EPB standards on hygrothermal performance of building components and building elements

This paper introduces the subset of EPB standards dealing with hygrothermal performance of building components and building elements. These EN ISO standards have a long tradition. The changes to make these standards fit into the set of EPB standards were mainly editorial.

Keywords: energy performance of buildings, EPB, EPB standards, EPB regulations, thermal transmission, building components, building elements.

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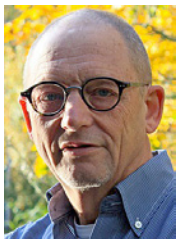

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The EPB standards on hygrothermal performance of building components and building elements concern the following standards mainly under EPB module M2-5 and developed under ISO/TC 163/SC 2 in collaboration with CEN/TC 89: EN ISO 6946 [2], EN ISO 10211 [3], EN ISO 10456 [4], EN ISO 13370 [5], EN ISO 13786 [6], EN ISO 13789 [7] and EN ISO 14683 [8], plus accompanying technical report, CEN ISO/TR 52019-2 [1].

History of this suite of standards

The first series of standards on thermal and hygrothermal properties of building components and elements were prepared by ISO Technical Committee TC 163 in the 1980s, as a result of growing global concern on future fuel shortages and inadequate health and comfort levels in buildings. During the following decades, these first standards were revised and new standards were added, to cope with new developments and additional needs. From the 1990s on, these standards were developed in close collaboration with CEN/TC 89.

Revision of this suite of standards (2013-2016)

The revisions (2013-2016) to make this suite of standards fit into the set of EPB standards are mainly editorial. This includes editorial changes to make the procedures unambiguous and software proof, to rationalize the choices (via the "Annex A/Annex B" approach) and to ensure consistent interconnections, in particular with all the other standards in EPB module M2 subset of EPB standards.

Main outputs

The main outputs of these standards are:

- thermal transmission properties of building elements (thermal resistance, thermal transmittance or dynamic thermal characteristics of a wall, floor or roof);
- heat transfer coefficient for the whole building (or part of a building).

General description of the standards

Together with EN ISO 10077-1, EN ISO 10077-2 and EN ISO 12631 (see other article, on the windows related standards); these standards provide the methodology to obtain heat transfer coefficients for a building starting from the properties of materials used for its construction and the size and geometry of the building.

The results provide input for calculation of energy needs for heating and cooling by EN ISO 52016-1 when one of the simplified (monthly or hourly) calculation methods is being used in EN ISO 52016-1 (see also [9] and parallel article on EN ISO 52016). In the case of detailed dynamic simulations, the component (or subcomponent) properties are used directly as inputs for the building simulation.

In applications where individual component properties are needed, the standards provide:

- in the case of minimum component requirements, the U-value or R-value of the construction;
- for multi-zone calculations with assumed thermal interaction between the zones, the thermal transmission properties of the separating construction;

Figure 1 illustrates the linkages between the various standards.

EN ISO 6946

EN ISO 6946 provides a calculation method that is valid for most building components (walls, suspended floors and roofs). It is based on calculating the upper limit of thermal resistance of the component (which would apply if the heat flow were unidirectional from warm side to cold side) and the lower limit (in which the plane separating each layer is isothermal). Except for components consisting entirely of homogeneous layers (for which the upper and lower limits are equal), the true thermal resistance of a component is between these two limits. The standard specifies use of the arithmetic mean of the two limits provided that their ratio does not exceed 1,5.

Options for national choices provided in "Annex A/ Annex B" comprise default thermal conductivity or thermal resistance values, criteria to allow specific simplifications and boundary conditions.

CEN ISO/TR 52019-2 provides calculation examples.

EN ISO 10211

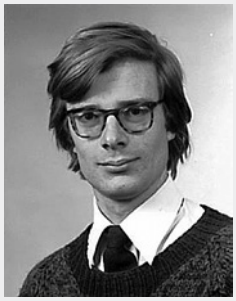
EN ISO 10211 specifies the method for detailed calculation of thermal bridges. It can be applied to a whole building or part of it, and also to the calculation of linear and point thermal transmittances which are used in EN ISO 13789.

Options for national choices provided in "Annex A/ Annex B" comprise default thermal conductivity values, criteria to allow specific simplifications and the required accuracy of the calculations.

EN ISO 13370

EN ISO 13370 is used for calculation of heat transfer via the ground, taking account of its contribution to the total thermal resistance in the case of *U*-value calculations and of its thermal inertia in the case of time-dependent calculations.

Brian Anderson (1948–2016)



It is with great sadness that we have to report that at the end of August 2016 we lost a colleague and friend to many – Brian Anderson.

Brian joined BRE in 1974 where his work was concerned with thermal insulation, thermal performance of buildings and prediction of energy use. He played a leading role in the preparation of European standards for thermal insulation and thermal performance. He was the WG9 convenor in ISO/TC 163/SC2 where he had led the revision of the suite of thermal transmission standards.

As one of the leading experts in the EPBD mandate M/343 (2004-2007), he was the main writer of the EPB "Umbrella document, EN/TR 15615, the basis for the current EN ISO 52000-1 and CEN ISO/TR 52000-2.

Only days after submission of the final drafts of the suite of thermal transmission standards to ISO, he died unexpectedly, just a few months before his retirement from BRE.

EN ISO 13370 specifies thermal properties for three representative types of ground. Particular values can be provided in EN ISO 13370 Annex A. Annex F of EN ISO 13370 contains a procedure for the application to dynamic simulation programs. This procedure is also used in EN ISO 52016-1 (see other article) for the hourly calculation of the energy needs for heating and cooling, internal temperatures and sensible and latent heat loads. In addition, special care has been taken to ensure that the monthly calculated heat transfer through the ground floor can be used as input for the monthly calculation method in the same EN ISO 52016-1. Extensive explanation, including validation and examples can be found in CEN ISO/TR 52019-2.

Options for national choices provided in "Annex A/Annex B" of the standard comprise default *U*-values for existing buildings, criteria to allow specific simplifications and environment conditions (incl. ground).

EN ISO 13786

EN ISO 13786 defines a method of calculation of the dynamic thermal characteristics of a building component.

Background information, explanation and examples can be found in CEN ISO/TR 52019-2.

Options for national choices provided in "Annex A/Annex B" of the standard are related to

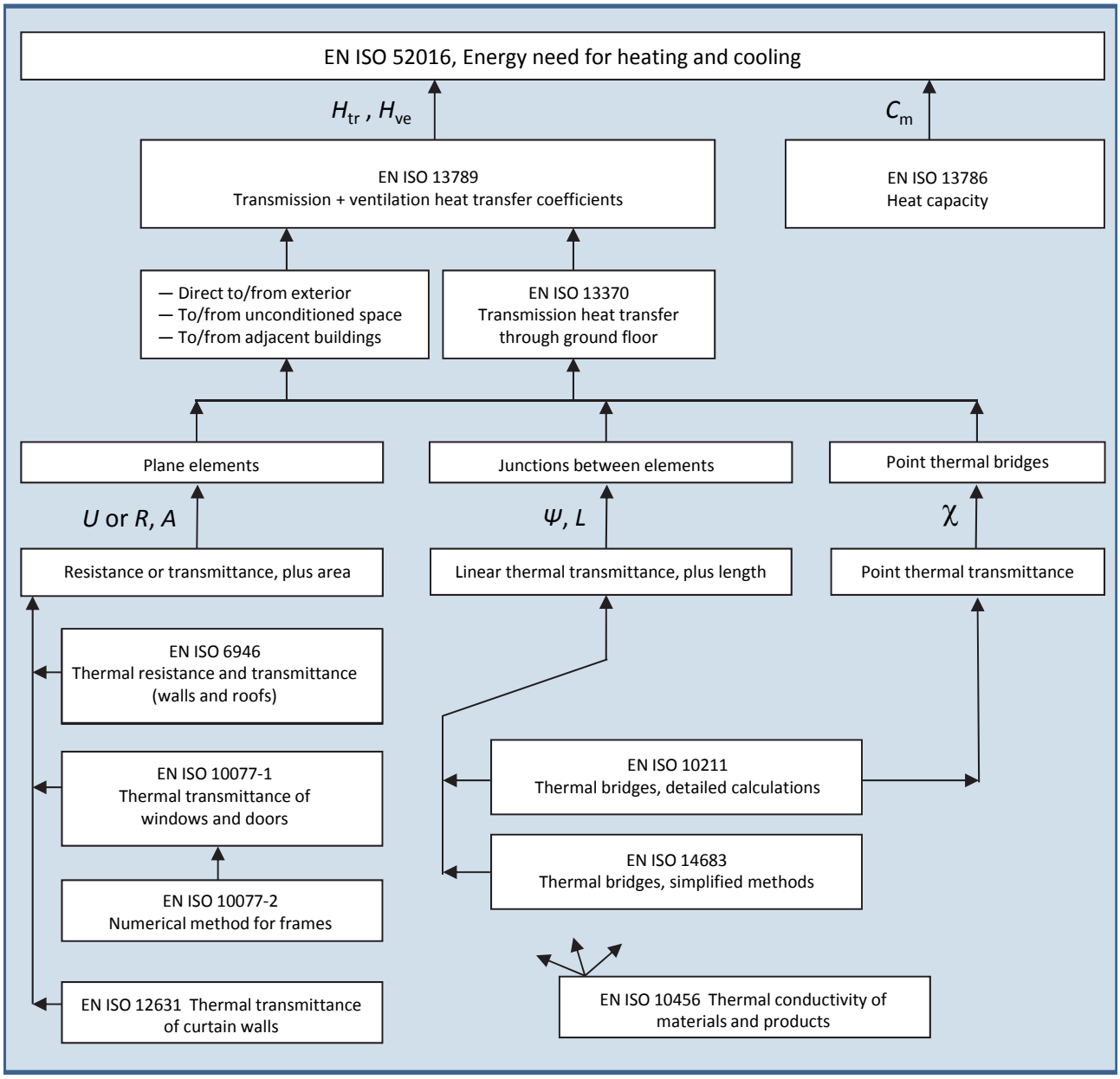


Figure 1. Linkage between the standards.

restrictions on the use of the simplified method given in the standard.

EN ISO 13789

EN ISO 13789 defines the calculation of the transmission heat transfer coefficient of a building, using the heat transmission properties of the building elements and thermal bridge used in its construction. A decision is needed on the system of dimensions to be used – internal, overall internal or external. Annex J of CEN ISO/TR 52019-2 illustrates the three systems and the effect of the systems on the linear thermal transmittance of junctions between elements. This annex is relevant also to EN ISO 10211 and EN ISO 14683.

For the ventilation heat, transfer coefficient the airflow rate through conditioned spaces is needed. Annex K of CEN ISO/TR 52019-2 provides a possible method, with associated data. However, for use within CEN, references are given to the CEN EPB standards under EPB module M5-5 (CEN/TC 156) that have been developed for this purpose.

Options for national choices provided in "Annex A/ Annex B" of the standard are related to the dimensioning system, choice of method for ventilation heat transfer and criteria for specific simplifications.

EN ISO 14683

EN ISO 14683 defines the methodology for determination of linear thermal transmittances and provides default values for when specific information is not available. CEN ISO/TR 52019-2 provides examples of the influence of thermal bridges on the transmission heat loss coefficient.

Options for national choices provided in "Annex A/ Annex B" of the standard are related to optional use of an e.g. national/regional thermal bridge catalogues and optional national/regional manual (simplified) calculation method.

Accompanying spreadsheets

In agreement with the rules for all EPB standards containing calculation procedures, spreadsheets were prepared during the preparation of the standards to demonstrate and validate the procedures. Spreadsheets are publicly available on (the draft versions of) EN ISO 6946, 13370 and 13789. Calculation examples are presented in the technical report CEN ISO/TR 52019-2.

No accompanying calculation spreadsheets were prepared on:

- EN ISO 10211: this standard does not provide a calculation procedure; it provides test cases and performance criteria for calculation procedures.
- EN ISO 13786: this standard provides complex matrix calculation procedures. Instead of a spreadsheet, Annex I of CEN ISO/TR 52019-2 contains examples of calculation results obtained by a computer program.
- EN ISO 14683: this standard does not provide a calculation procedure; it provides choices between procedures provided elsewhere and default tabulated values. Instead of a spreadsheet, Annex L of CEN ISO/TR 52019-2 contains examples of the use of default values.

Conclusion

The revisions (2013-2016) to make the suite of EN ISO standards on hygrothermal performance of building components and building elements fit into the set of EPB standards are mainly editorial. This resulted in a subset that is unambiguous and software proof, with rationalized choices (via the "Annex A/Annex B" approach) and with consistent interconnections, in particular with all the other standards in EPB module M2 subset of EPB standards. ■

References

[1] CEN ISO/TR 52019 2, Energy performance of buildings (EPB) — Building and Building Elements — Hygrothermal performance of building components and building elements — Part 2: Explanation and justification.

[2] EN ISO 6946, Building components and building elements — Thermal resistance and thermal transmittance — Calculation methods.

[3] EN ISO 10211, Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations.

[4] EN ISO 10456, Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values.

[5] EN ISO 13370, Thermal performance of buildings — Heat transfer via the ground — Calculation methods.

[6] EN ISO 13786, Thermal performance of building components – Dynamic thermal characteristics —Calculation methods.

[7] EN ISO 13789, Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method.

[8] EN ISO 14683, Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values.

[9] Dick van Dijk, Marleen Spiekman, Dirk Van Orshoven, Wim Plokker, Subset of EPB standards on the energy use and the thermal performance of buildings and building elements, The REHVA European HVAC Journal, issue: "Focus on EPB standards", Vol. 52, Issue 1, January 2015.