



August 2008: Issue 1

Non - Residential New Build 4.2.5 Green Roofs



energy saving



warmth



quietness



fire protection



sustainability

Non-residential New Build

Green Roof - Contents

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Green roofs

Solution optimiser and pathfinder



A green roof is a roof that is partially or completely covered with vegetation and soil, or growing medium, planted over a waterproofing membrane.

Green roofs may also include additional layers such as a root barrier and drainage and irrigation systems.

Green roofs not only provide amenity space for building users, but critically, reduce heating (by adding mass and thermal resistance value) and cooling (by evaporative cooling) loads on a building. Additionally, the inclusion of the growing medium and vegetation will help control stormwater run off.

Green roofs

Construction compatibility with Part L2A

Elemental U-value requirement

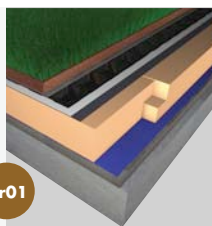
Knauf Insulation solution

Warm deck green roof with single ply membrane

Product*: Polyfoam Roofboard Extra
Description: Warm deck green roof with ultra strong XPS insulation below single ply membrane

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Gr01

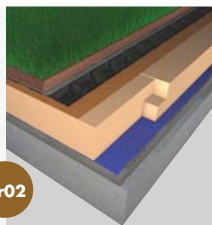


Protected membrane green roof

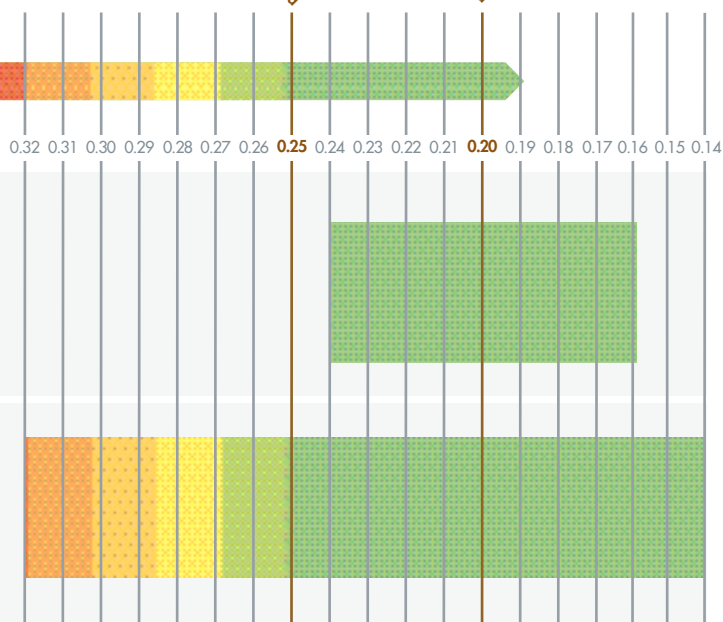
Product*: Polyfoam Slimline System
Description: Protected membrane green roof with ultra strong XPS insulation and water-shedding system

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Gr02



U-values



Key

U-values achievable by constructions within this document.

* Recommended Knauf Insulation product(s). Other products may be applicable.

Pb01 Find online. Visit www.knaufinsulation.co.uk and key in construction code to find the most up to date information on your chosen solution.

Green roofs

Green roof design

The green roof can vary from simple plants to mature trees and shrubs which will impose higher loads on the structure and thus the insulation layer. Besides the enhanced thermal resistance, another major benefit of green roofs is their ability to slow the rate of rainwater runoff.

It has been found that they can retain up to 75% of rainwater, gradually releasing it back into the atmosphere via condensation and transpiration, while retaining pollutants in their soil. Green roofs can be categorised as "intensive", "semi-intensive" or "extensive", depending on the depth of planting medium and the amount of maintenance they need.

The benefits

Improves environment

- Creates a beneficial microclimate by cooling and humidifying the surrounding air
- Absorbs greenhouse gases
- Absorbs air pollution and dust
- Provides a habitat for animals and plants
- High water retention
- Run-off attenuation reduces stress on surface water drainage systems

Building fabric

- Protects the roof from mechanical damage and ultra violet radiation, frost and weathering – thus extending the life of the waterproof membrane
- Reduces noise levels

Can use recycled materials

- Many of the materials used in green roof construction are manufactured from recycled building materials and plastics, reducing landfill disposal

Types of green roofs

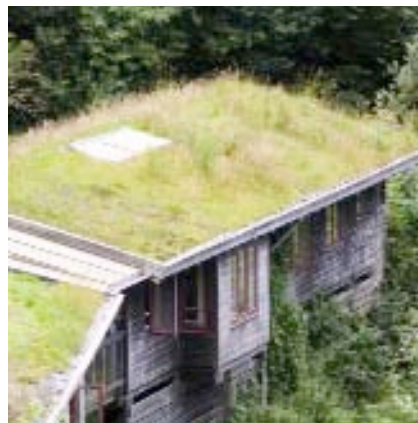
There are three types of green roof:



1. Extensive

These have shallow (typically 70mm) soils and support sedums, moss, herbs and grasses. They are used where roof access is not required. It is the lightest type of green roof. Extensive green roofs provide attractive protection to the waterproof membrane and significantly reduced water run-off. When the green roof is completed, the building owner must water and weed on a regular basis for the first year until the plants are established to ensure proper growth and success.

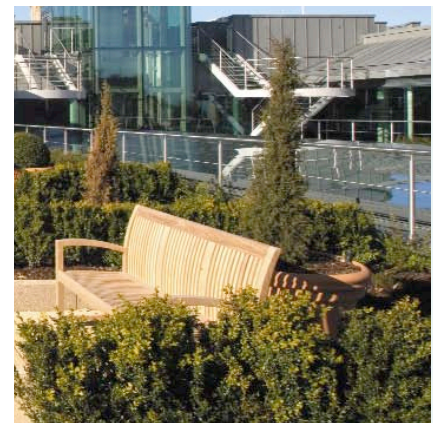
2. Semi-intensive



A deeper soil layer (typically 150mm) than extensive roofs enables a wider variety of plants to be grown, including shrubs and woody plants. They are ideal where the roof is overlooked and year-round colour is required with only periodic maintenance. Where access is required, areas of paving can be included in the design.

3. Intensive

With a deep soil layer (150mm upwards) a wide



variety of plant types can be grown, from lawns to semi-mature trees. The type of planting will determine the depth of soil required, the need for an irrigation system and the level of maintenance. Regular roof access is normally provided on this type of green roof, so paved areas, walls and even water features are incorporated in the design.

Regulatory compliance

There are no regulations or British Standards specifically relating to green roofs in the UK. Most suppliers of green roof components comply with the German Green Roof Standards, known as the FLA. However, a building with a green roof is of course subject to the same building regulation requirements as a building with a conventional flat or pitched roof.

Roof loadings

Table 4 indicates typical loadings on a green roof. Advice on particular schemes should be sought from the green roof supplier.

A reputable manufacturer/supplier of green roof systems will be able to supply product data sheets on each of the components comprising any particular green roof build-up.

Table 4: Design loads on a green roof

Type of green roof	Weight (kg/m ²)
Extensive design	60-150
Gravel surface	90-150
Paved surface	160-220
Intensive design	200-550

Warm or inverted build-up

It is possible to design a green roof system above both warm and inverted roof constructions. The green roof elements are the same in both cases, only the demands on the insulation and the position of waterproof membrane change.

Insulation

The thermal insulation should be capable of resisting both the dead load of the green roof and any additional live loads if regular access to the roof is planned.

In a protected insulation roof, the insulation should also be impervious to water. Extruded polystyrene is the preferred choice.

The soil in a green roof does offer some insulation value but is normally ignored in U-value calculations. This is because the insulation value of the soil varies with the water content.

Waterproof membrane

The green roof makes it difficult and expensive to renew and repair the waterproof membrane. The waterproof membrane, therefore, should be selected for its high performance and longevity.

The waterproofing system beneath any green roof should preferably be root resistant in the long term to the German FLL standards. If the waterproofing is not root resistant then the green roof system must include a separate root barrier, usually immediately above the waterproof membrane. The waterproofing system must be leak tested and certified as such immediately before the installation of the green roof.

The design of the waterproofing and its detailing to perimeters, outlets, protrusions through the roof etc., should take into account the depth of the green roof build up. The waterproofing should always be 150mm above soil level at upstands and protrusions, and at least 50mm at external perimeters. A 300 to 500mm wide layer of gravel or paving is recommended at all junctions with upstands, rooflights etc.

Drainage

Green roofs should be designed with a fall of at least 1:60. This prevents the risk of ponding in deflections in the roof deck, which can be harmful to the plants.

Each roof area should contain at least two roof outlets, or a roof outlet and an overflow. An inspection chamber should be constructed over each outlet to allow regular inspection and cleaning of vegetation from the outlet grating. Consult the supplier of the green roof components for their recommendations on the number of drainage outlets.

A green roof can absorb and store a high proportion of the rainwater that falls on it, helping to prevent local flood risk.

Wind uplift

Wind uplift is greatest at the edges of roofs. At these points, paving slabs or coarse gravel are usually used to prevent wind suction displacing the soil layer in a green roof. The soil layer is most vulnerable in its early stages, before the root system of the planting material helps to provide a degree of reinforcement.

Generally, the higher the building above the ground, the greater the risk of wind uplift.

Fire performance

The soil layer generally provides the fire protection in a green roof. For extensive roofs, the soil layer should be at least 30mm deep and contain less than 20% organic matter. Gravel strips or paving slabs are required to act as fire breaks around all rooflights and below windows to walls. They must be kept free of flammable vegetation.

Green roofs

Warm deck green roof with single ply membrane

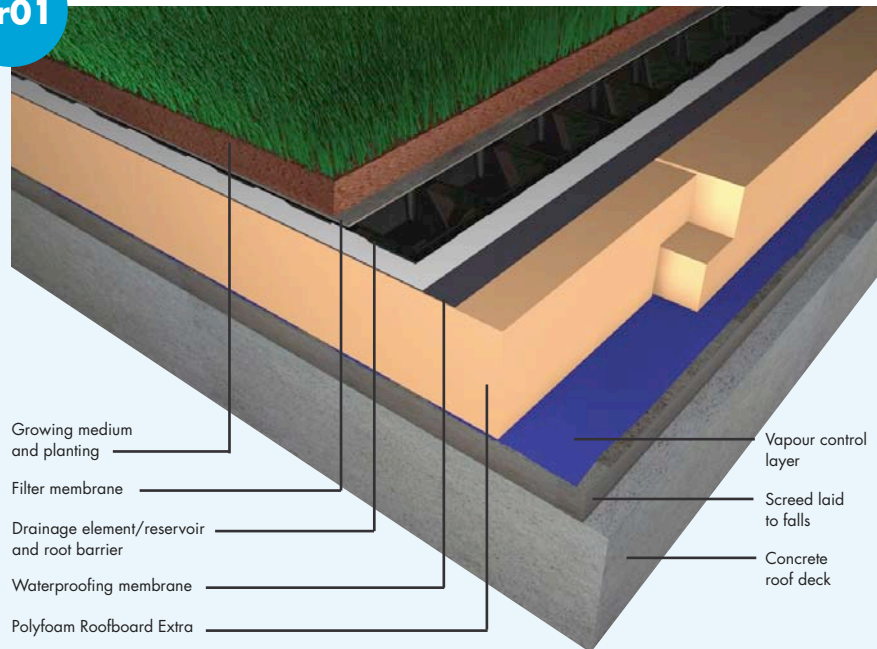


Polyfoam Roofboard

Gr01

Advantages

- ✓ Highly cost effective solution with compressive strength that will support a green or garden roof
- ✓ Suitable for use in any green or garden roof system
- ✓ Protects the waterproofing membrane from UV degradation
- ✓ Green roofs reduce peak hour run-off, improving water management and reducing the risk of flooding



Products

Polyfoam Roofboard Extra is a 100% ozone friendly, extruded polystyrene, rigid board insulation. It is lightweight, yet has excellent compressive strength. It is supplied with interlocking rebated edges.

Typical construction

Any type of roof deck designed as a new build, or intended for refurbishment, can be designed as a green or garden roof, provided the roof structure is capable of carrying the associated loads.

The waterproofing is installed above the insulation to create a warm deck construction. The waterproofing layer is then covered with moisture reservoirs (and in some cases, root barriers). These are then overlaid with a filtration membrane, and planting to create a green or garden roof.

A green roof (or extensive roof) constitutes lightweight growing matter, e.g. sedum.

A garden roof (or intensive roof) can vary from simple plants to mature trees and shrubs which will impose higher loads on the structure and thus the insulation layer.

Green or garden roof systems may differ by supplier. In all cases, the insulation layer needs to have high compressive strength in order to offer the right level of long term structural support to the growing layer.

Installation

The vapour control layer should be laid over the structural deck and all joints lapped and bonded.

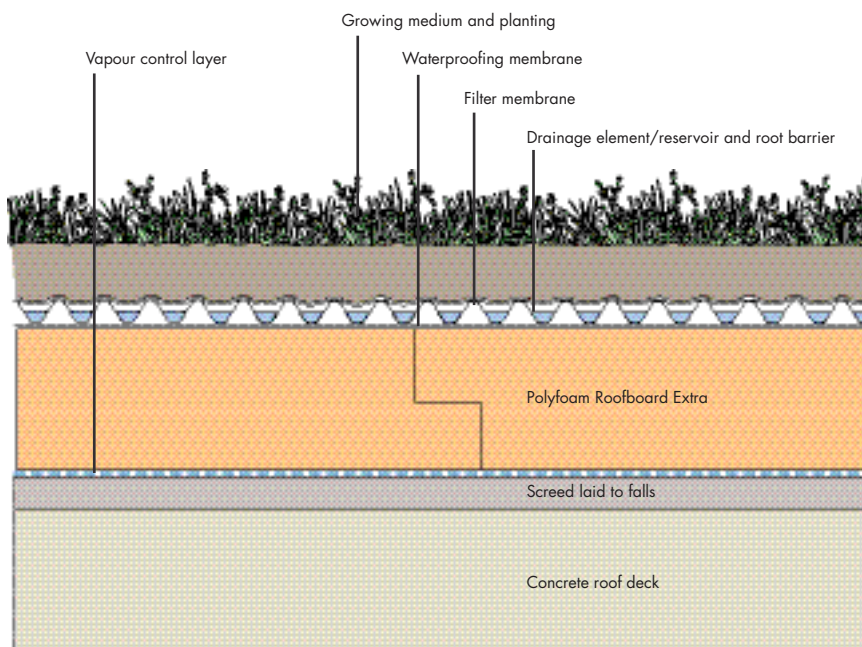
The insulation boards are then laid in a staggered pattern from one corner of the roof. If a PVC membrane is being used the membrane should be separated from the Polyfoam to prevent plasticiser migration. Alternatively, Polyfoam Roofboard Extra (Foil Faced) board can be used.

Where a mechanically fixed membrane is being used, Polyfoam Roofboard Extra should be mechanically fixed to the deck with two centrally placed fixings in each board to secure the boards in place before the membrane is fixed.

Where a fully bonded membrane system is used, each layer of insulation must be bonded as well as the waterproof membrane itself. A polyurethane based adhesive is recommended.

The specified green roof system is then installed, each layer is laid on an advancing front in order to protect the waterproofing membrane from mechanical damage as the materials are transported across the roof.

Typical section



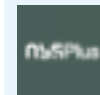
Typical specification

The vapour control layer and Polyfoam Roofboard Extra*, thicknessmm to be mechanically fixed*/adhered* to the roof deck.

(*delete as required)

The single ply membrane should be applied over the insulation in accordance with the appropriate manufacturer's recommended specification.

The single ply membrane to be overlaid with a root barrier/ moisture reservoir as specified ensuring there are no gaps and edges are overlapped. This to be covered with a filtration layer, and growing matter as specified to client requirements.



Alternatively, consult the National Building Specifications (NBS) based on Standard Version J42. It contains a set of proprietary clauses, which are edited versions written by Knauf Insulation.

Performance

Compression resistance

Polyfoam Roofboard Extra has a minimum compressive strength of 350 kPa.

A factor of safety of 5 should be applied to the compressive strength of the products for long term static loads.

Thermal performance

Polyfoam Roofboard Extra up to 120mm thick has a thermal conductivity of 0.029 W/mK, and 0.031 W/mK above this.

The actual performance in use is outlined in Table 30.

Fire performance

When Polyfoam Roofboard Extra is installed in a green roof it will not contribute to the development stages of a fire.

Table 30: Typical U-values of warm deck green roof

Product	U-values (W/m ² K)	
	Thickness (mm)	150mm concrete 40mm screed 13mm plaster
Polyfoam Roofboard Extra		
	170 (120 + 50)	0.16
	160 (110 + 50)	0.17
	150 (2 x 75)	0.18
	140	0.19
	130	0.21
	120	0.22
	110	0.24

Note: The U-values have been calculated to BS EN ISO 6946: 1997.

For project specific calculations contact our Technical Advisory Centre on 01744 766666.

Green roofs

Protected membrane green roof

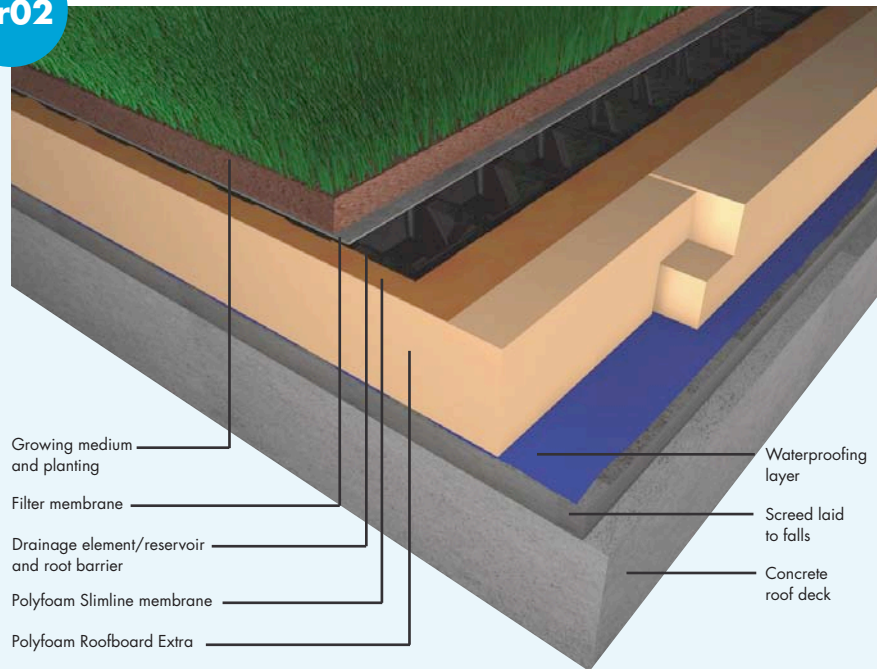


Polyfoam Slimline System

Gr02

Advantages

- ✓ Highly cost effective solution with compressive strength that will support a green or garden roof, as well as a paved or terraced area
- ✓ High thermal performance due to Polyfoam Slimline System
- ✓ Suitable for use in any green or garden roof system
- ✓ Protects the waterproofing membrane from UV degradation and temperature extremes, increasing the membrane's in service life
- ✓ Thermal performance and stability of the insulation is unaffected by moisture



Products

Polyfoam Roofboard Extra/Super are 100% ozone friendly, extruded polystyrene, rigid insulation boards that are lightweight, yet have excellent structural strength and moisture resistance.

Polyfoam Slimline membrane is a high performance, non woven polypropylene geotextile membrane that prevents the passage of water and is water vapour permeable.

Typical construction

Any type of roof deck designed as a new build, or intended for refurbishment, can be designed as a green or garden roof, provided the roof structure is capable of carrying the associated loads.

The waterproofing is installed below the insulation to create a protected membrane construction. The waterproof layer is overlaid with Polyfoam Roofboard and the Polyfoam Slimline membrane. This is then covered with moisture reservoirs (and in some cases, root barriers). These are then overlaid with a filtration membrane and planting to create a green or garden roof.

A green roof (or extensive roof) constitutes lightweight growing matter, e.g. sedum.

A garden roof (or intensive roof) can vary from simple plants to mature trees and shrubs which will impose higher loads on the structure and thus the insulation layer.

Green or garden roof systems may differ by supplier. In all cases, the insulation layer needs to be both highly resistant to the effect of exposure to water and have high compressive strength in order to offer the anticipated level of thermal performance and structural support to the growing layer in the long term.

Installation

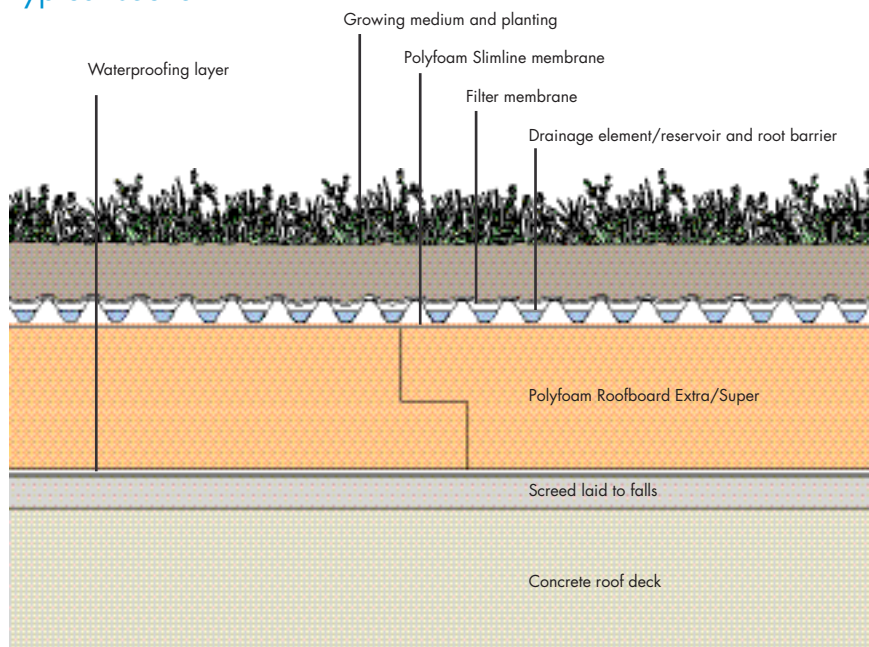
The waterproof membrane must be free of loose gravel and grit before the insulation board is laid. On existing roofs, any existing chippings should be covered with a polyethylene cushioning layer, such as Floorfoam 5.

For mastic asphalt finishes, a separating, non-woven polyester fleece should be laid immediately below the insulation and turned up at all upstands.

The boards should be laid in a staggered pattern from the point of access across the roof. It is important that all joints between boards are tight fitting and there are no gaps at junctions with rooflights, upstands etc.

The specified green roof system is then installed, each layer is laid on an advancing front in order to protect the waterproofing membrane from mechanical damage as the materials are transported across the roof and to protect the boards from wind uplift.

Typical section



Typical specification

The whole of the roof area, lined with a waterproof membrane to be insulated with Polyfoam Roofboard Extra*/Super*,mm thick, covered with Polyfoam Slimline membrane. The Slimline membrane to be overlaid with a root barrier/ moisture reservoir as specified ensuring there are no gaps and edges are overlapped. This to be covered with a filtration layer, and growing matter as specified to client requirements.

Alternatively, consult the National Building Specifications (NBS) based on Standard Version J21, J41 or J42. It contains a set of proprietary clauses, which are edited versions written by Knauf Insulation.

Performance

Compression resistance

Polyfoam Roofboard is highly resistant to compression and withstands both occasional and long term static loads.

Knauf Insulation recommends a factor of safety of 3 for occasional loading (5 for long term static loads) is applied to the compressive strength of the product.

Moisture resistance

Polyfoam Roofboard is highly resistant to moisture and can be laid in standing water or up against wet concrete with negligible impact on the performance of the product.

Thermal performance

The thermal conductivity of Polyfoam Roofboard Extra up to 120mm is 0.029 W/mK and 0.031 W/mK above this.

The thermal conductivity of Polyfoam Roofboard Super varies between 0.034 and 0.036 W/mK depending on thickness.

The actual performance in use is outlined in Table 31.

Fire performance

When Polyfoam Roofboard is installed in a green roof it will not contribute to the development stages of a fire.

Table 31: Typical U-values for green or garden roofs insulated with Polyfoam Slimline System in protected membrane roof

Product	Thickness (mm)	U-values (W/m ² K)
		150mm concrete, 40mm screed 13mm plaster
Polyfoam Roofboard Extra	200 (2x100)	0.15
	190 (130+60)	0.14
	180 (120+60)	0.15
	170 (120+50)	0.16
	160 (110+50)	0.17
	150 (2x75)	0.18
	140	0.19
Polyfoam Roofboard Super	130	0.21
	120	0.22
	110	0.24
	225 (3 x 75)	0.15
	200 (2 x 100)	0.16
	175 (100 + 75)	0.19
	150 (2 x 75)	0.21
	125 (75 + 50)	0.25
100	0.32	

Note: The U-values have been calculated to BS EN ISO 6946: 1997.

For project specific calculations contact our Technical Advisory Centre on 01744 766666.

KNAUFINSULATION



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