

SAP 10 Technical Paper  
S10TP-05

---

TREATMENT OF THERMAL BRIDGES

Issue 1.2

(Previously published as CONSP-06)

## DOCUMENT REVISIONS

Documents will be revised by issue of updated editions or amendments. Revised documents will be posted on the website at <https://bregroup.com/sap/sap10>.

Technical or other changes which affect product recognition requirements (for example) will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

Users of this document should ensure that they possess the latest issue.

## DOCUMENT REVISION LOG

DATE	VERSION NO.	AMENDMENT DETAILS	APPROVED BY
30/06/2016	1.0	First issue	Paul Davidson
11/11/2020	1.1	Reviewed and renamed	Paul Davidson
11/03/2022	1.2	Updated following completion of SAP 10.2	John Henderson

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 2 of 12

## TABLE OF CONTENTS

1.	INTRODUCTION .....	4
1.1	Treatment of thermal bridges in SAP 2012 .....	4
1.2	Shortcomings of the SAP 2012 method .....	5
2.	CHANGES FOR SAP 10.2 .....	6
2.1	Default 'y-value' option made worse for new build .....	6
2.2	Remove the 'approved' values.....	7
2.3	Review and revise the 'default' values .....	7
2.4	Allow use of non-government construction detailed scheme.....	7
3.	IMPACT OF-CHANGES .....	8
4.	SUMMARY .....	8
	<b>APPENDIX A</b> – Examples used to generate default y-value .....	10
	<b>APPENDIX B</b> - Revised Table K1: Values of $\Psi$ for different types of junction .....	11

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 3 of 12

# 1. INTRODUCTION

As dwellings have become better insulated, the importance of thermal bridging has increased. In well insulated dwellings, the effect that thermal bridging can have on the overall thermal performance can be very significant. Recent research suggests that thermal bridging can be responsible for up to 30% of a dwelling's heat loss in highly insulated buildings.

The heat loss associated with thermal bridges is usually expressed as a linear thermal transmittance (' $\Psi$ -value', W/m·K; also commonly written as 'psi-value'). It is the rate of heat loss per unit length of the thermal bridge, and per degree kelvin temperature difference between the inside and outside. This paper considers the way in which thermal bridges were treated in SAP 2012 and describes improvements made for SAP 10.2.

## 1.1 Treatment of thermal bridges in SAP 2012

In SAP 2012, assessors had three options for thermal bridging:

1. The use of a global factor (a ' $\gamma$ -value' of 0.15 W/m<sup>2</sup>K), which is multiplied by the dwelling's total exposed surface area, as described in SAP Appendix K.
2. Entering the length of each junction only, which is multiplied by a default  $\Psi$ -value for that junction type from SAP Table K1.
3. Entering both the length and  $\Psi$ -value of each junction.

Default  $\Psi$ -values values from Table K1 could be mixed with user-supplied values.

When utilising option 3 for inputting information for linear thermal transmittance, allowable sources were as follows:

- 'Approved' values taken from:
  - England 'Accredited Construction Details for Part L'
  - Scotland 'Accredited Construction Details'
- 'Default' values taken from SAP Table K1
- Calculated values

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 4 of 12

- Calculated by ‘a person with suitable expertise and experience’

## 1.2 Shortcomings of the SAP 2012 method

The use of the generic  $\psi$ -value of 0.15, which is multiplied by the sum of the total area of external elements, was an allowable method for both new and existing buildings where the details of the thermal bridges were not known, or not specified for the SAP assessment. This method relies on default values for assumed standardised house types, which does not provide the most accurate assessment. For new build, details of each junction should be available as part of the design process, so the use of this data should be encouraged in as many cases as possible.

The SAP 2012 method also enabled the utilisation of out-of-date ‘approved’ values and ‘default’ values, which reduced the robustness of the input information. The ‘approved’ values were taken from the Part L Accredited Construction Details, which were developed in 2002. Typical U-values have improved significantly since these details were assessed. Also, the same  $\Psi$ -value is applied regardless of the U-value of flanking elements, when research has shown that altering the U-value alters heat loss via thermal bridging.

Additionally, the same approved or default  $\Psi$ -value was used for each detail, regardless of construction type and covers:

- Steel frame details
- Timber frame details
- Masonry cavity wall insulation details
- Masonry internal wall insulation details
- Masonry external wall insulation details

Again, research has shown that a significant difference in  $\Psi$ -value should be used for different wall types, even with the same target U-value in each flanking element.

The ‘default’ values listed in Table K1 were expanded for SAP 2012, but not revised from the 2009 figures, so are also potentially quite out of date.

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 5 of 12

These methods lead to potential inaccuracies in the assessment process, and an increased performance gap. Given the significance of thermal bridging this is an area of SAP that needed improving for SAP 10.2.

## 2. CHANGES FOR SAP 10.2

### 2.1 Default 'y-value' option made worse for new build

Consideration was given to removing the y-value option from the potential options for assessing thermal bridging for new build assessments because this method leads to additional assumptions and inaccuracies in the assessment process. Ideally therefore, for new build assessments, thermal bridging should be calculated on the basis of the summation of the length of each junction multiplied by the relevant  $\Psi$ -value. However, there may be cases where this is impractical. For example, small builders doing one-off designs are thought to commonly use the y-value option in SAP 2012. Therefore, we have continued to allow the y-value approach. However, it has been pointed out (e.g. in the ZCH 'performance gap' study) that it is possible to design a building where using the more detailed  $\Psi$ -value approach gives a *worse* resulting heat loss than would be obtained using the default y-value, in which case there would be a temptation to use the latter approach to knowingly obtain an unrealistically better result. **We therefore have raised the default y-value to 0.2** to make this situation much less likely to arise. This figure is based on a series of examples run using the detailed approach with worse than average (but still realistic) junction details – see Appendix A.

**Note:** The wording of individual approved documents published in each of the UK administrations could potentially override this assumption in SAP, either by disallowing the use of y-values, or stating a different default assumption.

When SAP is used to rate the performance of existing buildings, where junction details will be unknown, we propose to continue using a generic y-value approach based on the age of the property, as described in RdSAP 2012, Table S13 (and in due course it's equivalent in RdSAP 10). Note that the y-values for existing buildings are intended to be averages (rather than pessimistic defaults used for new dwellings) since there is no alternative but to use them.

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 6 of 12

## 2.2 Remove the ‘approved’ values

The ‘approved’ column has been removed from Table K1. The ‘old’ Approved Construction Details (ACDs) in England were developed in 2002, and are now considerably out of date.

In addition to this, the ‘approved’ values are applied to a range of wall types, as opposed to an individual detail set (and set of values) for each wall type variation. Accurate  $\Psi$ -values take into account the U-value of the flanking elements – a single value covering a range of construction types was deemed not to be appropriate.

**Note:** The wording of individual approved documents (or their supporting documents) published by particular UK administrations could potentially override this assumption in SAP, by publishing new approved values.

## 2.3 Review and revise the ‘default’ values

The ‘default’ values have been reviewed and compared with a range of details that are currently used in practice (including some recently developed ACDs, as well as other sets of junction details). The old ‘default’ values had not been revised for a long time and were out of date given current design and best practice.

The new values are purposely pessimistic. They are based the worst performing example of each type in common use to encourage the assessor / housebuilder to move towards assessing each detail separately (or utilising ACDs or other sources) – helping to close the performance gap.

The revised ‘default’ values are included within Appendix B.

## 2.4 Allow use of non-government construction detailed scheme

SAP 10.2 allows for the use of ACDs from reputable non-government databases, in addition to government ACDs which were allowed for in previous versions of SAP.

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 7 of 12

### 3. IMPACT OF-CHANGES

The key aim of revisions 2.1 (worsening the  $\gamma$ -value for new build), 2.2 (removal of 'approved' column values), 2.3 (revision of the 'default' values) and 2.4 (allow non-government certified thermal details schemes) is to enable a more accurate assessment, with less reliance on assumptions, defaults and / or out of date approved values.

Worsening the default  $\gamma$ -value will encourage assessors to supply junction length data and then either apply the appropriate revised 'default'  $\Psi$ -value, or the accredited / certified detail  $\Psi$ -values. This will facilitate a more accurate assessment.

Removing the aging 'approved' values will encourage assessors to evaluate the performance of junction details in a more robust manner. Similarly, ensuring 'default' values are reasonably pessimistic will further discourage reliance on  $\Psi$ -values that do not necessarily reflect actual design details.

Enabling use of non-government ACD schemes in SAP10.2 software will make it much easier and faster for assessors to use reliable data.

### 4. SUMMARY

SAP 2012 allows assessors to utilise a generic  $\gamma$ -value of 0.15 for new homes which is based on assumed junction lengths and types, and based on standard house types. This reduces the accuracy of the assessment.

The 'out-of-date 'approved' values in SAP 2012, which can no longer be considered credible or accurate, also have the potential to significantly impact calculated dwelling heat loss.

The inclusion of 'default' values which in some cases are not pessimistic enough does not discourage assessor reliance on values that do not represent the actual detail, in some cases reducing the quality of input data, and ultimately contributing to the 'performance gap'.

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 8 of 12



In SAP 10.2, assessors are encouraged to use more robust and accurate thermal bridging values by the worsening of the default 'y-value' (for new build), the removal of existing outdated 'approved'  $\Psi$ -values, the worsening of 'default'  $\Psi$ -values and by allowing assessors to use a robust, independent sources of thermal bridging details.

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 9 of 12

## APPENDIX A – Examples used to generate default y-value

	Weighting:		0.35	TESA (m <sup>2</sup> )		0.22	TESA (m <sup>2</sup> )		0.19	TESA (m <sup>2</sup> )		0.16	TESA (m <sup>2</sup> )		0.08	TESA (m <sup>2</sup> )		
	Current defaults		Detached	253.0	Semi-detached			191.3	Mid-terrace			136.8	Ground-floor flat			118.5	Bungalow	214.8
Junction	Ψ- value (W/m·K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m <sup>2</sup> K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m <sup>2</sup> K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m <sup>2</sup> K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m <sup>2</sup> K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m <sup>2</sup> K)		
Roof eaves	0.12	14.2	1.704	0.007	13.3	1.596	0.008	11.6	1.392	0.010		0	0.000	13.6	1.632	0.008		
Roof Gable	0.48	15.6	7.488	0.030	7.2	3.456	0.018		0	0.000		0	0.000	19.8	9.504	0.044		
Wall/floor	0.14	29.8	4.172	0.016	20.5	2.87	0.015	11.6	1.624	0.012	12.6	1.764	0.015		0	0.000		
Wall/balcony	0.04		0	0.000		0	0.000		0	0.000	3.2	0.128	0.001		0	0.000		
Wall/party wall	0.12		0	0.000	10.0	1.2	0.006	20.0	2.4	0.018	9.0	1.08	0.009		0	0.000		
Wall/wall (corner)	0.18	20.0	3.6	0.014	10.0	1.8	0.009		0	0.000	2.4	0.432	0.004	9.6	1.728	0.008		
Wall/ground floor	0.32	29.8	9.536	0.038	20.5	6.56	0.034	11.6	3.712	0.027	12.6	4.032	0.034	33.4	10.688	0.050		
Lintel	1	20.0	20.034	0.079	16.7	16.692	0.087	14.6	14.58	0.107	11.9	11.928	0.101	12.9	12.876	0.060		
Cill	0.08	20.0	1.60272	0.006	16.7	1.33536	0.007	14.6	1.1664	0.009	11.9	0.95424	0.008	12.9	1.03008	0.005		
Jamb	0.1	27.3	2.73	0.011	27.1	2.71	0.014	21.3	2.13	0.016	18.6	1.86	0.016	20.7	2.07	0.010		
Totals:			50.86672	<b>0.201</b>		38.21936	<b>0.200</b>		27.0044	<b>0.197</b>		22.17824	<b>0.187</b>		39.52808	<b>0.184</b>		
Average y-value (weighted by house type):				<b>0.197</b> W/m <sup>2</sup> K														
y-value rounded to 2 dec.:				<b>0.20</b> W/m <sup>2</sup> K														

## APPENDIX B - Revised Table K1: Values of $\Psi$ for different types of junction

(Changes are shown in red text.)

Table K1: Values of $\Psi$ for different types of junction		SAP 2012 'default' values $\Psi$ (W/m·K)	SAP 10 'default' values $\Psi$ (W/m·K)
<b>Junctions with an external wall</b>			
E1	Steel lintel with perforated steel base plate	1.00	1.00
E2	Other lintels (including other steel lintels)	1.00	1.00
E3	Sill	0.08	0.10
E4	Jamb	0.10	0.10
E5	Ground floor (normal)	0.32	0.32
E19	Ground floor (inverted)	0.07	0.10
E20	Exposed floor (normal)	0.32	0.32
E21	Exposed floor (inverted)	0.32	0.32
E22	Basement floor	0.07	0.22
E6	Intermediate floor within a dwelling	0.14	0.14
E7	Party floor between dwellings (in blocks of flats)	0.14	0.28
E8	Balcony within a dwelling, wall insulation continuous	0.00	0.10
E9	Balcony between dwellings, wall insulation continuous	0.04	0.15
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	1.00	1.00
E10	Eaves (insulation at ceiling level)	0.12	0.12
E24	Eaves (insulation at ceiling level - inverted)	0.24	0.15
E11	Eaves (insulation at rafter level)	0.08	0.15
E12	Gable (insulation at ceiling level)	0.48	0.25
E13	Gable (insulation at rafter level)	0.08	0.25
E14	Flat roof	0.08	0.16
E15	Flat roof with parapet	0.56	0.30
E16	Corner (normal)	0.18	0.18
E17	Corner (inverted – internal area greater than external area)	0.00	0.00
E18	Party wall between dwellings	0.12	0.24
E25	Staggered party wall between dwellings	0.12	0.24

Issue: 1.2	Treatment of thermal bridges	S10TP-05
Date: 11/03/2022		Page 11 of 12

Junctions with a party wall			
P1	Ground floor	0.16	0.32
P6	Ground floor (inverted)	0.07	0.32
P2	Intermediate floor within a dwelling	0.00	0.00
P3	Intermediate floor between dwellings (in blocks of flats)	0.00	0.00
P7	Exposed floor (normal)	0.16	0.48
P8	Exposed floor (inverted)	0.24	0.48
P4	Roof (insulation at ceiling level)	0.24	0.48
P5	Roof (insulation at rafter level)	0.08	0.48
Junctions within a roof or with a room-in-roof			
R1	Head of roof window	0.08	0.24
R2	Sill of roof window	0.06	0.24
R3	Jamb of roof window	0.08	0.24
R4	Ridge (vaulted ceiling)	0.08	0.12
R5	Ridge (inverted)	0.04	0.12
R6	Flat ceiling	0.06	0.12
R7	Flat ceiling (inverted)	0.04	0.12
R8	Roof to wall (rafter)	0.06	0.12
R9	Roof to wall (flat ceiling)	0.04	0.32
R10	All other roof or room-in-roof junctions	n/a	0.32
R11	Upstands or kerbs of rooflights	n/a	0.24
Junctions adjacent to unheated space			
B1	External wall has U-value change (part of wall is adjacent to unheated space)	n/a	0.10
B2	Roof has U-value change (part of wall is adjacent to unheated space)	n/a	0.30
B3	Floor has U-value change (part of wall is adjacent to unheated space)	n/a	0.32
B4	External Wall - wall between heated and unheated space	n/a	0.20
B5	External Wall - Floor between heated and unheated space	n/a	0.14
B6	External Wall - Floor between heated and unheated space	n/a	0.30