June 2016

Cost Comparison
Calculated -vs- Default Psi Values

How to save up to £60/m² on Build Cost using Calculated Thermal Bridging Values

The Challenge

With the ever increasing demands to reduce energy use and carbon emissions in the operation of the building, it has become necessary to design buildings already capable of meeting these needs. National regulations are constantly being revised to limit heat through the fabric of the building and Building Regulations impose whole building targets and maximum U-values for elements of the construction which are applied as a way to limit the losses.

However, as the U-values in the main fabric of the building are lowered, the influence of linear thermal bridging (linear thermal transmittance, Ψ value) at junctions of the construction increases and becomes significant in the overall heat lost through the building envelope. Thermal bridges exist where any wall breaks the continuity of external fabric insulation (for example at junctions with external walls, floors and roof) or where, due to the geometry of the junction, the actual heat loss is greater than that given by considering the U-values of the flanking elements alone. Additional heat losses associated with these thermal bridges are required to be accounted for in 'Standard Assessment Procedure' (SAP) calculations.

Changes to the way heat losses along the length of junctions of constructions (linear thermal bridges) are calculated in Part L has had a significant impact on the specification for external walls, with aircrete benefiting from its inherent low thermal conductivity. The issue of linear thermal bridging is hugely significant. As U-values get even tighter, calculated heat loss from junctions can now account for as much as 50% of the heat lost through the fabric.

The Ψ value is a property of the thermal bridge junction and is the rate of heat flow per unit length of the thermal bridge.

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The Choices Currently

Approved Document L gives 4 choices of what to use for thermal bridges:

1) Table K1 of SAP gives values of Ψ applicable to different types of junctions when built in accordance with a set of construction details known as the Approved Construction Details (ACDs).

These details can be found on the Government's Planning Portal website at www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/bcassociateddocuments9/acd and cover most common forms of construction, but in a very generic format. For example, for a typical cavity wall construction, the detail permits any type of thermal insulation in the cavity and is applicable to all types of masonry unit used on the inner skin of external wall. As a result, the values in the Table K1 of SAP tend to be conservative values.

2) Use calculated bespoke values. There are a number of websites available which provide an extensive range of psi values for a complete set of junctions using aircrete.

The Constructive Details Limited website (www.constructivedetails.co.uk) has three general construction types and produce a handbook for each, being:

- Cavity wall construction with a cavity fully filled with thermal insulation and an inner leaf of aircrete masonry
- Cavity wall construction with a cavity partially filled with thermal insulation and an inner leaf of aircrete masonry
- Solid aircrete wall with external insulation boards.

The LABC website (www.labc.co.uk/registration-schemes/construction-details) provides a set of registered construction details that are built around the conventions for energy assessment. If the designer is looking for a particular junction type he can use the search function on the website to locate the detail.

The details from both the CDL and LABC have one thing in common; they have checklists and indications of what the critical points are to enable a construction to be checked on site and verified by an independent inspector and Building Control.

In the majority of cases, the psi values calculated and shown on both the CDL and LABC websites will be much improved from those obtained from the Planning Portal website. Typical Improvements re shown in Fig 1.

3) Use SAP Appendix K, Default values - this is an expensive solution. The values tend to be twice those given in 1 above, but there is no control over the junction detail. Hence, they tend to be very safe but very conservative values.

4) Use conservative default 'y-value' of 0.15 and ignore junction lengths. This will result in a very expensive solution, as demonstrated verleaf in Table 1.

Fig 1
Party Wall - Ground Floor Junction

Ψ - values (W/mK)
SAP 2012 Approved value - 0.080

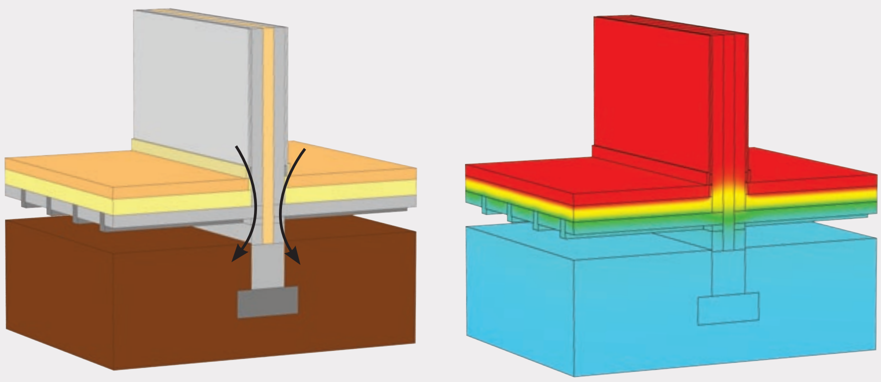
Constructive Details calculated values

H+H Party Wall

Standard grade	0.043
High Strength grade	0.049

39%-46% Improvement*

* Celcon Floor Blocks
or Celcon Foundation Blocks



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Cost Exercise

Calfordseadon were commissioned to carry out a cost exercise to demonstrate the financial benefit of using calculated psi-values as opposed to the default psi-values. The case study was calculated to reflect a development of 20 houses in the South East of England at 2015 price levels. The figures were then represented as costs per dwelling and costs per square metre to enable comparison. In each case, the constructions used achieved compliance with Part L for both the Fabric Energy Efficiency Standard and the Target Emission Rating.

Case 1- Calculated psi values based on LABC construction details

This case considers a brick faced, partially filled cavity wall with 50mm of PIR (Celotex) insulation and a 100mm Celcon aircrete inner leaf block. Roof insulation consists of 400mm mineral wool. The floor is of beam and block construction with 150mm insulation PIR underneath the screed. Windows are double glazed.

Case 2 - Thermal bridging is ignored (default y= 0.15).

When using the default y value of 0.15, to achieve compliance with Part L, the fabric of the homes has to be improved considerably and renewable energy has to be employed. This case is of the same construction type as Case 1 but with the partial fill insulation increased to 150mm PIR (with foundations adjusted to suit). It also requires 0.55 kWp photovoltaics to the roof, increased floor insulation of 175mm PIR and the windows to be changed to triple glazing.

The following table compares the findings for Cases 1 and 2:

Table 1

Case	Total Price	Cost per Unit	Cost per m^2	Pecentage from Case 1	Extra over cost per unit	Extra over cost
Case 1	£1,465,250	£73,260	£807	0%	0	0
Case 2	£1,574,600	£78,730	£867	7.46%	£5,470	£60/m^2

Conclusion

If default values rather than calculated psi values are used there is a significant increase in build cost. The design cost, is however, fairly negligible. SAP assessors and designers need to be made aware of where to obtain the information which will allow simple construction solutions to be designed and specified.

To put things into perspective, the cost savings will be lower than the actual cost of block material and laying costs for the blockwork.

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