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TREATMENT OF THERMAL BRIDGES

Issue 1.0

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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 of a dwelling can be very significant. Recent research undertaken has shown 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 (‘Ψ-value’, W/m·K). This paper considers the way in which thermal bridges are currently treated in SAP and proposes improvements for SAP 2016.

1.1 Treatment of thermal bridges in SAP 2012

At present, SAP assessors have three options when looking at thermal bridging:

1. The use of a global factor (y-value), which is multiplied by the total exposed surface area, as described in SAP Appendix K.
2. On the basis of the summation of the length of each junction multiplied by its default Ψ-value from SAP Table K1.
3. On the basis of the summation of the length of each junction multiplied by user-supplied Ψ-values.

Values from Table K1 can be mixed with user-supplied values.

When utilising option 3 for inputting information for linear thermal transmittance, sources can be 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
    - Calculated by ’a person with suitable expertise and experience’

1.2 Shortcomings of the current method

The use of the generic y-value of 0.15, which is multiplied by the sum of the total area of external elements, is a potential method for both new and existing buildings where the details of the thermal bridges are 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The current method also enables the utilisation of out-of-date 'approved' values and 'default' values, which reduces the robustness of the input information. The 'approved' values are 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 Ψ–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 Ψ–value is 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 Ψ–value should be used for different wall types, even with the same target U-value in each flanking element.

The 'default' values that are currently listed in Table K1 were expanded for SAP 2012, but not revised from the 2009 figures.

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 which should be improved.

2. PROPOSED CHANGES FOR SAP 2016

2.1 Worsen the ‘y-value’ option for new build

Consideration has been 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 Ψ-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 propose to continue to allow the y-value approach. However, it has been pointed out (e.g. in the ZCH ‘performance gap’ study) that it is readily possible to design a building where using the more detailed Ψ-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 propose to worsen 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 and worse than average (but still realistic) junction details – see Appendix A.

Note: This is conditional on a change to the relevant Approved Documents. At present the Approved Document (Part L – England) permits the use of y = 0.15 for new dwellings, while Scotland has removed this option. Discussion around this will therefore be needed with:

- England
- Wales
- Northern Ireland
- Scotland

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 SAP 2012, Table S13. 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.

2.2 Remove the 'approved' values

It is proposed that the 'approved' column is removed from Table K1. The 'current' 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 Ψ–values must take into account the U-value of the flanking elements – a single value covering a range of construction types is not appropriate.

Note: Scottish Building Standards have recently revised their ACDs, with a detailed set for each of the following wall types: timber frame, masonry (partial fill cavity) and steel frame. Ireland's DECLG have also developed an even more expansive set of details, with a range of wall types, and variation in target U-value.

2.3 Review and revise the 'default' values

It is proposed that the 'default' values should be reviewed and compared with a range of details that are currently used in practice (which could include recently developed ACDs, as well as other sets of junction details). The current 'default' values have not been revised and may be out of date given current design and best practice.

It may also be prudent to ensure that the default values are sufficiently pessimistic, by choosing the worst performing example of each type in common use, to encourage the assessor / industry to move towards assessing each detail separately (or utilising ACDs or other sources) – helping to close the performance gap.

Proposed revised 'default' values are included within Appendix B.

2.4 Provide reference to Certified Thermal Details and Products scheme

SAP will continue to be able to use ACDs in England from any source. However as an additional service, the SAP specification will be altered to allow software using the specification to access data from other databases. For example, the BRE Certified Thermal Details and Products scheme database has been developed to enable it to be accessible in SAP 2016 software (similar to the principles of the Products Characteristics Database). This scheme database will host both BRE certified details and government accredited details (e.g. recent ACDs from Scotland and Ireland), which will enable assessors to more accurately assess building performance. The scheme database allows users to search a wide range of accurate and independently assessed thermal junction details, products and elements, ensuring accuracy, consistency and credibility through the SAP assessment process. The database will be open to other ACD schemes.

Where utilising a detail within the Government Accredited Construction Details (ACDs), a tolerance in flanking element U-value of ±10% is proposed – for example:

U-value = 0.18 W/m^{2}K, tolerance range = 0.162 (0.16) to 0.198 (0.20) W/m^{2}K

Without this allowance, pre-calculated values would only be usable in the case of an exact match.

3. IMPACT OF PROPOSED CHANGES

The key aim of revisions 2.1 (worsening the y-value for new build), 2.2 (removal of 'approved' column values), 2.3 (revision of the 'default' values) and 2.4 (provide reference / link to 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 y-value will encourage assessors to provide junction length data and then apply either the appropriate revised 'default' Ψ-value, or accredited / certified detail Ψ-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 Ψ-values that do not necessarily reflect actual design details.

Enabling and supporting a direct link / reference to the Certified Thermal Details and Products Scheme (or similarly robust and independent schemes) for use in SAP 2016 software will make it much easier for assessors to use reliable data.

4. SUMMARY

SAP 2012 allows assessors to utilise a generic y-value of 0.15 for new homes which is based on assumed junction lengths and types, and on the basis of 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 to be 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 fails to 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'.

It is proposed that SAP 2016 encourages assessors 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' Ψ-values, the worsening of 'default' Ψ-values and by providing assessors with a direct link to a robust, accurate and independent resource for thermal bridging details.

APPENDIX A – Examples used to generate default y-value

	Weighting:		0.35	TESA (m²)		0.22	TESA (m²)		0.19	TESA (m²)		0.16	TESA (m²)		0.08	TESA (m²)
	Current defaults		Detached	253.0	Semi-detached		191.3	Mid-terrace		136.8	Ground-floor flat		118.5		Bungallow	214.8
Junction	Ψ- value (W/m·K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m²K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m²K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m²K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m²K)	Total length l (m)	l x Ψ (W/K)	y-value (W/m²K)
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	**0.201**		38.21936	**0.200**		27.0044	**0.197**		22.17824	**0.187**		39.52808	**0.184**

Average y-value (weighted by house type): 0.197 W/m²K

y-value rounded to 2 dec.: **0.20** W/m²K

APPENDIX B - Revised Table K1: Values of Ψ for different types of junction

Table K1: Values of Ψ for different types of junction		Current 'default' values Ψ (W/m·K)	Proposed 'default' values Ψ (W/m·K)
Junctions with an external wall			
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

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	Remove
P3	Intermediate floor between dwellings (in blocks of flats)	0.00	Remove
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
Junctions adjacent to unheated space			
B1	External wall has U-value change (part of wall is adjacent to unheated space)		0.10
B2	Roof has U-value change (part of wall is adjacent to unheated space)		0.30
B3	Floor has U-value change (part of wall is adjacent to unheated space)		0.32
B4	External Wall - wall between heated and unheated space		0.20
B5	External Wall - Floor between heated and unheated space		0.14
B6	External Wall - Floor between heated and unheated space		0.30