Insulation

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Building Regulations for the Conservation of Fuel & Power

ENGLAND – EXISTING BUILDINGS OTHER THAN DWELLINGS

2013 EDITION

Kingspan®

Low Energy –
Low Carbon Buildings

Contents

Introduction

Approved Documents L

Approved Documents L (ADL), published by The Department for Communities & Local Government (DCLG), give technical guidance on how to meet the energy efficiency requirements of the Building Regulations 2010, as amended, for building work carried out in England.

There are four Approved Documents L:

- Approved Document L1A: Conservation of fuel & power in new dwellings (ADL1A);
- Approved Document L1B: Conservation of fuel & power in existing dwellings (ADL1B);
- Approved Document L2A: Conservation of fuel & power in new buildings other than dwellings (ADL2A); and
- Approved Document L2B: Conservation of fuel & power in existing buildings other than dwellings (ADL2B).

Each document sets out what, in ordinary circumstances, may be accepted as reasonable provision for compliance with the energy efficiency requirements of the Building Regulations for the type of building work in question.

About this Document

Kingspan Insulation has produced this document as a simple guide to the 2010 edition of ADL1B, as amended in 2013. It specifically concentrates on the parts that are relevant to building fabric insulation, whilst showing how compliance can be achieved using Kingspan Insulation products for roofs, walls and floors and, for the purpose of comparison, thermally equivalent solutions using other common insulation materials.

Approved Document L2B – Existing Buildings Other than Dwellings

Introduction

ADL2B gives guidance on ways of demonstrating 'reasonable provision' for compliance with the energy efficiency requirements of the Building Regulations, for building work on 'existing buildings other than dwellings'.

The 2010 edition of ADL2B, as amended in 2013, came into effect on 6th April 2014. The guidance given is applicable to building work originating from plans and notices submitted to a building control body (BCB) for approval on or after this date.

Types of Work Covered

There are certain types of work in relation to existing dwellings where the ADL2B says that the use of either ADL1B, ADL2A, or to follow only a limited amount of the guidance given in ADL2B is likely to be more appropriate.

These are:

- in mixed–use developments, ADL1B should be used for guidance relating to the works on the individual dwellings with ADL2B being used for guidance relating to the parts of the building that are not a dwelling such as heated common areas or any commercial or retail space;
- for first fit–out works in buildings such as shell and core office buildings or business park units, the guidance in ADL2A covering first fit–out should be followed, but note that the appropriate guidance for any subsequent fit–out works is contained in ADL2B;
- where a proposed extension has a total useful floor area that is both greater than 100 m^2, and greater than 25% of the total useful floor area of the existing building, the work should be regarded as a new building and the guidance in ADL2A followed – however, consequential improvements may apply, in which case the guidance set out in ADL2B would be relevant;
- where the work involves the construction of modular and portable subassemblies that have been obtained from a centrally held stock or from the disassembly or relocation of such buildings at other premises, the guidance in ADL2A should be followed – however, consequential improvements may also apply if the work was to extend an existing building, in which case the guidance set out in ADL2B would be relevant; and
- where the work involves a building that either before the work, or after the work is completed, contains one or more dwellings, the guidance in ADL1B would apply to each dwelling – it should be noted that dwellings are defined as self–contained units, rooms for residential purposes are not dwellings, and so this ADL2B applies to them.

U–value Calculations

All U–values should be calculated using the methods and conventions set out in BR 443 (Conventions for U–value calculations) and should include allowances for any repeating thermal bridges.

New & Replacement Thermal Elements

Any new or replacement roofs, walls and floors should have U–values no worse than those shown in Table 1.

Element[1]	U–value (W/m²·K)
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.18
Flat roof or roof with integral insulation	0.18
Wall	0.28[2]
Floor[3]	0.22[4]
Swimming pool basin	0.25

[1] *'Roof' Includes the roof parts of dormer windows, and 'wall' includes the wall parts (cheeks) of dormer windows.*
[2] *Area–weighted average values.*
[3] *A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.*
[4] *A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels. The U–value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged dwelling.*

Table 1: New and Replacement Element U–values

The new or replacement building fabric should be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements e.g. wall and floor junctions, and at the edges of elements such as those around window and door openings. Reasonable provision should also be made to reduce unwanted air–leakage through the newly constructed thermal elements.

Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not contiguous and the cavity between them is subject to air movement. To avoid this problem, either the insulation layer should be contiguous with the air barrier at all points in the building envelope, or the space between them should be filled with solid material such as in a masonry wall.

A suitable approach to showing the requirement has been achieved would be to submit a report signed by a suitably qualified person confirming that appropriate design details and building techniques have been specified, and that the work has been carried out in ways that can be expected to achieve reasonable conformity with the specifications. Reasonable provision would be: to adopt design details published on the Accredited Construction Details website; or to demonstrate that the specified details provide adequate protection against surface condensation using the guidance in IP 1/06 and BR 497.

Renovation of Thermal Elements

A thermal element is defined as the part of a wall, floor or roof which separates a thermally conditioned part of the building from: the external environment; another unconditioned part of the building; or another part of the building which is used for a different purpose from the conditioned space, and is conditioned to a different temperature.

Renovation of a thermal element through the provision of a new layer includes either:

- cladding or rendering the external surface of the thermal element; or
- dry–lining the internal surface of a thermal element.

Renovation of a thermal element through the replacement of an existing layer includes either:

- stripping down the element to expose the basic structural components (brick / blockwork, timber / metal frame, joists, rafters, etc.) and then rebuilding to achieve all the necessary performance requirements; or
- replacing the water proof membrane on a flat roof.

Where a thermal element is renovated, the performance of the whole element should be improved to achieve or better the target U–value set out in Table 2, provided the area to be renovated is greater than 50% of the surface of the individual element or 25% of the total building envelope.

Element[1]	Threshold U–value ($W/m^2 \cdot K$)	Target U–value ($W/m^2 \cdot K$)
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation at rafter level[6]	0.35	0.18
Flat roof or roof with integral insulation[7]	0.35	0.18
Wall – cavity insulation[2]	0.70	0.55
Wall – external or internal insulation[3]	0.70	0.30
Floor[4,5]	0.70	0.25

[1] *'Roof' Includes the roof parts of dormer windows and 'wall' Includes the wall parts (cheeks) of dormer windows.*
[2] *This applies only in the case of a wall suitable for the installation of cavity insulation. Where this is not the case, it should be treated as 'wall – external or internal insulation'.*
[3] *A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.*
[4] *The U–value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.*
[5] *A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.*
[6] *A lesser provision may be appropriate where meeting such a standard would create limitations on head room. In such cases, the depth of the insulation plus any required air gap should be at least to the depth of the rafters, and the thermal performance of the chosen insulant should be such as to achieve the best practicable U–value.*
[7] *A lesser provision may be appropriate if there are particular problems associated with the load–bearing capacity of the frame or the upstand height.*

Table 2: Renovation Elements and Retained Elements U–values ($W/m^2 \cdot K$)

When assessing this percentage, the area of the element should be taken as that of the individual element, not all the elements of that type in the building. The area of the element should also be interpreted in the context of whether the element is being renovated from inside or outside. For example: if removing all the plaster finish from the inside of a solid brick wall, the area of the element is the area of external wall in the room; if removing external render, it is the area of the elevation in which that wall sits; if all the roofing on the flat roof of an extension is being stripped down, the area of the element is the roof area of the extension, not the total roof area of the dwelling.

If achievement of the target U–value set out in Table 2 is not technically or functionally feasible or would not achieve a simple payback of 15 years or less, the element should be upgraded to the best standard that is technically and functionally feasible and which can be achieved within a simple payback of no greater than 15 years.

When making a simple payback calculation the following guidance should be used:

- the cost should be the marginal cost, i.e. the additional cost (materials and labour) of the works over and above the works that were intended, not the whole cost of the works;
- the cost of implementing the measure should be based on prices current at the date the proposals are made known to the building control body and be confirmed in a report signed by a suitably qualified person;
- the annual energy savings should be estimated using SBEM or other approved software; and
- the energy prices that are current at the time of the application to building control should be used when evaluating the annual energy savings – current energy prices can be obtained from the DECC website at www.gov.uk/government/organisations/department–of–energy–climate–change/about/statistics#energy–price–statistics

Retained Thermal Elements

Where an existing thermal element is part of a building subject to a material change of use, where an existing element is to become part of the thermal envelope where previously it was not, or where an existing element is being upgraded as a consequential improvement, reasonable provision would be to upgrade those thermal elements whose U–value is worse than the threshold U–value in Table 2 to achieve the target U–values in Table 2, provided this is technically, functionally and economically feasible.

A reasonable test of economic feasibility is to achieve a simple payback of 15 years or less. Where the target U–value in Table 2 is not technically, functionally or economically feasible, then the thermal element should be upgraded to the best standard that is technically and functionally feasible and delivers a simple payback period of 15 years or less. Generally, this lesser standard should not be worse than 0.7 $W/m^2 \cdot K$. For guidance on payback calculations see above.

Examples of where lesser provision than the target U–value might apply are where the thickness of the additional insulation might reduce usable floor area of any room by more than 5 per cent or create difficulties with adjoining floor levels, or where the weight of the additional insulation might not be supported by the existing structural frame.

Approved Document L2B – Existing Buildings Other than Dwellings

Extensions, Conservatories & Porches

Where a proposed extension has a total useful floor area that is both greater than 100 m^2, and greater than 25% of the total useful floor area of the existing building, the work should be regarded as a new building and the guidance in ADL2A followed.

Where an extension involves the provision of new or replacement roofs, walls and floors, the work should comply with the requirements for new or replacement thermal elements, detailed above.

Where the work involves retained roofs, walls and floors, the work should comply with the requirements for retained thermal elements, detailed above.

The area of windows, roof windows and doors in extensions should not exceed the sum of 25% of the floor area of the extension plus the area of any windows or doors which, as a result of the extension works, no longer exist or are no longer exposed.

The Approved Document also contains elemental requirements for window, door & rooflight areas and performance, heating & hot water systems, mechanical ventilation, mechanical cooling, lighting, renewable energy systems and the provision of operating and maintenance instructions.

To provide design flexibility, U–values referred to above may be varied provided that the area weighted U–value of all the elements in the extension is no greater than that of an extension of the same size and shape that complies with the U–value standards and the opening areas referred to above.

Where even greater design flexibility is required, reasonable provision would be to use an approved calculation tool to demonstrate that the calculated carbon dioxide emission rate from the building with its proposed extension is no greater than for the dwelling plus a notional extension complying with the U–value standards and the opening areas referred to above. The specification of the existing building used in conjunction with the notional extension as the basis of setting the CO_2 target for the building work, shall include all upgrades that will be included in fulfilment of the requirement for consequential improvements. If, as part of achieving this CO_2 target, upgrades are proposed to the existing dwelling over and above the requirement for consequential improvements, such upgrades should be implemented to a standard that is no worse than the target U–value for improving retained thermal elements set out Table 2.

Conservatories and porches are exempt from the Building Regulations if they: are built at ground level; have a floor area no greater than 30 m^2; retain the existing dwelling walls, doors and windows which separate the conservatory from the dwelling or, if removed, they are replaced by walls, windows and doors which meet the requirements for replacements; and where the heating system of the dwelling is not extended into the conservatory or porch.

Where a conservatory or porch is not exempt, ADL2B states that any walls, doors and windows that may separate the conservatory from the main building should be insulated and draught proofed to at least the same extent as the rest of the existing dwelling.

The opaque roofs, walls and floors of the conservatory should have U–values no worse than those contained in Table 1.

ADL1B also contains elemental requirements for window, door & rooflight U–values, heating systems, their controls and the provision of operating and maintenance instructions.

Removing, and not replacing, any or all of the thermal separation between the dwelling and an existing exempt extension, or extending the dwelling's heating system into the extension, means the extension ceases to be exempt. This constitutes a change to the building's energy status. In such situations, the extension should be treated as a conventional extension and reasonable provision would be to demonstrate that it meets the requirements for extensions.

Where a swimming pool is being provided in a building, the U–value of the basin (walls and floor) should be not worse than 0.25 $W/m^2 \cdot K$ calculated according to BS EN IS0 13370.

Material Change of Use & Change of Energy Status

Where a building is subject to a change of use, e.g. from one non–dwelling building type to another, or a change to its energy status, e.g. any change which results in a building becoming subject to the energy efficiency requirements of the Building Regulations, where previously it was not, then ADL2B requires that the thermal performance of the walls, floors and roofs achieve a minimum standard of performance. This standard of performance varies depending on the nature of the works taking place.

Where the work involves the provision of new or replacement roofs, walls and floors, the work should comply with the requirements for new or replacement thermal elements, detailed above.

Where the work involves retained roofs, walls and floors, the work should comply with the requirements for retained thermal elements, detailed above.

ADL2B also contains requirements for triggering the replacement of windows, doors & rooflights and elemental requirements for window, door & rooflight U–values, heating & hot water systems, mechanical ventilation, mechanical cooling, lighting, renewable energy systems and the provision of operating and maintenance instructions.

Where design flexibility is required, reasonable provision would be to use an approved calculation tool to demonstrate that the calculated carbon dioxide emission rate from the building as it will become is no greater than if the building had been improved following the guidance above.

Consequential Improvements

When an existing building with a total useful floor area of over 1,000 m^2 undergoes: an extension; the initial provision of any fixed building service (other than a renewable energy generator); or an increase to the installed capacity of any fixed building service (other than a renewable energy generator); consequential improvements are required to the existing building to the extent that they are technically, functionally and economically feasible.

Where a building is extended, or the habitable area is increased, a way of complying would be to adopt measures such as those in Table 3 to the extent that their value is not less than 10% of the value of the principal works. The value of the principal works and the value of the consequential improvements should be established using prices current at the date the proposals are made known to the building control body. They should be made known by way of a report signed by a suitably qualified person, e.g. a chartered quantity surveyor, as part of the initial notice or deposit of plans.

Consequential Improvement Measures
Upgrading heating systems more than 15 years old by the provision of new plant or improved controls
Upgrading cooling systems more than 15 years old by the provision of new plant or improved controls
Upgrading air–handling systems more than 15 years old by the provision of new plant or improved controls
Upgrading general lighting systems that have an average lamp efficacy of less than 40 lamp–lumens per circuitwatt and that serve areas greater than 100 m^2 by the provision of new luminaires or improved controls
Installing energy metering following the guidance given in CIBSE TM 39
Upgrading thermal elements which have threshold U–values worse than those set out in Table 2 following the guidance given for retained thermal elements
Replacing existing windows, roof windows, rooflights or doors (but excluding display windows and high usage entrance doors) which have a U value worse than 3.3 $W/m^2{\cdot}K$ following the guidance given in ADL2B for replacing controlled fittings
Increasing the on–site low and zero carbon (LZC) energy–generating systems, if the existing on–site systems provide less than 10% of on–site energy demand, provided the increase would achieve a simple payback of 7 years or less
Measures specified In the Recommendations Report produced in parallel with a valid Energy Performance Certificate
The first 7 items will usually meet the 15 year simple payback criterion. A shorter payback period is given in the 8th item because such measures are likely to be more capital intensive or more risky than the others.

Table 3: Improvements That in Ordinary Circumstances are Practical and Economically Feasible

Where it is proposed to install, or increase the installed capacity per unit area, of a fixed building service, reasonable provision would be to make consequential improvements in line with the guidance immediately above for extensions.

However, in addition, where it is economically feasible, the fabric of those parts of the building served by the service should also be improved. The cost of any improvement made to the fabric of those parts of the building cannot be taken as contributing to the required value of the consequential improvements and the extent of such work is not limited by the 10% threshold. Reasonable provision for improving the fabric of those parts of the building would be to follow the guidance below to the extent that the work is technically, functionally and economically feasible. The following would be economically feasible in normal circumstances.

Where the installed capacity per unit area of a heating system is increased, the thermal elements within the area served which have threshold U–values worse than those set out in Table 2 should be upgraded following the guidance for retained thermal elements. Existing windows, roof windows, rooflights or doors (but excluding display windows and high usage entrance doors) within the area served and which have U–values worse than 3.3 $W/m^2 \cdot K$ should be replaced following the guidance given in ADL2B for replacing controlled fittings.

Where the installed capacity per unit area of a cooling system is increased, the thermal elements within the area served which have threshold U–values worse than those set out in Table 2 should be upgraded following the guidance for retained thermal elements. Additionally, if the area of windows, roof windows (but excluding display windows) within the area served exceeds 40% of the façade area, or the area of rooflights exceeds 20% of the area of the roof and the design solar load exceeds 25 W/m^2, then the solar control provisions should be upgraded following the guidance given in ADL2B. There is also a requirement for lighting efficacy.

Where improvement works other than the 'trigger activities' listed above are planned as part of the building work, owners can use these as contributing to the consequential improvements. The exception to this is if additional work is being done to the existing building to compensate for a poorer standard of an extension.

For example, if, as well as extending the building, the proposals included total window replacement, then the window replacement work would satisfy the requirement for consequential improvements, provided the cost was at least 10% of the cost of the extension.

Measures, such as those listed in Table 3, that achieve a simple payback not exceeding 15 years will be economically feasible unless there are unusual circumstances. For example, if the remaining life of the building is less than 15 years it would be economic to carry out only improvements with payback periods within that life.

Kingspan Insulation Solutions

Constructions & U-values

Set out in the following pages, are constructions, using Kingspan Insulation products, which are designed to meet the U–values shown in Tables 1 & 2. These U–values are valid for the constructions shown in the details immediately above.

Also shown, is a range of alternative solutions that other insulation manufacturers might offer.

The constructions shown do not comprise an exhaustive list of Kingspan Insulation solutions. Please contact the Kingspan Insulation Technical Service Department (see rear cover), if you require similar calculations for other constructions.

U–values have been calculated using the methods detailed in:

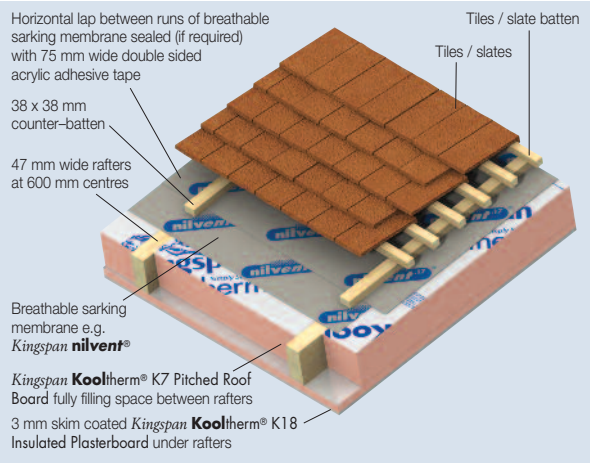
- BS EN ISO 6946: 2007 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method);
- BS EN ISO 13370: 1998 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods); and
- using the conventions set out in BR443 (Conventions for U–value calculations).

For the purposes of these calculations, the standard of workmanship has been assumed good and, therefore, the correction factor for air gaps has been ignored.

The figures quoted are for guidance only. A detailed U–value calculation and a condensation risk analysis should be completed for each project. Please contact the Kingspan Insulation Technical Service Department (see rear cover).

Kingspan Insulation Solutions – New Elements

Pitched Roof – Insulation Between & Under Rafters



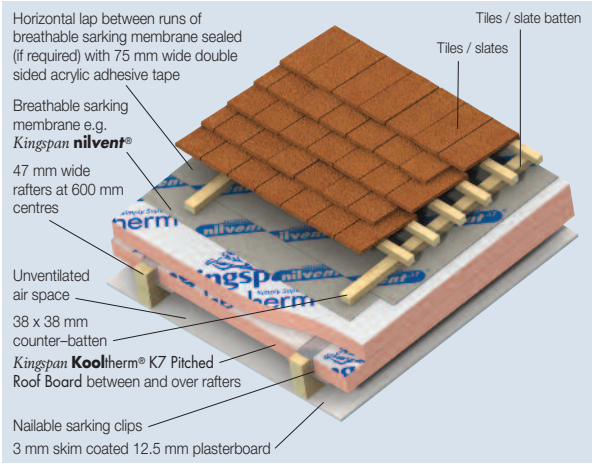
Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan Kooltherm®	100	100	42.5	142.5	THINNER
Glass Fibre* (Between)	125	125	92.5	217.5	
& XPS** (Under)	100	100	122.5	222.5	THICKER

**Assuming thermal conductivity 0.037 W/m·K.*
***Assuming thermal conductivity 0.036 W/m·K.*
****All insulated plasterboard thicknesses include 12.5 mm plasterboard.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that insulated plasterboard is fixed using carbon steel fixings with a cross–sectional area of 4.00 mm², with fixings 16.7 per m². The effect of fixings for Kingspan Kooltherm® and the 92.5 mm XPS insulated plasterboard is insignificant as the insulation layer penetrated is not the main insulation layer.

Using *Kingspan* **Kool**therm® can result in a thinner overall construction, regardless of rafter depth, and is less likely to have a prohibitive effect on headroom. There may be practicality issues with fixing a 122.5 mm insulated plasterboard product.

Kingspan Insulation Solutions – New Elements

Pitched Roof – Insulation Between & Over Rafters

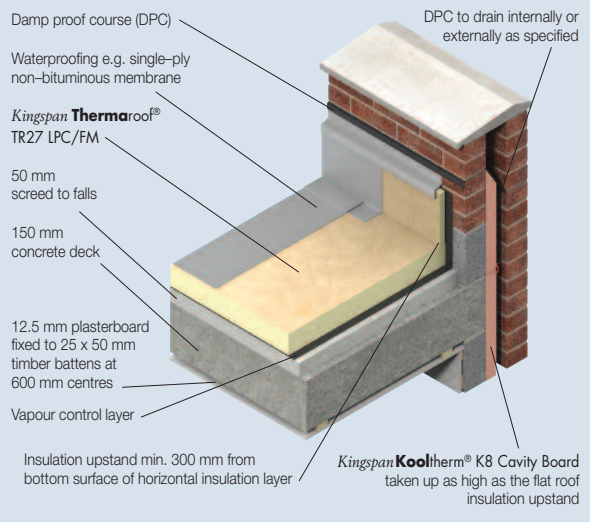


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan **Kool**therm®	100	50	55	155	THINNER
Rock Fibre*	130	130	80	210	
XPS**	100	80	120	220	THICKER

**Assuming thermal conductivity 0.038 W/m·K for between & 0.036 W/m·K for over.*
***Assuming thermal conductivity 0.036 W/m·K.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that the layers of insulation over the rafters are fixed using stainless steel fixings with a cross–sectional area 7.45 mm², with 6.2 fixings per m² (insulant thickness 41–60 mm), 8.3 fixings per m² (insulant thickness 61–80 mm), and 10.0 fixings per m² (insulant thickness > 80 mm).

Using *Kingspan* **Kool**therm® can result in a thinner overall construction, regardless of rafter depth, and is less likely to have a prohibitive aesthetic effect on bargeboard / fascia board depth. There may be cost issues with the rafter depth required for some solutions.

Flat Roof – Concrete Deck



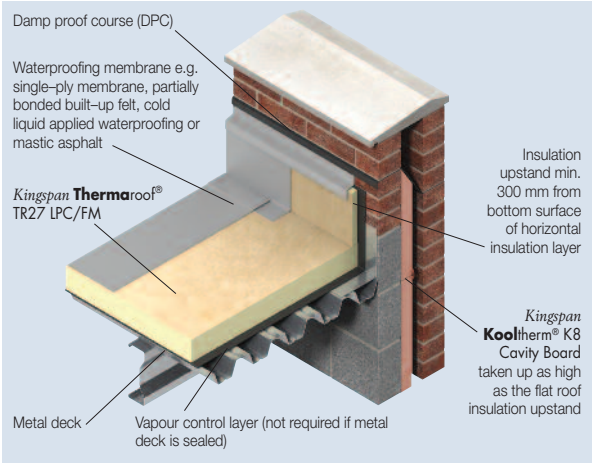
Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Roofing System* & Kingspan Thermaroof® TR27 LPC/FM (Overlay)	35 + 25	60	THINNEST
Kingspan Thermaroof® TR27 LPC/FM	120	120	THINNER
Rock Fibre**	95 + 95	190	THICKER

** The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 10%.*
***Assuming thermal conductivity 0.038 W/m·K.*
NB Where multiple layers of insulation of different thicknesses are shown, the second thickness is the overlay board.
These calculations assume that the insulation boards are fully bonded to the vapour control layer.

It can be seen from the tables above that the *Kingspan* OPTIM-R™ **Roofing System** insulation thickness can be significantly less than that for rock mineral fibre – one third of the thickness, which may allow lower parapets and shorter fixings. Furthermore, the weight of the insulation in the rock mineral fibre solution, shown above, will be over 7 times that in the *Kingspan* **Therma**roof® solution. The manual handling and roof loading implications of this weight should be carefully considered.

Kingspan Insulation Solutions – New Elements

Flat Roof – Metal Deck

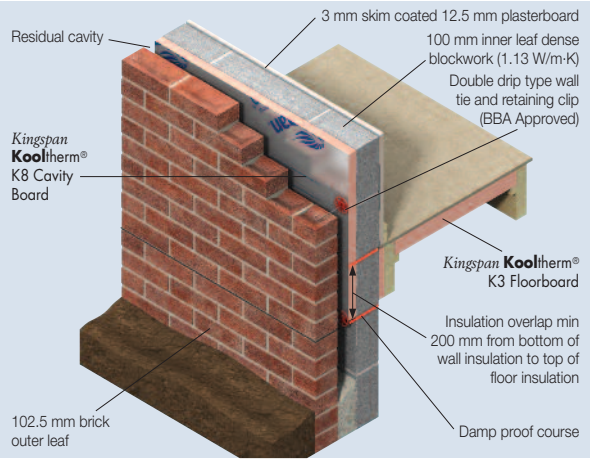


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ **Roofing System*** & *Kingspan* **Therma**roof® TR27 LPC/FM (Overlay)	40 + 25	65 (+ 12 mm particle board)	THINNEST
Kingspan **Therma**roof® TR27 LPC/FM	130	130	THINNER
Rock Fibre**	95 + 105	200	THICKER

** In the Kingspan OPTIM-R™ Roofing System a 12 mm cement particle decking board is installed over the metal deck and below the VCL. The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 10%.*
***Assuming thermal conductivity 0.038 W/m·K.*
NB Where multiple layers of insulation of different thicknesses are shown, the second thickness is the overlay board. These calculations assume that the Kingspan OPTIM-R™ component of the Kingspan OPTIM-R™ Roofing System is fully bonded to the vapour control layer, and that all other insulation boards are mechanically fixed. When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume thermally broken fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

It can be seen from the tables above, that the *Kingspan* OPTIM-R™ **Roofing System** insulation thickness can be significantly less than that for rock mineral fibre – almost one third of the thickness, which may allow lower parapets and shorter fixings. Furthermore, the weight of the insulation in the rock mineral fibre solution, shown above, will be over 7 times that in the *Kingspan* **Therma**roof® solution. The manual handling and roof loading implications of this weight should be carefully considered.

Cavity Wall – Cavity Insulation Only



Insulation Thicknesses to Achieve a U–value of 0.28 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Cavity Width (mm)	
Kingspan **Kool**therm® (Partial Fill)	50	115	THINNER
Glass Fibre* (Full Fill)	115**	115	THICKER

**Assuming thermal conductivity 0.037 W/m·K.*

***The insulation fully, rather than partially, fills the cavity and, so, the wall tie specification will differ and no retaining clips will be present.*

NB When calculating U–values to BS EN ISO 6946: 2007, the type of wall tie used may change the thickness of insulation required.

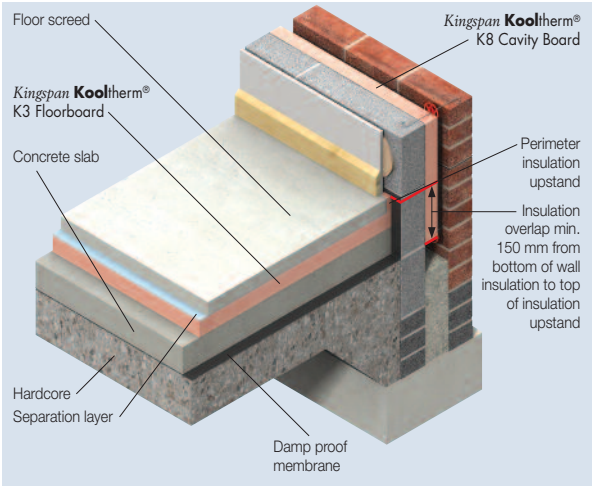
These calculations assume the following:

- *for 100 mm cavity widths, a stainless steel flexible tie with 2.5 ties per m² and a cross–sectional area of 12.50 mm²; and*
- *for 115 mm full fill cavity widths, a stainless steel flexible tie with 3.0 ties per m² and a cross–sectional area of 60.80 mm².*

A standard cavity of just 100 mm can be used with the *Kingspan* **Kool**therm® K8 Cavity Board solution, reducing total wall width by 15 mm, compared with the glass mineral fibre full fill alternative shown above.

Kingspan Insulation Solutions – New Elements

Ground Floor – Solid Concrete

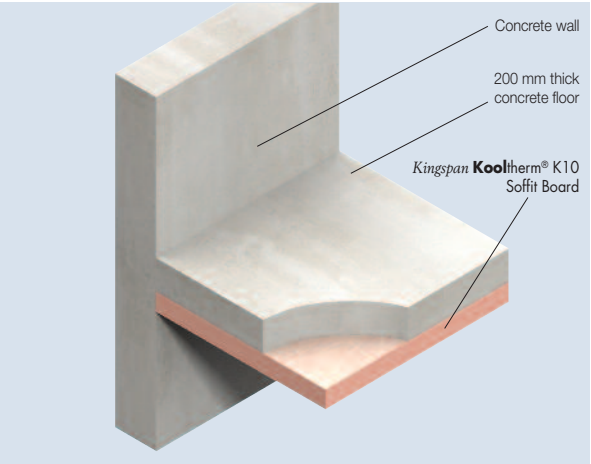


Insulation Thicknesses to Achieve a U–value of 0.22 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Flooring System*	30	30	THINNEST
Kingspan **Kool**therm®	60	60	THINNER
EPS**	110	110	THICKER

**The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 15%.*
***Assuming thermal conductivity 0.038 W/m·K.*
NB For the purposes of these calculations, using the method as detailed in BS EN ISO 13370: 1998, the soil has been assumed to be clay or silt, and the wall insulation is assumed to overlap the floor insulation by minimum 150 mm. The P/A ratio is taken as 0.5.

Using the *Kingspan* **Kool**therm® or the *Kingspan* OPTIM-R™ **Flooring System** rather than the expanded polystyrene solution, in the floor shown above, can result in having to dig out, and dispose of, less soil to make the space to accommodate the insulation.

Soffit – Fixed Directly to Concrete



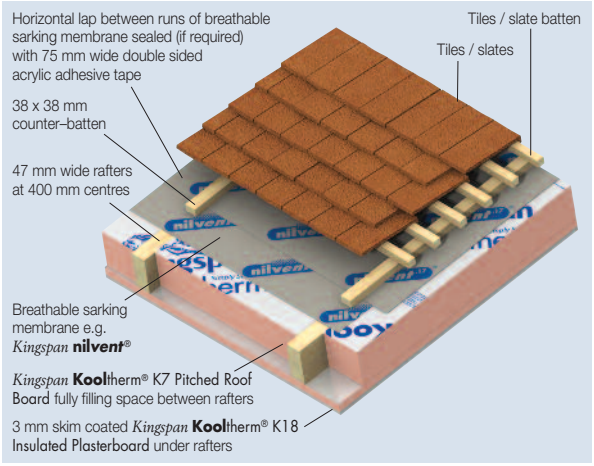
Insulation Thicknesses to Achieve a U–value of 0.22 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Cavity Width (mm)	
Kingspan **Kool**therm®	85	85	THINNER
Rock Fibre*	160	160	THICKER

**Assuming thermal conductivity 0.038 W/m·K.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of fixing used may change the thickness of insulation required. These calculations assume the use of thermally broken fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

At almost half the thickness of fibre, using *Kingspan* **Kool**therm® helps to maximise headroom in soffit applications. Coupled with a reduced weight and a reduced number of fixings, the *Kingspan* **Kool**therm® solution has many advantages over the competition.

Kingspan Insulation Solutions – Refurbishment / Retained Elements

Pitched Roof – Re-roof with Insulation Between & Under Rafters

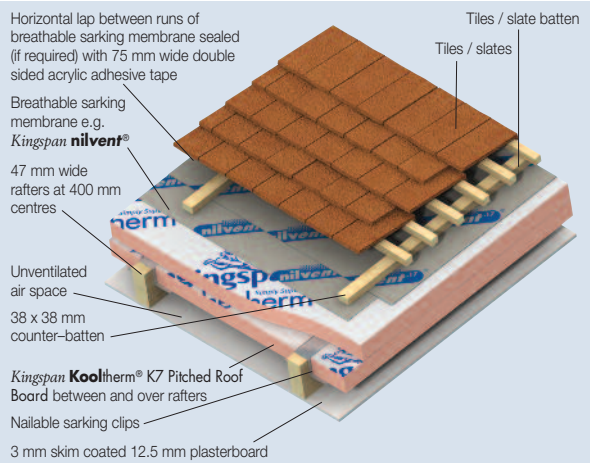


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan **Kool**therm®	100	100	52.5	152.5	THINNER
Glass Fibre* (Between)	125	125	102.5	227.5	
& XPS** (Under)	100	100	132.5	232.5	THICKER

**Assuming thermal conductivity 0.037 W/m·K.*
***Assuming thermal conductivity 0.036 W/m·K.*
****All insulated plasterboard thicknesses include 12.5 mm plasterboard.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that insulated plasterboard is fixed using carbon steel fixings with a cross–sectional area of 4.00 mm², with fixings 16.7 per m². The effect of fixings for Kingspan **Kool**therm® *and the 102.5 mm XPS insulated plasterboard is insignificant as the insulation layer penetrated is not the main insulation layer.*

Using *Kingspan* **Kool**therm® can result in a thinner overall construction, regardless of rafter depth, and is less likely to have a prohibitive effect on headroom. There may be practicality issues with fixing a 132.5 mm insulated plasterboard product.

Pitched Roof – Re-roof with Insulation Between & Over Rafters



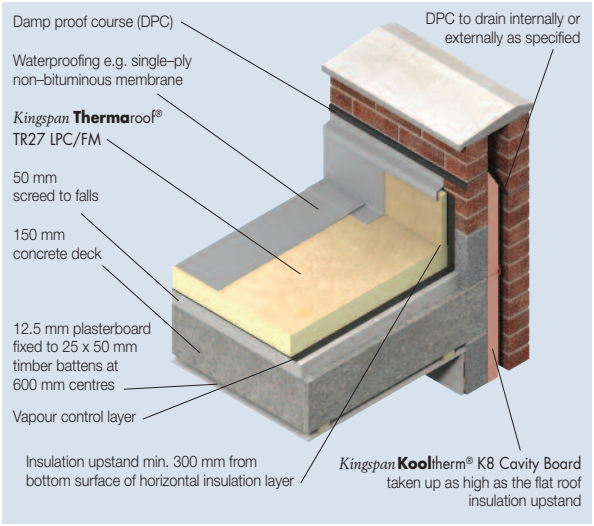
Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan **Kool**therm®	100	55	55	155	THINNER
Rock Fibre*	140	140	80	220	
XPS**	100	80	120	220	THICKER

**Assuming thermal conductivity 0.038 W/m·K for between & 0.036 W/m·K for over.*
***Assuming thermal conductivity 0.036 W/m·K.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that the layers of insulation over the rafters are fixed using stainless steel fixings with a cross–sectional area 7.45 mm², with 6.2 fixings per m² (insulant thickness 41–60 mm), 8.3 fixings per m² (insulant thickness 61–80 mm), and 10.0 fixings per m² (insulant thickness > 80 mm).

Using *Kingspan* **Kool**therm® can result in a thinner overall construction, regardless of rafter depth, and is less likely to have a prohibitive aesthetic effect on bargeboard / fascia board depth. There may be cost issues with the rafter depth required for some solutions.

Kingspan Insulation Solutions – Refurbishment / Retained Elements

Flat Roof – Concrete Deck

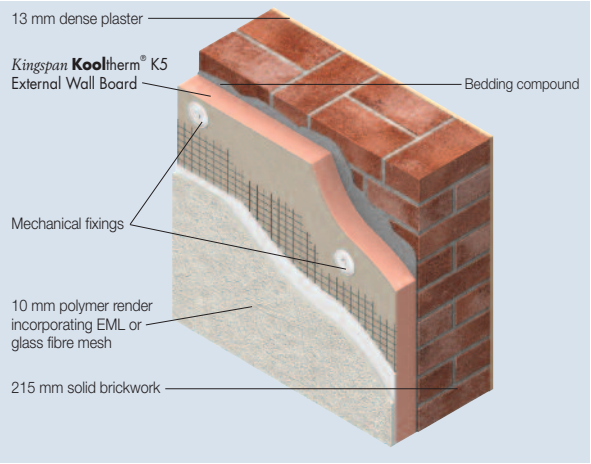


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Roofing System* & Kingspan Thermaroof® TR27 LPC/FM (Overlay)	35 + 25	60	THINNEST
Kingspan Thermaroof® TR27 LPC/FM	120	120	THINNER
Rock Fibre**	95 + 95	190	THICKER

** The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 10%.*
***Assuming thermal conductivity 0.038 W/m·K.*
NB Where multiple layers of insulation of different thicknesses are shown, the second thickness is the overlay board.
These calculations assume that the insulation boards are fully bonded to the vapour control layer.

It can be seen from the tables above that the Kingspan OPTIM-R™ **Roofing System** insulation thickness can be significantly less than that for rock mineral fibre – one third of the thickness, which may allow lower parapets. Furthermore, the weight of the insulation in the rock mineral fibre solution, shown above, will be over 7 times that in the Kingspan **Therma**roof® solution. The manual handling and roof loading implications of this weight should be carefully considered.

Solid Wall – External Wall Insulation



Insulation Thicknesses to Achieve a U–value of 0.30 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ External Wall System*	35	35 (+ 12 mm carrier board)	THINNEST
Kingspan Kooltherm®	55	55	THINNER
Rock Fibre**	105	105	THICKER
EPS**	105	105	

** The Kingspan OPTIM-R™ External Wall System is overlaid with a magnesium silicate render carrier board. This is mechanically fixed through the appropriate horizontal or vertical Kingspan OPTIM-R™ fix panels using carbon steel fasteners with a cross–sectional area of 7.44 mm², with 2.88 fasteners per m². The bridging effect of the Kingspan OPTIM-R™ flex & Kingspan OPTIM-R™ fix components of the System is taken as 30%.*

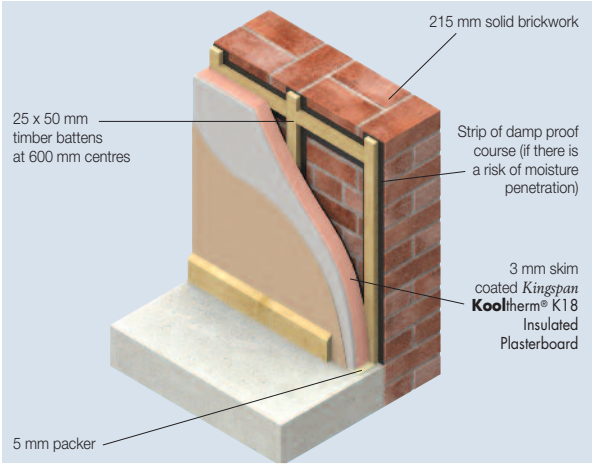
***Assuming thermal conductivity 0.038 W/m·K.*

NB These calculations assume that the Kingspan OPTIM-R™ component of the Kingspan OPTIM-R™ External Wall System is adhesive fixed to the substrate, and that all other insulation boards are mechanically fixed. When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations also assume thermally broken fasteners with a thermal conductivity 1.00 W/m·K or less, the effect of which is insignificant.

Kingspan **Kool**therm® or the *Kingspan* OPTIM-R™ **External Wall System** can dramatically reduce the thickness of insulation compared with the alternatives shown above. In refurbishment projects, where space under the eaves may be constrained, this could be critical. LABC guidance makes it clear that the required U-value of 0.30 W/m²·K can not be relaxed on the grounds that poorly performing insulation materials can not meet the required U-value in the space available.

Kingspan Insulation Solutions – Refurbishment / Retained Elements

Solid Wall – Internal Wall Insulation

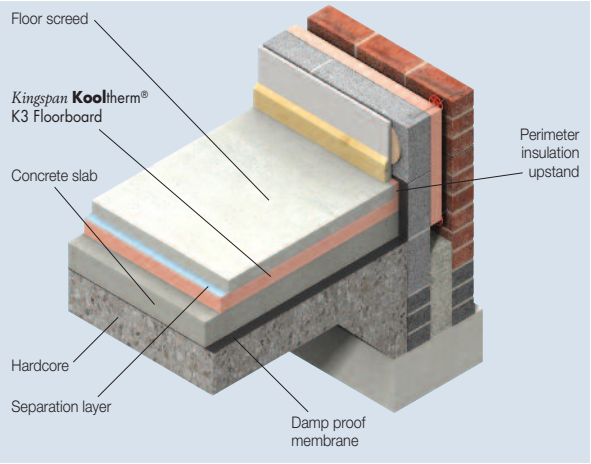


Insulation Thicknesses to Achieve a U–value of 0.30 W/m²·K			
Insulation Material	Insulation Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan **Kool**therm®	62.5	62.5	THINNER
XPS*	112.5	112.5	
Glass Fibre**	130****	145	THICKER

**Assuming thermal conductivity 0.036 W/m·K.*
***Assuming thermal conductivity 0.035 W/m·K.*
****All insulated plasterboard thicknesses include 12.5 mm plasterboard.*
***** Assuming construction illustrated above, but with insulated plasterboard on battens replaced with freestanding (25 mm gap between studs and wall) timber stud framework lined with 15 mm plasterboard, with glass fibre fitted between studs. A 15% bridging factor has been assumed for the timber stud framework. The thermal conductivity of the timber has been assumed to be 0.12 W/m·K. NB When calculating U–values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that insulated plasterboard is fixed with carbon steel fasteners with a cross–sectional area of 4.00 mm², with 16.7 fasteners per m².*

Using *Kingspan* **Kool**therm® can result in a thinner overall construction, compared with the alternatives shown above. In refurbishment projects, where floor space may be constrained, this could be critical. LABC guidance makes it clear that the required U-value of 0.30 W/m²·K can not be relaxed on the grounds that poorly performing insulation materials can not meet the required U-value in the space available.

Ground Floor – Solid Concrete



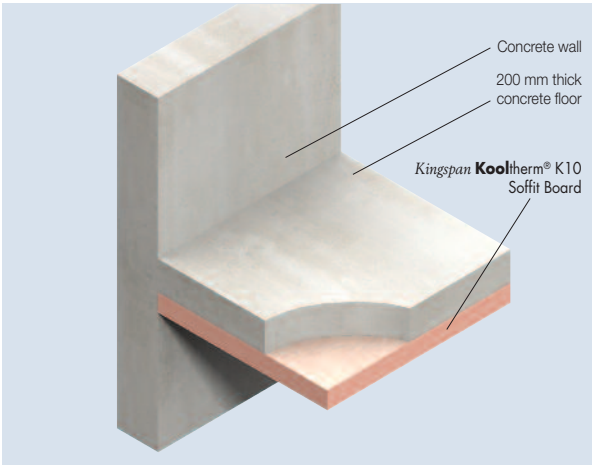
Insulation Thicknesses to Achieve a U–value of 0.25 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Flooring System*	25	25	THINNEST
Kingspan **Kool**therm®	50	50	THINNER
EPS**	90	90	THICKER

**The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 15%.*
***Assuming thermal conductivity 0.038 W/m·K.*
NB For the purposes of these calculations, using the method as detailed in BS EN ISO 13370: 1998, the soil has been assumed to be clay or silt, and the wall insulation is assumed to overlap the floor insulation by minimum 150 mm. The P/A ratio is taken as 0.5.

Using the *Kingspan* **Kool**therm® or the *Kingspan* OPTIM-R™ **Flooring System** rather than the expanded polystyrene solution, in the floor shown above, can result in having to dig out, and dispose of, less soil to make the space to accommodate the insulation.

Kingspan Insulation Solutions – Refurbishment / Retained Elements

Soffit – Directly Fixed to Concrete



Insulation Thicknesses to Achieve a U–value of 0.25 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Cavity Width (mm)	
Kingspan **Kool**therm®	75	75	THINNER
Rock Fibre*	140	140	THICKER

**Assuming thermal conductivity 0.038 W/m·K.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of fixing used may change the thickness of insulation required. These calculations assume the use of thermally broken fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

At almost half the thickness of fibre, using *Kingspan* **Kool**therm® helps to maximise headroom in soffit applications. Coupled with a reduced weight and a reduced number of fixings, the *Kingspan* **Kool**therm® solution has many advantages over the competition.

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