to constant internal temperature;
2. the annual heat required to maintain the specified set-point temperatures in the building;
3. the annual energy required by the heating system of the building for space heating, using heating system characteristics which are to be found in specific European or International Standards, or, by default, in national documents.

The building can have several zones with different set-point temperatures, and can have intermittent heating.

The calculation period is the month. For residential buildings the calculation can also be performed for the heating season. Monthly calculation gives correct results on an annual basis, but the results for individual months close to the beginning and the end of the heating season can have large relative errors. Annex J provides some information on the accuracy of the method.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN ISO 13370:1998, *Thermal performance of buildings – Heat transfer via the ground – Calculation methods (ISO 13370:1998)*.

EN ISO 13789, *Thermal performance of buildings – Transmission heat loss coefficient – Calculation method (ISO 13789:1999)*.

3 Terms and definitions

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

3.1 calculation period

time period for the calculation of heat losses and gains

NOTE The calculation period is the month. For residential buildings the calculation can also be performed for the heating season.

3.2 external temperature

temperature of external air

NOTE For transmission heat loss calculations, the radiant temperature of the external environment is supposed equal to the external air temperature; long-wave transmission to the sky is considered in F.5.

3.3 internal temperature

arithmetic average of the air temperature and the mean radiant temperature at the centre of the occupied zone

NOTE This is the approximate operative temperature according to ISO 7726, *Ergonomics of the thermal environment - Instruments for measuring physical quantities*.

3.4 set-point temperature

internal temperature, as fixed by the control system in normal heating mode

3.5 set-back temperature

minimum internal temperature to be maintained during reduced heating periods

3.6 adjusted internal temperature

constant virtual internal temperature leading to the same heat loss as intermittent heating

3.7 heated space

room or enclosure heated to a given set-point temperature

3.8 unheated space

room or enclosure which is not part of the heated space

3.9 heat use

heat to be delivered to the heated space by an ideal heating system to maintain the set-point temperature during a given period of time

NOTE The heat use can include additional building heat loss resulting from non-uniform temperature distribution and non-ideal temperature control, if they are taken into account by increasing the set-point temperature and not included in the heat loss due to the heating system.

3.10 energy use for space heating

thermal energy to be delivered to the heating system to satisfy the heat use

3.11 intermittent heating

heating pattern where normal heating periods alternate with reduced heating periods

3.12 modes of intermittence

during intermittent heating, the heating system is operated according to either of the following modes:

- 3.12.1 **normal mode:** the heating system functions to maintain the internal temperature at the value it would have with continuous heating;
- 3.12.2 **cut-off mode:** the heating system does not provide heat;
- 3.12.3 **reduced heating power mode:** the heating system provides a heat flow rate lower than in normal heating;
- 3.12.4 **set-back mode:** heat flow rate is controlled to maintain a set-back temperature;
- 3.12.5 **boost mode:** the heating system runs at full power in order to reach the set-point temperature at or before the end of the reduced heating period

NOTE Depending on the control system, the boost mode can start according to two different strategies:

a) fixed time boost: the start of the boost mode is fixed by the user;

b) optimised boost: the time when the set-point internal temperature is recovered is fixed by the user, and the control system optimises the start of the boost mode, taking account of the external and internal temperatures.

3.13 **heated zone**

part of the heated space with a given set-point temperature, throughout which the internal temperature is assumed to have negligible spatial variations

3.14 **heat transfer coefficient**

heat flow rate between two zones divided by the temperature difference between both zones

3.15 **heat loss coefficient**

heat transfer coefficient from the heated space to the external environment

NOTE The heat loss coefficient of the building cannot be used when the multi-zone calculation method according to annex B is applied

3.16 **building heat loss**

heat transferred from heated space to the external environment by transmission and by ventilation, during a given period of time

3.17 **ventilation heat loss**

heat lost with the air leaving the heated space either by exfiltration or ventilation

3.18 **transmission heat loss**

heat loss by transmission through the building envelope and through the ground

3.19 **heat gains**

heat generated within or entering into the heated space from heat sources other than the space and hot water heating systems

NOTE These include internal heat gains and solar gains.

3.20 **internal heat gains**

heat provided within the building by occupants (sensible metabolic heat) and by appliances other than the space and hot water heating systems (lighting, domestic appliances, office equipment, etc.)

3.21 **solar gains**

heat provided by solar radiation entering into the building through windows or passive solar devices such as sunspaces, transparent insulation and solar walls

NOTE Active solar devices such as solar collectors are considered as part of the heating system.

3.22 **solar irradiation**

incident solar heat per area over a given period

3.23
utilisation factor

factor reducing the total monthly or seasonal heat gains to obtain the resulting reduction of the heat use

3.24
recovered heat

heat recovered from the environment or from heating and hot water systems (including auxiliary equipment), if not directly taken into account in a reduction of the heating system losses

3.25
ventilation heat recovery

heat recovered from the exhaust air

3.26
heating system losses

total of the heat lost by the heating system, including recovered system heat loss

4 Symbols and abbreviations

Table 1 — Symbols and units

Symbol	Quantity	Unit
A	area	m^2
a	numerical parameter in utilisation factor	-
b	correction factor for unheated zones	-
C	effective heat capacity of a heated space	J/K
c	specific heat capacity	J/(kg·K)
d	layer thickness	m
F	factor	-
g	total solar energy transmittance of a building element	-
I	solar irradiance	J/m ²
H	heat transfer coefficient, heat loss coefficient	W/K
h	surface coefficient of heat transfer	W/(m ² ·K)
L	length	m
N	number	
Q	quantity of heat or energy	J
R	thermal resistance	m ² ·K/W
T	thermodynamic temperature	K
t	time, period of time	s
U	thermal transmittance	W/(m ² ·K)
V	volume of air in a heated zone	m ³
$\dot{V}$	airflow rate	m ³ /s
Φ	heat flow rate, heating power	W
Z	heat loss parameter for solar walls	W/(m ² ·K)
α	absorption coefficient of a surface for solar radiation	-
γ	gain/loss ratio	-
δ	ratio of the accumulated internal-external temperature difference when the ventilation is on to its value over the calculation period	-
ε	emissivity of a surface for thermal radiation	-

Symbol	Quantity	Unit
η	efficiency, utilisation factor for the gains	-
κ	factor related to heat losses of ventilated solar walls	-
θ	Celsius temperature	°C
ρ	density	kg/m ³
σ	Stefan-Boltzmann constant ($\sigma = 5,67 \times 10^{-8}$)	W/(m ² ·K ⁴)
τ	time constant	s
χ	heat capacity per area	J/(m ² ·K)
ξ	ratio of the effects of a change in heating flow rate on the internal temperature and on the structure temperature	-
ζ	effective part of the heat capacity	-
ω	ratio of the total solar radiation falling on the element when the air layer is open to the total solar radiation during the calculation period	-

NOTE Hours can be used as the unit of time instead of seconds for all quantities involving time (i.e. for time periods as well as for air change rates), but in that case the unit of energy is Watt-hours [Wh] instead of Joules.

Table 2 — Subscripts

C	capacity, calculation, convective	f	form, final	r	radiative, recovered, reduced
F	frame	g	gains	s	solar, sunspace
G	ground	h	heating, heated, hemispherical	sb	set back
L	loss	hol	holidays	se	surface external
P	related to power	hw	hot water	si	surface internal
S	shading	i	internal	ss	surface-sky average
T	transmission	ih	intermittent heating	sw	solar wall
V	ventilation	<i>i,j,k,m,n</i>	dummy integers	t	transparent insulation
a	air	l	layer	th	heating system
ad	adjusted	m	metabolic, month	u	unheated
ap	appliances	nh	no heating	v	ventilation
bh	boost heating	o	overall	w	window
c	structure	p	partition wall	y, z	zone number
d	design, daily, direct	pp	peak power	⊥	perpendicular
e	exterior, envelope	ps	permanent shading	0	base, reference

5 Outline of the calculation procedure and required data

5.1 Energy balance

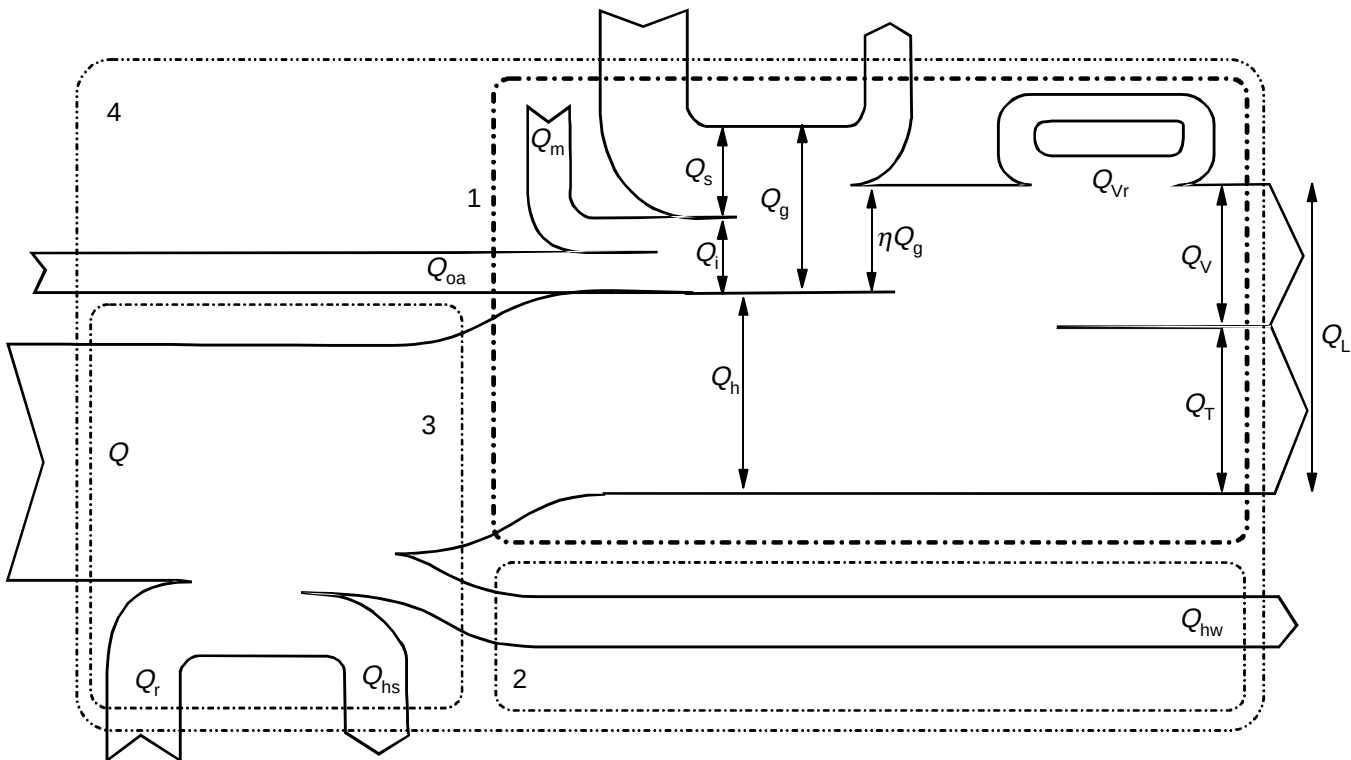
The energy balance includes the following terms (only sensible heat is considered):

5. transmission and ventilation heat loss from the heated space to the external environment;
6. transmission and ventilation heat transfer between adjacent zones;
7. internal heat gains;
8. solar gains;
9. generation, distribution, emission and control losses of the space heating system;
10. energy input to the space heating system.

It may also include recovered energy from various sources.

NOTE As heat gains may induce internal temperature to rise above the set-point, the resulting additional heat loss is taken into account through a utilisation factor reducing heat gains.

The main terms of the energy balance are schematically illustrated in Figure 1.



Key

Q	Energy use for heating	Q_h	Heat use
Q_{oa}	Heat from other appliances	Q_v	Ventilation heat loss
Q_r	Recovered energy	Q_{vr}	Ventilation heat recovery
Q_{hs}	Losses from the heating system	Q_T	Transmission heat loss
Q_m	Metabolic heat	Q_{hw}	Heat for hot water preparation
Q_s	Passive solar gains	Q_L	Total heat loss
Q_i	Internal gains	1	Boundary of the heated zone
Q_g	Total gains	2	Boundary of the hot water system
ηQ_g	Useful gains	3	Boundary of the heating plant
		4	Boundary of the building

Figure 1 – Energy balance of a building

5.2 Calculation procedure

The calculation procedure is summarised below. In addition, the special approach given in annex A shall be followed when applying this standard to existing buildings.

- 1) Define the boundaries of the heated space and, if appropriate, of different zones and unheated spaces, according to 5.3.
- 2) In case of intermittent heating or intermittent ventilation define, within the calculation period, the periods having different heating and ventilation patterns (e.g. day, night, weekend) according to clause 6.

- 3) For a single zone calculation, calculate the heat loss coefficient of the heated space according to clause 7; or for a multi-zone calculation, follow the procedure in annex B.
- 4) For seasonal calculation, define or calculate the length and climatic data of the heating season, according to 9.2.

Then, for each calculation period (month or heating season):

- 5) calculate the adjusted internal temperature for each period according to clause 6;
- 6) calculate the heat loss, Q_L , according to clause 7;
- 7) calculate the internal heat gains, Q_i , according to 8.1;
- 8) calculate the solar gains, Q_s , according to 8.2;
- 9) calculate the utilisation factor for heat gains, η , according to 9.2;
- 10) calculate the heat use, Q_h , for all calculation periods, according to clause 9;
- 11) calculate the annual heat use, Q_h , according to clause 10;
- 12) calculate the energy use for heating taking into account the losses of the heating system, according to clause 11.

5.3 Definition of boundaries and zones

5.3.1 Boundary of the heated space

The boundary of the heated space consists of all the building elements separating the considered heated space from external environment or from adjacent heated zones or unheated spaces.

5.3.2 Thermal zones

5.3.2.1 Single zone calculation

When the heated space is heated to the same temperature throughout, and when internal and solar gains are relatively small or evenly distributed throughout the building, the single zone calculation applies.

The division in zones is not required when:

- a) set-point temperatures of the zones never differ by more than 4 K, and it is expected that the gain/loss ratios differ by less than 0,4 (e.g. between south and north zones), or
- b) doors between zones are likely to be frequently open.

In such cases, even if the set-point temperature is not uniform, the single zone calculation applies. Then the internal temperature to be used is:

$$\theta_i = \frac{\sum_z H_z \theta_{iz}}{\sum_z H_z} \quad (1)$$

where

θ_{iz} is the set-point temperature of zone z ;

H_z is the heat loss coefficient, according to clause 6, but calculated separately for each zone z .

In this case, a unique intermittence pattern shall be chosen.

5.3.2.2 Multi-zone calculation

In other cases with significant differences in set-point temperatures or heat gains, the building is divided into several zones.

If the purpose of the calculation is to assess heat use for each zone individually, then the calculation procedure given in annex B shall be used.

Otherwise, each zone may be calculated independently using the single zone procedure and assuming adiabatic boundaries between zones. The energy use for the building is the sum of the energy use calculated for the individual zones.

5.4 Input data

5.4.1 Source and type of input data

When no International Standard is given as a reference, the necessary information may be obtained from national standards or other suitable documents, and these should be used where available. The informative annexes give values or methods to obtain values when the required information is otherwise not available.

For predicting the energy needs or judging compliance with regulations or specifications, conventional values shall be used, in order to make the results comparable between different buildings.

For optimisation of a planned building or retrofitting an existing building, the best available estimate for that particular building shall be used (see annex A). However, if no better estimates are available, conventional values may be used as first approximations.

The physical dimensions of the building construction shall be consistent throughout the calculation. Internal, external or overall internal dimensions can be used, but the same type shall be kept for the whole calculation and the type of dimensions used shall be clearly indicated in the report.

NOTE 1 Some linear thermal transmittances of thermal bridges depend on the type of dimensions used.

The input data required for single zone calculation are listed below. Some of these data may be different for each calculation period (e.g. shading correction factors, airflow rates in cold months) and for each period of an intermittence pattern (e.g. air flow rate, thermal transmittance of windows due to closing of shutters during night periods). Input data for heat loss are

H_T transmission heat loss coefficient according to EN ISO 13789.

NOTE 2 In contrast with EN ISO 13789, daily average values of the thermal transmittance of windows with shutters can be determined on the basis of the values given by EN ISO 10077-1, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: Simplified method*.

$\dot{V}$ air flow rate through the building, including airflows to and from unheated spaces.

5.4.2 Input data for heat gains

Φ_i average internal heat gains during the calculation period.

For glazed envelope elements, the following data shall be collected separately for each orientation (e.g. horizontal, pitched, and vertical south and north):

A_j area of opening in the building envelope for each window or door;

F_{Fj} frame factor, i.e. transparent fraction of the area A_j , not occupied by a frame;

F_{Sj} shading correction factor, i.e. average shaded fraction of the area A_j ;

g_j total solar energy transmittance for solar radiation.

NOTE In non-residential buildings internal gains vary substantially between occupied and non-occupied periods. Gains can be first calculated for each occupancy period and then averaged taking into account the length of each period. This calculation is often easier on a weekly basis.

Additional data shall be collected for components that collect solar radiation, such as transparent insulation, ventilated solar walls and sunspaces, and for calculation of the effect of intermittent heating. The required data are listed in annexes E and F. Annex H gives some information on data useful to assess the solar gains.

5.4.3 Dynamic characteristics

C heat capacity of the heated space, calculated for heat use according to 9.2;

τ time constant of the heated space

NOTE Either C or τ should be specified, not both.

5.4.4 Input data for energy use

Q_{hs} losses of the heating system.

5.4.5 Climatic data

The calculation method requires the following climatic data:

θ_e monthly or seasonal average of external temperature;

$I_{s,j}$ monthly or seasonal total solar radiation per area for each orientation j , in J/m².

NOTE EN ISO 15927-1, *Hygrothermal performance of buildings – Calculation and presentation of climatic data – Part 1: Monthly and annual means of single meteorological elements* is available.

6 Intermittent heating

6.1 Intermittence patterns

When intermittent heating is applied, the calculation period(s) shall be divided into normal heating periods alternating with reduced heating periods (e.g. nights, week-ends, and holidays).

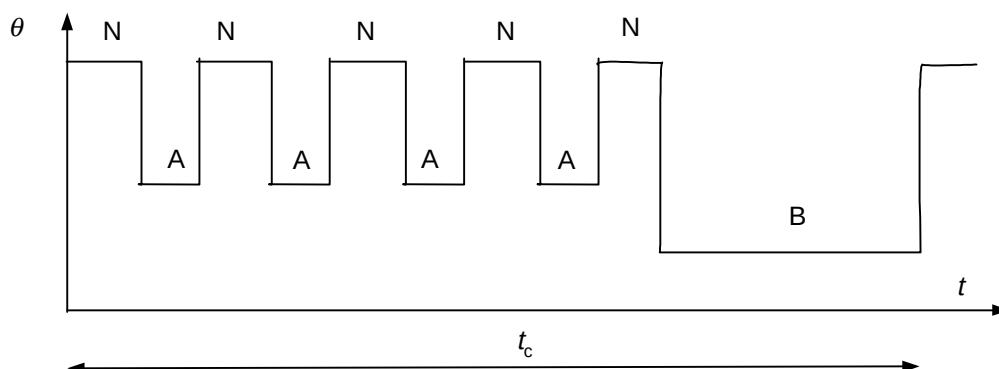
All the normal heating periods shall have the same set-point temperature.

There may be several types of reduced heating periods with different patterns.

Within each calculation period, each type of reduced heating period is characterized by:

11. its duration;
12. the number of occurrences of that type of period in one calculation period;
13. the relevant mode of intermittence (see 3.12) ;
14. where relevant, the set-back temperature or the reduced heating power;
15. the boost mode (see 3.12.5) and the maximum heating power during the boost period.

An example is shown in Figure 2, where the calculation period includes four type A reduced heating periods (e.g. nights) and one type B reduced heating period (week-end).



Key

θ Set-point temperature

t Time

t_c Calculation period

N Normal heating period

A Reduced heating period type A

B Reduced heating period type B

Figure 2 – Example of intermittence pattern

The division into different periods is not required when:

- set-point temperature variations between normal heating and reduced heating periods are lower than 3 K: in this case time average of set-point temperatures may be used;
- the time constant of the building (see 9.2.2) is greater than three times the duration of the longest reduced period: in this case the normal set-point temperature may be used for all periods;
- the time constant of the building is less than 0,2 times the duration of the shortest reduced heating period: in this case the time average of set-point temperatures may be used.

The heating system is supposed to deliver sufficient heating power to enable intermittent heating.

NOTE 1 In non residential buildings, variations of set-point temperatures and ventilation flow rates are often linked to occupancy. Splitting into different periods facilitates the evaluation of the mean air flow rate in each of them.

NOTE 2 As heating patterns are usually defined on a weekly basis, their definition will be facilitated if calculations are performed for one week per month.

6.2 Adjusted internal temperature

The adjusted internal temperature is the constant internal temperature which would result in the same heat loss as that obtained with intermittent heating during the period.

For each reduced period, the adjusted internal temperature shall be calculated using the procedure defined in annex C for daily or weekly reductions, and annex D for holidays.

Values of adjusted internal temperature may also be provided at a national level based on the type of building, building use, heating system, etc.

7 Heat loss (single zone calculation)

7.1 Without intermittent heating

The total heat loss, Q_L , of a single zone building at a uniform internal temperature and for a given calculation period, is:

$$Q_L = H (\theta_i - \theta_e) t \quad (2)$$

where

- θ_i is the set-point temperature;
- θ_e is the average external temperature during the calculation period;
- t is the duration of the calculation period;
- H is the heat loss coefficient of the building, calculated according to 7.3.

Equation (2) can be adapted at national level to allow for the use of degree-days. The result of the adapted relation shall nevertheless be the same as that of Equation (2) for any building.

7.2 With intermittent heating

If the division into different heating periods is not applicable, see 7.1.

If the division into different heating periods is applicable, the total heat loss, Q_L , of a single zone building at a uniform internal temperature and for a given calculation period, is calculated from Equation (3):

$$Q_L = \sum_{j=1}^N N_j H_j (\theta_{i,ad,j} - \theta_e) t_j \quad (3)$$

where

- N is the number of heating period types (e.g. 3 for normal, nights, and week-ends);
- N_j is the number of heating periods of each type during the calculation period;
- $\theta_{i,ad,j}$ is the adjusted internal temperature of the heating period j ;
- t_j is the duration of the heating period j ;
- H_j is the heat loss coefficient of the building during period j , calculated according to 7.3.

NOTE $\sum_{j=1}^N N_j t_j$ is equal to the duration of the calculation period.

To simplify the notation the subscript j is omitted below. Nevertheless when the division into heating periods is applicable the calculation shall be performed for each heating period.

7.3 Heat loss coefficient

The heat loss coefficient of a single zone building at a uniform internal temperature, and for a given calculation period or sub-period, is defined by Equation (4):

$$H = H_T + H_V \quad (4)$$

where

- H_T is the transmission heat loss coefficient, calculated according to EN ISO 13789 (for envelope elements incorporating ventilating devices, see annex E);
- H_V is the ventilation heat loss coefficient (see 7.5).

7.4 Buildings with significant heat loss through the ground

EN ISO 13789 states that the steady state method given in EN ISO 13370 should be used to include heat loss through the ground into the transmission heat loss coefficient H_T . However, that could result monthly heat losses through the ground being overestimated by 30 % to 40 % in winter and, if heat loss through the ground is an important part of the total heat loss, detailed calculation of the ground heat loss according to B.1 of EN ISO 13370:1998 shall be done. In this case, the total heat loss Q_L is given,

16. without division into different heating periods, by:

$$Q_L = (H'(\theta_i - \theta_e) + \Phi_G) t \quad (5)$$

17. in case of division into different heating periods, by:

$$Q_L = \sum_{j=1}^N N_j H' j (\theta_{i,ad,j} - \theta_e) t_j + \Phi_G t \quad (6)$$

where

H' is calculated according to 7.3 but without ground heat loss;

Φ_G is the heat loss rate through the ground calculated according to EN ISO 13370.

7.5 Ventilation heat loss coefficient

7.5.1 Principle

The ventilation heat loss coefficient, H_V , is calculated from:

$$H_V = \rho_a c_a \dot{V} \quad (7)$$

where

$\dot{V}$ is the airflow rate through the heated space;

$\rho_a c_a$ is the heat capacity of air per volume.

NOTE 1 If the air flow rate, $\dot{V}$, is in m^3/s , $\rho_a c_a \approx 1200 \text{ J}/(\text{m}^3 \cdot \text{K})$. If $\dot{V}$ is given in m^3/h , $\rho_a c_a \approx 0,34 \text{ Wh}/(\text{m}^3 \cdot \text{K})$.

Average airflow rate over each heating period shall be used.

For residential buildings, the airflow rate, $\dot{V}$, may be calculated either according to EN 13465, or provided at national level based on the type of building, building use, climate, exposition, etc.

For other buildings, the airflow rate, $\dot{V}$, may be calculated either according to an appropriate International Standard, or provided at national level based on the type of building, building use, climate, exposition, etc.

NOTE 2 Unless otherwise specified, the method in annex G can be used.

7.5.2 Heat recovery

Heat recovery from exhaust air is taken into account by reducing the real airflow rate in proportion to the efficiency of heat recovery.

This efficiency is always smaller than the effectiveness of the heat exchanger itself. It shall take account of differences between supply and extract airflow rates, of leakage and infiltration through the building envelope, and recirculation of air.