Insulation

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Building Regulations for the Conservation of Fuel and Power

NEW BUILD – BUILDINGS OTHER THAN DWELLINGS

PART L 2010 Health Check

Kingspan®

Low Energy – Low Carbon Buildings

Contents

Introduction

The requirements for conservation of fuel and power, which includes thermal insulation, in buildings in England & Wales are detailed in Approved Documents (AD) L1A, L1B, L2A & L2B to the Building Regulations 2010.

This document is designed as a simple guide to the new 2010 Edition of Approved Document L2A (Conservation of fuel and power in new buildings other than dwellings) to the Building Regulations 2010 (England & Wales), showing how to meet its requirements using solutions from Kingspan Insulation.

Details are given about the content of the new Approved Document L2A, the effects it will have on methods of roof, wall and floor construction and the thicknesses of Kingspan Insulation products required to achieve the new standards. The required thicknesses of other commonly used insulation materials are also shown for the purposes of comparison.

Should you require further information about any of the new Approved Documents (L1A, L1B, L2A & L2B) or how Kingspan Insulation products can be used to comply with the changing Regulations, please contact the Kingspan Insulation Technical Services Department (see rear cover).

Approved Document L2A – A Summary

Types of Work Covered

The new 2010 Edition of Approved Document L2A – Conservation of fuel and power in new buildings other than dwellings (ADL2A) to the Building Regulations 2010 (England & Wales) came into effect on October 1, 2010 and, from that date, all plans submitted for Building Control approval need to comply with the new requirements.

The Approved Document provides guidance on how to, in ordinary circumstances, comply with the relevant Building Regulations when carrying out:

- work on new buildings other than dwellings;
- fit–out works if these are included as part of the construction of the building; and
- extensions with a total useful floor area greater than 100 m^2 and greater than 25% of the total useful floor area of the existing building other than dwelling.

There are certain types of work in relation to new buildings where ADL2A says that the use of either ADL1A (New Dwellings) or ADL2B (Existing Buildings other than Dwellings) is likely to be more appropriate.

These are:

- buildings that contain dwellings – in most instances, ADL1A should be used for guidance relating to the works on the individual dwellings with ADL2A 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;
- if a building that is to be used for commercial purposes but contains living accommodation, it should be treated as a dwelling if the commercial part of the building could revert to domestic use on change of ownership; and
- fit–out works not included as part of the construction of the building should use ADL2B.

Complying with the Building Regulations

There is a need to show that the carbon dioxide (CO_2) emissions from the building other than dwelling as constructed are as good as, if not better than a defined target and that, in so doing, limits to design flexibility for individual elements, e.g. wall U–value, floor U–value, fixed building services, are met. There is also a requirement to show that the quality of construction ensures that the building other than dwelling, as built, achieves the intended performance standard. There are other requirements to which insulation has limited or no significance.

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.

Conservatories

If a conservatory is built as part of the new building, its performance should be assessed following the guidance given in ADL2B.

Swimming Pool Basins

Where a swimming pool basin is constructed as part of a new building, the basin should have a U–value no worse than 0.25 $W/m^2 \cdot K$, calculated according to BS EN ISO 13370. The CO_2 emissions of the building other than dwelling should be assessed as if the basin were not there although the pool hall should be included. The floor area covered by the basin should be assumed to have a U–value equivalent to that of the pool surround for the purposes of calculating the CO_2 emissions of the building.

Carbon Dioxide Emissions

The new ADL2A is based on a whole building approach to CO_2 emissions. All buildings other than dwellings must be designed and built such that their Building CO_2 Emissions Rate (BER) is no worse than a defined Target CO_2 Emissions Rate (TER).

The BER and TER are expressed in mass of CO_2 in kilograms per square metre of total useable floor area per year ($kg/m^2/yr$). They are calculated using the Government's Simplified Building Energy Model (SBEM) for those buildings whose design features are capable of being adequately modelled by SBEM, or other approved software, by considering amongst other things space heating & cooling, hot water, ventilation and internal fixed lighting requirements for the specific building activity.

The TER is calculated by using approved software to determine the CO_2 emissions from a notional building of the same size and shape as the actual building using the reference values set out in the 2010 NCM Modelling Guide.

Note that the TER is no longer based on a 2002 notional building and an improvement factor. This approach to target setting has been adopted because the level of improvement that can be reasonably expected varies significantly by building sector and so a blanket improvement factor would be inequitable. The specification delivers an overall 25% reduction in $C0_2$ emissions across the new–build mix for the non–dwellings sector (the so–called 'aggregate approach'). Some building types will be required to improve by more than 25%, some by less, but all should achieve the required level of improvement at approximately the same cost of carbon mitigation.

A pre–construction design BER calculation should be carried out, using the same calculation tool as used to calculate the TER, and provided to the building control body along with a list of specifications, so as to indicate that the design is compliant and to generate a list of features critical to compliance.

The final calculation of BER for the purposes of demonstrating compliance must be based on the building as constructed and include any changes to the performance specification made during construction and the measured air permeability.

The BER can be reduced by specific factors if advanced energy management features are provided in the actual building.

Approved Document L2A – A Summary

Limits to Design Flexibility

The new Approved Document sets limiting U–value standards for the envelope of a building other than dwelling in order to ensure a reasonable minimum envelope performance.

This provision is included to make building other than dwelling designs robust for future changes in heating system, e.g. if a renewable energy system is installed it may not be replaced upon failure and it would be inappropriate to allow the cost of the system to be compensated for with poor envelope performance.

It is of note that the use of these limiting U–values will almost certainly result in the building other than dwelling failing to achieve the required TER.

A limiting value of 10 $m^3/hour/m^2$ at 50 Pa is also set for air permeability and limits are also given for the performance of the building services of the building other than dwelling.

Linear Thermal Bridging

The 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, and at the edges of elements such as those around window and door openings.

Reasonable provision would be:

- to adopt a quality–assured approved accredited construction details scheme, in which case the calculated linear thermal transmittance (ψ) value can be used directly in the BER calculation;
- to use details that are not part of a quality–assured approved accredited construction details scheme, but that have ψ–values calculated by a person with suitable expertise and experience, in which case the calculated ψ–values for use in the BER calculation are increased by 0.02 W/m·K or 25% whichever is greater;
- to use unaccredited details, with no specific ψ–value quantification, in which case the generic linear thermal bridge values given in IP 1/06, increased by 0.04 W/m·K or 50% whichever is greater, must be used in the BER calculation.

ψ–values and temperature factors should be calculated following the guidance set out in BR 497, with temperature factors no worse than the performance set out in BRE IP 1/06 and, for the first two approaches, the builder must demonstrate that an appropriate system of site inspection is in place to give confidence that the construction procedures achieve the required standards of consistency.

NB At the time of publication no accredited construction details schemes had been approved. Until such time that accredited construction details schemes are approved, the calculated value of linear transmittance may be used in SAP without any performance penalty being added, where this has been calculated by a suitably experienced and qualified person, and the builder has provided information about the way the detail is to be constructed to building control.

Air Permeability Testing

The designer chooses the performance standard for air permeability when calculating the BER.

In order to comply, the air permeability, measured by pressure testing, should not be worse than 10 $m^3/hour/m^2$ at 50 Pa and the BER calculated using the measured air permeability should not be worse than the TER.

All buildings other than dwellings, including extensions which fall under ADL2A, should be pressure tested with the following exceptions:

- buildings with a total useable floor area less than 500 m^2 – the developer may choose to avoid the need to air pressure test provided that the air permeability used in the BER is taken as 15 $m^3/hour/m^2$ at 50 Pa;
- factory made modular buildings with a total useable floor area less than 500 m^2, a planned time of use of more than 2 years at more than one location, and where no site assembly work is needed other than making linkages between standard modules using standard link details – the installer must have pressure test data from a minimum of five in–situ measurements incorporating the same module types and link details as utilised in the actual building, indicating that the average test result is better than the design air permeability as specified in the BER calculation by not less than 1 $m^3/hour/m^2$ at 50 Pa;
- large extensions, covered by ADL2A, where sealing off the extension from the existing building is impractical;
- large complex buildings – where the building size is too large or complex, it might be impractical to carry out an air pressure test, instead, a way of showing compliance would be to appoint a suitably qualified person to undertake a detailed programme of design development, component testing and site supervision to give confidence that a continuous air barrier will be achieved – in this case it would not be reasonable to claim air permeability better than 5.0 $m^3/hour/m^2$ at 50 Pa has been achieved; and
- compartmentalised buildings – where buildings are compartmentalised into self–contained units with no internal connections it may be impractical to carry out whole building pressure tests, instead, reasonable provision would be to carry out a pressure test on a representative area of the building.

If a building other than dwelling fails to achieve compliance then remedial measures should be carried out on the building other than dwelling such as on re–test the measured air permeability is not worse than 10 $m^3/hour/m^2$ at 50 Pa and the BER calculated using the measured air permeability is not worse than the TER.

If it proves impractical to meet the design air permeability, any shortfall must be compensated through improvements to subsequent fit–out activities. Builders may therefore wish to schedule pressure tests early enough to facilitate remedial work on the building fabric.

If the measured air permeability on retest is greater than the design air permeability but less than the limiting value of 10 $m^3/hour/m^2$ at 50 Pa, then other improvements may be required to achieve the TER. This means that builders would be unwise to claim a design air permeability better than 10 $m^3/hour/m^2$ at 50 Pa unless they are confident of achieving the improved value.

Other Requirements

The Approved Document also contains requirements for the avoidance of overheating caused by excessive solar gains, the commissioning of building services systems and the provision of operating and maintenance instructions.

Simplifying the Complex

The Pitfalls in the Approach & What U-Values Should be Adopted

The new ADL2A is here at last, and although many would argue that the latest changes could have been more stringent given the imperative of climate change, they are here for the next three years and the focus now has to be on how the new demands are going to be met.

Whilst there is flexibility in the method, a certain amount of caution needs to be exercised in the complicated task of achieving compliance, in order to avoid leaving a building vulnerable to either failure on completion or deterioration in the future.

The use of an overall CO_2 emissions method of calculating compliance is now well established in people's consciousness. What is also fairly widely understood is the much broader scope that is allowed by the overall carbon dioxide emissions method, e.g. the ability to consider, amongst other things, air leakage rates and site installed renewable energy supply. However, there needs to be a clear caveat to these approaches.

As a fundamental principle of energy saving, the primary focus should always be on ensuring that the building fabric is intrinsically thermally efficient. It makes no sense to have excessive and heavy outlay on expensive renewable supply, without first reducing energy demand. Renewables are a valuable way to build on the reduction in CO_2 emissions when the building envelope provides robust and low energy consumption, but if they are put in at the expense of the building fabric thermal efficiency they represent an overly capital intensive investment.

Low air leakage rates again should be treated with caution. They are a desirable feature of low CO_2 emission buildings, but the construction industry today has so far failed to prove that it can ubiquitously deliver air–leakage rates of 7 $m^3/hour/m^2$ at 50 Pa or less with traditional building technologies. There may be potentially heavy remedial costs involved if a building reliant on a low air leakage rate to meet the requirements of ADL1A fails its pressure test, costs exacerbated by delay whilst remedial work is carried out. Adopting the minimum required value of 10 $m^3/hour/m^2$ at 50 Pa would be much more prudent.

The answer to all of these issues lies in the building fabric. The new ADL2A contains minimum fallback U–values for the building fabric but much tighter standards will be required for most buildings to hit their CO_2 emissions target. The actual U–value required will depend on the design of the building, orientation, heating system etc. etc. etc. There is massive flexibility……..and complexity. It is estimated that a specifiers may have to go through 10–20 iterations of SBEM or another approved tool in order to get their design to comply with the new requirements.

However, analysis to date is showing that, for buildings that are not heavily air–conditioned, the U–values in Table 3 are at or around the best starting point for specifiers to work from in getting their design to comply with ADL2A. They will be almost exactly what is required for some buildings and short of what is required for others, but at least the will cut some of the iterations out of the design process. The gap between what these U–values provide and the target emissions rate can be made up by any other the other variables in SBEM or other approved tools.

Element	U–value ($W/m^2{\cdot}K$)
All roofs	0.14
Walls	0.22
Floors	0.18

Table 3 Recommended Starting Point U–values

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 Table 3. 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.

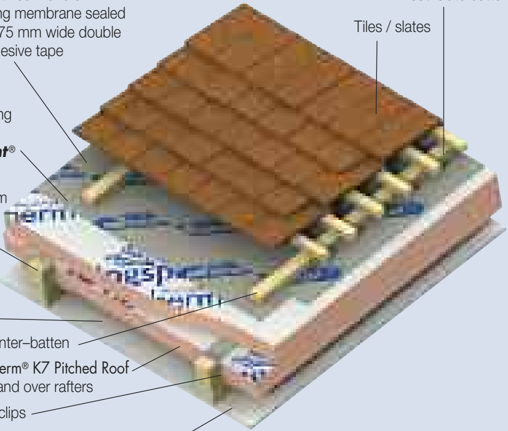
U–values have been calculated using the methods detailed in BS EN ISO 6946: 2007 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method), BS EN ISO 13370: 1998 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods), 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).

Solutions

Pitched Roofs – Insulation Between and Over Rafters



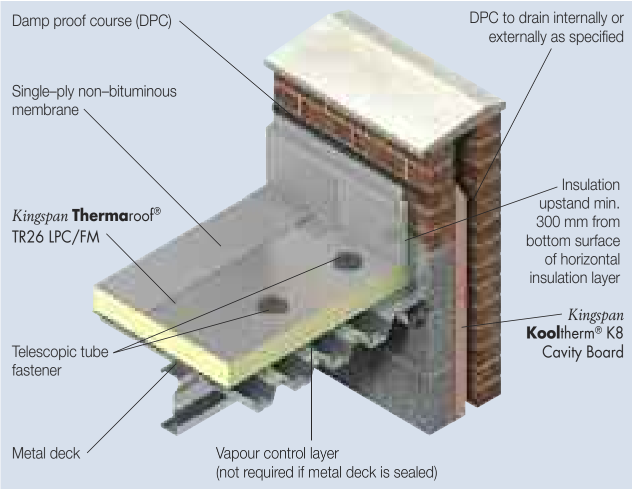
Kingspan **Kool**therm® Solution to Achieve a U–Value of 0.14 W/m²·K
100 mm deep rafters with 70 mm *Kingspan* **Kool**therm® K7 Pitched Roof Board between, and 70 mm *Kingspan* **Kool**therm® K7 Pitched Roof Board over rafters

What Solution(s) Other Insulation Manufacturers Might Offer
195 mm deep rafters with 195 mm rock mineral fibre (0.038 W/m·K) between, and 80 mm rock mineral fibre (0.036 W/m·K) over rafters
100 mm deep rafters with 100 mm extruded polystyrene (0.030 W/m·K) between, and 115 mm extruded polystyrene (0.029 W/m·K) over rafters
Assumes construction as illustrated above, but with different types and thicknesses of insulation material, and a different rafter depth (in one case).

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.

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 over rafter layers of insulation are fixed using stainless steel fixings with a cross sectional area 7.45 mm², with 8.3 per m² (insulant thickness 61–80 mm) and 10.0 per m² (insulant thickness > 80 mm).

Flat Roofs – Metal Deck



Kingspan **Therma**roof® Solution to Achieve a U–Value of 0.14 W/m²·K
150 mm *Kingspan* **Therma**roof® TR27 LPC / FM in a single layer

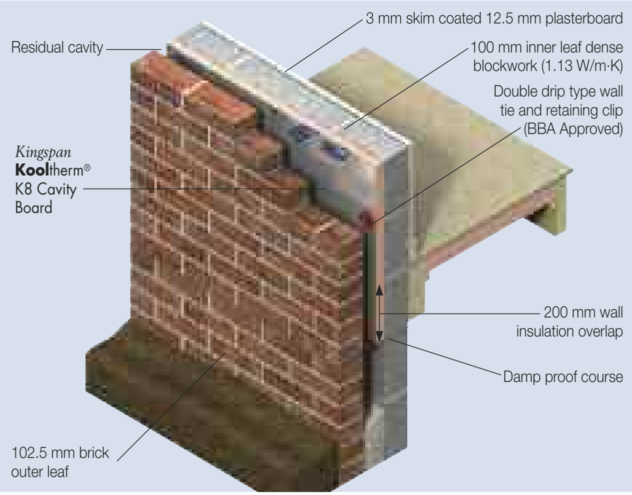
What Solution(s) Other Insulation Manufacturers Might Offer
260 mm rock mineral fibre (0.038 W/m·K) in two layers (95 & 165 mm)
Assumes construction as illustrated above, but with a different type and thickness of insulation material.

Using Kingspan Thermaroof® can result in thinner insulation, which may allow lower parapets and shorter fixings. The Kingspan Thermaroof® solution shown requires a single layer of insulation compared with the double layer rock mineral fibre solution. Furthermore, the weight of the insulation in the rock mineral fibre solution, shown above, will be over 8 times that in the Kingspan Thermaroof® solution. The manual handling and roof loading implications of this weight should be carefully considered.

NB These calculations assume that insulation boards are mechanically fixed through a sealed metal deck, or a vapour control layer. 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 telescopic tube fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

Solutions

Cavity Walls



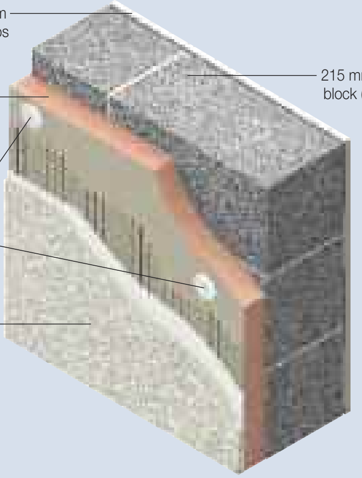
Kingspan **Kool**therm® Solution to Achieve a U–Value of 0.22 W/m²·K
65 mm partial fill *Kingspan* **Kool**therm® K8 Cavity Board in an overall 115 mm wide cavity

What Solution(s) Other Insulation Manufacturers Might Offer
155 mm full fill glass mineral fibre (0.037 W/m·K) in an overall 155 mm wide cavity
Assumes construction as illustrated above, but with a different type and thickness of insulation material. The insulation fully, rather than partially, fills the cavity and, so, the wall tie specification will differ and no retaining clips will be present.

A cavity of just 115 mm can be used with the Kingspan Kooltherm® K8 Cavity Board solution, reducing total wall width by 40 mm, compared with the glass mineral fibre full fill alternative shown above. A 155 mm wide cavity may require a much more onerous wall tie specification, which will increase thermal bridging.

NB When calculating U–values to BS EN ISO 6946: 2007, the type of wall tie used may change the thickness of insulation required. For 115 mm cavity widths, calculations assume a stainless steel flexible tie with 2.5 ties per m² and a cross–sectional area of 12.50 mm². For 155 mm full fill cavity widths, calculations assume a stainless steel flexible tie with 2.5 ties per m² and a cross–sectional area of 30.00 mm².

Solid Walls



Kingspan **Kool**therm® Solution to Achieve a U–Value of 0.22 W/m²·K
60 mm *Kingspan* **Kool**therm® K5 External Wall Board

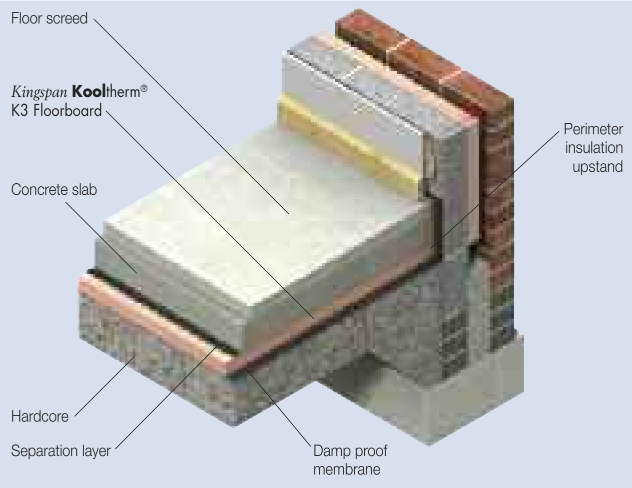
What Solution(s) Other Insulation Manufacturers Might Offer
110 mm of rock mineral fibre (0.038 W/m·K) or expanded polystyrene (0.038 W/m·K)
Assumes construction as illustrated above, but with different types and thicknesses of insulation materials.

Using Kingspan Kooltherm® can give a wall width, excluding lining, of just 285 mm compared with the alternatives shown above, which require a 50 mm wider wall.

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 telescopic tube fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

Solutions

Ground Floors – Solid Concrete



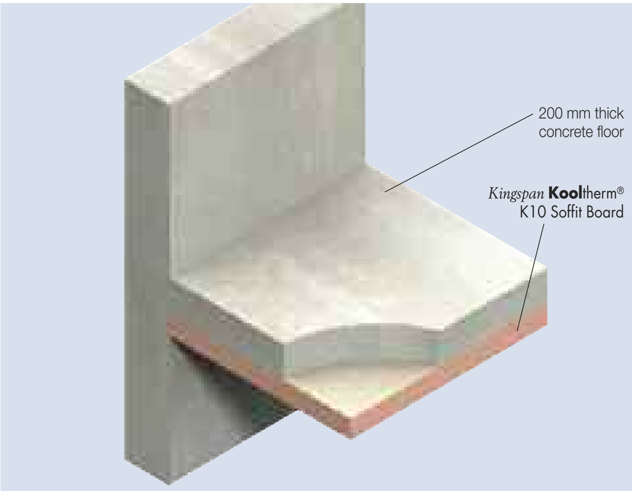
Kingspan **Kool**therm® Solution to Achieve a U–Value of 0.18 W/m²·K
45 mm *Kingspan* **Kool**therm® K3 Floorboard under slab or under screed with floor P/A ratio of 0.2

What Solution(s) Other Insulation Manufacturers Might Offer
90 mm of expanded polystyrene (0.038 W/m·K) under slab or under screed with floor P/A ratio of 0.2
Assumes construction as illustrated above, but with a different type and thickness of insulation material.

Using Kingspan Kooltherm® rather than extruded polystyrene, in the floor shown above, can result in having to dig out, and dispose of, only half as much soil to make the space to accommodate the insulation.

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.

Soffits



Kingspan **Kool**therm® Solution to Achieve a U–Value of 0.18 W/m²·K
110 mm *Kingspan* **Kool**therm® K10 Soffit Board

What Solution(s) Other Insulation Manufacturers Might Offer
195 mm of rock mineral fibre (0.038 W/m·K)
Assumes construction as illustrated above, but with a different type and thickness of insulation material.

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

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 telescopic tube fasteners with a thermal conductivity of 1.00 W/m·K or less, the effect of which is insignificant.

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