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Agrément Certificate
21/5923
Product Sheet 1

RAVAGO BUILDING SOLUTIONS UK

RAVATHERM XPS X ULTRA 300 SL INVERTED ROOF INSULATION

This Agrément Certificate Product Sheet(1) relates to Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation, extruded polystyrene (XPS) boards for use in the inverted roof concept (above the roof waterproofing) on new and existing domestic and non-domestic untrafficked flat roofs, and balconies and terraced roofs subject to pedestrian access only, with either zero pitch or slopes between 1:80 and 1:6. The product is used in conjunction with the Ravatherm XPS X MK filter/water-flow-reducing layer between the insulation and the ballast layer, forming the Ravatherm MinK system.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Thermal performance — the design thermal conductivity value (λ_u), including moisture correction factor, of the product is 0.028 $W \cdot m^{-1} \cdot K^{-1}$ for 105 to 205 mm board thicknesses (see section 6).

Condensation — the product can contribute to limiting the risk of surface and interstitial condensation (see section 7).

Strength and stability — the product, when installed on appropriate decks finished with a gravel ballast layer or paving slabs, can be used on flat roofs with limited pedestrian access associated with maintenance operations, and pedestrian access roofs (on balconies and roof terraces) subject to foot traffic only (see section 8).

Durability — the product will remain effective as an insulant for at least 25 years, as long as the Ravatherm XPS X MK filter/water-flow-reducing layer is in place (see section 12).

The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 22 July 2021

Hardy Giesler
Chief Executive Officer

The BBA is a UKAS accredited certification body – Number 113.
The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.
Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

Regulations

In the opinion of the BBA, Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):

The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The product can contribute to satisfying this Requirement. See sections 7.4 and 7.5 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The product can contribute to satisfying this Requirement. See sections 6.1 and 6.2 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The product is acceptable. See section 12.1 and the *Installation* part of this Certificate.
Regulation:	**26**	**CO_2 emission rates for new buildings**
Regulation:	**26A**	**Fabric energy efficiency rates for new dwellings (applicable to England only)**
Regulation:	**26A**	**Primary energy consumption rates for new buildings (applicable to Wales only)**
Regulation:	**26B**	**Fabric performance values for new dwellings (applicable to Wales only)**
Comment:		The product can contribute to satisfying these Regulations. See sections 6.1 and 6.2 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		The product is acceptable. See sections 11.1 and 12.1 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	3.15	Condensation
Comment:		The product can contribute to satisfying this Standard, with reference to clauses 3.15.1(1)(2), 3.15.3(1)(2), 3.15.4(1)(2), 3.15.5(1)(2) and 3.15.6(1)(2). See sections 7.4 and 7.6 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The product can contribute to satisfying these Standards, with reference to clauses, or parts of, 6.1.1(1), 6.1.2(1)(2), 6.1.4(1)(2), 6.1.5(1), 6.1.6(1)(2), 6.1.7(2), 6.1.8(2) to 6.1.10(2), 6.2.1(1)(2), 6.2.2(1), 6.2.3(1)(2), 6.2.4(1)(2), 6.2.5(2), 6.2.6(1)(2) to 6.2.11(1)(2), 6.2.12(2) and 6.2.13(1)(2). See sections 6.1 and 6.2 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The product can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. In addition, the product can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4(1)(2) [Aspects 1(1)(2) and 2(1)], 7.1.6(1)(2) [Aspects 1(1)(2) and 2(1)] and 7.1.7(1)(2) [Aspect 1(1)(2)]. See section 6.1 of this Certificate.

Regulation:	**12**	**Building standards applicable to conversions**
Comment:		All comments given for the product under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1[(1)(2)] and Schedule 6[(1)(2)]. (1) Technical Handbook (Domestic) (2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	**23**	**Fitness of materials and workmanship**
Comment:		The product is acceptable. See section 12.1 and the *Installation* part of this Certificate.
Regulation:	**28(b)**	**Resistance to moisture and weather**
Regulation:	**29**	**Condensation**
Comment:		The product can contribute to satisfying these Regulations. See section 7.4 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Regulation:	**40(2)**	**Target carbon dioxide emission rate**
Comment:		The product can contribute to satisfying these Regulations. See sections 6.1 and 6.2 of this Certificate.

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: 3 *Delivery and site handling* (3.4) and 13 *Installation* (13.3, 13.5 and 13.7) of this Certificate.

Additional Information

NHBC Standards 2021

In the opinion of the BBA, Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Chapter 7.1 *Flat roofs, terraces and balconies*.

CE marking

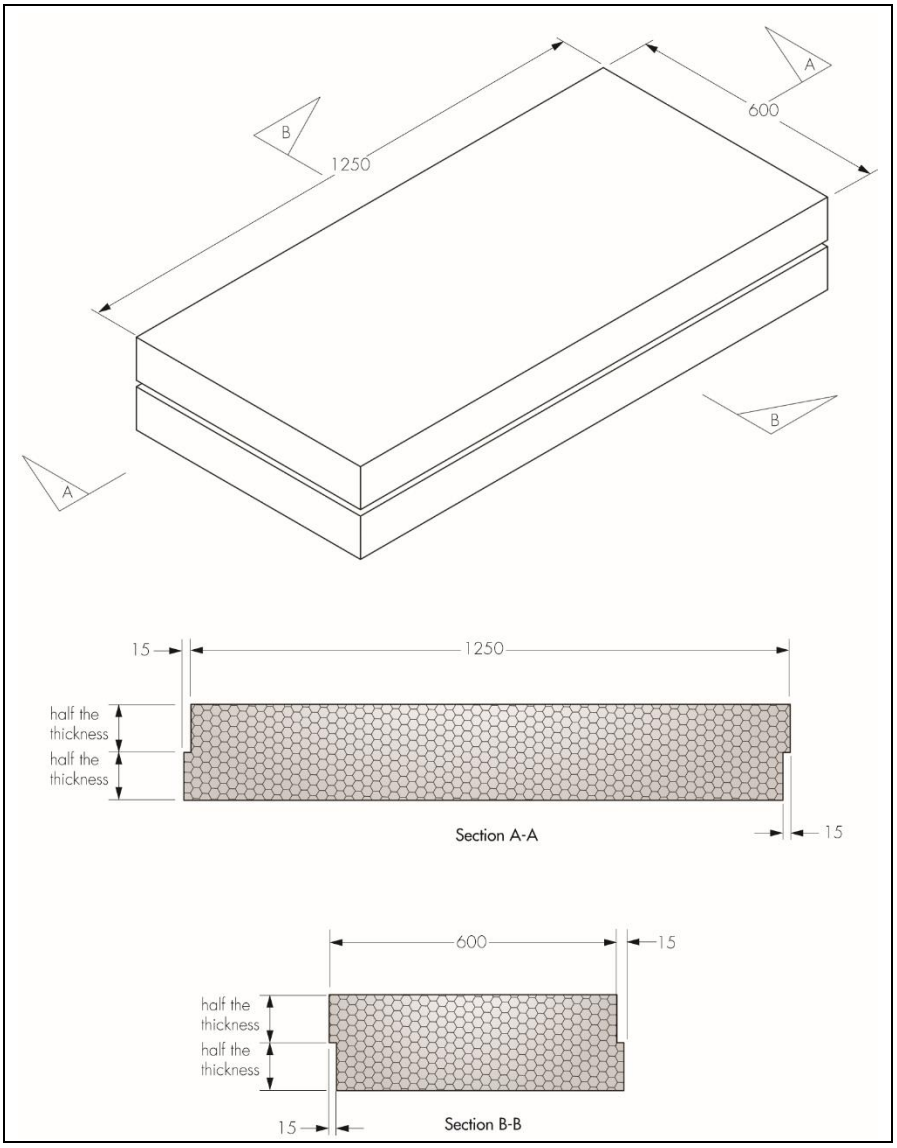
The Certificate holder has taken the responsibility of CE marking the product in accordance with harmonised European Standard BS EN 13164 : 2012.

Technical Specification

1 Description

1.1 The Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation comprises extruded polystyrene (XPS) foam boards, available in one standard size and rebated for lap jointing (see Figure 1). The boards are used in conjunction with the Ravatherm XPS X MK filter/water-flow-reducing layer, and are for use with a gravel ballast or paving finish.

Figure 1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation boards



Length A (mm)	Width B (mm)	Thickness T (mm)
1250	600	105, 130, 145, 175, 205

1.2 The product has the nominal characteristics shown in Table 1.

Table 1 Nominal characteristics of Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation

Work size – length x width (mm)	1250 x 600
Overall size – length x width (mm)	1265 x 615
Available thicknesses (mm)	105, 130, 145, 175, 205
Edge detail	Rebated (15 mm x half board thickness)
Minimum compressive stress at 10% deformation (kPa)	300
Colour	Grey

1.3 Ravatherm XPS X MK filter/water-flow-reducing layer, is used as both a filter layer and water-flow-reducing layer between the insulation and the roof ballast layer. The nominal characteristics are shown in Table 2.

Table 2 Nominal characteristics of the Ravatherm XPS X MK filter/water-flow-reducing layer

Material type (vapour permeable membrane)	Non-woven spunbonded polyethylene
Roll sizes (m)	100 x 3 50 x 1.5
Water vapour resistance ($MN \cdot s \cdot g^{-1}$)	0.17
Head of water test (1.0 m)	No penetration
Mass per unit area ($g \cdot m^{-2}$)	60
Lap joints (mm) — unsealed	300

1.4 Ancillary items outside the scope of this Certificate include:

- gravel ballast comprising a washed low fines aggregate, rounded and 16 to 32 mm in size (nominal), and laid to a minimum depth of 50 mm, or
- paving ballast of minimum 40 mm thickness (see section 9.2)
- proprietary paving support/spacer pads
- separating or cushion layers, if required (see section 4.11)
- rainwater outlet grilles
- dual-level rainwater outlets
- flashings and skirtings.

2 Manufacture

2.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation boards are manufactured on a continuous automated production line. Raw materials are transferred from storage silos and fed into individual weigh-hoppers in which the prescribed raw material quantities are automatically check-weighed. Ingredients are mixed in a horizontal screw conveyor and transferred to the extruder. A plastic melt is formed in the extruder into which a blowing agent is injected. The melt is extruded through a die to form a continuous board.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control being operated by the manufacturer are being maintained.

2.3 The management system of the manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by BSI Management Systems (Certificate Q05968).

3 Delivery and site handling

3.1 The product is delivered to site in polythene shrink-wrapped packs incorporating a label with the Certificate holder's trade name, product description and characteristics, and the BBA logo incorporating the number of this Certificate.

3.2 The product must be stored flat, off the ground on a clean, level surface, and under cover or protected with opaque polythene, to protect it from high winds and prolonged exposure to sunlight. Where possible, packs should be stored inside. If outside, the boards should be raised above ground level, and not be in contact with ground moisture.

3.3 The product is light and easy to handle, and care should be exercised to avoid crushing the edges or corners. If damaged, the product should be discarded.

3.4 The product must not be exposed to open flame or other ignition sources, or to solvents or other chemicals.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation.

Design Considerations

4 Use

4.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation, is suitable for use as thermal insulation in the inverted roof concept (above the roof waterproofing) on new and existing domestic and non-domestic untrafficked flat roofs, and balconies and terraced roofs subject to pedestrian access only, with either a zero pitch or slopes between 1:80 and 1:6, on a suitably designed timber, concrete or metal structural deck and appropriate fully supported waterproofing system. The product is to be overlaid with the Ravatherm XPS X MK filter/water-flow-reducing layer; a gravel ballast or paving slab finish is then applied on top.

4.2 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation boards must always be overlaid with the Ravatherm XPS X MK filter/water-flow-reducing layer, which acts as a filter layer preventing fines and other debris from passing through and also as a water-flow-reducing layer minimising cold rainwater flowing between the insulation and the roof waterproofing with consequent heat loss. This membrane must be laid with 300 mm laps (see section 14.3) and covered with a gravel ballast or paving finish.

4.3 For the purpose of this Certificate:

- flat roofs are defined as those roofs having either a minimum finished fall between 1:80 and 1:6, or a zero pitch with finished falls from 0 to 1:80. For design purposes on sloping flat roofs, twice the minimum finished fall should be assumed, unless a detailed analysis of the roof is available, including overall and local deflection, direction of falls etc. See also *BBA Information Sheet No 4.*

- untrafficked roofs are defined as those roofs subject only to pedestrian traffic during installation of the system and to carry out maintenance of the roof covering and cleaning of gutters. Traffic in excess of the above criteria is outside the scope of this Certificate and special precautions, such as the use of higher compressive strength grade insulation and additional protection to the waterproofing membrane, will be necessary.

- pedestrian access roofs are defined as roofs consisting of the structural deck and all the layers on it, including waterproofing, thermal insulation and a surface protective layer designed for foot traffic and gathering of people greater than that required for maintenance.

4.4 Concrete, metal or timber roofs should be designed in accordance with the relevant provisions of BS 6229 : 2018, BS 8217 : 2005 and BS 8218 : 1998, in particular to accommodate the weight of the ballast layer.

4.5 Care must be taken to ensure that upgraded roofs are capable of carrying the increased load and depth of the installed system.

4.6 Decks should be covered with one or more of the following roof waterproofing specifications:

- built-up specifications using reinforced bitumen membranes to BS 8747 : 2007 in accordance with the recommendations of Table 5, and installed to the relevant clauses of BS 8217 : 2005
- mastic asphalt laid in accordance with BS 8218 : 1998
- other waterproofing systems which are the subject of a current Agrément Certificate, and laid in accordance with, and within the limitations imposed by, that Certificate.

4.7 It is essential that roof falls and drainage paths are correctly designed to avoid ponding (and the subsequent risk of silt build-up) and stresses in freezing conditions, and to reduce water entry in the event of a failure in the waterproofing layer.

4.8 The roof must be designed with adequate falls unless the roof waterproofing system has been specifically designed and covered by a valid BBA Certificate for use in a zero pitch roof application. For zero pitch roofs it is particularly

important to identify the correct drainage points, to ensure that drainage is sufficient and effective. Reference should be made to the appropriate clauses of the LRWA Guidance Note No 7 *Specifier Guidance for Flat Roof Falls,* which generally requires surface drainage falls in most situations.

4.9 Dual-level roof drainage should be provided in accordance with BS 6229 : 2018 and BS EN 12056-3 : 2000 to drain water off at the level of the Ravatherm XPS X MK filter/water-flow-reducing layer and also at the level of the roof waterproofing.

4.10 Drainage points need to be located at the lowest point of the roof, to facilitate the effective removal of rainwater. Care is needed to identify these locations. For example, precast concrete decks will deflect between spans, and mid-span may be the lowest point of the roof rather than roof edges or column supports.

4.11 Where there is a risk from plasticiser migration or other contaminants from the roof waterproofing (such as PVC single-ply membranes), a suitable plastic fibre or similar isolating sheet must be interposed between the roof waterproofing and the insulation boards. For loose laid single-layer roof waterproofing membranes, a cushion layer should be interposed.

4.12 A roof ballast layer must be installed as work progresses, to protect both the Ravatherm XPS X MK filter/water-flow-reducing layer Ravatherm XPS X MK filter/water-flow-reducing layer and the Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation boards from the effects of wind uplift, UV degradation and foot traffic. The ballasted roof finish may be either gravel ballast or paving, which must be assessed by a specialist for its suitability according to region exposure and building height. In addition, the dead load imposed by the finish must be allowed for in calculating the total acceptable load on the deck. Care must be taken to ensure that upgraded roofs are capable of carrying the increased load and depth of the installed system. Ballast must not be stacked in one place on the roof unless the roof is capable of supporting it.

4.13 Gravel ballast should be washed, rounded and 16 to 32 mm in size (nominal), and laid to a minimum thickness of 50 mm. The minimum size of ballast depends on the wind loads and parapet height to prevent wind scour of the ballast. The ballast should be installed in accordance with BS EN 1991-1-4 : 2005 and its UK National Annex.

4.14 The gravel ballast specification given in section 4.13 is suitable for sheltered regions, or buildings up to 10 storeys. On buildings up to 15 storeys, this specification may be used, but the perimeter must be loaded with paving determined by reference to BS EN 1991-1-4 : 2005. For other exposure conditions or tall buildings, specialist advice should be sought.

4.15 A paving finish ballast comprising a minimum 40 mm thickness of cast stone, mineral or pressed concrete paving slabs, is suitable in sheltered regions and in buildings up to 15 storeys. For other exposure conditions or tall buildings, specialist advice should be sought. Paving slabs can be either laid fully supported, or may be supported using proprietary support/spacer pads, in accordance with the Certificate holder's recommendations.

5 Practicability of installation

The product is designed to be installed by a competent general builder or contractor experienced with this type of product.

6 Thermal performance

6.1 Calculations of the thermal transmittance (U value) of a specific roof construction should be carried out in accordance with BS EN ISO 6946 : 2017 and BRE Report BR 443 : 2019, using the design thermal conductivity value (λ_U) (including moisture correction factor) and the $f\chi$ drainage correction for the system as given below. See also *BBA Information Sheet No 4*

- 0.028 $W \cdot m^{-1} \cdot K^{-1}$ — design thermal conductivity value (λ_U) (which is the declared lambda λ_D with addition of moisture correction) for 105 to 205 mm thicknesses of Ravatherm XPS X ULTRA 300 SL
- $f\chi$ = 0.001 — the product of the water-flow-reducing-layer drainage factor '*f*' and the factor 'χ' for increased heat loss caused by rainwater flowing on the waterproof layer (0.04 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$). (system incorporates the Ravatherm XPS X MK filter/water-flow-reducing layer).

6.2 The value of a completed roof will depend on the insulation thickness, type of substrate and internal finish. When considering insulation requirements, designers should refer to the detailed guidance contained in the documents supporting the national Building Regulations. The U values shown in Table 3 indicate that the product can contribute to a roof achieving typical U values referred to in those supporting documents.

Table 3 Example U(1) values for flat roof and zero pitch applications (incorporating the Ravatherm XPS X MK filter/water-flow-reducing layer)

Required U value ($W \cdot m^{-2} \cdot K^{-1}$)	Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation, thickness required(2) (mm)	
	$p^{(3)}$ = 3 ($mm \cdot day^{-1}$)	$p^{(3)}$ = 8 ($mm \cdot day^{-1}$)
0.13	205	130 + 105
0.15	175	205
0.16	175	175
0.18	145	175
0.20	130	145
0.25	105	105

(1) Deck taken as 200 mm dense reinforced concrete (λ = 2.5 $W \cdot m^{-1} \cdot K^{-1}$) with a 10 mm bitumen ($\lambda$ = 0.23 $W \cdot m^{-1} \cdot K^{-1}$) waterproofing layer.
(2) Thinnest available insulation thickness or thickness combination to achieve the required U value. Thickest board as bottom layer, when double layer used.
(3) Values for p taken as examples of best to worst case for all UK locations, with a $f\chi$ value of 0.001.

6.3 Rainfall reaching the roof waterproofing membrane will temporarily affect the rate of heat loss from the roof and should be accounted for by adding a correction (ΔU_r) to the calculated roof U value in accordance with Annex F.4 of BS EN ISO 6946 : 2017, as follows:

$\Delta U_r = pf\chi (R_1/R_T)^2$ where:

ΔU_r = correction to the calculated thermal transmittance of the roof element ($W \cdot m^{-2} \cdot K^{-1}$)

p = average rate of precipitation during the heating season ($mm \cdot day^{-1}$)(1)

f = drainage factor giving the fraction of p reaching the waterproof membrane.

χ = factor for increased heat loss caused by rainwater flowing on the membrane (0.04 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$)

R_1 = thermal resistance of the layer of insulation above the waterproofing membrane ($m^2 \cdot K \cdot W^{-1}$)

R_T = total thermal resistance of the construction before application of the correction ($m^2 \cdot K \cdot W^{-1}$)

fx = 0.001 (system incorporates the Ravatherm XPS X MK filter/water-flow-reducing layer.

Junctions

6.4 Care must be taken in the overall design and construction of junctions with other elements and openings to minimise thermal bridges and air infiltration. Detailed guidance can be found in the documents supporting the national Building Regulations.

7 Condensation

7.1 Warm water trapped under the boards is likely to be replaced by colder water during rainfall. Therefore, during heavy or continuous rainfall the roof waterproofing and the deck will be cooled. If condensation does occur it will be short-term, disappearing when the rain stops.

7.2 The risk of interstitial condensation will be minimal with concrete decks but metal and timber decks will be subjected to short periods of moisture; therefore timber must be treated with a suitable preservative in accordance with BS 8417 : 2011.

7.3 For systems using paving, a condensation risk analysis may be necessary using dynamic software in accordance with BS EN 15026 : 2007, depending on the climatic conditions existing in the location where it is installed.

Interstitial condensation

7.4 Roofs will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Section 4 and Annexes D and H. Further guidance may be obtained from BRE Report BR 262 : 2002.

Surface condensation

7.5 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.35 $W \cdot m^{-2} \cdot K^{-1}$ at any point and the junctions with walls are designed in accordance with section 6.4 of this Certificate.

7.6 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 1.2 $W \cdot m^{-2} \cdot K^{-1}$ at any point. Guidance may be obtained from BS 5250 : 2011, Annex H. Further guidance may be obtained from BRE Report BR 262 : 2002 and section 6.4 of this Certificate.

8 Strength and stability

8.1 The structural strength and deformation of both the roof structure and the inverted roof insulation panels must be assessed by a suitably experienced and qualified individual, to resist actions due to the combination of the dead load imposed by the paving and gravel ballast finish, and the imposed load from foot traffic, snow and the possible weight of rain water (should the roof outlet(s) become blocked).

8.2 The completed system has adequate resistance to the loads associated with light maintenance traffic on roofs, and to pedestrian foot traffic on balconies and roof terraces, provided the Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation panels are protected above by the Ravatherm XPS X MK filter/water-flow-reducing layer together with paving slabs or a gravel ballast finish. When covered with a ballast layer, as specified in section 4, the product can accept the limited pedestrian foot traffic and light concentrated loads associated with installation and maintenance operations.

9 Behaviour in relation to fire

9.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation boards have a reaction to fire classification(1) of Class E to BS EN 13501-1 : 2018.

(1) CSTB. Report No RA18-0020, 06 July 2020. Copies can be obtained from the Certificate holder.

9.2 When ballasted with aggregate (minimum 50 mm depth) or fully supported cast stone or mineral slabs of at least 40 mm thickness, the roof can be considered to be unrestricted by the documents supporting the national Building Regulations with respect to proximity to a relevant boundary.

9.3 The designation of other roof covering specifications should be confirmed as required by the national Building Regulations.

9.4 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation should not be laid over compartment walls.

10 Effect on roof coverings

10.1 The protected inverted roof system will provide solar protection and also limit the range of temperatures to which the waterproofing membrane will be subjected. Placing the insulation on top of the roof covering will normally lead to an extended life of the waterproof membrane.

10.2 Separation or cushion layers between the insulation boards and the roof waterproofing may be needed in some circumstances (see section 4.11 of this Certificate).

11 Maintenance

11.1 The inverted roof concept should require little or no maintenance, other than annual removal of any plants (in the case of gravel/paving finish), cleaning/checking of water outlets and gutters if necessary and checking that the gravel ballast is still in place and not interfering with or blocking gullies or outlets. Any displaced ballast, for example by wind scouring, should be promptly returned to its original state.

11.2 The use of chemicals (eg weed killers) should be checked for compatibility with the insulation, filter/water-flow-reducing layer and deck waterproofing layer. The Certificate holder can advise on the suitability of a particular product.

11.3 Should a leak occur in the waterproof membrane, it must be repaired following removal of the gravel ballast or paving ballast layer, filter/water-flow-reducing layer and the insulation boards. Correct reinstatement of these layers must be carried out, taking care not to damage the filter/water-flow-reducing layer.

12 Durability

12.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation is rot resistant and, as long as the Ravatherm XPS X MK filter/water-flow-reducing layer remains undamaged, will have a life of at least 25 years under normal circumstances.

12.2 Care must be taken to ensure that the gravel ballast or paving, once installed, provides cover to the insulation and the Ravatherm XPS X MK filter/water-flow-reducing layer at all times to avoid the risk of UV degradation.

Installation

13 General

13.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation should be installed in accordance with the Certificate holder's instructions, taking into account the relevant design guidance in section 4 of this Certificate, and providing adequate load-bearing capacity, falls, drainage, sound roof waterproofing and limited risk of condensation.

13.2 It is essential to establish that the roof waterproofing has been installed correctly and that it is weathertight, clean and free from any extraneous matter. Every joint between sheets, flashing and other details must be checked to ensure that the roof covering is suitable for an inverted roof specification.

13.3 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation is laid in a brick bond pattern; it is essential that all joints between the boards are tight and that no gaps exist where they meet rooflights, edge details and other services which perforate the roof deck. The boards can be cut easily using a fine-toothed saw, sharp knife or a hot wire cutter.

13.4 When the product is to be placed over a loose-laid roof covering, it should be installed and ballasted as soon as possible to protect the covering from the effects of wind uplift (see sections 4.12 to 4.15) and installers must take care not to damage the existing roof waterproofing.

13.5 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation is light and may be installed in any weather but, due to its size, care will be needed in high winds. Installers must not carry it near to parapets or apertures in the deck and, once placed, the product must be covered with the Ravatherm XPS X MK filter/water-flow-reducing layer and ballasted as soon as possible.

13.6 The ballast loading layer should be installed in accordance with BS 6399-2 : 1997, BS EN 1991-1-4 : 2005, BRE Digest 295 : 1985 and BRE Digest 311 : 1986.

13.7 The ballast loading layer must be applied as work progresses to protect the insulation and the filter/water-control layer from the effects of wind uplift, solar degradation and foot traffic. The ballast must not be stacked in one place on the roof unless the roof is strong enough to support it.

Upgrading roofs

13.8 In existing roofs (see Figure 6), the requirements of sections 13.1 to 13.7 also apply. In addition, the existing roofing and substructure must be examined for degradation and, where necessary, repairs effected. Particular consideration should be given to the condensation risk that the existing roof structure may present (see section 7 of this Certificate).

13.9 Where, for example, parapets, details and services have insufficient height to accommodate the increased depth of insulation/protection, due provision needs to be made (that is, a minimum of 150 mm from the top of the gravel to the top of the skirtings must be provided).

13.10 If upgrading involves laying the product on existing inverted roof insulation, the advice of the Certificate holder should be sought.

13.11 Rainwater outlets may need to be modified or replaced to suit, eg by the installation of gravel guards.

14 Procedure

14.1 Ravatherm XPS X ULTRA 300 SL Inverted Roof Insulation and the Ravatherm XPS X MK filter/water-flow-reducing layer are laid in accordance with the Certificate holder's installation instructions and this Certificate.

14.2 Single-layer roofing must be the subject of very close scrutiny, and the inspection must include an examination for perforation and for the likelihood of subsequent perforation from beneath (by, for example, uneven decks and protruding nail heads).

14.3 The Ravatherm XPS X MK filter/water-flow-reducing layer should be loose-laid over the insulation, at right angles to the slope, with 300 mm unsealed lap joints overlapping in the downward direction of the flat roof slope. At upstands and penetrations, the Ravatherm XPS X MK filter/water-flow-reducing layer must be turned up to finish above the surface of the ballast layer (protected by a cover flashing) and turned down at drainage outlets.

14.4 The ballast layer (comprising either a gravel ballast or paving slabs) must then be laid over the Ravatherm XPS X MK filter/water-flow-reducing layer as soon as possible, to prevent flotation, wind uplift, UV degradation and damage from foot traffic.

Gravel ballast finish

14.5 The gravel ballast layer (see sections 4.13, 4.14 and 9.2) must be carefully placed directly over the Ravatherm XPS X MK filter/water-flow-reducing layer to ensure complete depth and cover is achieved over the entire surface of the system.

14.6 Gravel must not contain excessive fines in order to prevent clogging of gullies and outlets and to discourage organic growth.

Paving slab finish

14.7 Standard pressed concrete, cast stone or mineral paving slabs of at least 40 mm thickness (see sections 4.15 and 9.2) must be carefully placed directly over the Ravatherm XPS X MK filter/water-flow-reducing layer to ensure complete cover is achieved over the entire surface of the system. Paving slabs can either be laid fully supported, or may be supported using proprietary support/spacer pads.

14.8 Typical construction details are given in the following Figures:

Figure 2 Typical installation detail — gravel/paving ballast finish

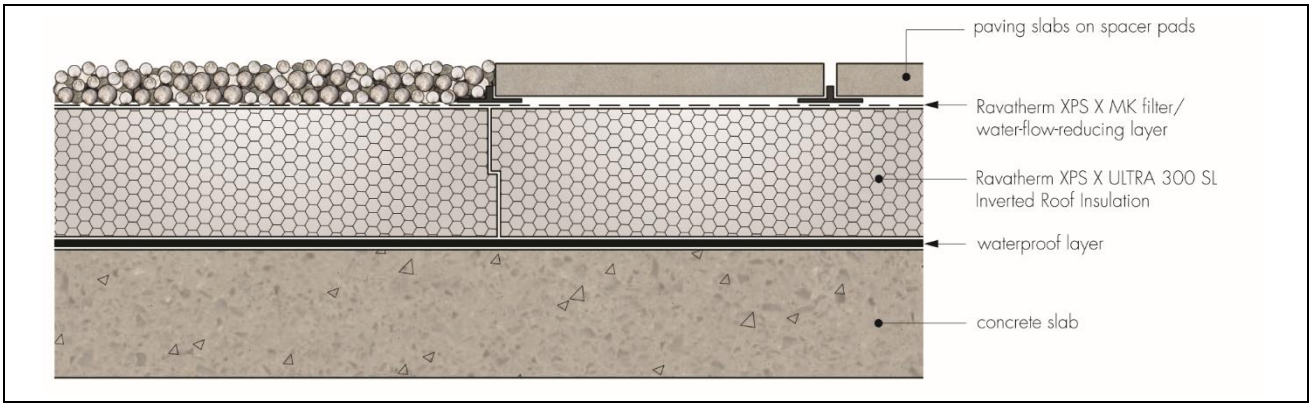


Figure 3 Water outlet detail — gravel finish

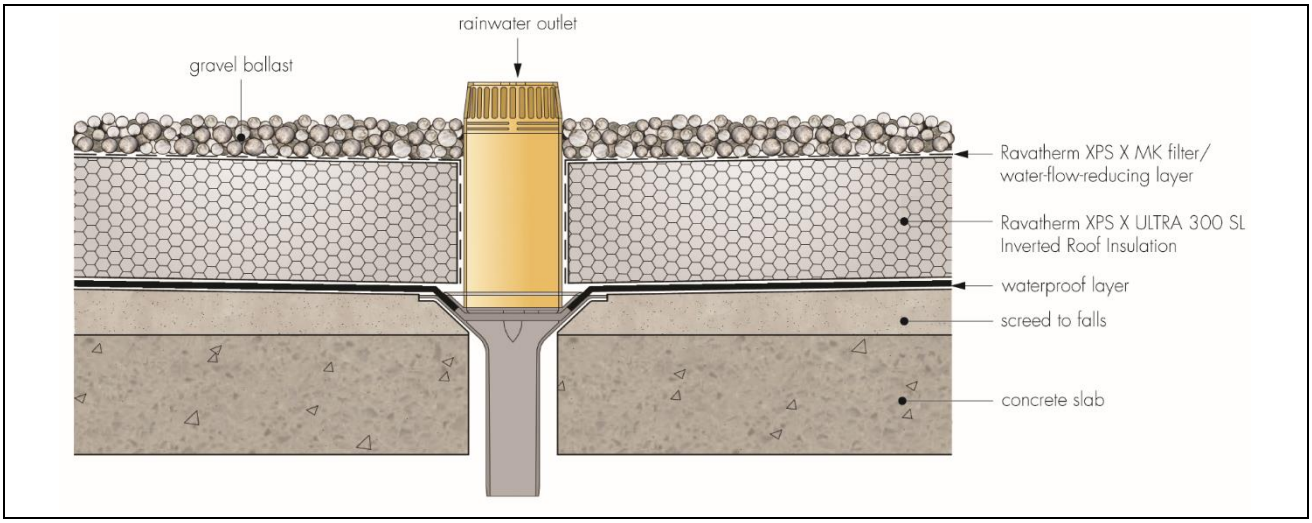


Figure 4 Water outlet detail — paving finish

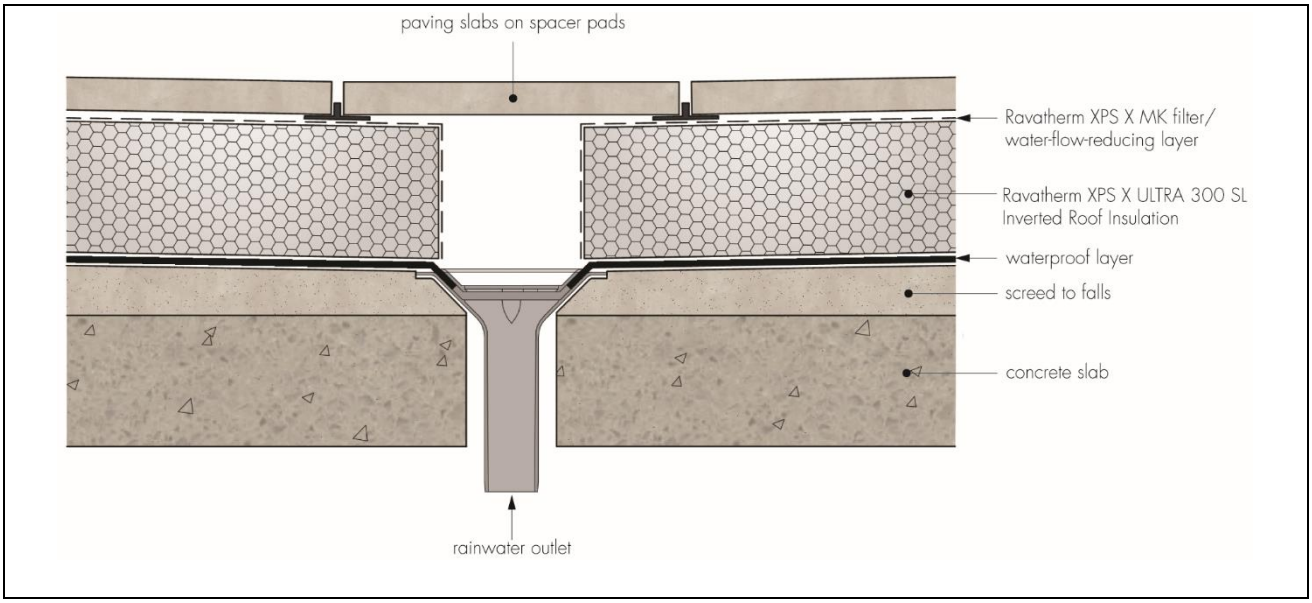


Figure 5 Parapet upstand detail — gravel/paving finish

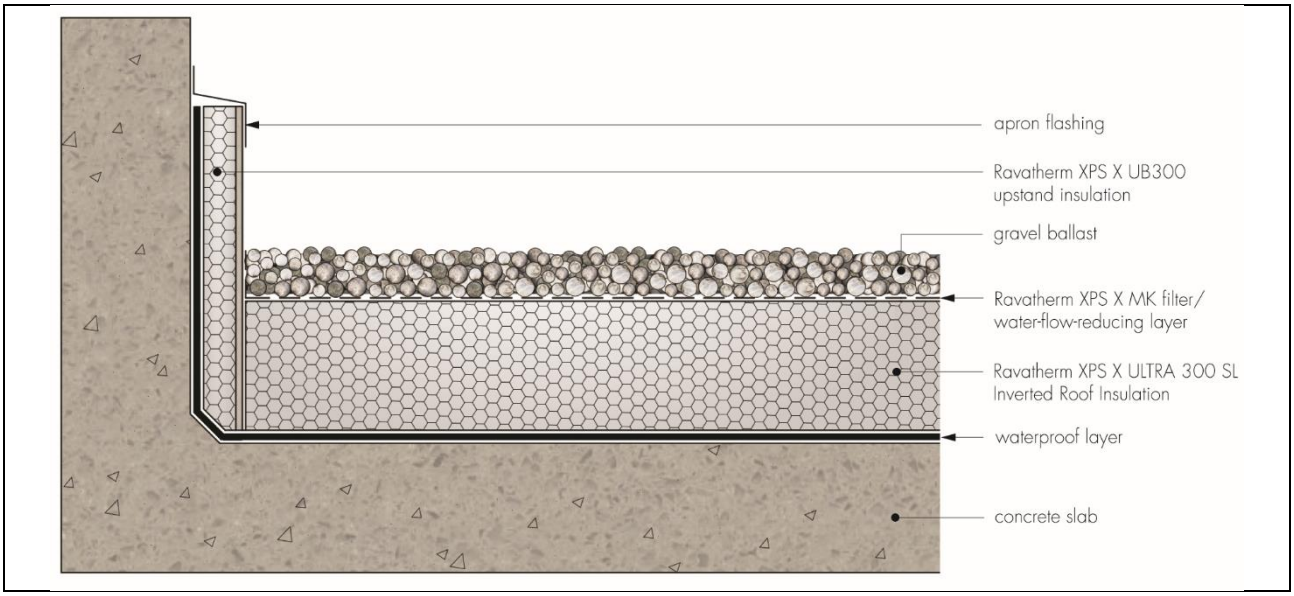
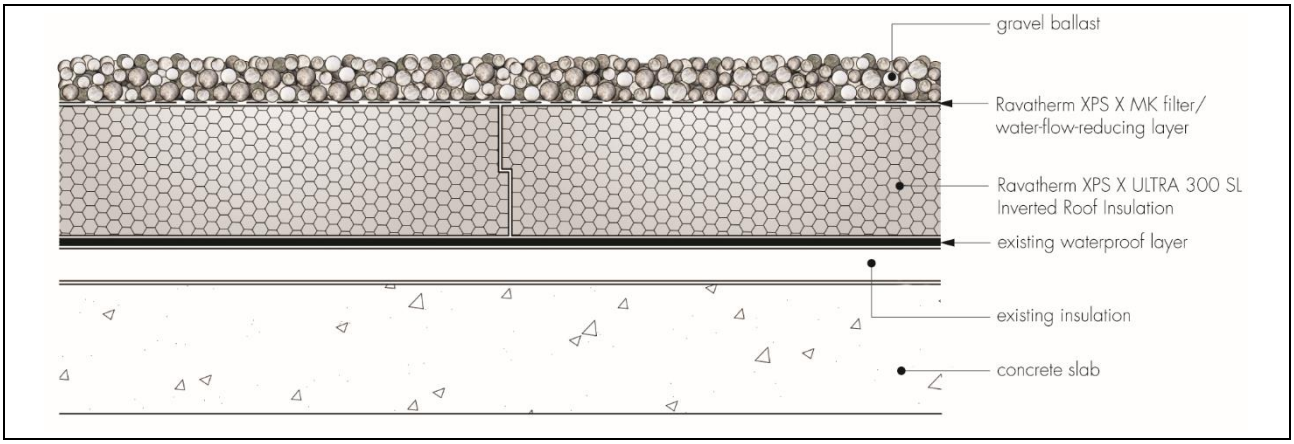


Figure 6 Upgrading existing insulation



Technical Investigations

15 Tests

Results of tests were assessed, to determine:

- thermal conductivity
- compressive strength
- water vapour permeability
- long-term water absorption by diffusion
- water absorption by total immersion
- resistance to freeze-thaw of the thermal insulation
- water flow through an inverted roof kit
- deformation under specified compressive load and temperature
- dimensional stability.

16 Investigations

16.1 Data on durability and properties in relation to fire were evaluated.

16.2 A calculation was undertaken to confirm the declared (λ_D) and design (λ_U) thermal conductivity values.

16.3 A series of U value calculations was carried out.

16.4 A condensation risk analysis was carried out.

16.5 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of materials used.

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LRWA Guidance Note No.7 : 2012 — *Specifier Guidance for Flat Roof Falls*

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