



# Building Regulations for the Conservation of Fuel & Power

ENGLAND - NEW DWELLINGS - 2013 EDITION



**Kingspan**®

*Low Energy –  
Low Carbon Buildings*



# Contents

	Page
Introduction	4
<hr/>	
Approved Document L1A - New Dwellings	5
Introduction	5
Types of Work Covered	5
Complying with Building Regulations	6
CO <sub>2</sub> Emissions & Fabric Energy Efficiency	7
Limits to Design Flexibility	10
Linear Thermal Bridging	11
Air-permeability Testing	12
Other Requirements	12
Simplifying the Complex	13
<hr/>	
Kingspan Insulation Solutions	14
Construction & U-values	14
Pitched Roof – Insulation Between & Under Rafters	15
Pitched Roof – Insulation Between & Over Rafters	16
Flat Roof – Concrete Deck with Suspended Plasterboard Ceiling	17
Cavity Wall – Cavity Insulation Only	18
Cavity Wall – Cavity Insulation & Insulated Dry-Lining on Dabs	19
Timber Frame Wall – Insulation between Timber Studs & Insulated Dry-Lining	20
Solid Blockwork Wall	21
Rainscreen Cladding on Steel Frame	22
Ground Floor – Solid Concrete with Insulation below Floor Slab	23

# Introduction

## Approved Documents L

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

There are four Approved Documents L:

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

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

## About this Document

Kingspan Insulation has produced this document as a simple guide to the 2013 edition of ADL1A, including the salient changes from the 2010 edition. 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 L1A - New Dwellings

## Introduction

ADL1A gives guidance on ways of demonstrating 'reasonable provision' for compliance with the energy efficiency requirements of the Building Regulations, for building work on 'new dwellings'. A dwelling can be defined as a 'self-contained unit designed to accommodate a single household'.

The 2013 edition of ADL1A comes into effect on 6th April 2014. The guidance given is applicable to building work originating from plans and notices submitted to a building control body (BCB) for approval on or after this date.

## Types of Work Covered

ADL1A is applicable to new dwellings. There are however, some instances where ADL1A indicates that it may be more appropriate to follow the guidance given in ADL2A or ADL1B. These are:

- mixed-use developments and multi-residential buildings – ADL2A should be used for the parts of the building that are not dwellings e.g. commercial or retail spaces and heated common areas (NB unheated common areas in residential buildings containing multiple dwellings should meet the area weighted limiting fabric standards detailed in Table 3 – see the 'Limits on Design Flexibility' section of this document), whereas ADL1A should be used for individual dwellings contained within the larger building;
- buildings exclusively containing rooms for residential purposes – ADL2A should be used since such buildings are not considered dwellings e.g. nursing homes and student accommodation;
- conservatories and / or porches installed at the same time as the construction of the dwelling – ADL1B should be used if there is adequate thermal separation between the installation and the dwelling and the heating system of the dwelling does not extend into the installation, whereas ADL1A should be used if there is no, or inadequate, thermal separation between the installation and the dwelling or if the heating system of the dwelling extends into the installation; and
- material change of use of all or part of a building – ADL1B should be used where a dwelling is created in an existing building e.g. a shop that is converted to a flat.

Buildings containing both living accommodation and space for commercial use (e.g. where both spaces share the same thermal envelope and there is direct access between the two), should be treated as a dwelling if the commercial part of the building could revert to domestic use e.g. a home office in a house.

# Approved Document L1A - New Dwellings

## Compliance with the Building Regulations

### **Demonstrating Compliance**

ADL1A 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 emission rate for the whole of the dwelling (referred to as the 'dwelling CO<sub>2</sub> emission rate' and expressed as 'DER'), does not exceed a defined maximum allowable emission rate (referred to as the 'Target CO<sub>2</sub> Emission Rate' and expressed as 'TER'). Equally, the designed energy loss through the building fabric for the whole of the dwelling (referred to as the 'Dwelling Fabric Energy Efficiency' and expressed as 'DFEE') must not exceed a defined maximum allowable energy loss (referred to as the 'Dwelling Target Fabric Energy Efficiency' and expressed as 'TFEE'). TER, DER, TFEE and DFEE calculations, must be carried out in accordance with the National Calculation Methodology (NCM) i.e. the 2012 edition of the Standard Assessment Procedure (SAP 2012).

Secondly, individual building fabric elements must achieve 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 dwelling 'as built' matches or exceeds that 'designed'.

### **Evidence of Compliance**

Much of the evidence for demonstrating compliance can comprise the results of calculations carried out using SAP 2012 compliant software.

ADL1A 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 ('designed') stage not less than one day before commencement of the works, and the second at post-construction ('as built') stage not more than five days after completion of the works.

Both the 'designed' and 'as built' submissions should include TER/DER and TFEE/DFEE calculations as well as a list of specifications, whilst demonstrating how they are met. NB The 'as built' submission must also include the assessed air-permeability of the dwelling and any changes to the 'designed' specifications.

The two submissions can be compared and used by the BCB to assist in checking whether what has been built 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 built' submission are used to provide information for the Energy Performance Certificate (EPC) for the completed dwelling.

## CO<sub>2</sub> Emissions & Fabric Energy Efficiency

ADL1A adopts a ‘whole building’ approach to minimising CO<sub>2</sub> emissions and fabric energy efficiency. A new dwelling must be designed and built such that:

- its DER is no worse than its TER; and
- its DFEE is no worse than its TFEE.

The TER and DER are expressed as the mass of CO<sub>2</sub> in kilograms, per square metre of floor area per annum (kg/m<sup>2</sup>/yr). TER and DER calculations take account of the CO<sub>2</sub> emission rate from space heating, hot water, ventilation and internal fixed lighting requirements using standardised assumptions for household occupancy in accordance with SAP 2012.

The TFEE and DFEE are expressed as the amount of energy consumed in units of kilowatt hours per square metre of floor area per annum (kWh/m<sup>2</sup>/yr). The TFEE and DFEE calculations take account of energy losses through:

- the different elements of the dwelling’s fabric i.e. roofs, walls, floors, doors and windows;
- thermal bridges at junctions, e.g. where a wall meets a floor, and around openings in the external element, e.g. the edges of a window; and
- air movement from leakage and ventilation.

Also considered in the calculations are the thermal mass of the dwelling and minor heat gains from different sources, e.g. the sun, the occupants, household appliances and artificial lighting.

A ‘notional dwelling’ of the same size and shape as the ‘actual dwelling’, built to a concurrent specification, is used to determine the TER and TFEE. The ADL1A 2013 notional dwelling specification is summarised in Section 5 of ADL1A and detailed in Appendix R of SAP 2012. The main elements of the concurrent specification of the notional dwelling that relate to the opaque building fabric are shown in Table 1.

Element	Value
All Roofs	0.13 W/m <sup>2</sup> ·K
Walls	0.18 W/m <sup>2</sup> ·K
Floors	0.13 W/m <sup>2</sup> ·K
Party Walls	0.00 W/m <sup>2</sup> ·K
Windows, Roof Windows, Glazed Rooflights & Glazed Doors	1.40 W/m <sup>2</sup> ·K / g-value 0.63
Opaque Doors	1.00 W/m <sup>2</sup> ·K
Semi Glazed Doors	1.20 W/m <sup>2</sup> ·K
Air-tightness	5.00 m <sup>3</sup> /hr/m <sup>2</sup> at 50 Pa
Linear Thermal Transmittance	Standardised ψ-values (see Appendix R of SAP 2012)
Thermal Mass	Medium

Table 1: Selected Reference Values from the ADL1A 2013 Notional Dwelling Specification

# Approved Document L1A - New Dwellings

## Calculating the TER

The TER is calculated as follows. The CO<sub>2</sub> emission rate from a notional dwelling of the same size and shape as the actual dwelling is calculated, using the notional building specification. The CO<sub>2</sub> emission rate from the proposed space heating and hot water (C<sub>H</sub>), pumps and fans (C<sub>PF</sub>) and internal lighting (C<sub>L</sub>) are calculated separately. The TER is then calculated using the following formula:

$$TER_{2013} = C_H \times FF + C_{PF} + C_L$$

where FF is the fuel factor as shown in Table 2:

Fuel Type	Fuel Factor
Mains Gas	1.00
LPG	1.06
Oil	1.17
B30K	1.00
Grid Electricity	1.55
Solid Mineral Fuel	1.35
Solid Multi Fuel	1.00
Any Fuel with CO <sub>2</sub> Emission Factor Less than that of Mains Gas	1.00

Table 2: Fuel Factor for Different Fuel Types

For buildings containing multiple dwellings e.g. terraced houses or apartments, an optional method may be selected when calculating the TER for all dwellings in the building. If this method is adopted, the floor area weighted average of all individual TER's of the dwellings contained within the larger building can be calculated using the formula:

$$\frac{(TER_1 \times \text{Floor Area}_1) + (TER_2 \times \text{Floor Area}_2) + (TER_3 \times \text{Floor Area}_3)}{(\text{Floor Area}_1 + \text{Floor Area}_2 + \text{Floor Area}_3)}$$

## Calculating the TFEE

The TFEE is calculated by determining the fabric energy efficiency from a notional dwelling of the same size and shape as the actual dwelling, using the notional dwelling specification – but with a 15% relaxation of the resultant target in order to allow a degree of flexibility.

For buildings containing multiple dwellings, the same optional method for calculating the floor area weighted average TER may be selected when calculating the TFEE for all dwellings in the building:

$$\frac{(TFEE_1 \times \text{Floor Area}_1) + (TFEE_2 \times \text{Floor Area}_2) + (TFEE_3 \times \text{Floor Area}_3)}{(\text{Floor Area}_1 + \text{Floor Area}_2 + \text{Floor Area}_3)}$$



### Achieving the TER & TFEE

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

The post-construction, or final, DER and DFEE are calculated using the performance standards of the actual dwelling. For the purpose of demonstrating compliance, the final DER and DFEE calculations must be based upon the dwelling 'as built' and must not only include any changes made to the performance specification during construction, but also the assessed air-permeability, which is determined as follows:

- where the dwelling has been pressure tested, the assessed air-permeability is the measured air-permeability;
- where the dwelling has not been tested, the assessed air-permeability is the average test result obtained from other dwellings of the same dwelling type on the development, but increased by a margin of +2.0 m<sup>3</sup>/hr/m<sup>2</sup> at 50 Pa; or
- on small developments (two units or less), where the builder has opted to avoid testing, the assessed air-permeability is 15 m<sup>3</sup>/hr/m<sup>2</sup> at 50 Pa.

For buildings containing multiple dwellings, compliance may be achieved by demonstrating that either:

- the individual DER and DFEE for each dwelling are no worse than the corresponding TER and TFEE, respectively; or
- the average DER and DFEE for all dwellings are no worse than the corresponding TER and TFEE, respectively.

If the latter method is adopted, the floor area weighted average of all the individual DER's and DFEE's for each dwelling contained within the larger building can be calculated using the formulae, respectively:

$$\frac{(\text{DER}_1 \times \text{Floor Area}_1) + (\text{DER}_2 \times \text{Floor Area}_2) + (\text{DER}_3 \times \text{Floor Area}_3)}{(\text{Floor Area}_1 + \text{Floor Area}_2 + \text{Floor Area}_3)}$$

$$\frac{(\text{DFEE}_1 \times \text{Floor Area}_1) + (\text{DFEE}_2 \times \text{Floor Area}_2) + (\text{DFEE}_3 \times \text{Floor Area}_3)}{(\text{Floor Area}_1 + \text{Floor Area}_2 + \text{Floor Area}_3)}$$

It is important to note that if the floor area weighted average method is adopted, it cannot be used across multiple separate buildings on a site and it is still necessary to provide information for each individual dwelling.

# Approved Document L1A - New Dwellings

## Limits to Design Flexibility

### Limiting Fabric Standards

ADL1A sets out area weighted limiting U-value standards for the different fabric elements of the dwelling. This provision is included to make the design of the dwelling robust should the performance of one fabric element, upon which achieving the TFE is highly dependent, fail or perform less well than expected.

The limiting U-values for the different fabric element types are shown in Table 3. It is of note that the use of the limiting U-values will almost certainly result in the dwelling failing to achieve the required TER and TFE, thus U-values, significantly better than those shown, are likely to be required.

NB The values shown in Table 3 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/m <sup>2</sup> ·K)
Roof	0.20
Wall	0.30
Floor	0.25
Party Wall	0.20
Windows, Roof Windows, Rooflights & Doors	2.00

Table 3: Limiting Fabric Parameters

### Limits for Air-permeability & Building Services

A limiting value of 10 m<sup>3</sup>/hr/m<sup>2</sup> at 50 Pa is set for air-permeability. In addition, limits are also given for the energy performance of the building services installed in the dwelling.

### Swimming Pool Basins

It must be noted that where a swimming pool basin is built as part of a new dwelling i.e. indoors, the basin should have a U-value no worse than 0.25 W/m<sup>2</sup>·K, calculated in accordance with BS EN ISO 13370 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods). The CO<sub>2</sub> emissions for the dwelling should be assessed as if the basin was not there though the pool hall should be included. For the purpose of calculating the CO<sub>2</sub> emissions, it should be assumed that the floor area covered by the basin has a U-value equivalent to that of the pool surround.

## 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 windows and door openings.

Reasonable provision would be to:

- a. adopt design details that are formally recognised by DCLG, in which case the calculated linear thermal transmittance values (referred to as 'psi-values' and expressed as ' $\psi$ -values') can be used directly in the DER calculation;
- b. use construction joint details with  $\psi$ -values and temperature factors 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 & temperature factors), with calculated temperature factors be no worse than the performance set out in BRE IP 1/06 (Assessing the effects of thermal bridging at junctions and around openings);
- c. use the  $\psi$ -values from the default column in Table K1 of SAP 2012;
- d. use a conservative default  $\gamma$ -value (whole dwelling thermal bridging allowance) of 0.15 W/m<sup>2</sup>·K, rather than  $\psi$ -values for each junction, which will be used in the DER and DFEE calculations (NB if this value is taken, then a  $\gamma$ -value of 0.05 W/m<sup>2</sup>·K will be used in the TER and TFEE calculations);  
or
- e. use a combination of a, b and c.

The effect of using  $\psi$ -values that are poorer than those used for setting the TER and TFEE, is that improved standards will be required elsewhere in the design, in order to compensate.

The thermal transmittance values in the ADL1A 2013 notional dwelling specification are much more stringent than the thermal transmittances defined in the 2007 edition of Accredited Construction Details (ACDs). As a consequence, the designer will have to compensate for those poorer performing junctions elsewhere in the fabric if the latter is adopted.

The builder should 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.

# Approved Document L1A - New Dwellings

## Air-Permeability Testing

On each separate development, an air-pressure test should be carried out on three units of each dwelling type, or 50% of all dwellings of that type, whichever is less. Note that a block of flats should be treated as a separate development, irrespective of the number of blocks on the site. Furthermore, ground, mid or top floor flats in each individual block are considered a separate dwelling type.

The dwellings that are to be tested should be selected from the first completed batch of units of each dwelling type.

The specific dwellings that comprise the test sample should be selected by the BCB in consultation with the pressure tester. They should be selected so that about half of the scheduled tests for each dwelling type are carried out during the construction phase of the first 25% of each dwelling type. The results of all tests on dwellings in the sample should be reported to the BCB, including any test failures.

Compliance with the requirements would be demonstrated if:

- the measured air-permeability is not worse than the limiting value of  $10 \text{ m}^3/\text{hr}/\text{m}^2$  at 50 Pa; and
- the DER and DFEE calculated using the measured air-permeability is not worse than the corresponding TER and the TFEE, respectively.

If satisfactory performance is not achieved, then remedial measures should be carried out on the dwelling and a new test carried out until it achieves the criteria set out above. In addition, a further dwelling of the same dwelling type should be tested, thereby increasing the overall sample size.

In addition to the remedial work on a dwelling that has failed the initial test, other dwellings of the same dwelling type that have not been tested should be examined and, where appropriate, similar remedial measures applied.

If a development has no more than two dwellings, then the developer can either: demonstrate that during the preceding twelve month period, a dwelling of the same dwelling type has achieved the designed air-permeability; or avoid the need to pressure test by using an air-permeability value of  $15 \text{ m}^3/\text{hr}/\text{m}^2$  at 50 Pa when calculating the DER and DFEE.

## Other Requirements

ADL1A 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 heating and hot water systems and the provision of operating and maintenance instructions.

## Simplifying the Complex

The ADL1A 2013 notional dwelling specification provides a useful function in that it provides a straightforward elemental route to compliance. If the actual dwelling is built entirely to the notional dwelling specification, it will meet the CO<sub>2</sub> emissions and fabric energy efficiency targets, as well as the limiting values for individual fabric elements and fixed building services.

Nonetheless, there is still huge scope for flexibility, should developers want it. Developers can, if they prefer, choose to diverge from the ADL1A notional dwelling specification, so long as the dwelling 'as built' achieves, or exceeds, the TER, TFEE and limiting values.

Indeed the ADL1A 2013 notional dwelling specification has been strengthened to deliver a 6% reduction in the CO<sub>2</sub> emission rate across the new homes build mix relative to ADL2A 2010. This reduction is manifested in the ADL1A 2013 notional dwelling specification by much tougher linear thermal transmittance values and a lower air-tightness value.

At present, a set of standard details to achieve the new linear thermal transmittances (e.g. 2013 ACDs) does not exist and is probably unlikely to be developed by DCLG. Likewise, adopting an air-permeability rate of 5 m<sup>2</sup>/hr/m<sup>2</sup> at 50 Pa in DER and DFEE is a risk for developers. This would require the tested sample of dwellings to achieve 3 m<sup>3</sup>/hr/m<sup>2</sup> at 50 Pa. This is an onerous target and current guidance is that such air-tight dwellings require mechanical ventilation with heat recovery systems to be installed.

The most practical route forward for developers may well be to continue to work with an air-permeability target of 7 m<sup>3</sup>/hr/m<sup>2</sup> at 50 Pa and to continue to adopt the 2007 ACDs, whilst compensating by adopting better fabric U-values than suggested by the ADL1A 2013 notional dwelling specification.

Modelling carried out by Kingspan Insulation suggests that the values shown in Table 4 are the best starting point U-values if adopting this latter approach.

Element	U-value (W/m <sup>2</sup> ·K)
All Roofs	0.11
Walls	0.16
Floors	0.11

Table 4: 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 given in the ADL1A 2013 notional dwelling specification, see Table 1; or
- the best starting point U-values, see Table 4, should the specification diverge from that given in the ADL1A 2013 notional dwelling specification.

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 Kingspan Insulation Technical Service Department if calculations for other constructions are required.

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

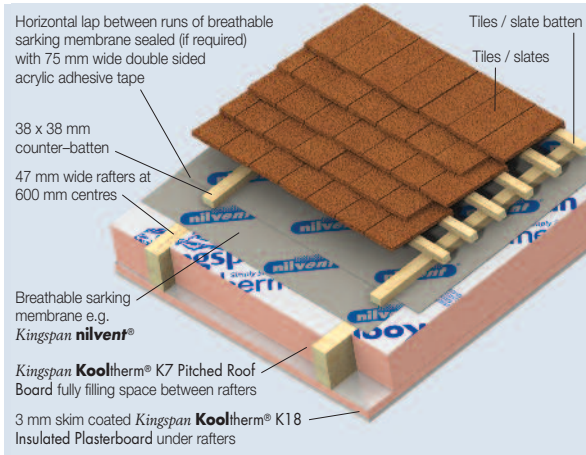
U-values have been calculated using the methods detailed in:

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

For the 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 for assistance.

## Pitched Roof - Insulation Between & Under Rafters



Insulation Material	Insulation Thicknesses to Achieve Different U-values							
	U-value (W/m <sup>2</sup> -K)							
	0.13				0.11			
	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)
<b>Kingspan Kooltherm®</b>	100	100	82.5	182.5	125	125	92.5	217.5
	125	125	62.5	187.5	150	150	72.5	222.5
Glass Fibre* (Between) & XPS** (Under)	150	150	152.5	302.5	175	175	172.5	347.5
	175	175	132.5	307.5	200	200	152.5	352.5

**THINNER**

**THICKER**

\*Assuming thermal conductivity 0.037 W/m-K.

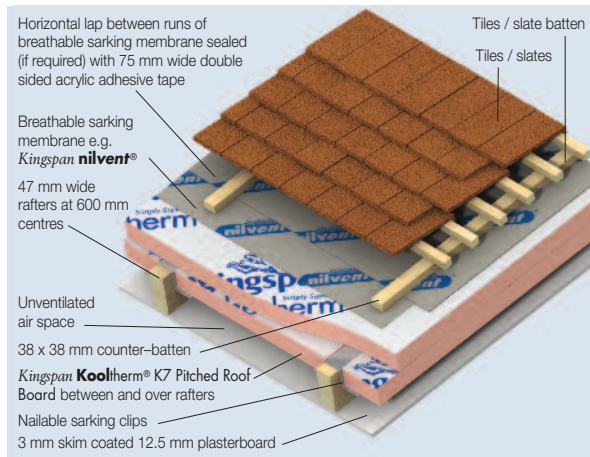
\*\*Assuming thermal conductivity 0.036 W/m-K.

\*\*\*All insulated plasterboard thicknesses include 12.5 mm plasterboard.

NB When calculating U-values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. The effect of fixings for the insulated plasterboard assumed in the calculations above is insignificant, since the insulation layer penetrated is not the main insulation layer.

Using **Kingspan Kooltherm®** can result in a much thinner overall construction, regardless of rafter depth, and is less likely to have a prohibitive effect on headroom. There may be severe practicality issues with fixing a 152.5 or 172.5 mm insulated plasterboard product.

## Pitched Roof - Insulation Between & Over Rafters



Insulation Material	Insulation Thicknesses to Achieve Different U-values								
	U-value (W/m <sup>2</sup> ·K)								
	0.13				0.11				
Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)	Rafter Depth (mm)	Between Rafter Insulation Thickness (mm)	Over Rafter Insulation Thickness (mm)	Overall Thickness (mm)		
Kingspan Kooltherm®	100	75	80	155	100	80	100	180	THINNER
Rock Fibre*	220	220	80	300	250	250	100	350	THICKER
XPS**	150	150	130	280	150	150	180	330	THICKER

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

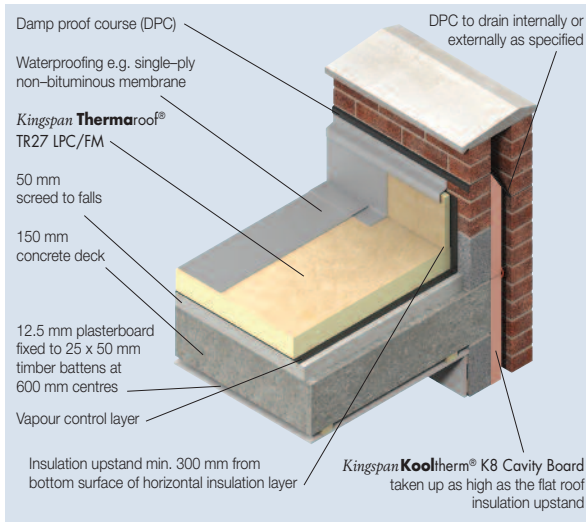
\*\*Assuming thermal conductivity 0.036 W/m·K.

NB When calculating U-values to BS EN ISO 6946: 2007, the type of mechanical fixing used may change the thickness of insulation required. These calculations assume that the layers of insulation over the rafters are fixed using stainless steel fixings with a cross-sectional area 7.45 mm<sup>2</sup>, with 8.3 per m<sup>2</sup> (insulant thickness 61–80 mm) and 10.0 per m<sup>2</sup> (insulant thickness > 80 mm).

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



## Flat Roof - Concrete Deck with Suspended Plasterboard Ceiling



Insulation Thicknesses to Achieve Different U-values					
Insulation Material	U-value (W/m <sup>2</sup> ·K)				
	0.13		0.11		
	Insulation Thickness (mm)	Overall Thickness (mm)	Insulation Thickness (mm)	Overall Thickness (mm)	
Kingspan <b>OPTIM-R</b> ™ Roofing System* & Kingspan <b>Thermaroof</b> ® TR27 LPC/FM (Overlay)	55 + 25	80	65 + 25	90	<b>THINNEST</b>
Kingspan <b>Thermaroof</b> ® TR27 LPC/FM	85 + 90	175	100 + 105	205	<b>THINNER</b>
Rock Fibre**	135 + 135	270	150 + 160	310	<b>THICKER</b>

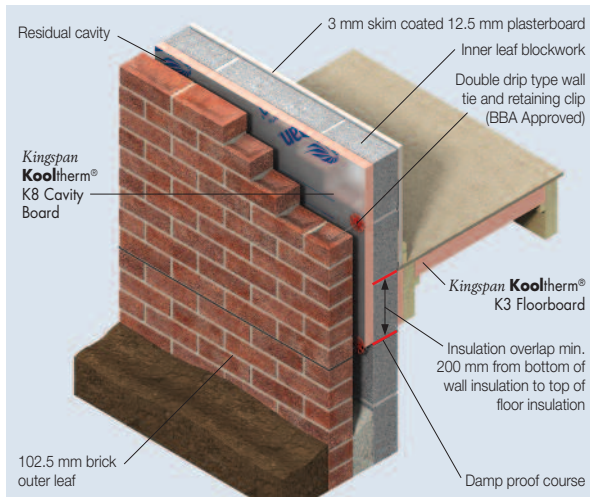
\*The bridging effect of the Kingspan **OPTIM-R**™ flex component of the System is taken as 10%.  
 \*\*Assuming thermal conductivity 0.038 W/m·K.

NB These calculations assume that insulation boards are fully bonded to the vapour control layer. Where multiple layers of insulation of different thicknesses are shown, the second thickness is the overlay board.

It can be seen from the table above that in all circumstances shown, the **Kingspan OPTIM-R**™ Roofing System insulation thickness can be significantly less than that for rock mineral fibre - over 3 times thinner, which may allow lower parapets and shorter fixings.

Furthermore, the weight of the insulation in the rock mineral fibre solution, shown above, may be over 7 times that for the **Kingspan Thermaroof**® solution. The manual handling and roof loading implications of this weight should be carefully considered.

## Cavity Wall - Cavity Insulation Only



Insulation Thicknesses to Achieve Different U-values				
Insulation Material	U-value (W/m <sup>2</sup> ·K)			
	0.18		0.16	
	Cavity Width (mm)	Insulation Thickness (mm)	Cavity Width (mm)	Insulation Thickness (mm)
Kingspan Kooltherm® (Partial Fill)	125	75	150	100
Glass Fibre* (Full Fill)	175	175**	200	200**

THINNER  
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.

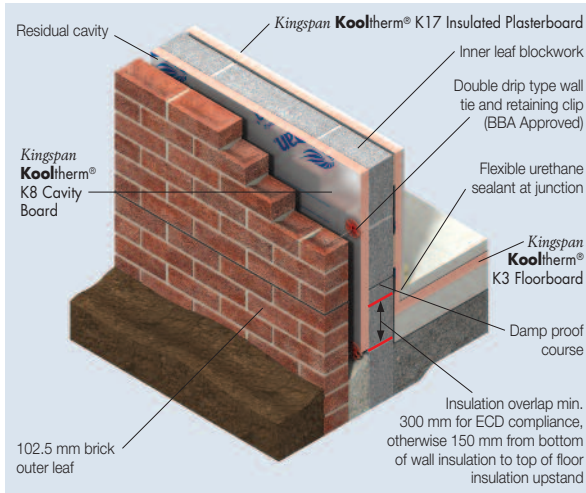
NB When calculating U-values to BS EN ISO 6946: 2007, the type of wall tie used may change the thickness of insulation required.

These calculations assume the following:

- for 125 mm cavity widths, a stainless steel flexible tie with 2.5 ties per m<sup>2</sup> and a cross-sectional area of 12.50 mm<sup>2</sup>;
- for 150 mm cavity widths, a stainless steel flexible tie with 2.5 ties per m<sup>2</sup> and a cross-sectional area of 23.00 mm<sup>2</sup>;
- for 175 mm full fill cavity widths, a stainless steel flexible tie with 2.5 ties per m<sup>2</sup> and a cross-sectional area of 30.00 mm<sup>2</sup>; and
- for 200 mm full fill cavity widths, a stainless steel flexible tie with 2.5 ties per m<sup>2</sup> and a cross-sectional area of 60.80 mm<sup>2</sup>;

Cavities of just 125 and 150 mm respectively can be used with the Kingspan Kooltherm® solution. In both circumstances shown in the table above, the use of the Kingspan Kooltherm® solution reduces total wall width by 50 mm, compared with the glass mineral fibre full fill alternatives. 175 and 200 mm wide cavities may require far more onerous wall tie specifications, which will increase thermal bridging.

## Cavity Wall - Cavity Insulation & Insulated Dry-Lining on Dabs



Insulation Material	Insulation Thicknesses to Achieve Different U-values								
	U-value (W/m <sup>2</sup> ·K)								
	0.18				0.16				
	Cavity Width (mm)	Insulation Thickness (mm)	Plasterboard Thickness (mm) <sup>****</sup>	Overall Thickness (mm)	Cavity Width (mm)	Insulation Thickness (mm)	Plasterboard Thickness (mm) <sup>****</sup>	Overall Thickness (mm)	
Kingspan Kooltherm <sup>®</sup> (Partial Fill)	100	50	37.5	87.5	100	50	52.5	102.5	<b>THINNER</b>
Glass Fibre* (Full Fill) & XPS** (Insulated Plasterboard)	100	100 <sup>***</sup>	72.5	172.5	100	100 <sup>***</sup>	102.5	202.5	<b>THICKER</b>

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

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

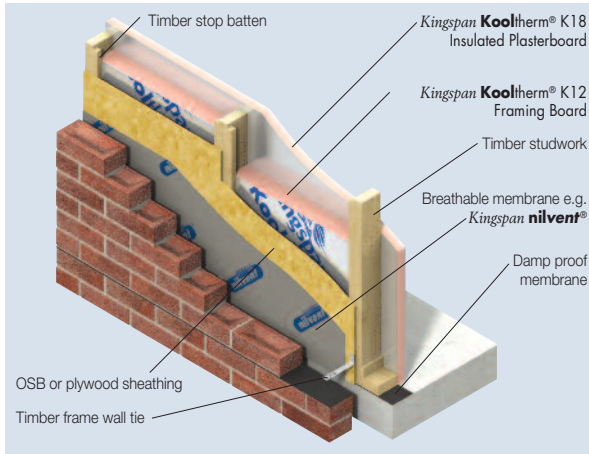
\*\*\*The insulation fully, rather than partially, fills the cavity and, so, the wall tie specification will differ and no retaining clips will be present.

\*\*\*\*All insulated plasterboard thicknesses include 12.5 mm plasterboard.

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 100 mm cavity widths, calculations assume a stainless steel flexible tie with 2.5 ties per m<sup>2</sup> and a cross-sectional area of 12.50 mm<sup>2</sup>.

It can be seen from the table above that in all circumstances shown, the use of **Kingspan Kooltherm<sup>®</sup>** can result in a wall construction that is 49% thinner than the glass mineral fibre and extruded polystyrene combination solutions.

# Timber Frame Wall - Insulation between Timber Studs & Insulated Dry-Lining



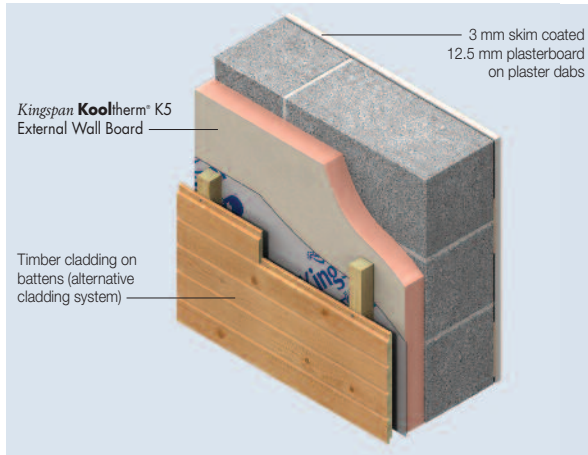
Insulation Material	Insulation Thicknesses to Achieve Different U-values								
	U-value (W/m <sup>2</sup> ·K)								
	0.18				0.16				
	Between Studs	Insulation	Plasterboard	Overall	Between Studs	Insulation	Plasterboard	Overall	
	Stud Depth (mm)	Thickness (mm)	Thickness (mm)*****	Thickness (mm)****	Stud Depth (mm)	Thickness (mm)	Thickness (mm)*****	Thickness (mm)****	
Kingspan Kooltherm®	89	70	52.5	141.5	89	70	72.5	161.5	THINNER
Glass Fibre* (Between Studs) & XPS** (Insulated Plasterboard)	140	140***	72.5	212.5	140	140***	97.5	237.5	THICKER
Glass Fibre* (Between)	235	235	0****	250.0	270	270	0****	285.0	

\*Assuming thermal conductivity 0.035 W/m·K.  
 \*\*Assuming thermal conductivity 0.036 W/m·K.  
 \*\*\*No timber stop battens as insulation fully fills studs.  
 \*\*\*\*Including redundant air-space between studs and plasterboard thickness.  
 \*\*\*\*\*A different lining specification – 15 mm plasterboard.  
 \*\*\*\*\*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. The effect of fixings for insulated plasterboard has been ignored in these calculations as the insulation layer penetrated is not the main insulation layer. A 15% bridging factor has been assumed for the timber stud. The thermal conductivity of the timber has been assumed to be 0.12 W/m·K.

Using Kingspan Kooltherm® can result in a thinner overall construction. The glass mineral fibre solutions shown above require considerably deeper studwork to accommodate the required thickness of insulation.

## Solid Blockwork Wall



Insulation Thicknesses to Achieve Different U-values			
Insulation Material	U-value (W/m <sup>2</sup> ·K)		
	0.18	0.16	
	Insulation Thickness (mm)	Insulation Thickness (mm)	
Kingspan <b>OPTIM-R</b> ™ External Wall System*	45	50	<b>THINNEST</b>
Kingspan <b>Kooltherm</b> ®	75	90	<b>THINNER</b>
Rock Fibre**	145	170	<b>THICKER</b>
EPS**	145	170	

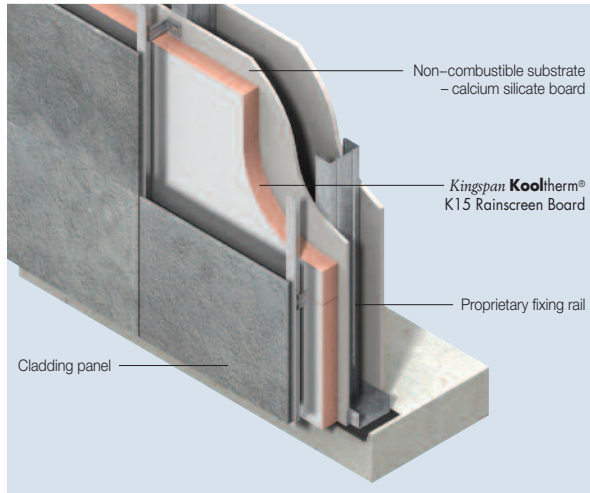
\*The bridging effect of the Kingspan **OPTIM-R**™ flex & Kingspan **OPTIM-R**™ fix components of the System is taken as 30%.  
\*\*Assuming thermal conductivity 0.038 W/m·K.

NB 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 the use of stainless steel fasteners of cross sectional area 7.44 mm<sup>2</sup> is assumed at a density of 4.4 per m<sup>2</sup>.

These calculations also assume thermally broken fasteners with a thermal conductivity 1.00 W/m·K or less, the effect of which is insignificant, for the fixing of the Kingspan **OPTIM-R**™ fix and Kingspan **OPTIM-R**™ flex components of the Kingspan **OPTIM-R**™ External Wall System.

Using **Kingspan Kooltherm**® 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



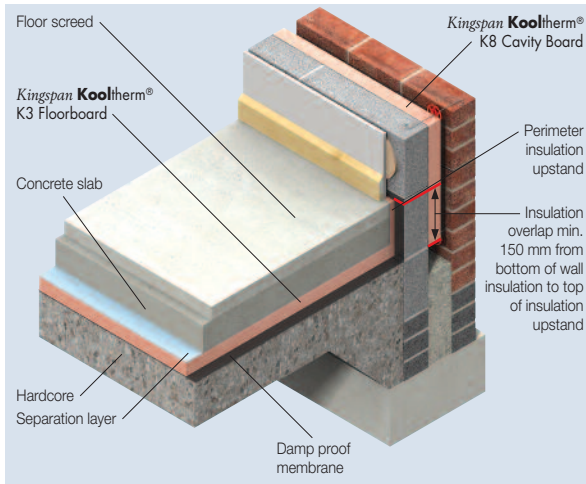
Insulation Thicknesses to Achieve Different U-values					
Insulation Material	U-value (W/m <sup>2</sup> ·K)				
	0.18		0.16		
	Insulation Thickness (mm)	Overall Thickness (mm)	Insulation Thickness (mm)	Overall Thickness (mm)	
<i>Kingspan OPTIM-R</i> Rainscreen System*	50 + 50	100	60 + 60	120	<b>THINNEST</b>
<i>Kingspan Kooltherm</i> ®	80 + 80	160	90 + 100	190	<b>THINNER</b>
Rock Fibre**	130 + 140	270	160 + 160	320	<b>THICKER</b>

\*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. When calculating U-values to BS EN ISO 6946: 2007, the type of discrete 'helping hand' bracket may change the thickness of insulation required. These calculations assume carbon steel fasteners of cross-sectional area 16.98 mm<sup>2</sup> at a density of 3.13 per m<sup>2</sup>.

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

## Ground Floor - Solid Concrete with Insulation below Floor Slab



Insulation Thicknesses to Achieve Different U-values		
Insulation Material	U-value (W/m <sup>2</sup> ·K)	
	0.13 Insulation Thickness (mm)	0.11 Insulation Thickness (mm)
Kingspan <b>OPTIM-R</b> Flooring System*	55	70
Kingspan <b>Kooltherm</b> <sup>®</sup>	125	140
EPS**	225	265

\*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.

**THINNEST**  
**THINNER**  
**THICKER**

Using **Kingspan Kooltherm**<sup>®</sup> or the **Kingspan OPTIM-R**<sup>™</sup> 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.

Furthermore, if you were using expanded polystyrene floor insulation under the old regulations, simply swapping the insulant to **Kingspan Kooltherm**<sup>®</sup> K3 Floorboard or the **Kingspan OPTIM-R**<sup>™</sup> Flooring System will mean that you will not need to alter your drawings or levels and should give a good enough U-value for the purposes of compliance.

## Customer Service

Tel: 01544 388 601

Fax: 01544 388 888

email: [customerservice@kingspaninsulation.co.uk](mailto:customerservice@kingspaninsulation.co.uk)

## Literature & Samples

Tel: 01544 387 384

Fax: 01544 387 484

email: [literature@kingspaninsulation.co.uk](mailto:literature@kingspaninsulation.co.uk)

## Tapered Roofing

Tel: 01544 387 383

Fax: 01544 387 483

email: [tapered@kingspaninsulation.co.uk](mailto:tapered@kingspaninsulation.co.uk)

## Technical Advice

Tel: 01544 387 382

Fax: 01544 387 482

email: [technical@kingspaninsulation.co.uk](mailto:technical@kingspaninsulation.co.uk)

## General Enquiries

Tel: 01544 388 601

Fax: 01544 388 888

email: [info@kingspaninsulation.co.uk](mailto:info@kingspaninsulation.co.uk)



**Kingspan Insulation Ltd**

Pembridge, Leominster, Herefordshire HR6 9LA, UK

[www.kingspaninsulation.co.uk](http://www.kingspaninsulation.co.uk)

© Kingspan, Kooltherm, Nilvent, Thermarof and the Lion Device are Registered Trademarks of the Kingspan Group plc in the UK and other countries. All rights reserved.

™ Optim-R is a Trademark of the Kingspan Group plc.

Kingspan Insulation Ltd. Registered in England & Wales, No. 01882722. Registered Office: Pembridge, Leominster, Herefordshire HR6 9LA UK.