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Agrément Certificate
18/5597
Product Sheet 1

GREEN STRUCTURAL INSULATED PANEL SYSTEM

GREEN STRUCTURAL INSULATED WALL AND ROOF PANELS

This Agrément Certificate Product Sheet(1) relates to Green Structural Insulated Wall and Roof Panels, structurally insulated panels manufactured from OSB/3 and rigid polyisocyanurate (PIR) foam, for use above the damp-proof course (dpc) in domestic and non-domestic applications up to three storeys high and room-in-roof applications (with a maximum storey height of three metres), as loadbearing inner leaf of external cavity walls, part of separating walls, internal loadbearing walls, and pitched roofs. The panels can also be used in non-loadbearing internal applications in multi-storey framed buildings subject to design and fire limitations.

(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

Strength and stability — the panels have adequate strength and stiffness to resist the loads associated with installation and in-service loading (see section 6).

Thermal performance — the panels contribute to the overall thermal performance of the wall and roof construction (see section 7).

Air permeability — dwellings incorporating the panels can achieve adequate air barrier continuity provided there is effective sealing around junctions, openings and penetrations (see section 8).

Condensation risk — when used in walls and roofs, the systems can contribute to limiting the risk of surface and interstitial condensation (see section 9).

Behaviour in relation to fire — with adequate protection, the panels, when used in external and separating walls, will satisfy the required fire resistance periods given in the relevant national Building Regulations (see section 10).

Resistance to airborne sound — test data indicate that separating walls used in conjunction with suitable linings and flanking elements can provide sufficient resistance to airborne sound (see section 12).

Durability — provided the installation remains weathertight and the panels are protected from damage by the external and internal finishes, the panels will have a 60 year minimum service life (see section 15).

The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 19 December 2018

Paul Valentine
Technical Excellence Director

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body – Number 113.

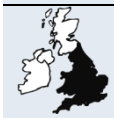
The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

Regulations

In the opinion of the BBA, Green Structural Insulated Wall and Roof Panels, 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:	**A1**	**Loading**
Comment:		Walls and roofs constructed from the panels will have sufficient strength and stiffness when designed in accordance with sections 6.1 to 6.6 of this Certificate.
Requirement:	**A3**	**Disproportionate collapse**
Comment:		Wall panels can contribute to a construction satisfying this Requirement. See section 6.9 of this Certificate.
Requirement:	**B3(1)(2)(3)**	**Internal fire spread (structure)**
Comment:		Walls with the requisite lining can give 30 or 60 minutes' fire resistance. See section 10 of this Certificate.
Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The panels can adequately limit the risk of surface condensation and will contribute to minimising the risk of interstitial condensation. See sections 9.1 and 9.2 of this Certificate.
Requirement:	**E1**	**Protection against sound from other parts of the building and adjoining buildings**
Comment:		When installed with suitable flanking elements, separating walls incorporating the panels can satisfy this Requirement. See section 12 of this Certificate.
Requirement:	**E2(a)**	**Protection against sound within a dwelling-house etc**
Comment:		A single-leaf, non-loadbearing partition incorporating the panels, with suitable plasterboard linings, can satisfy this Requirement. See section 12.2 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power (New dwellings)**
Requirement:	**L2(a)(i)**	**Conservation of fuel and power (New buildings other than dwellings)**
Comment:		The panels can contribute to satisfying these Requirements. See sections 7, 8.1 and 8.2 of this Certificate.
Regulation:	**7**	**Materials and workmanship**
Comment:		The panels are acceptable. See section 15 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 panels can contribute to satisfying these Regulations although compensating fabric and/or services measures may be required. See sections 7.1, 7.2, 8.1 and 9.2 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		The panels can contribute to a construction satisfying this Regulation. See sections 14 and 15 and the *Installation* part of this Certificate.

Regulation:	**9**	**Building standards applicable to construction**
Standard:	1.1(a)	Structure
Comment:		Walls and roofs incorporating the panels will have sufficient strength and stiffness with reference to clauses 1.1.1(1) and 1.1.2(1) of this Standard, when designed and constructed in accordance with sections 6.1 to 6.6 of this Certificate.
Standard:	1.2	Disproportionate Collapse
Comment:		Wall panels can contribute to a construction satisfying the requirements of this Standard, with reference to clause 1.2.1(1)(2). See section 6.9 of this Certificate.
Standard:	2.1	Compartmentation
Standard:	2.2	Separation
Comment:		Walls using the appropriate lining can achieve a period of fire resistance of 'medium' duration, with reference to clauses 2.2.1(1) to 2.2.3(1) of these Standards. See section 10 of this Certificate.
Standard:	2.3	Structural protection
Comment:		Walls using the appropriate lining can achieve a period of fire resistance of 'medium' duration, with reference to clauses 2.3.1(1), 2.3.2(1), 2.3.3(1) and 2.3.5(1) of this Standard. See section 10 of this Certificate.
Standard:	2.4	Cavities
Comment:		Walls using an appropriate cavity barrier can satisfy this Standard, with reference to clauses 2.4.1(1), 2.4.2(1) and 2.4.7(1). See section 10 of this Certificate.
Standard:	2.6	Spread to neighbouring buildings
Comment:		Walls using the appropriate lining can achieve a period of fire resistance of 'medium' duration, with reference to clause 2.6.1(1) of this Standard. See section 10 of this Certificate.
Standard:	3.15	Condensation
Comment:		The panels can adequately limit the risk of surface condensation and will contribute to minimising the risk of interstitial condensation, with reference to clauses 3.15.1(1) to 3.15.4(1) of this Standard. See sections 9.1 and 9.2 of this Certificate.
Standard:	5.1	Noise separation
Comment:		Separating walls with suitable linings and flanking elements can satisfy this Standard, with reference to clauses 5.1.1(1), 5.1.2(1) and 5.1.4(1). See sections 12.1 and 12.2 of this Certificate.
Standard:	5.2	Noise reduction between rooms
Comment:		Internal walls with suitable linings can satisfy this Standard, with reference to clauses 5.2.1(1) and 5.2.2(1). See sections 12.1 and 12.2 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Comment:		The panels can contribute to satisfying this Standard, with reference to clauses 6.1.2(1) and 6.1.6(1). Compensating fabric and/or services measures may be required. See sections 7, 8.1 and 8.3 of this Certificate.
Standard:	6.2	Building insulation envelope
Comment:		The panels can contribute to satisfying these Standards, with reference to clauses 6.2.1(1), 6.2.3(1) and 6.2.4(1). See sections 7, 8.1 and 8.3 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The products can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction satisfying a bronze level of sustainability as defined in this Standard. In addition, the products can contribute to a construction satisfying 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)(2)], 7.1.6(1)(2) [Aspects 1(1)(2) and 2(1)(2)] and 7.1.7(1)(2) [Aspect 1(1)(2)]. See section 7 of this Certificate.

Regulation:	**12**	**Building standards applicable to conversions**
Comment:		All comments given for the products 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(a)(i) (iii)(b)**	**Fitness of materials and workmanship**
Comment:		The products are acceptable. See section 15 and the *Installation* part of this Certificate.
Regulation:	**28**	**Resistance to moisture and weather**
Comment:		Wall and roof panels can adequately limit the risk of moisture ingress from the ground and weather. See sections 13.1 to 13.3 of this Certificate.
Regulation:	**29**	**Condensation**
Comment:		The panels can contribute to minimising the risk of interstitial condensation. See sections 8.1, 8.2 and 9.2 of this Certificate.
Regulation:	**30**	**Stability**
Comment:		Walls and roofs constructed from the panels will have adequate strength and stiffness to satisfy this Regulation. See sections 6.1 to 6.6 of this Certificate.
Regulation:	**31**	**Disproportionate collapse**
Comment:		Wall panels can contribute to a construction satisfying this Regulation. See section 6.9 of this Certificate.
Regulation:	**35**	**Internal fire spread — Structure**
Comment:		The panels can be used in walls required to have a fire resistance of 60 minutes. See section 10 of this Certificate.
Regulation:	**39(a)**	**Conservation measures**
Regulation:	**40**	**Target carbon dioxide emissions Rate**
Comment:		The panels contribute to satisfying these Regulations. See sections 7, 8.1 and 8.2 of this Certificate.
Regulation:	**49**	**Protection against sound from other parts of the building and from adjoining buildings**
Regulation:	**50**	**Protection against sound within a dwelling or room for residential purposes**
Regulation:	**51**	**Reverberation in the common internal parts of a buildings containing flats or rooms for residential purposes**
Comment:		When installed with suitable flanking elements, separating walls incorporating the panels can satisfy these Regulations. See sections 12.1 and 12.2 of this Certificate.

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

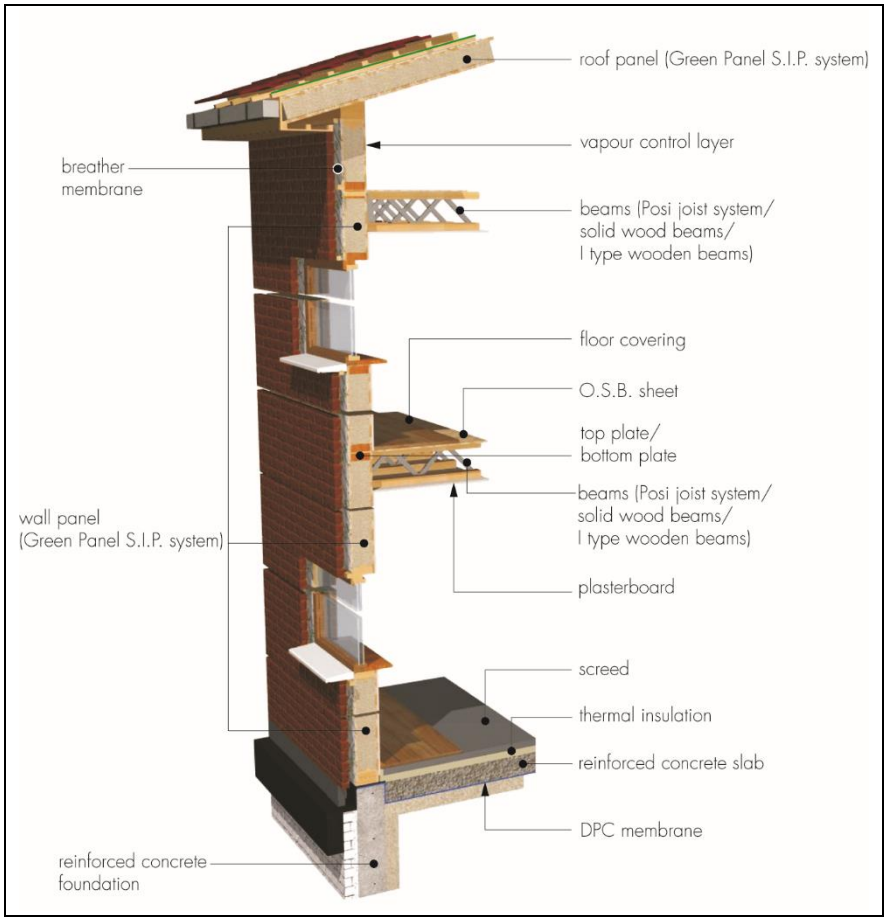
Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 3 *Delivery and site handling* (3.3) of this Certificate.

1 Description

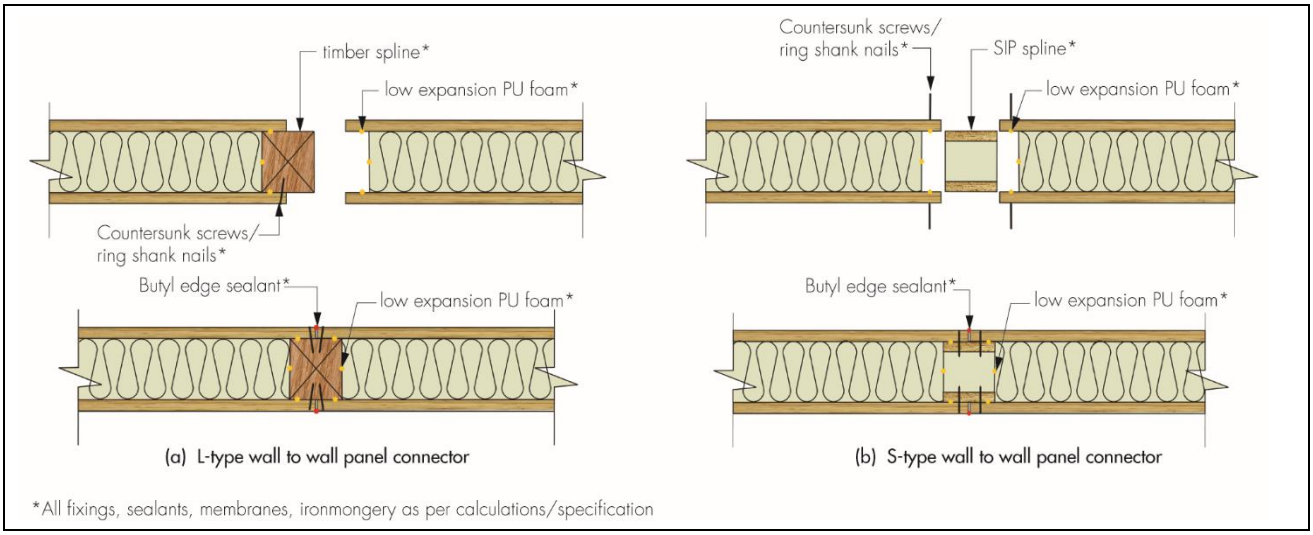
1.1 Green Structural Insulated Wall and Roof Panels (see Figure 1 and Table 1) are structural elements used for wall and roof construction consisting of a solid timber framing, internal and external sheathing of 15 mm thick oriented strand board, Type 3 (OSB/3) to BS EN 300 : 2006, and a rigid insulation core of 90, 120 or 150 mm thickness made from rigid PIR foam of density 46 kg·m^{-3}. Solid timber top, bottom and edge plates of minimum grade C24 are used based on the design requirements.

Figure 1 Green Structural Insulated Wall and Roof Panels



1.2 The panels are connected by either C24 grade timber splines (L-type connection) or SIP panel splines of the same configuration (S-type connection), to the same thickness as the insulation core to suit the panel thickness (cut to length as required), and located in preformed rebates within the PIR core (see Figure 2). Openings are formed with pre-cut panels. Timber framing and inserts for openings and junctions are installed on site.

Figure 2 Wall to wall panel connectors (L and S Type)



1.3 The panels have the nominal characteristics given in Table 1.

Table 1 Green Structural Insulated Wall and Roof Panels — specifications

Aspect (unit)	Dimensions/details
overall thickness (mm)	120, 150 or 180
OSB thickness (mm)	15
insulation thickness (mm)	90, 120 or 150
insulation density ($kg \cdot m^{-3}$)	46
overall maximum panel size (m)	3.0 x 1.25
mass ($kg \cdot m^{-2}$)	22.14 to 24.9
edge detail	Rebated to receive splines
connectors	90 mm wide timber (L-type) or SIP panel spline (S-type) joint to the same thickness as the insulation core

1.4 Ancillary items for use with the panels, but outside the scope of this Certificate, include:

- head and bottom plate — 89, 119 mm or 149 by 45 mm C24 kiln dried softwood timber
- lintels — treated softwood timber of a minimum grade C24 to structural design requirements
- framing for openings — treated softwood timber of a minimum grade C24 to structural design requirements
- fasteners — SIPS type screws (specification dependant on application, see the Certificate holder's Technical Manual for further information)
- nails — 2.8 mm diameter by 50 mm length galvanized ring/shank nail for use with a nail gun
- purlins and support beams — typically timber, steel or glulam to structural design requirements
- joist hangers and fixings — specified on a project basis
- joists and fixings — specified on a project basis
- dry lining battens — minimum 38 mm wide by 11 mm deep softwood, OSB/3 or vertical metal rails
- wall ties — typically at 600 mm centres horizontally and 450 mm vertically
- counter battens — treated softwood counter battens, minimum 50 mm wide by 25 mm deep
- tiling/slate battens — sizing as per BS 5534 : 2014
- membranes and vapour barriers
- damp-proof courses (dpcs)
- L-shaped fixing cleats
  - — top of panel fixing with slotted holes in each face
  - — bottom of panel fixing with slotted holes in longer face and fixed hole in shorter face
- cleat anchor bolts to structural design requirements
- roof coverings including tiling and sheeting
- cavity closers
- cavity barriers
- silicone and urethane sealant

- plasterboard
- internal and external finishes, eg cladding
- injectable mortar grout to seal against air infiltration
- holding-down brackets and straps.

2 Manufacture

2.1 The products are composite building panels made from a core of rigid PIR foam, sandwiched between two structural skins of OSB/3. Insulating foam is injected in between the OSB/3 panels via pre-drilled injection holes in the manufacturing jig, under compression to aid the curing process. Once suitably filled, the panels are stored at a pre-determined temperature to allow the insulation foam to set.

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 operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 The panels are delivered with polythene protection to each stack, with edge protectors and banded packaging used for initial transit and temporary protection. Each panel bears the BBA logo incorporating the number of this Certificate. They should be stored flat (no more than nine panels high for 120 mm thickness, eight high for 150 mm thickness, and seven high for 180 mm thickness) over suitable stillage to a slight fall (to allow rain run-off). Bearers should be at maximum 1250 mm centres (end bearers no more than 150 mm from end of panel), and aligned vertically between individual packs in accordance with the Certificate holder's guidelines.

3.2 The products should be stored inside, or in dry, sheltered conditions at least 150 mm off the ground, and covered with opaque polyethylene sheeting or tarpaulin, until they are ready to be erected.

3.3 Small individual panels can be lifted manually in accordance with current Health and Safety guidelines; panelised walls, panelised roof elements and packs of panels must be lifted by mechanical means using the lifting straps built into, and located at the top and bottom of, each panel section. Temporary timber blocks should be used where required to protect panel edges during lifting operations.

3.4 The panels can withstand the normal loads associated with site handling and installation. Damaged panels should be assessed and repaired, if appropriate, prior to use.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Green Structural Insulated Wall and Roof Panels.

Design Considerations

4 Use

4.1 Green Structural Insulated Wall and Roof Panels are suitable for use above the dpc in domestic and non-domestic applications up to three storeys high and room-in-roof applications (with a maximum storey height of three metres), as loadbearing inner leaf of external cavity walls, part of separating walls, internal loadbearing walls, and pitched roofs. The panels can also be used in non-loadbearing internal applications in multi-storey framed buildings subject to design and fire limitations. Wall panels are generally formed in whole or part wall lengths, including openings, subject to design, manufacture, lifting, hoisting and transport restrictions.

4.2 When panels are used to construct the inner leaf of an external cavity wall, the outer masonry leaf and all masonry below the dpc must be built in accordance with BS EN 1996-1-1 : 2005, BS EN 1996-2 : 2006 and BS EN 1996-3 : 2006, and their UK National Annexes, and PD 6697 : 2010. Consideration should be given to the provision of movement joints and detailing at interfaces with the timber frame, to account for differential movement. The Certificate holder should be contacted for further guidance.

4.3 Structural calculations for the design of wall and roof panels are carried out in accordance with standard timber frame industry good practice and should be undertaken by a chartered structural engineer, who should contact the Certificate holder for full design guidance.

4.4 Openings for windows and doors are created by using appropriately sized panels which allow the timber framings and lintels to be installed on site.

4.5 Foundations and floors (outside the scope of this Certificate) must be approved for use by the Certificate holder's technical staff, and should be suitably level and square to accept the wall panels.

4.6 When used as roof panels, roof tiles and slates should be applied in accordance with BS 5534 : 2014.

4.7 Where buildings need to comply with *NHBC Standards* 2018, specifiers should observe the requirements of that document.

5 Practicability of installation

The panels should only be installed by installers who have been approved by the Certificate holder.

6 Strength and stability

General

6.1 The wall and roof panels will have adequate strength and stiffness when used in accordance with the provisions of this Certificate. When using the panels, building designers must take account of the long-term creep effects of permanent loading and cracking to internal finishes. Due consideration must also be given to any fire-resistance restrictions (see section 10).

6.2 The limit state design values to be used when evaluating the design in compliance with Eurocodes are given in Table 2. The structural capacity data is based on test results and the design principles set out in BS EN 14509 : 2013 and BS EN 1995-1-1 : 2004 and its UK National Annex, and is intended to provide the designer with sufficient information to undertake the structural design of these elements. Design must be done by an appropriately qualified structural engineer with in-depth knowledge of these Standards before using the tabulated data and/or contact the Certificate holder for further advice. When carrying out individual building design calculations, serviceability limits should be taken into account in respect of deflection considering both shear and bending deformations, including the long-term creep effects of permanent loading.

Table 2 Structural properties – limit state design[1]

Strength	Unit	Panel thickness (mm)		
		120	150	180
Bending strength[2] (M)	kN·m	3.9	5.4	7.8
Shear strength[2] (V)	kN	8.0	8.0	8.0
Bearing strength[3] (B) (minimum 45 mm bearing)	$kN \cdot m^{-2}$	6.9	6.9	6.9
Concentric in-plane strength[4]	kN	65.2	83.5	102.2
Eccentric in-plane strength[4][5]	kN	55.5	69.7	75.3
Stiffness				
EI_{inst} for wind load checks	$N \cdot mm^2$	1.10E+12	1.60E+12	2.10E+12
EI_{perm} for long-term deflection	$N \cdot mm^2$	$EI_{inst}/(1 + 1.87)$		
GA_{inst} for wind load checks	N	3.10E+05	3.40E+05	3.60E+05
GA_{perm} for long-term deflection	N	$GA_{inst}/(1 + 6.45)$		

(1) The strength values in this Table are design values for unit length of the panel that should be compared to the worst loading case at the Ultimate Limit State (ULS).

(2) When checking a panel under combined loading, the formula: $N_{Ed}/N_{Rd} + M_{Ed}/M_{Rd} < 1.0$ should be evaluated, where *N_{Rd} and M_{Rd} are taken from the values above and N_{Ed} and M_{Ed} are calculated from design loads.* The deflection of the panel should also be checked to ensure it is within appropriate limits.

(3) The bearing strength (B) should be used where a panel spans continuously over a central support. The bearing strength at an end support should be resisted by including an edge timber in the panel at the support.

(4) Applicable for laterally supported at 2500 mm maximum vertical centres.

(5) For eccentric in-plane loads the maximum eccentricity of the resultant load from the panel centreline must not exceed h/4 where h is the panel thickness.

6.3 The strength of all connection details tying walls and roofs must be evaluated to ensure stability of the overall building design. The specification and design of these items must be determined by the chartered structural engineer responsible for the stability of the building. Guidance on the design of connection details may be obtained from the Certificate holder's Technical Manual.

Wall panels

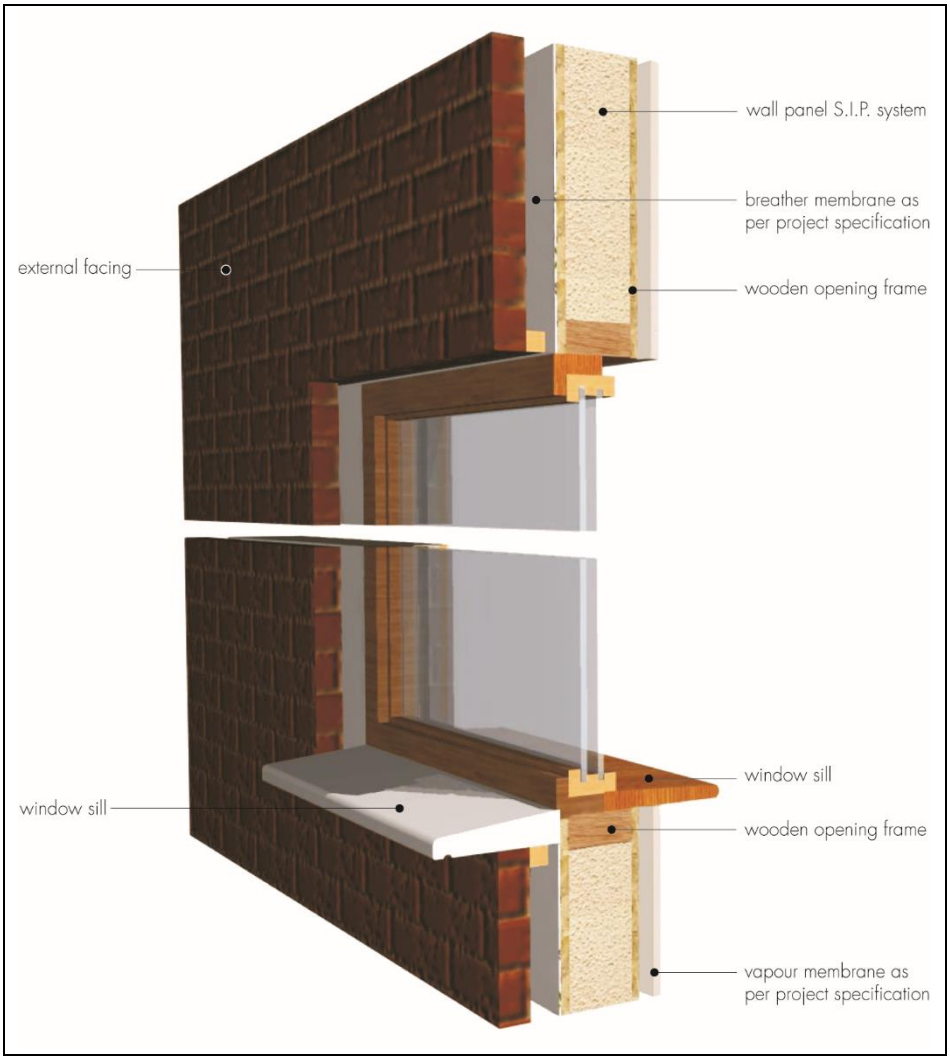
6.4 In the design of buildings, account must be taken of sliding, overturning and panel racking. The methods given in BS EN 1995-1-1 : 2004 and its UK National Annex may be used to assess racking resistance. Based on testing carried out by the Certificate holder in accordance with the guidelines for racking loading set out in BS EN 594 : 2011, a characteristic racking resistance[1][2] of 2.25 $kN \cdot m^{-1}$ for the wall panel thickness range can be assumed. The number and size of openings within the installed panels, together with any changes to the method of fixing to the sole plate and, in turn, the sole plate to the foundation, will affect this value. The suitably qualified and experienced individual must take these items into account when producing stability calculations. The strength of all connection details which tie walls to other structural elements (such as walls, roofs and solid timber splines) must be evaluated and provide adequate stability for the overall building design. Guidance on the design of connection details may be obtained from the Certificate holder. As the wall panel is a closed panel system, the requirements for extra anchors to the structure through use of holding-down brackets or straps should be considered by the structural engineer at the design stage.

(1) Racking resistance testing was carried out on a 120 mm thick panel. The characteristic racking resistance value assumes that the OSB skins are bonded to the PIR infill and screwed to the sole plate using 40 mm long by 3 mm screws wire nails at minimum 200 mm centres. Anchor bolts for fixing the sole plate to the test rig for the racking resistance tests were 10 mm diameter at 600 mm centres. Any changes to this assumption will affect the resistance value and the design engineer should modify the characteristic racking resistance accordingly.

(2) The characteristic racking resistance value may be modified by partial factors in accordance with BS EN 1995-1-1 : 2004 and its UK National Annex to obtain the design racking resistance value.

6.5 Lintels and framing around openings form an integral part of the loadbearing wall panels (see Figure 3). The sizing of lintels must be determined by the suitably qualified and experienced individual responsible for the design. The formation of openings for windows and doors in panels should only be carried out under approved factory conditions or, alternatively on site, by using individual pre-engineered panels. The structural design of any buildings must take account of the reduction in loadbearing capacity of the panels and the overall stability of the building due to the number and location of openings. Small service openings such as for pipework for flues may only be made through the panels on site when agreed by the Certificate holder.

Figure 3 Example window frame detail



6.6 When the panels are used to construct the inner leaf of an external cavity wall, the outer masonry leaf and all masonry below the dpc must be designed and constructed in accordance with BS EN 1996-1-1 : 2005, BS EN 1996-1-2 : 2005, BS EN 1996-2 : 2006 and BS EN 1996-3 : 2006, and their UK National Annexes, and PD 6697 : 2010.

6.7 As part of the structural design, consideration should be given to the support of eccentric loads imparted by central heating systems or kitchen appliances mounted on the wall construction incorporating the panels.

6.8 Stainless steel wall ties (outside the scope of this Certificate), can be directly attached to the OSB/3 face of the panels using stainless-steel screw fasteners as approved by the Certificate holder.

6.9 The structure incorporating the panels must be designed by an appropriately qualified structural engineer to satisfy the requirements of disproportionate collapse in the national Building Regulations and BS EN 1991-1-7 : 2006 and its UK National Annex.

Roof panels

6.10 The provision of holes or notches (eg for services, roof lights and dormer features) will affect the design assumptions and the chartered structural engineer must provide appropriate designs and details. Further advice can be sought from the Certificate holder.

7 Thermal performance

7.1 Calculations of thermal transmittance (U value) should be carried out in accordance with BS EN ISO 6946 : 2017 and BRE Report BR 443 : 2006, using the thermal conductivities given in Table 3 or panel thermal resistances given in Table 4.

Table 3 Thermal conductivities

Insulation	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)
PIR foam core	0.027(1)
OSB	0.13
Solid timber	0.12

(1) Declared thermal conductivity (λ_D)

Table 4 Example panel thermal resistance (R) values ($m^{-2} \cdot K \cdot W^{-1}$)

Element	Walls			Pitched Roof		
Panel thickness (mm)	120	150	180	120	150	180
Bridging fraction	7.2% (S-type connection)			7.2% (L-type connection)		
Panel R value ($m^2 \cdot K \cdot W^{-1}$) (1)	3.403	4.516	5.629	2.948	3.841	4.733

(1) In accordance with section 7 'SIPS' of BRE Report BR 443 : 2006. These panel R values may be used in combined U value calculations where the stated bridging fractions are not exceeded.

7.2 The U value of a complete element will depend on the selected panel thickness, the amount of timber bridging and the internal and external finishes. Calculated U values for example constructions (see Figure 4) are given in Table 5.

Table 5 Example wall and roof thermal transmittance (U) values ($W \cdot m^{-2} \cdot K^{-1}$)

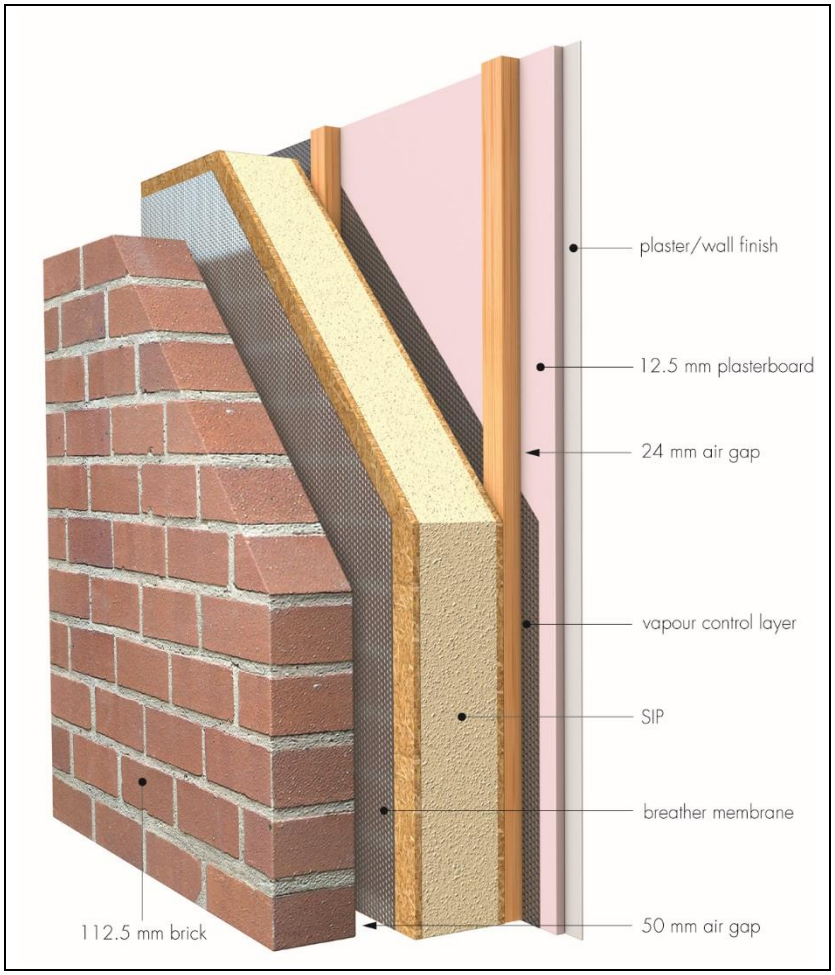
Element	**Panel thickness (mm)**(1)		
	120	**150**	**180**
Wall(2)	0.24	0.19	0.16
Roof(3)	0.29	0.23	0.19

(1) Includes a 25 mm services cavity (11.8% timber battens at 0.13 $W \cdot m^{-1} \cdot K^{-1}$) and 12.5 mm plasterboard λ = 0.25 $W \cdot m^{-1} \cdot K^{-1}$.

(2) Includes 102.5 mm brickwork, 50 mm vented cavity, breather membrane, panel with 7.2% cassette bridging (S-type connection).

(3) Includes slates/tiles, well ventilated air space, LR roof tile underlay, panel with 7.2% cassette bridging (L-type connection).

Figure 4 Example construction for U value calculation



7.3 A system incorporating the panels can contribute to maintaining continuity of thermal insulation around openings and between panels. Care must be taken in the overall design and construction of junctions with other elements to minimise thermal bridges and air infiltration. Detailed guidance can be found in the documents supporting the national Building Regulations.

8 Air permeability

8.1 The panels can contribute to achieving adequate resistance to unwanted air infiltration provided there is effective sealing around junctions.

8.2 In England and Wales and Northern Ireland, completed buildings are subject to pre-completion testing for airtightness in accordance with the requirements of Approved Documents L1A and L2B (section 20A), Technical Booklet F1 (sections 2.59 to 2.69) and Technical Booklet F2 (sections 2.72 to 2.77) respectively.

8.3 A proportion of completed buildings in a development is subject to pre-completion airtightness testing. Exceptions for small developments can be found in the documents supporting the national Building Regulations.

9 Condensation risk

Surface condensation

9.1 Provided the panels are properly assembled and sealed together as detailed in section 13, the risk of surface condensation under normal domestic use will be acceptable for elements and for junctions and openings in accordance with section 7.3.

Interstitial condensation

9.2 Elements will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, using the water vapour diffusion factors (μ) in Table 6.

Table 6 Water vapour diffusion factors

Item	water vapour diffusion factors (μ)
OSB warm side	50
PIR foam core	60
OSB cold side	50

9.3 Example calculations using humidity Class 4 (high occupancy dwellings) indicate that any interstitial condensation forming will dissipate in the summer months.

9.4 In roofs, a vapour permeable membrane with a maximum vapour resistance of 0.25 $MN \cdot s \cdot g^{-1}$ should be used, and for the walls, a breather membrane with a maximum vapour resistance of 0.60 $MN \cdot s \cdot g^{-1}$.

9.5 The risk of interstitial condensation in both the external walling and the roofing is greatest when the building is drying out after construction. Guidance on preventing condensation is given in BRE Digest 369 and BRE Report BR 262 : 2002.

10 Behaviour in relation to fire

10.1 When tested to BS 476-21 : 1987, a system incorporating panels fixed directly to a 16 mm thick plasterboard with 6g x 41 mm bugle head coarse threaded screw fixings at 400 mm centres achieved the results shown in Table 7.

Table 7 Fire performance to fire-resistance test, to BS 476-21 : 1987

Performance	Axial load ($kN \cdot m^{-1}$)	Construction
FR60	6.33	16 mm plasterboard fixed directly to 150 mm panel

10.2 Assessment of test results and design details shows that the panels are suitable for use in external walls not less than one metre(1) from a relevant boundary, and in separating walls that require fire-resistance periods not less than:

- external walls: 30(2) or 60 minutes(3) (from inside)
- separating walls: 60 minutes(3) (from either side).

(1) In Scotland, the panels may be used in external walls not more than one metre from a boundary, the recommendations of the Building (Scotland) Regulations 2004 (as amended), Technical Handbook (Domestic), Clause 2.6.5 are followed and the external wall cladding is constructed from non-combustible material.
(2) 'Short duration' in Scotland.
(3) 'Medium duration' in Scotland.

10.3 The OSB/3 panel linings have a Class 3(1) surface spread of flame designation. The maximum vertical or horizontal distance between cavity barriers is therefore 10 metres.

(1) 'High risk' in Scotland.

11 Proximity of flues and appliances

When installing the products in close proximity to certain flue pipes and/or heat-producing appliances, the following provisions of the national Building Regulations are applicable:

England and Wales — Approved Document J
Scotland — Mandatory Standard 3.18, clauses 3.18.1(1) to 3.18.6(1)

(1) Technical Handbook (Domestic).

Northern Ireland — Technical Booklet L.

12 Resistance to airborne sound

12.1 Testing to BS EN ISO 10140-2 : 2010 (airborne) and BS EN ISO 10140-3 : 2010 (impact) has indicated that the products will contribute to a wall satisfying the requirements for reducing flanking sound transmission in party walls.

12.2 Separating walls and party walls require pre-completion testing.

12.3 Good working practice should be adopted for sealing all joints. Double or triple layers of plasterboard should be staggered. Relevant practices detailed within the *Robust Details - Part E - Resistance to the passage of sound (as amended 2004)* must be adopted.

12.4 It is essential that care is taken in the design, and during installation, to avoid direct paths for airborne sound transmission and to minimise paths for flanking sound transmission.

13 Weathertightness

13.1 When the panels are used to form the inner leaf of an external cavity wall, the outer masonry leaf must be designed and constructed in accordance with BS EN 1996-1-1 : 2005, BS EN 1996-2 : 2006 and BS EN 1996-3 : 2006, and their UK National Annexes, and PD 6697 : 2010, and must incorporate dpcs and cavity trays. A breather membrane is required with this type of construction.

13.2 When used with other outer leaf construction, cladding or render systems, the final weather resistance of the building is dependent upon the efficient positioning and sealing of all joints. The guidance given in BRE Digest 262, Section 3, should be followed with regard to rain penetration, in that the designer selects a construction appropriate to the local wind-driven rain index, paying due regard to the design detailing, workmanship and materials to be used.

13.3 Roofing should be detailed in accordance with BS 5534 : 2014 to ensure moisture is prevented from coming into contact with the panels.

13.4 The performance of windows and doors is outside the scope of this Certificate.

13.5 The requirements set out in *NHBC Standards* 2018 for minimum cavity widths between wall panel outer face and external finishes should be noted and adhered to.

14 Maintenance and repair

Although maintenance is not envisaged for the panels, regular checks should be carried out on the finishes to ensure that any damage is detected and repaired as soon as possible.

15 Durability

15.1 The panels will have comparable durability to that of OSB/3 to BS EN 300 : 2006. Therefore, provided the installation remains weathertight and damp-proof, a service life of at least 60 years may be expected.

15.2 Timber used in areas that could be at risk of moisture accumulation, eg sole plates, should be preservative-treated in accordance with the recommendations given in BS 8417 : 2011.

Installation

16 General

16.1 Erection of Green Structural Insulated Wall and Roof Panels must comply with the details given in the Certificate holder's Construction Manual and the provisions of this Certificate (see Figure 5 for party wall options).

Figure 5 Party wall options

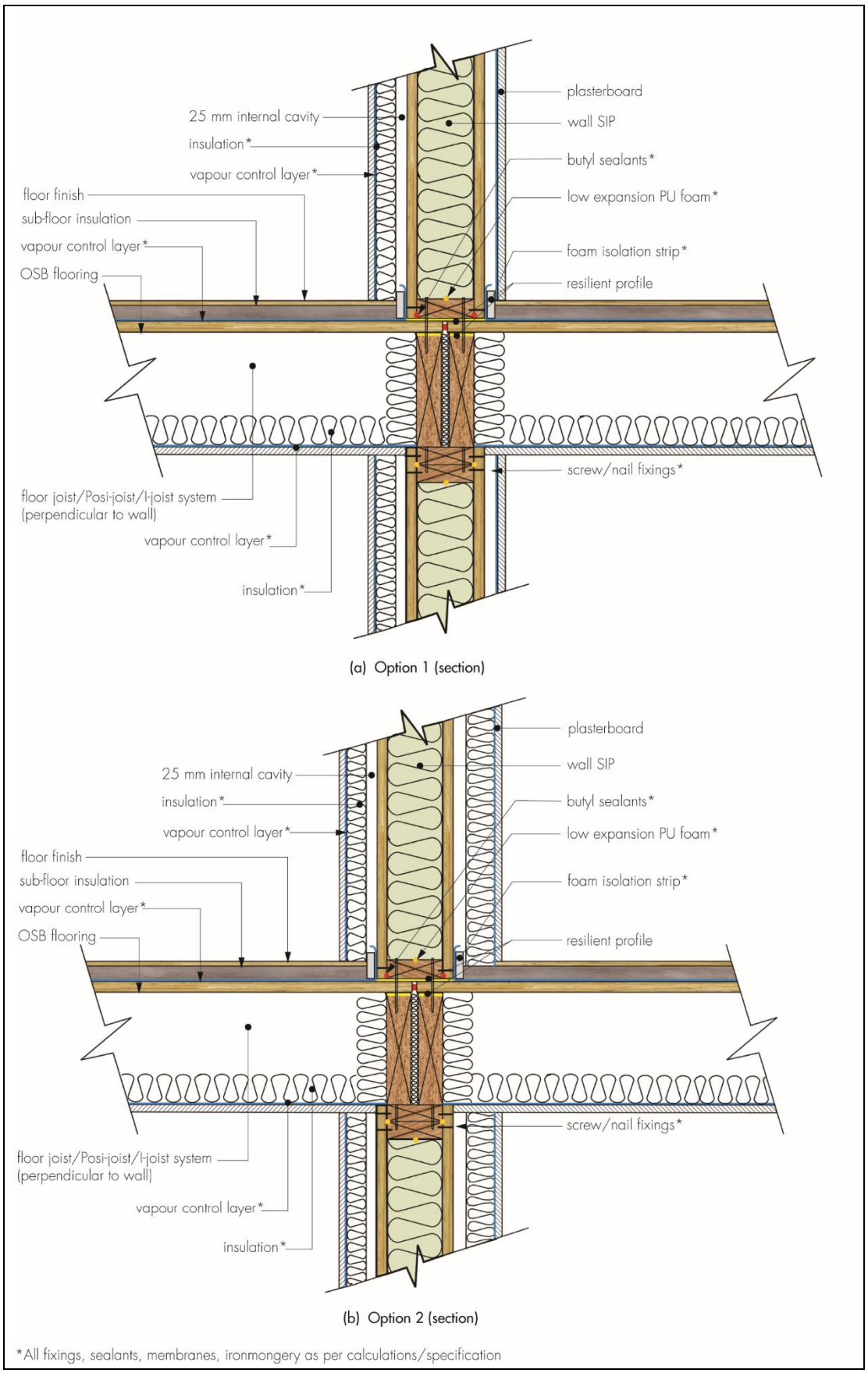


Figure 5 Party wall options (continued)

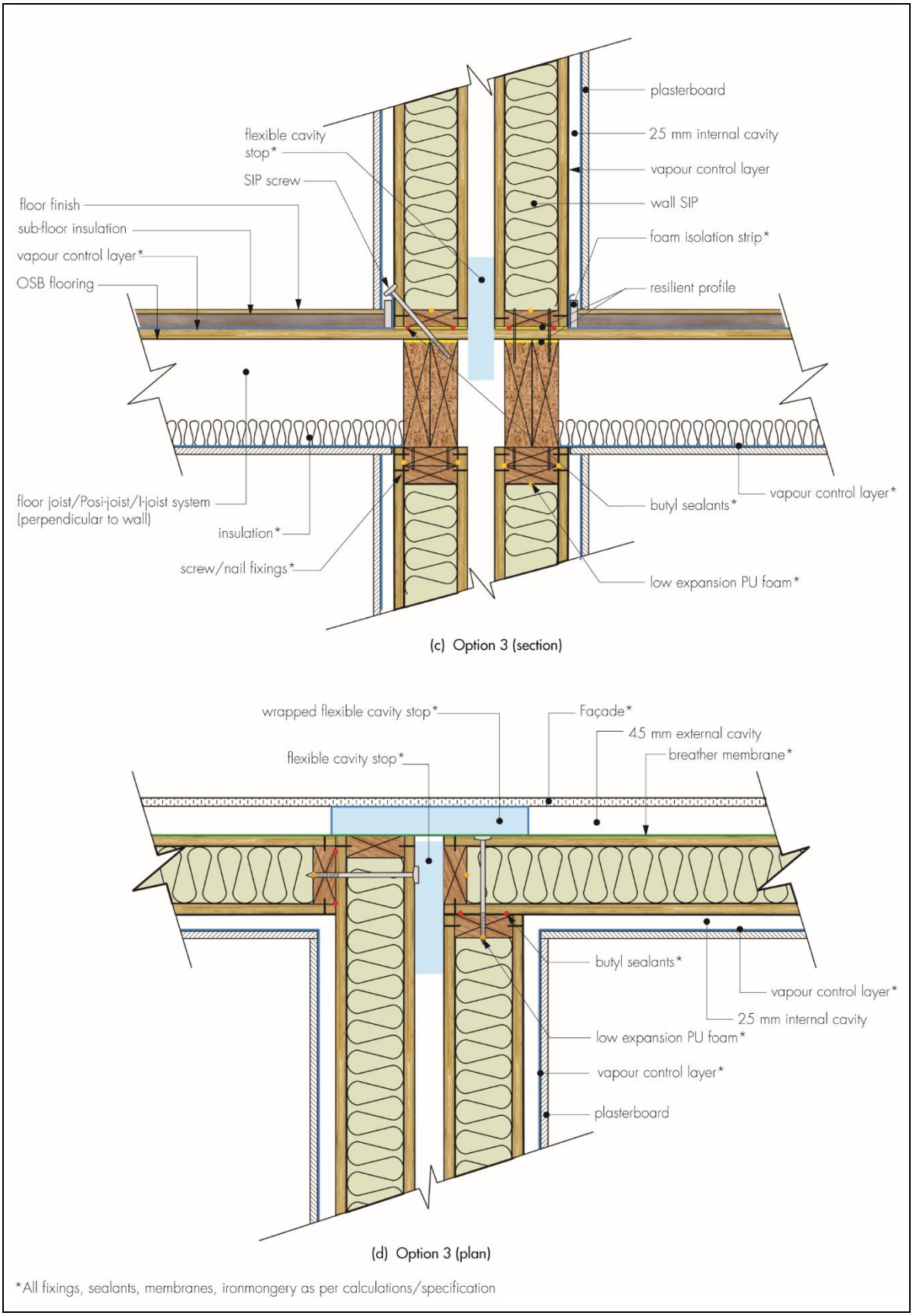
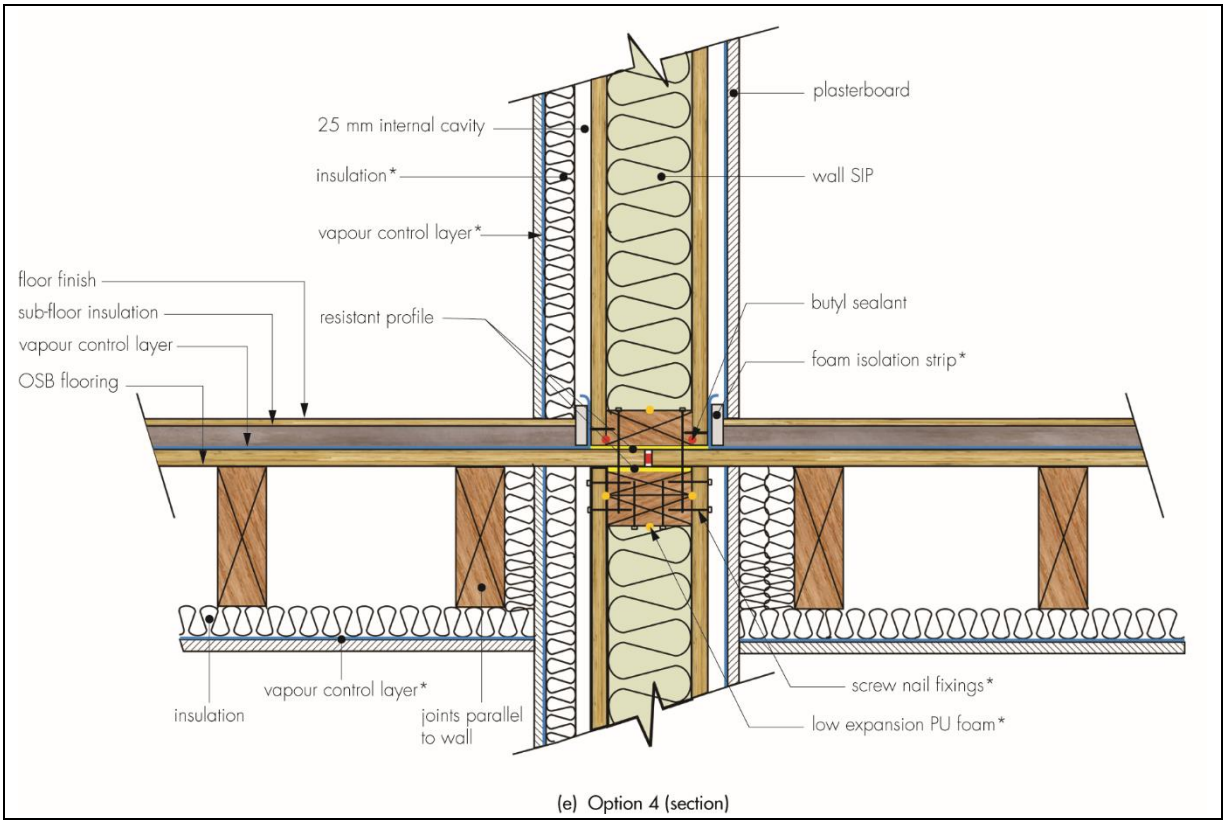


Figure 5 Party wall options (continued)



(e) Option 4 (section)

16.2 When used as loadbearing construction, the main contractor must ensure that the accuracy of the foundation is in accordance with the Certificate holder's instructions. In particular, the following details must be within the tolerance of ± 5 mm:

- level of the foundation or other bearing support
- overall width and length of the building footprint
- diagonals used for checking the overall squareness of the building(1).

(1) Adjustment may be possible through the sole plates.

16.3 When used as an infill panel (not vertically load bearing), the main contractor must:

- verify that the dimensions and flatness of the surface that the panels will be supported on, are within the Certificate holder's tolerances, which are:
  - deviation from plumb line: 1/1000
  - deviation on dimensions of the support frame (length and height): 5 mm
  - deviation on orthogonality: 5 mm
- a sufficient and precise support system needs to be used according to the structural calculations in the project assessment. This can either be metal profiles, wooden profiles or any other material or profile indicated by the structural engineer. The support of the panels on the frame can be achieved with fasteners (SIP screws, bolts, etc) as specified by the calculations and indications of the structural engineer
- it is proposed that the frame of the panels should have a minimum 5 mm gap from the main building structure, so the panel will not be in contact with the main structure. The gap created should be filled with fire rated expansion foam or other material provided by the project assessment
- it is proposed that dpc membranes must be used on the "contact" points between the panel and building frame so transfer of humidity from the building frame towards the panels is avoided, especially in cases where the structure of the building is either metal or concrete
- it is proposed that an appropriate gap should be maintained on the perimeter of the infill wall for expansion/differential movement purposes. This gap can be filled with fire rated expansion foam or any other material proposed by the project assessment

- in the case that the infill wall is installed on the exterior side of the building (external wall) sufficient firestops should be installed on the perimeter joints and joints between panels
- the perimeter joints and joints between panels should be insulated using butyl rubber tape.

16.4 Guidance on the procedure for installing the infill panels is limited due to the variations in the structural frame construction and detailing. Erection methods for lifting the infill panels into place, specification and design of brackets, and fixings and tolerances, will therefore need to be determined by the project design engineer for each structure in which the infill panels are used. Further guidance on the most commonly used types of framing structures can be obtained from the Certificate holder's Technical Manual.

17 Procedure

Foundation construction

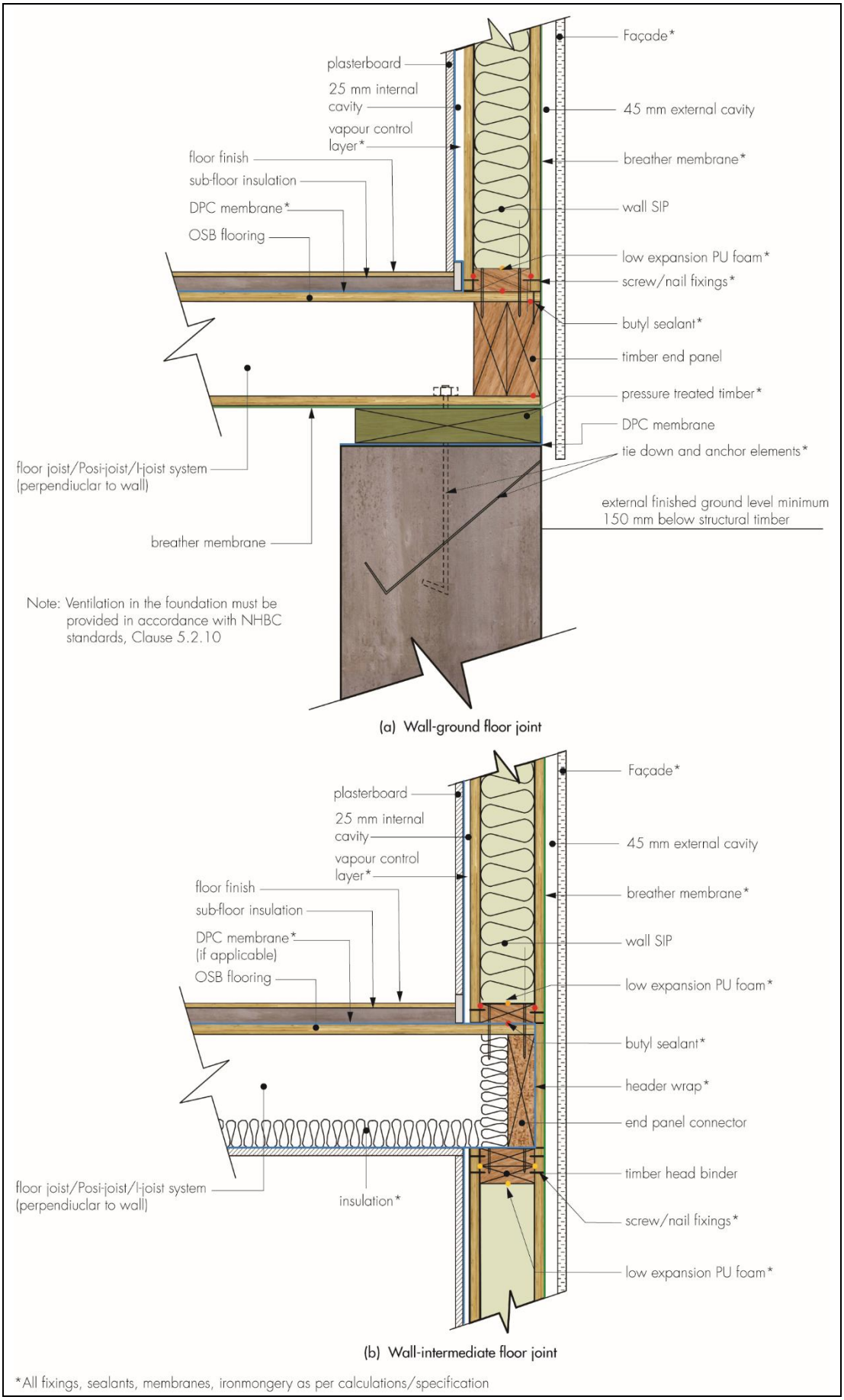
17.1 A suitable dpc must be laid on top of the foundation or sub-structure masonry with two beads of silicone sealant applied to the top surface.

17.2 A 45 mm deep treated softwood (C24) sole plate is combined with a 45 mm wide bottom plate, positioned over the dpc and fixed to the foundation using fixings approved by the Certificate holder and the structural design engineer's requirements. Tolerances for sole plates can be adjusted as per the Certificate holder's Technical Manual or their recommendations. Proprietary injectable mortar grouting is used to seal against air infiltration.

Wall construction

17.3 Wall panels are generally assembled horizontally, using S type joints, sealed using expanding urethane. Joints of the panel are tightened. Timber lintels, where required, are fixed into position over openings. A continuous timber head plate is fitted into the rout at the top of panels. Generally, all timber-to-rigid PIR foam connections are sealed using expanding urethane. All timber-to-timber connections are sealed using two beads of silicone sealant. (See Figure 6 for wall-floor joint).

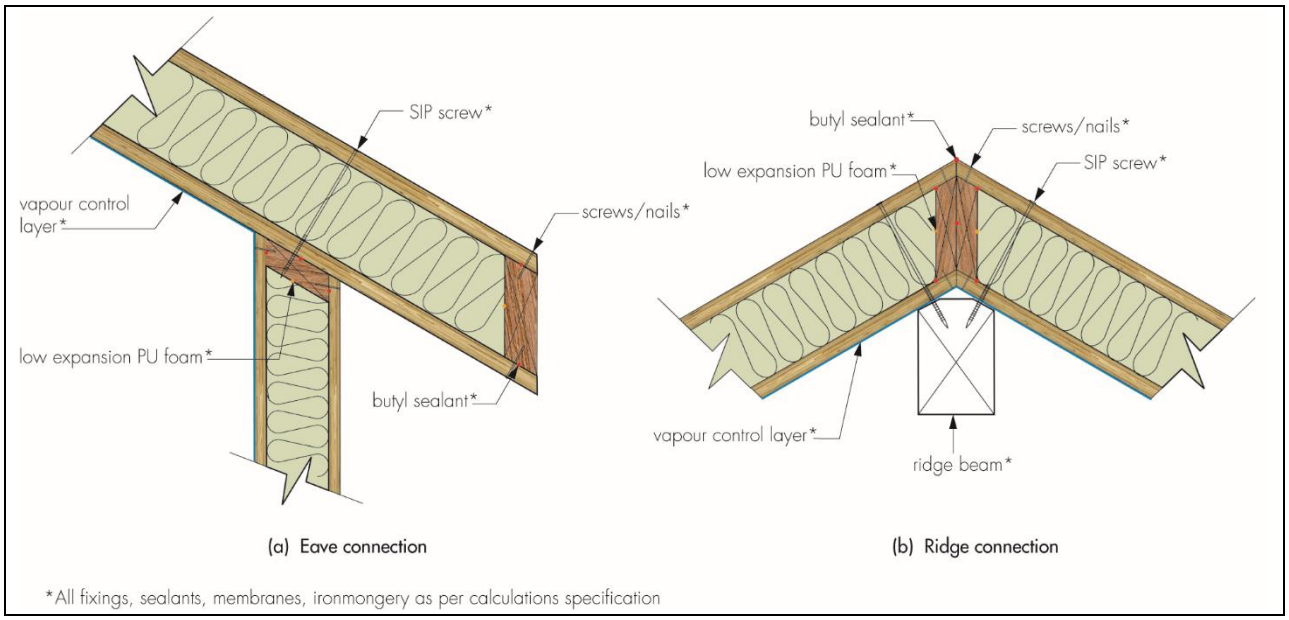
Figure 6 Wall-Floor joints



Roof construction

17.4 The supporting walls are made fully rigid by screw/nail fixings as approved by the Certificate holder, and intermediate/ridge beams/purlins in accordance with the design requirements, which are incorporated within preformed pockets in the wall panel. A wall plate is fixed onto the top of the head plate, the top of which is angled to suit the pitch of the roof. (See Figure 7 for roof joint details).

Figure 7 Roof joint details



17.5 Roof panels are positioned, mechanically handled, working from one gable wall to the other. Panels are joined (as for the wall construction) and fixed through to the structural supporting timber members to the structural engineer's design requirements. The roof panel is overlaid with a vapour permeable membrane (see section 9.3). Treated softwood counter battens (minimum 25 mm deep by 50 mm wide) are fixed through to the roof panel using stainless steel screws as approved by the Certificate holder and at centres to the chartered engineer's design requirements. A variety of roof finishes (see section 1.5) can be adopted, subject to the Certificate holder's approval.

Technical Investigations

18 Tests

Tests were carried out and the results assessed to determine:

- bending moment resistance test
- bearing resistance test
- shear resistance test
- resistance to compressive axial force
- resistance to eccentric compressive axial force
- resistance to compressive axial force with transverse forces
- resistance to eccentric compressive axial force with transverse forces
- fatigue test
- resistance to racking force
- creep test
- acoustic test
- resistance to fire test.

19 Investigations

19.1 An examination was made of technical data relating to structural properties and design calculations.

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

19.3 Visits were made to a site in the UK to assess the installation processes.

19.4 A condensation risk assessment to BS 5250 : 2002 was undertaken for a typical wall and roof construction.

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BS 5250 : 2011 + A1 : 2016 *Code of practice for control of condensation in buildings*

BS 5534 : 2014 + A2 : 2018 *Slating and tiling for pitched roofs and vertical cladding — Code of practice*

BS 8417 : 2011 + A1 : 2014 *Preservation of wood — Code of practice*

BS EN 300 : 2006 *Oriented Strand Boards (OSB) — Definitions, classification and specifications*

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20 Conditions

20.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
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- is subject to English Law.

20.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

20.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

20.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

20.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

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- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

20.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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