



Building Regulations for the Conservation of Fuel and Power



England & Wales
Edition

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Introduction

INTRODUCTION

This document is designed as a simple guide to the changing Building Regulations 2000 (England & Wales) Approved Documents L1 & L2 (Conservation of fuel and power), showing how to meet the requirements using Kingspan Insulation products.

Details are given of the content of Approved Documents L1 & L2, the effects they 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.

This document also addresses other issues that are currently changing the way the construction industry builds roofs, walls and floors.

Should you require further information about the new Approved Documents L1 & L2, or how Kingspan Insulation products can be used to comply with the changing Regulations, please contact Kingspan Insulation's Technical Services Department (see rear cover).

BUILDING REGULATIONS FOR THE CONSERVATION OF FUEL & POWER

The requirements for thermal insulation (Conservation of fuel and power) in buildings in England & Wales are detailed in The Building Regulations 2000 Approved Documents L1 & L2.

During the Autumn of 2001, the revised Building Regulations 2001 (England and Wales) Approved Documents L1 & L2 (Conservation of fuel and power) were published. They will come into effect on April 1, 2002 and, from that date, all plans submitted for Building Control approval need to comply with the new requirements.

NEW ELEMENTAL U-VALUE CALCULATION PROCEDURES

All U-values for walls and roofs will have to be calculated by an entirely new method, the Combined Method, which has been adopted to bring England & Wales in line with the European Standard calculation method, BS EN ISO 6946: 1997 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation method). It takes all cold bridges into greater account than done by the old "Proportional Area Method", and may affect the U-value of such constructions.

All U-values for floors will have to be calculated by another entirely new method, which has been adopted to bring England & Wales in line with the European Standard calculation method, BS EN ISO 13370: 1998 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods). The U-value of the floor is largely dependent upon the exposed perimeter of the floor and its area, although in some cases the structure of the floor is also involved. If the structure of the floor contains cold bridges, then this calculation method takes them into greater account than done by the old "BRE Information Paper IP 3/90 Method", and may affect the U-value of such constructions.

NB the above mentioned calculation procedures are not valid for constructions bridged by repeating metal elements e.g. spacers in twin skin metal construction. In these cases, the thermal bridging effect may be greater than predicted by the BS EN ISO 6946: 1997 or BS EN ISO 13370: 1998 methods, because the heat flow is very non-linear (the 'finning effect'). This non-linear heat flow can be calculated by finite element analysis, the details of which are beyond the scope of these pages.

Methods of Compliance – Dwellings

METHODS OF COMPLIANCE – DWELLINGS

THREE METHODS OF COMPLIANCE

There are three methods for dwelling designs to comply with the new requirements. These are detailed in Approved Document L1.

ELEMENTAL U-VALUE METHOD

The new requirements can be satisfied by the maximum elemental U-values shown in Table 1. These elemental U-values mark a significant tightening of standards over those allowed in the previous 1995 edition of Approved Document L.

The amount of insulation needed to achieve all of these U-values will be significantly increased.

The Government has also given an indication of the likely elemental U-value requirements to be included in the next changes to Approved Document L1, likely to be in place not before 2007. These U-values are also shown in Table 1.

Table 1

Maximum U-Values (W/m ² .K)		
Element	2002	2007
Room in Roof	0.20*	0.16
Lofts	0.16	0.16
Flat Roofs	0.25	0.16
Walls	0.35	0.25
Floors	0.25	0.22
Windows/Doors/Rooflights	2.20/2.00**	1.80

* a U-value of 0.30 W/m².K is allowable for material alterations

** depending upon type of frame

The U-values shown in Table 1 for 'Windows / Doors / Rooflights' are the requirements for the average U-value of windows, doors and rooflights together. This value requires that the sum of the areas of these elements does not exceed 25% of the total floor area.

Approved Document L1 allows for some flexibility in the treatment of extensions in trading off the performance of one element against the other, with the proviso that the overall heat loss of the extension is no greater than if the extension were designed to the values given in Table 1. For small extensions Approved Document L1 requires that the standard of energy performance is no worse than that of the existing dwelling.

The Elemental Method of Compliance also requires that certain minimum boiler efficiencies are also met. Mains natural gas boilers must have a minimum SEDBUK of 78%, that for LPG is 80% and for oil, 85%.

TARGET U-VALUE METHOD

An alternative, if more complex, procedure to demonstrate compliance will be the Target U-value Method. This requires that the average U-value of a dwelling must not exceed a calculated Target U-value.

The beneficial effect of solar gains and boiler efficiency can be incorporated into the calculation.

This method gives some flexibility, but under no circumstance can U-values be worse than those shown in Table 2.

Table 2

Element	U-Values (W/m ² .K)
Roofs	0.35
Exposed Walls	0.70
Exposed/Ground Floors	0.70

CARBON INDEX METHOD

If the Carbon Index of a dwelling, calculated to the method given in SAP 2001, is 8.00 or greater, the design is deemed to comply. This method gives even greater flexibility, but under no circumstance can U-values be worse than those shown in Table 2.

OTHER REQUIREMENTS APPLICABLE TO ALL METHODS OF COMPLIANCE FOR DWELLINGS

The new Approved Document L1 requires that reasonable provision is made to reduce unwanted air leakage. This can be achieved by following the guidance given in the document "Robust Standard Details", or to pressure test the dwelling and achieve an air leakage rate no worse than 10 m³/hour/m² at an applied pressure difference 50 Pa.

The new Approved Document L1 also has requirements for:

- limiting thermal bridging at junctions and around openings;
- replacement windows, doors, rooflights, boilers and hot water cylinders;
- space heating control systems;
- hot water systems;
- commissioning of heating and hot water systems;
- operating and maintenance instructions for heating and hot water systems;
- insulation of pipes and ducts;
- internal and external lighting; and
- conservatories.

MATERIAL ALTERATIONS

When the structure of a roof or ground floor is being substantially replaced, Approved Document L1 requires that insulation should be provided so that the structure will achieve the U-value given in Table 1.

When the structure of an external wall is being substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided.

When an exposed wall has its external rendering / cladding or internal surface finish substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided.

When a separating wall to an unheated space has its internal surface finish substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided.

MATERIAL CHANGES OF USE

Similarly, when a change of use from one purpose group to another occurs (i.e. a 'conversion'), the insulation standards will need to be improved as far as is possible to match those required of a new building. In particular:

- where the U-value of a loft is worse than 0.35 W/m².K, additional insulation should be provided to bring the U-value down to 0.25 W/m².K;
- when the structure of a roof or ground floor is being substantially replaced, insulation should be provided so that the structure will achieve the U-value given in Table 1;
- when the structure of an external wall is being substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided;
- when an exposed wall has its external rendering / cladding or internal surface finish substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided;
- when a separating wall to an unheated space has its internal surface finish substantially replaced, Approved Document L1 requires that a reasonable thickness of insulation should be provided.

Methods of Compliance – Non-Domestic

METHODS OF COMPLIANCE – NON-DOMESTIC

THREE METHODS OF COMPLIANCE

There are three methods of non-dwelling designs to comply with the new requirements. These are detailed in Approved Document L2.

ELEMENTAL U-VALUE METHOD

The new requirements can be satisfied by the maximum elemental U-values shown in Table 3. These elemental U-values mark a significant tightening of standards over those allowed in the previous 1995 edition of Approved Document L.

The amount of insulation needed to achieve all of these U-values will be significantly increased.

The Government has also given an indication of the likely elemental U-value requirements to be included in the next changes to Approved Document L2, likely to be in place not before 2007. These U-values are also shown in Table 3.

Table 3

Maximum U-Values (W/m ² .K)		
Element	2002	2007
Room in Roof	0.20*	0.16
Lofts	0.16	0.16
Flat Roofs	0.25	0.16
Walls	0.35	0.25
Floors	0.25	0.22
Windows/Doors/Roof windows	2.20/2.00**	1.80
Rooflights	2.2	1.80
Vehicle Access Doors	0.7	no indication given

* a U-value of 0.30 W/m².K is allowable for material alterations

** depending upon type of frame

The U-values shown in Table 3 for 'Windows / Doors / Roof windows' are the requirements for the average U-value of windows, doors and roof windows together.

The sum of the areas of windows, doors and rooflights must not exceed those shown in Table 4.

Table 4

Building Type	Windows and Personnel Doors (% of Exposed Wall Area)	Vehicle Access Doors, Display Windows and Similar Glazing	Rooflights (% of Roof Area)
Residential Buildings (where people temporarily or permanently reside)	30%	as required	20%
Places of Assembly, Offices and Shops	40%	as required	20%
Industrial and Storage Buildings	15%	as required	20%

Approved Document L2 allows for some flexibility in the Elemental Method for non-domestic buildings. Calculations can be used to show that the rate of heat loss through the envelope of the proposed building (which could have different U-values or areas of openings than shown in Tables 3 & 4) is not greater than the rate of heat loss from a notional building of the same size and shape designed to the U-values and areas shown in Tables 3 & 4.

The Approved Document does, however, provide some constraints on this trade off: most notably that, under no circumstance, can U-values be worse than those shown in Table 5.

Calculations can also be used to trade-off heating system efficiency with building fabric U-values in either direction.

Table 5

Element	U-Values (W/m ² .K)
Roofs	0.35
Exposed Walls	0.70
Exposed/Ground Floors	0.70

The Elemental Method of Compliance also has requirements for:

- avoiding solar overheating
- heating system efficiency
- limiting thermal bridging at junctions and around openings;
- space heating control systems;
- hot water systems and controls;
- insulation of pipes, ducts and vessels;
- lighting efficiency and controls; and
- air-conditioning and mechanical ventilation systems.

WHOLE-BUILDING METHOD

This method allows a completely free design. For offices the calculated carbon performance rating (CPR) for the proposed building must be no greater than a defined limit. However, under no circumstance can U-values be worse than those shown in Table 5. Approved Document L2 gives separate standards for schools and hospitals.

CARBON EMISSIONS CALCULATION METHOD

This method allows a completely free design. The carbon emissions for the proposed building calculated, using an acceptable method, must be no greater than those for a similar reference building designed to comply with the Elemental Method. However, under no circumstance can U-values be worse than those shown in Table 5. Approved Document L2 gives separate standards for schools and hospitals.

OTHER REQUIREMENTS APPLICABLE TO ALL METHODS OF COMPLIANCE FOR NON-DOMESTIC BUILDINGS

The new Approved Document L2 requires that reasonable provision is made to reduce unwanted air leakage. This can be achieved by one of the following methods.

For buildings less than 1,000 m², providing a reasonably continuous air barrier in contact with the insulation layer and having this certified by a competent person whilst:

- taking special care at junctions between elements and around door and window openings;
- sealing gaps around service penetrations; and
- draft proofing external doors and windows.

For domestic style construction satisfactory design details are described in the document "Robust Standard Details"

For buildings of any size pressure testing the building and achieve an air leakage rate no worse than 10 m³/hour/m² at an applied pressure difference 50 Pa. And, following a remedial course of action as defined in the Approved Document if the building does not achieve this standard.

The new Approved Document L2 also has requirements for:

- continuity of insulation;
- replacement windows, doors, rooflights, heating systems, hot water systems, lighting systems, air-conditioning systems and mechanical ventilation systems;
- inspection and commissioning of the building services systems;
- the provision of a building log-book;
- installation of energy meters; and
- conservatories, atria and similar sun-spaces.

MATERIAL ALTERATIONS

When the structure of a roof or ground floor is being substantially replaced, Approved Document L2 requires that insulation should be provided so that the structure will achieve the U-value given in Table 3.

When the structure of an external wall is being substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided.

When an exposed wall has its external rendering / cladding or internal surface finish substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided.

When a separating wall to an unheated space has its internal surface finish substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided.

When carrying out material alteration work, Approved Document L2 requires that reasonable sealing measures be taken to improve airtightness.

MATERIAL CHANGES OF USE

Similarly, when a change of use from one purpose group to another occurs (i.e. a 'conversion'), the insulation standards will need to be improved as far as is possible to match those required of a new building. In particular:

- where the U-value of a loft is worse than 0.35 W/m².K, additional insulation should be provided to bring the U-value down to 0.25 W/m².K;
- when the structure of a roof or ground floor is being substantially replaced, insulation should be provided so that the structure will achieve the U-value appropriate for a new building of its type and given in Table 3;
- when the structure of an external wall is being substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided;
- when an exposed wall has its external rendering / cladding or internal surface finish substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided;
- when a separating wall to an unheated space has its internal surface finish substantially replaced, Approved Document L2 requires that a reasonable thickness of insulation should be provided;
- when carrying out material alteration work, Approved Document L2 requires that reasonable sealing measures be taken to improve airtightness.

Pitched Roofs – Assessment of Impact

GENERAL

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Lofts	0.16	0.16
Warm Roof/ Room in Roof	0.20*	0.16

*a U-value of 0.30 W/m².K is allowable for material alterations

LOFTS

REQUIRED THICKNESSES

NB 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 thicknesses of loft insulation required to meet a U-value of 0.16 W/m².K, assuming 100 x 48 mm joists at 600 mm centres, are as follows: rock mineral fibre (0.037 W/m.K) requires 100 mm between joists and 125 mm over joists; glass mineral fibre (0.040 W/m.K) requires 100 mm between joists and 140 mm over joists. The two layers are installed in a cross-layered manner.

BLOCKED VENTILATION

- Ventilation paths can be vulnerable to blockage due to overfilling of the eaves with mineral fibre.
- This can lead directly to creation of condensation and onset of mould growth.
- The potential for degradation of roof timbers may be extremely high.
- As thicker mineral fibre is required to meet the provisions of Approved Documents L1 & L2, the likelihood of blocked eaves ventilation may increase.

STORAGE

- Mineral fibre loft insulation may not be compatible with storage of items in the loft as the items being stored may compress the mineral fibre, which defeats the purpose of installing it.
- This may be more likely to be true as the thickness of mineral fibre needed to meet the requirements of Approved Documents L1 & L2 increases.

MISSING INSULATION

Studies have shown that missing loft insulation caused by poor installation could be regarded as causing:

- 57% increase in heat loss from the Nation's roofs; which equates to the unnecessary release of
- 2,560 million kg of CO₂ equivalent emissions per year;
- 8,937 GW.h (million kW.h) of wasted heat loss per annum nationally (the equivalent of nearly three power stations!); and
- £199 million per year extra heating costs.

AIR MOVEMENT

- Mineral fibre can allow an unhindered path for air intrusion.
- Even the minimum air movement in lofts required by Building Regulations can dramatically reduce the thermal efficiency of mineral fibre.
- Air movement over mineral fibre as little as 1 m/s can lead to increases in heat loss of up to 100%.
- Air movement through mineral fibre can result in increases in heat loss of up to 500%.
- Air movement can result in increased heating cost and the risk of condensation and mould growth on ceilings.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

THE NEED FOR SPACE

- 33% of homeowners would like an extra bedroom.
- 43% said they did not have enough storage space.
- 22% thought they had too few rooms in their house.

DoE Housing Attitudes Survey

PPG3

- Building land is at a premium and the drive is on from PPG3 for higher density housing.
- It is, therefore, difficult to increase the overall plot size and add rooms 'horizontally'.
- It is easier to increase the living area 'vertically'.

In the face of all this mounting pressure, the use of rafter level insulation is rapidly increasing in creating a 'warm roof space', which may be used for a warm storage area or may be fully converted to a 'room in roof'.

WARM ROOF SPACE / ROOM IN ROOF

VALUE

- Valuable additional living space can easily be created with rafter level insulation.
- Creating a 'room in the roof' will virtually always increase sale value by significantly more than it costs.
- Creating a 'warm roof space' if not converted to a functional room, provides a warm storage area and avoids the need for pipework and tank insulation.

REQUIRED THICKNESSES

The following tables show the thicknesses of rafter level insulation required to meet required U-values.

NB when calculating U-values to BS EN ISO 6946: 1997, the type of mechanical fixing used may change the thickness of insulation required. The effect of fixings have been ignored for the purposes of these calculations. Please contact the Kingspan Insulation Technical Services Department (see rear cover) for project calculations.

NB 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.



Mineral fibre loft insulation blocking eaves ventilation



Condensation occurring on the underside of sarking felt

INSULATION BETWEEN & UNDER RAFTER – WARM ROOF SPACE / COLD RAFTER

- If a non-breathable roofing membrane is used, Building Regulations require a 50 mm ventilated air space above the insulation to remove any moisture vapour and avoid the risk of condensation formation.
- If a breathable roofing membrane e.g. **Kingspan nilvent™** is used, the need for roof space ventilation is negated.
- Eliminates the risk of cold bridging and condensation formation / pattern staining.
- The between rafter component must have a thermal resistance greater than, or equal to, the under rafter component to avoid the risk of condensation between the insulation layers.

Likely to be the most acceptable solution to achieving a U-value of 0.20 W/m².K or better as it minimises barge board depths and maximises headroom availability in the 'warm roof space'.

Insulant	Thickness (mm) Required to Achieve U-value of 0.20 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	30 + 40*	50 + 50*
Rigid Urethane (0.022 W/m.K)	90	125
XPS (0.028 W/m.K)	120	160
Rock Mineral Fibre (0.035 W/m.K)	150	200
EPS (0.037 W/m.K)	160	215
Glass Mineral Fibre (0.040 W/m.K)	170	230

*NB calculations based on rafters being underlined with an insulated plasterboard comprising 12.5 mm plasterboard and 25 mm of the specified insulant with the specified thermal conductivity. Thickness shown in the table above is only the between rafter component. NB calculations assume 50 mm wide rafters at 600 mm centres, and a 25 mm (min.) unventilated airspace above the insulation between rafters. * multiple layers required as maximum thickness exceeded. First thickness refers to inner layer, second thickness to outer layer. The thermal resistance of the outer layer must be ≥ that of the inner layer so as to avoid condensation.*

- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.
- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- If required, the 50 mm air gap for ventilation may be difficult to guarantee with non-rigid insulants such as glass wool or rock wool.
- The continuity of non-rigid insulation such as glass mineral wool or rock mineral wool may be difficult to guarantee between rafters.

Pitched Roofs – Assessment of Impact

INSULATION BETWEEN RAFTER – WARM ROOF SPACE / COLD RAFTER

- If a non-breathable roofing membrane is used, Building Regulations require a 50 mm ventilated air space above the insulation to remove any moisture vapour and avoid the risk of condensation formation.
- If a breathable roofing membrane e.g. **Kingspan nilvent™** is used, the need for roof space ventilation is negated.

Insulant	Thickness (mm) Required to Achieve U-value of 0.20 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	55 + 60*	45 + 50 + 50*
Rigid Urethane (0.022 W/m.K)	130	170
XPS (0.028 W/m.K)	160	205
Rock Mineral Fibre (0.035 W/m.K)	190	245
EPS (0.037 W/m.K)	200	255
Glass Mineral Fibre (0.040 W/m.K)	210	270

NB calculations assume 50 mm wide rafters at 600 mm centres, and a 25 mm (min.) unventilated air space above the insulation.

* multiple layers required as maximum thickness exceeded. Thinnest layer should be the innermost layer so as to avoid condensation.



Project – Self-Build House Extension, Herefordshire
 Products – Kingspan Thermapitch TP10 installed between rafters with a layer of 25 mm Kingspan Thermawall TW56 below rafters.
 External photograph courtesy of Graham Wilson.

- The thinner the insulation the less the chance is of having to specify deeper than necessary rafters or batten out rafters in order to accommodate the insulation.
- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.
- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- If required, the 50 mm air gap for ventilation above the insulation may be difficult to guarantee with non-rigid insulants such as glass wool or rock wool.
- The continuity of non-rigid insulation, such as glass mineral wool or rock mineral wool, may be difficult to guarantee between rafters.

INSULATION OVER & BETWEEN RAFTER – WARM ROOF SPACE / WARM RAFTER

- Keeps the whole structure warm.
- Negates the need for roof space ventilation.
- Eliminates the risk of cold bridging and condensation formation / pattern staining.
- The over rafter component must have a thermal resistance greater than, or equal to, the between rafter component to avoid the risk of condensation between the insulation layers.

Insulant	Thickness (mm) Required to Achieve U-value of 0.20 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	40 + 45	55 + 60
Rigid Urethane (0.022 W/m.K)	50 + 55	65 + 70
XPS (0.028 W/m.K)	115 + 30*	160 + 30*
EPS (0.034 W/m.K)	145 + 30*	195 + 30*
Rock Mineral Fibre (0.034 W/m.K over rafter)	100 + 75	145 + 75

NB first thickness refers to thickness between rafters, second thickness over rafters. The thermal resistance of the over rafter layer must be ≥ that of the between rafter layer so as to avoid condensation.

NB calculations assume 50 mm wide rafters at 600 mm centres, and a 125 mm (min.) air space below the between rafter insulation.

* these solutions are provided as a single top hat section piece of insulation.

- The thinner the over rafter insulation the shorter, cheaper and easier to use the fixings.
- The thinner the insulation the less the chance is of having to specify deeper than necessary rafters or batten out rafters in order to accommodate the insulation.
- The thicker insulation types may necessitate unacceptably deep bargeboards.
- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.
- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- The continuity of non-rigid insulation, such as glass mineral wool or rock mineral wool, may be difficult to guarantee between rafters.



Project – Self-Build House, Lancashire
 Product – Kingspan Thermapitch TP10 installed between rafters

INSULATION OVER RAFTER – WARM ROOF SPACE / WARM RAFTER

- Keeps the whole structure warm.
- Negates the need for roof space ventilation.
- Eliminates the risk of cold bridging and condensation formation / pattern staining.

Insulant	Thickness (mm) Required to Achieve U-value of 0.20 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	*	*
Rigid Urethane (0.022 W/m.K)	100	125
XPS (0.028 W/m.K)	125	165
EPS (0.034 W/m.K)	150	200
Rock Mineral Fibre (0.040 W/m.K)	175 †	235 †

* maximum available thickness exceeded, multi-layer insulation is not recommended in over rafter applications, use between and over rafter solution.

† this thickness of product may not be available, in which case it may be more appropriate to use the between and over rafter solution.

- The thinner the over rafter insulation the shorter, cheaper and easier to use the fixings.
- The thicker insulation types may necessitate unacceptably deep barge boards.
- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.
- Mineral fibre can be irritating to install, requiring special clothing and dust masks.



Project – Loft conversion
Product – Kingspan Thermapitch TP10

Whichever solution you pick to the question of where to place rafter level insulation, it is clear that rigid phenolic insulation or rigid urethane insulation provide the thinnest solutions to the requirements of Approved Documents L1 & L2, thus providing the optimum solutions in terms of condensation risk reduction, headroom and bargeboard depth.

Kingspan pitched roof insulation boards **Kingspan Thermapitch** TP10 zero ODP (rigid urethane insulation) and **Kingspan Kooltherm**® K7 Pitched Roof Board (rigid phenolic insulation):

- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- can provide maximum headroom;
- can minimise barge board depth;
- can help eliminate condensation risk;
- are non-fibrous; and
- are unaffected by air movement.



Project – The Zethus Centre, Dartford
Products – Kingspan Thermapitch TP10 installed between rafters.
Client – The Palmer Partnership
Specifier – The Palmer Partnership

Tapered Roofing – Assessment of Impact

GENERAL

PONDING

- Flat roofs may be subject to the development of ponding over their lifetime.
- Ponding may submit the roof to thermal shock, alkaline formation and mould growth - all of which will seriously decrease the design life of the roof.
- Ponding can significantly affect roof loading, causing deflection in the deck and even more serious problems with drainage.
- The best solution is to eliminate ponding by designing an adequate fall into the roof.

SCREED TO FALLS, TIMBER FIRTINGS TO FALLS OR TAPERED INSULATION

- With a flat deck, designing an adequate fall into the roof can be achieved by using screed to falls and a flat insulation board, timber firrings to falls and a flat insulation board or a tapered insulation system.
- An independent cost analysis has shown that tapered insulation is the most cost-effective method of introducing a fall into a flat roof.
- Tapered insulation is also significantly lighter than screed to falls solutions and does not suffer from lengthy drying times.

It is clear that tapered insulation is the most cost efficient solution to ponding problems for roofs with a flat deck.

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Flat Roofs	0.25	0.16



REQUIRED THICKNESSES

The table below shows the average thicknesses of tapered insulation required to meet required U-values.

NB when calculating U-values to BS EN ISO 6946: 1997, the type of mechanical fixing used may change the thickness of insulation required. The effect of fixings has been ignored for the purposes of these calculations. Please contact the Kingspan Insulation Technical Services Department (see rear cover) for project calculations.

NB 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.

Insulant	Thickness (mm) Required to Achieve U-value of 0.25 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Urethane (0.022 W/m.K)	85	135
XPS (0.028 W/m.K)	105	170
EPS (0.034 W/m.K)	130	210
Rock Mineral Fibre (0.040 W/m.K)	150	245

NB calculations assume metal deck and single ply membrane



Project – Parrswood Leisure Centre, Salford.
Products – 2,000 m² of Kingspan Thermataper TT46.
Client – MWB & Thornfield Developments.
Specifier – Edward Kirby Associates.

Project – Dunsoughlin Civic Centre
Client – Meath County Council
Specifier – Grafton Architects
Contractor – John Sisk and Son Ltd
Product – Kingspan Thermataper TT46
Photography – ©Dennis Gilbert / View

THICKNESS

- Rigid urethane systems may offer the thinnest solutions to the requirements of Approved Documents L1 & L2.

DENSITY

- Rigid urethane systems have a typical density of 32 kg/m³.
- Rock mineral fibre systems have a density of up to 180-200 kg/m³.

STRUCTURAL CONCERNS

- Rigid urethane systems are therefore considerably lighter than rock mineral fibre systems, with potential implications for the structural design of buildings.

MANUAL HANDLING REGULATIONS

- The weight of individual boards in a rigid urethane system is less likely to contravene manual handling regulations than in a rock mineral fibre system.



Project – Stag Brewery, Mortlake, London.
Products – 9,000 m² of Kingspan Thermataper TT42 and Kingspan Therमारooft TR22.
Client – Budweiser Stag Brewing Company.
Specifier – Baarco (a consortium of Midland Roofing and M&J Roofing).

THE EFFECTS OF WATER

- Water can enter a flat roof because of condensation, due to leaky vapour control layers or because of weathering membrane failure.
- Where water does enter a flat roof insulated with mineral fibre, it will be trapped in an almost impervious tank created by the vapour control layer and weathering membrane and it will be partially absorbed by the insulant.
- Research has shown that 'water repellent' mineral fibre can absorb water in quantities of up to 40% by volume under such pressure changes.

- Where there is a free supply of water to the warm side of the construction, as can be the case in flat roofs, 1% by volume of water can increase heat loss by 85%.
- If rigid urethane insulation has been installed, the water will not flow into the insulant and thus the area of ingress will be restricted.



Project – Trafford Centre, Manchester.
Products – 11,000 m² of Kingspan Thermataper TT46.
Client – The Trafford Centre Ltd.
Specifier – Leach Rhodes Walker.
Main Contractor – Bovis Construction Ltd.
Roofing Contractor – Pitchmastic plc.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid urethane tapered roofing systems offer the lightest and thinnest solutions to the requirements of Approved Documents L1 & L2.

Kingspan Thermataper zero ODP System:

- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- are lightweight; and
- are non-fibrous.

Flat Roofing – Assessment of Impact

GENERAL

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Flat Roofs	0.25	0.16



Project – American Air Museum, Duxford.
Products – 5,000 m² of Kingspan Thermaroof TR27.
Client – Imperial War Museum.
Specifier – Foster & Partners.
Main Contractor – John Sisk & Son

REQUIRED THICKNESSES

The table below shows the thicknesses of flat roof insulation required to meet required U-values.

NB when calculating U-values to BS EN ISO 6946: 1997, the type of mechanical fixing used may change the thickness of insulation required. The effect of fixings has been ignored for the purposes of these calculations. Please contact the Kingspan Insulation Technical Services Department (see rear cover) for project calculations.

NB 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.

Insulant	Thickness (mm) Required to Achieve U-value of 0.25 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.16 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	70	50 + 60*
Rigid Urethane (0.022 W/m.K)	85	135
XPS (0.028 W/m.K)	105	170
EPS (0.034 W/m.K)	130	210
Rock Mineral Fibre (0.040 W/m.K)	150	245

NB calculations assume metal deck and single ply membrane

** multiple layers required as maximum thickness exceeded.*

First thickness refers to inner layer, second thickness to outer layer.

The thermal resistance of the outer layer must be ≥ that of the inner layer so as to avoid condensation.



Project – Royal Bank of Scotland, Edinburgh.
Products – Kingspan Styrozone N 300 R on a protected membrane roof.

THICKNESS

- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.

DENSITY

- Rigid urethane systems have a typical density of 32 kg/m³.
- Rigid phenolic systems have a typical density of 60 kg/m³.
- Rock mineral fibre systems have a density of up to 180-200 kg/m³.

STRUCTURAL CONCERNS

- Rigid phenolic and rigid urethane systems are therefore considerably lighter than rock mineral fibre systems, with potential implications for the structural design of buildings.

MANUAL HANDLING REGULATIONS

- The weight of individual rigid phenolic or urethane boards is less likely to contravene manual handling regulations than individual rock mineral fibre boards.

THE EFFECTS OF WATER

- Water can enter a flat roof because of condensation due to leaky vapour control layers or because of weathering membrane failure.
- Where water does enter a flat roof insulated with mineral fibre, it will be trapped in an almost impervious tank created by the vapour control layer and weathering membrane and it will be partially absorbed by the insulant.
- Research has shown that 'water repellent' mineral fibre can absorb water in quantities of up to 40% by volume under such pressure changes.
- Where there is a free supply of water to the warm side of the construction, as can be the case in flat roofs, 1% by volume of water can increase heat loss by 85%.
- If rigid phenolic or rigid urethane insulation has been installed, the water will not flow into the insulant and thus the area of ingress will be restricted.

LONGEVITY

- Mineral fibre flat roof insulants may have the potential for incomplete recovery from repeated traffic.
- This can generate ponding, increasing the possibility of failure of the weathering membrane.
- This may also lead to fixings puncturing the waterproofing membrane as they stand proud of the degraded insulation.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid phenolic or rigid urethane flat roofing insulants offer the lightest and thinnest solutions to the requirements of Approved Documents L1 & L2 whilst minimising the effects of traffic.

Kingspan Kooltherm® and **Kingspan Thermaroof** zero ODP flat roof insulation boards:

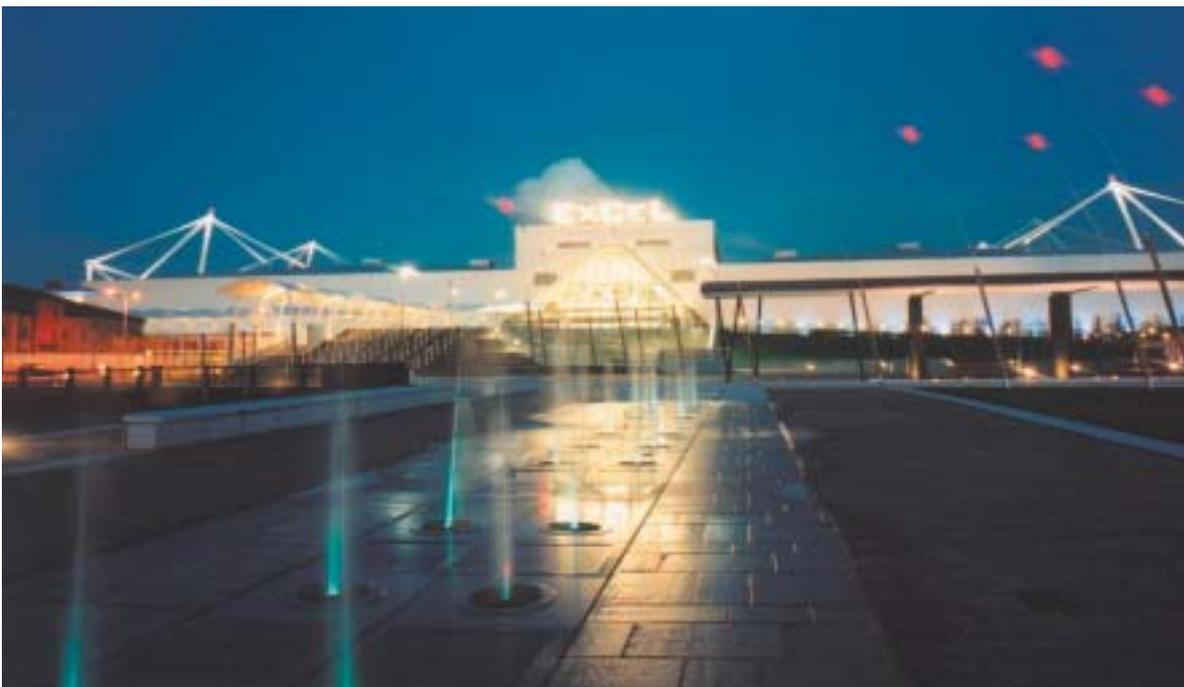
- are available for use with most waterproofing membranes;
- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- are lightweight;
- are less susceptible to the effects of traffic; and
- are non-fibrous.

Project – ExCel, London.

Products – 90,000 m² of Kingspan Thermaroof TR26.

Specifier – Moxley Architects.

Roofing Contractor – Hathaway Roofing Ltd.



Timber Frame Walls – Assessment of Impact

GENERAL

RETHINKING CONSTRUCTION

- The Egan Report “Rethinking Construction” seeks to minimise on-site labour and waste, reduce the number of defects, optimise construction costs, and speed up the whole building process.
- Prefabricated timber framing is seen as one way of complying with this agenda.

TRADITIONAL PRACTICE

- Timber frame walls as traditionally constructed typically comprise 89 mm deep studs filled with 90 mm mineral fibre quilt/batts.
- This construction achieved the former elemental U-value requirement of 0.45 W/m².K using the previously applicable proportional area method of calculation.

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Walls	0.35	0.25

REQUIRED THICKNESSES

The table below shows the thicknesses of timber frame wall insulation required to meet required U-values.

NB 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.

INSULATION BETWEEN STUDS

Insulant	Thickness (mm) Required to Achieve U-value of 0.35 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.25 W/m ² .K
Rigid Urethane* (0.022 W/m.K)	50	90
XPS (0.028 W/m.K)*	80	125
EPS (0.037 W/m.K)*	100	150
Rock Mineral Fibre** (0.037 W/m.K)	110	160
Glass Mineral Fibre** (0.040 W/m.K)	115	170

NB calculations assume 15 mm plasterboard, brick outer leaf and 15% framing factor.

* assumes 20 mm (min.) airspace on warm side of insulation layer for service runs.

** assumes stud depth equal to thickness of insulation.

THICKNESS

- The timber framing industry uses standard stud depths of 89 mm and 140 mm.
- In order to achieve a U-value of 0.35 W/m².K, 110/115 mm of mineral fibre quilt/batts of the type currently used may be required.
- This would require stud depths to be increased to 140 mm to accommodate the insulation.
- Mineral fibre in timber frames relies on friction to hold it vertical and so a slight over-thickness is normally used.
- Therefore, a standard insulation thickness of, say, 150 mm, would most likely be used.
- 50 mm of **Kingspan Thermawall TW55 zero ODP** between 89 mm deep studs will also achieve a U-value of 0.35 W/m².K.



Project – The Zethus Centre, Dartford.

Products – 500 m² of Kingspan Kooltherm K12 Framing Board between studs.

Client – The Palmer Partnership.

Specifier – The Palmer Partnership.

BUILD COSTS

- **Kingspan Thermawall TW55 zero ODP** is more expensive than mineral fibre quilt but 140 mm deep studs require more timber than 89 mm deep studs.
- A cost analysis shows that **Kingspan Thermawall TW55 zero ODP** offers the cheapest overall solution.
- The increase in cost for each solution compared with previous practice has been examined.
- The additional cost of the 50 mm **Kingspan Thermawall TW55 zero ODP** option is 37% lower than that for 150 mm thick mineral fibre and 140 mm deep studs.

DESIGN COSTS

- There is no need to change your building designs, just the insulation specification. The savings in design time costs are obvious.

TRANSPORT COSTS

- No change in transport costs. 140 mm deep studs would increase transport costs by approximately 50%.

HANDLING

- Handling 140 mm deep wall panels on site will incur additional cost because of the additional weight. **Kingspan Thermawall TW55 zero ODP** insulated panels maintain constant handling costs.

PPG3

- Building land is at a premium and the drive is on from PPG3 for higher density housing.
- It is, therefore, difficult to increase the overall plot size and add rooms 'horizontally'.
- Greater wall thicknesses would impact on either the living space or on garden space.
- You do not need to compromise internal living space or footprint size for 50% additional wall thickness that might be a consequence of using mineral fibre quilt/batts.

SERVICE RUNS

- 50 mm of **Kingspan Thermawall TW55 zero ODP** in an 89 mm stud cavity allows 39 mm for service runs etc. without compromising the depth of the insulation layer.

INSULATION CONTINUITY

- There is no danger of slumping and sagging of insulation with **Kingspan Thermawall TW55 zero ODP**.



Project – Rangers Training and Development Centre, Auchenhowie, Milngavie.

Products – 1,400 m² of Kingspan Kooltherm K12 Framing Board.
Client – Rangers Football Club and the Rangers Development Fund.
Specifier – Garth Hutchinson and Partners.



Project – Playgroup Building, Almondbury Infant and Nursery, Huddersfield.

Products – Kingspan Thermawall TW55.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid phenolic insulation or rigid urethane insulation can provide the thinnest solutions to the requirements of Approved Documents L1 & L2, and can provide the optimum solution in terms of space, costs, transportation and handling.

Kingspan timber frame insulation boards **Kingspan Thermawall TW55 zero ODP** (rigid urethane insulation) and **Kingspan Kooltherm® K12 Framing Board** (rigid phenolic insulation):

- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- can be used as an insulated sheathing board for timber framing as well as between timber frame wall studs;
- are available pre-cut to suit stud dimensions and centres;
- are unaffected by air movement or moisture;
- are lightweight; and
- are non-fibrous.

Masonry Cavity Walls – Assessment of Impact

GENERAL

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Walls	0.35	0.25



Project – Self-Build House Extension, Herefordshire.
 Products – Kingspan Thermawall TW50 partial fill cavity wall insulation with a layer of Kingspan Thermawall TW52 insulated dry-lining board (not shown).
 Specifier – Paul Hackett, Leominster.



Project – Botanic Gardens, Dublin.
 Products – 2000m² Kingspan Thermawall TW50.
 Specifier – Office of Public Works, Dublin.
 Main Contractor – Cleary & Doyle

**NB when calculating U-values to BS EN ISO 6946: 1997, the type of wall tie used may change the thickness of insulation required. These calculations assume a stainless steel double triangle tie 3.7 mm diameter, giving a cross sectional area of 10.75 mm². Please contact the Kingspan Insulation Technical Services Department (see rear cover) for project calculations.*

NB 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.

CAVITY WALLS FULLY FILLED WITH MINERAL FIBRE

*REQUIRED THICKNESSES - INJECTED FULL FILL MINERAL FIBRE

The thicknesses of injected full fill mineral fibre required to meet a U-value of 0.35 W/m².K, assuming 12.5 mm plasterboard on dabs lining a medium density block (0.510 W/m.K) inner leaf and brick outer leaf, are as follows. Rock mineral fibre (0.039 W/m.K) requires 85 mm, and glass mineral fibre (0.040 W/m.K) requires 90 mm.

The thicknesses of injected full fill mineral fibre required to meet a U-value of 0.25 W/m².K, assuming 12.5 mm plasterboard on dabs lining a medium density block (0.510 W/m.K) inner leaf and brick outer leaf, are as follows. Rock mineral fibre (0.039 W/m.K) requires 130 mm, and glass mineral fibre (0.040 W/m.K) require 135 mm.

WORKMANSHIP - INJECTED FULL FILL MINERAL FIBRE

- Effective installation can be compromised by a variety of common occurrences.
- These include dirty ties and mortar spots, too narrow or variable width cavities, penetrations such as soil pipes or cables and unsuitable injection hole patterns.
- The result can be voids in the insulation coverage.

MISSING INSULATION - INJECTED FULL FILL MINERAL FIBRE

Studies have shown that missing injected full fill mineral fibre cavity wall insulation caused by poor installation could be regarded as causing:

- 67% increase in heat loss from the Nation's walls insulated with injected full fill mineral fibre cavity wall insulation; which equates to the unnecessary release of
- 473 million kg of CO₂ equivalent emissions per year;
- 1,651 GW.h (million kW.h) of wasted heat loss per annum nationally (the equivalent of over half a power station!); and
- £37 million per year extra heating costs.

HEALTH & SAFETY - INJECTED FULL FILL MINERAL FIBRE

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

UNINSULATED CAVITY WALLS WITH A RESIDUAL EMPTY CAVITY

*REQUIRED THICKNESSES - FULL FILL BATTS

The thicknesses of full fill batts required to meet a U-values of 0.35 W/m².K, 12.5 mm plasterboard on dabs lining a medium density block (0.510 W/m.K) inner leaf and brick outer leaf, are as follows: both rock mineral fibre (0.036 W/m.K) and glass mineral fibre (0.036 W/m.K) require 80 mm.

The thicknesses of full fill batts required to meet a U-values of 0.25 W/m².K, 12.5 mm plasterboard on dabs lining a medium density block (0.510 W/m.K) inner leaf and brick outer leaf, are as follows: both rock mineral fibre (0.036 W/m.K) and glass mineral fibre (0.036 W/m.K) require 120 mm.

WORKMANSHIP - FULL FILL BATTS

- Due to its open fibrous structure, poor site practice can encourage water penetration into mineral fibre full fill batt cavity wall insulation.
- 1% moisture by volume in mineral fibre insulants can reduce thermal performance by between 75% and 105%.
- It has been shown that it would be reasonable to expect that a mineral fibre full fill batt cavity wall insulation moisture content of 1% by volume is prevalent for 9 months of the year in the UK.

WET INSULATION - FULL FILL BATTS

Studies have shown that wet mineral fibre full fill batt cavity wall insulation caused by poor installation could be regarded as causing:

- 30% increase in heat loss from the Nation's walls insulated with full fill mineral fibre batts; which equates to the unnecessary release of
- 505 million kg of CO₂ equivalent emissions per year;
- 1,764 GW.h (million kW.h) of wasted heat loss per annum nationally (the equivalent of over half a power station!); and
- £39 million per year extra heating costs.

HEALTH & SAFETY - FULL FILL BATTS

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

The concept of full fill cavity wall insulation overlooks the fundamental reason for the cavity being there in the first place – which is to allow an exit route for rain and moisture penetrating the outer leaf and for condensation. In the face of all of this mounting pressure the use of cavity walls with a residual empty cavity is rapidly increasing.

*REQUIRED THICKNESSES – LIGHTWEIGHT AERATED CONCRETE BLOCKS

A 325 mm lightweight aerated concrete block (0.11 W/m.K) would be required to meet a U-value of 0.35 W/m².K, assuming plaster lining, brick outer leaf and normal mortar joints. 295 mm would be required for the same but with thin joint mortar.

A 395 mm lightweight aerated concrete block (0.11 W/m.K) would be required to meet a U-value of 0.25 W/m².K, assuming plaster lining, brick outer leaf and normal mortar joints. 395 mm would be required for the same, but with thin joint mortar.

PPG3

- Building land is at a premium and the drive is on from PPG3 for higher density housing.
- It is, therefore, difficult to increase the overall plot size and add rooms 'horizontally'.
- Greater wall thicknesses would impact on either the living space or on garden space.
- You do not need to compromise internal living space or footprint size for the additional wall thickness that will be a consequence of using lightweight aerated concrete blocks as the sole insulation layer.

The concept of cavity walls that rely entirely on a lightweight aerated concrete block for insulation is unlikely to survive the changes to the Regulations. The market is likely to favour solutions that use an additional insulation layer as a method of reducing overall wall thickness.



Project – Star City, Birmingham.

Products – 11,000 m² of Kingspan Thermawall TW50.

Client – Richardsons and Carillion plc.

Specifier – Jerde Partnership International with Geoffrey Reid and Associates.

Main Contractor – Carillion plc.

Masonry Cavity Walls – Assessment of Impact

INSULATED CAVITY WALLS WITH A RESIDUAL EMPTY CAVITY

*REQUIRED THICKNESSES

The tables below shows the thicknesses of masonry cavity wall insulation required to meet required U-values.

PARTIAL FILL CAVITY WALL INSULATION

Thickness (mm) Required to Achieve U-value of 0.35 W/m².K

Insulant	Block Thermal Conductivity (W/m.K)			
	1.13	0.51	0.15	0.11
Rigid Phenolic (0.018 W/m.K)	35	35	25	25
Rigid Urethane (0.022 W/m.K)	45	40	30	30
XPS (0.028 W/m.K)	60	60	45	40
Rock Mineral Fibre (0.033 W/m.K)	70	70	55	50
Glass Mineral Fibre (0.036 W/m.K)	75	75	60	55
EPS (0.037 W/m.K)	80	75	60	55

NB calculations assume 12.5 mm plasterboard on dabs lining a block inner leaf and brick outer leaf.

Thickness (mm) Required to Achieve U-value of 0.25 W/m².K

Insulant	Block Thermal Conductivity (W/m.K)			
	1.13	0.51	0.15	0.11
Rigid Phenolic (0.018 W/m.K)	55	55	45	45
Rigid Urethane (0.022 W/m.K)	65	65	55	50
XPS (0.028 W/m.K)	90	90	80	75
Rock Mineral Fibre (0.033 W/m.K)	110	105	90	85
Glass Mineral Fibre (0.036 W/m.K)	115	115	100	95
EPS (0.037 W/m.K)	120	115	105	95

NB calculations assume 12.5mm plasterboard on dabs lining a block inner leaf and brick outer leaf.

THICKNESS

- The thinner the insulation the shorter and cheaper the wall ties.
- The thicker insulation types may have knock on implications for the sizing of other components of the building e.g. footings.
- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.

PPG3

- Building land is at a premium and the drive is on from PPG3 for higher density housing.
- It is, therefore, difficult to increase the overall plot size and add rooms 'horizontally'.
- Greater wall thicknesses would impact on either the living space or on garden space.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid phenolic or rigid urethane insulants offer the thinnest partial fill cavity wall solutions to the requirements of Approved Documents L1 & L2.

Kingspan partial full cavity wall insulation boards **Kingspan Thermawall TW50** zero ODP (rigid urethane insulation) and **Kingspan Kooltherm* K8 Cavity Board** (rigid phenolic insulation):

- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- are resistant to moisture penetration;
- are unaffected by air movement; and
- are non-fibrous.



Project – Burtan Hall, Dublin.

Products – 1500 m² of Kingspan Thermawall TW50.

Specifier – Horan Keogan Ryan.

Main Contractor – TBD Building Contractors.

CAVITY WALL WITH INSULATED DRY LINING

Thickness (mm) Required to Achieve U-value of 0.35 W/m².K

Insulant	Block Thermal Conductivity (W/m.K)			
	1.13	0.51	0.15	0.11
Rigid Phenolic (0.018 W/m.K)	40	40	30	30
Rigid Urethane (0.026 W/m.K)	55	50	45	40
XPS (0.028 W/m.K)	60	60	45	40
Glass Mineral Fibre (0.033 W/m.K)	70	70	55	50
Rock Mineral Fibre (0.034 W/m.K)	75	70	55	50
EPS (0.037 W/m.K)	80	75	60	55

NB calculations assume insulated plasterboard on dabs, block inner leaf and brick outer leaf.

Thickness (mm) Required to Achieve U-value of 0.25 W/m².K

Insulant	Block Thermal Conductivity (W/m.K)			
	1.13	0.51	0.15	0.11
Rigid Phenolic (0.018 W/m.K)	60	60	50	50
Rigid Urethane (0.026 W/m.K)*	80	80	75	70
XPS (0.028 W/m.K)	90	90	80	75
Glass Mineral Fibre (0.033 W/m.K)	110	105	90	85
Rock Mineral Fibre (0.034 W/m.K)	110	105	95	90
EPS (0.037 W/m.K)	120	115	105	95

NB calculations assume insulated plasterboard on dabs, block inner leaf and brick outer leaf.

* 0.025 W/m.K for thicknesses of 80 mm.

THICKNESS

- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.

PPG3

- Building land is at a premium and the drive is on from PPG3 for higher density housing.
- It is, therefore, difficult to increase the overall plot size and add rooms 'horizontally'.
- Greater wall thicknesses would impact on either the living space or on garden space.



Project – Bob Downes Memorial Hut, Derbyshire.
 Products – Kingspan Thermawall TW52.
 Client – The Climbers Club.
 Specifier – Craig Harwood Architectural Design.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid phenolic or rigid urethane insulants offer the thinnest insulated plasterboard solutions to the requirements of Approved Documents L1 & L2.

The Kingspan insulated dry lining boards **Kingspan Thermawall TW52** zero ODP and **Kingspan Thermawall TW56** zero ODP (rigid urethane insulation):

- provide one of the best thermal performances of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- are resistant to moisture penetration;
- are unaffected by air movement; and
- are non-fibrous.



Project – Monument Court, Lower Canal Walk, Southampton.
 Products – 600 m² of Kingspan Thermawall TW52.
 Client – Bayview Developments Ltd.
 Specifier – Tony Oldfield Architects.
 Contractor – Hood Properties Ltd.

Floors – Assessment of Impact

FLOORS – ASSESSMENT OF IMPACT

U-VALUE REQUIREMENTS

The table below shows the range of U-values that are likely to be used following the introduction of the new Approved Documents L1 & L2. The U-values shown apply to both dwellings and non-domestic buildings.

	Elemental U-value Required By Approved Documents L1 & L2 (W/m ² .K)	DETR Indication Of The Likely Elemental U-value Required Not Before 2007 (W/m ² .K)
Floors	0.25	0.22

REQUIRED THICKNESSES

The table below shows the thicknesses of floor insulation required to meet required U-values.

NB 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.

Insulant	Thickness (mm) Required to Achieve U-value of 0.25 W/m ² .K	Thickness (mm) Required to Achieve U-value of 0.22 W/m ² .K
Rigid Phenolic (0.018 W/m.K)	45	55
Rigid Urethane (0.022 W/m.K)	55	70
XPS (0.028 W/m.K)	70	85
Glass Mineral Fibre (0.031 W/m.K)	80	95
EPS (0.037 W/m.K)	95	115
Rock Mineral Fibre (0.038 W/m.K)	95	115

NB calculations assume 7 x 7 m solid concrete or beam and dense block floor. Area is 49 m². Perimeter is 28 m. P/A is 0.57.



Project – Self-Build House using Potton Timber Frame, Bodmin.
Products – Kingspan Thermafloor TF70 under screed with an underfloor heating system.

THICKNESS

- Rigid phenolic and rigid urethane insulation boards offer the thinnest solutions to the requirements of Approved Documents L1 & L2.



Project – National Football Museum, Preston, Lancashire.
Products – 2,000m² of Kingspan Kooltherm K10 Soffit Board.
Specifier – OMI Architects.

COMPRESSIVE STRENGTH

- Rigid phenolic, rigid urethane and extruded polystyrene floor insulation boards have compressive strengths in excess of 150 kPa at 10% compression.
- That for standard mineral wool products can be considerably less e.g. less than 10 kPa at 10% compression.



Project – Office building car park.
Products – Kingspan Kooltherm K10 Soffit Board.

HEALTH & SAFETY

- Mineral fibre can be irritating to install, requiring special clothing and dust masks.
- There is a maximum exposure limit associated with the handling of mineral fibre.

Rigid phenolic or rigid urethane insulants offer the thinnest floor insulation solutions to the requirements of Approved Documents L1 & L2.

The Kingspan floor insulation boards **Kingspan Thermafloor TF70** zero ODP (rigid urethane insulation), **Kingspan Thermafloor TF73** zero ODP (extruded polystyrene bonded to chipboard) and **Kingspan Kooltherm® K3** Floorboard (rigid phenolic insulation):

- provide the best thermal performance of all commonly available insulants;
- can help you to achieve U-values required by Approved Documents L1 & L2 with minimal thickness;
- are unaffected by moisture;
- are lightweight; and
- are non-fibrous.

References

The Building Regulations 2000. Conservation of fuel and power.

- Kingspan Insulation recommends that you read **Approved Document L, DTLR, 2001**.

Air Movement and Mineral Fibre Loft Insulation

- Kingspan Insulation recommends that you read the reports **Mineral Fibre Loft Insulation, Workmanship, Ventilation & Condensation** and **Mineral Fibre Performance** available from Kingspan Insulation Marketing Department (see rear cover).

Workmanship and Missing Mineral Fibre Loft Insulation

- Kingspan Insulation recommends that you read the report **Mineral Fibre Loft Insulation, Compaction, Settlement, Missing Mineral Fibre and Heat Loss** available from Kingspan Insulation Marketing Department (see rear cover).

Pitched Roofing and the use of Rafter Level Insulation

- The case for using rafter level insulation is detailed in the report **Pitched Roofing and the use of Rafter Level Insulation** available from Kingspan Insulation Marketing Department (see rear cover).

Flat Roof Drainage – Rethinking Construction

- The case for using Kingspan Thermataper Systems to create a fall on roofs with a flat deck is given in **Flat Roof Drainage – Rethinking Construction** available from Kingspan Insulation Marketing Department (see rear cover).

Timber Frame Walls – Rethinking Construction

- The case for using Kingspan Thermawall TW55 in timber frame walls is given in **Timber Frame Walls – Rethinking Construction** available from Kingspan Insulation Marketing Department (see rear cover).

Injected Mineral Fibre Full Fill and Voids

- Kingspan Insulation recommends that you read the report **Injected Mineral Fibre Full Fill Cavity Wall Insulation, Workmanship, Voids and Heat Loss** available from Kingspan Insulation Marketing Department (see rear cover).

Mineral Fibre Full Fill Batts, Workmanship and Water

- Kingspan Insulation recommends that you read the report **Mineral Fibre Full Fill Batt Cavity Wall Insulation, Workmanship, Water & Heat Loss** available from Kingspan Insulation Marketing Department (see rear cover).

Mineral Fibre Partial Fill Slabs and Air Movement

- Kingspan Insulation recommends that you read the report **Mineral Fibre Performance** available from Kingspan Insulation Marketing Department (see rear cover).

Lifetime Energy, CO₂ and Financial Balances for Insulation Materials

- Kingspan Insulation recommends that you read the report **Lifetime Energy, CO₂ and Financial Balances for Insulation Materials – Summary Version** available from Kingspan Insulation Marketing Department (see rear cover).

CUSTOMER SERVICE

For quotations, order placement and details of despatches please contact our Building Fabric Insulation Customer Services Department on the numbers below:

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Kingspan Insulation Ltd support all of their products with a comprehensive Technical Advisory Service for specifiers, stockists and contractors.

This includes a free computer-aided service designed to give fast, accurate technical advice. Simply phone our **TECHLINE** with your project specification and we can run calculations to provide U-values, condensation/dew point risk, required insulation thicknesses etc.... Thereafter we can run any number of permutations to help you achieve your desired targets.

We can also give general application advice and advice on design detailing and fixing etc... Site surveys are also undertaken as appropriate.

Please contact our Building Fabric Insulation Technical Services Department on the **TECHLINE** numbers below:



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LITERATURE AND SAMPLES

Kingspan Insulation produces a comprehensive range of technical literature for specifiers, contractors, stockists and end users. The literature contains clear 'user friendly' advice on typical design; design considerations; thermal properties; sitework and product data.

Available as a complete Design Manual, on CD-ROM or as individual product brochures, Kingspan Insulation technical literature is an essential specification tool. For copies please contact our Marketing Department on the numbers below:

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