RAVATHERM™ XPS X

Insulating inverted flat roofs with Ravatherm XPS X

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE 21/5874

Ravago BUILDING SOLUTIONS

Ravatherm XPS X has been created specifically for inverted roofs – a form of flat roof where the thermal insulation is placed above the waterproof membrane. The added benefit of this type of roofing is that the membrane is also protected from expansion and contraction caused by changes in the weather and temperature. The inverted roof system is ideally suited to flat roofs of heavyweight construction, and offers a durable, attractive roof finish for roofs where maintenance traffic is expected.

About Ravatherm XPS X

Ravatherm XPS X was originally developed to deliver improved thermal performance for inverted flat roof applications. The extrusion technology gives it a uniform structure of closed cells and a smooth skin, making it suitable for applications where the insulation material is directly exposed to a moist environment over a long period of time. It has been formulated with the addition of infra-red 'blockers' or particles, finely dispersed in the cell walls. These scatter and reflect heat radiation, helping to keep a building warm in winter and cool in summer.

Ravatherm XPS X uses carbon dioxide as a blowing agent, which gives it an ozone depleting potential (ODP) of zero and a Global Warming Potential of less than five.

Ravatherm XPS X has exceptionally good thermal conductivity, with low lambda values – the measure of a product's insulating capacity – and it can be produced in a wide variety of thicknesses, which, linked to its superior insulation performance, means it is effective for many locations and uses.

Ravatherm XPS X's rot resistance makes it ideal for insulating green and blue roofs, and it is also used in terrace roofs, car park decks and refurbishments.

Ravatherm XPS X has high strength and rigidity, and good dimensional stability. It can be cut easily and accurately using hand tools, offering simple and quick installation with minimal waste.

The product can be used in conjunction with the Ravatherm XPS X MK filter/water-flow-reducing layer between the insulation and the ballast layer, forming the Ravatherm XPS X MK system. Adding Ravatherm XPS X MK waterflow reducing layer over the insulation before placing ballast or paving on spacers, means most of the rainwater flows above the insulation, minimising rain water cooling of the water proofing layer. (see appendix page 11)

A Declaration of Performance (DOP) for Ravatherm XPS X can be found in http://dop.ravatherm.com/

Performance summary

- Declared thermal conductivity of 0.031 W/mK in thicknesses of 80mm, 100mm, 120mm, 130mm, 140mm, 160mm, 180mm and 200mm.
- Global Warming Potential (GWP) of less than five.
- Low thermal conductivity minimises the board thickness needed to achieve a specific U-value thus allowing the designer greater flexibility.
- Closed cell structure for high compressive strength in load-bearing applications
- Low water absorption – natural resistance to rain, snow, frost and water vapour.
- Exceptionally stable, retaining initial insulation performance and physical integrity in exposed conditions over the very long term.
- User-friendliness – Ravatherm XPS X is easily worked with normal hand tools.
- Hygiene – Ravatherm XPS X boards have low susceptibility to rot, minimising mould or fungal growth. They are clean, odourless and free from irritating dust.
- Service life – properly installed Ravatherm XPS X boards have a service life comparable with that of the building or structure.
- XPS X 300SL boards are BBA certified.

Please contact technical.uk.rbs@ravago.com to request information of a system provider or roofing contractor stockist to suit your individual project.

Constructing an inverted roof

Figure 1.
Inverted roof with gravel ballast/paving slabs

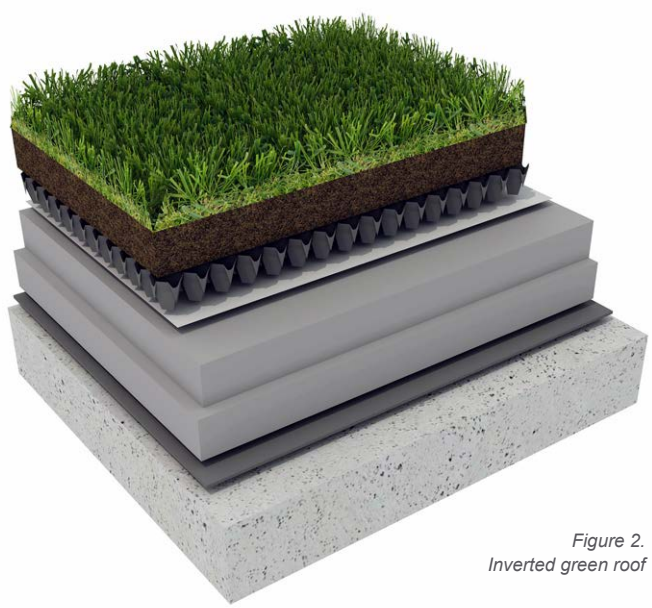

Figure 2.
Inverted green roof

- Ravatherm XPS X is designed to give the maximum benefit in inverted roof construction. Its range of thicknesses allows thermal performance to be matched to project requirements. Its rigid boards provide a firm base for the ballast layer and its shiplapped edges ensure a good interlock between boards, which helps prevent thermal bridging.

- Inverted roof constructions can be categorised as heavyweight or lightweight by reference to the form of building construction involved. If the structure incorporates a concrete slab it will normally be cost effective to design the slab to support the load of 80-120 kg/m^2 imposed by a ballasted inverted roof system.

Basic principles

Roof loadings

The basic roof structure may be of concrete, metal or timber: it must be strong enough to withstand the maximum predicted loads with a suitable factor of safety.

Inverted roofs are subject to three main loads:

- dead loads: the self-weight of all the materials used: for calculation advice see BS 6399: Part 1
- wind loads: the positive and negative pressures acting on the roof should be calculated using either the standard or directional method given in BS 6399: Part 2. To calculate the weight of ballast required to resist wind uplift refer to BRE Digest 295. The stability of the ballast selected against wind scour can be assessed using BRE Digest 311
- imposed loads: see BS 6399: Part 3.

Roof waterproofing

The inverted roof concept can be used with a wide range of waterproofing materials, including mastic asphalt, high performance built-up bitumen felt, hot melt modified bitumen, PU based systems and single ply polymeric membranes. Seek advice from manufacturers on compatibility of their waterproofing materials with Ravatherm XPS X.

Thermal performance

Table 1 shows the thickness of insulation required to achieve a range of U-values. In an inverted roof construction some rainwater will run off beneath the insulation boards and in doing so may draw heat from the deck.

This 'rainwater cooling effect' requires an increase in insulation thickness in order to meet BS EN ISO 6946. However, this increase can be substantially reduced by using the Ravatherm XPS X MK system, where the heat loss due to rainwater cooling reduces the amount of insulation required.

Condensation

The inverted roof construction can greatly reduce the risk of condensation in an existing building by keeping the roof structure and the waterproof layer above the dew point temperature.

Where a building is likely to have a high level of humidity, as in the case of swimming pools or commercial kitchens, a condensation risk assessment should be undertaken by a suitably qualified professional. A method for calculating the risk of interstitial condensation is given in BS EN ISO 13788.

Roofs with high thermal capacity - such as concrete at least 150mm thick - do not undergo rapid cooling by rainwater run-off.

Fire

Inverted roofs ballasted with incombustible material, such as aggregate or paving slabs, offer adequate resistance to the external fire rating of Broof(t4) which make the roof unrestricted with respect to proximity to a relevant boundary under Approved Document B of the Building Regulations.

Ravatherm XPS X is rated Euroclass E under BS EN 13501-1 Reaction to Fire test.

U-value	0.17	0.15	0.14	0.12	0.10
Ravatherm XPS X 300 SL	180	200	220*	260*	300*

Table 1: Required Ravatherm XPS X 300 SL thickness (mm) to meet U-values W/mK using the Ravatherm XPS X MK system

Roof build-up:
Ballast (aggregate/pavers)
Ravatherm XPS X MK
Ravatherm XPS X 300 SL
Geotextile separation layer (if required)
Hot melt waterproofing
Reinforced concrete deck 200mm

Rainwater cooling penalty calculated to BS EN ISO 6946 Annex D4, p=3mm/day

**2 layers of insulation required*

Roof falls and drainage

Good drainage is vital to the long-term performance of a flat roof. As with any building element, when designing a flat roof, it is good design practice to follow and adopt relevant design guidance. The most referred to guidance is that of BS 6229:2018 – flat roofs with continuously supported coverings which recommends an appropriate fall be accommodated within the roof design, including inverted flat roofs.

It is also vital that the roof is adequately drained to prevent ponding on the waterproofing layer. The location, size and number of rainwater outlets should be designed in accordance with BS EN 12056-3:2000.

The roof deck should also be without deflections or depressions in which water may pond. To perform effectively, Ravatherm XPS X boards should not be totally or permanently submerged in water during the product's lifetime on a roof.

If the roof is regarded as 'zero pitch', then particular attention must be given to the provision of roof drainage to prevent ponding, as outlined in the BBA Information Bulletin No 4. The location, number and size of the drainage outlets need to be designed to facilitate acceptable removal of rainwater (and water from other precipitation) to avoid the thermal insulation boards within the inverted roof construction being either totally or permanently immersed in water.

If significant areas of ponding as a result of back falls are identified, an appropriate design strategy must be adopted to ensure their removal prior to the insulation being installed. Specify rainwater outlets which will accept run-off from both the top of the insulation and the surface of the waterproofing.

Further guidance and information can be found in ETAG 031, Guideline for European Technical Approval of Inverted Roof Insulation Kits Part 1.

Separating layers

The recommendations for the use of separating layers in inverted roof construction are as follows:

Between waterproof layer and insulation:

- mastic asphalt: BS 8218 requires a loose-laid nonwoven polyester fleece 130 - 140g/m2 lapped 200 - 300mm
- bituminous felts: separating layer not normally required
- single ply polymeric membranes: a loose laid nonwoven polyester fleece is normally recommended for pPVC membranes – consult the membrane supplier
- recommended for pPVC membranes - consult the membrane supplier
- PU based systems - consult supplier.

Between insulation and ballast:

- to prevent fines from being washed under the insulation where they could damage the waterproof membrane use a loose-laid filter fabric, e.g. Ravatherm XPS X MK – see Appendix on page 11
- to reduce the depth of ballast required to counter board flotation to 50 mm washed 20/40 aggregate, irrespective of the insulation thickness, use a loose-laid non-woven geotextile e.g. Ravatherm XPS X MK lapped 300 mm. To prevent flotation the drainage must be properly designed, installed and maintained.

Roof coverings/finishings

BALLAST

In the inverted roof system, insulation laid over the waterproofing layer must be suitably loaded to restrain it against flotation and wind uplift and to protect it against damage and long-term degradation by UV light.

Both washed aggregate and dense concrete paving slabs on corner spacer supports are suitable as ballast for use with Ravatherm XPS X insulation.

AGGREGATE

This gives a good appearance at an economical cost and should be 20-40mm nominal diameter, clean, washed and reasonably free from fines. When boards are overlaid with a suitable separating layer such as Ravatherm XPS X MK – lapped 300mm, then a 50mm depth of 20/40 aggregate may be sufficient to counter flotation of the insulation. Additional ballast may, however, be needed in those areas subject to wind uplift, such as exposed perimeters and corners.

Aggregate should be replaced by paving slabs:

- to form walkways where regular foot traffic is expected
- where the kerb at the roof edge is too shallow to retain the aggregate
- at perimeters, where calculations indicate aggregate will not provide sufficient resistance to wind uplift or will be affected by wind scour – see BRE Digest 311.

PAVING

Pressed concrete pavers 600mm x 600mm and 50mm thick should be raised off the insulation on corner spacers to allow drainage and to avoid rocking.

Edge details

Upstands at parapets and abutments should be protected by Ravatherm XPS X UB300 boards, which include a fibre cement layer to prevent damage by UV light. This boards must be set vertically and secured by an apron flashing.

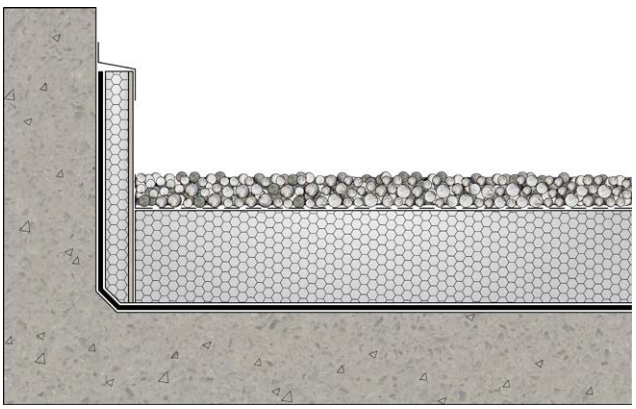

Figure 3. Inverted roof – detail at upstand

Extending the insulation in this way affords a consistent level of protection and helps to avoid thermal bridging. Apron flashings should be carried to at least 150mm above the surface of the ballast.

Kerbs, including those at verges and rooflights, should be high enough to contain the insulation and the ballast. Ravatherm XPS X boards should be fitted tight against kerbs.

Advice on whether Ravatherm XPS X UB300 is suitable for all buildings in regards to compliance with Approved Document B shall be sought after.

Drains and gutters

Outlet gratings may be raised on spacer rings to reduce the risk of blockage: cut a hole in the Ravatherm XPS X boards to accommodate the outlets.

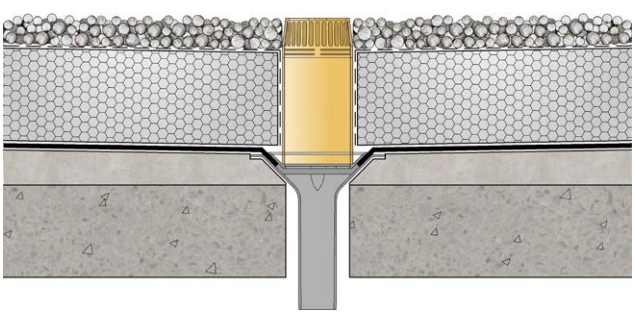

Figure 4. Ravatherm XPS X MK system in the inverted roof

A paving slab on spacer pads may be used above a flat grating.

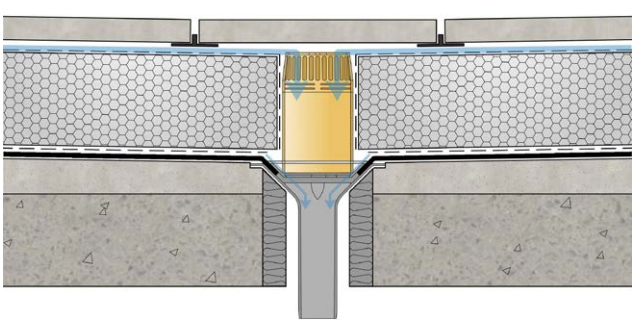

Figure 5. Ballasted inverted roof – outlet protected by paving slabs

Where possible, line internal gutters with Ravatherm XPS X to prevent thermal bridging - the gutter may be spanned by paving slabs on spacer pads.

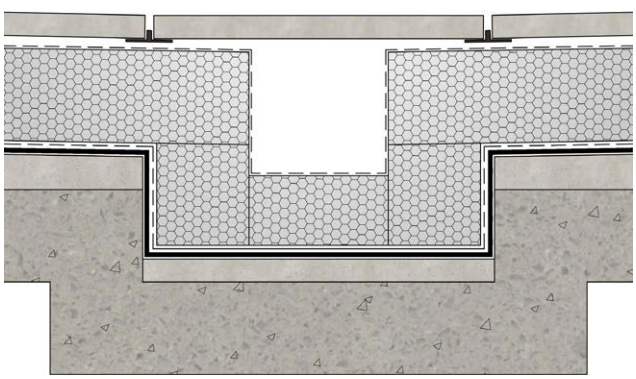

Figure 6. Ballasted inverted roof - insulation over internal gutter

Where the roof drains to an edge gutter terminate aggregate ballast with a row of paving slabs on suitable supports and protect the edge of the Ravatherm XPS X boards with a cover flashing.

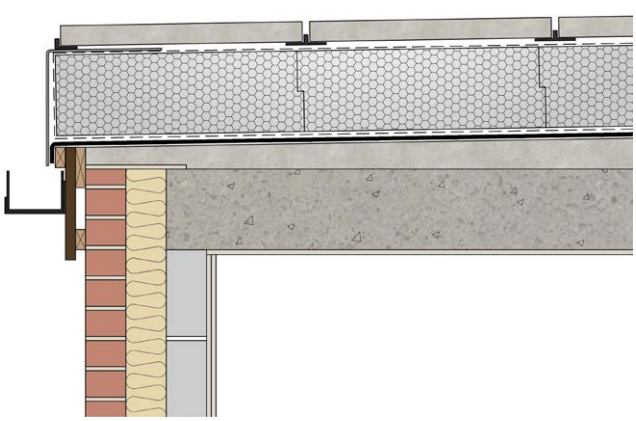

Figure 7. Ballasted inverted roof – detail at eaves

Installation methods/sequence

1. Inspect the roof to ensure it is clean. Plan the installation sequence and the layout of Ravatherm XPS X boards.
2. Lay the separating layer (if required) over the waterproof layer; lap all edges by 200-300mm, at perimeters and penetrations turn up above the installed thickness of the insulation.
3. Lay Ravatherm XPS X insulation boards in brick bond pattern with shiplap edges pushed together firmly.

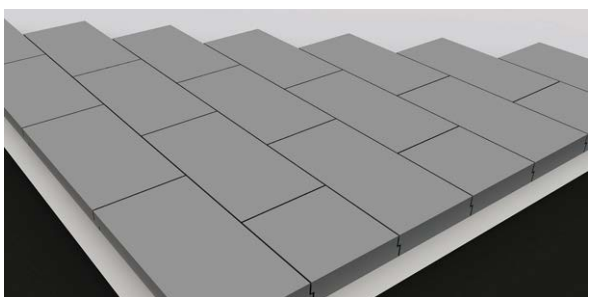

Figure 8.

4. Fit Ravatherm XPS X boards neatly around penetrations. Cut boards with a sharp knife or fine-toothed saw.

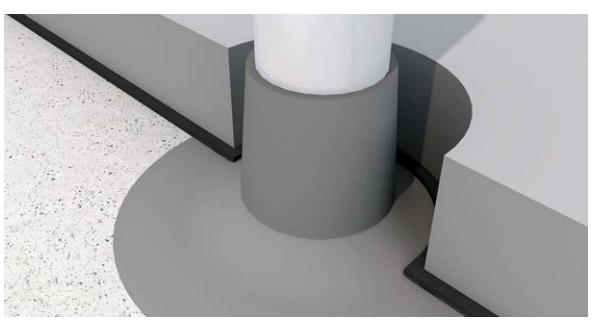

Figure 9.

5. Insulate upstands with Ravatherm XPS X UB300 set vertically and covered with an apron flashing.

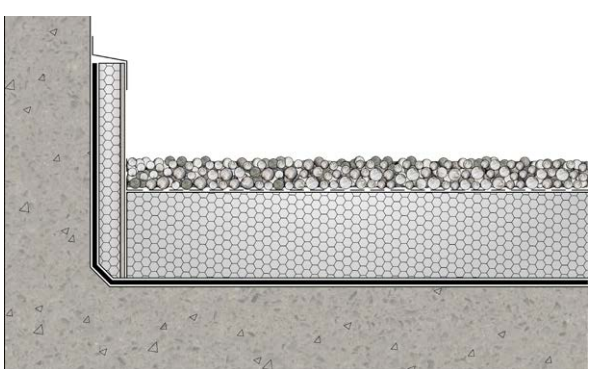

Figure 10.

6. Lay Ravatherm XPS X MK at right angles to the slope starting at bottom of slope and overlapping sequentially with 300mm laps.

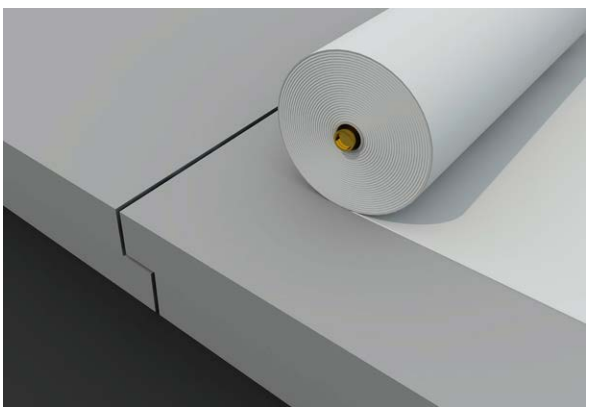

Figure 11.

At upstands and penetrations turn up the filter layer so it finishes above the surface of the ballast.

At drainage outlets neatly cut and turn down the filter layer to discharge water at the outlet positions.

7. Lay paving slabs on supports around roof perimeters and penetrations as required.
8. Lay the ballast layer progressively. Work on an advancing front away from the point of access so all ballast material is carried across a protected waterproof layer.

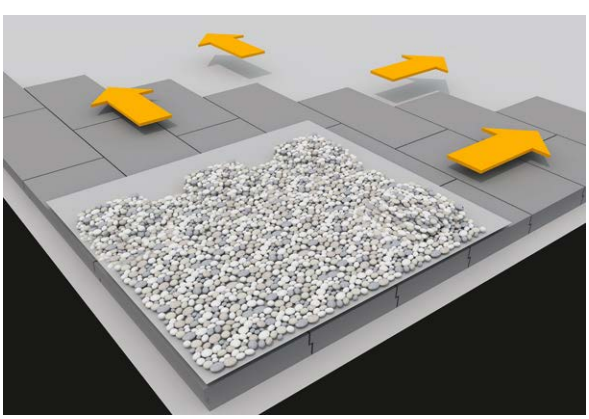

Figure 12.

Key points

- Do not proceed if roof deck is unsuitable to receive insulation
- careful setting-out before installation begins will minimise cutting and wastage
- take care not to over-stress any area of the roof while distributing the ballast
- use scaffold boards when barrowing materials over Ravatherm XPS X boards.

Ravatherm XPS X 300 SL

- Thicknesses: 50, 80, 100, 120, 130, 140, 160, 180, 200mm
- Board size: 1250 x 600mm
- Edge profile: shiplap
- Design loading: 130kN/m^2
- Reaction to fire: BS EN 13164 Euroclass E
- Working temperature range: -50°C to +75°C
- BBA certified.

Further advice:

- do not lay insulation until roof is clear of other substrates
- clean off all dirt and debris from base
- lay separation layer as required
- set out to minimise cutting and avoid small cut pieces at perimeters and penetrations
- loose lay boards, tightly butted and to brick pattern, cut cleanly to fit closely around projections, upstands, rainwater outlets, etc
- on completion of laying ensure boards are in good condition, with no springing, flexing or rocking
- secure boards against wind uplift as soon as practicable
- lay Ravatherm XPS X MK.

Disclaimer

Ravatherm XPS X contains a flame retardant additive to inhibit accidental ignition from a small fire source. Ravatherm XPS X is however, combustible and if exposed to an intensive fire may burn rapidly.

During shipment, storage, installation and use Ravatherm XPS X should not be exposed to flames or other ignition sources.

Fire classification is based on small scale tests, which may not reflect the reaction of the products in its end use state under actual fire conditions.

Ravatherm XPS X should, when installed, be adequately protected from direct exposure to fire.

Recommendations about the methods, use of materials and construction details are given as a service to designers and contractors. These are based on the experience of Ravago with the use of Ravatherm XPS X.

Any drawings are meant only to illustrate various possible applications and should not be taken as a basis for design.

Since Ravago Building Solutions is a materials supplier and exercises no control over the installation of Ravatherm XPS X, no responsibility is accepted for such drawings and recommendations.

In particular, no responsibility is accepted by Ravago for the systems in which Ravatherm XPS X is used or the method of application by which they are installed. The legal obligations of Ravago in respect of any sale of Ravatherm XPS X shall be determined solely by the terms of the respective sales contract.

For technical enquiries email technical.uk.rbs@ravago.com

Ravago Building Solutions
Estuary Road
King's Lynn
PE30 2HJ

RavagoBuildingSolutionsUK

@RInsulationUK

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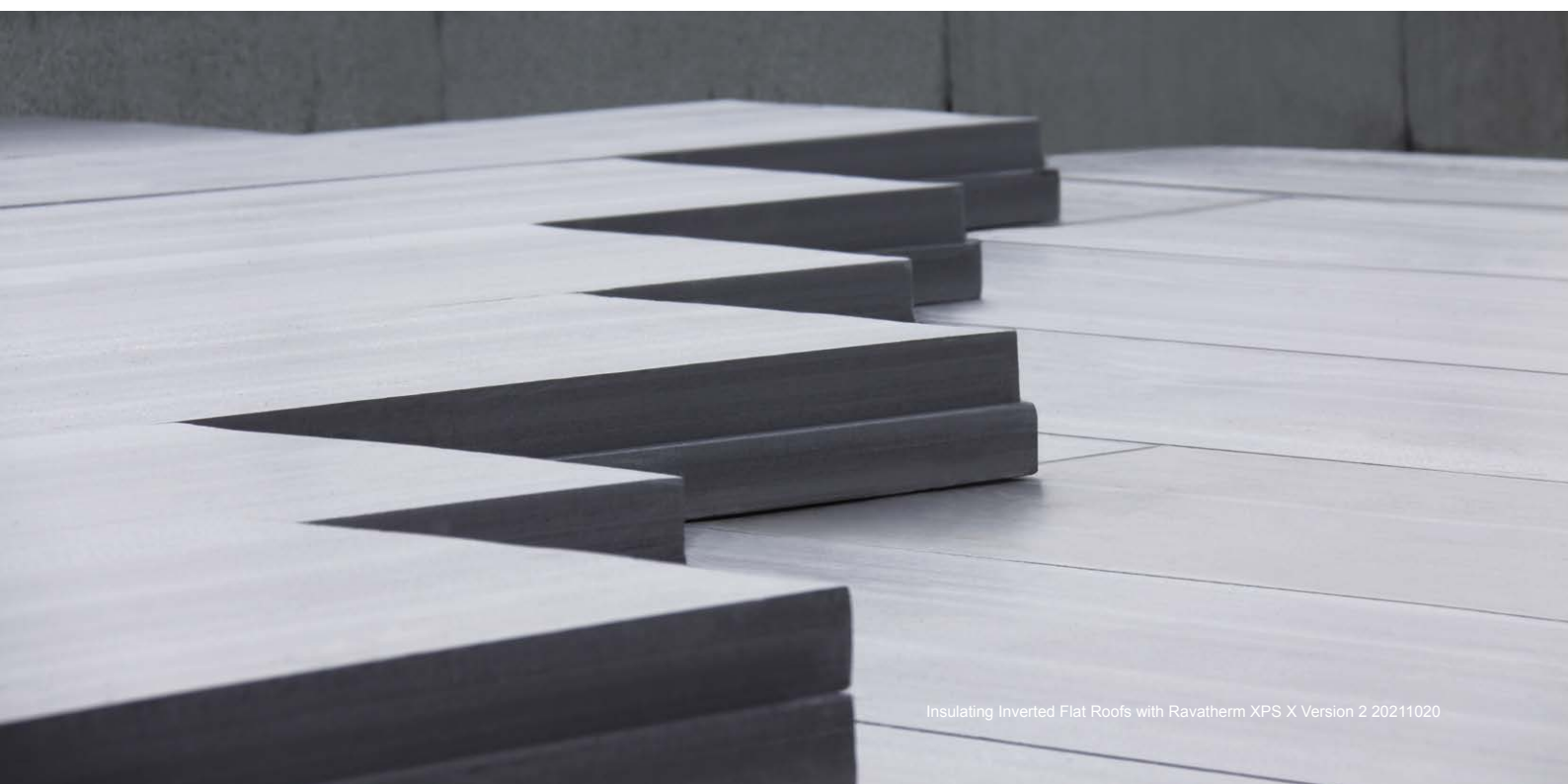

Appendix

The Ravatherm XPS X MK system

Ravatherm XPS X MK is a geotextile membrane that is waterproof, but at the same time water vapour permeable. Used in conjunction with Ravatherm XPS X as a waterflow reducing layer, it minimises heat loss and can therefore reduce the volume of insulation required.

Ravatherm XPS X MK prevents rainwater from reaching the waterproofing layer, thereby reducing the rainwater cooling effect caused by rainwater flowing between the insulation and waterproofing membrane.

Installation

Ravatherm XPS X MK should be loose-laid over the insulation, at right angles to the slope with 300mm laps running down the slope. This will allow the ballast, 20/40 aggregate, to counter board flotation to be reduced to 50mm. At upstands and penetrations Ravatherm XPS X MK should be turned up to finish above the surface of the ballast.

Properties and characteristics

- water vapour permeable
- water resistant
- tear resistant
- UV stable - can be left exposed outdoors for up to four months
- fire - melts and shrinks away from a heat source (unclassifiable as regards Building Regulations)
- temperature - retains flexibility and toughness down to -73°C, melting point is 135°C
- excellent rot resistance making it ideal for insulating green roofs.

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Estuary Road
King's Lynn
PE30 2HJ

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