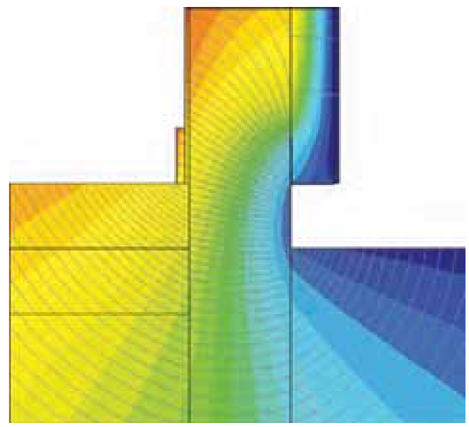
Reducing thermal bridging at junctions when designing and installing solid wall insulation

Caroline Weeks, Tim Ward and Colin King



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Cover photographs:
Typical external wall insulation being applied (left)
Thermal bridging modelling image of an external wall/ground floor junction (top right)
Thermal image of a dwelling (bottom right; courtesy of Joanne Hopper)

Contents

Executive summary

With the advent of the Green Deal, Energy Company Obligation (ECO) and other financial incentives to improve the UK's existing building stock, there has never been a more relevant time to push the construction industry towards better performance. Current practice during refurbishment does little or nothing to minimise the effects of thermal bridging or inconsistency in thermal envelope performance. This guide sets out clear principles and methods that should be considered and adopted during the design and installation of solid wall insulation in order to reduce thermal bridging effects, maximise carbon dioxide (CO_2) emission reductions and minimise the risk of condensation.

The effect of installing external and internal wall insulation in typical solid wall homes has been modelled for junctions with windows, eaves, floors and party walls. Potential problems are considered, taking examples from recent refurbishment projects in which BRE has been involved. This BRE Trust Report will be a useful resource for public and private clients looking to improve the performance of their properties and for architects/designers, specifiers and installers.

1 Introduction

Improving the energy efficiency of the existing building stock is one of the biggest challenges facing the UK. In particular, traditional solid wall houses are more difficult and more costly to improve than more modern, cavity wall constructions. Initiatives such as the Green Deal should serve to finally encourage such refurbishment. However, current industry practice does little or nothing to minimise the effects of thermal bridging or inconsistency in thermal envelope performance when installing insulation in solid wall dwellings. Making the effort to minimise thermal bridges is considered likely to add more time and expense to what is already regarded as a costly improvement measure.

This BRE Trust Report seeks to highlight the importance of appropriate detailing for both externally and internally applied solid wall insulation and demonstrates its effect on heat flow and potential condensation risk at key junctions.

3 Detailing of external wall insulation

3.1 Window jamb

For the window jamb junction in the 'uninsulated' base case, it is assumed that the window frame is situated in the centre of the wall cross-section, with external render and internal plaster returned to the window frame (Figure 2a). In the case where the wall is externally insulated, it is assumed that the insulation will run flush to the edge of the jamb and the render finish will again be returned to the window (Figure 2c).

To improve this junction, it is recommended that a fillet of insulation is applied within the window reveal prior to rendering (Figure 2d). In this 'improved' case, a 20 mm thickness of insulation with a thermal conductivity of 0.02 W/mK (such as phenolic foam) is assumed, since typically there will be a 30–40 mm space between the existing wall and any opening casement windows that may be present. In reality, the thickness of the applied insulation has to be tailored to the available space within the reveal, and a lack of such space is often quoted as the reason why improved detailing cannot be practically achieved.

Such restrictions are lessened if new windows are installed at the same time as the external insulation is applied. In such circumstances it is then possible to design appropriate window frame arrangements to allow the desired insulation detail to be included. There may also be scope to insulate across the entire cross-section of the wall at the reveal, but this is not explored in this study. This issue regarding replacement windows applies also to the window head and window sill junctions that follow.

The application of the external insulation to the wall significantly reduces the U-value of the wall, hence reducing the overall heat loss. However, the concentration of different-coloured bands around the location of the window frame in Figure 2c indicates the rapid temperature drop across this particular location. The ψ-value of Figure 2c is significantly higher than the base-case ψ-value in Figure 2b, the reason being that although the heat loss through the wall itself has been reduced, there is more lateral heat loss flowing towards the junction.

It is interesting to note that, despite this concentration of heat flow at the junction, the temperature factor at the coldest internal point of the junction (where the plaster meets the window frame) has in fact improved from the base case and does not drop below the critical value of 0.75.

Figure 2d includes additional insulation returned into the reveal. Here the ψ-value has returned (ie reduced) to a more acceptable value and the temperature factor has risen again, hence further reducing the risk of condensation or mould growth at the junction.

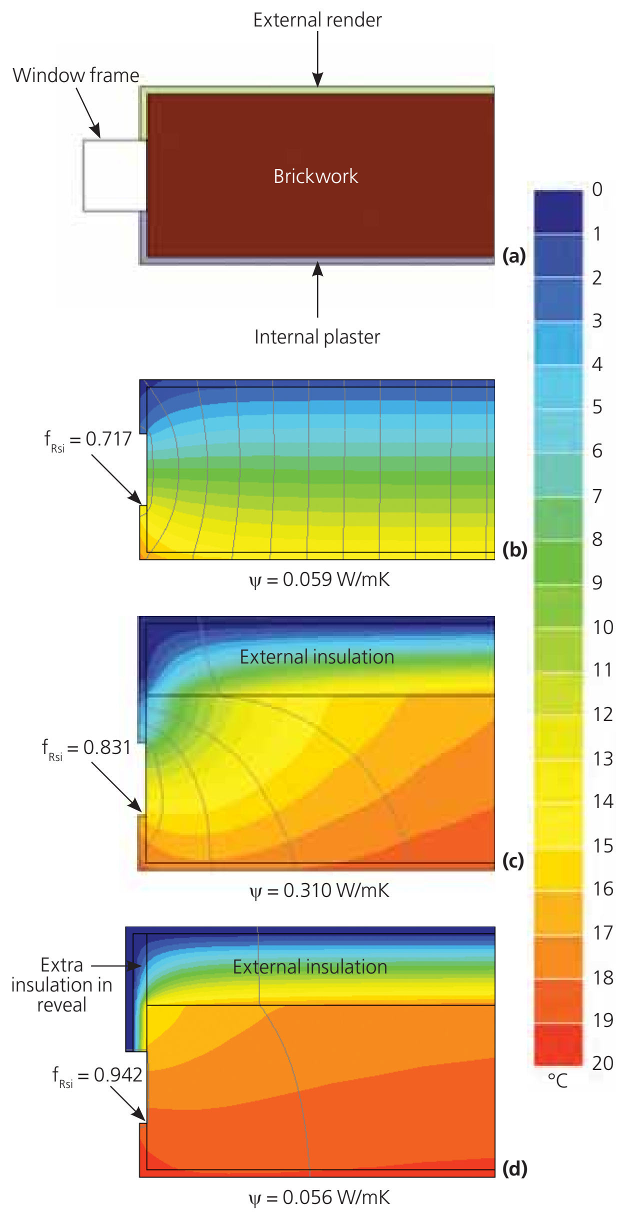

Figure 2: Junction detail for window jamb
a: 'Uninsulated' detail
b: 'Uninsulated' modelling results
c: 'Typical' external insulation
d: 'Improved' external insulation

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