Engineered Timber Systems

TECHNICAL BULLETIN

(2-) Rj7
First Issue February 2014

A PSI OF RELIEF

LINEAR THERMAL BRIDGING & THE KINGSPAN TEK BUILDING SYSTEM

Kingspan®

Low Energy –
Low Carbon Buildings

TECHNICAL BULLETIN

What is Linear Thermal Bridging?

When undertaking heat loss calculations for dwellings there are two types of thermal bridging that are to be considered:

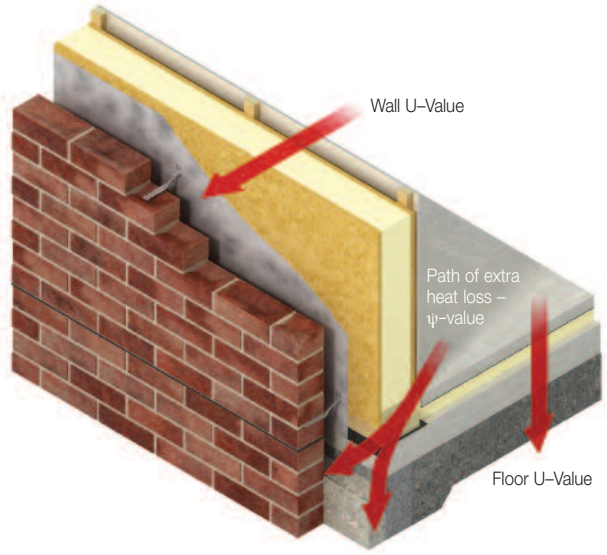
- repeating thermal bridges; and
- non repeating linear thermal bridges.

Repeating thermal bridges occur where a material with a significantly worse thermal conductivity interrupts the insulation layer in a construction i.e. timber studs etc. U-value calculations for conventional timber frame systems take into account the effects of repeating thermal bridges. Guidance documents for the calculation of U-values, BS / I.S. EN ISO 6946: 2007 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method) and BR443 (Conventions for U–value calculations), indicate that in a typical domestic timber frame building, a minimum of 15% of walls and 6% of the pitched roof is un-insulated.

The percentage figures quoted include structural timbers and noggins, but do not account for timbers that are outside the wall or pitched roof area used for heat loss calculations, such as timbers around window zones, and at intermediate floors. The insulation layer in the *Kingspan* **TEK**® Building System is not interrupted by repeating studwork. Therefore, there is less repeating thermal bridging, which can yield better thermal performance. There are, however, some thermal bridges, e.g. where timbers are used to support point loads etc. The overall result is that the *Kingspan* **TEK**® Building System only has 4% thermal bridging from timber elements for a typical domestic building wall and 1% thermal bridging from timber elements for a typical domestic building roof.

Linear thermal bridges occur at junctions, e.g. wall to floor, and openings, e.g. windows, in the building fabric, and are expressed as psi-values (ψ). A ψ-value is the heat loss through a junction, which is additional to the heat flow through the adjoining plane elements, divided by the length of the junction, and is expressed in W/m.K. The effect of all linear thermal bridges in a building is expressed as a building's y-value. This is the sum of the ψ-values of all individual linear thermal bridges, each multiplied by its individual length, and is expressed in $W/m^2 \cdot K$.

ψ–values are calculated using complex, and often expensive thermal modelling software such as Heat 2, Heat 3, Bisco or Trisco. Modelling can be undertaken in 2D or 3D, and can take many hours to complete. Thermal modelling software must comply with BS EN ISO 10211.



In depth information with regards thermal modelling and conventions for calculation can be found in the following papers:

- BS EN ISO 10211 (Thermal bridges in building construction – Heat flows and surfaces temperatures – Detailed Calculations);
- BRE Information Paper IP 1/06 (Assessing the effects of thermal bridging at junctions and around openings); and
- BR 497 (Conventions for calculating linear thermal transmittance and temperature factors).

ψ-values are not taken into account in U–value calculations, but, instead, they are taken into account separately in the calculation methodologies used to assess the operational CO_2 emissions of buildings e.g. SAP in UK and DEAP in the Republic of Ireland.

Approved Document L1A to the Building Regulations (2013 edition) requires that SAP2012 is used to generate performance targets for dwelling compliance, and the performance of the actual dwelling to check against these targets. If the performance of the actual dwelling is better than that of the targets then compliance is achieved.

There are a number of options regarding which ψ-values to adopt in the calculation of the performance of the actual dwelling:

a) adopt pre-existing design details that have been formally recognised by DCLG, in which case the ψ-values for these design details can be used directly in the actual dwelling SAP calculations; or

b) use design details with ψ–values and temperature factors that have been calculated by a person with suitable expertise and experience, in which case the ψ-values for these design details can be used directly in the actual dwelling SAP calculations; or

c) use the default ψ-values from Table K1 of SAP2012, reproduced in Table 1 (below), in the actual dwelling SAP calculations; or

d) use a conservative default y–value of 0.15 W/m²·K, rather than ψ-values for each junction, in the actual dwelling SAP calculations.

If options a), b) or c) are taken, then a combination of a), b) and c) ψ-values is permitted, and the ψ-values used for the notional dwelling to generate the compliance targets are those detailed in SAP2012 Appendix R, reproduced in Table 1 (below). If option d) is taken, then a y-value of 0.05 W/m²·K will be used to set the compliance targets.

The effect of using ψ-values for the actual dwelling, that are poorer than those used to set the compliance targets, or using the conservative default y-value of 0.15 W/m²·K in approach d), would be to require much improved standards elsewhere in the design to compensate for these poorer values.

ψ-values for the *Kingspan* **TEK**® Building System

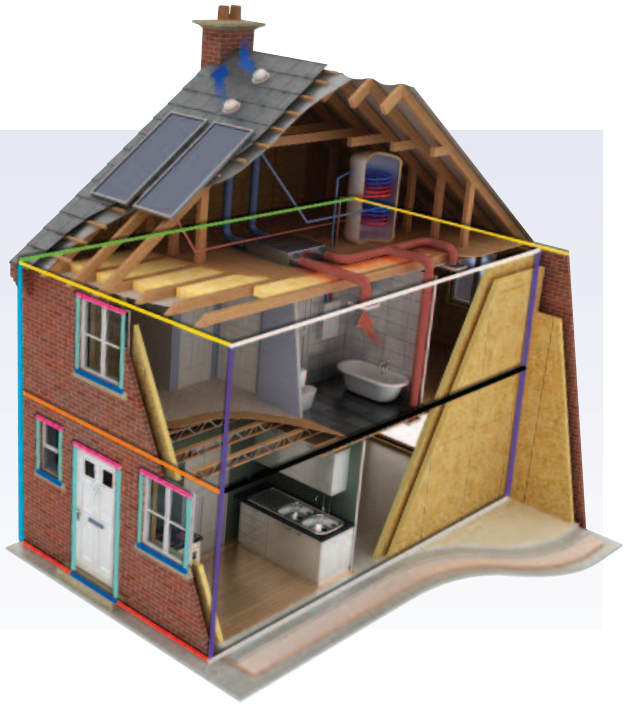
Kingspan Insulation has had a number of the junctions detailed in the *Kingspan* **TEK**® Building System Standard Details Handbook modelled and ψ-values calculated for them. Some of these are detailed in the table on the following page. They are compatible with option b) above, having been calculated by a person with suitable expertise and experience. The diagram below illustrates the location of some of these junctions.

The column in Table 1, labelled "Basic *Kingspan* **TEK**® Building System", shows ψ-values for buildings constructed with the *Kingspan* **TEK**® Building System with no additional insulation lining the *Kingspan* **TEK**® Building System panels. The four columns to the right show ψ-values for constructions with additional insulation lining the *Kingspan* **TEK**® Building System panels. These four columns represent so-called "Enhanced Construction Details".

The *Kingspan* **TEK**® Building System achieves very good ψ-values, due to the continuity of insulation at junctions and openings inherent in the System's design. Many of these ψ-values are better than the values used to set the targets for compliance with Approved Document L1A to the Building Regulations for England (2013 edition). This will assist significantly in Building Regulations compliance. These ψ-values are also generally considerably better than the SAP2012 default values.

For further information and an expanded set of junctions, details and ψ-values, please contact the Kingspan Insulation Technical Services Department (see rear cover).

- Openings, lintel
- Openings, jamb
- Openings, sill
- Ground floor / external wall junction
- Intermediate floor / external wall junction
- Loft floor at eaves
- Loft floor junction with gable
- Wall corner
- Party wall / external wall junction
- Party wall / ground floor junction
- Party wall / intermediate floor junction
- Party wall / loft floor junction



	SAP Conventions Detail Reference	Junction Description	Default Value in SAP 2012	ADL1A 2013 Compliance Target Values	*Kingspan* **TEK**® Standard Detail Reference	Psi–value (Ψ) (W/m·K)				
						Basic *Kingspan* **TEK**® Building System	Walls Lined with 20 mm of *Kingspan* **Therma**wall® TW55*[8]	Walls Lined with 50 mm of *Kingspan* **Therma**wall® TW55*[8]	Walls Lined with 75 mm of *Kingspan* **Therma**wall® TW55*[8]	Walls Lined with 90 mm of *Kingspan* **Therma**wall® TW55*[8]
Openings in a *Kingspan* **TEK**® Building System External Wall*[7]	E1	Steel lintel with perforated base plate and with *Kingspan* **Kool**therm® Cavity Closer	1.00	0.05	W8	0.06	0.05	0.04	0.04	0.04
	E3	Sill with *Kingspan* **Kool**therm® Cavity Closer	0.08	0.05	W7a	0.03	0.03	0.02	0.02	0.03
	E4	Jamb with *Kingspan* **Kool**therm® Cavity Closer	0.10	0.05	W6b	0.06	0.05	0.04	0.04	0.04
Junctions with a *Kingspan* **TEK**® Building System External Wall*[7]	E5	Concrete ground floor (U = 0.13 W/m²·K)	0.32	0.16	W2A	0.06	0.06	0.06	0.06	0.06
	E6	Intermediate timber floor within a dwelling	0.14	0.00	F4	0.10	0.10	0.10	0.10	0.10
	E7	Intermediate timber floor between dwellings (in blocks of flats)	0.14	0.07	F3	0.07	0.07	0.07	0.06	0.06
	E10	Loft floor at eaves *[5]	0.12	0.06	R10	0.06	0.05	0.04	0.03	0.03
	E11	*Kingspan* **TEK**® Building System panel pitched roof at eaves	0.08	0.04	R1 *[1]	0.09	0.09	0.09	0.09	0.09
	E12	Loft floor junction with gable *[5]	0.48	0.06	R11	0.03	0.03	0.02	0.02	0.02
	E13	*Kingspan* **TEK**® Building System panel pitched roof at verge	0.08	0.08	R12	0.04	0.03	0.02	0.02	0.02
	E15	Flat roof with parapet*[6]	0.56	0.56	R13	0.10	0.08	0.08	0.08	0.08
	E16	Wall corner (normal)	0.18	0.09	W5A Ext	0.05	0.03	0.01	0.00	0.00
	E17	Wall corner (inverted – internal area greater than external area)	0.00*[2]	-0.09	W5A Int	-0.03	-0.03	-0.03	-0.02	-0.02
	E18	Party wall between dwellings	0.12	0.06	W18A	0.04	0.04	0.03	0.03	0.03
Junctions with a *Kingspan* **TEK**® Building System Party Wall	P1	Concrete ground floor (U = 0.13 W/m²·K)	0.16	0.08	W18D	0.08	0.08*[3]	0.08*[3]	0.08*[3]	0.08*[3]
	P2	Intermediate floor within a dwelling	0.00	0.00	W18F/18G	0.00*[4]	0.00*[4]	0.00*[4]	0.00*[4]	0.00*[4]
	P3	Intermediate floor between dwellings (in blocks of flats)	0.00	0.00	W18F/18G	0.00*[4]	0.00*[4]	0.00*[4]	0.00*[4]	0.00*[4]
	P4	Loft floor *[5]	0.24	0.12	W12B	0.02	0.02*[3]	0.02*[3]	0.02*[3]	0.02*[3]
	P5	*Kingspan* **TEK**® Building System panel pitched roof	0.08	0.08	W18H	0.03	0.03*[3]	0.03*[3]	0.03*[3]	0.03*[3]
Openings in a *Kingspan* **TEK**® Building System Pitched Roof	R1	Head	0.08	0.08	R6a	0.09	0.07	0.07*[3]	0.07*[3]	0.07*[3]
	R2	Sill	0.06	0.06	R6a	0.09	0.07	0.07*[3]	0.07*[3]	0.07*[3]
	R3	Jamb	0.08	0.08	R6b	0.08	0.07	0.07*[3]	0.07*[3]	0.07*[3]
Junctions within a *Kingspan* **TEK**® Building System Pitched Roof	R4	Ridge (vaulted ceiling)	0.08	0.08	R3b	0.03	0.01	0.07*[3]	0.07*[3]	0.07*[3]
	R5	Ridge (inverted)	0.04	0.04	R7a	-0.01	-0.02	-0.02*[3]	-0.02*[3]	-0.02*[3]

**1 Junction R1 includes an intermediate floor in the junction detail.*

**2 SAP conventions document notes that there is no ACD for inverted corners and that a value of 0.00 W/m.K should be used.*

**3 Not tested – use best case tested value for this detail.*

**4 For solid and filled party walls there if no heat–loss, as no thermal bypass is possible via this route.*

**5 Insulation between and over ceiling joists and 15 mm plasterboard ceiling to achieve a U of 0.13 W/m²·K.*

**6 Warm deck flat roof with 15 mm plasterboard ceiling.*

**7 External wall assumed to be: brick outer leaf, 50 mm cavity, foil faced breather membrane, Kingspan TEK Building System panel, 12.5 mm thick plasterboard on 25 mm deep battens.*

**8 Internal insulation is installed directly against the inner surface of the Kingspan TEK Building System panel and lined with 12.5 mm thick plasterboard on 25 mm deep battens. Where the wall construction has an additional layer of insulation, the ceiling also has 25 mm of the same insulation behind the plasterboard ceiling with no airspace between.*

Table 1: Psi–values (ψ) for Standard Details

Contact Details

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For quotations, order placement and details of despatches please contact the Kingspan Insulation Customer Service Department on the numbers below:

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Technical Advice

Kingspan Insulation supports all of its products with a comprehensive Technical Advisory Service for specifiers, stockists and contractors.

This includes a computer–aided service designed to give fast, accurate technical advice. Simply phone the Kingspan Insulation Technical Service Department with your project specification. Calculations can be carried out to provide U–values, condensation / dew point risk, required insulation thicknesses etc… Thereafter any number of permutations can be provided to help you achieve your desired targets.

The Kingspan Insulation Technical Service Department can also give general application advice and advice on design detailing and fixing etc... Site surveys are also undertaken as appropriate.

The Kingspan Insulation British Technical Service Department operates under a management system certified to the BBA Scheme for Assessing the Competency of Persons to Undertake U–value and Condensation Risk Calculations.

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Literature & Samples

Kingspan Insulation produces a comprehensive range of technical literature for specifiers, contractors, stockists and end users. The literature contains clear ‘user friendly’ advice on typical design; design considerations; thermal properties; sitework and product data.

Kingspan **TEK**® technical literature is an essential specification tool. For copies please contact the Kingspan Insulation Marketing Department or visit the *Kingspan* **TEK**® website, using the details below:

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The Structural Timber Association (STA)

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