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BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

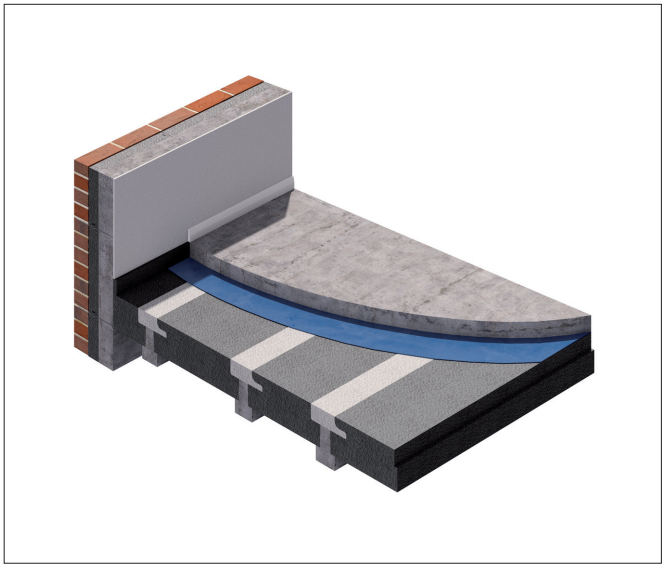
Agrément Certificate
14/5094
Product Sheet 3

JABLITE FLOORING SYSTEMS

JABLITE THERMAL FLOOR SYSTEM ALL-IN-ONE

This Agrément Certificate Product Sheet[1] relates to Jablite Thermal Floor System All-in-One, comprising precast pre-stressed concrete beams, a range of expanded polystyrene (EPS) infill panels, EPS connectors, concrete perimeter slip-bricks and concrete closure blocks. The system is for use in conjunction with a structural concrete topping for suspended concrete ground floors in single-family dwellings, flats, communal areas in blocks of flats and other 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

Strength and stability — the system has adequate strength and stiffness to support a suitable structural concrete topping and can sustain and transmit the dead and imposed floor loads (see section 6).

Thermal performance — the EPS products can enable a floor to meet the design U values specified in the national Building Regulations (see section 7).

Condensation risk — the system can contribute to limiting the risk of condensation (see section 8).

Durability — the system components, including the EPS insulation, concrete beams and concrete topping reinforced with steel mesh or macro/micro-polymer-fibres, 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: 11 November 2016

Brian Chamberlain
Head of Approvals — Engineering

Claire Curtis-Thomas
Chief Executive

Certificate amended on 17 November 2016 to make minor changes to Figure 2.

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, Jablite Thermal Floor System All-in-One, 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 6.2, 6.3, 6.7, 6.9, 6.11 to 6.14, 6.17 to 6.19, 6.21, 6.22 and 6.23 of this Certificate.
Requirement:	C2(c)	Resistance to moisture
Comment:		The system can contribute to limiting the risk of surface condensation. See sections 8.1, 8.4 and 8.5 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 of this Certificate.
Regulation:	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)	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)]. See sections 6.2, 6.3, 6.7, 6.9, 6.11 to 6.14, 6.17 to 6.19, 6.21, 6.22 and 6.23 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)]. See sections 8.1, 8.5 and 8.6 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Comment:		The system can contribute to satisfying this Standard, with reference to clauses 6.1.1[(1)] and 6.1.6[(1)]. See section 7.3 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)] and 6.2.3[(1)]. See section 7.3 of this Certificate.
Standard:	7.1(a)(b)	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)] [Aspects 1[(1)] and 2[(1)]], 7.1.6[(1)] [Aspects 1[(1)] and 2[(1)]] and 7.1.7[(1)] [Aspect 1[(1)]]. See section 7.3 of this Certificate.

(1) Technical Handbook (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 6.2, 6.3, 6.7, 6.9, 6.11 to 6.14, 6.17 to 6.19, 6.21, 6.22 and 6.23 of this Certificate.
Regulation:	39(a)(i)	Conservation measures
Regulation:	40(2)	Target carbon dioxide emission rate
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: 3 *Delivery and site handling* (3.6), 6 *Strength and stability* (6.18) and 14 *Procedure* (14.20) of this Certificate.

Additional Information

NHBC Standards 2016

NHBC accepts the use of Jablite Thermal Floor System All-in-One installed with macro-polymer fibre/steel mesh structural concrete toppings(1), provided it is installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 5.2 *Suspended ground floors*.

(1) NHBC do not accept the use of micro-polymer fibre structural concrete toppings (see Table 3, footnote 6 of this Certificate).

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 and BS EN 13163 : 2012.

Technical Specification

1 Description

1.1 Jablite Thermal Floor System All-in-One comprises precast, pre-stressed concrete beams, a range of expanded polystyrene (EPS) Infill Panels (Full Panel, Half Panel, End Panel, Start Panel and Make up Infill Panels), EPS Connectors, concrete closure blocks, concrete perimeter slip-bricks and a structural concrete topping for use in suspended ground floors.

1.2 The Infill Panels and Connectors have the nominal characteristic properties given in Table 1 and Figure 1 of this Certificate. The load-bearing factory-fitted connectors are click jointed within the panels by interference fit, negating the need for adhesive.

Table 1 Characteristic properties of Infill Panels and Connectors

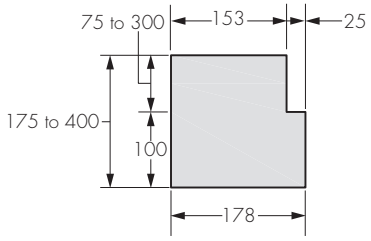
Description	Overall standard thickness (mm)	Width		Length (mm)	Compressive stress at 10% deformation (kPa)	Bending strength (kPa)	Mechanical resistance according to BS EN 15037-4	Thermal conductivity (λ_D) value ($W \cdot m^{-1} \cdot K^{-1}$) and colour	Moisture diffusion coefficient (μ)
		Top (mm)	Bottom (mm)						
Full Panel	175, 210, 260, 305, 400	483	533	1220	70	115	R1a	0.030 Grey	20 to 40[3]
Half Panel	175, 210, 260, 305, 400	293	343						
End Panel	175, 210, 260, 305, 400	310	335						
Start Panel	175, 210 260, 305, 400	153	178						
Single connector	75, 110, 160, 205, 300[1]	Minimum 106[2]	Minimum 156[2]	1220	130 150 200	180 200 250	—	0.036 White/0.030 Grey 0.035 White/0.030 Grey 0.033 White/0.031 Grey	30-70[3] 30-70[3] 40-100[3]
Double connector	75, 110, 160, 205, 300[1]	Minimum 198[2]	Minimum 248[2]		130 150 200	180 200 250	—	0.036 White/0.030 Grey 0.035 White/0.030 Grey 0.033 White/0.031 Grey	30-70[3] 30-70[3] 40-100[3]
Triple connector	75, 110, 160, 205, 300[1]	Minimum 290[2]	Minimum 340[2]		130 150 200	180 200 250	—	0.036 White/0.030 Grey 0.035 White/0.030 Grey 0.033 White/0.031 Grey	30-70[3] 30-70[3] 40-100[3]
Make up (2)	75, 110, 160, 205, 300[1]	600	600		130 150 200	180 200 250	—	0.036 White/0.030 Grey 0.035 White/0.030 Grey 0.033 White/0.031 Grey	30-70[3] 30-70[3] 40-100[3]
Make up (1)	100	400	400		90	135	R1a	0.030 Grey	30-70[3]

(1) For other EPS Connectors, the Certificate holder should be contacted for Make up (2) thicknesses between 75 mm and 300 mm. For configuration of the maximum thickness of the EPS Connectors and the EPS Make up (2) and the minimum top flanges of concrete beams, see Table 2 of this Certificate.

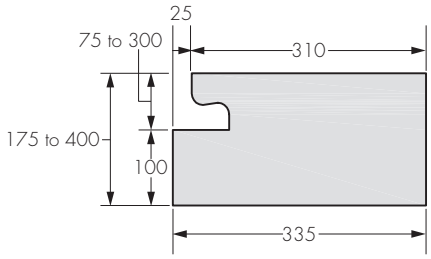
(2) For other widths of top/bottom of EPS Connectors to suit the top flange width of the concrete beam, the Certificate holder should be contacted (see Table 2 of this Certificate for further information).

(3) It is recommended that the least favourable value is used in calculations of risk of interstitial condensation; see section 8.1 of this Certificate.

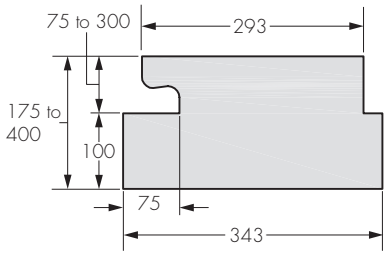
Figure 1 Example standard EPS Infill Panels dimensions



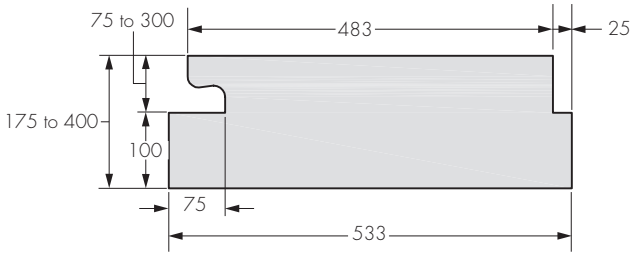
EPS start infill panel



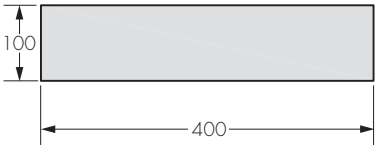
EPS end infill panel



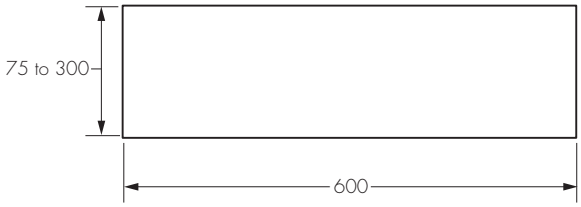
EPS half infill panel



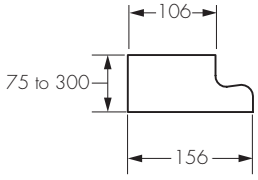
EPS full infill panel



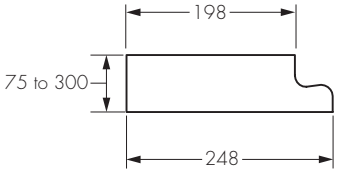
EPS make up (1)



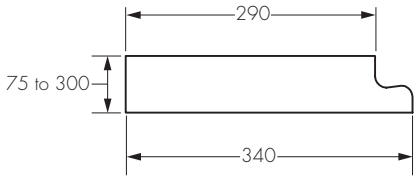
EPS make up (2)



EPS single connectors



EPS double connectors



EPS triple connectors

drawing showing factory assembly
of panels and connectors.
Single piece installation.

all measurements are in mm

1.3 The Certificate holder's specifications for ancillary items used in conjunction with the EPS products include the following:

- pre-stressed concrete beams of the type and size shown in Figure 2 of this Certificate, CE marked and 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 6.17 to 6.24 of this Certificate
- concrete toppings—for specifications, see Table 3 and sections 6.11 to 6.16 of this Certificate
- the polymer fibres must be CE marked in accordance with BS EN 14889-2 : 2006, with the minimum specification as defined in Table 3 of this Certificate. Consideration must be given to the requirements of Technical Report Number TR65, *Guidance on the use of macro-synthetic-fibre-reinforced concrete* for concrete toppings reinforced with macro polymer fibres
- concrete closure blocks with a compressive strength equal to, or greater than, that of the blocks used to form the inner leaf of the wall
- insulation edge strips — for application around the perimeter of structural concrete toppings

1.4 Ancillary items outside the scope of this Certificate include:

- gas barriers where required
- vapour control layer (VCL)
- damp-proof membranes (dpm) with third-party approval.

Figure 2 Pre-cast concrete beams used for thermal and full-scale tests (measurements in mm)

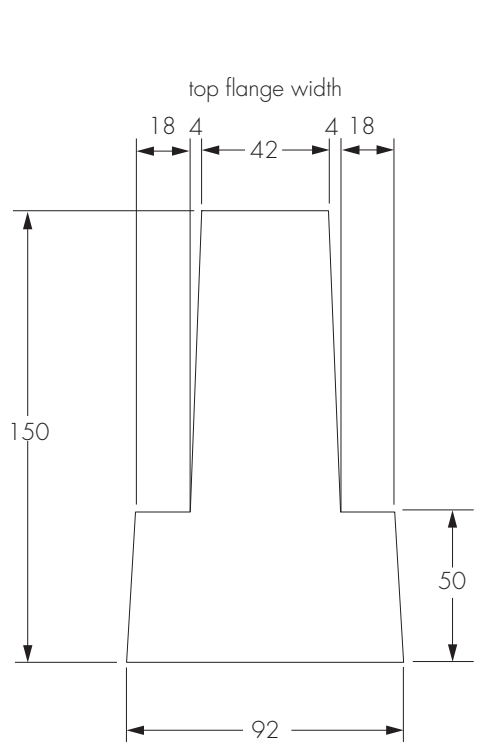


figure 2a

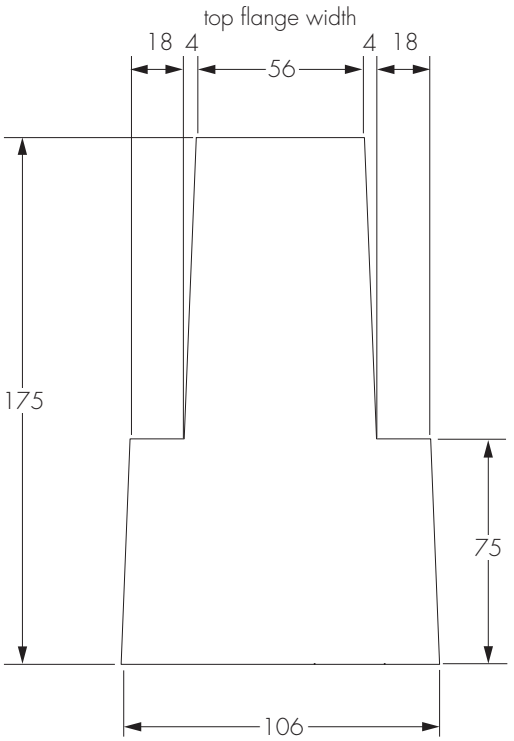


figure 2b

2 Manufacture

2.1 The EPS Connectors and Infill Panels are manufactured from expanded polystyrene beads using conventional moulding techniques.

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 Jablite Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001: 2008 by the BSI (Certificate FM01260).

Additional Information

3 Delivery and site handling

3.1 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.

3.2 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.

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

3.4 The EPS Connectors and Infill Panels are wrapped in polyethene but are otherwise unprotected. Therefore, reasonable care must be taken during transit and storage to avoid damage.

3.5 The EPS Connectors and Infill Panels should 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.

3.6 The EPS Connectors and Infill Panels must not be exposed to flame or ignition sources.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Jablite Thermal Floor System All-in-One.

Design Considerations

4 General

4.1 Jablite Thermal Floor System All-in-One is satisfactory for use as part of a suspended ground floor (over a sub-floor void) in buildings where the loads do not exceed those specified in Table 4 of this Certificate.

4.2 A suitably experienced/qualified engineer should perform a site-specific assessment/design to ensure that:

- the EPS Connectors, Infill Panels, Make up Infill Panels, concrete beams and structural concrete toppings are suitable for the intended use, based on the recommendations in this Certificate and the relevant parts of BS EN 15037-1 : 2008 and BS EN 15037-4 : 2010
- if concrete beams other than those shown in Figure 2a are specified, the requirement of section 6.20 must also be satisfied
- the floor is not loaded by construction materials until the 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 the external sources eg building construction or rail traffic are excluded from the system.

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

4.4 In locations where clay heave is anticipated, an additional void of up to 150 mm 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.

4.5 Electrical cables in contact with the EPS 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 structural concrete topping is maintained, eg above pipes.

4.7 The selected structural concrete topping must be designed and installed strictly in accordance with this Certificate and the Certificate holder's instructions (see section 6.13). The dosage rate for micro- and macro-fibres must be in accordance with Table 3 of this Certificate. The tolerance for the batching process and criteria for acceptability of macro-polymer-fibre content must be in accordance with Tables 27 and B.2 of BS EN 206 : 2013.

4.8 Where required, lateral restraint should be provided at ground floor level in accordance with the requirements of the national Building Regulations, BS EN 8103-1 : 2011 and *NHBC Standards* 2016.

5 Practicability of installation

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

6 Strength and stability

General

6.1 The design engineer must ensure that the concrete beams and structural concrete topping are suitable for the intended application (see section 4.2 of this Certificate).

EPS products

6.2 The EPS Connectors in conjunction with EPS Infill Panels provide a permanent formwork for the structural concrete topping. The EPS Connectors and Make up Infill Panels (2) also contribute to the short- and long-term structural performance of the floor by transferring the vertical imposed and dead loads to the concrete beams.

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

6.4 The EPS Infill Panels may be cut to accommodate varying beam lengths; these must be at least 300 mm long and should be positioned at the floor edges. The widths of the Starter and the End Panels are 178 mm and 335 mm respectively.

6.5 The EPS Panels are designed to have a normal bearing of 18 mm, with a 3 mm allowance for misalignment and manufacturing tolerances in the straightness of the beam, with a minimum bearing width of 15 mm.

6.6 The Make up Infill Panels (1) (see section 14) should not be used at widths greater than 400 mm.

6.7 The EPS Connectors and Make up Infill Panel (2) have adequate resistance to short-term and long-term creep compression. However, the size of the loading plate for imposed point loads must be ≥ 100 mm by 100 mm. The declared level of compressive creep of the EPS Connectors is CC (2/1.5/50)30 to BS EN 13163 : 2012.

6.8 To prevent concrete ingress where a VCL, gas membrane or dpm is not placed above the Connectors and Infill Panels, the following procedures should be followed:

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

6.9 The EPS Connector and Make up Infill Panel (2) must be used in conjunction with a concrete beam that has a top flange width equal to or greater than 42 mm or 56 mm (see Figure 2 and Table 2 of this Certificate). Alternatively, concrete beams with a greater top flange width specified in Table 2 of this Certificate can be considered as acceptable provided that the conditions specified in section 6.20 of this Certificate are met.

Table 2 EPS Connector and Make up Infill Panel thickness and compressive stress in conjunction with beam in Figures 2a and 2b

EPS Connector and Make up infill panel thickness (mm)	Declared level of compressive stress at 10% EPS Connector and Make up infill panel (kPa)	Minimum top flange width of concrete beam (mm)
75 to 150	150	42
75 to 120	130	56
75 to 205	150	56
75 to 300	200	42 or 56

6.10 Spacers for supporting steel mesh reinforcement should be located on spreader plates over the EPS Connectors. 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

6.11 The concrete topping thickness and reinforcement specification must be as shown in Table 3 for loadings defined in Table 4 of this Certificate. The concrete topping above the EPS Start and End Panels must be designed as a cantilevered slab and must not exceed 335 mm.

6.12 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.

6.13 Full-scale testing and calculations indicate that the structural concrete topping specifications in Table 3 of this Certificate, in conjunction with the concrete beams defined in Table 5 and Figure 2 and the EPS Connectors and Infill Panels specified in Table 1 and Figure 1, are suitable for use in buildings with allowable characteristic loads defined in Table 4 of this Certificate.

Table 3 Structural concrete topping specifications for buildings with allowable characteristic loads defined in Table 4 of this Certificate

Overall concrete thickness above the services (mm)	Strength class of concrete	Maximum aggregate[1] size (mm)	Type of concrete	Reinforcement specifications
75	25/30	10	Standard[5]	Macro-fibre Durus S400[2], dosage[3][4] of 4 kg·m^{-3} 45 mm long, 0.9 mm diameter, tensile strength 465 MPa, modulus of elasticity 3350 MPa and 0.9 mm diameter (Class II in accordance with BS EN 14889-2 : 2006) One layer of A142 mesh to BS 4483 : 2005 with a characteristic yield strength of (f_{yk}) 500 N·mm^{-2}. Nominal cover to reinforcement steel must be 35 mm Fibrin X-T, 13 mm to 19 mm long, 22 microns diameter (minimum)[6] polypropylene fibres (subject of BBA Certificate 06/4373, Product Sheet 3) at a rate 0.91 kg·m^{-3}

(1) The aggregate for concrete must comply with BS EN 12620 : 2002.
(2) The macro-polymer-fibre used in the full scale testing was in accordance with *BBA Certificate of Constancy of Performance* 0836-CPR-14/P006.
(3) The minimum residual flexural tensile strength of macro-polymer-fibre concrete topping used for full scale and prism tests was 1.60 MPa at 0.5 mm CMOD (crack mouth opening displacement) and 1.79 MPa at 3.5 mm CMOD when tested in accordance with BS EN 14651 : 2005, BS EN 14845-1 : 2007 and BS EN 14845-2 : 2006.
(4) Macro-polymer-fibre content should be measured on each site in accordance with BS EN 14488-7 : 2006 for fresh and hardened concrete reinforced with macro-polymer fibres.
(5) The slump of the concrete topping used for full scale test was S4 and the sand content was greater than 45%.
(6) Micro-polymer-fibre structural concrete toppings are not accepted on NHBC sites.

6.14 Permitted loadings for structural concrete toppings reinforced with macro-polymer-fibres, steel mesh and micro-polymer-fibres are shown in Table 4 of this Certificate.

Table 4 Maximum characteristic imposed partition loads and weight of finishes for structural concrete toppings reinforced with macro or micro-polymer-fibres or steel mesh A142

Description	Characteristic loads for single-family dwellings	Maximum characteristic loads for single-family dwellings or communal areas in blocks of flats or other suitable buildings
	Concrete topping reinforced with micro-polymer-fibres	Concrete topping reinforced with macro-polymer-fibres or steel mesh A142
Imposed uniformly distributed load (UDL) (kN·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·m^{-1})	1.0[3]	3.0[3]
Allowance for moveable partition (kN·m^{-2})	1.0[3]	1.0[3]
Finishes (kN·m^{-2})	0.5	

(1) Imposed concentrated load must not be combined with the uniformly-distributed imposed load or other variable actions.
(2) Imposed concentrated load must be applied over a square plate of area not less than 100 mm by 100 mm.
(3) Moveable and line load partition loads must not be combined with line load partition wall.

6.15 The maximum length of the cantilevered slab from the top face of the concrete beam should not exceed 335 mm (see Figure 4 of this Certificate).

6.16 The maximum distance of the concentrated load applied on the cantilever from the top face of the beam does not exceed 268 mm (335-42-25 = 268).

Pre-stressed concrete beam

6.17 The EPS Connectors, Start, End, Half, Full Panels and Make-up Infill Panels are for use with self-bearing pre-stressed concrete beams normal weight concrete, which provides the final strength of the floor system independently of any other constituent part of the floor system.

6.18 The dimensions and specification of the pre-stressed concrete beams that were used in the full-scale structural tests are shown in Figure 2 and Table 5 of this Certificate.

Table 5 Properties of the concrete beams used for full-scale test

Property	Value	
	Beam Figure 2a	Beam Figure 2b
Characteristic compressive strength of the concrete beam at 28 days — (f_{ck}) cylinder (N·mm^{-2}) according to DoP for each concrete beam	55	50
Area of concrete (mm^2)	9000	13725
Secant modulus of elasticity of concrete (E_{cm}) (N·mm^{-2})	38214	37277
Second moment of area of area (I) (mm^4)	17,028,000	340,493,000
Aggregate	Granite	Carboniferous Limestone and Quartzite Sand
Number of 5 mm diameter wires(1)	4	5
Characteristic tensile strength of pre-stressing steel (f_{pk}) (N·mm^{-2})	1770	1770
Characteristic tensile strength 0.1% proof stress of pre-stressing steel ($f_{p0,1k}$) (N·mm^{-2})	1556	1520
Service moment resistance (kN·m)	5.46	7.483
Ultimate moment resistance (kN·m)	7.34	11.819
Ultimate shear resistance (kN)	12.20	21.648
Initial pre-stress force (kN)	104.24	121.61
Pre-stress force after losses (kN)	73.56	90.58
Eccentricity (mm)	21.90	24.56
Weight of beam per meter (kg.m^{-1})	22.94	34.98

(1) The indented pre-stressing steel wire must be in accordance with BS 5896 : 2012.

6.19 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 suitably-experienced/qualified engineer must ensure the following criteria are met for other floors under the specified loading conditions:

(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): $f = \Pi/2(EI/mL^4)0.5$

Where:

δ is the deflection of the concrete beam in mm for UDL (see Table 6).

EI is dynamic flexural rigidity of the member (Nm^2).

m is the effective mass supported by the concrete beam loaded as defined in Table 4 (kg·m^{-2}).

L is the span of the member (m).

(1) The vibration due to rhythmic activity (such as dancing) and the external sources (such as building construction or rail traffic) will be excluded from the beam and block floor systems.

6.20 Other pre-stressed concrete beams can be considered as acceptable alternatives if a suitably experienced/qualified engineer confirms that the following conditions for the tested beam are met:

- the pre-stressed concrete beams must be designed in accordance with BS EN 1992-1-1 : 2004 (Eurocode 2) and its UK National Annex by a suitably-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 serviceability deflection limit of the proposed concrete beam must be in accordance with BS EN 1992-1-1 : 2004, as summarised in Table 6 of this Certificate.

Table 6 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 E_{cm} is the secant modulus of elasticity of concrete beam and ψ is the long-term creep coefficient of the concrete beam and is assumed to be equal to 2.

- the deflection of the proposed pre-stressed concrete beam for the same length and loads at each stage (defined in Table 6 of this Certificate) is equal to or less than the concrete beam shown in Figure 2a
- the value of Ecm for limestone and sandstone aggregates should be reduced by 10% and 30% respectively
- the frequency of the concrete beam is greater than 4 Hz, as defined in section 6.19 for floor vibration
- the concrete beam is self-bearing and there should be no account made for possible composite action between the beams and the EPS in-fill panels or the structural concrete topping
- the maximum length of the cantilevered slab from the top face of the concrete beam does not exceed 300 mm
- the maximum distance of the concentrated load applied on the cantilever load from the top face of the beam does not exceed 233 mm (300-42-25 = 233)
- the imposed loads (UDL and concentrated load) must be in accordance with BS EN 1991-1-1 : 2002 and its UK National Annex, and not exceeding the values shown in the Table 4 of this Certificate
- the minimum bearing width to support the concrete beam is 90 mm.

6.21 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 (6.10 and 6.14a, or the less favourable equations 6.10a, 6.10b and 6.14a). The lowest effective span obtained from these equations will be considered to be the maximum effective span of the concrete beam.

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

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

6.24 The concrete beam is self-bearing and no account should be made for possible composite action between the beams and the EPS Connectors, Make up Infill Panels (2) or the structural 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 BR 443 : 2006.

7.2 A floor deck U value (from inside to the under floor void) will depend significantly on the types and number of precast concrete beams, EPS Infill Block and Connectors. The thermal resistance of each T-beam and EPS configuration should be numerically modelled to BS EN ISO 10211 : 2007 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 7.1.

7.3 Example floor U values given in Table 7 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 7 Example floor U values[1][2] for single beam configurations[3] (W·m⁻²·K⁻¹)

Beam option	p/a ratio	EPS 130 Connector	EPS 150 Connector	EPS 200 Connector
	m·m²	—	75 mm white	300 mm grey
Beam 42 mm x 150 mm Refer to figure 2a	0.4	—	0.16	0.072
	0.6	—	0.17	0.074
	0.7	—	0.17	0.075
	0.9	—	0.18	0.075
	m·m²	75 mm white	—	300 mm grey
Beam 56 mm x 175 mm Refer to figure 2b	0.4	0.16	—	0.073
	0.6	0.18	—	0.075
	0.7	0.18	—	0.075
	0.9	0.18	—	0.076

(1) These calculations are in accordance with sections 7.1 and 7.2 and assume:
- the T-beam λ is 2.0 W·m⁻¹·K⁻¹ and 75 mm concrete screed λ is 1.15 W·m⁻¹·K⁻¹
- a 300 mm thick perimeter wall with a U value of 0.35 W·m⁻²·K⁻¹
- underfloor ventilation area is 0.0015 m²·m⁻¹
- ground conductivity is 1.5 W·m⁻¹·K⁻¹
- all other parameters are default values from BRE Report BR 443 : 2006.

(2) Infill panel is EPS 70 high performance (grey).
(3) 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.

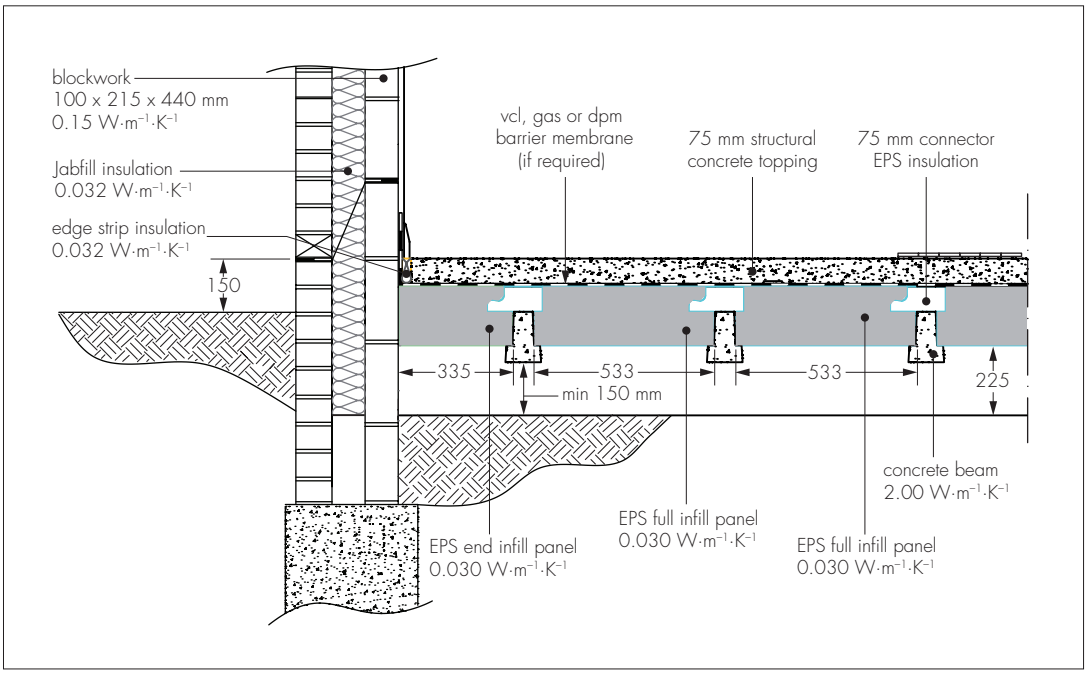
7.5 The junction ψ-values given in Table 8 may be used in SAP calculations or values can be modelled in accordance with the requirements and guidance in BRE Report BR 497 : 2007, BRE Information Paper IP 1/06 and the provisions in the documents supporting the national Building Regulations relating to competency to perform calculations, determine robustness of design/construction, and limiting heat loss by air infiltration.

Table 8 Junction psi values

Junction	ψ (W·m⁻¹·K⁻¹)
External wall	
– Figure 3	0.054[1]
– other	0.32[2]
Party wall	0.16[2]

(1) Value correct for junction shown in Figure 3 for 175 mm beams parallel to wall and for 175 mm beams perpendicular to the wall.
(2) Conservative defaults from SAP 2012.

Figure 3 Example junction construction



8 Condensation risk

Interstitial condensation

8.1 When there is no gas membrane, dpm or VCL located above the insulation, there is a risk of interstitial condensation forming on the concrete beam, which may be persistent. Therefore, the risk for each case should be assessed, both through the beam and through the insulation, in accordance with BS EN ISO 13788 : 2012 and BS 5250 : 2011, Annex D.3, accounting for the slab construction, dwelling humidity class, dwelling type, dwelling location and use of any VCL, dpm and/or gas membrane.

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 $mm^2 \cdot m^{-1}$ 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 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 Panels.

Surface condensation

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

8.5 The example construction described was used to model a 3D corner which achieved a temperature factor of 0.90, which equals or improves upon all of the critical temperature factors, f_{CRsi}, detailed in tables 1 and 2 of BRE Information Paper IP 1/06.

8.6 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 are designed and constructed to BS 5250 : 2011. Additional guidance can be found in BRE Report BR 262 : 2002.

8.7 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 components are installed within the floor structure and, therefore, do not require maintenance.

10 Durability

10.1 The EPS products are protected in service from organic solvents and substances liable to cause deterioration and will be effective as insulation for the life of the building in which they are installed.

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 durability of the concrete topping reinforced with polymer fibres will be at least equivalent to that of plain concrete of the same grade.

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

11 Reuse and recyclability

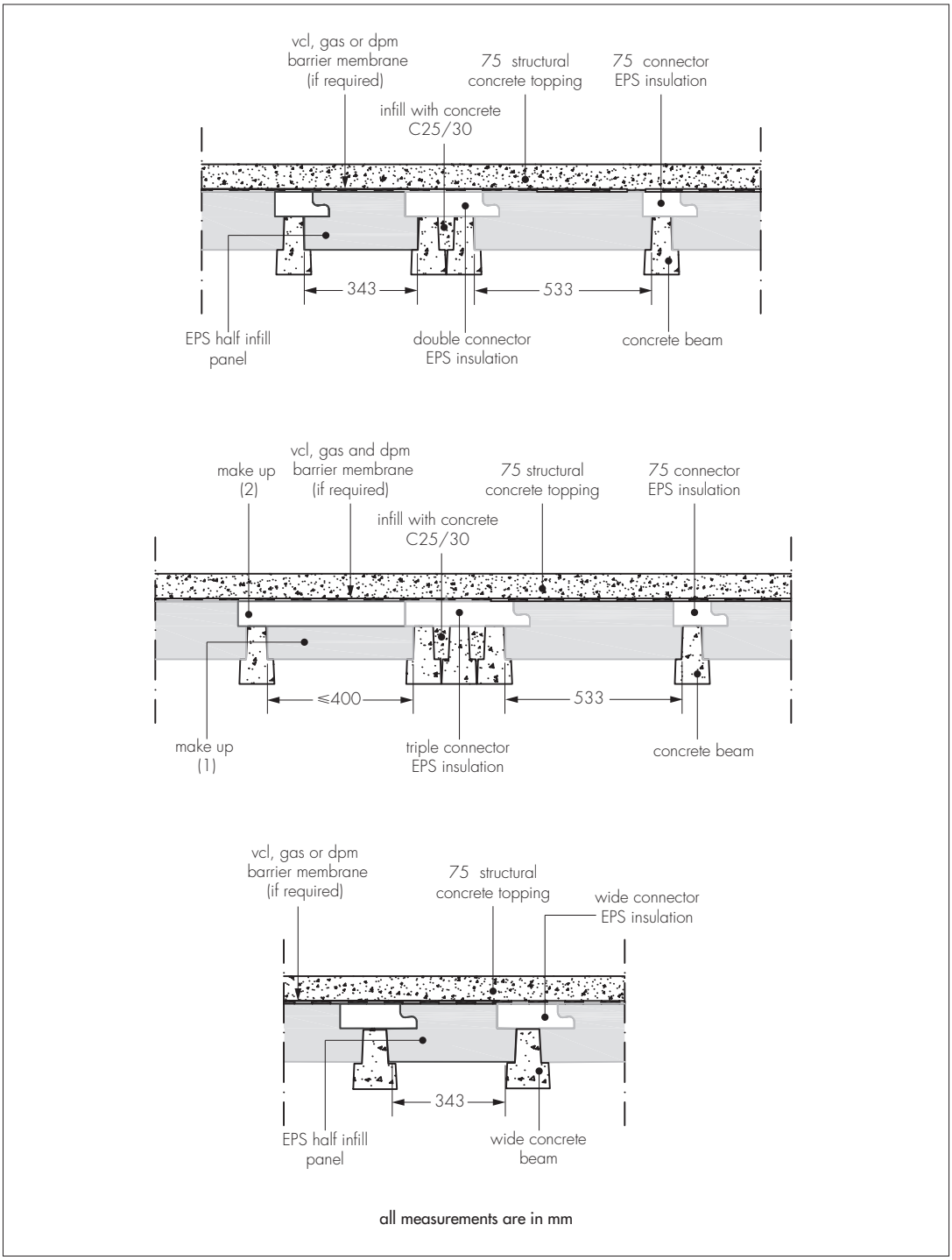
EPS material can be readily recycled if free from debris and contamination. The concrete and reinforcement steel can also be recycled.

Installation

12 General

Details of typical Jablite Thermal Floor System All-in-One assemblies using precast concrete beams and EPS Infill Panels are shown in Figure 4.

Figure 4 Examples of beam and EPS block assemblies



13 Site preparation

13.1 The ground beneath the floor should be free of topsoil and vegetation. Oversite concrete or surface seals are not required, but material added to bring the solum to an even surface must be hard and dry.

13.2 Where clay soil of low-, medium- or high-volume change potentially exists, the final minimum void depth should be increased appropriately to prevent problems associated with heave (see section 4.4). With good natural drainage or where site drains are provided to prevent water collecting and standing, the ground level beneath the floor does not need to be raised to the external ground level.

13.3 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.

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

13.5 The beams are laid in the positions shown on the floor plan. Each beam is tightly placed against the beam spacing blocks. Further installation details are given in sections 14.2 and 14.3 of this Certificate.

14 Procedure

14.1 Normal precautions for handling EPS materials should be taken to avoid damaging the EPS products during offloading, storage, handling and installation. Any damaged blocks must be replaced before pouring the concrete.

14.2 A damp proof course (dpc) should be laid on top of the bearing and end walls.

14.3 The pre-cast concrete beams are positioned at approximate locations and centres shown on the Jablite approved drawing.

14.4 Starter Panels are attached to the first beam. The beams and attached panels are then positioned tightly against the wall.

14.5 The remaining beams must be accurately positioned in line, in accordance with the Jablite approved layout drawing using the spacer/closure blocks. The spacer/closure blocks are bedded in mortar.

14.6 The EPS Infill blocks are installed, working from the start panels and the first beam.

14.7 The panels can be cut with a handsaw where required. Off-cuts greater than 300 mm may be used elsewhere in the floor zone.

14.8 Make up Infill Panels can be used to accommodate the gaps in non-standard beam spacings. These are cut to suit on site as per the approved drawing. Make up Infill Panels (between the beams) should not be more than 400 mm wide.

14.9 Finally, the End Panels are installed to complete the infill installation.

14.10 A gas barrier, VCL or dpm can be installed where required between the uppermost layer of insulation and the concrete topping.

14.11 If gas carcassing or underfloor heating pipes are specified, these can be secured to the uppermost layer of insulation material. If a gas barrier, VCL or dpm is not required, this can be achieved using standard pipe clips secured directly to the insulation. If a gas barrier, VCL or dpm membrane is required, pipes should be taped securely in position. Care must be taken not to puncture the gas, VCL or dpm.

14.12 If required, perimeter edge insulation strips (thermal resistance ≥ 0.75 $m^2 \cdot K \cdot W^{-1}$) are installed against the perimeter wall.

14.13 If a steel mesh is specified, spacers should be positioned over spreader plates (minimum four per m^2 and minimum size 50 mm by 50 mm). These should be installed to position the steel mesh at the correct level.

14.14 The EPS panels are cut as appropriate to accommodate service penetrations, eg soil vent pipes, and the resulting gaps filled with expanding foam or other insulation to minimise local cold bridging and air infiltration.

14.15 Should any other cutting be required, the advice of the Certificate holder should be sought.

14.16 Although they can withstand light foot traffic (see section 6.2), care should still be taken not to walk unnecessarily over the installed EPS 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.

14.17 When using a concrete pump, truck or skip, concrete should not be discharged onto the polystyrene panels from heights greater than 500 mm and concrete heaps must not be formed over 300 mm high.

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

14.19 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 eg by use of a self-levelling concrete topping.

14.20 Throughout the installation process, due consideration must be given to relevant health and safety regulations and the Certificate holder's product information sheets.

Technical Investigations

15 Tests

15.1 A series of full scale tests were carried out to ensure the compatibility of the structural concrete topping with the maximum deflection of the concrete beams under service and ultimate loads. The tests were designed to create the maximum curvature of the beam using the macro/micro-polymer-fibre and steel-reinforced concrete toppings.

15.2 Full scale tests were carried out to ensure that the short-term strain of the EPS Connectors and Make up Infill Panels under the applied loads remained within the permitted elastic performance limit of 1.5%.

15.3 Tests were conducted on the system and the results assessed to determine:

- resistance to construction loads
- short and long term thickness reduction of the EPS Connectors and Make up Infill Panels
- thermal conductivity (λ_D *values*)
- dimensional accuracy
- durability.

16 Investigations

16.1 Floor deck U values were derived by modelling to BS EN ISO 10211 : 2007 and BS EN 15037-4 : 2010 Annex F, and example floor U values calculated to BS EN ISO 13370 : 2007.

16.2 The risk of condensation was determined in accordance with BS 5250 : 2011.

16.3 The practicability of installation and detailing techniques were assessed.

16.4 The manufacturing processes for the EPS panels were evaluated including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

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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*

BS EN 1990 : 2002 *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*
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BRE Report (BR 497 : 2007) *Conventions for calculating linear thermal transmittance and temperature factors*

Technical Report Number TR65 : 2007 *Guidance on the use of Macro-synthetic- fibre-reinforced Concrete*

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 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.

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
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- 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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