Conventions for U-value calculations

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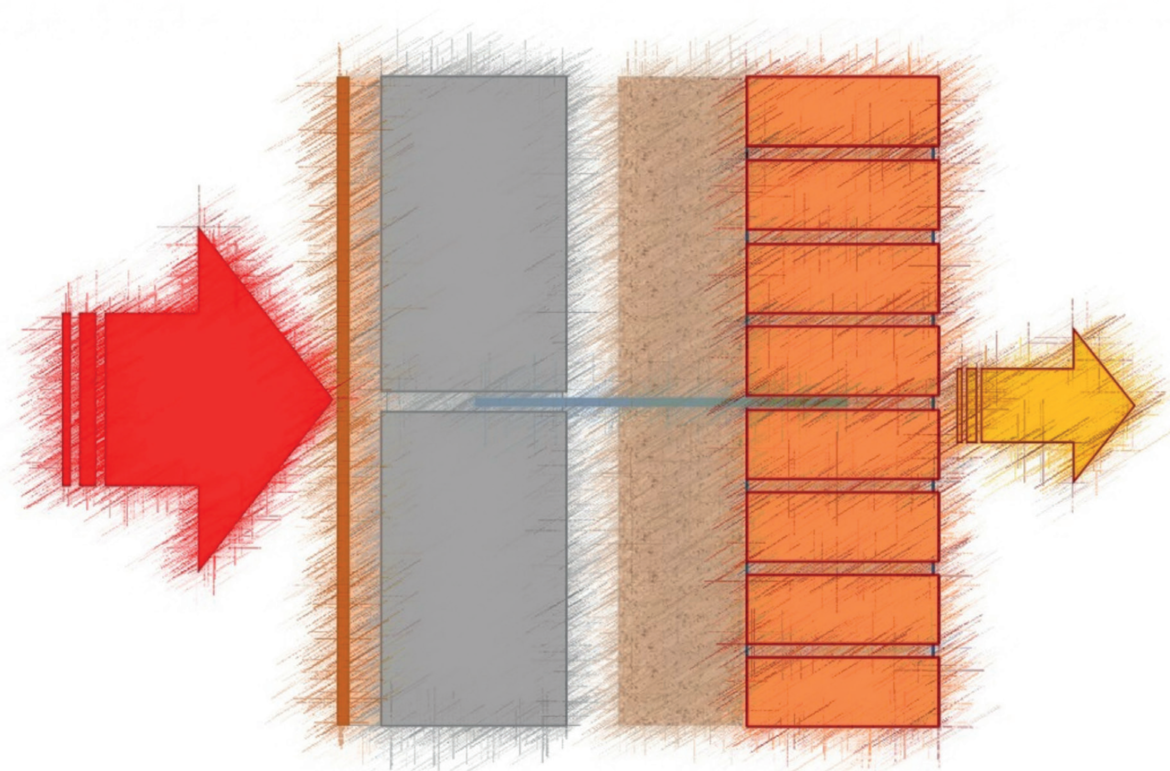

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In memory of Dr Brian Anderson

This document is published in memory of **Brian Anderson [1948–2016]**, the author of the 2002 and 2006 editions of this document.

Dr Brian Anderson was the lead author for the original BR 443 – Conventions for U-values, and the newly published revised version has been shaped by his initial input at the technical scoping stage prior to his unexpected passing in 2016.


BRE: 5166977

Brian's contribution to the industry was huge, and with his expertise he guided, informed, and enabled both government and generations of engineers, architects, builders, teachers, and students to understand and construct better performing homes. He led the development and maintenance of BREDEM, and later SAP (the methodology by which we assess the compliance of domestic dwellings against the Energy Performance of Buildings Directive) and authored a range of more than 30 technical publications and papers to support this.

He also played a leading role in the preparation of European standards for thermal insulation and thermal performance, including chairing the committees for British Standards Institution (BSI) that co-ordinates the UK input to the European Committee for Standardisation's (CEN) 'Thermal performance of buildings and building components', and playing a strategic role within CEN to ensure consistency and compatibility of various standards. The sum of Brian's work has had a profound, lasting, and positive impact on us all – enabling the United Kingdom to measure and reduce household fuel use and provide a mechanism for reducing the nation's carbon emissions and addressing fuel poverty.

Brian was recognised and held in the highest esteem by those who knew him or of his work. He was admired and respected by colleagues and clients alike, based on his deep knowledge and experience, positive attitude, and polite manner. He was a quiet and unassuming gentleman who had a passion for his work. His passing has been an enormous loss to both BRE and the industry, and BRE is proud to publish the revised BR 443 in honour of his great contribution to the built environment.

Contents

1 Introduction

1.1 General

This BRE report, BR 443 (2019), is an update to the 2006 edition, primarily reflecting changes in British, European, and international standards.

Calculation methods for the determination of heat transfer through building elements between internal and external environments are based on standards that were developed in the CEN and the International Organization for Standardization (ISO) and published as British Standards.

Since publication of the previous edition of this document, European standards specifying calculation methods for thermal properties have been amended, replacing the previous British standards BS EN ISO 6946, BS EN ISO 10211, BS EN ISO 10456, BS EN ISO13370, and BS EN ISO 13789, in addition to many other standards.

Earlier versions of this publication included references to the standards that were applicable at the time of publication. This document uses references to BS EN ISO standards published from 2017 onwards.

For constructions that cannot be handled by the basic calculation methods, the U-value can be calculated by numerical analysis or measured by a hot box method. This document gives guidance on the appropriate standards used for establishing measured values of thermal transmittance (U-value) and the appropriate standards used for establishing the thermal resistance (R-value) of a construction layer by numerical calculation. See section 2.

The guidance in this document is concerned with the calculated U-values of new building elements, including walls, roofs, floors, windows, and doors.

Guidance is given on

- Thermal conductivity of materials (section 3)
- Various issues that commonly arise when undertaking U-value calculations (section 4)
- Various types of construction element, identifying which of the issues mentioned in section 4 apply to which construction type (sections 7 to 14)

The document does not reproduce the details of the calculation methods, for which the reader is referred to the relevant British Standards and other sources (see *References and further reading*).

In existing buildings, the calculation of the thermal resistance (R-value) or thermal transmittance (U-value) can be difficult for the following reasons:

- Materials traditionally used in buildings may not be homogeneous and their thermal conductivity values may not be available
- Establishing the exact composition and dimensions of layers of materials requires destructive methods, which will not always be possible

Generic U-values for various elements of existing domestic buildings can be obtained from SAP (the Standard Assessment Procedure for energy rating of dwellings); see also section 15 of this document.