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Energy performance of buildings - Method for calculation of the design heat load - Part 2: Explanation and justification of EN 12831-1, Module M3-3

Heizungsanlagen und wasserbasierte Kühlanlagen in Gebäuden - Methoden zur Berechnung der Norm-Heizlast - Teil 2: Begleitender TR zur EN 12831-1 (Raum-Heizlast)

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Energy performance of buildings - Method for calculation of the design heat load - Part 2: Explanation and justification of EN 12831-1, Module M3-3

Performance énergétique des bâtiments - Méthode de calcul de la charge thermique nominale - Partie 2 : Explication et justification de l'EN 12831-1, Module M3-3

Heizungsanlagen und wasserbasierte Kühlanlagen in Gebäuden - Methoden zur Berechnung der Norm-Heizlast - Teil 2: Begleitender TR zur EN 12831-1 (Raum-Heizlast)

This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 228.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (FprCEN/TR 12831-2:2016) has been prepared by Technical Committee CEN/TC 228 “Heating systems and water based cooling systems in buildings”, the secretariat of which is held by DIN.

This document is currently submitted to the vote on TR.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Introduction

In order to facilitate the necessary overall consistency and coherence, in terminology, approach, input/output relations and formats, for the whole set of EPB-standards, the following documents and tools are available:

a) a document with basic principles to be followed in drafting EPB-standards: CEN/TS 16628:2014, Energy Performance of Buildings - Basic Principles for the set of EPB standards [1];

b) a document with detailed technical rules to be followed in drafting EPB-standards; CEN/TS 16629:2014, Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards [2];

c) the detailed technical rules are the basis for the following tools:

   1) a common template for each EPB-standard, including specific drafting instructions for the relevant clauses;

   2) a common template for each technical report that accompanies an EPB standard or a cluster of EPB standards, including specific drafting instructions for the relevant clauses;

   3) a common template for the spreadsheet that accompanies each EPB standard, to demonstrate the correctness of the EPB calculation procedures.

Each EPB-standards follows the basic principles and the detailed technical rules and relates to the overarching EPB-standard, prEN ISO 52000-1 [3].

One of the main purposes of the revision of the EPB-standards is to enable that laws and regulations directly refer to the EPB-standards and make compliance with them compulsory. This requires that the set of EPB-standards consists of a systematic, clear, comprehensive and unambiguous set of energy performance procedures. The number of options provided is kept as low as possible, taking into account national and regional differences in climate, culture and building tradition, policy and legal frameworks (subsidiarity principle). For each option, an informative default option is provided (FprEN 12831-1:2016, Annex B).

Rationale behind the EPB technical reports

There is a risk that the purpose and limitations of the EPB standards will be misunderstood, unless the background and context to their contents – and the thinking behind them – is explained in some detail to readers of the standards. Consequently, various types of informative contents are recorded and made available for users to properly understand, apply and nationally or regionally implement the EPB standards.

If this explanation would have been attempted in the standards themselves, the result is likely to be confusing and cumbersome, especially if the standards are implemented or referenced in national or regional building codes.

Therefore, each EPB standard is accompanied by an informative technical report, like this one, where all informative content is collected, to ensure a clear separation between normative and informative contents (see CEN/TS 16629 [1]):

— to avoid flooding and confusing the actual normative part with informative content;

— to reduce the page count of the actual standard; and

— to facilitate understanding of the set of EPB standards.

This was also one of the main recommendations from the European CENSE project [2] that laid the foundation for the preparation of the set of EPB standards.

1 Scope

This Technical Report refers to standard FprEN 12831, module M3-3 (FprEN 12831-1).

It contains information to support the correct understanding, use and national adaptation of standard FprEN 12831-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

FprEN 12831-1:2016, *Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3*

EN ISO 6946, *Non-destructive testing - Ultrasonic testing - Specification for step wedge calibration block (ISO 16946)*

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

EN ISO 10077-1, *Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1)*

prEN ISO 52000-1:2015, *Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures (ISO/DIS 52000-1:2015)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, prEN ISO 52000-1:2015, FprEN 12831-1:2016 apply.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this Technical Report, the symbols given in prEN ISO 52000-1:2015 and FprEN 12831-1:2016 apply.

4.2 Subscripts

For the purposes of this Technical Report, subscripts given in prEN ISO 52000-1:2015 and FprEN 12831-1:2016 apply

5 Information on the methods

FprEN 12831-1 describes a method to calculate the design heat load of

— heated spaces (usually rooms);

— building entities (apartments etc.) or whole buildings containing heated spaces.

The design heat load is required in the sizing of several components of a heating systems, such as

— heat emission components (e.g. radiators);

— heat distribution components (tubing etc.); and

— heat generators (boilers etc.).

FprEN 12831-1 contains several methods for this purpose,

— a standard method that describes a versatile approach to calculate the design heat load of

  — heated spaces / single rooms;

  — building entities; and

  — a whole building;

— a simplified method for the calculation of the design heat load of a building; and

— a simplified method for the calculation of the design heat load of heated spaces.

6 Method description

6.1 Standard method

6.1.1 Rationale, case of application

The standard method is a detailed approach for the calculation of the design heat load. The method is based on design criteria, such as internal and external design temperatures, and detailed information about the building or the heated spaces that the heat load shall be determined for. While the approach itself is versatile in that it can be used for new (to-be-built) and existing or old buildings either way, it is usually easier to apply to new ones than to old ones for several reasons, e.g.:

— detailed knowledge about the building, such as U-values, level of air tightness, etc., is required. In new buildings, the knowledge of this information can be considered a given; in old buildings, often, it cannot.

— in the process of constructing (new) buildings, usually, not only a single component of the heating system but the heating system as a whole has to be designed/sized. Therefore, a detailed heat load calculation is virtually mandatory. In the reconstruction of old/existing buildings, there are many cases where only parts of the heating system are to be replaced; e.g. replacing only the heat generator. Here, a detailed heat load calculation requires much more effort than is adequate for the task given.

6.1.2 Assumptions

Considerations within FprEN 12831 are based on steady-state conditions, e.g.:

— assuming constant internal, external and ground temperatures;

— considering to-be-heated rooms as already heated to the required temperature – meaning that the method basically determines how much power is required to maintain the required temperature (although, a simplified approach for the determination of heating-up power is given in the standard as well);

— assuming constant physical building properties (independent of time, temperature, etc.)

6.1.3 Data input

6.1.3.1 General

An extensive list of all input parameters and sources that shall be used to obtain them is given in the standard. In what follows, some items are named that may require some more explanation than is given in the standard.

6.1.3.2 Space allocation / partitioning of buildings

FprEN 12831-1 uses the following terms to describe scope(s) of the heat balance:

— **Building (Build)**

A whole building.

— **Building entity (BE)**

A portion of the building that can contain one or more rooms. A building entity is defined by use as a portion of the building that belongs to one user (owner(s), tenant(s), etc.) in a way that if one room of the entity is heated, it may be assumed that the other rooms of that entity are – give or take – heated as well. Typical examples are:

a) an apartment / a flat;

b) an office unit, etc.

In the scope of FprEN 12831-1, each building entity has an internal temperature that is a property of the building entity as a whole. That temperature is required to calculate heat loss from other rooms to that building entity.

— **Zone / Ventilation zone (z)**

A zone is a portion of the building that can contain one or more rooms. It is defined as an entity where all contained rooms are air-connected by design (through internal ATDs / shortened door leafs, etc.). By design, there is no air transfer between several ventilation zones. Usually, a zone is also a building entity.

— **Heated space (i)**

Each space heated to uniform conditions is considered a *heated space*. A *heated space* is separated from other spaces by building elements, such as walls etc. Usually each room is a *heated space*. The terms *heated space* and (*heated*) *room* are used synonymously in the standard.

6.1.3.3 Climatic data

The following climate data shall be provided through national standardization bodies:

— Reference external design temperature in [°C]: nationally defined default value(s) of the external temperature; can be transformed into the external temperature at the building site by means of the temperature gradient.

— Reference height in [m]: the mean height level that corresponds with the given reference external design temperature (e.g. height of the weather station whose measurements the *reference external temperature* is based on).

— Reference Temperature gradient in [K/m]: the rate of height-dependent temperature in- or decrease; together with the reference external temperature and the height of the building site, it shall be used to determine the external temperature at the building site and allows adjustment in case of significant height differences between the building site and the place the *reference external temperature* refers to.

— Annual mean external temperature in [°C]: annual mean value of the external temperature; distinction between different reference sites, height levels, etc. is not necessarily required, but may be implemented nationally.

— Parameters for the determination of the influence of the thermal storage capacity: a linear function to determine a temperature correction term ($\Delta\theta$) that allows for the influence of the building's thermal storage capacity on the heat loss. The following parameters are required:

  a) basic value in [K];

  b) slope in [K/h];

  c) optionally, lower and upper limit of the correction function in [K].

In using this temperature adjustment, the external design temperature takes building properties into account and, therefore, becomes a calculation value that may differ from the actual external temperature on the building site.

That data can be given either as a single set of default values, to be applied nation-wide, or – with a higher degree of geographical distinction – for several reference sites. A reference site is a defined area of equal or similar climate conditions. The number and sizes of reference sites shall be set according to the given geographical variance of climate conditions. The geographical scope to each reference site shall be defined, e.g. by reference to cities, regions, etc.

Either adjustment may be nullified on a national basis.

6.1.3.4 Internal design temperature

The internal design temperature is the temperature that is required for a certain kind of use of a heated space. Within FprEN 12831-1, the term is understood as an operative temperature. It is usually agreed upon by the customer that orders the installation of a heating system and the contractor planning or installing the heating system. For calculation purposes, normative default values shall be provided nationally (e.g. 20 °C in residential rooms, etc.). In the absence of national values, FprEN 12831 provides default values in an informative annex.

The internal design temperature is required in the calculation of design heat losses. It is fully independent from room height and heat transport mechanisms. The internal design temperature does not factor in effects as air temperature gradients, significantly differing air and radiant temperature, etc. If however necessary, adjustments to consider such effects are done by means of a temperature adjustment factor and the *effective internal temperature* θ^*_{int}, e.g. in calculating temperature adjusted heat loss coefficients after FprEN 12831-1:2016, 6.3.2/6.3.8. Therefore, in order to correctly consider the abovementioned effects, the internal design temperature $\theta_{int,i}$ shall not be manipulated.

Additional information on internal temperatures can be found in the international standards EN ISO 7730 and EN 15251.

6.1.3.5 Thermal transmittance

6.1.3.5.1 General

Thermal transmittances of the building elements of the thermal envelope shall be determined in accordance with:

— EN ISO 6946 (opaque elements);

— EN ISO 10077-1 (doors and windows); or

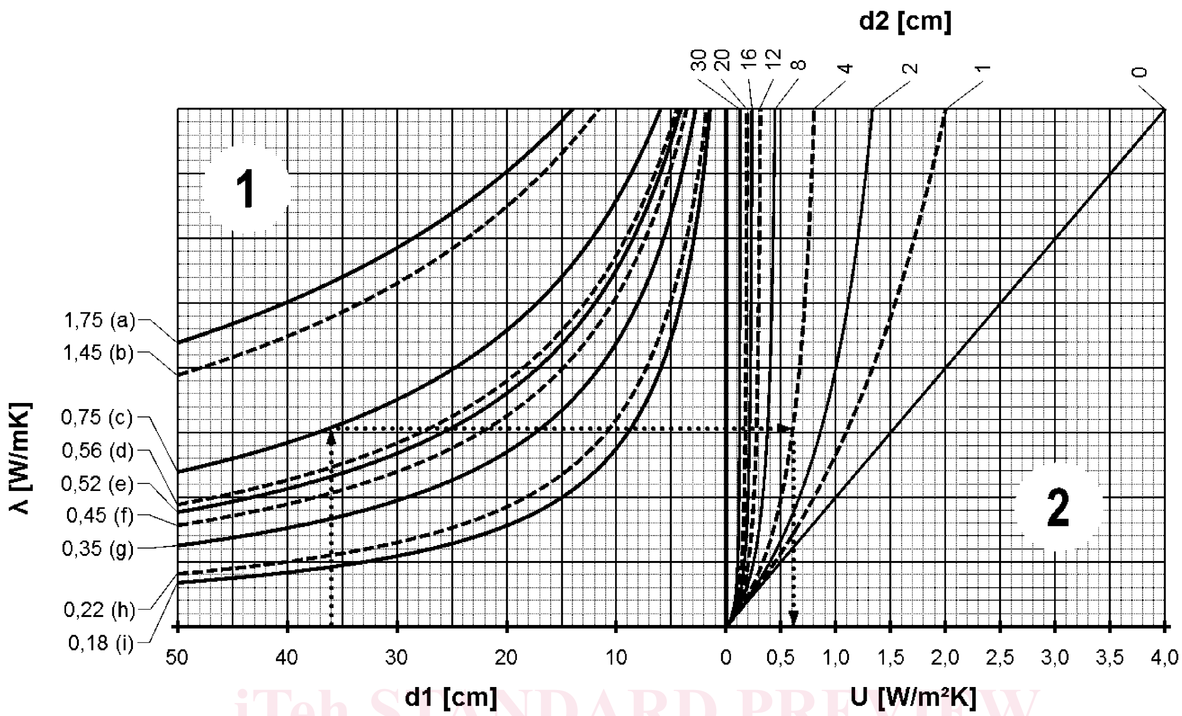
— information given in European Technical Approvals.

Note that U-values determined after methods differing significantly from EN ISO 6946 / EN ISO 10077-1 may require an additional adjustment in order to be applied within FprEN 12831. This is done through a *correction factor for the influence of building part properties and meteorological conditions [...]* e_k (see chapter *input data*).

6.1.3.5.2 Simplified determination of U-values based on the referred standards

On the basis of the methods described in the abovementioned standards, U-values may also be determined in a simplified way (e.g. for teaching materials), exemplarily shown in the following nomograms.

External and internal walls (vertical)



Key

Wall material

a Solid concrete

b Sand-lime brick

c Solid brick

d Hollow brick

e Concrete with crushed brick

f Light concrete

g Drywall/plasteboard

h Wood

i Light/cellular concrete or insulation brick

Axes

d1 wall thickness without insulation

d2 thickness of the insulation

λ thermal conductivity

U thermal transmittance

Reading example:

1 36 cm masonry (solid brick) with

2 4 cm thermal insulation

U_{total} approximately 0,6 W/m^{2}K

Figure 1 — Estimation of U-values based on structure, walls

The nomograph is based on the following equation and boundary conditions.

$$U = \frac{1}{R_{si} + R_{se} + \frac{d_1}{\lambda_1} + \frac{d_2}{\lambda_2}} \qquad (1)$$