Insulation

CI/SfB Rn7 M2

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Building Regulations for the Conservation of Fuel & Power

WALES – EXISTING BUILDINGS OTHER THAN DWELLINGS

2014 EDITION

Kingspan®

Low Energy – Low Carbon Buildings

Contents

Introduction

Approved Documents L

Approved Documents L (ADL), published by the Welsh Government (Llywodraeth Cymru), provide technical guidance on how to meet the energy efficiency requirements of the Building Regulations 2010, as amended, for building work carried out in Wales.

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 2014 edition of ADL2B for use in Wales, including the salient changes from the 2010 edition, which was for use in both England & Wales. 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 to 'existing buildings other than dwellings' including those that contain rooms for residential purposes, such as those in nursing homes or halls of residences containing student accommodation.

The 2014 edition of ADL2B came into effect on 31st July 2014. The guidance given is applicable to non–exempt 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

ADL2B is applicable to existing buildings other than dwellings where the building work comprises the extension, conversion or renovation of the building (or parts of), which are subject to the energy efficiency requirements of the regulations i.e. walled and roofed constructions that use energy to heat or cool the indoor climate (but not for process needs such as egg hatching facilities) It gives specific guidance for building work involving, amongst other things, windows and doors, fixed buildings services and thermal elements.

Windows and doors are defined as those that separate a conditioned space from the external environment, the ground, and any parts of the building which are not conditioned or, where another part of the building, which is not a dwelling, is heated or cooled to a different temperature.

A fixed building service is defined as any part of, or any controls associated with either, or a combination of: fixed internal or external lighting systems (excluding emergency escape or specialist process lighting); or fixed systems for heating, hot water, air–conditioning or mechanical ventilation.

A thermal element is defined as a roof, wall or floor, which separates a heated space from the external environment, the ground and any unheated parts of the building, or where another part of the building that is not considered part of the building itself (e.g. an indoor car park) is heated to a different temperature.

There are however, some instances where ADL2B indicates that it may be more appropriate to follow only some of the guidance that it gives or to follow the guidance given in ADL1B or ADL2A. These are:

- buildings such as shell and core offices or business park units – ADL2A should be used for first fit–out works, whilst ADL2B should be used for subsequent fit–out works;
- large extensions to existing buildings – ADL2A should be used where the extension comprises a total useful floor area greater than 100 m^2 and is greater than 25% of the total useful floor area of the existing building, and ADL2B should be used where there is a requirement for consequential improvements;
- modular and portable buildings – ADL2A should be used where the work involves the construction of sub–assemblies obtained from centrally held stock or from the disassembly or relocation of such buildings at other premises, and ADL2B should be used where there is a requirement for consequential improvements i.e. if the work comprises the extension of an existing building; and
- buildings containing one or more dwellings either before or after the work is completed – ADL1B should be used for each dwelling.

New or Replacement Thermal Elements

Any new or replacement roofs, walls and floors in extensions, conversions and material changes of use should achieve, or better, the maximum U–values shown in Table 1.

Element[1]	Maximum U–value[3] (W/m²·K)	
	Buildings Essentially Domestic in Character[2]	All Other Non–Domestic Buildings
Lofts	0.15	0.15
Other roofs	0.15	0.18
Walls	0.21	0.26
Floors[4]	0.18	0.22

[1] *'Roof and loft' includes the roof and loft parts of dormer windows, and 'wall' includes the walls or cheeks of dormer windows.*

[2] *For example, student accommodation, care homes, and similar uses where occupancy levels and internal gains are essentially domestic in character.*

[3] *U–values for thermal elements comprising roofs, walls and floors, should be calculated using the methods and conventions set out in BR 443 (Conventions for U–value Calculations).*

[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 building.*

Table 1: Maximum U–values for New or Replacement Thermal Elements

Retained Thermal Elements

Where an existing thermal element is either part of a building that is subject to a material change of use, or is to become part of the thermal envelope where previously it was not e.g. as part of an extension or a conversion where the space is now to be heated, reasonable provision would be to upgrade the element to achieve the maximum U–value for that element type set out in Table 2, provided that it is functionally, technically and economically feasible. A reasonable test of economic feasibility is to achieve a payback for the initial cost of the upgrade measure through energy savings within 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 annual energy savings should be estimated using in accordance with the latest version of the National Calculation Methodology (NCM) using approved software; and
- VAT should be taken into account for both the cost and the saving.

If achievement of the maximum U–value is not functionally, technically or economically feasible, the element should be upgraded to the best standard that is functionally, technically and economically feasible. Generally, this lesser standard should be no worse than the limiting U–value for that element type also set out in Table 2.

Examples of where a lesser provision than the maximum U–value might apply are where the weight of the additional insulation might not be supported by the existing structure, or where the thickness of the additional insulation might reduce the usable floor area of any room by more than five per cent, create difficulties with adjoining floor levels, or create insufficient headroom.

In such cases, the choice of insulant should be based upon the best thermal performance that is practicable to achieve a U–value as close as possible to the limiting U–value for each element type.

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the 'Design Flexibility' section of this document.

Element[1]	Maximum U–value[2] ($W/m^2 \cdot K$)	Limiting U–value[2] ($W/m^2 \cdot K$)
Lofts	0.16	0.35
Other roofs	0.18	0.35
Walls – cavity insulation[3]	0.55	0.70
Walls – external or internal insulation	0.30	0.70
Floors[4]	0.25	0.70

[1] 'Roof and loft' includes the roof and loft parts of dormer windows, and 'wall' includes the walls or cheeks of dormer windows.
[2] U–values for thermal elements comprising roofs, walls and floors, should be calculated using the methods and conventions set out in BR 443 (Conventions for U–value Calculations).
[3] If a wall has a cavity but it is not suitable for filling with cavity insulation, it should be treated as 'wall – external or internal insulation'.
[4] 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 2: Maximum U–values for Retained or Renovated Thermal Elements

Renovated Thermal Elements

The renovation of a thermal element through the provision of a new layer means either:

- cladding or rendering its external surface; or
- dry–lining its internal surface.

The renovation of a thermal element through the replacement of an existing layer means either:

- stripping it down to its basic structural components (masonry, timber frame, steel frame etc) and then rebuilding it; or
- replacing the waterproof membrane of a flat roof.

Where a thermal element is subject to renovation, the performance of the whole element should be improved to achieve, or better, the maximum U–value for that element type shown in Table 2, provided the area to be renovated is greater than 50% of the surface of the individual element, or 25% of the surface of the total building envelope.

When assessing this percentage, the area of the element should be taken as that of the individual element, and 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 the 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 and not the total roof area of the building.

As with retained thermal elements, if achievement of the maximum U–value is not functionally, technically or economically feasible, the element should be upgraded to the best standard that is functionally, technically and economically feasible. Generally, this lesser standard should be no worse than the limiting U–value for that element type also set out in Table 2.

Examples of where a lesser provision than the maximum U–value might apply are where the weight of the additional insulation might not be supported by the existing structure, or where the thickness of the additional insulation might reduce the usable floor area of any room by more than five per cent, create difficulties with adjoining floor levels or create insufficient headroom.

In such cases, the choice of insulant should be based upon the best thermal performance that is practicable to achieve a U–value as close as possible to the limiting U–value for each element type.

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the ‘Design Flexibility’ section of this document.

For guidance on payback calculations see the ‘Retained Thermal Elements’ section of this document.

Approved Document L2B – Existing Buildings Other than Dwellings

Thermal Elements in Extensions

Where a proposed extension has a total useful floor area that is 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 or floors, the work should comply with the requirements for new or replacement thermal elements, as detailed above.

Where the work involves the incorporation of a part of the existing building structure not previously subject to the energy efficiency requirements e.g. a garage, any retained roofs, walls or floors should comply with the requirements for retained thermal elements, as detailed above.

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the 'Design Flexibility' section of this document.

Thermal Elements in Conversions, Material Change of Use & Change of Energy Status

Where a building is subject to a conversion, a change of use e.g. from one non–dwelling building type to another, or to a change to its energy status e.g. any change which results in the building becoming subject to the energy efficiency requirements of the Building Regulations, where previously it was not, then ADL2B requires the thermal performance of the roof, walls and floors to 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 or floors, the work should comply with the requirements for new or replacement thermal elements, as detailed above.

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

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the 'Design Flexibility' section of this document.

Windows & Doors

ADL1B gives specific guidance for building work comprising the installation of replacement, the enlargement of existing and the creation of new windows and doors. It also however, gives separate guidance, which includes elemental requirements for window, door, roof window and rooflight U–values, for extensions, conversions, material changes of use and conservatories and porches.

In all cases, insulated cavity closers should be installed around new windows and doors, where appropriate.

Fixed Building Services

ADL2B refers directly to the Non–Domestic Building Services Compliance Guide for the minimum standards of energy efficiency for work involving the provision, extension, alteration or replacement of a fixed building service.

Conservatories & Porches

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; are thermally separated from the heated space of the building; and do not contain an independent fixed heating appliance or do not use the heating system of the building whereby the system is extended into the conservatory or porch.

Non–exempt conservatories and porches should be thermally separated from the heated space of the building and their opaque roof, wall and floor elements should achieve U–values no worse than those given in Table 3.

Element[1]	Maximum U–value[2] for new fabric
Walls	0.28[3]
Floors[4]	0.22[5]
Pitched roofs – insulation at ceiling level	0.16
Pitched roofs – insulation at rafter level	0.18
Swimming pool basins	0.25

[1] *Roof includes the roof parts of dormer windows, and 'wall' includes the wall parts (cheeks) of dormer windows.*
[2] *U–values for thermal elements comprising roofs, walls and floors, should be calculated using the methods and conventions set out in BR 443 (Conventions for U–value Calculations).*
[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*

Table 3: Maximum U–values for New Thermal Elements in Non–Exempt Conservatories & Porches

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

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the 'Design Flexibility' section of this document.

Indoor Swimming Pools

Both the walls and floors comprising the basin of new indoor swimming pools should achieve a U–value no worse than 0.25 $W/m^2 \cdot K$. In addition, design consideration should be given to: compressive creep, insulation boards not being fully supported; and the effects of point loading. Furthermore, particular care should be given to the avoidance of thermal bridging – especially around basin wall and floor junctions with foundations.

Two alternative optional approaches are also allowed, providing greater design flexibility. For details, refer to the 'Design Flexibility' section of this document.

Consequential Improvements

Consequential improvements (subject to technical, functional and economical feasibility) are required:

- for all existing buildings other than dwellings where the building is extended or converted such that there is a requirement for the provision or extension of a fixed heating appliance in a previously unheated space; or
- for those existing buildings other than dwellings with a total useful floor area greater than 1000 m^2 where a new fixed building service is provided for the first time, or the installed capacity of an existing service (other than renewable energy generators) is increased.

Where a building is extended, or part of the building is converted, increasing the conditioned volume, a way of complying would be to adopt measures such as those in Table 4 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 circuit watt 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 to the maximum U–values 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·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
Measures specified in an assessment provided by an accredited Green Deal Assessor
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 4: Improvements that in Ordinary Circumstances are Practical & 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, 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 U–values worse than the limiting U–values set out in Table 2 should be upgraded following the guidance for retained thermal elements. There is also a requirement for the upgrading of existing windows, roof windows, rooflights or doors (but excluding display windows and high usage entrance doors) within the area served.

Where the installed capacity per unit area of a cooling system is increased, the thermal elements within the area served which have U–values worse than the limiting U–values set out in Table 2 should be upgraded following the guidance for retained thermal elements. There is also a requirement for solar control provisions and 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.

Design Flexibility

In order to allow greater design flexibility, some elements of the design may be relaxed if compensated for elsewhere. For example, where the required area of windows and doors exceeds the limit for extensions set out in ADL2B, improved wall and floor U–values may balance the shortfall associated with the increase in heat gains / losses through the glazing.

There are two alternative optional approaches to the standards based approach set out in the relevant sections of ADL2B. These are:

- the U–value trade off approach, which requires the calculation of an area–weighted average U–value; and
- the equivalent carbon target approach, which requires an assessment carried out by an accredited Non–Domestic Energy Assessor (NDEA) in accordance with the NCM, to calculate the CO_2 emissions for both the notional and actual proposals.

Both approaches require two calculations. One is based upon a notional building that complies with the requirements set out in the relevant sections of ADL2B to form the benchmark proposal. The other is based upon the actual building, which if required, can trade–off better performance against poorer performing elements, so long as it complies with the benchmark.

Although U–value requirements maybe relaxed, the U–value of any individual thermal element should be no worse than the limiting U–value for that element type set out in Table 2, for both the U–value trade–off and equivalent carbon target approaches.

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.

Design & Installation Standards

The new or replacement building fabric should be carefully designed, detailed and constructed to: avoid gaps in the insulation; minimise air–leakage; and limit reasonably avoidable thermal bridges. Particular attention should be paid around window and door openings, to junctions between building elements, such as between the walls and roof, and at changes of geometry, for example a corner in a wall or a hip in a roof. For new building fabric, this requirement can be achieved by adopting the Accredited Construction Details (ACDs) for Part L.

Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not continuous and the cavity between them is subject to air movement. To avoid this problem, either the insulation layer should be continuous 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 construction design details approved by the Welsh Government; or to demonstrate that the specified details provide adequate protection against surface condensation using the guidance in IP 1/06 and BR 497.

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, if you require similar calculations for other constructions.

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

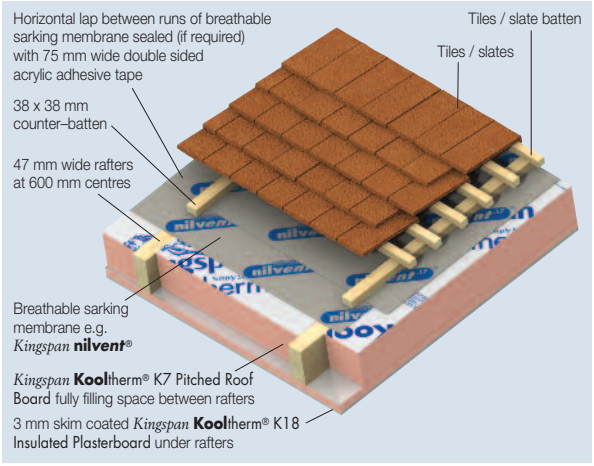
- BS EN ISO 6946: 2007 (Building components & building elements. Thermal resistance & thermal transmittance. Calculation method);
- BS EN ISO 13370: 2007 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods); and
- using the conventions set out in BR 443 (Conventions for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

Kingspan Insulation Solutions – New Thermal Elements

Pitched Roof – Insulation Between & Under Rafters



Insulation Thicknesses to Achieve Different U–values

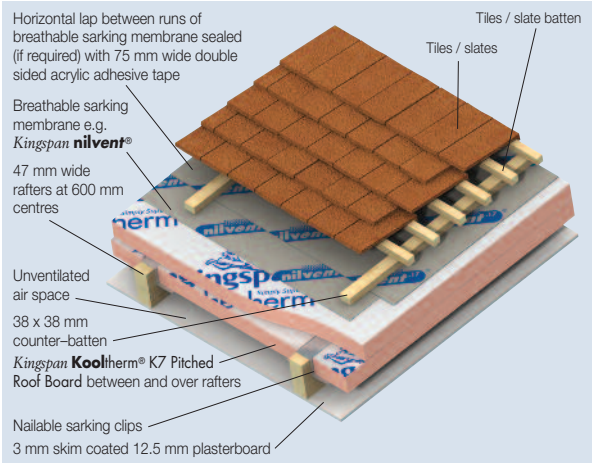
	U–value (W/m²·K)								
	0.18				0.15				
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan Kooltherm®	100	100	42.5	142.5	100	100	62.5	162.5	THINNER
Glass Fibre* (Between) & XPS** (Under)	125 100	125 100	92.5 122.5	217.5 222.5	125 100	125 100	132.5 162.5	257.5 262.5	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 16.7 fixings per m². The effect of fixings for Kingspan Kooltherm® and both the 92.5 mm and 132.5 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 and 162.5 mm insulated plasterboard product.

Kingspan Insulation Solutions – New Thermal Elements

Pitched Roof – Insulation Between & Over Rafters



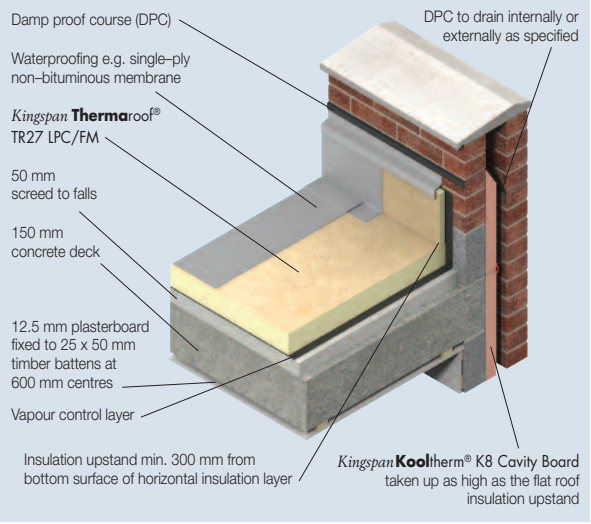
Insulation Thicknesses to Achieve Different U–values

Insulation Material	U–value (W/m²·K) 0.18 Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)***	Overall Insulation Thickness (mm)	0.15 Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)***	Overall Insulation Thickness (mm)	
Kingspan Kooltherm®	100	50	55	155	100	60	70	170	THINNEST
Rock Fibre*	100	100	110	210	100	100	140	240	THINNER
XPS**	100	80	120	220	100	100	140	240	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 of 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



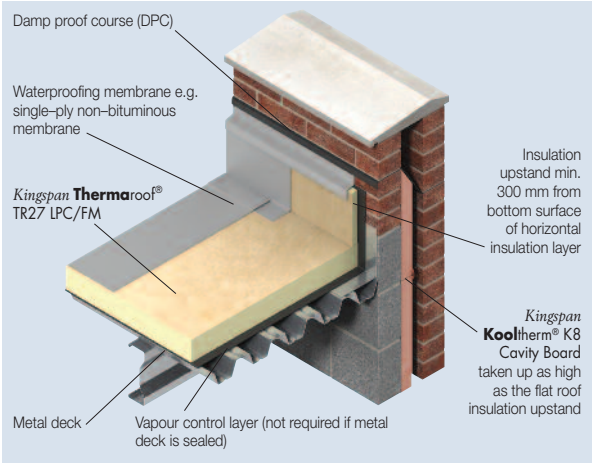
Insulation Thicknesses to Achieve Different U–values					
	U–value (W/m²·K)				
	0.18		0.15		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ **Roofing System*** & *Kingspan* **Therma**roof® TR27 LPC/FM (Overlay)	35 + 25	60	45 + 25	70	THINNEST
Kingspan **Therma**roof® TR27 LPC/FM	120	120	145	145	THINNER
Rock Fibre**	95 + 95	190	80 + 145	225	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 Thermal Elements

Flat Roof – Metal Deck



Insulation Thicknesses to Achieve Different U–values

Insulation Material	U–value (W/m²·K) 0.18 Insulation Thickness (mm)	0.18 Overall Thickness (mm)	0.15 Insulation Thickness (mm)	0.15 Overall Thickness (mm)	
Kingspan OPTIM-R™ Roofing System* & Kingspan Thermaroof® TR27 LPC/FM (Overlay)	40 + 25 (+ 12 mm particle board)	77	50 + 25 (+ 12 mm particle board)	82	THINNEST
Kingspan Thermaroof® TR27 LPC/FM	130	130	155	155	THINNER
Rock Fibre**	95 + 105	200	120 + 120	240	THICKER

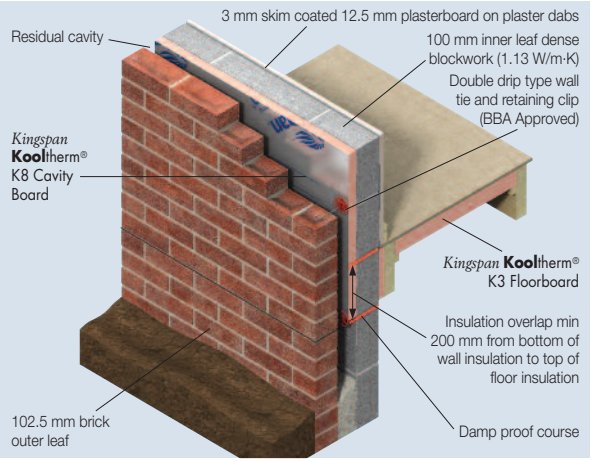
In the Kingspan OPTIM-R™ Roofing System a 12 mm cement particle decking board is installed over the metal deck and below the VCL. The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 10%.

***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 Different U–values					
	U–value (W/m²·K)				
	0.26		0.21		
Insulation Material	Insulation Thickness (mm)	Overall Cavity Width (mm)	Insulation Thickness (mm)	Overall Cavity Width (mm)	
Kingspan **Kool**therm® (Partial Fill)	55	105	70	120	THINNER
Glass Fibre* (Full Fill) 120	130**	130	160**	160	THICKER

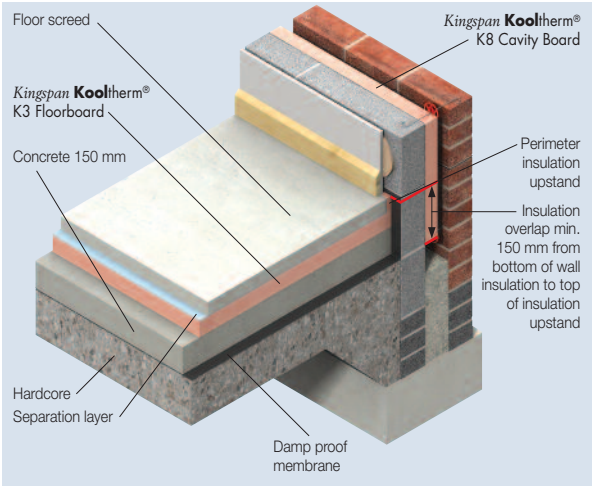
**Assuming thermal conductivity 0.037 W/m·K.*
***The insulation fully, rather than partially, fills the cavity and, so, the wall tie specification will differ and no retaining clips will be present.*
NB When calculating U–values to BS EN ISO 6946: 2007, the type of wall tie used may change the thickness of insulation required.
These calculations assume the following:

- *for 105 & 120 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 130 & 160 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.*

The *Kingspan* **Kool**therm® K8 Cavity Board solution, reduces total wall width by 15 mm, compared with the glass mineral fibre full fill alternative shown above.

Kingspan Insulation Solutions – New Thermal Elements

Ground Floor – Solid Concrete

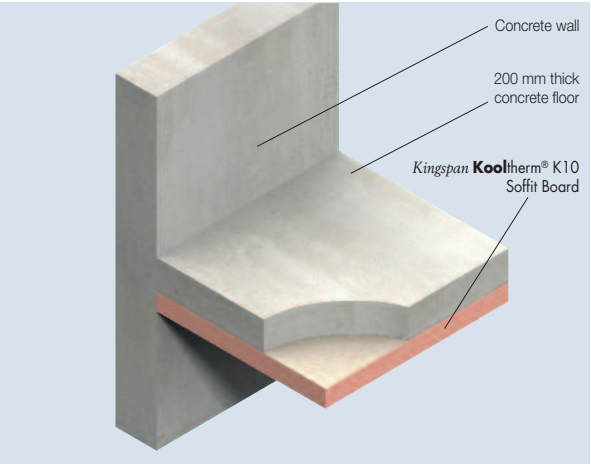


Insulation Thicknesses to Achieve Different U–values					
	U–value (W/m²·K)				
	0.22		0.18		
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Flooring System*	30	30	35	35	THINNEST
Kingspan Kooltherm®	60	160	75	75	THINNER
EPS**	110	110	140	140	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



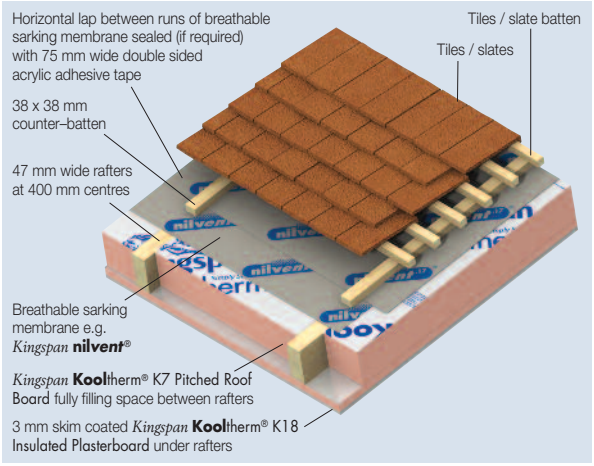
Insulation Thicknesses to Achieve Different U–values					
	U–value (W/m²·K)				
	0.22		0.18		
Insulation Material	Insulation Thickness (mm)	Overall Soffit Thickness (mm)	Insulation Thickness (mm)	Overall Soffit Thickness (mm)	
Kingspan **Kool**therm®	85	285	105	305	THINNER
Rock Fibre*	160	360	100 + 100	400	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 roughly 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 – Retained or Renovated Thermal Elements

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

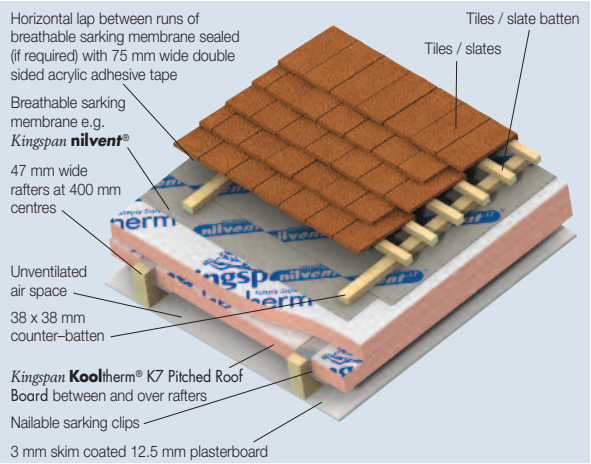


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Under Rafter Insulated Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan Kooltherm®	100	100	52.5	152.5	THINNER
Glass Fibre* (Between)	125	125	102.5	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 16.7 fixing 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* **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



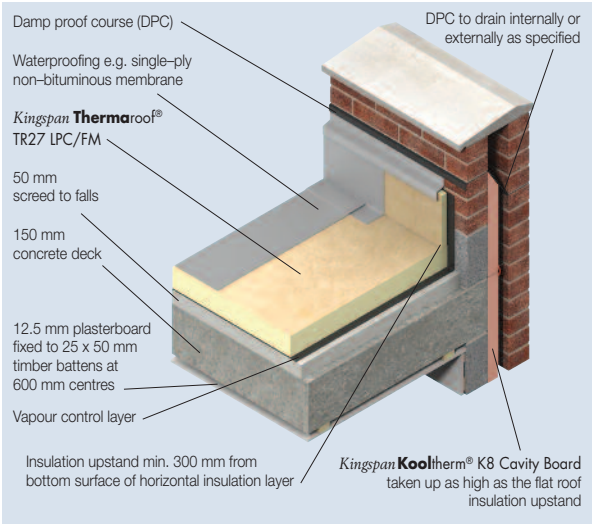
Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K					
Insulation Material	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan **Kool**therm®	100	55	55	155	THINNER
Rock Fibre*	140	140	80	220	
XPS**	100	80	120	220	THICKER

**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 of 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 – Retained or Renovated Thermal Elements

Flat Roof – Concrete Deck

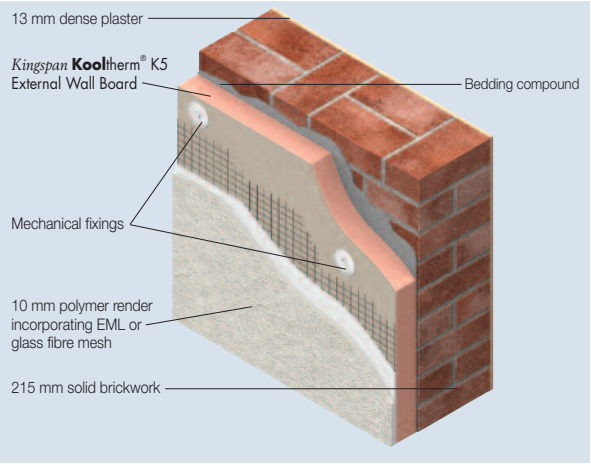


Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Roofing System* & Kingspan Thermaroof® TR27 LPC/FM (Overlay)	35 + 25	60	THINNEST
Kingspan Thermaroof® TR27 LPC/FM	120	120	THINNER
Rock Fibre**	95 + 95	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 (+12 mm carrier board)	47	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%.*

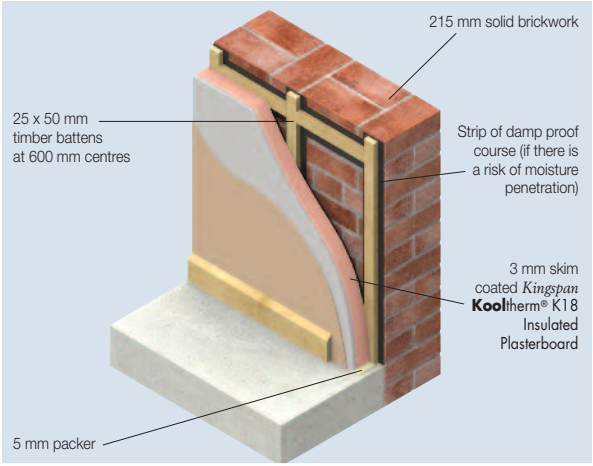
***Assuming thermal conductivity 0.038 W/m·K.*

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 – Retained or Renovated Thermal Elements

Solid Wall – Internal Wall Insulation

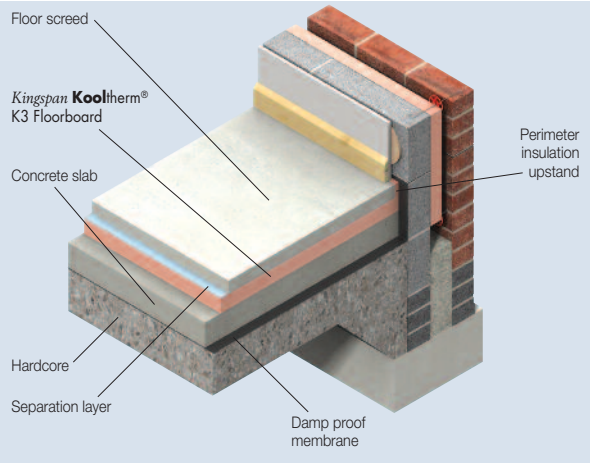


Insulation Thicknesses to Achieve a U–value of 0.30 W/m²·K			
Insulation Material	Insulation Plasterboard Thickness (mm)***	Overall Thickness (mm)	
Kingspan **Kool**therm®	62.5	62.5	THINNER
XPS*	112.5	112.5	
Glass Fibre**	130****	145	THICKER

**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



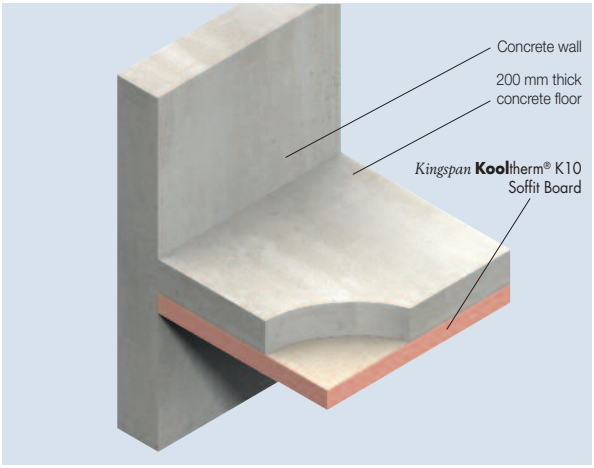
Insulation Thicknesses to Achieve a U–value of 0.25 W/m²·K			
Insulation Material	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan OPTIM-R™ Flooring System*	25	25	THINNEST
Kingspan **Kool**therm®	50	50	THINNER
EPS**	90	90	THICKER

**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 – Retained or Renovated Thermal 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 Soffit Thickness (mm)	
Kingspan **Kool**therm®	75	275	THINNER
Rock Fibre*	140	340	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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