Thermal Bridging & Y-Value Calculator

Easy Reference Guide

www.xtratherm.com/y-calculator
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1. What is Y-value Calculator?

The Xtratherm Y-Calculator tool is an easy to use calculator to determine the thermal bridging heat loss from non repeating thermal bridges that must be accounted for in SAP 2009 and SAP 2012.

Xtratherm Y-Calculator tool enables designers and architects to take full advantage of good detailing based on the Accredited Details for Construction (ACDs). The ACDs have been used as the basis for SAP input for a number of years. This tool illustrates the value of using the table K1 accredited PSI values or enhanced PSI values achieved with the same detail using Xtratherm insulation.

The Y-value result is given for 3 options allowed for in SAP.
Y-Calculator User Guide

2. What you’ll need...

Your Y-value is calculated using the length (m) of each thermal bridge you have in a design, and the total heatloss area of the building (this does not include the party wall). These figures will be readable from your existing SAP calculations, or if you are completing SAP the figures are taken directly from the design. (Contact Xtratherm Technical support to talk about our take-off spreadsheet - make life a lot easier for energy assessors!)

2.1 Get Started!

This app has been designed to help you take full advantage of good detailing on site when using SAP. Xtratherm enhanced detailing delivers energy performance.

2.2 SAP Choice

Choose the SAP version you are working to. SAP 2012 includes 19 additional junctions that should be accounted for.
2.3 Insulation Choice

**FLOORS**
Using either Xtratherm partial fill XT/CWP or built-in full fill CavityTherm can deliver U-values to meet full FEES in a max 150mm cavity. PSI values are calculated within a U-value range of between 0.22 and 0.14W/m²K. For specific calculation contact Xtratherm Technical Support.

**WALLS**
T&G Xtratherm Hyfloor is available in 3 thicknesses, PSI values are calculated within a U-value range of between 0.17 and 0.11W/m²K. For specific calculation contact Xtratherm Technical Support.

**ROOM IN ROOF (SAP 2012 ONLY)**
The additional thermal bridges added to the 2012 version of SAP will have greatest impact on room-in-roof designs. The added junctions at stud walls within such roofs will have a significant impact on the resultant overall Y-value. Xtratherm recommend the use of T&G Sarking insulation over the rafters to eliminate the new junctions and provide a single insulated plain that makes installation easier to install airtightness treatments easier to install.

2.4 Total Envelope Area

Input the Total Heat loss area taken from your SAP calculation. Areas of external walls, floors roofs and openings.
2.5 Block Choice

Which type of block are you intending to use? Typically lambda values are assumed as Aerated 0.15W/m²K, medium 0.52W/m²K and dense 1.15W/m²K. Variations in conductivity around the figure make little difference to the result.

Northern Ireland Details - specific details to N. Ireland building norms (Windows are generally set further back) are used in the calculations, using dense block only. Specific details and certifications will be sent to you when you chose this option.

2.6 Area Choice

Add a length (m) against your chosen junction identifies the accredited detail you will use on site and the Xtratherm certificates that you will receive by email to verify the PSI value for Building Control.

Areas will highlight once junctions within them are completed.

The 'Calculate' button will only activate after you have entered all junction lengths.

2.7 Junction Details

Add a length (m) against your chosen junction identifies the accredited detail you will use on site and the Xtratherm certificates that you will receive by email to verify the PSI value for Building Control.

Jump to Next Section
2.8 Results

You will receive 3 options available in SAP:

1. Default - (where no particular details are used)
2. Default Accredited - (When ACDs are used)
3. Xtratherm (When ACDs are used, and Xtratherm materials are used in the walls and floors) 2013 Part L and Full FEEs standards for 2016 ask for a Y-value of 0.05.

2.9 Request Certificates

When you submit your details, Xtratherm technical department will forward your results and PSI value certificates for the junctions chosen. If you just want us to give you a call tick the call back box and we will call you for free.

2.10 Thank You!

To start again with another calculation just click here.
3. What is a thermal bridge?

Thermal bridging can occur in three different ways:

a. Repeating

An example would be the effect of rafters penetrating the insulation layer on a sloped roof every 600mm. Another example would be the break made by timber framing when the insulation is placed between the studs. This type of bridge is predictable and is accounted for when U-values are calculated to EN6946. Your insulation supply will calculate the build-up whilst proportioning those particular thermal bridges and take them into account. A set of conventions are available within the BRE publication BR443 ‘Conventions for U-value calculations’. It sets the rules for completing U-values competently and provides guidance for real scenarios, for example on how wall ties should be accounted for and the default add-on penalty if square edged insulation boards are used instead of engineered jointed or overlapped.

b. Non-repeating

Non-repeating thermal bridging typically occurs at the junctions between plain building elements, e.g. at wall/roof and wall/floor junctions, and around openings, e.g. at window jambs, where the continuity of the insulation is interrupted or compromised because of the junctions detail such as at corners of the building. This thermal bridging increases the heat loss and also the risk of condensation due to the lower localised internal surface temperatures. It has been estimated that in a well insulated house around 30% of the heat loss can occur due to non-repeating thermal bridges.

c. Random

A more difficult thermal bridge to plan for and detail, but when they occur they can lead to not only an increase in heat loss at that particular area, but the increased possibility of condensation forming on the cold surface and resultant mould growth. These random thermal bridges, like for example meter boxes, should be insulated effectively and accounted for in the overall heat loss calculation.
PSI Values explained...

4.1 Accredited Details (ACDs) England, Scotland & N. Ireland

Like all other inputs into a building energy calculation, the way that insulation is installed to avoid thermal bridging has a numerical input into the software – which is called a Y-value. A set of ‘good practice’ details have been available in the form of ‘Accredited Details’ ACDs published by the DCLG in England. These ACDs are a set of design drawings for the junctions listed in Table K1 of SAP which are most prone to heat loss. They detail how the insulation should be installed at these junctions in order to improve not only the heat loss but also airtightness results. Xtratherm details are based on these ACDs. The Scottish Government has produced its own set of Accredited Construction Details (Scotland) 2010. Differences in traditional build methods have led to slightly different details being used, not only in Scotland, but also in Northern Ireland. Typically the traditional window detail placed the framing further into the construction, whereby a different PSI value will be achieved. For this reason the Y-Calculator program shows a specific Northern Ireland choice when choosing the wall block type.

4.2 The Y-Value

The Y-value is the term used to describe the sum of all (or to be more correct those identified in Table K1 of SAP) the non-repeating thermal bridges divided by the Total Heat Loss Area of the building, and is expressed as W/m²K. Its relevance or impact can be described most clearly if you view the Y-value as a U-value ‘penalty’ that is added onto the average U-value of your design to account for the thermal bridges. So let’s take an example of a well insulated property where the designed U-values for wall, floor, roof and openings average 0.20W/m²K. The Y-value is added to this average, so if your detailing has not been particularly good, a Y-value of 0.15 takes your average back to 0.35W/m²K which is the equivalent of taking away approximately half of the insulation that was put into the building! So reducing the Y-value down to around 0.05 or better (the target set to achieve Full FEES standards for 2016) has real advantages.

The Y-value is determined by quantifying this extra heat loss at junctions through thermal bridging by way of its linear thermal transmittance or Psi (Ψ) value in units of (W/mK). The PSI value target is set within Table K1 of SAP, for instance the target PSI value for a window reveal is set at 0.05, but this can be improved to around 0.02 using proprietary closers or wider traditional reveal insulation. When all the junctions are quantified (in lineal metres) they are multiplied by their individual PSI Values. The sum of all the L x PSI are then divided by the Total Heatloss Area for the building (ie. The area of walls, floor roofs and openings) and this results in your Y-value.

4.3 So what junctions must be accounted for?

The junctions that should be included in your calculation are listed in Table K1 within SAP, but between SAP 2009 and SAP 2012 an additional 19 junctions were added. These new junctions are primarily concerned with junctions within room-in-roof constructions; these extra details will add significantly to the Y-value result for such designed. Xtratherm have developed the Y-calc software to allow room-in-the-roofs to be insulated externally with sarking insulation that creates a warm roof. Placing the insulation over the rafters provides uniform plane and allows for continuity of the insulation layer, therefore avoiding the difficult to treat junctions that are encountered when insulating internally. The warm roof construction also allows for easier air barrier detailing.
4.4 What PSI values do you use?

Table K1 typically allocates 2 different PSI values against each junction, an APPROVED value or a DEFAULT Value (see below)

<table>
<thead>
<tr>
<th>Ref</th>
<th>Junction detail</th>
<th>Ψ (W/m²K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Lintels</td>
<td>0.50</td>
</tr>
<tr>
<td>E2</td>
<td>Lintels</td>
<td>0.30</td>
</tr>
<tr>
<td>E3</td>
<td>Sill</td>
<td>0.04</td>
</tr>
<tr>
<td>E4</td>
<td>Jamb</td>
<td>0.05</td>
</tr>
</tbody>
</table>

As you as you can see, the approved PSI values perform much better than the default values. This approved value can only be used if the Government Approved Details (ACDs) have been used, witnessed and signed off on site. If no particular detailing has been planned for, the default value must be used.

There is however another route to determining the PSI value of a junction, which is to have it calculated by a professional who has been deemed competent to do so. Xtratherm’s technical team have undergone competency training with the BRE (British research establishment) for thermal analysis and the results of these calculations are allowed to be used for the PSI values for these junctions.

4.5 Building Regulations and Thermal Bridging Calculations?

Building regulation state that reasonable provision to avoid thermal bridging would be to:

a. Adopt the ACDs – then use the PSI values attributed to them.

b. Use details that have been calculated by a person of suitable expertise and experience following the guidance set out in BR497 ‘Conventions for calculating linear thermal transmittance and temperature factors’ – then use these PSI values in the SAP calculation. (See Temperature Factors later)

c. Use the ‘default’ PSI values in table K1.

d. Use the (very) conservative default Y-value of 0.15W/(m²K)

Note: Evidence of suitable expertise and experience for calculating linear thermal transmittance would be to demonstrate that the person has been trained in the software used to carry out the calculation, has applied that model to the example calculations in BR 497 and has achieved results that are within stated tolerances.

4.6 What should happen on the actual building site?

Part L states:

‘The builder should demonstrate to the BCB that an appropriate system of site inspection is in place to give confidence that the construction procedures achieve the required level of consistency.’
4.7 Xtratherm have produced their own PSI values - but have they been calculated by competent people?

The BRE, who were involved in the standard EN ISO 10211 for assessing thermal bridging, produced both BR497 and the Paper IP1/06, run their own competency course for thermal bridge modelling. Xtratherm were the first participants to successfully pass the course. This allows us to calculate Xtratherm partial and full fill wall systems with our floor insulation. Xtratherm PIR is an extremely efficient insulation material with the added benefit of engineered jointing, which we use when calculating the bridging.

4.8 Are Xtratherm details different than the ACDs?

No. The Xtratherm PSI value are based on exactly the same details as the equivalent ACD for partial and full fill walls. These details have been developed by government to reflect the ‘norms’ that exist on building sites throughout the UK. Xtratherm have decided to use these details as they are the most widely used.

4.9 Will Xtratherm calculate bespoke PSI values?

To complete a PSI value analysis on a new detail could take up to 2 days to analyse, it is a very time consuming process to be done correctly using the correct software. It is recommended under EN 10211 that 3D software is used as this method produces an analysis of the ‘temperature factor’ or f factor. Xtratherm do not offer commercial calculations, but contact our office if you require this and we can advise you on finding companies that do.

4.10 What is the f factor? Is it important? (The temperature factor)

The PSI value determines the heat loss through a junction, such heat loss will not be noticed by an individual in a property – but they will notice condensation and mould growth, which is why calculating the Temperature Factor becomes an essential part of thermal bridging calculation. 3D modelling of a junction not only determines heat loss, but also the likelihood of condensation and mould growth appearing on the surface area of that detail, which is determined by assessing the temperature factor. The temperature factor f must be determined to comply with building regulations.

‘Reasonable provision for the temperature factors is that they should achieve a performance no worse than those set out in BRE information Paper IP1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of a building’
4.11 What are the results of bad detailing?

We addressed extra heat loss experiences through bad junction detailing in paragraph 4.10, but the visual evidence of mould growth on bad detailing is the most compelling argument to get the detailing correct from the start. No one will complain of heat loss from a bad corner detail, but once black mould appears, a completely different scenario arises for purchases of new homes.

4.12 Is there a greater threat from bad detailing now than there was in the past?

Bad detailing happens. Gaps are left between insulation boards or corners are left open, but in previous years (before the current, more stringent building regulations) condensation and the resultant mould appearing was not an issue because, paradoxically, our homes were not well insulated! Water vapour in the atmosphere will stay as a gas as long as the air temperature is kept reasonably high, but once that air is allowed to cool (for instance when it hits a cold junction), the cold air loses the ability to ‘hold on’ to the moisture – so it deposits it in the form of condensation. In the past, in our not-so-well insulated houses, the temperature difference between insulated areas and badly insulated areas wasn’t that great – we didn’t have that much insulation installed, so no great variation in surface temperatures occurred (Temperature Factors). If an area of condensation did form, ventilation from unintentional draft under doors, badly fitted window and gaps in the building generally helped such moisture to dissipate. Now it’s all changed: better insulation values and better air tightness are leaving us more exposed to the threat of condensation and mould. The better insulated the flanking elements (walls or floors) are either side of a junction, the colder the junction becomes. So improving U-values, without improving thermal bridging Y-values, would lead to potential problems in our better insulated homes. It is for this reason that the building regulations have asked us to improve the Y-value goal from 0.15 to 0.08 to around 0.05. Not just to save energy, but also to avoid building problems into our well insulated buildings.

4.13 How are Xtratherm PSI values so much better than those in Table K1?

Xtratherm insulation materials are extremely efficient with thermal conductivities as low as 0.021W/m²K, but unlike other manufacturers, Xtratherm have taken detailing into account when developing products to ensure both thermal and detailing performances are addressed. The Xtratherm products used in the PSI value calculations are engineered jointed, which in itself improves the U-value when compared to using squared edged insulation which has a defaulted penalty of 0.01 added to the calculated U-value (See extract from BR443 ‘Conventions for U-value calculations’). We also provide components such as pre-formed corner boards and ventilation voids that insulate junctions effectively. The Xtratherm PSI values are calculated using our engineered products, however substituting them with other materials may not result in the same PSI value. It is for this reason that Xtratherm results are so effective.
References

1. ‘Conventions for U-value calculations’

2. Planning Portal Accredited Details
   http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/bcassociateddocuments9/acd

3. Accredited Construction Details (Scotland) 2010

4. SAP 2009

5. SAP 2012
   http://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf
Technical Support

Talk to our professional, fully qualified team to assist you in finding the right solution for you.

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