Second edition

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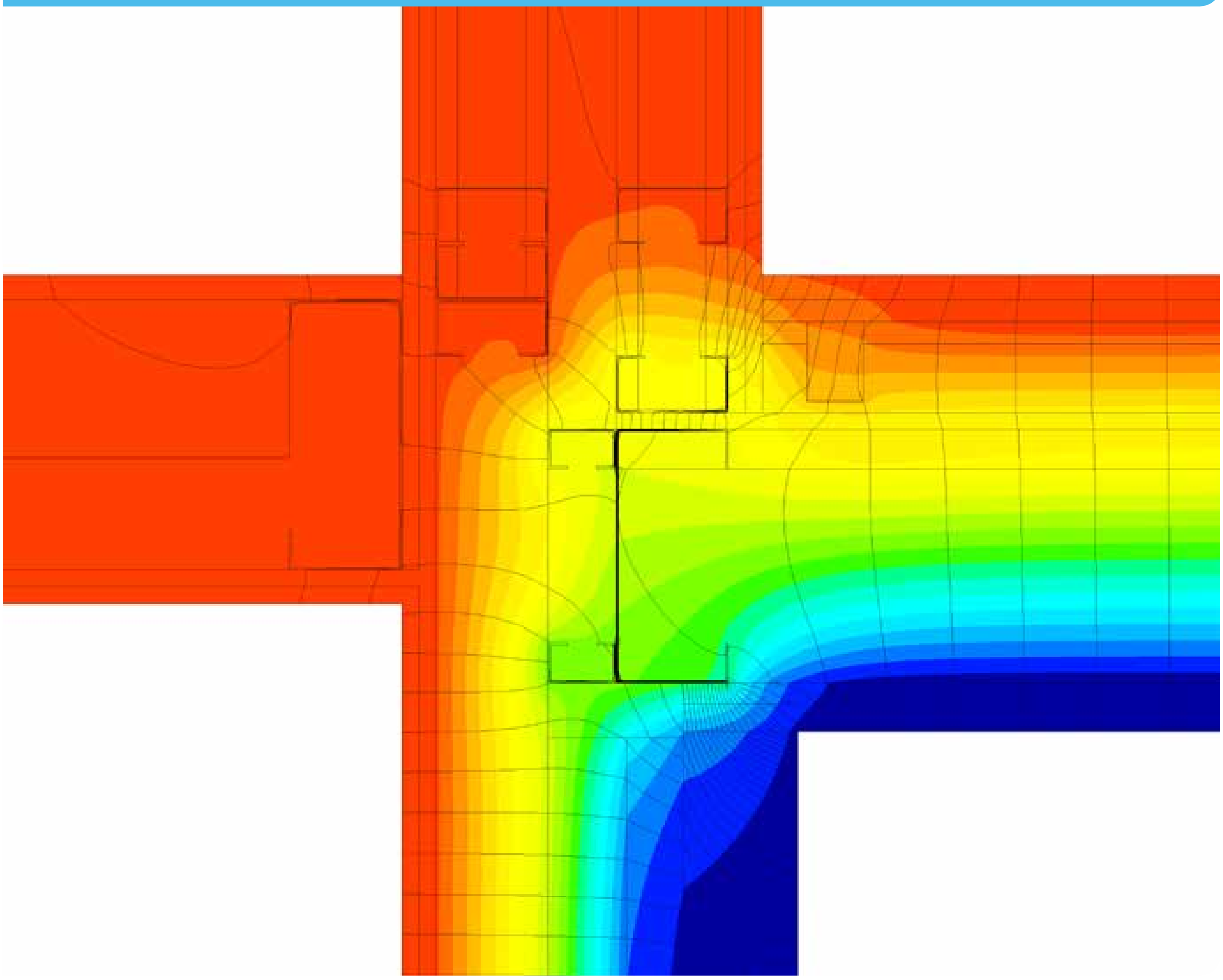
Tim Ward, Graeme Hannah and Chris Sanders



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The research and writing for this publication has been funded by BRE Trust, the largest UK charity dedicated specifically to research and education in the built environment. BRE Trust uses the profits made by its trading companies to fund new research and education programmes that advance knowledge, innovation and communication for public benefit.

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Tel: +44 (0) 1344 328038
Fax: +44 (0) 1344 328005
Email: brepress@ihs.com

Printed using FSC or PEFC material from sustainable forests.

BR 497
First published 2007
Second edition 2016
ISBN 978-1-84806-440-9

The first edition of this report was produced as part of the research programme of the Sustainable Buildings Division of the Department for Communities and Local Government. This revision was produced as part of the research programme of the BRE Trust.

Any updates to the guidance given in this publication will be posted at www.bre.co.uk/br497updates

Contents

Cont'd . . .

4 Junction types *(cont'd)*

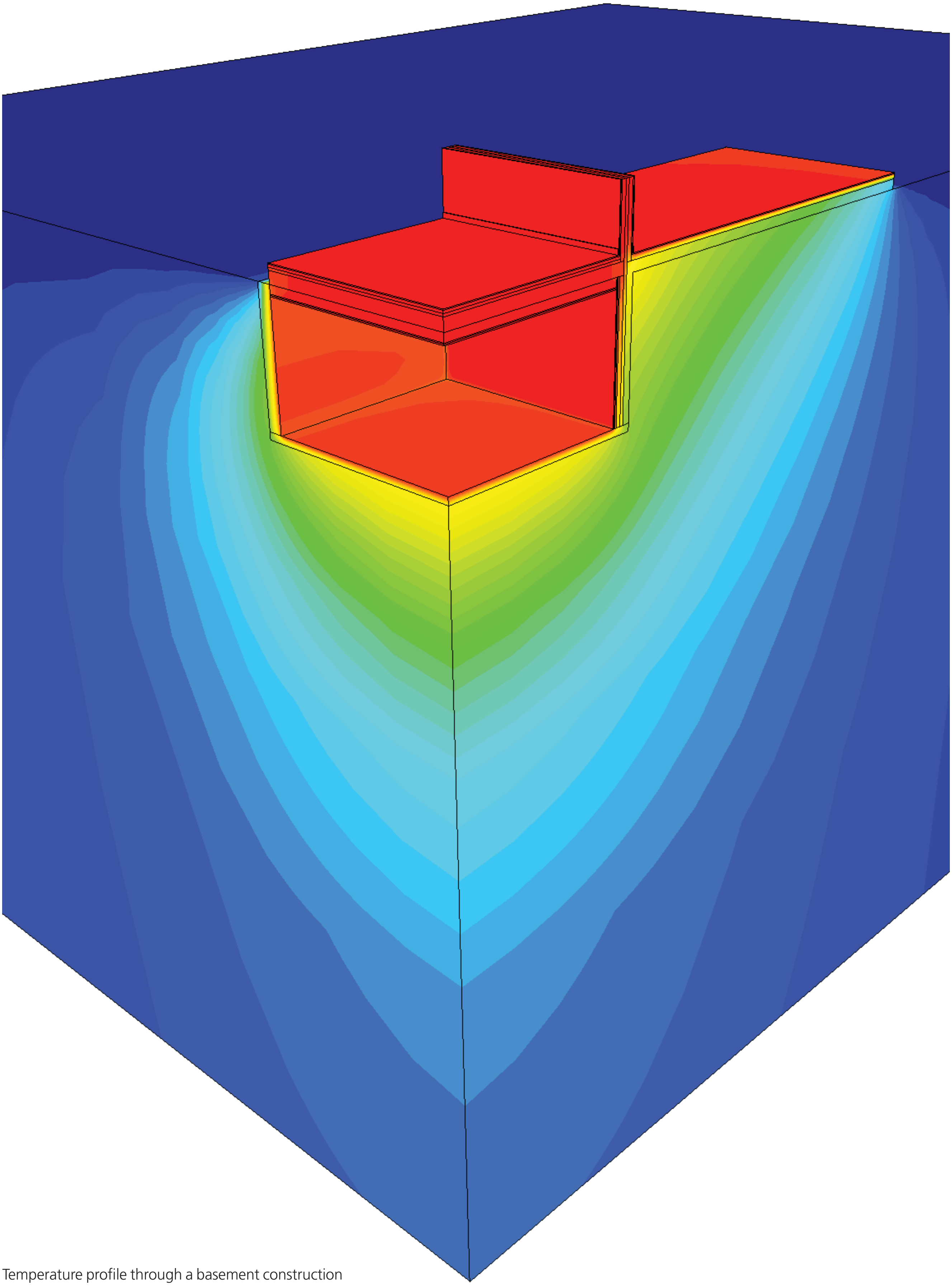
Abbreviations and notation

Abbreviations

dpc	damp proof course
dpm	damp proof membrane
low-e	low emissivity
P/A	perimeter divided by area ratio
1D	one dimension/one-dimensional
2D	two dimensions/two-dimensional
3D	three dimensions/three-dimensional

Notation

A	area
b	width
β	angle of slope
χ	point thermal transmittance
d	thickness
e	external environment
f	temperature factor
h	height
h_{se}	heat transfer coefficient of external surface
h_{si}	heat transfer coefficient of inside surface
H	heat transfer factor
i	internal environment
L	thermal coupling coefficient
ℓ	length in metres over which U applies
n	number of units
Q	total heat flow
R_{se}	thermal resistance of external surface
R_{si}	thermal resistance of inside surface
T	temperature
U	U-value
w	width
Ψ	linear thermal transmittance



Temperature profile through a basement construction and the adjacent ground

1 Introduction

Global warming, with the need to limit CO_2 emissions into the atmosphere, is the principal driver for conserving fuel and power in buildings. Confirmation that this is very much part of the UK Government's agenda is found in the successive changes to Part L of the Building Regulations in England[1] and Wales[2], with similar changes to the equivalent sections in Scotland[3] and Northern Ireland[4].

The introduction of more highly insulated buildings, that has resulted from the need to save energy, has also led to the need for more sophisticated methods for calculating heat loss and surface temperatures than were previously felt to be adequate. Two changes are particularly important:

- While U-values of the building fabric could previously be calculated by assuming that an element was made up of a series of parallel layers, each with uniform thermal resistance, it is now recognised that features such as mortar joints, timber studs or the metal spacers in built-up roofs cause thermal bridging of the insulation layer(s) and so contribute significantly to the heat loss. A more detailed calculation method for U-values, as defined in BS EN ISO 6946:2007[5], has been introduced to take account of these repeating thermal bridges.
- It has also been recognised that thermal bridging at the junctions between the various plane building elements (walls, roofs and floors) of a building and those around openings in walls and roofs can add significantly to the fabric heat loss. The higher heat flows that occur, because of complex geometries or the use of materials with a high thermal conductivity, also cause localised reduction in the internal surface temperatures, which in turn can lead to surface condensation and mould problems.

Although various simplified calculation methods have been developed to take account of the effects of thermal bridging in certain situations, two- or three- dimensional heat flow calculations continue to be required for *some* U-value and for *most* (non-repeating) thermal bridge calculations. These calculations of two- or three-dimensional heat flow require the use of numerical modelling software. Several packages are available but, whereas most software packages themselves are validated as being able to produce correct and consistent results, many important decisions are left to the user regarding the input to the modelling software and the determination of certain quantities from the output of the software, both of which can have a significant effect on the results.

This BRE guide (BR 497) gives the information needed to carry out these calculations so that different users of the same software package and users of different software packages can obtain consistent results. However, *before using the conventions* given in BR 497 it is important for the numerical modeller to demonstrate that the numerical modelling software used can model the validation examples in BS EN ISO 10211:2007[6] with results that agree with the stated values of temperature and heat flow within the tolerance indicated in the standard for each appropriate validation example.

BR 497 has been prepared to complement the outline methodology for the treatment of thermal bridges given in BRE Information Paper IP 1/06[7]. It can be used by assessors who wish to undertake numerical modelling calculations to determine the thermal performance of junctions. It is referenced in the relevant government policy documents operating in England, Scotland, Wales, Northern Ireland and the Republic of Ireland.