



Building Regulations for the Conservation of Fuel and Power

ENGLAND - EXISTING DWELLINGS



2013 EDITION



Kingspan®

*Low Energy –
Low Carbon Buildings*

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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 ADL2B 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 L1B - Existing Dwellings

Introduction

ADL1B gives guidance on ways of demonstrating 'reasonable provision' for compliance with the energy efficiency requirements of the Building Regulations, for building work on 'existing dwellings'. A dwelling can be defined as a 'self-contained unit designed to accommodate a single household'.

The 2010 edition of ADL1B, 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 ADL1B says that the use of 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;
- heated common areas in buildings containing multiple dwellings are not classified as dwellings, therefore they fall outside the scope of ADL1B – reasonable provision for these areas would be to follow the guidance in ADL2B; and
- buildings containing rooms for residential purposes such as nursing homes, student accommodation and similar are not considered as dwellings, and in such cases ADL2B would apply.

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/m ² -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. A suitable approach to showing the requirement has been achieved would be to adopt Accredited Construction Details (ACDs).

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 ·K)	Target U-value (W/m ² ·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/m²·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.

Approved Document L1B - Existing Dwellings

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 SAP 2012; 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, or where an existing element is to become part of the thermal envelope where previously it was not, e.g. as part of a loft or garage conversion where the space is now to be heated, 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/m²·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.

Extensions, Conservatories & Porches

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 renovation of roofs, walls and floors, the work should comply with the requirements for renovation of 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 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 SAP 2012 to demonstrate that the calculated carbon dioxide emission rate from the dwelling 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 with door area set equal to the door area of the proposed extension, and the remainder of the openings being classified as windows. If, as part of achieving this, upgrades are proposed to the existing dwelling, 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 m²; 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, ADL1B 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/m²·K calculated according to BS EN ISO 13370.

Approved Document L1B - Existing Dwellings

Material Change of Use & Change of Energy Status

Where a building is subject to a change of use, e.g. from commercial to domestic use, 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 ADL1B 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.

ADL1B 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 SAP 2012 to demonstrate that the calculated carbon dioxide emission rate from all of the dwellings in the building as it will become is no greater than if each dwelling had been improved following the guidance above.

Consequential Improvements

When an existing building with a total useful floor area of over 1,000 m² 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.

Only a relatively small number of existing dwellings will exceed 1,000 m² in size and technical guidance on achieving compliance is given in ADL2B.

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.

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 and 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:

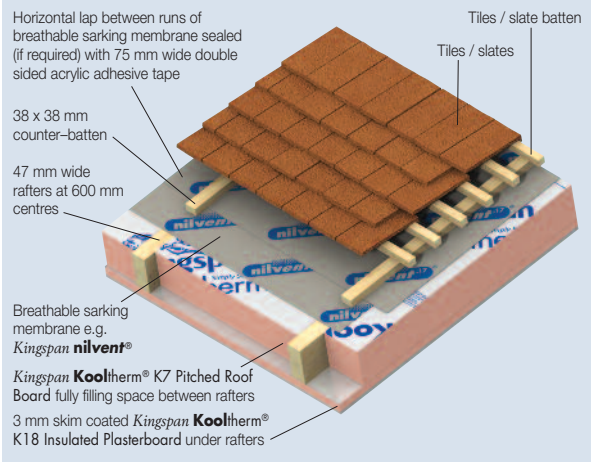
- BS EN ISO 6946: 2007 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method);
- BS EN ISO 13370: 1998 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods); and
- using the conventions set out in BR 443 (Conventions 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



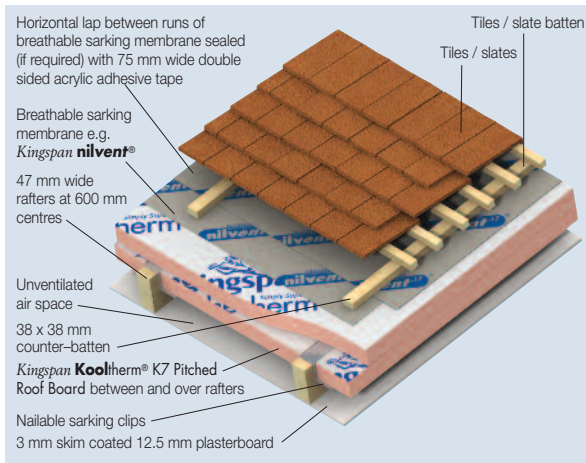
Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² -K				
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)**	Overall Thickness (mm)
Kingspan Kooltherm ®	100	100	42.5	142.5
Glass Fibre* (Between)	125	125	92.5	217.5
& XPS** (Under)	100	100	122.5	222.5

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*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 Kooltherm**® 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.

Pitched Roof - Insulation Between & Over Rafters



Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K				
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)
<i>Kingspan Kooltherm®</i>	100	50	55	155
Rock Fibre*	130	130	80	210
XPS**	100	80	120	220

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*Assuming thermal conductivity 0.038 W/m·K for between & 0.036 W/m·K for over.

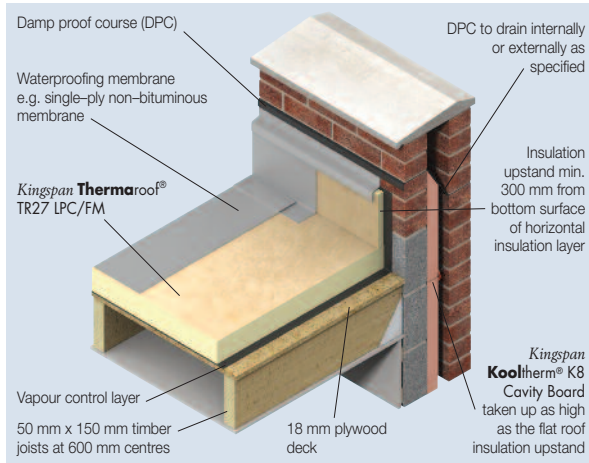
**Assuming thermal conductivity 0.036 W/m·K.

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 Kooltherm®* 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 - New Elements

Flat Roof - Timber Deck



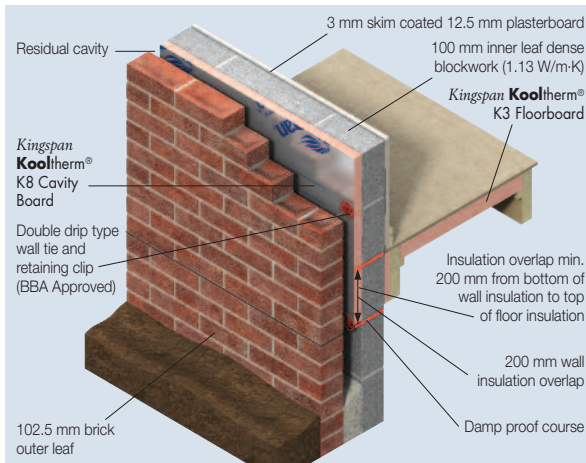
Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R Roofing System* & Kingspan Thermaroof ® TR27 LPC/FM (Overlay)	35 + 25	60
Kingspan Thermaroof ® TR27 LPC/FM	120	120
Rock Fibre**	95 + 95	190

* 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.

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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 Thermaroof**® 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/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Cavity Width (mm)
Kingspan Kooltherm® (Partial Fill)	50	115
Glass Fibre* (Full Fill)	115**	115

*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:

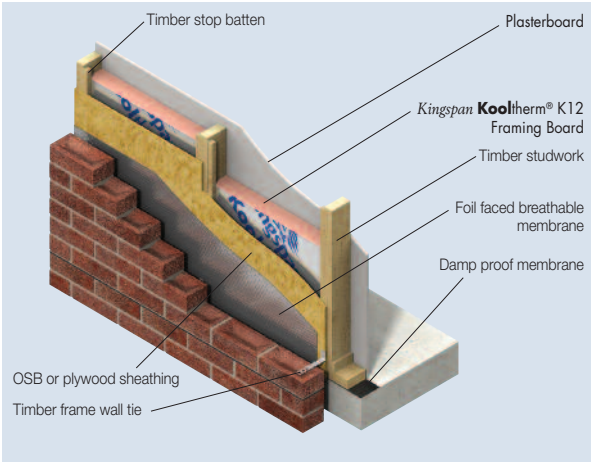
- for 100 mm cavity widths, a stainless steel flexible tie with 2.5 ties per m² and a cross-sectional area of 12.50 mm²; and
- for 115 mm full fill cavity widths, a stainless steel flexible tie with 3.0 ties per m² and a cross-sectional area of 60.80 mm².

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A standard cavity of just 100 mm can be used with the **Kingspan Kooltherm® 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

Timber Frame Wall



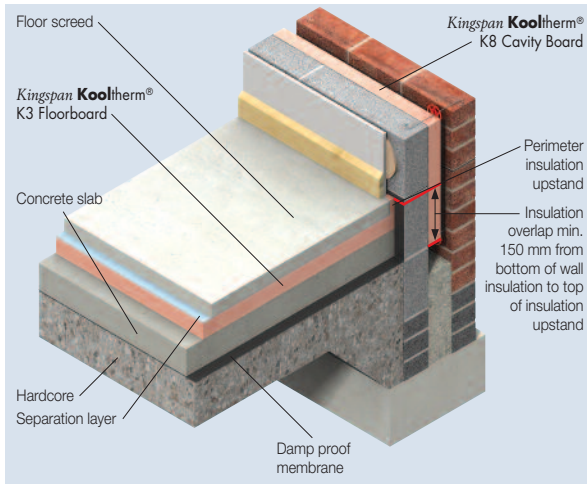
Insulation Thicknesses to Achieve a U-value of 0.28 W/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Stud Depth (mm)
Kingspan Kooltherm ®	65	89
Glass Fibre*	105	140

**Assuming thermal conductivity 0.035 W/m·K.
NB A 15% bridging factor has been assumed for the timber stud. The thermal conductivity of the timber has been assumed to be 0.12 W/m·K. Calculations assume that a foil faced breather membrane yields an airspace thermal resistance of 0.52 m²·K/W.*

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Using **Kingspan Kooltherm**® can result in a thinner overall construction. The glass mineral fibre solution shown above requires considerably deeper studwork to accommodate the required thickness of insulation. This may have a cost implication.

Ground Floor - Solid Concrete



Insulation Thicknesses to Achieve a U-value of 0.22 W/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R Flooring System*	30	30
Kingspan Kooltherm ®	60	60
EPS**	110	110

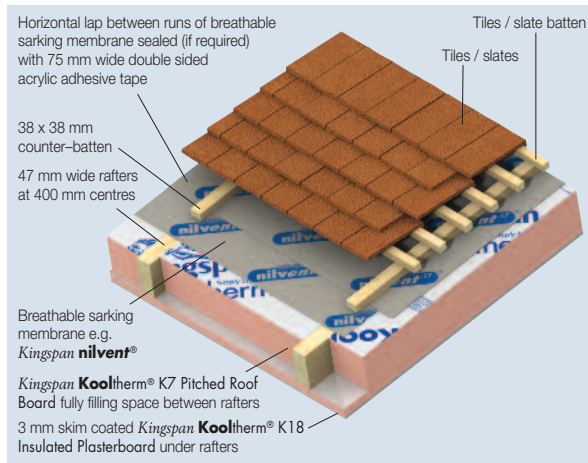
*The bridging effect of the Kingspan **OPTIM-R** flex component of the System is taken as 15%.
 **Assuming thermal conductivity 0.038 W/m·K.
 NB For the purposes of these calculations, using the method as detailed in BS EN ISO 13370: 1998, the soil has been assumed to be clay or silt, and the wall insulation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

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Using the **Kingspan Kooltherm**® 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 - Refurbished / Retained Elements

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



Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K				
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)
Kingspan Kooltherm ®	100	100	52.5	152.5
Glass Fibre* (Between)	125	125	102.5	227.5
& XPS** (Under)	100	100	132.5	232.5

THINNER

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*Assuming thermal conductivity 0.037 W/m·K.

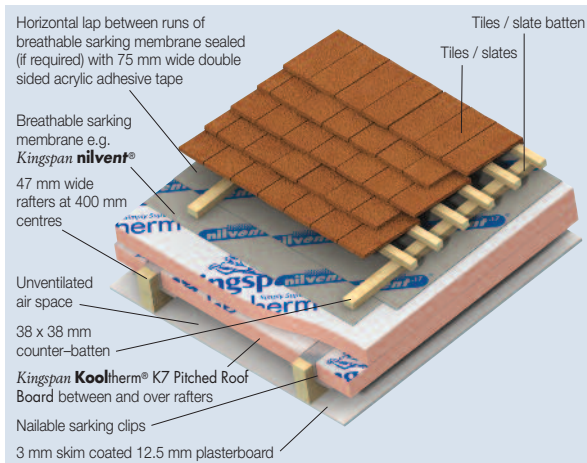
**Assuming thermal conductivity 0.036 W/m·K.

***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 102.5 mm XPS insulated plasterboard is insignificant as the insulation layer penetrated is not the main insulation layer.

Using **Kingspan Kooltherm**® 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 Material	Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K			
	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)
<i>Kingspan Kooltherm</i> ®	100	55	55	155
Rock Fibre*	140	140	80	220
XPS**	100	80	120	220

THINNER

THICKER

*Assuming thermal conductivity 0.038 W/m·K for between & 0.036 W/m·K for over.

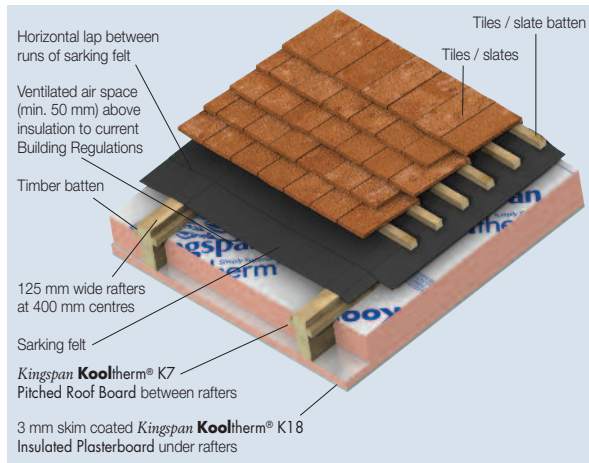
**Assuming thermal conductivity 0.036 W/m·K.

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 Kooltherm*® 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 - Refurbished / Retained Elements

Pitched Roof - Loft Conversion with Insulation Between & Under Rafters



Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K				
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)
Kingspan Kooltherm®	125	75	62.5	187.5
Glass Fibre* (Between) & XPS** (Under)	125	75	147.5	272.5

THINNER

THICKER

*Assuming thermal conductivity 0.037 W/m·K.

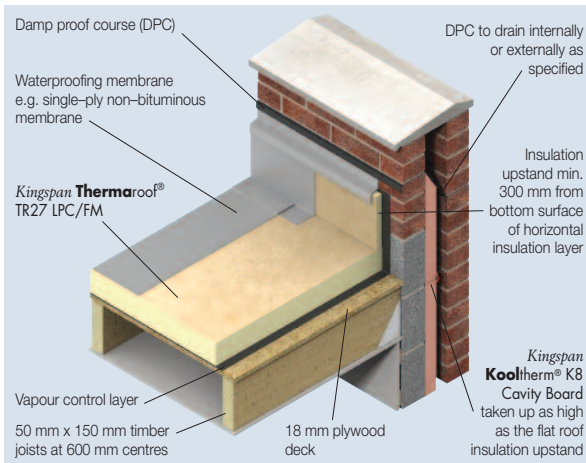
**Assuming thermal conductivity 0.036 W/m·K.

***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®** insulated plasterboard is insignificant as the insulation layer penetrated is not the main insulation layer.

Using **Kingspan Kooltherm®** 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 severe practicality issues with fixing a 147.5 mm insulated plasterboard product.

Flat Roof - Timber Deck



Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R Roofing System* & Kingspan Thermaroof ® TR27 LPC/FM (Overlay)	35 + 25	60
Kingspan Thermaroof ® TR27 LPC/FM	120	120
Rock Fibre**	95 + 95	190

* 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.

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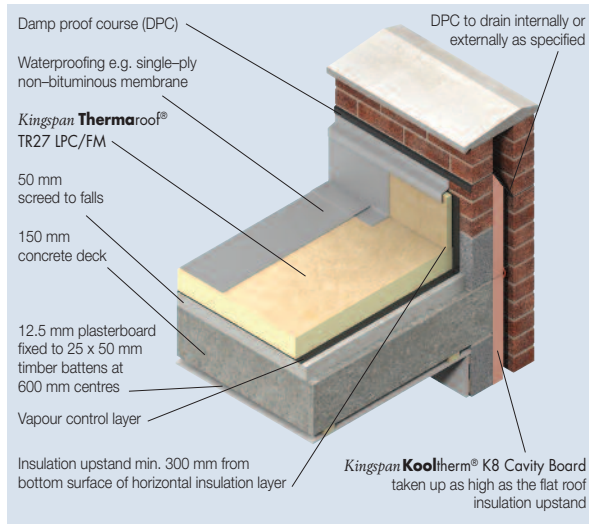
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It can be seen from the tables above that the **Kingspan OPTIM-R** Roofing System insulation thickness can be significantly less than that for rock mineral fibre - one third of the thickness, which may allow lower parapets. Furthermore, the weight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

Kingspan Insulation Solutions - Refurbished / Retained Elements

Flat Roof - Concrete Deck



Insulation Thicknesses to Achieve a U-value of 0.18 W/m ² -K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R® Roofing System* & Kingspan Thermaroof® TR27 LPC/FM (Overlay)	35 + 25	60
Kingspan Thermaroof® TR27 LPC/FM	120	120
Rock Fibre**	95 + 95	190

* 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.

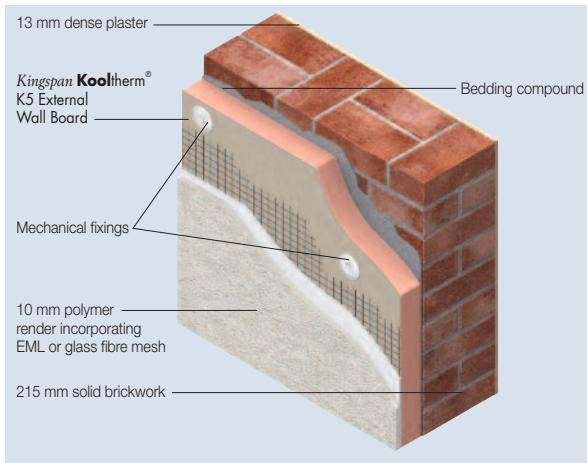
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It can be seen from the tables above that the **Kingspan OPTIM-R™ Roofing System** insulation thickness can be significantly less than that for rock mineral fibre - one third of the thickness, which may allow lower parapets. Furthermore, the weight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

Solid Walls - External Wall Insulation



Insulation Thicknesses to Achieve a U-value of 0.30 W/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R External Wall System*	35	35 (+ 12 mm carrier board)
Kingspan Kooltherm ®	55	55
Rock Fibre**	105	105
EPS**	105	105

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* 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%.

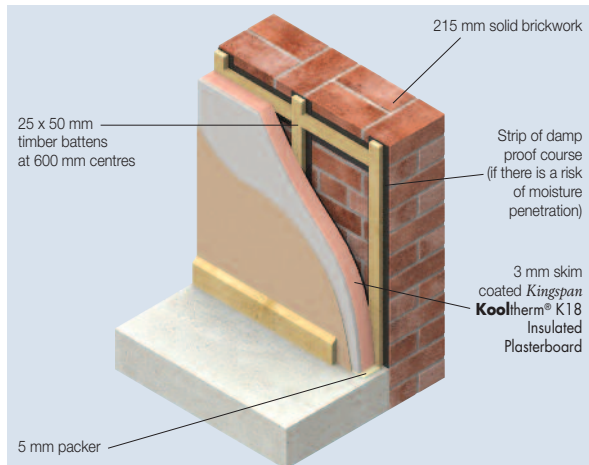
**Assuming thermal conductivity 0.038 W/m·K.

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 Kooltherm® 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 - Refurbished / Retained Elements

Solid Wall - Internal Wall Insulation



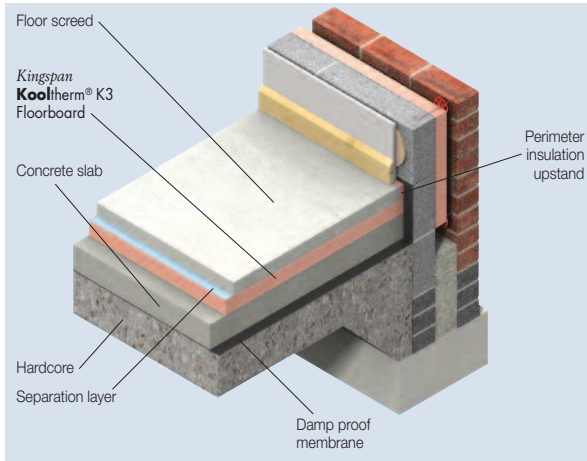
Insulation Thicknesses to Achieve a U-value of 0.30 W/m ² -K		
Insulation Material	Insulation Plasterboard Thickness (mm) ^{***}	Overall Thickness (mm)
Kingspan Kooltherm [®]	62.5	62.5
XPS [*]	112.5	112.5
Glass Fibre ^{**}	130 ^{****}	145

^{*}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.

THINNER
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Using **Kingspan Kooltherm**[®] 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/m ² ·K		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)
Kingspan OPTIM-R Flooring System*	25	25
Kingspan Kooltherm ®	50	50
EPS**	90	90

*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.

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Using the **Kingspan Kooltherm**® 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.

Customer Service

Tel: 01544 388 601

Fax: 01544 388 888

email: customerservice@kingspaninsulation.co.uk

Literature & Samples

Tel: 01544 387 384

Fax: 01544 387 484

email: literature@kingspaninsulation.co.uk

Tapered Roofing

Tel: 01544 387 383

Fax: 01544 387 483

email: tapered@kingspaninsulation.co.uk

Technical Advice

Tel: 01544 387 382

Fax: 01544 387 482

email: technical@kingspaninsulation.co.uk

General Enquiries

Tel: 01544 388 601

Fax: 01544 388 888

email: info@kingspaninsulation.co.uk



Kingspan Insulation Ltd

Pembridge, Leominster, Herefordshire HR6 9LA, UK

www.kingspaninsulation.co.uk

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