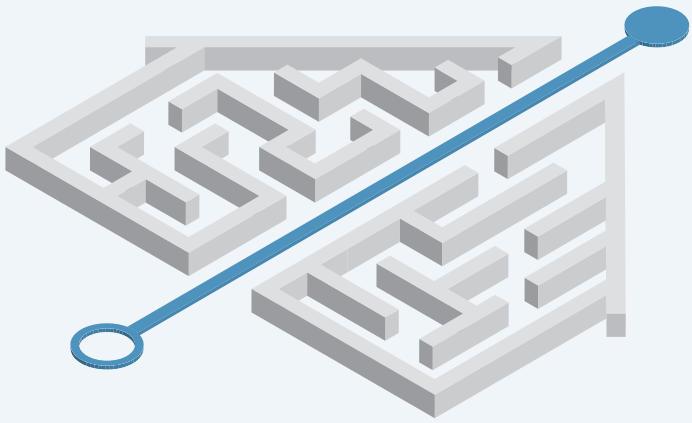

CLOSING THE GAP BETWEEN

DESIGN & AS-BUILT PERFORMANCE

END OF TERM REPORT

July 2014

APPENDIX E

ZERO CARBON HUB

The Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering zero carbon homes in England from 2016. The Hub reports directly to the 2016 Taskforce.

To find out more, or if you would like to contribute to the work of the Zero Carbon Hub, please contact: info@zerocarbonhub.org.

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This document contains Appendix E to the End of Term Report, which is available from www.zerocarbonhub.org

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APPENDIX E: CONSTRUCTION JOINT DETAILS WORK GROUP PROPOSALS

This appendix was produced by a Work Group dedicated to tackling Performance Gap issues relating to construction joint details.

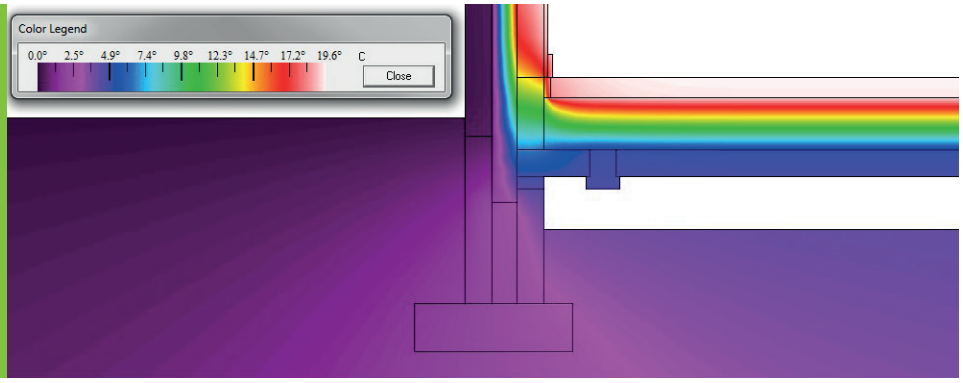
It should be noted that only relatively minor amendments and edits have been made to the recommendations provided by the Work Group. Many of these have been included in the main report[1] with additional Work Group recommendations included here.

Note also that since the Work Group concluded their scope of works, a more detailed and costed proposal to deliver elements of these recommendations is being developed by the Zero Carbon Hub. That proposal will aim to take forward one of the main recommendations in the End of Term Report: to develop an industry-owned and maintained Construction Details Scheme, providing 'assured' as-built performance values for the most common major fabric junctions and systems. Importantly, that proposal will cover the detail of construction elements (walls, floors, roofs, and so on) in addition to construction joints, whereas this appendix covers only the latter.

1. See in particular pages 31-32 and 37-40 of the End of Term Report. To download the report please visit: www.zerocarbonhub.org/full-lib

Introduction

In the context of thermal performance, construction joints refer to junctions between building elements – such as between a wall and a window or between the floor and the wall – where there is a lack of continuity or change in the insulation. At these points SAP (the Standard Assessment Procedure used to assess a home's energy and carbon performance) requires that an allowance is made for energy loss at such junctions by summing up the length of the junction and the energy loss associated with that specific junction, expressed by its Psi-value, as described in Appendix K of the SAP document.



Isotherm construction detail of a suspended beam and block floor with a partially filled cavity wall; there is a thermal bridge through the internal blockwork between the wall and the floor (image courtesy of British Board of Agrément).

The importance of good detailing at these junctions is becoming more important as Fabric Energy Efficiency targets are tightened. Poor detailing will require other areas of the building specification to be increased in order to achieve the required overall performance; for example higher thermal performance building elements (e.g. walls, floors, roofs), which will have cost implications.

Psi-values are derived from the thermal modelling of the junction concerned – a process carried out using specialist software – following guidance laid out in the BRE report 'BR497 Conventions for Calculating Linear Thermal Transmittance and Temperature Factors' (commonly referred to as 'BR497'). The value can be influenced by changes in the position of building components (e.g. the amount of window frame bearing on an external brick wall) and by the U-value of surrounding building elements.

In Building Regulation terms, Part L1A 2013 (section 3.9) requires that buildings are constructed so that there are "no reasonably avoidable thermal bridges" at such junctions. It also provides guidance on acceptable sources of Psi-values for inclusion in SAP calculations, these being:

1. To use construction joint details and their attendant Psi-values included in DCLG Approved Construction Details or those formally recognised by DCLG. At the time of writing, no up-to-date Approved Construction Details exist.
2. To use details and Psi-values modelled by a person with suitable expertise and experience, who can demonstrate competence in using the software and in correctly interpreting BR497 guidance.
3. To use in the absence of modelled details the default Psi-values included in SAP Appendix K.
4. To avoid calculating the energy loss from individual junctions completely by using a conservative energy loss value for the dwelling (a y-value of 0.15) in the SAP calculation.

Summary of Findings

The cross-industry Work Group, set up to advise on construction joint issues as part of the Performance Gap project, has concluded the following:

- With the exception of a limited number of technical staff, there is generally a poor level of understanding across the design / build process of: Psi-values, the importance of good detailing practice and the implications of what may seem minor variations from such designs.
- Whilst the predecessors to Approved Construction Details (the DCLG Accredited Construction Details) are used in SAP calculations, they are often used for mathematical purposes only in achieving SAP 'as designed compliance'. Follow-through to ensure that the details are actually used on site is often poor, as is feedback from site to energy assessors when design changes are made on site. These details are also now out of date, in part due to the U-value of surrounding elements used when the calculations were carried out, with some details also considered impractical to build on site.
- Larger developers tend to follow route 2 (i.e. Psi-values modelled by a suitably qualified individual) in modelling what they consider to be buildable on site. However a number of issues exist:
  - Modellers can arrive at different Psi-values dependant on their interpretation of modelling protocols in BR497. This document needs updating to provide modellers with greater clarity and updated guidance.
  - A potential conflict exists between using junctions which have low modelled Psi-values and those which are truly robust; i.e. have been checked against likely site build issues such as tolerances and product substitution. The use of more conservative Psi-values in SAP calculations will result in cost increases from other mitigating measures (e.g. the use of lower building element U-values).
- The number of junctions recognised in SAP Appendix K is often less than the actual number of 'energy losing' junctions in a dwelling, particularly with more complex designs. When this occurs, an allowance for such junctions may not be included in the SAP calculation work and the resulting designed energy performance will be over-optimistic. There is also concern that some of the default Psi-values may be over-optimistic and that using Psi-values from a number of different sources (i.e. some modelled, some ACDs, some defaults), whilst leading to SAP 'as-designed' compliance, may not be taking into account buildability issues on site.
- It is apparent that many of the junctions have only a limited impact on energy loss and thus modelling and 'SAP calculating' every possible junction could add costs for very little energy efficiency gain.
- Small to medium sized builders currently have little guidance on how to deal with junctions. The subject will be covered in the new NHBC Foundation 'Part L 2013: Where to Start' guide currently under development, although this will only cover a limited number of core details. A range of new 'best practice' Approved Construction Details as envisaged in Part L1A is now badly needed.

- A combination of the following factors can result in divergence between the energy loss through junctions calculated at the design stage and that actually achieved during the build:
  - A limited knowledge of the implications of minor changes to details;
  - The practical difficulties of building some details that can look good on paper;
  - A lack of awareness by the building tradesmen of the junction detail concerned; and
  - A lack of feedback to energy assessors when junction designs have changed.
- Modellers lack a well recognised means of demonstrating their competence and a focal point for discussing and resolving technical issues as they emerge. The currently accepted position seems to be that they should receive training in the use of software and successfully model test examples. However this alone does not guarantee consistency of approach when judging often subjective matters like buildability. The competency scheme model used by thermal modellers supporting the British Fenestration Rating Council scheme for windows has a good record in striking a balance between technical rigour and cost – a similar approach for junction modellers is worthy of consideration.
- There is interest amongst users of details (e.g. architects and energy assessors) in the concept of pattern books and databases of proven details, particularly where these complement detailing already being provided by manufacturers. The DataHolz database developed for this purpose in Austria has been studied both in technical and financial terms. This online database (www.dataholz.com) of thermal and other details is operated as a voluntary scheme on a not-for-profit basis and the details held on it have a 'deemed to satisfy' status with the Austrian building control authorities. In particular it is worth noting the financial model by which the commercial risks to the scheme provider were minimised through up-front grant funding for the development costs. This has allowed the scheme to operate at modest on-going charges which in turn has encouraged uptake. It is also worth noting that the DataHolz database includes detailing far beyond the fairly narrow confines of construction joints. However, given the UK industry's current understanding of thermal detailing, it is considered premature to invest in I.T. solutions before developing greater cross-industry understanding and competence, to achieve a consistency of approach in the market.

Recommendations and Actions

The Construction Joint Details Work Group considered the issues and problems with the current situation and proposed the following five point action plan:

1. The accuracy, consistency and robustness of modelled junctions and Psi-values be improved by:

   A. The updating of existing modelling protocols, namely BR497. It is understood that this work is underway at BRE, supported financially by the BRE Trust. Note that support from industry is crucial to the robustness and success of these updates.

   B. The development of a competency scheme for modellers to provide both a forum for modellers and a vehicle for agreeing guidance on robustness. It is recommended that the development costs of such a scheme (estimated at around £30,000) be funded via some form of government grant so as to allow the scheme provider to set on-going running costs at a commercially attractive rate for potential scheme members.

   C. Improving the wording in Part L to clarify routes to demonstrate competence and thus encourage scheme membership.

2. Initial 'pump-prime funding' be provided to develop a set of up-to-date construction details, as envisaged in Part L1A, aimed at providing a set of best practice details covering the major junctions, systems and building elements (i.e. 80% of energy loss) on masonry, timber and concrete frame construction. These details should take account of the robustness protocols developed in 1b, providing they can be developed within the appropriate timeframe. This should be an industry owned and maintained scheme, with the details listed on a publicly available database, providing technical drawings, additional guidance and other material.

3. Developers and manufacturers should continue to collaborate in reviewing best practice and publishing new details in the period up to and beyond 2020, so that advances in detailing are made available to the largest possible audience.

4. Organisations such as Construction Skills and RIBA should be engaged with in the process of improving knowledge and understanding of construction joint detailing through, for example, inclusion in site work training courses and Continuing Professional Development.

5. The issues of demonstrating the successful build of specified details and improving the flow of relevant information from design to build stage, and where needed back again, is included in the wider topic of verification and testing dealt with elsewhere in the main report. The concept of using databases of proven details should also be considered in the future as part of the wider topic of the increased use of I.T. and B.I.M.

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