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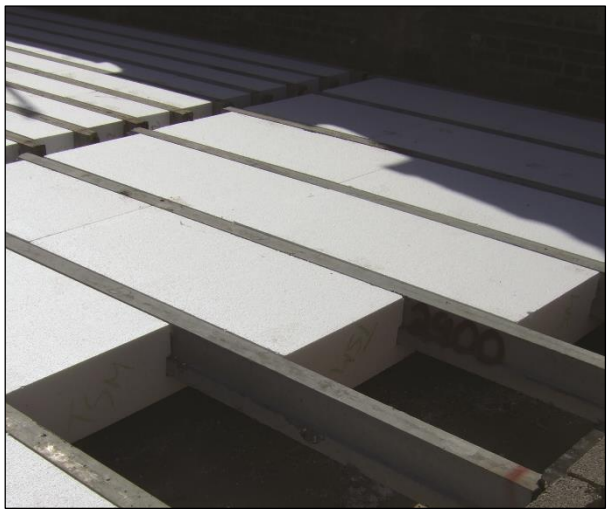
Agrément Certificate
17/5431
Product Sheet 1

S AND B FLOORING SYSTEMS

S AND B WARM BEAM, AND S AND B WARM BEAM PLUS

This Agrément Certificate Product Sheet(1) relates to S and B Warm Beam, and S and B Warm Beam Plus, expanded polystyrene (EPS) blocks for use in conjunction with precast concrete beams, concrete perimeters, concrete closure blocks and steel-mesh-reinforced structural concrete toppings to a given specification, to construct insulated, suspended ground floors in residential and commercial buildings within the load criteria specified in this Certificate.

(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

Structural performance — the system has adequate strength to resist the design loads and transmit the dead and imposed floor loads. The EPS blocks have adequate strength to carry the short-term loads likely to be encountered during construction of the floor but make no further load-bearing contribution once the steel-mesh-reinforced structural concrete topping has reached full strength (see section 6).
Thermal performance — the EPS blocks can enable a floor to meet the design U values specified in the national Building Regulations (see section 7).
Condensation risk — the EPS blocks can contribute to limiting the risk of condensation (see section 8).
Durability — the system components, including the EPS insulation, concrete beams and structural concrete topping reinforced with steel mesh, will have a design life equivalent to that of the building in which they are incorporated (see section 10).

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 First issue: 20 June 2017

Brian Chamberlain
Head of Technical Excellence

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.

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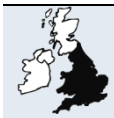
Regulations

In the opinion of the BBA, S and B Warm Beam, and S and B Warm Beam Plus, 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(1)**	**Loading**
Comment:		The system can sustain and transmit dead and imposed floor loads to the ground. See sections 6.7 to 6.15.
Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The system can contribute to limiting the risk of condensation. See sections 8.1 and 8.4 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The system can contribute to satisfying this Requirement. See section 7.3.
Requirement:	**7**	**Materials and workmanship**
Comment:		The system is acceptable. See section 10 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 system can contribute to satisfying these Regulations. See section 7.3 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		The system can contribute to a construction satisfying this Regulation. See section 10 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to 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)(2). See sections 6.7 to 6.15 of this Certificate.
Standard:	3.15	Condensation
Comment:		The system can contribute to limiting the risk of condensation, with reference to clauses 3.15.1(1)(2), 3.15.4(1)(2) and 3.15.5(1)(2). See sections 8.1 and 8.5 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Comment:		The system can contribute to satisfying the requirements of this Standard, with reference to clauses 6.1.1(1), 6.1.6(1) and 6.1.2(2). See section 7.3 of this Certificate.
Standard:	6.2	Building insulation envelope
Comment:		The system will contribute to meeting this Standard with reference to clauses 6.2.1(1)(2), 6.2.3(1), 6.2.4(1)(2), 6.2.5(2), 6.2.6(2) and 6.2.13(1). See section 7.3 of this Certificate
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The system can contribute to meeting 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 stainability as defined in this Standard, with reference to clauses 7.1.4[(1)] [Aspects 1[(1)] and 2[(1)]], 7.1.6[(1)(2)] [Aspects 1[(1)(2)] and 2[(1)]], 7.1.7[(1)] [Aspect 1[(1)]], 7.1.9[(2)] [Aspect 1[(2)]] and 7.1.10[(2)] [Aspect 1[(2)]]. See section 7 of this Certificate. (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 system is acceptable. See section 10 and the *Installation* part of this Certificate.
Regulation:	**29**	**Condensation**
Comment:		The system can contribute to limiting the risk of interstitial condensation. See section 8.1 of this Certificate.
Regulation:	**30**	**Stability**
Comment:		The system can sustain and transmit dead and imposed floor loads to the ground. See sections 6.7 to 6.15 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Regulation:	**40(2)**	**Target carbon dioxide emission rates**
Comment:		The system can contribute to satisfying these Regulations. See section 7.3 of this Certificate.

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

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

See sections: 1 *Description* (1.2), 3 *Delivery and site handling* (3.2, 3.5 and 3.7) and *14 Procedure* (14.3 to 14.6 and 14.8) of this Certificate.

Additional Information

NHBC Standards 2017

NHBC accepts the use of S and B Warm Beam, and S and B Warm Beam Plus, provided they are installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 5.2 *Suspended ground floors.*

CE marking

The Certificate holder has taken the responsibility of CE marking the EPS products in accordance with harmonised European Standard BS EN 15037-4: 2010.

Technical Specification

1 Description

1.1 S and B Warm Beam, and S and B Warm Beam Plus comprise a range of profiled, expanded polystyrene (EPS) blocks, for use in conjunction with precast concrete beams, concrete closure blocks, concrete perimeters and steel-mesh-reinforcement structural concrete toppings.

1.2 The blocks have the nominal characteristics shown in Table 1 and Figures 1 and 2 of this Certificate.

Table 1 Warm Beam and Warm Beam Plus product range

Product reference	Product name	For use with: concrete beam depth (mm)	Block dimensions		
			Width at top face (mm)	Overall width (mm)	Overall thickness (mm)
A150	150 beam single max	150	540	725	223 to 370
B150	150 beam double max	150	540	850	223 to 370
C150	150 beam triple max	150	540	975	223 to 370
D150	150 beam single narrow	150	215-270	400-470	223 to 370
E150	150 beam double narrow	150	215-270	525-660	223 to 370
F150	150 beam triple narrow	150	215-270	650-820	223 to 370
A225	225 beam single max	225	540	740	283 to 370
B225	225 beam double max	225	540	895	283 to 370
C225	225 beam triple max	225	540	1050	283 to 370
D225	225 beam single narrow	225	215-270	400-470	283 to 370
E225	225 beam double narrow	225	215-270	525-660	283 to 370
F225	225 beam triple narrow	225	215-270	650-820	283 to 370
G150	150 beam starter block	150	300	465	223 to 370
H150	150 beam finish block	150	300	300	223 to 370
G225	225 beam starter block	225	300	465	283 to 370
H225	225 beam finish block	225	300	300	283 to 370

Figure 1 Warm Beam Plus blocks for use with 150 mm deep beams

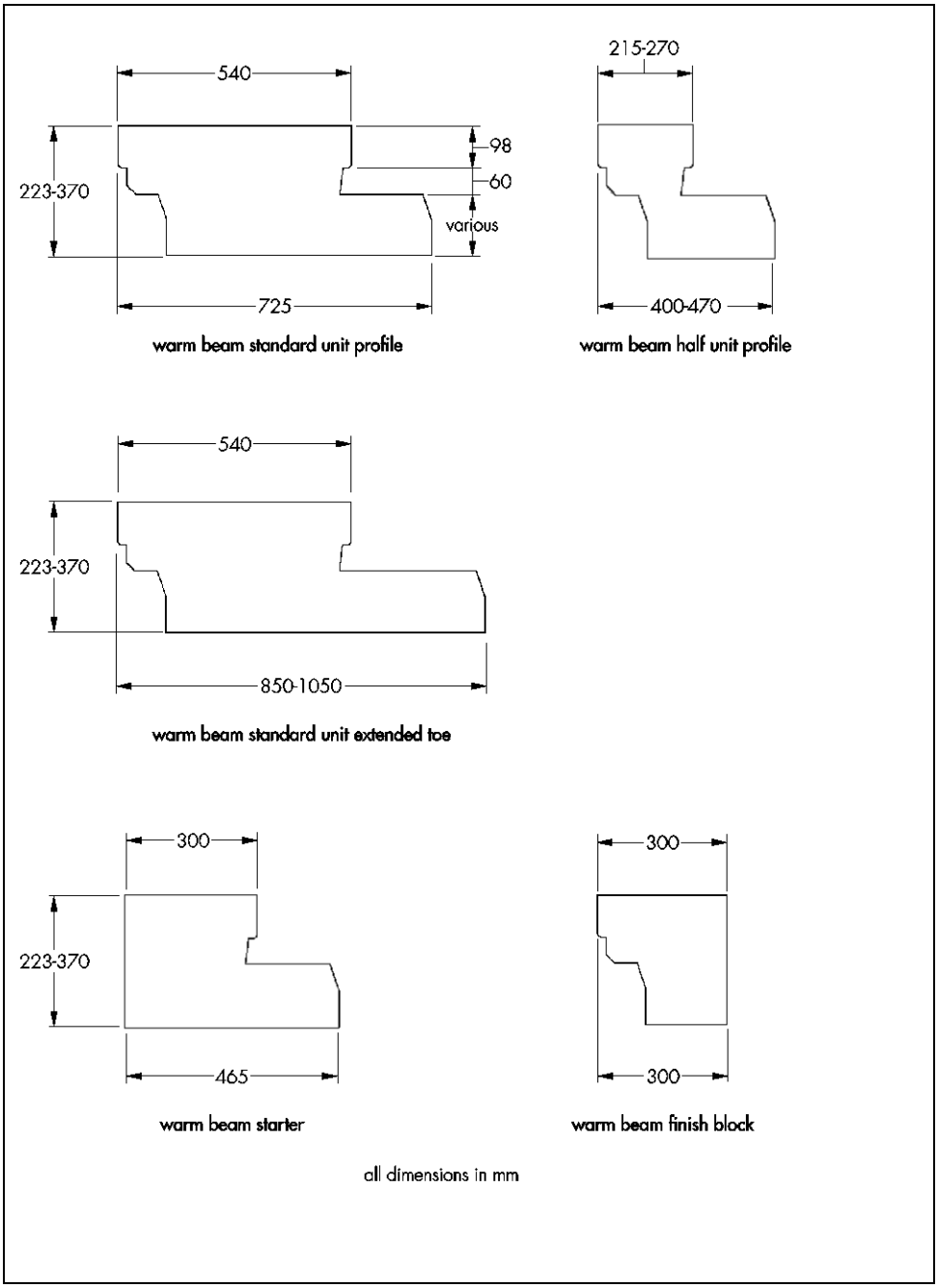
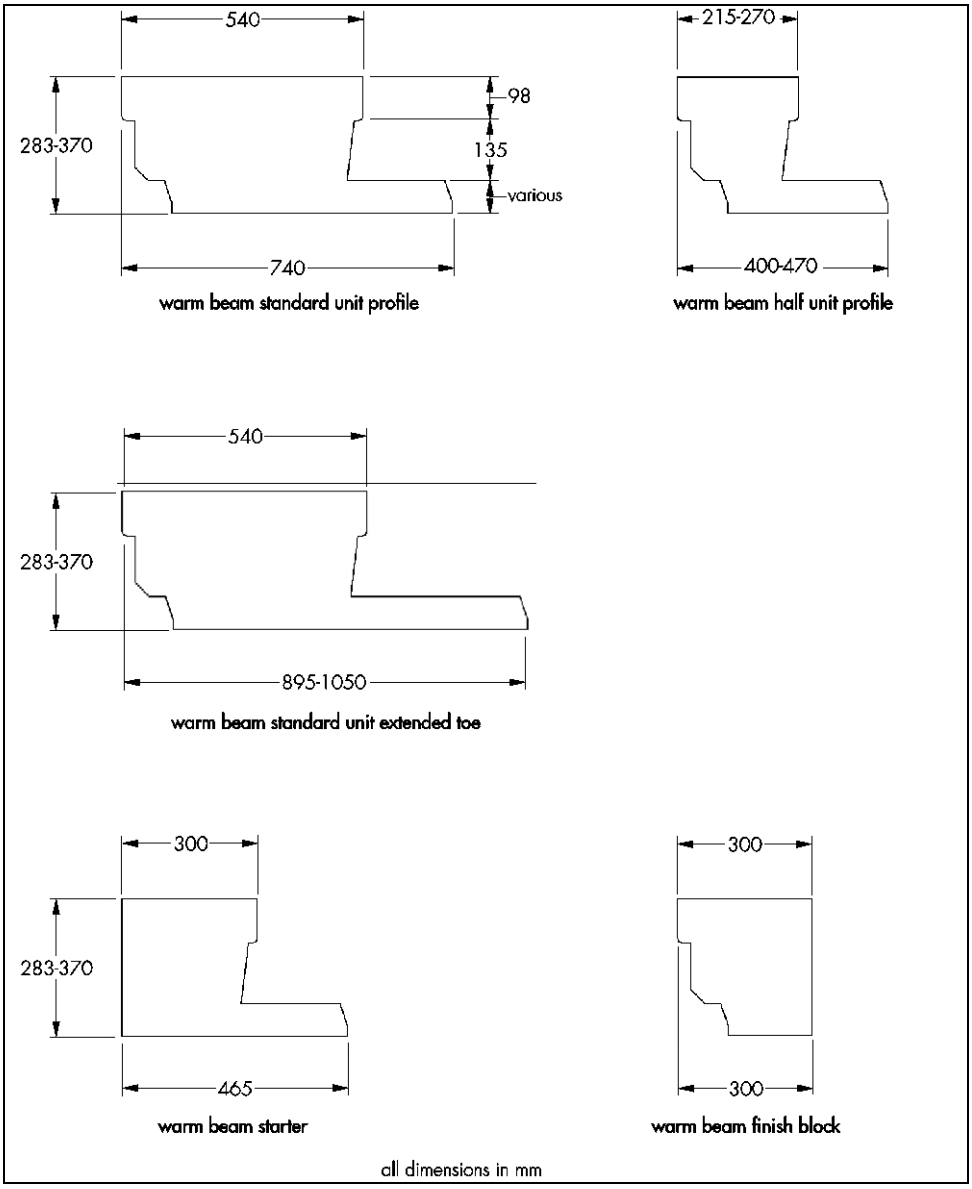


Figure 2 Warm Beam and Warm Beam Plus blocks for use with 225 mm deep beams



1.3 The blocks are supplied as standard in 1200 mm and 640 mm lengths and can be cut on site as required to suit various beam lengths, subject to a minimum length of 320 mm (see section 6.4). The associated thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$) $\lambda_{90/90}$ values are:

- S and B Warm Beam EPS blocks (white EPS100E) 0.036
- S and B Warm Beam Plus EPS blocks (grey EPS100E) 0.030

1.4 Subject to order size, EPS blocks can be manufactured to suit different beam profiles, widths and heights from those shown in Figure 4. Excluding beam and EPS block tolerances, the nominal toe gap width should be 4 mm, the nominal bearing width should be 20 mm and the nominal gap between the top edge of the EPS block and the beam face should be 3 mm (see also sections 6.5, 7.2 and 14.7 of this Certificate).

1.5 The declared level of compression stress at 10% deformation and the mechanical resistance to concentrated load of the blocks is 100 kPa [CS(10) 100] and 1.5 kN (type R1 and class R1a) in accordance with BS EN 13163 : 2012 and BS EN 15037-4 : 2010, respectively.

1.6 Moisture diffusion of the blocks' 100 kPa coefficient (μ) is between 30 to 70, in accordance with BS EN 13163 : 2012.

1.7 The Certificate holder's specifications for ancillary items used in conjunction with the EPS blocks include:

- pre-stressed concrete beams of the type and size shown in Figure 4 of this Certificate, CE marked and designed in accordance with BS EN15037-1 : 2008. The pre-stressed concrete beams should also be designed in accordance with BS EN 1992-1-1 : 2004 and its UK National Annex, BS EN 206 : 2013, BS 8500-1 : 2015 and BS 8500-2 : 2015. See sections 6.11 to 6.15 of this Certificate
- steel-mesh-reinforced structural concrete topping — to one of the specifications given in Table 2, depending on the proposed floor usage
- concrete perimeter and closure blocks manufactured in accordance with BS EN 771-3 : 2011 with a minimum compressive strength of 7.3 N·mm² (see Figure 3 for detail of concrete closure blocks).

Figure 3 Typical concrete closure blocks

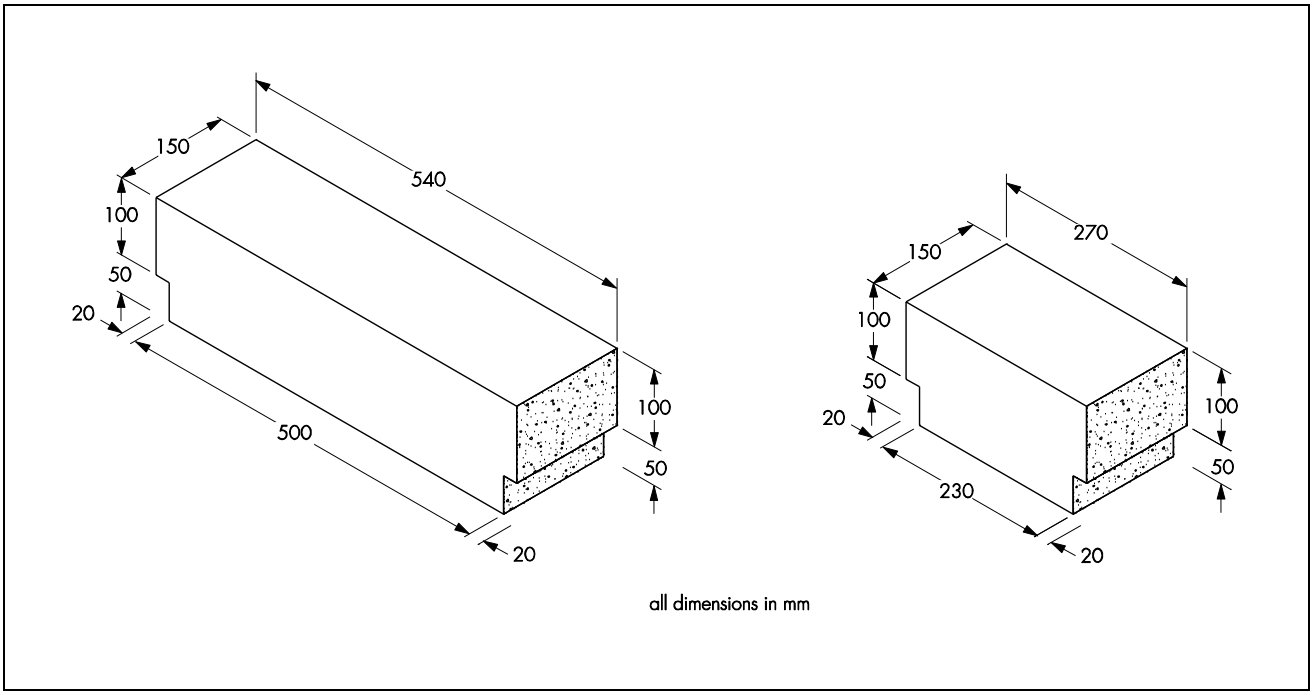
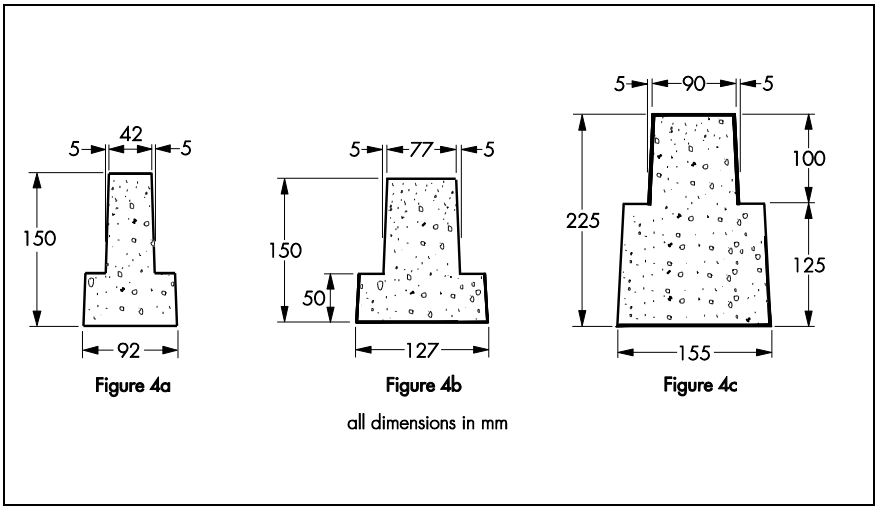


Figure 4 Typical concrete beam section (dimensions in mm)



1.8 Ancillary items outside the scope of this Certificate include:

- Gas resistant barrier, where required
- Damp-proof membranes (dpm) with third-party approval
- Insulation strips — for perimeter of steel-mesh-reinforced structural concrete toppings.

2 Manufacture

2.1 S and B Warm Beam and S and B Warm Beam Plus blocks are cut to the required profile (by a computer-controlled hot-wire cutter) from moulded blocks of EPS manufactured in accordance with BS EN 13163 : 2012.

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.

2.3 The management system of S and B EPS Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001: 2008 by the BBA (Certificate No 03/Q001).

3 Delivery and site handling

3.1 The blocks are delivered to site wrapped in plastic film. Each block is marked with the Certificate holder's product reference (see Table 1) and, if requested, the customer's own reference code.

3.2 The blocks should be handled with care during off loading, storage and installation. Particular attention will be required for blocks with long toe lengths.

3.3 The blocks should be stacked on a flat base and protected from direct sunlight and high winds.

3.4 Contact with solvents and organic-based materials should be avoided.

3.5 The blocks must not be exposed to flame or ignition.

3.6 Care must be taken when unloading, stacking and storing the concrete beams to prevent damage. They should be lifted as near as possible to each end and must remain the correct way up at all times. On site, concrete beams must be stored on timber bearers on suitable level ground.

3.7 The concrete beams should be stacked horizontally, one above the other. Timber bearers should be placed close to the beam ends (within 300 mm) and vertically aligned.

3.8 For storage periods exceeding three months, the concrete beams should be kept under cover.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on S and B Warm Beam and S and B Warm Beam Plus.

Design Considerations

4 General

4.1 S and B Warm Beam and S and B Warm Beam Plus blocks, when used in conjunction with concrete beams and steel-mesh-reinforced concrete topping to the Certificate holder's specification (see section 6.8) and in accordance with the recommendations of this Certificate, are effective in forming insulated, suspended ground floors for use in residential and commercial buildings.

4.2 An appropriately qualified engineer should perform a site-specific assessment/design to ensure that:

- the EPS blocks, concrete beam and steel-mesh-reinforced structural concrete topping are suitable for the intended use, based on the recommendations contained in this Certificate and the relevant parts of BS EN 15037-1 : 2008 (see section 6.10) and BS EN 15037-4 : 2010
- the floor is not loaded with construction materials until the steel-mesh-reinforced structural concrete topping has reached its design strength
- the floor vibration due to footfall exceeds the natural frequency of 4.0 Hz. The vibration due to rhythmic activity (such as dancing) and external sources (eg building construction or rail traffic) are excluded from the system.

4.3 A void of at least 150 mm deep must be provided for the system between the underside of the floor and the ground surface.

4.4 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 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)

4.5 Electrical cables running below the EPS blocks should be enclosed in a suitable conduit, such as rigid PVC. The Certificate holder should be consulted for further advice.

4.6 The system is suitable for use in floors with underfloor heating systems. Care must be taken to ensure that the minimum design thickness of steel-mesh-reinforced structural concrete topping is maintained, eg above pipes.

4.7 Lateral restraint should be provided at ground floor level in accordance with the requirements of the national Building Regulations, BS 8103-1: 2011 and *NHBC Standards* 2017.

4.8 Floors constructed using the blocks are not suitable for use in ground floors built above basements.

5 Practicability of installation

The system should be installed by contractors/builders experienced with this type of flooring system.

6 Structural and stability

6.1 An appropriately qualified engineer must ensure that the concrete beams and steel-mesh-reinforced structural concrete topping are suitable for their intended use.

EPS blocks

6.2 The EPS blocks provide a permanent formwork to the steel-mesh-reinforced structural concrete topping. The blocks make no further contribution to the long-term structural performance of the floor, once the steel-mesh-reinforced structural concrete topping has been placed and has obtained its full design strength.

6.3 Subject to compliance with the design and installation requirements of this Certificate, the EPS blocks have adequate strength to carry the normal temporary loads expected during the construction phase of the floor system, including the weight of the steel-mesh-reinforced structural concrete topping when poured.

6.4 EPS blocks (minimum 320 mm long), to accommodate varying beam lengths, should be positioned at the floor edges. Starter and finished blocks should not be more than 300 mm wide at the top. See section 14.5.

6.5 The EPS blocks are designed to have a normal bearing of 20 mm, with a 5 mm allowance for misalignment and manufacturing tolerances in the straightness of the beam. A minimum bearing width of 15 mm must therefore be ensured.

6.6 Spacers for supporting steel mesh reinforcement should be located along the beams or on spreader plates over the EPS blocks. This will reduce the risk of accidental penetration of the EPS during the construction phase and resulting misalignment of the reinforcement within the structural concrete topping depth.

Structural concrete toppings reinforced with steel mesh

6.7 The structural concrete topping should be in accordance with BS 8500-1 : 2015, BS 8500-2 : 2015 and BS EN 206 : 2013, manufactured in plants covered by the QSRMC scheme (Quality Scheme for Ready Mixed Concrete) and laid by personnel with the appropriate skills and experience.

6.8 Steel mesh and concrete depth should be sized and designed according to BS EN 1990 : 2002, BS 1991-1-1 : 2002 and BS EN 1992-1-1 : 2004 and their UK National Annexes. See Table 2 of this Certificate for specification of concrete and steel mesh size for domestic and communal areas in blocks of flat and offices (for permitted loads, see Table 3 of this Certificate). The maximum aggregate size is 10 mm. Start and end panels must be designed as a cantilever slab (see also section 6.4) and must not exceed 300 mm.

Table 2 Steel-mesh-reinforced structural concrete topping specifications[(1)(2)(3)]

Use	Specification
Single-family dwellings	60 mm thick (overall concrete thickness above the services), C28/35 concrete reinforced with one layer of A142 steel mesh located at mid-depth of concrete slab (cover to reinforcement steel mesh 27 mm)
Single-family dwellings and communal areas in blocks of flats and offices	75 mm thick (overall concrete thickness above the services), C25/30 concrete reinforced with one layer of A142 steel mesh located at mid-depth of concrete slab (cover to reinforcement steel mesh 34 mm)

(1) The aggregate for concrete must comply with BS EN 12620 : 2002.
(2) Workability of the concrete should be selected as appropriate for the intended installation method, in accordance with BS 8500-1 : 2015 and BS EN 206 : 2013.
(3) Steel mesh should be in accordance with BS 4483 : 2005 with a characteristic yield strength (fyk) of 500 $N \cdot mm^{-2}$.

Table 3 Imposed and partition loads

Description	Maximum characteristic loads for single-family dwellings	Maximum characteristic loads for communal areas in blocks of flats and offices
Imposed uniformly distributed load (UDL) ($kN \cdot m^{-2}$)	1.5[(1)]	3.0[(1)]
Imposed concentrated load (kN)	2.0[(1)(2)]	4.0[(1)(2)]
Line load partition parallel and perpendicular to the beam ($kN \cdot m^{-1}$)	3.0[(3)]	3.0[(3)]
Allowance for moveable partition ($kN \cdot m^{-2}$)	1.0[(3)]	1.0[(3)]

(1) Imposed concentrated load must not be combined with the uniformly distributed load, imposed load or other variable actions.
(2) Imposed concentrated load is assumed to be applied over a square plate of area not less than 50 mm by 50 mm.
(3) Moveable partition loads must not be combined with line load partition walls.

6.9 The maximum distance of the concentrated load applied on the cantilever from the top face of the beam does not exceed 233 mm (300(1)—42(2)—25(3) = 233).

(1) Length of cantilever slab (see Figure 5).
(2) Width of plasterboard, skirting board and skim.
(3) Half of width of a 50 mm square plate (imposed concentrated load for residential buildings is assumed to be applied over a square plate of area not less than 50 by 50 mm).

Precast concrete beams

6.10 The EPS blocks are for use with self-bearing pre-stressed concrete beams (of normal weight concrete) which provide the final strength of the floor system independently of any other constituent part of the floor system.

6.11 An appropriately qualified engineer must ensure that the following criteria are met:

- the pre-stressed concrete beams must be designed in accordance with BS EN 1992-1-1 : 2004 and its UK National Annex, by an appropriately qualified engineer to ensure that the beams are adequate to resist the applied loading
- the proposed pre-stressed concrete beam must be CE marked and manufactured and designed in accordance with the requirements of BS EN 15037-1 : 2008
- the natural frequency of the concrete beam used in the test assemblies due to footfall(1) is greater than 4 Hz, as defined below:
  (a) The concrete beam should have a natural frequency greater than 4 Hz when loaded with full dead load plus 0.1 x imposed load (UDL).
  (b) The natural frequency of a simply supported concrete beam under UDL loading is determined from either equation (A) or (B), shown below:

  Equation (A): $f = 18/\delta^{0.5}$
  Equation (B): $f = \Pi/2(EI/mL4)^{0.5}$

  Where:
  δ is the deflection of the concrete beam in mm for UDL.
  EI is the dynamic flexural rigidity of the member (Nm^2).
  m is the effective mass supported by the concrete beam loaded in kg/m
  L is the span of the member (m)

- the serviceability deflection limit of the proposed concrete beam must be in accordance with BS EN 1992-1-1 : 2004, as summarised in Table 4 of this Certificate.

Table 4 Deflection limitation of pre-stressed concrete beams

Description	Limit for deflection
Camber at transfer of pre-stressed force under the self-weight of the beam	span/250
Deflection at application of finishes (permanent dead loads)	span/250
Deflection for long-term under quasi-permanent loads (M_{QP})(1) measured below the level of the supports after losses of the pre-stress force and the effect of creep in the modulus of elasticity of the concrete beam ($E_{c,eff}$)(2)	span/250
Movement due to quasi-permanent loads after application of finishes	span/500

(1) M_{QP} is the moment under the quasi-permanent load combination (refer to equation 6.16a of BS EN 1990 : 2002).
(2) Effective modulus of elasticity of concrete obtained from equation $E_{cm}/(1+\psi)$, where ψ is the long-term creep coefficient of the concrete beam and assumed to be equal to 2. The value of E_{cm} for limestone and sandstone aggregates should be reduced by 10% and 30% respectively.

6.12 The minimum bearing width to support the concrete beam is 90 mm in accordance with BS EN 8103-1 : 2011.

6.13 The maximum effective span of the concrete beam (assumed to be a simply supported and self-bearing beam) must be calculated using the equations from BS EN 1990 : 2002 (6.14a and 6.10, or the less favourable equations in 6.10a and 10b). The lowest effective span obtained from these equations will be considered to be the maximum effective span of the concrete beam.

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

6.15 The concrete beam is self-bearing and no account must be made for possible composite action between the concrete beams and the EPS blocks or the steel-mesh-reinforced concrete topping.

7 Thermal performance

7.1 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, should be calculated to BS EN ISO 13370 : 2007 and BRE Report 443 : 2006.

7.2 A floor deck U value (from inside to the underfloor void) will depend significantly on the types and number of precast concrete beams and EPS infill blocks. The thermal resistance of each beam and EPS configuration should be numerically modelled to BS EN ISO 10211: 2007 and BS EN 15037-4: 2010 using a design toe gap width of 9 mm. 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 7.1.

7.3 Example floor U values given in Table 5 indicate that the system can enable a floor to meet, or improve upon, design floor U values of between 0.13 $W \cdot m^{-2} \cdot K^{-1}$ and 0.25 $W \cdot m^{-2} \cdot K^{-1}$ specified in the documents supporting the national Building Regulations.

Table 5 Example floor U value(1) for a single beam configurations(2) ($W \cdot m^{-2} \cdot K^{-1}$)

Beam option	**p/a ratio m/m²**	**White EPS 100E (S & B Warm Beam)** with 223 mm block	**Grey EPS 100E (S & B Warm Beam Plus)** with 370 mm block
92 mm x 150 mm (refer to Figure 4a)	0.4	0.18	0.097
	0.6	0.19	0.10
	0.7	0.19	0.10
	0.9	0.20	0.10
127mm x 150 mm (refer to Figure 4b)	**p/a ratio m/m²**	**White EPS 100E (S & B Warm Beam)** with 223 mm block	**Grey EPS 100E (S & B Warm Beam Plus)** with 370 mm block
	0.4	0.19	0.098
	0.6	0.20	0.10
	0.7	0.20	0.10
	0.9	0.21	0.10
155mm x 225 mm (refer to Figure 4c)	**p/a ratio m/m²**	**White EPS 100E (S & B Warm Beam)** with 283 mm block	**Grey EPS 100E (S & B Warm Beam Plus)** with 370 mm block
	0.4	0.20	0.12
	0.6	0.21	0.12
	0.7	0.22	0.13
	0.9	0.22	0.13

(1) These calculations are in accordance with sections 7.1 and 7.2 of this Certificate and assume:
- the beam λ is 2.0 $W \cdot m^{-1} \cdot K^{-1}$ and the 60 mm steel-mesh-reinforced 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 : 2006.

(2) Configuration used: 100% single beams at full centres.

Junction ψ-values

7.4 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.

7.5 The junction ψ-values given in Table 6 may be used in SAP calculations, or values can be modelled in accordance with the requirements and guidance in BRE Report BR 497 : 2007, 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 6 Junction psi values

Junction	Ψ ($Wm^{-1}·K^{-1}$)
External wall with ground floor (normal) – E5(1)	0.32(2)
Party wall with ground floor – P1(1)	0.16(2)

(1) Refer to Standard Assessment Procedure (SAP) 2012 version 9.92.
(2) Conservative defaults from SAP 2012.

8 Condensation risk

Interstitial condensation

8.1 Floors will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011 and this Certificate

8.2 To help minimise the risk of condensation, the void space beneath the lowest point of the floor construction should 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 should be sized at not less than 1500 $mm^2·m^{-1}$ run of external wall or 500 $mm^2·m^{-2}$ of floor area, whichever is greater. Where pipes are used to carry ventilating air, these should be at least 100 mm diameter.

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

Surface condensation

8.4 Floors will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.7 $W·m^{-2}·K^{-1}$ 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 IP1/06.

8.5 Floors will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 1.2 $W·m^{-2}·K^{-1}$ at any point and when designed and constructed to BS 5250 : 2011, Annex F. Further guidance may be obtained from BRE Report BR 262 : 2002

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

9 Maintenance

The system is designed to be installed within the floor structure; therefore, it does not require maintenance.

10 Durability

10.1 Suspended ground floors incorporating S and B Warm Beam and S and B Warm Beam Plus blocks will have adequate durability for the design life of the building, when designed and installed in accordance with the requirements of this Certificate.

10.2 The exposure condition beneath a suspended ground floor over a ventilated void and soil is class XC1, in accordance with BS EN 1992-1-1 : 2004. The concrete beam will have adequate durability for this exposure condition.

10.3 The concrete topping reinforced with steel mesh will have adequate durability for exposure class XC1.

11 Reuse and recyclability

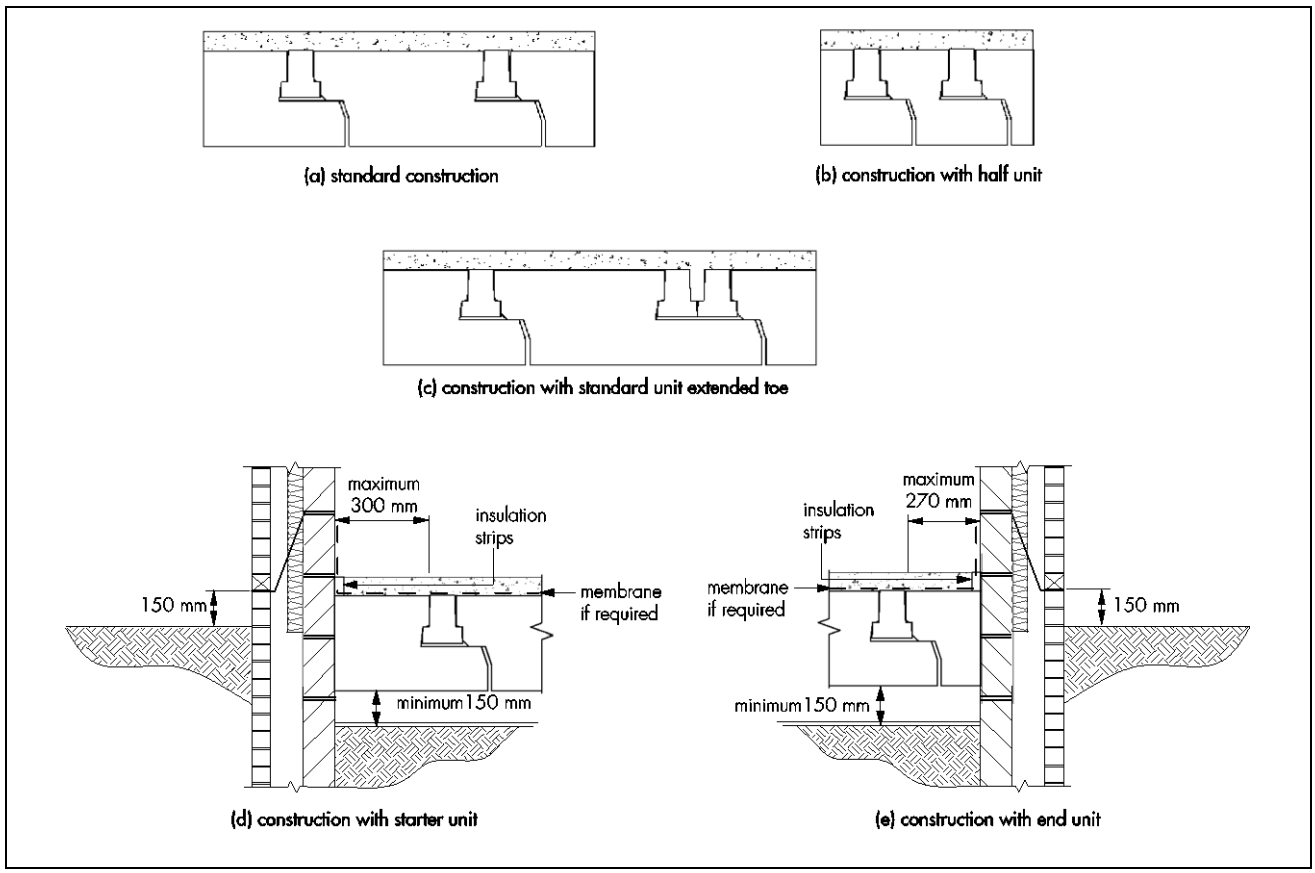
EPS material can be readily recycled if free from debris and contamination. The concrete and reinforcement steel can also be recycled.

Installation

12 General

Details of a typical S and B EPS system using precast concrete beams and EPS infill is shown in Figure 5.

Figure 5 Typical details



13 Site preparation

13.1 A void of sufficient depth must be provided beneath the floor construction to facilitate block installation, provide sub-floor ventilation and, where appropriate, accommodate clay heave (see sections 4.3 and 4.4 of this Certificate).

13.2 The ground beneath the floor should 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.

13.3 Provision should be included for ventilation of the sub-floor space and to resist moisture ingress and should be in accordance with normal good practice, for example, provision of ventilators and adequate drainage of the sub-floor.

13.4 A continuous damp-proof course should be laid along the support wall below the floor in accordance with BS 8102 : 2009.

14 Procedure

14.1 Normal precautions for handling EPS materials should be taken to avoid damaging.

14.2 The installer should confirm that the concrete beams and EPS blocks supplied to site agree with the details shown on the engineer's drawings for the project.

14.3 Starting from one edge, the concrete beams are laid into the approximate position in accordance with the specifications. An off-cut of polystyrene block can be used as a spacing guide as installation progresses from one side to the other.

14.4 Starter blocks are fitted into place between the outer wall of the building and the first beam. Once all the starter blocks are in place, the beam is edged back into position holding the blocks tightly against the outer wall. Starter blocks may be cut on site from full width blocks using a saw or hot wire cutter. Alternatively, pre-cut starter blocks are supplied by the Certificate holder. Where long lengths of concrete beam are used, mechanical lifting equipment may be required to aid final location.

14.5 With the first beam accurately positioned, the next row of polystyrene blocks is inserted with the toe of the block wrapped underneath and fitting snugly onto the shoulder of the first beam, before it is rotated into position onto the shoulder of the adjacent beam. The adjacent beam is then edged into position to ensure a close, tight fit. Blocks should be cut to the required length to fit at the end of the rows, subject to a minimum cut length of 320 mm (see section 6.4). Closure blocks are used between the beam-bearing ends to ensure the beams are positioned as per the beam centres shown in the S & B EPS Ltd drawing.

14.6 The blocks must be fitted tightly around drains and other conduits, with spaces filled in by off-cuts of material.

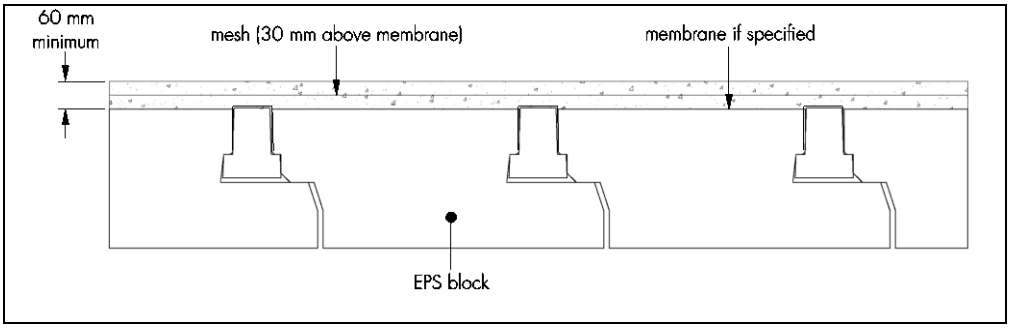
14.7 The installer should check that the EPS blocks are centrally located between the concrete beams, with a maximum gap of 5 mm between the EPS blocks and the beam face. These gaps can be due to normal construction or manufacturing tolerances.

14.8 Once the beams and EPS blocks have been installed, the walls supporting the beams are built up to finished floor level with bricks or concrete blocks cut to suit.

14.9 Care should be taken not to walk over the installed blocks. If a temporary working platform is required, the blocks should be covered with a suitably rigid board.

14.10 If required, a damp proof membrane or a radon- or methane-resistant membrane can be installed over the whole floor area in accordance with the membrane manufacturer's instructions (see Figure 6).

Figure 6 Typical membrane installation



14.11 The steel reinforcing mesh should be placed in position, supported on propriety spacers located at sufficiently close centres to ensure that the required cover is achieved.

14.12 Before pouring the steel-mesh-reinforced structural concrete topping, it must be ensured that the blocks are centrally located between the beams.

14.13 The steel-mesh-reinforced structural concrete topping should be laid as soon as possible after the blocks have been installed.

14.14 When using a concrete pump, truck or skip, concrete should not be discharged onto the polystyrene blocks from heights greater than 300 mm, and concrete heaps must not be formed over 150 mm high.

14.15 When wheelbarrows are used, heavy duty timber planks must be placed to spread the wheel load to the concrete joists. Spot boards must be used when tipping and shovelling.

14.16 Provision should be made for a suitable concrete finish to be achieved without standing on or overloading the polystyrene panels, for example compacting beams.

14.17 The following must be taken into account throughout the installation process:

- cube compressive strength and slump tests for concrete topping, to ensure they are within the acceptable limits
- concrete topping not to be poured below 5°C
- maximum temperature the concrete is placed is 30°C and decreasing
- concrete not to be poured during rainfall
- appropriate joints between the opening of two adjacent rooms to be provided.

14.18 To prevent shrinkage cracking:

- joints should be incorporated into the slab. However, joints must not compromise the structural performance of the topping
- an aspect ratio greater than 2:1 should be avoided
- 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
- a compressible insulating material around the perimeter of the plot should be provided
- a steel mesh should be provided at each corner of the openings if the size of the opening exceeds 500 mm x 500 mm
- consideration should be given to the provision of an appropriate detail on external walls at the position of porches.

Technical Investigations

15 Tests

Tests were carried out and the results assessed to determine:

- the resistance of the polystyrene blocks to temporary construction phase loading for minimum cut length and minimum bearing width
- the resistance of full length polystyrene blocks to temporary construction phase loading to BS EN15037-4 : 2010.

16 Investigations

16.1 An assessment was made of existing data to determine:

- structural adequacy of concrete topping reinforced with A142 steel mesh in accordance with BS EN 1992-1-1 : 2004 and BS EN 15037-1 : 2008
- thermal properties
- durability
- dimensional accuracy

16.2 Typical U values were derived for the floor system using modelling to BS EN 10211 : 2007 and BS EN 15037-4 : 2010, Annex F and example U values calculated to BS EN ISO 13370 : 2007.

16.3 The risk of condensation was assessed to BS 5250 : 2011.

16.4 Site visits were carried out to assess the practicability of installation of floor systems incorporating the blocks.

16.5 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.

Bibliography

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

BS EN 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 : 2015 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*
BS 8500-2 : 2015 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*

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

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BS EN 1990 : 2002 *Eurocode — Basis of structural design*
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BS EN 15037-1 : 2008 *Precast concrete products — Beam-and-block floor systems — Beams*

BS EN 15037-4 : 2010 *Precast concrete products — Beam-and-block floor systems — Expanded polystyrene blocks*

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BS EN ISO 10211 : 2007 *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

BS EN ISO 13370 : 2007 *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

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

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BRE Report (BR 443 : 2006) *Conventions for U-value calculations*
BRE Report (BR 497 : 2007) *Conventions for calculating linear thermal transmittance and temperature factors*

17 Conditions

17.1 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 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.

17.2 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.

17.3 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.

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

17.5 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/system or any other product/system
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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.

17.6 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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