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Agrément Certificate
17/5431
Product Sheet 2 Issue 2

S AND B FLOORING SYSTEMS

S AND B WARMBEAM TOP SHEET SYSTEM

This Agrément Certificate Product Sheet(1) relates to the S and B Warmbeam Top Sheet System comprising a range of expanded polystyrene (EPS) infill panels and an EPS top sheet. The system is used in conjunction with precast, prestressed concrete beams, structural concrete toppings, concrete closure blocks and perimeter slip-bricks. The system is for use in suspended concrete ground floors in single-family dwellings, flats and communal areas in blocks of flats within the load criteria specified in this Certificate.

(1) Hereinafter referred to as 'Certificate'.

The assessment includes

Product factors:

- compliance with Building Regulations
- compliance with additional regulatory or non-regulatory information where applicable
- evaluation against technical specifications
- assessment criteria and technical investigations
- uses and design considerations

Process factors:

- compliance with Scheme requirements
- installation, delivery, handling and storage
- production and quality controls
- maintenance and repair

Ongoing contractual Scheme elements†:

- regular assessment of production
- formal 3-yearly review

KEY FACTORS ASSESSED

Section 1. Mechanical resistance and stability
Section 2. Safety in case of fire
Section 3. Hygiene, health and the environment
Section 4. Safety and accessibility in use
Section 5. Protection against noise
Section 6. Energy economy and heat retention
Section 7. Sustainable use of natural resources
Section 8. Durability

The BBA has awarded this Certificate to the company named above for the system described herein. This system 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 Second issue: 2 July 2024
Originally certified on 2 March 2018

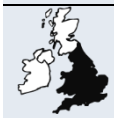
Hardy Giesler
Chief Executive Officer

SUMMARY OF ASSESSMENT AND COMPLIANCE

This section provides a summary of the assessment conclusions; readers should refer to the later sections of this Certificate for information about the assessments carried out.

Compliance with Regulations

Having assessed the key factors, the opinion of the BBA is that the S and B Warmbeam Top Sheet System, 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 Building Regulations 2010 (England and Wales) (as amended)

Requirement:	**A1(1)**	**Loading**
Comment:		The system can sustain and transmit dead and imposed floor loads to the ground. See section 1 of this Certificate.
Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The system can contribute to limiting the risk of surface condensation. See section 3 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The system can contribute to satisfying this Requirement. See section 6 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The system is acceptable. See sections 8 and 9 of this Certificate.
Regulation:	**25B**	**Nearly zero-energy requirements for new buildings**
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)**
Regulation:	**26C**	**Target primary energy rates for new buildings (applicable to England only)**
Regulation:	**26C**	**Energy efficiency rating (applicable to Wales only)**
Comment:		The system can contribute to satisfying these Regulations. See section 6 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)**	**Fitness and durability of materials and workmanship**
Comment:		The system can contribute to a construction satisfying this Regulation. See sections 8 and 9 of this Certificate.
Regulation:	**9**	**Building standards - construction**
Standard:	1.1(a)(b)	Structure
Comment:		The system can sustain and transmit dead and imposed floor loads to the ground, with reference to clause 1.1.1(1) of this Standard. See section 1 of this Certificate.
Standard:	3.15	Condensation
Comment:		The system can contribute to limiting the risk of surface and interstitial condensation, with reference to clauses 3.15.1(1), 3.15.4(1) and 3.15.5(1) of this Standard. See section 3 of this Certificate.
Standard:	6.1(b)(c)	Energy demand and carbon dioxide emissions
Comment:	(d)	The system can contribute to satisfying of this Standard, with reference to clause 6.1.1(1). See section 6 of this Certificate.

Standard:	6.2	Building insulation envelope
Comment:		The system can contribute to satisfying the requirements of this Standard, with reference to clauses 6.2.1(1), 6.2.3(1), 6.2.8(1) 6.2.9(1) and 6.2.12(1). See section 6 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The system 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 system can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4(1), 7.1.6(1) and 7.1.7(1). See section 6 of this Certificate.
		(1) Technical Handbook (Domestic).

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

Regulation:	**23(1)(a)(i)**	**Fitness of materials and workmanship**
Comment:	**(iii)(b)(i)(ii)**	The system is acceptable. See sections 8 and 9 of this Certificate.
Regulation:	**29**	**Condensation**
Comment:		The system can contribute to limiting the risk of interstitial condensation. See section 3 of this Certificate.
Regulation:	**30**	**Stability**
Comment:		The system can sustain and transmit dead and imposed floor loads to the ground. See section 1 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Regulation:	**40(2)**	**Target carbon dioxide emission rate**
Regulation:	**43(b)**	**Nearly zero-energy requirements for new buildings**
Comment		The system can contribute to satisfying these Regulations. See section 6 of this Certificate

Additional Information

NHBC Standards 2024

In the opinion of the BBA, the S and B Warmbeam Top Sheet System, with macro-polymer, steel fibres and steel mesh structural concrete toppings(1), 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 5.2 *Suspended ground floors.*

(1) The NHBC does not accept the use of micro-polymer fibre structural concrete toppings.

Fulfilment of Requirements

The BBA has judged the S and B Warmbeam Top Sheet System to be satisfactory for use as described in this Certificate. the S and B Warmbeam Top Sheet System comprising a range of expanded polystyrene (EPS) infill panels, an EPS top sheet. The system is used in conjunction with precast prestressed concrete beams, structural concrete toppings, concrete closure blocks and perimeter slip-bricks. The system is for use in suspended concrete ground floors in single-family dwellings, flats and communal areas in blocks of flats within the load criteria specified in this Certificate.

ASSESSMENT

Product description and intended use

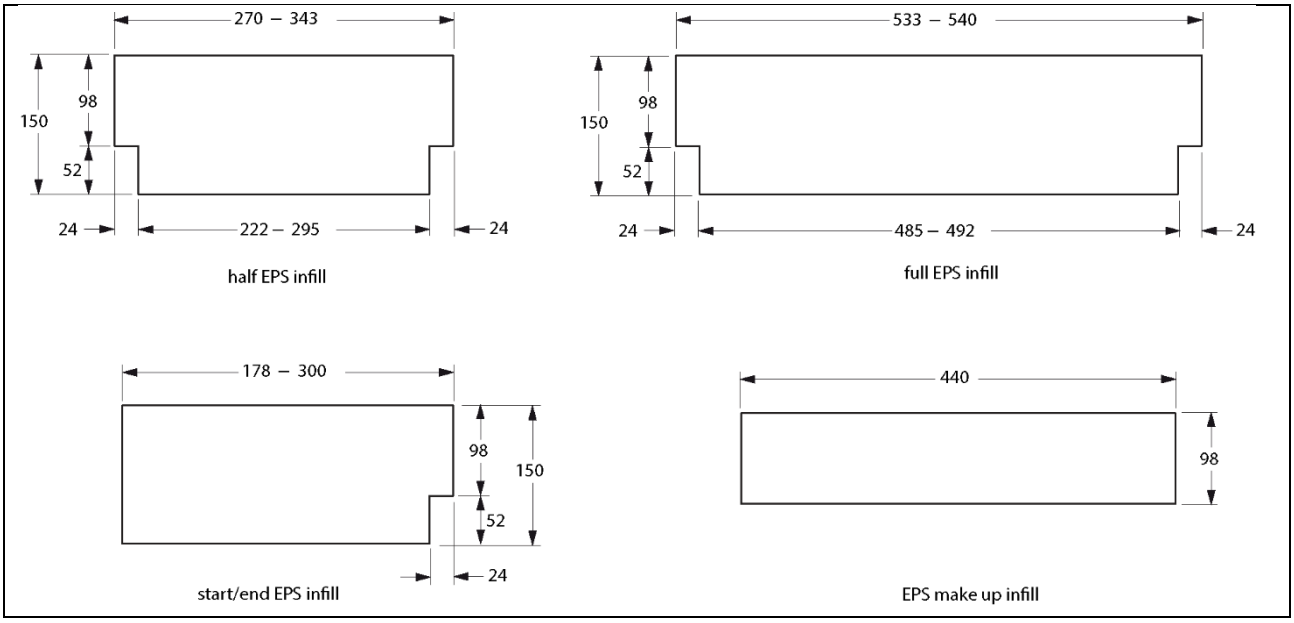
The Certificate holder provided the following description for the system under assessment. The S and B Warmbeam Top Sheet System consists of a range of infill panels (full, half, start/end and make-up) and top sheet , see Table 1 and Figure 1. The EPS components have the nominal characteristics given in Table 1.

Table 1 Nominal characteristics of the EPS components

Characteristic (unit)	Full panel	Half panel	Start/end panel	Make-up panel	Top sheet(1)
Thickness (mm)	150 to 225	150 to 225	150 to 225	98	50 to 300
Top width (mm)	533 to 540	270 to 343	178 to 300	up to 440	1200
Bottom width (mm)	485 to 492	222 to 295	154 to 276	—	1200
Length (mm)	1200	1200	1200	1200	2400
Compressive strength at 10% deformation (kPa)	70	70	70	100	120, 150,200
Mechanical resistance according to BS EN 15037-4 : 2010	Type R1 and Class R1 a	Type R1 and Class R1 a	Type R1 and Class R1 a	Type R1 and Class R1 a	—

(1) Bending strength of the EPS top sheet is in accordance with the principles of BS EN 13163 : 2012, Table C.1.

Figure 1 Example standard dimensions of EPS infill panels (all dimensions in mm)



Ancillary Items

The Certificate holder recommends the following ancillary items for use with the system, but these materials have not been assessed by the BBA and are outside the scope of this Certificate:

- precast, prestressed concrete beams — of the type and size shown in Figure 3
- concrete topping(1) — reinforced with steel mesh to the specifications given section 9
- concrete topping(1) — reinforced with macro polymer or steel fibres to the specifications given in Table 3, with a maximum aggregate size of 10 to 20 mm
- insulation strips (width 25 mm) — for perimeter of structural concrete toppings
- concrete closure blocks and concrete perimeter slip-bricks — with a compressive strength equal to, or greater than, that of the blocks used to form the inner leaf of the wall. For dimensions of concrete closure blocks, see Figure 2
- where required, gas barrier membrane(2) — with third-party approval
- vapour control layer (VCL)(2)
- damp-proof membrane (DPM)(2) — with third-party approval
- Steel edge clips — a construction aid for the start/end infill panels.

(1) The concrete used in the precast, prestressed concrete beam and concrete toppings must comply with BS EN 206 : 2013, BS 8500-1 : 2023 and BS 8500-2 : 2023.
(2) Must be compatible with EPS.

Figure 2 Closure blocks and slip-bricks details (all dimensions in mm)

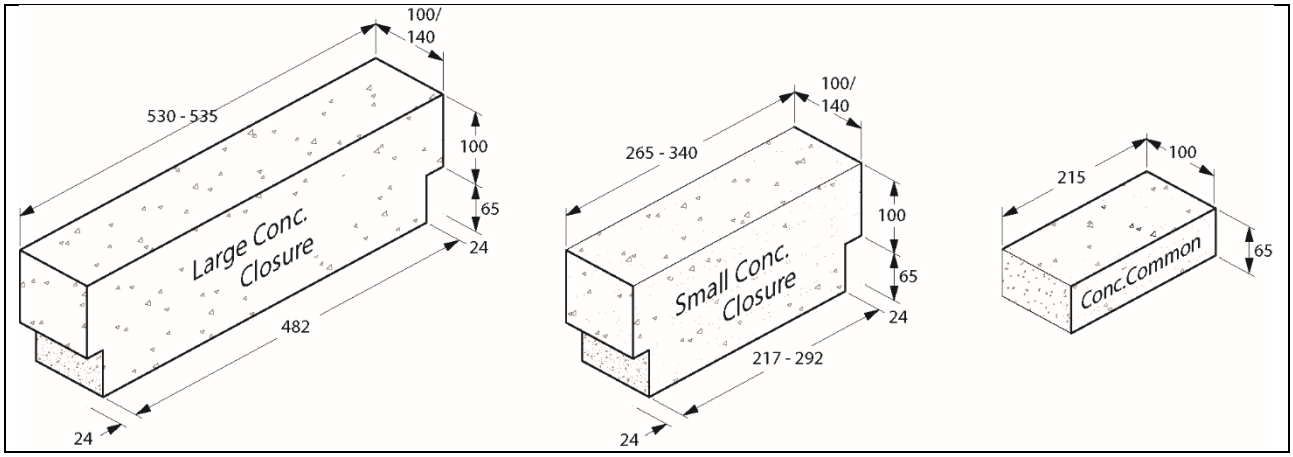
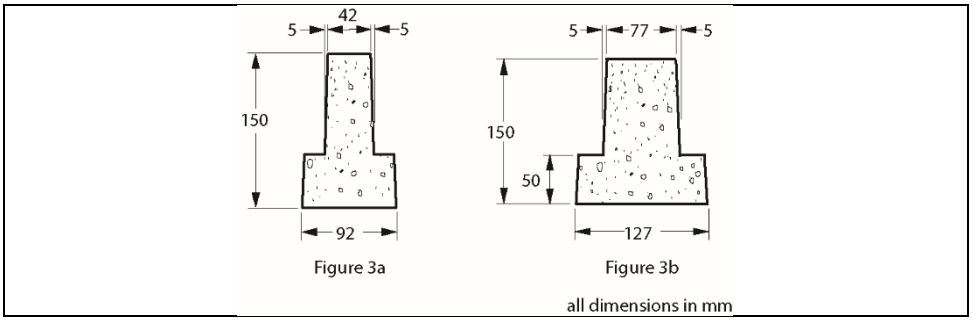


Figure 3 Precast concrete beams used for structural testing and thermal calculations



Product assessment – key factors

The system was assessed for the following key factors, and the outcome of the assessments is shown below. Conclusions relating to the Building Regulations apply to the whole of the UK unless otherwise stated.

1 Mechanical resistance and stability

Data were assessed for the following characteristics.

1.1 Behaviour under loadings

1.1.1 Results of short- and long-term stress versus strain behaviour of the EPS top sheet under permanent and variable actions are shown in Tables 2 and 3. The top sheet must be used in conjunction with a concrete beam that has a top flange width as specified in Table 3.

Table 2 Short- and long-term stress vs strain behaviour of the EPS top sheet under the load from communal areas in blocks of flats

Product assessed	Assessment method	Requirement	Results
EPS top sheet	BBA Method	The strain against stress performance of the EPS top sheet under the applied loads at serviceability limit state (SLS) conditions must remain within the permitted elastic performance limit of 1.0%	Pass
		The long-term thickness reduction of EPS structural boards must remain within the acceptable limit of 2% after 50 years, when subjected to a permanent compressive stress of 0.3 σ_{10} (σ_{10} is the compressive stress of the EPS at 10% deformation)	Pass

Table 3 Correlation between the EPS top sheet thickness and compressive stress in conjunction with the precast, prestressed concrete beams in Figures 3a and 3b, width of top flange of concrete beam and loads(1)

EPS top sheet Thickness (mm)	Declared level of compressive stress at 10% strain of EPS top sheet (kPa)	Minimum width of top flange of concrete beam (mm)	Maximum imposed(2)(3) concentrated load (kN)	Maximum imposed(2) UDL ($kN \cdot m^{-2}$)	Maximum line load partition in any orientation ($kN \cdot m^{-1}$)
65-95	120	42(4)	2.0	1.5	1.0
96-119			4.0	3.0	1.0
120-300			4.0	3.0	3.0
50-74	150		2.0	1.5	1.0
75-89			4.0	3.0	1.0
90-300			4.0	3.0	3.0
50-74	200		4.0	3.0	1.0
75-300			4.0	3.0	3.0

(1) Self-weight of 75 mm concrete slab and weight of 0.5 $kN \cdot m^{-2}$ finishes have been taken into account. For further details, see Table 9 of this Certificate

(2) Imposed concentrated loads must not be combined with imposed uniformly distributed loads (UDL) or other variable actions.

(3) Imposed concentrated load must be applied on a 100 x 100 mm plate.

(4) Maximum precast, prestressed concrete beam spacing at 592 mm C/C.

1.1.2 EPS infill panels were tested to establish their resistance to the concentrated load expected during the installation of the system and the subsequent over-concreting. The test result is given in Table 4.

Table 4 Load capacity of EPS infill panels (1) against construction loads

Product assessed	Assessment method	Requirement	Results
EPS full panel, half panel, start/end panel, make-up panel(2)	BBA Method	Resistance to construction load	Pass

(1) EPS infill panels must have a normal bearing of 18 mm, with a 3 mm allowance for misalignment and manufacturing tolerances in the straightness of the precast prestressed beam, with a minimum bearing width of 15 mm.

(2) Make-up panels must not be used at widths greater than 440 mm.

1.1.3 Results of resistance of the EPS top sheets, including punching behaviour, excessive deformation against short-term construction loading and other short-term loads commonly associated with installation, ie concrete heap, are given in Table 5.

Table 5 Resistance of EPS top sheets against construction loadings

Product assessed	Assessment method	Requirement	Results
EPS top sheets	BBA Method	No puncture or excessive deformation under construction loads (concentrated load of 0.5 kN)	Pass
		Concrete must not be discharged onto EPS top sheets from heights greater than 500 mm and concrete depths must not be formed over 300 mm high	Pass

1.1.4 On the basis of data assessed, the EPS top sheets can resist the permanent and variable actions from loads associated with communal areas in blocks of flats defined in this Certificate, and their short- and long-term strains remain within acceptable limits. The EPS top sheets and EPS infill panels can also resist against the applied load during installation.

2 Safety in case of fire

Not applicable.

3 Hygiene, health and the environment

Data were assessed for the following characteristics.

3.1 Water vapour permeability

The Certificate holder has declared the water vapour resistance factors (μ values) shown in Table 6.

Table 6 Water vapour diffusion resistance factors (μ values)

Product assessed	Assessment method	Requirement	Result (μ)
EPS 70	BS EN 13163 : 2012	Declared value	20-40
EPS 100/120/150			30-70
EPS 200			40-100

3.2 Condensation

3.2.1 When there is no gas barrier membrane or VCL located above the EPS top sheets or any VCL laid over the precast, prestressed concrete beam, there is a risk of interstitial condensation forming on the concrete beam, which may be persistent. Therefore, the risk for each case must be assessed, both through the concrete beam and the insulation, in accordance with BS EN ISO 13788 : 2012 and BS 5250 : 2021, accounting for the slab construction, dwelling humidity class, dwelling type and dwelling location and use of any VCL, DPM and/or gas barrier membrane.

3.2.2 On the basis of calculations carried out by the BBA in accordance with BS EN ISO 13788 : 2012 and BS 5250 : 2021, the system can adequately limit the risk of surface condensation in dwellings and flats.

3.2.3 The performance of other constructions must be evaluated in accordance with the documents supporting the relevant national Building Regulations.

4 Safety and accessibility in use

Not applicable.

5 Protection against noise

Not applicable.

6 Energy economy and heat retention

Data were assessed for the following characteristics.

6.1 Thermal conductivity

The Certificate holder has declared the thermal conductivity values (λ_D) shown in Table 7.

Table 7 Declared thermal conductivity (λ_D) values

Product assessed	Assessment method	Requirement	Result (λ_D) ($W \cdot m^{-1} \cdot K^{-1}$)
EPS 70 white	BS EN 13163 : 2012	Declared value	0.038
EPS 100 and 120 white			0.036
EPS 150 white			0.035
EPS 200 white			0.034
EPS 70, 120 and 150 grey			0.031
EPS 100 grey			0.030

6.2 Thermal performance

6.2.1 Example floor U values given in Table 8, for a typical floor construction, indicate that the system can enable a floor to meet, or improve upon, design floor U values of between 0.11 and 0.25 $W \cdot m^{-2} \cdot K^{-1}$, as specified in the documents supporting the national Building Regulations.

6.2.2 A floor deck U value (from inside to the underfloor void) will depend significantly on the types and number of precast, prestressed concrete beams and EPS infill panels. The thermal resistance of each concrete beam and EPS configuration must be numerically modelled to BS EN ISO 10211 : 2017 and BS EN 15037-4 : 2010. The floor deck U value may then be taken as an area-weighted average and the overall floor U value calculated as described in section 6.2.3.

Table 8 Example floor U values(1) for single beam configurations(2) ($W \cdot m^{-2} \cdot K^{-1}$)

Beam option	p/a ratio $m \cdot m^2$	50 mm EPS White 120 top sheet with 150 mm EPS White 70 infill panel	300 mm EPS Grey 120 or 150 top sheet with 150 mm EPS Grey 70 infill panel
150 x 92 mm Refer to Figure 3a	0.4	0.18	0.070
	0.6	0.20	0.072
	0.7	0.20	0.072
	0.9	0.21	0.073
150 x 127 mm Refer to Figure 3b	0.4	0.19	0.071
	0.6	0.21	0.073
	0.7	0.21	0.074
	0.9	0.22	0.074

(1) These calculations are in accordance with sections 6.2.1 and 6.2.2 and assume:
- the concrete beam λ is 2.0 $W \cdot m^{-1} \cdot K^{-1}$ and 75 mm concrete topping λ is 1.15 $W \cdot m^{-1} \cdot K^{-1}$
- a 300 mm thick perimeter wall with a U value of 0.35 $W \cdot m^{-2} \cdot K^{-1}$
- underfloor ventilation area is 0.0015 $m^2 \cdot m^{-1}$
- ground conductivity is 1.5 $W \cdot m^{-1} \cdot K^{-1}$
- all other parameters are default values from BRE Report BR 443 : 2019

(2) Configuration used – all single precast prestressed beams at full centres.

6.2.3 The overall floor U value will depend significantly on the deck U value, the ratio of the exposed (and semi-exposed) floor perimeter length to floor area (p/a), the amount of underfloor ventilation and the ground thermal conductivity. Each floor U value, therefore, must be calculated to BS EN ISO 13370 : 2017 and BRE Report BR 443 : 2019.

7 Sustainable use of natural resources

Data were assessed for the following characteristics.

7.1 Environmental information

EPS material can be recycled if free from debris and contamination. The concrete and reinforcement steel can also be recycled.

8 Durability

8.1 Service life

Under normal service conditions, the system will have a life of at least 60 years, provided it is designed, installed and maintained in accordance with this Certificate and the Certificate holder's instructions.

PROCESS ASSESSMENT

Information provided by the Certificate holder was assessed for the following factors:

9 Design, installation, workmanship and maintenance

9.1 Design

9.1.1 The design process was assessed by the BBA and the following requirements apply in order to satisfy the performance assessed in this Certificate.

9.1.2 A suitably experienced and competent individual must perform a site-specific assessment/design to ensure that the proposed system is in accordance with the principles and requirements of this Certificate and the relevant parts of BS EN 13163 : 2012 and BS EN 15037-4 : 2010. A suitably experienced and competent individual must also ensure that the precast, prestressed concrete beams and structural concrete toppings are in accordance with the requirements of this Certificate and the relevant parts of BS EN 15037-1 : 2008.

9.1.3 For loadings defined in Table 9, the structural concrete topping specification must be as shown in Table 10. The structural concrete topping (outside the scope of this Certificate) above the start/end panels must be designed as a cantilevered slab and must not exceed 178 and 300 mm respectively (see Figure 4). The structural concrete topping reinforced with steel mesh must be designed in accordance with BS EN 1990 : 2002, BS EN 1991-1-1 : 2002 and BS EN 1992-1-1 : 2004, and their UK National Annexes.

Table 9 Maximum characteristic imposed partition loads and weight of finishes for structural concrete topping reinforced with macro-polymer or steel fibres or steel mesh A142. Imposed concentrated load must be applied over a square plate of area not less than 100 by 100 mm

Description	Maximum characteristic loads for single-family dwellings — reinforced with macro-polymer fibres, steel fibres or steel mesh A142	Maximum characteristic loads for communal areas in blocks of flats or other suitable buildings — reinforced with steel mesh A142
Variable action uniformly distributed load (UDL) ($kN \cdot m^{-2}$)	1.5(1)	3.0(1)
Variable concentrated load (kN)	2.0(1)(2)	4.0(1)(2)
Permanent action line load partition parallel and perpendicular to the precast prestressed beam ($kN \cdot m^{-1}$)	1.0(3)	1.0-3.0(3)(4)
Variable action allowance for moveable partition ($kN \cdot m^{-2}$)	1.0(3)	1.0(3)
Permanent action for finishes ($kN \cdot m^{-2}$)	0.5	

(1) Variable action concentrated load must not be combined with the imposed UDL or other variable actions.
(2) Variable action allowance for moveable partition must not be combined with permanent action line load partition wall.
(3) Non-load bearing partition walls heavier than 1 $kN \cdot m^{-1}$, in any orientation with respect to the concrete beams, must either be supported by a foundation or the concrete beams designed to sustain the specific loading.
(4) For further details, see Table 3 of this Certificate.

Table 10 Specification of structural concrete toppings (1)(2)(3)(4)(5)

Ref no.	Reinforcement
1	One layer of A142 mesh to BS 4483 : 2005 with a characteristic yield strength (f_{yk}) of 500 N·mm^{-2}. Reinforcement must be placed at mid height of the concrete slab
2	Novomesh B&BA(7)(8) (steel), dosage rate 17.5 kg·m^{-3}, steel flat end, steel fibres, fibre length 50 mm, diameter 1.0 mm, tensile strength 1150 N·mm^{-2}
3	Novomesh B&BA(6)(7)(9) (macro polymer and micro polyolefin), dosage rate 3.84 kg·m^{-3}, shape of macro fibre: continuously deformed, 60 mm long, 0.56 mm diameter, tensile strength 600 N·mm^{-2}, modulus of elasticity 7000 N·mm^{-2}
4	Adfil SF86(7)(8) (steel fibre), dosage rate 13.33 kg·m^{-3}, 60 mm long, diameter 0.75 mm, tensile strength 1225 N·mm^{-2}, modulus of elasticity 200000 N·mm^{-2}
5	Durus Easy Finish(6)(7) (macro-polymer fibre), dosage rate 3.00 kg·m^{-3}, 40 mm long, 0.7 mm equivalent diameter, tensile strength 470 N·mm^{-2}, modulus of elasticity 6000 N·mm^{-2}
6	Adfil SF86(7)(8)(steel fibre), dosage rate 7.50 kg·m^{-3}, 60 mm long, diameter 0.75 mm, tensile strength 1225 N·mm^{-2}, modulus of elasticity 200000 N·mm^{-2}
7	Durus Easy Finish(6)(7) (macro-polymer fibre), dosage rate 2.50 kg·m^{-3}, 40 mm long, 0.7 mm equivalent diameter, tensile strength 470 N·mm^{-2}, modulus of elasticity 6000 N·mm^{-2}
8	Nexus 85 (6)(7) (macro-polymer fibre), dosage rate 2.25 kg·m^{-3}, shape (continuously deformed), specific gravity 0.91, melting point 165, 60 mm long, 0.7 mm nominal diameter
9	Zenith 60(7)(8) (steel fibre), dosage rate 7.5 kg·m^{-3}, shape (straight with hook end), 60 mm long, nominal diameter 1.0 mm
10	SikaFiber-1050 B&BA HF(7)(8) (steel fibre) dosage rate 11.5 kg, shape (corrugated/wavy), steel grade (low carbon), tensile strength 700 N·mm^{-2}, 50 ± 3 mm long, width 3 ± 0.5, thickness 0.75 ± 0.25 mm, depth 2.25 ± 0.25, density 7850 kg·m^{-3}
11	ABC(7)(8) (steel fibre), dosage rate 12.5 kg·m^{-3}, shape (deformed with hooked ends), 60 mm long, diameter 0.75 mm, density (kg·m^{-3}) 0.9, tensile strength 1200 N·mm^{-2}, modulus of elasticity 210,000 N·mm^{-2}
12	ABC(6)(7) (macro-polymer fibre), dosage rate 5.0 kg·m^{-3}, 55 mm long, 0.65 mm diameter, tensile strength 510 N·mm^{-2}
13	Apex 60(7)(8) (steel fibre), dosage rate 7.5 kgm^{-3}, shape (straight with hook end), 60 mm long, nominal diameter 1 mm, density 7850 kg·m^{-3}

(1) The overall depth of concrete topping above the services is 65 or 75 mm

(2) The fibres listed in the Table 10 can be used within a C28/35 standard concrete (see footnote 3, below) with maximum 20 mm aggregate (see footnote 4, below) or C28/35 self-compacting (see footnote 5, below) concrete with maximum 10 mm aggregate (see footnote 4, below).

(3) For standard concrete, the slump must be Class S3 (100 to 150 mm) or S4 (for spot samples taken from initial discharge, 140 to 230 mm).

(4) The aggregate for concrete must comply with BS EN 12620 : 2013.

(5) For self-compacting concrete, the slump flow class must be SF1 (550 to 650 mm) or SF2 (660 to 750 mm). The sand content must be greater than 45%.

(6) For fresh concrete, the macro-polymer fibres content must be measured in accordance with BS EN 14488-7 : 2006.

(7) The dosage rates of steel and polymer fibres defined in the Table 10 include 15% additional fibres and are designed to give the minimum required residual flexural tensile strength of concrete topping with steel or macro-polymer fibres.

(8) For fresh and hardened concrete, the steel fibres content must be measured in accordance with BS EN 14721 : 2005.

(9) Micro-polymer-fibre-only structural concrete toppings are not accepted on NHBC sites.

9.1.4 Precast, prestressed concrete beams are outside the scope of this Certificate and must be specified and designed by a suitably experienced and competent individual. A suitably experienced and competent individual must also design the concrete beam required for the floor in accordance with the principles of BS EN 1992-1-1 : 2004 and its UK National Annex, and CE marked/deigned in accordance with the principles of BS EN 15037-1 : 2008, and ensure that the natural frequency (f) of the precast prestressed concrete beam due to footfall(1) is greater than 4 Hertz (Hz) as defined below for each floor under the specified loading conditions:

(a) the precast, prestressed concrete beam must have a natural frequency greater than 4 Hz when loaded with full permanent action plus 0.1 x variable UDL action

(b) the natural frequency (f) in Hz of a simply supported precast, prestressed concrete beam under UDL loading is determined from equation: $f = 18/\Delta^{0.5}$, where Δ is the deflection of the precast prestressed concrete beam in mm for variable UDL action [as defined in item (a)] and permanent UDL actions.

(1) The vibration due to rhythmic activity (such as dancing) and external sources (such as building construction or rail traffic) must be designed to satisfy the requirements. However, assessment of such vibration is outside the scope of this Certificate.

9.1.5 The concrete topping above the start/end panels must be designed as a cantilever slab and must not exceed 178 and 300 mm respectively (see Figure 4).

9.1.6 The maximum length of the cantilevered slab from the top face of the precast, prestressed concrete beam must be 280 mm (see Figure 4).

9.1.7 The maximum distance of the concentrated load applied on the cantilever from the top face of the precast, prestressed concrete beam must be 188 mm [$300^{(1)} - 25^{(2)} + 5^{(3)} - 42^{(4)} - 50^{(5)} = 188$].

(1) Length of cantilever slab (see Figure 4).
(2) Width of plasterboard, skirting board and skim.
(3) Half of width of a 100 mm square plate (imposed concentrated load for residential buildings is assumed to be applied over a square plate not less than 100 by 100 mm).
(4) Thickness of plasterboard, skirting board and skim.

9.1.8 The selected structural concrete topping must be designed and installed strictly in accordance with this Certificate. The dosage rate for micro-polymer[(1)], macro-polymer and steel fibres must be in accordance with Table 10.

(1) Micro-polymer-fibre structural concrete toppings are not accepted on NHBC sites.

9.1.9 Where required, lateral restraint must be provided at ground floor level in accordance with the requirements of the national Building Regulations, BS 8103-1 : 2011 and *NHBC Standards* 2024.

9.1.10 Care must be taken in the overall design and construction of junctions between the floor and external, internal, and party walls, to limit excessive heat loss and air infiltration.

9.1.11 In locations where clay heave is anticipated, a greater void depth may be required to accommodate the possible expansion of the ground below the floor. In such cases where the risk of clay heave has been confirmed by geotechnical investigations, a total void of up to 300 mm (refer to the *NHBC Standards* 2024, Chapter 4.2 *Building near trees*) may be required as follows:

- high-volume change potential (300 mm total void)
- medium-volume change potential (250 mm total void)
- low-volume change potential (200 mm total void).

9.1.12 In England, Wales and Northern Ireland, floors will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.7 $W \cdot m^{-2} \cdot K^{-1}$ at any point and the junctions with walls are in accordance with the relevant requirements of *Limiting thermal bridging and air leakage : Robust construction details for dwellings and similar buildings* TSO 2002 or BRE Information Paper IP 1/06.

9.1.13 In Scotland, floors 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 and the floor is designed and constructed to BS 5250 : 2021. Additional guidance can be found in BRE Report BR 262 : 2002.

9.1.14 To minimise the risk of surface condensation at service penetrations, care must be taken to minimise gaps in the insulation layer.

9.1.15 The junction ψ-values given in Table 11 may be used in Standard Assessment Procedure (SAP) calculations or values can be modelled in accordance with the requirements and guidance in BRE Report BR 497 : 2016, BRE Information Paper IP 1/06 and the provisions in the documents supporting the national Building Regulations relating to competency to perform calculations, determine robustness of design/construction and limiting heat loss by air infiltration.

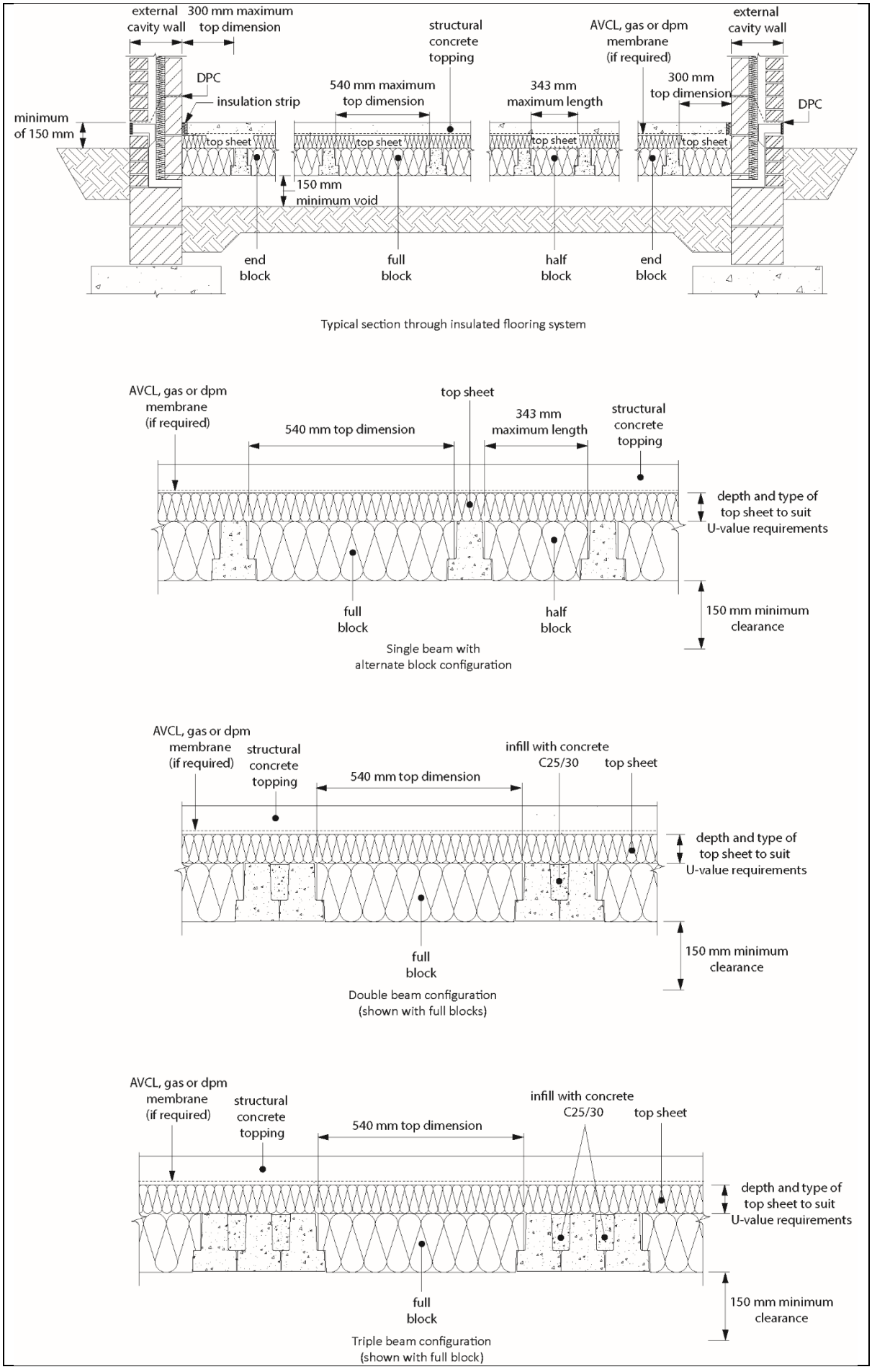
Table 11 Junction ψ values

Junction	Ref [1]	Ψ ($W \cdot m^{-1} \cdot K^{-1}$)
External wall with ground floor (normal)	E5	0.32[2]
Party wall with ground floor	P1	0.16[2]

(1) From SAP 2012, Table K1.

(2) Conservative defaults from SAP 2012.

Figure 4 Example beam and EPS block assemblies



9.1.16 To help minimise the risk of condensation, the void space beneath the lowest point of the floor construction must be at least 150 mm high, with provision for adequate through-ventilation in the form of ventilation openings provided in two opposing external walls. The ventilation openings must be sized at not less than 1500 $mm^2 \cdot m^{-1}$ run of external wall or 500 $mm^2 \cdot m^{-2}$ of floor area, whichever is greater. Where pipes are used to carry ventilating air, these must be at least 100 mm diameter.

9.1.17 To minimise the risk of interstitial condensation at junctions with external walls, specifiers must ensure that the wall insulation extends to at least 150 mm below the bottom of the EPS infill panel.

9.1.18 Where clay soil of low-, medium- or high-volume change potential exists, the final minimum void depth must be increased appropriately to prevent problems associated with heave. The sub-floor void must have good natural drainage or land drains must be provided to prevent standing water within the sub-floor void when this is below external ground level.

9.1.19 The ground beneath the floor must be free of topsoil and vegetation. Oversite concrete or other surface seal is not required, but material added to bring the solum to an even surface must be hard and dry.

9.1.20 Damp-proofing and ventilation arrangements must be in accordance with normal good practice (for example, by the provision of damp-proof sleeves to ventilators and adequate drainage of the sub-floor.

9.1.21 A continuous damp proof course (DPC) must be laid along the supporting wall below the precast, prestressed beam and block bearings in accordance with BS 8102 : 2009.

9.2 Installation

9.2.1 Installation instructions provided by the Certificate holder were assessed and judged to be appropriate and adequate.

9.2.2 Installation must be carried out in accordance with this Certificate and the Certificate holder's instructions. A summary of instructions and guidance is provided in Annex A of this Certificate.

9.2.3 Where two or more precast, prestressed concrete beams are placed side by side, eg beneath load bearing walls, the spaces between the beam webs must be in-filled with concrete with a minimum strength class of C25/30 to give unity of action.

9.2.4 The minimum bearing width to support the precast prestressed concrete beam is 90 mm in accordance with the principles of BS 8103-1 : 2011.

9.2.5 Electrical cables running within the EPS components must be enclosed in a suitable conduit, such as rigid PVC. The Certificate holder should be consulted for further advice, but such advice is outside the scope of this Certificate.

9.2.6 On sites which may be subject to emissions of gas or volatile organic compounds (VOCs), a suitably experienced and competent individual must assess the compatibility of the insulation with any potential emissions.

9.2.7 The floor must not be loaded by construction materials until the concrete toppings have reached their design strength.

9.2.8 The specified concrete topping must be poured carefully and not dropped from a height greater than 500 mm; concrete heaps must not be formed over 300 mm high.

9.2.9 Any components damaged during offloading, storage, handling and installation must be replaced before pouring the concrete

9.3 Workmanship

Practicability of installation was assessed by the BBA on the basis of the Certificate holder's information. To achieve the performance described in this Certificate, installation of the system must be carried out by a competent general builder, or contractor, experienced with this type of system.

9.4 Maintenance and repair

As the system is installed within the floor structure and has suitable durability, maintenance is not required.

10 Manufacture

10.1 The production processes for the product have been assessed, and provide assurance that the quality controls are satisfactory according to the following factors:

10.1.1 The manufacturer has provided documented information on the materials, processes, testing and control factors.

10.1.2 The quality control operated over batches of incoming materials has been assessed and deemed appropriate and adequate.

10.1.3 The quality control procedures and product testing to be undertaken have been assessed and deemed appropriate and adequate.

10.1.4 The process for management of non-conformities has been assessed and deemed appropriate and adequate.

10.1.5 An audit of each production location was undertaken, and it was confirmed that the production process was in accordance with the documented process, and that equipment has been properly tested and calibrated.

† 10.2 The BBA has undertaken to review 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.

11 Delivery and site handling

11.1 The Certificate holder has stated that the EPS components are delivered to site in packaging bearing the component name, the Certificate holder's name and batch number.

11.2 Delivery and site handing must be performed in accordance with the Certificate holder's instructions and this Certificate, including:

11.2.1 The EPS components are wrapped in polythene but are otherwise unprotected. Therefore, reasonable care must be taken during transit and storage to avoid damage.

11.2.2 The EPS components must be stacked on a flat base, clear of the ground, protected against prolonged direct sunlight and secured to avoid wind damage. Care must be taken to avoid contact with organic solvents.

11.2.3 The EPS components must not be exposed to flame or ignition sources. Careful consideration must also be given to the management of fire risk when in storage.

ANNEX A – SUPPLEMENTARY INFORMATION †

Supporting information in this Annex is relevant to the system but has not formed part of the material assessed for the 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.

UKCA marking

The Certificate holder has taken the responsibility of UKCA marking the EPS components in accordance with Designated Standards European Standard EN 15037-4 : 2010 and EN 13163 : 2012.

Management Systems Certification for production

The management system of S and B EPS Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by the BBA (Certificate 03/Q001).

Additional information on installation

A.1 Details of example cross sections for the S and B Warmbeam Top Sheet System are shown in Figure 4.

Site preparation

A.2 The precast, prestressed beams are laid in the positions shown on the floor plan. Each precast, prestressed beam is tightly placed against the beam spacing blocks.

Procedure

A.3 Normal precautions for handling EPS materials should be taken to avoid damaging the components during offloading, storage, handling and installation.

A.4 The precast, prestressed concrete beams are positioned at the approximate locations and centres shown on the approved drawings.

A.5 The start panels are positioned against the inside face of the wall. The adjacent beam is then moved into position to support the profiled edge of the panel. The flat face of the panel provides a tight friction fit against the wall.

A.6 EPS infill panels may be cut to accommodate varying beam lengths but must be at least 300 mm long and should be positioned at the floor edges. The widths of the start/end panels are 178 and 300 mm respectively.

A.7 The remaining concrete beams are installed in line with the approved layout drawing using the relevant concrete closure blocks or a suitable gauge to ensure the correct centres. The concrete closure blocks are bedded in mortar.

A.8 EPS infill panels may be cut with a handsaw where required. Offcuts greater than 300 mm may be used elsewhere in the floor.

A.9 EPS Infill panels are then used to complete the floor zone at the normal beam spacing.

A.10 Gaps in non-standard beam spacing may be filled using Make-up panels to a maximum of 440 mm; these can be cut on site to the required dimension.

A.11 Finally, End infill panels are installed to complete the infill installation.

A.12 The EPS top sheet insulation is laid over the floor and cut with a handsaw to accommodate service penetrations and part sheet widths where necessary. Small offcuts can be used to seal around service penetrations.

A.13 If required a gas barrier membrane can be installed, as per the manufacturer's instructions.

A.14 If specified, underfloor heating pipes can be installed. These can be secured to the top sheet insulation material using standard pipe clips. Care must be taken not to puncture any membranes if installed.

A.15 Insulation strips may be installed if required to prevent cold bridging.

A.16 If steel mesh is specified, spacers should be positioned over spreader plates, minimum four per m² and minimum 50 by 50 mm. These should be installed to position the steel mesh at the correct level. Spacers for supporting steel mesh reinforcement should be located on spreader plates over the top sheets. This will reduce the risk of accidental penetration of the EPS during the construction phase and any resulting misalignment of the reinforcement within the structural concrete topping.

A.17 Should any other cutting be required, the advice of the Certificate holder should be sought, but such advice is outside the scope of this Certificate.

A.18 Although they can withstand light foot traffic, care should still be taken not to walk unnecessarily over the installed EPS infill panels. If a temporary working platform is required, the panels should be covered with a suitably rigid board. To avoid damage to the panels, the structural concrete topping should be laid as soon as possible after the panels have been installed.

A.19 When wheelbarrows are used, planks must be placed to spread the wheel load to the concrete beams. Spot boards must be used when tipping and shovelling.

A.20 The structural concrete topping is placed and compacted. Provision should be made for a suitable concrete finish to be achieved, preferably by operatives not standing on the panels or boards, eg by the use of a self-levelling concrete topping.

A.21 The structural concrete topping should be in accordance with BS 8500-1 : 2023, BS 8500-2 : 2023 and BS EN 206 : 2013, manufactured in plants covered by the Quality Scheme for Ready Mixed Concrete (QSRMC) scheme and laid by personnel with the appropriate skills and experience.

A.22 Throughout the installation process, due consideration must be given to the relevant health and safety regulations.

A.23 To prevent concrete ingress where a VCL, gas barrier membrane or DPM is not placed above the top sheets, the procedures described below should be followed:

- the joints between the top sheets, or around service openings, should be taped, with minimum width 75 mm, and/or
- any gaps between insulation top sheets or around service openings, visible prior to installing the concrete, must be filled with either expanding foam or strips of insulation.

A.24 The following good practice should be followed throughout the installation process:

- cube compressive strength and slump tests for concrete topping
- limitation of slump for standard concrete and slump flow for self-compacting concrete
- concrete topping not to be poured below 5°C
- the maximum temperature at which the concrete should be placed is 30°C and decreasing
- concrete should not be poured during rainfall
- all the ingredients including the fibres should be added at the plant mixer.

To prevent shrinkage cracks:

- joints should be incorporated into the slab and appropriate joints between the opening of two adjacent rooms to be provided. Inclusion of joints must not compromise structural performance of the concrete topping
- where the internal walls are built through the slab, a joint should be formed across the door threshold where the wall separates the two rooms
- an aspect ratio greater than 2:1 should be avoided
- a compressible insulating material around the perimeter of the plot to be provided
- avoid the use of high shrinkage potential aggregate
- the w/c ratio should not be increased beyond the limits specified in BS 8500-1 : 2015, BS 8500-2 : 2015 and BS EN 206 : 2013
- steel mesh or loose bars should be placed across re-entrant corners and any openings greater than 500 x 500 mm
- consideration should be given to the provision of an appropriate detail (eg crack inducer) on external walls at the position of porches.

Bibliography

BRE Information Paper IP 1/06, 2006 Edition, March 7, 2006, *Assessing the effects of thermal bridging at junctions and around openings*

BRE Report BR 262 : 2002 *Thermal insulation : avoiding risks*

BRE Report BR 443 : 2019 *Conventions for U-value calculations*

BRE Report BR 497 : 2016 *Conventions for calculating linear thermal transmittance and temperature factors*

BS 4483 : 2005 *Steel fabric for the reinforcement of concrete — Specification*

BS 5250 : 2021 *Management of moisture in buildings — Code of practice*

BS 8102 : 2009 *Code of practice for protection of below ground structures against water from the ground*

BS 8103-1 : 2011 *Structural design of low-rise buildings — Code of practice for stability, site investigation, foundations, precast concrete floors and ground floor slabs for housing*

BS 8500-1 : 2023 *Concrete — Complementary British Standard to BS EN 206 — Method of specifying and guidance for the specifier*
BS 8500-2 : 2023 *Concrete — Complementary guidance to BS EN 206 — Specification for constituent materials and concrete*

BS EN 206 : 2013 + A1 : 2021 *Concrete — Specification, performance, production and conformity*

BS EN 1990 : 2002 + A1 : 2005 *Eurocode : Basis of structural design*
NA to BS EN 1990 : 2002 + A1 : 2005 UK National Annex to Eurocode : *Basis of structural design*

BS EN 1991-1-1 : 2002 *Eurocode 1 : Actions on structures — General Actions — Densities, self-weight, imposed loads for buildings*
NA to BS EN 1991-1-1 : 2002 UK National Annex to *Eurocode 1 : Actions on structures — General Actions — Densities, self-weight, imposed loads for buildings*

BS EN 1992-1-1 : 2004 + A1 : 2014 *Design of concrete structures — General rules and rules for buildings , bridges and civil engineering structures*
NA to BS EN 1992-1-1 : 2004 + A1 : 2014 UK National Annex to *Eurocode 2* : *Design of concrete structures — General rules and rules for buildings*

BS EN 12620 : 2013 *Aggregates for concrete*

BS EN 13163 : 2012 + A2 : 2016 *Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification*

BS EN 14488-7 : 2006 *Testing sprayed concrete — Fibre content of fibre reinforced concrete*

BS EN 14721 : 2005 + A1 : 2007 *Test method for metallic fibre concrete — Measuring the fibre content in fresh and hardened concrete*

BS EN 15037-1 : 2008 *Precast concrete products — Beam-and-block floor systems — Beams*
BS EN 15037-4 : 2010 + A1 : 2013 *Precast concrete products — Beam-and-block floor systems — Expanded polystyrene blocks*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

BS EN ISO 10211 : 2017 *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

BS EN ISO 13370 : 2017 *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

BS EN ISO 13788 : 2012 *Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods (ISO13788:2012)*

TSO 2002 : *Limiting thermal bridging and air leakage : Robust construction details for dwellings and similar buildings*

Conditions

1 This Certificate:

- relates only to the product 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
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

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.

3 This Certificate will be displayed on the BBA website, and the Certificate Holder is entitled to use the Certificate and Certificate logo, provided that the product 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.

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

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:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product
- actual installations of the product, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to UKCA marking and CE marking.

6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product which is contained or referred to in this Certificate is the minimum required to be met when the product 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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