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CI/SfB
(23.4) Xf2

Agrément Certificate No 06/4369

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Designated by Government to issue European Technical Approvals

TDECK EPS PANEL SYSTEM

Système de solives et dalles porteuses pour planchers
Bodenbalken

Product

- *THIS CERTIFICATE RELATES TO THE TDECK EPS PANEL SYSTEM, COMPRISING A RANGE OF EXPANDED POLYSTYRENE (EPS) PANELS, POLYSTYRENE INFILL SHEETS AND PUSH-FIX DOWELS AND PINS.*
- *The system is used to construct insulated, suspended ground floors when used in conjunction with prestressed concrete joists, concrete and aerated concrete perimeter blocks and a structural screed to the Certificate holder's specification, but these products are outside the scope of this Certificate.*
- *The system is for use in domestic and non-domestic locations where the imposed loading does not exceed 5 kNm^{-2} and concentrated loads do not exceed 4.5 kN.*

Regulations

1 The Building Regulations 2000 (as amended) (England and Wales)

The Secretary of State has agreed with the British Board of Agrément the aspects of performance to be used by the BBA in assessing the compliance of floors with the Building Regulations, and the requirements of the Building Regulations to which floor components can contribute in achieving compliance. In the opinion of the BBA, the Tdeck EPS Panel System, if installed and used in accordance with the conditions stated in this Certificate, will meet or contribute to meeting the relevant requirements.

Requirement:	A1(1)	Loading
Comment:		Floors incorporating the system can be designed to sustain and transmit dead and imposed floor loads to the ground. See sections 8.1 to 8.6 of this Certificate.
Requirement:	C2(c)	Resistance to moisture
Comment:		Floors incorporating the system can adequately limit the risk of surface and interstitial condensation. See sections 11.1 and 11.2 of this Certificate.
Requirement:	L1(a)(i)	Conservation of fuel and power
Comment:		The system can enable a floor to contribute to a building meeting its Target Emission Rate. See sections 9.1 to 9.4 and 10 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The system is acceptable. See sections 15.1 and 15.2 of this Certificate.

2 The Building (Scotland) Regulations 2004

In the opinion of the BBA, the Tdeck EPS Panel System, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Regulations and related Mandatory Standards as listed below.

Regulation:	8	Fitness and durability of materials and workmanship
Regulation:	8(1)	Fitness and durability of materials and workmanship
Comment:		The system can contribute to a construction meeting this Regulation. See sections 15.1 and 15.2 and the *Installation* part of this Certificate.
Regulation:	9	Building standards — construction
Standard:	1.1	Structure
Comment:		Floors incorporating the system can be designed to be capable of safely accommodating dead and imposed loads, with reference to clause 1.1.1[(1)(2)]. See sections 8.1 to 8.6 of this Certificate.
Standard:	3.15	Condensation
Comment:		The system will have a minimal risk of interstitial and surface condensation, with reference to clauses 3.15.1[(1)], 3.15.3[(1)] and 3.15.4[(1)]. See sections 11.1 and 11.2 of this Certificate.
Standard:	6.2	Buildings insulation envelope
Comment:		Floors incorporating the system can achieve the U value in the Elemental Method referred to in clause 6.1.2[(1)(2)]. See sections 9.1 to 9.4 and 10 of this Certificate.

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).

3 The Building Regulations (Northern Ireland) 2000

In the opinion of the BBA, the Tdeck EPS Panel System, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Building Regulations as listed below.

Regulation:	B2	Fitness of materials and workmanship
Comment:		The system is acceptable. See sections 15.1 and 15.2 of this Certificate.
Regulation:	C5	Condensation
Comment:		The system will have a minimal risk of interstitial condensation. See section 11.2 of this Certificate.
Regulation:	D1	Stability
Comment:		Floors incorporating the system can be designed to sustain and transmit dead and imposed floor loads to the ground. See sections 8.1 to 8.6 of this Certificate.
Regulation:	F2	Building fabric
Comment:		Floors incorporating the system will achieve the U values specified in the Elemental Method. See sections 9.1 to 9.4 and 10 of this Certificate.

4 Construction (Design and Management) Regulations 1994 (as amended)
Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See section: 6 *Delivery and site handling* (6.2).

Technical Specification

5 Description

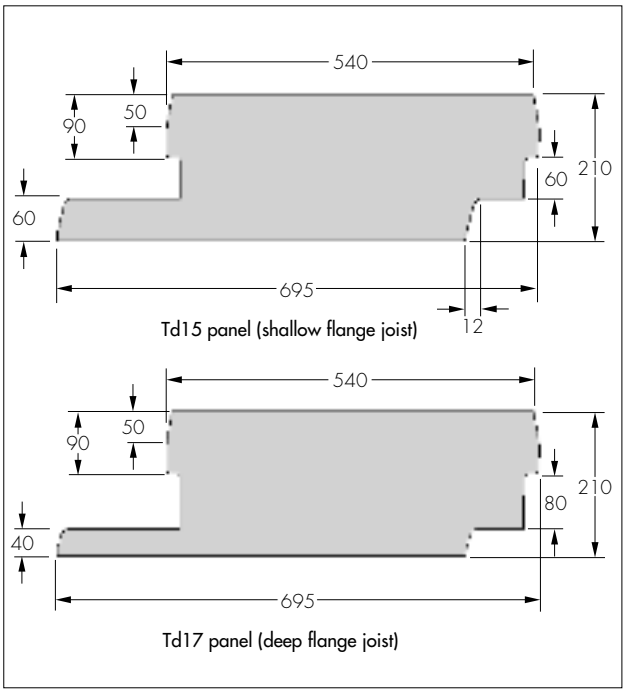
5.1 The Tdeck EPS Panel System comprises Td15 and Td17 EPS panels, polystyrene sheets and push-fix dowels and pins. To construct a suspended ground floor, the system must be used in conjunction with approved prestressed concrete joists, standard and aerated concrete perimeter blocks and a structural concrete screed to the Certificate holder's specification. These components are outside the scope of this Certificate (see Figure 1).

5.2 The expanded polystyrene panels (available in profiles Td15 and Td17) and polystyrene sheets are manufactured using conventional moulding techniques from expandable polystyrene beads and have a nominal density of 17 kgm^{-3} and a nominal thermal conductivity of 0.036 $Wm^{-1}K^{-1}$. The panels are available in 1200 mm lengths[(1)] and 210 mm thick and can be cut to suit various joist lengths[(2)] and spacings. The panel dimensions (see Figure 1) are designed to be compatible with prestressed concrete joists designed to support 100 mm deep concrete flooring blocks.

(1) Other lengths are available on request.

(2) A minimum panel length of 300 mm after cutting is specified by the Certificate holder.

Figure 1 Polystyrene (EPS) panel — main dimensions (all dimensions in mm)

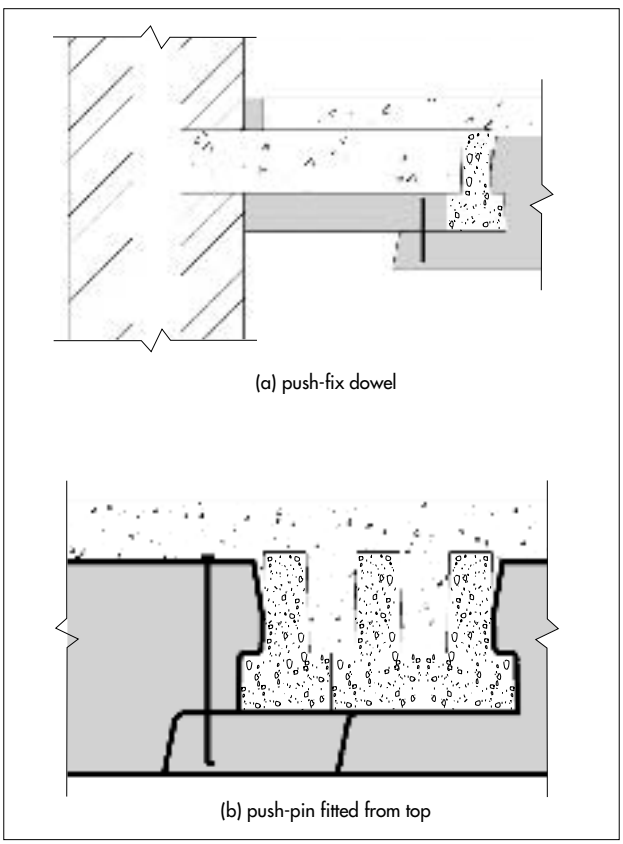


5.3 Polystyrene infill sheets (60 mm thick) and polystyrene edge strips[1] (30 mm thick), are used in conjunction with standard and aerated concrete perimeter blocks to provide continuous insulation cover of the floor.

(1) Alternative material could be used at appropriate thickness depending on thermal conductivity (λ value) to achieve a minimum *R* value of 0.75 m^2KW^{-1}.

5.4 The dowels and proprietary pins are manufactured from stainless steel to BS 970-1 : 1996, and are used to support the polystyrene sheet (see Figure 2).

Figure 2 Dowel and pin detail



5.5 Ancillary items used with the system and outside the scope of this Certificate are:

- the structural concrete screed — in accordance with BS 8204-1 : 2003, and consists of a minimum 60 mm thick (50 mm above the top of the joist) either:
  - grade 30 concrete with a maximum aggregate size of 10 mm, reinforced with Fibrin 23 polypropylene fibres at a rate of between 0.90 kgm^{-3} and 0.91 kgm^{-3}, or
  - grade, 35 self-levelling and compacting concrete with Fibrin PC12 polypropylene fibres at a rate of 0.75 kgm^{-3} and an admixture PCP or PCE superplasticer.
- prestressed concrete joists — designed to BS 8110-1 : 1997. Dimensions of typical widely-available joists are shown in Figure 3
- the concrete closure and edge blocks — are manufactured in accordance with BS EN 771-3 : 2003 and aerated concrete perimeter blocks should have BBA (or other third party) certification and must have a compressive strength equal to, or greater than, that of the blocks used to form the inner leaf of the wall (see Figure 4).

Figure 3 Typical prestressed concrete joist section (all dimensions in mm)

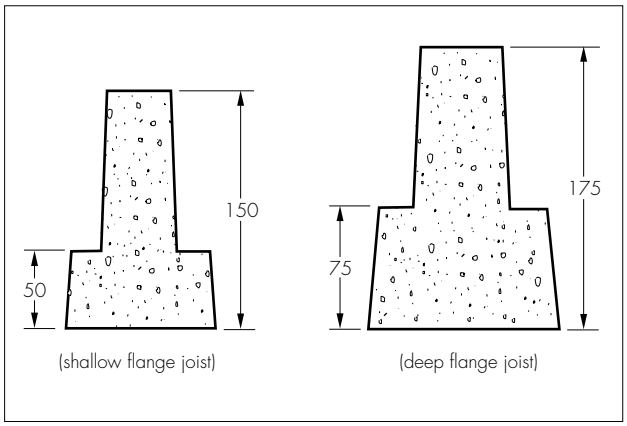
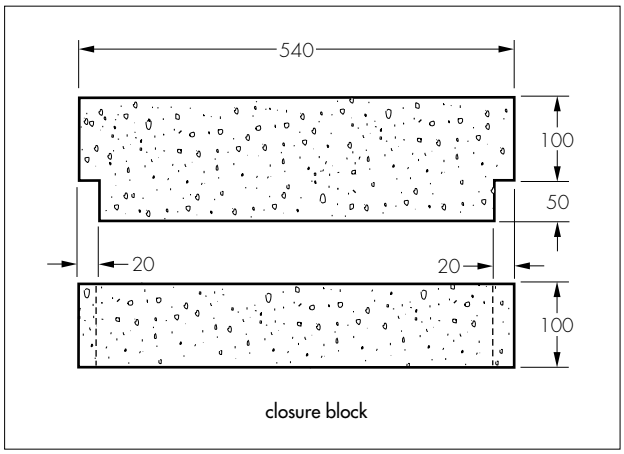
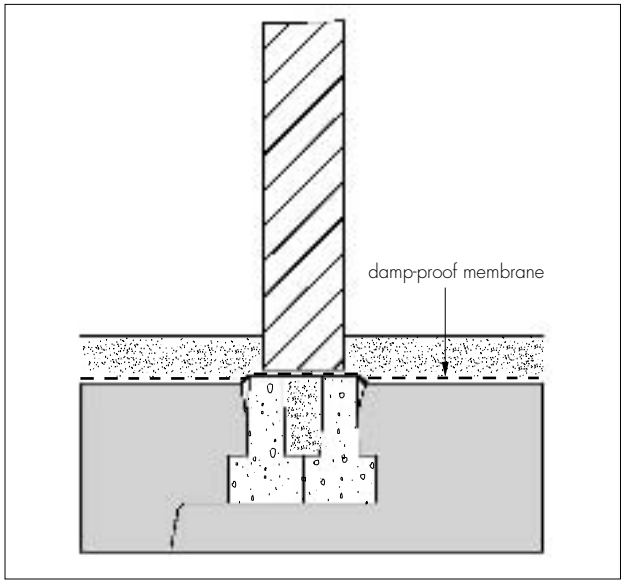


Figure 4 Typical proprietary concrete closure blocks (all dimensions in mm)



5.6 The system will not be adversely affected by the incorporation of a membrane up to 1 mm thick, installed in accordance with the membrane manufacturer's recommendations to provide a damp-proof membrane, airtight radon or methane barrier (see Figure 5).

Figure 5 Typical radon barrier installation



6 Delivery and site handling

6.1 Polystyrene components are shrink-wrapped and banded in cube packs, but are unprotected. Reasonable care must be taken during transit and storage to avoid damage.

6.2 The polystyrene components should be stored under cover, stacked on a flat base, clear of the ground and protected against direct sunlight and secured to avoid wind damage. Care must be taken to avoid contact with solvents and with materials containing volatile organic components, such as coal tar, pitch and timber newly treated with creosote.

6.3 Dowels and proprietary pins are supplied in cardboard boxes.

Design Data

7 General

The Tdeck EPS Panel System panels are assessed as suitable for use as part of a ground-floor installation when used in accordance with this Certificate.

8 Structural performance

8.1 The structural floor screed spans over the prestressed concrete joists and does not rely on composite action.

8.2 Structural tests were used to verify the ability of both types of concrete toppings to be used in situations where the following design loads are applicable:

- point load of 4.5 kN
- uniformly distributed load of 5 kNm^{-2}, together with an allowance of 1.0 kNm^{-2} for partitions
- line load of 5 kNm^{-1} from blockwork, both perpendicular and parallel to the span.

8.3 The structural properties of the concrete joists calculated in accordance with BS 8110-1 : 1997 should be obtained from the manufacturer. The following considerations apply:

- the bearing length of the prestressed concrete joists must be determined in accordance with BS 8110-1 : 1997. Support walls must be designed to carry the full dead and imposed floor loadings
- where multiple concrete joists are used to support blockwork walls, the spaces between the top flanges should be infilled with concrete of minimum C30 grade, to ensure unity of action
- maximum allowable spans of concrete joists/floor system are not covered by this Certificate.

8.4 Where the joists run parallel to the external cavity walls, the aerated concrete perimeter blocks are built into the structural external wall (see section 5.5) bridging the gap between the wall and the first joist, to act as formwork for the structural screed see Figure 6.

8.5 Due to manufacturing and construction tolerances, the bearings of the polystyrene infill blocks may be reduced. It is important to ensure that the minimum bearing that the polystyrene has on the supporting joist, is 15 mm. The normal bearing will be 20 mm (5 mm allowance made for misalignment and manufacturing tolerances in the straightness of the joist).

8.6 Where the joists run parallel to the external wall and rest against the inner skin, polystyrene infill is used see Figure 6.

9 Thermal performance

9.1 The thermal performance of each building, incorporating the panels must be evaluated in accordance with the relevant national Building Regulations, and is the responsibility of the overall designer of the building.

9.2 Calculations of the thermal transmittance (U value) of specific floors should be based on an EPS nominal thermal conductivity value of 0.036 $Wm^{-1}K^{-1}$ and the relevant panel dimensions shown in Figure 1.

9.3 Typical ground-floor U values, calculated in accordance with BS EN ISO 6946 : 1997 and BS EN ISO 13370 : 1998, indicate the values shown in Table 1.

Table 1 Floor U values

Perimeter/ area ratio	U value ($Wm^{-2}K^{-1}$)			
	Td15 panel (shallow flange joist)	improvement in elemental value (%)	Td17 panel (deep flange joist)	improvement in elemental value (%)
0.4	0.19	24	0.22	12
0.5	0.20	20	0.23	8
0.6	0.21	16	0.24	4
0.7	0.21	16	0.24	4
0.8	0.21	16	0.25	0
0.9	0.22	12	0.25	0

Note: The U values in Table 1 are based on the following parameters:

Thermal transmittance of the suspended part of floor (U_f)[1] is 0.261 $Wm^{-2}K^{-1}$ for the Td15 floor and 0.315 $Wm^{-2}K^{-1}$ for the Td17 floor, in the following constructions:

- structural concrete topping — conductivity 2.0 $Wm^{-1}K^{-1}$, thickness at least 60 mm above top of joist
- precast concrete joist – conductivity 2.3 $Wm^{-1}K^{-1}$, spacing, 600 mm centres.

(1) The average slab U value is slightly dependent on the use of other joist spacings and floor finishes and these should be taken into account in any calculations for a specific floor.

Total floor U values are based on the following parameters:

- soil (taken as typical clay) – conductivity 1.5 $Wm^{-1}K^{-1}$
- wall (300 mm thick) – U value 0.35 $Wm^{-2}K^{-1}$
- design wind speed – 5 ms^{-1}
- underfloor ventilation – 1500 $mm^{-2}m^{-1}$
- wind shielding factor – 0.05
- void depth under slab – 150 mm (nominal).

9.4 Constructions incorporating the floor can meet the requirements of the national Building Regulations thus:

England and Wales

- ground floors incorporating the panels can improve on the U value (0.25 $Wm^{-2}K^{-1}$) required by the Elemental Method of complying with the 2002 Requirements. The panels can therefore contribute to a building achieving the required overall carbon dioxide emission rate reduction of on average 20% for dwellings and 23% or 28% (for air-conditioned locations) for buildings other than dwellings, see Table 1
- junctions shown in Figures 6(b) and 6(e) adequately limit heat loss by conduction and, when installed to limit air infiltration, see section 10, comply with the requirements of the TSO publication *Limiting thermal bridging and air leakage : Robust construction details for dwellings and similar buildings* TSO 2002, Junctions 6(c) and 6(e) also comply with the requirements of the recently published Accredited Construction Details (version 1.0). The default psi values quoted in BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings*, Table 3, may be taken for these junctions and be used in SAP 2005 or SBEM calculations.

Scotland

- ground floors incorporating the panels can achieve U values better than the 0.25 $Wm^{-2}K^{-1}$ value required by the Elemental Method of compliance, see Table 1
- junctions shown in Figures 6(b) to 6(e) adequately limit heat loss by conduction and comply with the requirements of BRE report (BR 262 : 2002) *Thermal insulation: avoiding risks*.

Northern Ireland

- ground floors incorporating the panels achieve U values better than the 0.45 $Wm^{-2}K^{-1}$ value required by the Elemental Method of compliance, see Table 1.

10 Air infiltration

To minimise heat loss by unwanted air infiltration, care must be taken to effectively seal service penetrations and junctions with abutting walls. Design guidance is given in the documents referred to in sections 9.3 and 9.4.

11 Condensation risk

11.1 The risk of surface condensation on the floor will be minimal under normal circumstances. To minimise the risk of surface condensation at junctions with walls, care should be taken to maintain insulation continuity, for example as shown in Figure 6.

11.2 The risk of interstitial condensation will be minimal under normal circumstances.

12 Underfloor heating

Where underfloor heating is to be used, a proprietary clip rail system designed in accordance with BS EN 1264-2 : 1998 should be used. The underfloor heating pipes should have an outside diameter of 16 mm. The concrete structural screed should be the same mix as previously described with the thickness increased to 85 mm, over the beams increased to 75 mm to ensure the required cover over the underfloor heating pipes.

13 Ventilation

Ventilation should provide the void beneath the floor with an equivalent open area of 1500 mm^2 per metre run of external perimeter wall.

14 Behaviour in relation to fire

An assessment was made of the contribution of the system to the development stages of a fire. The assessment concluded, in relation to floors constructed in accordance with the Certificate holder's specifications, that the polystyrene infill blocks will be contained within the floor by the structural concrete topping, until the topping itself is destroyed. Therefore, they will not contribute to the development stages of a fire or present a smoke or toxic hazard. Electrical cables running within the polystyrene should be enclosed in a suitable conduit, such as rigid PVC.

15 Durability

15.1 The exposure condition beneath a suspended ground floor over a ventilated void and soil without oversite concrete or other surface seal is considered to be 'moderate' for the prestressed concrete joists and 'mild' for structural screed as defined in BS 8110-1 : 1997 (Table 3.2). The prestressed concrete joists and structural screed will have adequate durability for these exposure conditions.

15.2 The polystyrene components are protected in service from agencies liable to cause deterioration and will be as durable as the prestressed concrete joists.

Installation

16 Site preparation

16.1 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 should be hard and dry.

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

16.3 The foundation should be brought up to the required level and a continuous damp-proof course laid along the support wall below the floor in accordance with BS 8102 : 1990.

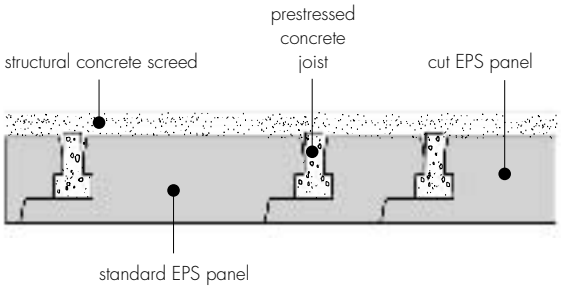
16.4 A void at least 150 mm deep must be provided between the underside of the polystyrene floor construction and the ground surface. With clay soil of medium or high volume change potential, the void depth should be increased appropriately to prevent problems associated with heave. With good natural 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 but, where the levels differ, the ability of the perimeter walls to act as retaining walls must be checked.

17 General

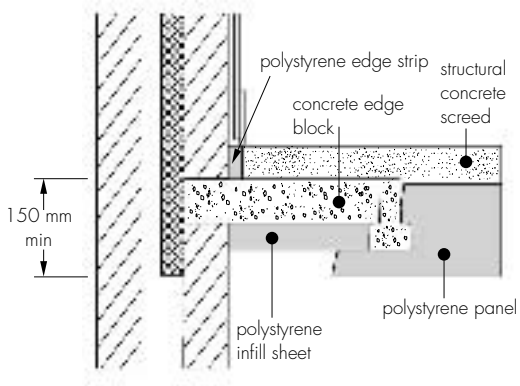
17.1 Typical details of the Tdeck EPS Panel System incorporated within a floor system are shown in Figure 6 and the Certificate holder's literature.

17.2 It should be confirmed whether the joist manufacturer's drawing agrees with the actual foundation and the joists match the specification and the panels supplied.

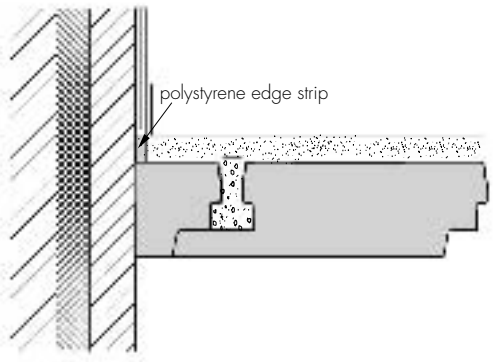
Figure 6 Basic system layout



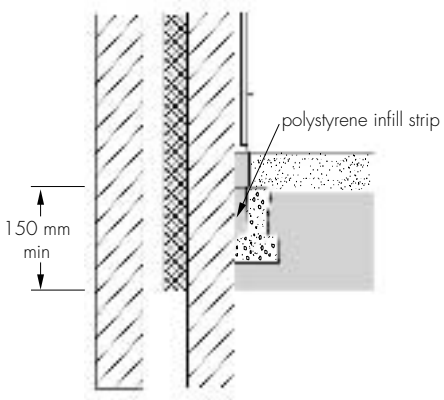
(a) joist and panel section



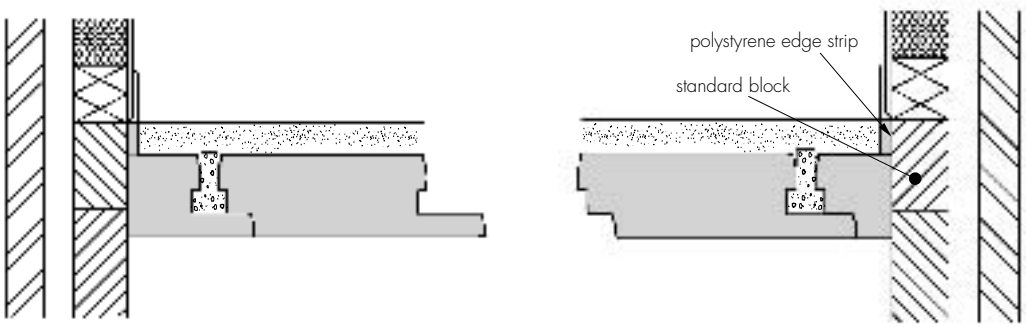
(b) edge detail – partial cavity fill



(c) edge detail – full fill cavity



(d) edge detail – partial cavity fill



(e) edge detail – timber frame

18 Procedure

18.1 The joists are laid into approximate position in accordance with the drawing. An offcut of a panel can be used as a spacing guide.

18.2 With the first joist accurately positioned, the polystyrene panels are placed into position ensuring that the toes are slipped underneath the joist and fitting snugly onto the shoulder of the joist before rotating into position on the shoulder of the adjacent joist. Panels can be cut to fit at the end of the rows. This procedure continues until the floor bay is complete.

18.3 Standard practice dictates that the toe of the panel should point to the outside wall. Where the direction changes, the underside of the joist or joists will be exposed. To complete the insulation cover, strips of 60 mm thick polystyrene sheet (supplied with the panels) are cut to suit and attached with fixing pins pushed through the adjacent panels into the strip.

18.4 If smaller panels are not available to fit joists at reduced centres, standard panels can be cut lengthways to suit the joist centres and a 20 mm by 90 mm rebate trimmed from the cut edge to fit snugly onto the joist shoulder.

18.5 Edge closures should follow the joist manufacturer's drawings. The most common method is to use special closure blocks or aircrete blocks cut to suit bridging the gap between wall and joist shoulder and insulation cut to suit from the 60 mm polystyrene sheet.

18.6 To provide a damp-proof, airtight radon or methane barrier, a membrane is installed over the whole floor area in accordance with the manufacturer's instructions.

18.7 Once the panels are installed, care must be taken not to walk on them. If a temporary working platform is required the panels should be covered with a suitably rigid board. To avoid damage to the polystyrene panels, the structural floor screed should be laid as soon as possible after the blocks have been installed.

18.8 Prior to pouring the structural floor screed it must be ensured that the polystyrene blocks are centrally located between the concrete joists with a maximum gap of 5 mm between the polystyrene and the joist face. These gaps may be due to normal construction or manufacturing tolerances.

18.9 Where gaps occur, concrete is placed along the edges of the polystyrene blocks to prevent displacement during the main concreting operation.

18.10 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.

18.11 When wheelbarrows are used, planks must be placed to spread the wheel load to the concrete joists.

18.12 Spot boards must be used when tipping and shovelling.

18.13 The concrete screed should be placed and compacted. Provision should be made for a suitable concrete finish to be achieved without standing on or overloading the polystyrene panels, for example compacting beams. Alternatively, self-levelling and self-compacting concrete screed (see section 5.5) can be used.

Technical Investigations

The following is a summary of the technical investigations carried out on the Tdeck EPS Panel System.

19 Tests

Tests were carried out to determine:

- the ability of the finished floor to withstand short- and long-term static loads and to distribute point loads to adjacent parallel concrete joists (mesh and fibre-reinforced screeds)
- that the structural screed (fibre reinforced) can span between concrete joists to resist loading without excessive deflection
- the adequacy of the polystyrene blocks for use as permanent formwork (resistance to construction loads)
- creep under sustained loading
- the ability of the finished floor to withstand impact loads
- the ability of the finished floor to withstand line loads from blockwork partition walls parallel and perpendicular to the prestressed concrete joists.

20 Investigations

20.1 An examination was made of existing data to:

- durability of the system
- condensation risk
- thermal properties
- fire risk assessment.

20.2 Floor U values and floor/wall junction psi values were assessed and the risk of condensation was evaluated.

20.3 Site visits were carried out to assess the practicability of installation including setting out and placement of the prestressed concrete joists, installing the infill blocks and polystyrene sheets and placing the concrete.

20.4 The manufacturing processes for the polystyrene infill blocks and sheets were examined including the methods adopted for quality control, and details obtained of the quality and composition of the materials used.

Bibliography

BS 970-1 : 1996 *Specification for wrought steels for mechanical and allied engineering purposes — General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels*

BS 8102 : 1990 *Code of practice for protection of structures against water from the ground*

BS 8110-1 : 1997 *Structural use of concrete — Code of practice for design and construction*

BS 8204-1 : 2003 *Screeds, bases and in-situ floorings — Concrete bases and cement sand levelling screeds to receive floorings — Code of practice*

BS EN 771-3 : 2003 *Specification for masonry units — Aggregate concrete masonry units (dense and light-weight aggregates)*

BS EN 1264-2 : 1998 *Floor heating — Systems and components — Determination of the thermal output*

BS EN ISO 6946 : 1997 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

BS EN ISO 13370 : 1998 *Thermal performance of buildings — Heat transfer via the ground — Calculation methods*

Conditions of Certification

21 Conditions

21.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- 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.

21.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

21.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant 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.

21.4 In granting this Certificate, the BBA is not responsible for:

- 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
- individual installations of the product or system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

21.5 Any information relating to the manufacture, supply, installation, use and maintenance 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 and maintained. It does not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the manufacture, supply, installation, use and maintenance of this product/system.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

In the opinion of the British Board of Agrément, the Tdeck EPS Panel System is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 06/4369 is accordingly awarded to Combined Thermal Solutions Ltd.

On behalf of the British Board of Agrément

Date of issue: 29th November 2006

Chief Executive

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For information about the Agrément Certificate, including validity and scope, tel: Hotline 01923 665400, or check the BBA website.