Insulation

CI/SfB
Rn7 M2
First Issue August 2014

# Building Regulations for the Conservation of Fuel & Power

WALES – NEW 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 give 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 ADL2A 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 L2A – New Buildings other than Dwellings

## Introduction

ADL2A gives guidance on ways of demonstrating 'reasonable provision' for compliance with the energy efficiency requirements of the Building Regulations, relevant to building work carried out on 'new buildings other than dwellings'.

The 2014 edition of ADL2A 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

ADL2A is applicable to new 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), when carrying out building work comprising:

- the construction of new non–domestic buildings;
- fit–out works, if included as part of the construction of a new building, or is the first fit–out of a shell and core development (e.g. business park units) where the shell is sold or let before the fit–out work is carried out;
- large extensions to existing buildings 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;
- modular and portable buildings where an existing module with an anticipated service life greater than two years is placed onto a new site, and 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;
- heated partitions of non–exempt buildings with a low energy demand e.g. an office in an unheated warehouse;
- the construction of indoor swimming pools, which are constructed as part of a new building; and
- the construction of conservatories and / or porches, which are constructed at the same time as a new building, thermally separated from the building and heated by a fixed heating system.

However, there are some instances where ADL2A indicates that it may be more appropriate to follow the guidance given in ADL1A or ADL2B. These are:

- buildings containing dwellings e.g. mixed–use developments – ADL1A should be used for individual dwellings contained within the larger building, whereas ADL2A should be used for the parts of the building that are not dwellings e.g. commercial or retail spaces, a caretakers office within a block of apartments and heated common areas (NB unheated common areas in residential buildings containing multiple dwellings should meet the area weighted limiting fabric standards detailed in ADL1A);
- buildings containing both living accommodation and space for commercial use (i.e. live–work units) – ADL1A should be used if the commercial part of the building could revert to domestic use e.g. a workshop in a house where both spaces are contained within the same heated space, there is direct access between the two spaces and much of the total area comprises the living accommodation;
- buildings for workshop, industrial or agricultural use with a high energy demand – fixed building services should satisfy the standards set out in ADL2B;
- fit–out works not included as part of the construction of the building – ADL2B should be used; and
- new conservatories and / or porches utilising a fixed heating system that is either independent of, or dependent on the building – ADL2B should be used where the conservatory and / or porch is constructed as an addition to an existing building, and ADL2A should be used where construction takes place at the same time as a new building.

## Compliance with the Building Regulations

**Demonstrating Compliance**

ADL2A gives criteria that must be met in order to demonstrate compliance with the energy efficiency requirements of the Building Regulations. These criteria comprise a mix of mandatory requirements and statutory guidance, some of which have little or no significance to insulation. Those that do are outlined below.

First and foremost, there is a need to show that the designed carbon dioxide ($CO_2$) emissions for the whole of the building (referred to as the ‘Dwelling $CO_2$ Emission Rate’ and expressed as ‘BER’), does not exceed a defined maximum allowable emission rate (referred to as the ‘Target $CO_2$ Emission Rate’ and expressed as ‘TER’). Equally, the designed primary energy for the whole of the building (referred to as the ‘Building Primary Energy Consumption’ and expressed as ‘BPEC’) must not exceed a defined maximum allowable primary energy consumption rate (referred to as the ‘Target Primary Energy Consumption’ and expressed as ‘TPEC’). NB Primary energy is energy that has not been subjected to any conversion or transformation process, which, in this case comprises the energy delivered to the building plus the energy used to produce that delivered energy.

TER, BER, TPEC and BPEC calculations, for buildings other than dwellings, should be carried out by an accredited energy assessor in accordance with the National Calculation Methodology (NCM) using either the Simplified Building Energy Model (SBEM) for buildings whose design features are capable of being adequately modelled by SBEM.

Secondly, individual building fabric elements and fixed building services must meet or exceed specified energy efficiency backstop standards, which limit design flexibility.

Thirdly, there is a need to show that the quality of construction is such that the energy performance of the building ‘as constructed’ matches or exceeds that ‘as designed’.

**Evidence of Compliance**

Much of the evidence that demonstrates compliance with the energy efficiency requirements can comprise the results of calculations carried out using approved compliance software such as iSBEM.

ADL2A recommends that two versions of the evidence are presented to the BCB in a standardised format. The first version should be submitted at pre–construction ('as designed') stage not less than one day before commencement of the works, and the second at post–construction ('as constructed') stage not more than five days after completion of the works.

Both the 'as designed' and 'as constructed' submissions should include the TER/BER and TPEC/BPEC calculations as well as a list of specifications, whilst demonstrating how they are met. NB The 'as constructed' submission should also include the assessed air–permeability of the building and any deviations from the 'as designed' specifications.

The two submissions can be compared and used by the BCB to assist in checking whether what has been constructed matches what has been designed. A clear connection should be made between the data input into the compliance software and the product specifications e.g. the type of wall construction that delivers the claimed U–value.

The calculations for the 'as constructed' submission may be used to provide information for the preparation of the Energy Performance Certificate (EPC) for the completed building.

## $CO_2$ Emissions & Primary Energy Consumption

**TER/BER & TPEC/BPEC**

ADL2A adopts a 'whole building' approach to minimising $CO_2$ emissions and primary energy consumption. A new building other than a dwelling must be designed and constructed such that:

- its BER is no worse than its TER; and
- its BPEC is no worse than its TPEC.

The TER and BER are expressed as the mass of $CO_2$ in kilograms, per square metre of total usable floor area per annum (kg/m$^2$/yr), whilst the TPEC and BPEC are expressed as the amount of primary energy consumed in units of kilowatt hours per square metre of total usable floor area per annum (kWh/m$^2$/yr).

TER, BER, TPEC and BPEC calculations take account of the requirements for space heating and cooling, hot water, ventilation and indoor fixed lighting, amongst other things, using standardised assumptions for the activities specific to the type of building and its use.

**Determining the TER & TPEC**

A 'notional building' of the same size and shape as the 'actual building', constructed to a concurrent specification, is used to determine the TER and TPEC. The ADL2A 2014 notional building is categorised into three building types:

- side lit or unlit and with a heating only HVAC specification;
- side lit or unlit and with a HVAC specification that includes cooling; and
- top lit.

The ADL2A 2014 notional building specification for each building type is summarised in Appendix B of ADL2A and detailed in the 2013 edition of the NCM Modelling Guide for Wales (2013 Wales NCM Modelling Guide).

In some instances, the specifications for the different elements of each of the above vary – most notably those for air–permeability, which differ according to the gross internal area of the building. In other instances, the specifications are the same e.g. those for the renewable energy contribution, where the area of roof mounted photovoltaic (PV) panels comprises 5.3% of the gross internal area of the building for all three building types.

The specification for the PV element is taken into account only when determining the TER, and not the TPEC. In order to ensure that the TPEC is based only on the energy performance of the building fabric and fixed building services, energy generated by the PV system is disregarded, thus inhibiting the incorporation of renewables to compensate for lesser performing fabric and services.

**Achieving the TER & TPEC**

The pre–construction BER and BPEC calculations should be carried out and presented to the BCB along with a list of specifications, so as to indicate that the building, 'as designed', is compliant and to generate a list of features critical to compliance.

The post–construction, or final, BER and BPEC are calculated using the performance standards of the actual building. For the purpose of demonstrating compliance, the final BER and BPEC calculations must be based upon the building 'as constructed' and must not only include any changes to the performance specification during construction, but also the assessed air–permeability.

It is possible to reduce the BER and BPEC by specific adjustment factors if enhanced energy management and control features that meet certain criteria are provided in the actual building.

## Indoor Swimming Pools

Where a swimming pool is constructed as part of a new building, the building should be assessed as though the pool basin is not present. The pool hall however, should be included in the TER, BER, TPEC and BPEC calculations. For the purpose of calculating the $CO_2$ emissions and primary energy consumption, the area covered by the pool basin should be treated as an equivalent area of floor with a U–value equivalent to that of the pool surround and, as shown in Table 1, no worse than 0.25 $W/m^2{\cdot}K$, calculated in accordance with BS EN ISO 13370 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods).

## Limits on Design Flexibility

**Limiting Fabric Standards**

Achieving the TPEC, which limits heat gains and losses through the building fabric and limits energy consumption by fixed building services, could be dependent upon very good performance of one specific design feature, yet poorer performance elsewhere. In order to ensure that the envelope of a building achieves a minimum energy performance, ADL2A sets out area weighted limiting U–value standards for the different fabric elements. This provision is included to make the design of the building robust should the performance of one fabric element fail or perform less well than expected, or should the heating system be changed in the future. For instance, if a renewable energy system is installed it may not be replaced upon failure, and allowing its installation to be to the detriment of reasonable building fabric energy performance, would be inappropriate.

The limiting U–values for different fabric elements are shown in Table 1. It is of note that the use of the limiting U–values will almost certainly result in the building failing to achieve the required TER and TPEC, thus U–values, significantly better than those shown, are likely to be required.

NB The values shown in the table below are **not** the U–values that should be adopted for compliance with the Building Regulations. For guidance, see the 'Simplifying the Complex' section of this document.

| Fabric Element | Area Weighted Average U–value (W/m²·K) |
|---|---|
| Roofs | 0.25 |
| Walls | 0.35 |
| Floors & Swimming Pool Basins | 0.25 |
| Windows, Roof Windows, Rooflights, Curtain Walling & Pedestrian Doors | 2.20 |
| Vehicle Access & Similar Large Doors | 1.50 |
| High Usage Entrance Doors & Roof Ventilators | 3.50 |

Table 1: Area Weighted Limiting Fabric Parameters

**Limits for Air–Permeability & Fixed Building Services**

A limiting value of 10 $m^3/hr/m^2$ at 50 Pa is set for air–permeability. In addition, limits are also set for the energy performance of the fixed building services installed in the building, the minimum energy efficiency standards for which are set out in the Non–Domestic Building Services Compliance Guide.

## 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 in the continuity of the layers; at the joints between elements; and at the edges of elements such as those around window and door openings.

Reasonable provision in the BER and BPEC calculations would be to:

a. use construction joint details that have been calculated by a person with suitable expertise and experience, following the guidance set out in BRE Report BR 497 (Conventions for calculating linear thermal transmittance and temperature factors), with a calculated temperature factor no worse than the performance set out in BRE IP1/06 (Assessing the effects of thermal bridging at junctions and around openings), and following a process flow sequence that has been provided to the BCB, indicating the way in which the detail should be constructed. In which case, the calculated linear thermal transmittance values (referred to as 'psi–values' and expressed as 'ψ–values') can be used directly in the BER and BPEC calculations (NB With increasing importance being placed upon reducing the performance gap between as–built and designed, this approach requires the builder to be able to demonstrate that an appropriate system of site inspection is in place to give confidence that the construction procedures achieve the required standards of consistency); or

b. use unaccredited details, with no specific ψ–value quantification, in which case the generic linear thermal bridge values given in BRE IP1/06 (Assessing the effects of thermal bridging at junctions and around openings), increased by 0.04 W/m·K or 50%, whichever is greater, must be used in the BER and BPEC calculations.

The adoption of design details that are formally recognised by DCLG is considered to fall under the approach described in 'a', therefore the calculated ψ–value can be used directly in the BER and BPEC calculations.

## Air-Permeability Testing

### Achieving Acceptable Air–Permeability

A performance standard is selected at design stage to determine the design air–permeability of a building for use in the pre–construction BER and BPEC calculations. The achieved air–permeability, measured by pressure testing at construction stage, is used in the post–construction BER and BPEC calculations.

Compliance with the requirements would be demonstrated if:

- the measured air–permeability is no worse than the limiting value of 10 $m^3/hr/m^2$ at 50 Pa; and
- the BER and BPEC, calculated using the measured air–permeability, are no worse than the corresponding TER and TPEC.

If a building fails to achieve compliance, then remedial measures should be carried out on the building such that on retest, the measured air–permeability is better than 10 $m^3/hr/m^2$ at 50 Pa and the BER and BPEC, calculated using the re–measured air–permeability, are no worse than the corresponding TER and TPEC.

If it proves impractical to meet the design air–permeability, any shortfall must be compensated for by improvements to subsequent fit–out activities. It would therefore be wise 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 $m^3/hr/m^2$ at 50 Pa, other improvements may be required to achieve the TER and TPEC. It would therefore be unwise to claim a design air–permeability better than 10 $m^3/hr/m^2$ at 50 Pa, unless there is confidence in achieving the improved value.

### Exemptions from Pressure Testing

All buildings, including applicable extensions, should be pressure tested except for the following exceptions:

- buildings with a total useful floor area less than 500 $m^2$ – if desired, the need to pressure test may be avoided by using an air–permeability value of 15 $m^3/hr/m^2$ at 50 Pa when calculating the BER and BPEC, on the condition that compensating improvements are made to other elements of the building fabric and services;
- factory made modular buildings with a floor area less than 500 $m^2$, a planned service life greater than two 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 those used in the actual building, indicating that the average test result is better than the design air–permeability as specified in the BER and BPEC calculations by not less than 1 $m^3/hr/m^2$ at 50 Pa;
- large extensions, covered by ADL2A, where sealing off the extension from the existing building is impractical;
- large complex buildings – in the circumstance that a building is too large or complex, it may be impractical to carry out an air pressure test, therefore an alternative way of demonstrating 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 that an air permeability better than 5 $m^3/hr/m^2$ at 50 Pa has been achieved; and
- compartmentalised buildings – it may be impractical to carry out whole building pressure tests in buildings that are compartmentalised into self–contained units with no internal connections, in which case, reasonable provision would be to carry out a pressure test on a representative area of the building.

## Other Requirements

ADL2A also contains requirements for the analysis of the feasibility of high efficiency alternative systems e.g. heat pumps or renewable energy powered district heating or cooling, the avoidance of overheating caused by excessive solar gains, the commissioning of building services systems and the provision of operating and maintenance instructions.

Furthermore, ADL2A requires the use of adequate and proper materials when carrying out building work, which must be executed in such a manner that a good standard of workmanship is achieved.

## Simplifying the Complex

Whilst the ADL2A 2014 notional building specification has been strengthened, primarily through increased air–tightness and improved system efficiencies, to deliver 20% $CO_2$ savings across the new non–domestic building mix relative to ADL2A 2010, the primary focus should still be on ensuring that the building fabric is sufficiently air–tight and intrinsically thermally efficient before other energy reduction / generation measures are considered, hence the introduction of the TPEC.

The practicalities of delivering air–permeability rates of 7 $m^3/hr/m^2$ at 50 Pa, let alone 5 or 3 $m^3/hr/m^2$ at 50 Pa, using traditional building technologies can be challenging. Reliance upon low air–permeability to meet the energy efficiency requirements may give rise to potentially hefty remedial costs upon failure to pass pressure tests – costs exacerbated by delay whilst the work is being carried out. Thus, adopting the minimum required value of 10 $m^3/hr/m^2$ at 50 Pa would be far more prudent.

Although the fabric targets for the differing building types in the notional building specification remain unchanged, analysis carried out by Kingspan Insulation is shows that, for buildings that are not heavily reliant on cooling, the U–values in Table 2 are at or around the best starting point for specifiers to work from to succeed in getting the 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 they will cut out some of the many iterations out of the design process. The gap between what these U–values provide and the target $CO_2$ emissions and primary energy consumption rates can be made up by any of other the other variables in iSBEM or other approved software.

| Element | U–value ($W/m^2 \cdot K$) |
|---|---|
| Roofs | 0.14 |
| Walls | 0.22 |
| Floors | 0.18 |

Table 2: Best Starting Point U–values

# Kingspan Insulation Solutions

## Constructions & U-Values

Set out in the following pages are examples of constructions using Kingspan Insulation products, which are designed to achieve the U–values shown in Table 2.

Each example construction is accompanied by a table, which gives the corresponding U–values and shows the practical thicknesses of Kingspan Insulation products required to achieve them. It is important to note that these U–values are valid only for the illustrated construction. Furthermore, these constructions do not comprise an exhaustive list of Kingspan Insulation solutions. Contact the Technical Service Department if similar calculations for other constructions are required.

In addition, possible alternative solutions using other common insulation materials are shown for the purpose of comparison.

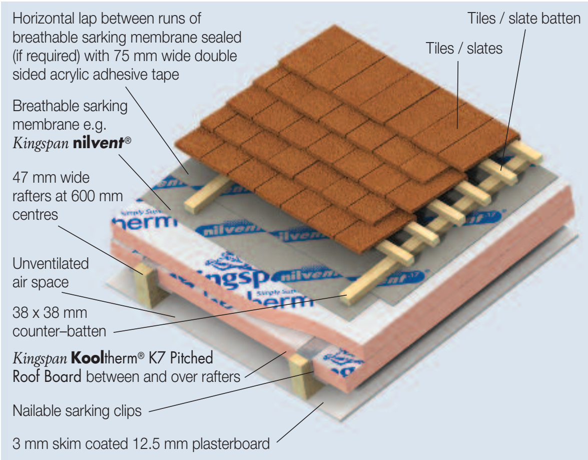
U–values have been calculated using the methods detailed in:

- BS EN ISO 6946: 2007 (Building components and 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 purpose of these calculations the standard of workmanship has been assumed good, and therefore the correction factor for air gaps has been ignored.

All figures quoted are for guidance only. A detailed U–value calculation and a condensation risk analysis should be carried out for each project. In which case, contact the Kingspan Insulation Technical Service Department.

# Pitched Roof – Insulation Between & Over Rafters



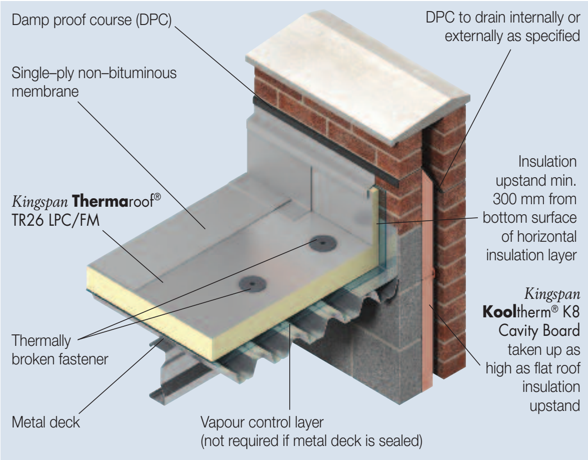

| Insulation Thicknesses to Achieve a U–value of 0.14 W/m²·K | | | | | |
|---|---|---|---|---|---|
| Insulation Material | Rafter Depth (mm) | Between Rafter Insulation Thickness (mm) | Over Rafter Insulation Thickness (mm) | Overall Thickness (mm) | |
| *Kingspan* **Kool**therm® | 100 | 70 | 70 | 170 | THINNER |
| Rock Fibre* | 195 | 195 | 80 | 275 | THICKER |
| XPS** | 150 | 150 | 125 | 275 | |

**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 8.3 per m² (insulant thickness 61–80 mm) and 10.0 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

## Flat Roof – Metal Deck

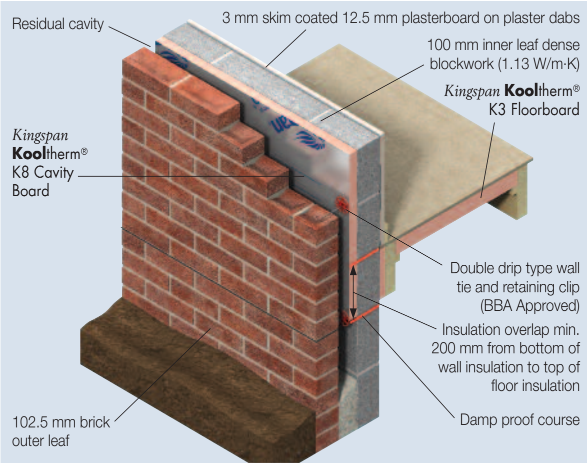



| Insulation Thicknesses to Achieve a U–value of 0.14 W/m²·K | | | |
|---|---|---|---|
| Insulation Material | Insulation Thickness (mm) | Overall Thickness (mm) | |
| *Kingspan* OPTIM-R™ Roofing System* & *Kingspan* **Therma**roof® TR27 LPC/FM (Overlay) | 50 + 25 (+ 12 mm particle board) | 87 | THINNEST |
| *Kingspan* **Therma**roof® TR26 LPC/FM | 150 | 150 | THINNER |
| Rock Fibre** | 95 + 165 | 260 | 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 – 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 8 times that in the *Kingspan* **Therma**roof® solution. The manual handling and roof loading implications of this weight should be carefully considered.

# Cavity Wall – Cavity Insulation Only




| Insulation Thicknesses to Achieve a U–value of 0.22 W/m²·K | | | |
|---|---|---|---|
| Insulation Material | Insulation Thickness (mm) | Overall Cavity Width (mm) | |
| *Kingspan* **Kool**therm® (Partial Fill) | 65 | 115 | THINNER |
| Glass Fibre* (Full Fill) | 155** | 155 | THICKER |

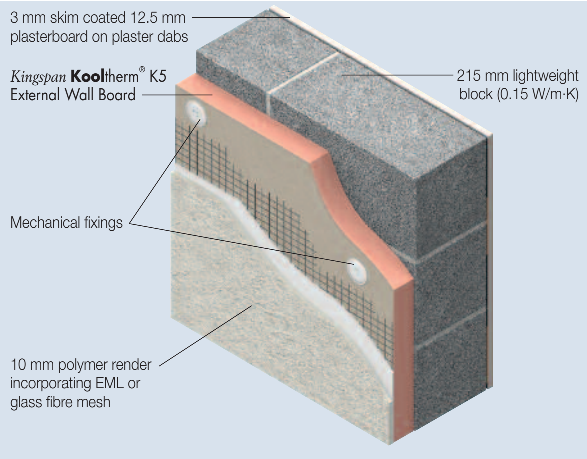
**Assuming thermal conductivity 0.037 W/m·K.*
***The insulation fully, rather than partially, fills the cavity and, so, the wall tie specification will differ and no retaining clips will be present.*
*NB When calculating U–values to BS EN ISO 6946: 2007, the type of wall tie used may change the thickness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

- *for 115 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 155 mm full fill cavity widths, a stainless steel flexible tie with 3 ties per m² and a cross–sectional area of 60.80 mm².*

A cavity of just 115 mm can be used with the *Kingspan* **Kool**therm® 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.

# Kingspan Insulation Solutions

## Solid Wall – External Wall Insulation




| Insulation Thicknesses to Achieve a U–value of 0.22 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* **Kool**therm® | 60 | 60 | THINNER |
| Rock Fibre** | 110 | 110 | THICKER |
| EPS** | 110 | 110 | |

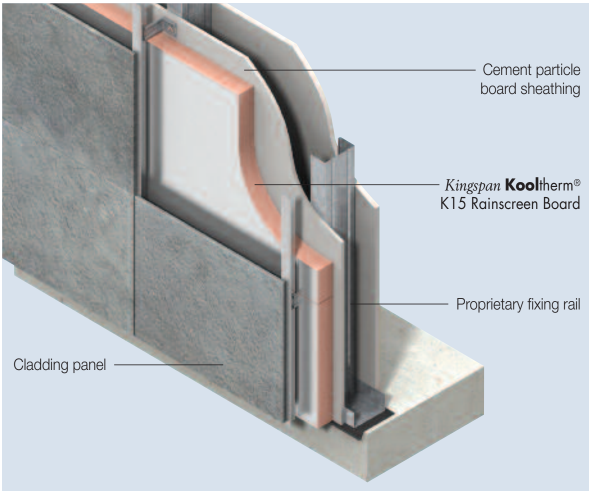
**In the Kingspan* OPTIM-R™ **External Wall System** *is overlaid with a magnesium silicate render carrier board. This is mechanically fixed through the appropriate horizontal or vertical Kingspan* OPTIM-R™ *fix panels using carbon steel fasteners with a cross–sectional area of 7.44 mm², with 2.88 fasteners 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.*

Using *Kingspan* **Kool**therm® or the *Kingspan* OPTIM-R™ **External Wall System** can dramatically reduce the width of the overall wall construction compared with the alternatives shown above.

# Rainscreen Cladding on Steel Frame



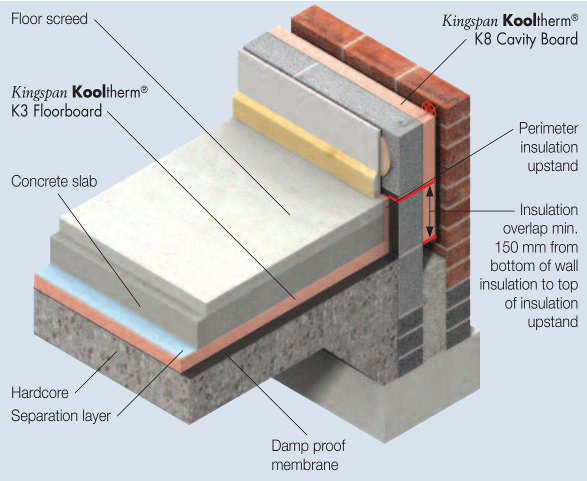

| Insulation Thicknesses to Achieve a U–value of 0.22 W/m²·K | | | |
|---|---|---|---|
| Insulation Material | Insulation Thickness (mm) | Overall Thickness (mm) | |
| *Kingspan* OPTIM-R™ Rainscreen System* | 30 + 40 | 70 | THINNEST |
| *Kingspan* **Kool**therm® | 120 | 120 | THINNER |
| Rock Fibre** | 200 | 200 | THICKER |

**The bridging effect of the Kingspan OPTIM-R™ flex & Kingspan OPTIM-R™ fix components of the System is taken as 30%.*
***Assuming thermal conductivity 0.035 W/m·K.*
*NB Where multiple layers of insulation of different thicknesses are shown, the second thickness is the outer layer. These calculations assume that the Kingspan OPTIM-R™ component of the Kingspan OPTIM-R™* Rainscreen 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 discrete 'helping hand' bracket and insulation fixings may change the thickness of insulation required. These calculations assume carbon steel fixings of cross–sectional area 16.98 mm² at a density of 3.13 per m² and that helping 'helping hand' brackets are installed at 600 mm centres horizontally and vertically.*

Using *Kingspan* **Kool**therm® or the *Kingspan* OPTIM-R™ **Rainscreen System** solution can result in a thinner overall construction. The rock mineral fibre solution shown above requires considerably deeper 'helping hand' brackets to accommodate the required thickness of insulation.

# Kingspan Insulation Solutions

## Ground Floor - Solid Concrete




| Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K | | | |
|---|---|---|---|
| Insulation Material | Insulation Thickness (mm) | Overall Thickness (mm) | |
| *Kingspan* OPTIM-R™ Flooring System* | 20 | 20 | THINNEST |
| *Kingspan* **Kool**therm® | 45 | 45 | THINNER |
| EPS** | 90 | 90 | THICKER |

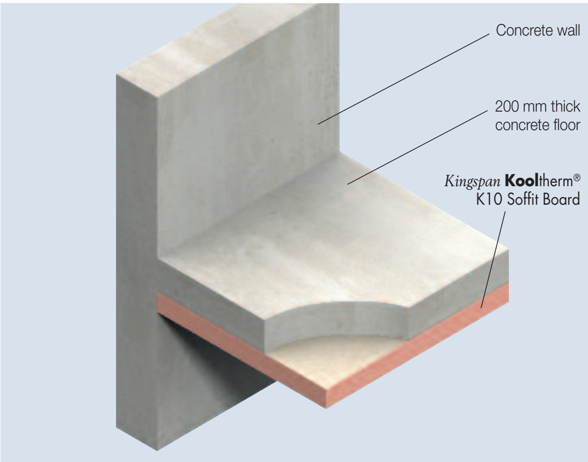
**The bridging effect of the Kingspan OPTIM-R™ flex component of the System is taken as 15%.*

***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 0.2.*

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

# Soffit – Directly Fixed to Concrete




| Insulation Thicknesses to Achieve a U–value of 0.18 W/m²·K | | | |
|---|---|---|---|
| Insulation Material | Insulation Thickness (mm) | Overall Soffit Thickness (mm) | |
| *Kingspan* **Kool**therm® | 110 | 310 | THINNER |
| Rock Fibre** | 195 | 395 | 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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