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Agrément Certificate

11/4811

Product Sheet 1

POLYSTEEL PERMANENT FORMWORK (WARMERWALL)

POLYSTEEL PSI-4000 SERIES INSULATING CONCRETE FORMS (ICF)

This Agrément Certificate Product Sheet⁽¹⁾ relates to PolySteel PSI-4000 Series Insulating Concrete Forms (ICF), for use in the formation of loadbearing and non-loadbearing internal, external and separating walls in dwellings and in buildings of a similar occupancy. Height restrictions apply in some cases.

(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

Practicability of installation — installation of the formwork should be carried out by trained operatives (see section 5).

Structural aspects — the system components have adequate strength to resist the loads associated with installation loading (see section 6).

Thermal performance — the system contributes to the overall thermal performance of the wall construction (see section 7).

Risk of condensation — walls, openings and junctions with other elements will adequately limit the risk of surface condensation (see section 8).

Behaviour in relation to fire — the forms are not classified as non-combustible or of limited combustibility and are restricted in some cases (see section 9).

Sound insulation — separating and internal walls with a minimum concrete core density and detailing stated in this Certificate will provide sufficient sound resistance (see section 14).

Durability — the system components are durable (see section 16).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Second issue: 8 June 2015

Simon Wroe
Head of Approvals - Engineering

Claire Curtis-Thomas
Chief Executive

Originally certificated on 2 February 2011

Certificate amended on 24 January 2020 to include Regulation 7(2) for England and Wales and new regulatory guidance for fire in Scotland.

This Certificate was amended on 22 May 2024 as part of a transition of The BBA Agrément Certificate scheme delivered under the BBA's ISO/IEC 17020 accreditation. This Certificate was issued originally under accreditation to ISO/IEC 17065. Sections marked with the symbol † are not issued under accreditation. Full conversion to the ISO/IEC 17020 format will take place at the next Certificate review. The BBA is a UKAS accredited Inspection Body (No.4345). Readers **MUST** check the validity of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly. Any photographs are for illustrative purposes only, do not constitute advice and must not be relied upon.

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Regulations

In the opinion of the BBA, PolySteel PSI-4000 Series Insulating Concrete Forms (ICF), if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement: A1	Loading
Requirement: A2	Ground movement
Requirement: A3	Disproportionate collapse
Comment:	Walls will have adequate strength and stiffness to satisfy these Requirements. See sections 6.1, 6.2, 6.3, 6.10 and 6.11 of this Certificate.
Requirement: B3(4)	Internal fire spread (structure)
Comment:	The system is restricted by this Requirement in some cases. See section 9.1 of this Certificate.
Requirement: B4(1)	External fire spread
Comment:	The system is restricted by this Requirement in some cases. See sections 9.1, 9.2 and 9.4 of this Certificate.
Requirement: C2(a)	Resistance to moisture
Comment:	Walls can adequately limit the risk of moisture ingress from the ground. See section 11.1 of this Certificate.
Requirement: C2(c)	Resistance to moisture
Comment:	Walls can adequately limit the risk of surface condensation and contribute to minimising the risk of interstitial condensation. See sections 8.1 and 8.2 of this Certificate.
Requirement: E1	Protection against sound from other parts of the building and adjoining buildings
Requirement: E2(a)	Protection against sound within a dwelling-house etc
Comment:	Walls can adequately satisfy these Requirements. See section 14 of this Certificate.
Requirement: L1	Conservation of fuel and power
Comment:	Walls can contribute to a building meeting the Target Emission Rate. See sections 7.5 to 7.7 of this Certificate. Walls can also adequately limit heat loss at junctions between walls, with other elements and around openings. See sections 7.1, 7.2, 7.5 to 7.7, 13.1 and 13.2 of this Certificate.
Regulation: 7(1)	Materials and workmanship
Comment:	The system is acceptable. See sections 16.1 and 16.2 and the <i>Installation</i> part of this Certificate.
Regulation: 7(2)	Materials and workmanship
Comment:	The system is restricted by this Regulation. See sections 9.1 to 9.3 of this Certificate.
Regulation: 26	CO₂ 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:	Walls formed from the system can satisfy or contribute to satisfy these Regulations. See section 7.1, 7.2 and 7.5 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 sections 15, 16.1 and 16.2 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building Standards applicable to construction
Standard:	1.1(a)(b)	Structure
Comment:		Walls formed from the system will have adequate strength and stiffness to satisfy this Standard, with reference to clauses 1.1.1 ⁽¹⁾⁽²⁾ to 1.1.3 ⁽¹⁾⁽²⁾ and, when suitably reinforced, clause 1.2.1 ⁽¹⁾⁽²⁾ . See sections 6.2, 6.3, 6.10 and 6.11 of this Certificate.
Standard:	1.2	Disproportionate collapse
Comment:		When taking into account building risk groups and number of storeys, walls will have adequate strength and stiffness to satisfy this Standard, with reference to clause 1.1.1 ⁽¹⁾⁽²⁾ and, when suitably reinforced, clause 1.2.1 ⁽¹⁾⁽²⁾ . See sections 6.2, 6.3, 6.10 and 6.11 of this Certificate.
Standard:	2.1	Compartmentation
Standard:	2.2	Separation
Standard:	2.3	Structural protection
Comment:		The system is restricted by these Standards in some cases with reference to clauses 2.1.12 ⁽²⁾ , 2.2.4 ⁽²⁾ , 2.2.5 ⁽²⁾ , 2.2.6 ⁽¹⁾ , 2.2.7 ⁽¹⁾ , 2.2.8 ⁽¹⁾ and 2.3.2 ⁽¹⁾⁽²⁾ . See sections 9.1, 9.2 and 9.5 of this Certificate.
Standard:	2.4	Cavities
Comment:		The system is restricted by this Standard, with reference to clauses 2.4.2 ⁽¹⁾⁽²⁾ , 2.4.4 ⁽¹⁾ and 2.4.6 ⁽²⁾ . See section 9.1, 9.2 and 9.5 of this Certificate.
Standard:	2.6	Spread to neighbouring buildings
Comment:		The system is restricted by this Standard, with reference to clauses 2.6.5 ⁽¹⁾ and 2.6.6 ⁽²⁾ . See section 9.1, 9.2 and 9.5 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		Walls can satisfy this Standard, with reference to clauses 3.4.1 ⁽²⁾ and 3.4.5 ⁽¹⁾ . See section 11.1 of this Certificate.
Standard:	3.15	Condensation
Comment:		Walls can adequately limit the risk of surface condensation, with reference to clauses 3.15.1 ⁽¹⁾⁽²⁾ and 3.15.3 ⁽¹⁾ . See section 8.1 of this Certificate. Walls can contribute to minimising the risk of interstitial condensation, with reference to clauses 3.15.1 ⁽¹⁾ , 3.15.4 ⁽¹⁾ and 3.15.5 ⁽¹⁾⁽²⁾ . See section 8.2 of this Certificate.
Standard:	5.1	Noise separation
Standard:	5.2	Noise reduction between rooms
Comment:		Separating walls satisfy these Standards, with reference to clauses 5.1.1 ⁽¹⁾⁽²⁾ , 5.1.2 ⁽¹⁾⁽²⁾ , 5.1.4 ⁽¹⁾⁽²⁾ , 5.1.7 ⁽²⁾ , 5.1.8 ⁽¹⁾ , 5.2.1 ⁽¹⁾⁽²⁾ and 5.2.2 ⁽¹⁾⁽²⁾ . See sections 14.1 and 14.2 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The system will enable, or contribute to enabling, a wall to meet these Standards, with reference to clauses 6.1.1 ⁽¹⁾⁽²⁾ , 6.1.4 ⁽¹⁾ , 6.1.5 ⁽¹⁾ , 6.2.1 ⁽¹⁾⁽²⁾ , 6.2.3 ⁽¹⁾ , 6.2.4 ⁽¹⁾⁽²⁾ , 6.2.5 ⁽¹⁾⁽²⁾ , 6.2.6 ⁽²⁾ and 6.2.7 ⁽²⁾ . See sections 7.1, 7.2, 7.5 to 7.7, 13.1 and 13.3 of this Certificate.

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).



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

Regulation:	23	Fitness of materials and workmanship
Comment:		The system is acceptable. See sections 16.1 and 16.2 and the <i>Installation</i> part of this Certificate.
Regulation:	28	Resistance to moisture and weather
Comment:		Walls can adequately limit the risk of moisture ingress from the ground. See section 11.1 of this Certificate.
Regulation:	29	Condensation
Comment:		Walls can contribute to minimising the risk of interstitial condensation. See section 8.2 of this Certificate.
Regulation:	30	Stability
Comment:		Walls will have adequate strength and stiffness to satisfy this Regulation. See sections 6.2, 6.3, 6.10 and 6.11 of this Certificate.
Regulation:	31	Disproportionate collapse
Comment:		Walls, when suitably reinforced, will have adequate strength and stiffness to satisfy this Regulation. See sections 6.2, 6.3, 6.10 and 6.11 of this Certificate.
Regulation:	35(4)	Internal fire spread – Structure
Comment:		The system is restricted by this Regulation in some cases. See section 9.1 of this Certificate.
Regulation:	36(a)	External fire spread
Comment:		The product is restricted by this Regulation in some cases. See sections 9.1, 9.2 and 9.4 of this Certificate.
Regulation:	39	Conservation measures
Regulation:	40	Target carbon dioxide emission rate
Comment:		Walls can contribute to a building satisfying the Target Emission Rate. See sections 7.5 to 7.7 of this Certificate. Walls can also adequately limit heat loss of unwanted air infiltration and excessive additional heat loss at junctions between walls, with other elements and around openings. See sections 7.1, 7.2, 7.5 to 7.7, 13.1 and 13.2 of this Certificate.
Regulation:	49	Protection against sound from other parts of the building and from adjoining buildings
Comment:		Separating walls can satisfy this Regulation. See sections 14.1 and 14.2 of this Certificate.

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, Principal Designer/CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 3 *Delivery and site handling* (3.4) and 18 *General* (18.1 and 18.2) of this Certificate.

Additional Information

NHBC Standards 2014

NHBC accepts the use of PolySteel PSI-4000 Series Insulating Concrete Forms (ICF), provided they are installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards 2.1 Concrete and its reinforcement* and *5.1 Substructure and ground bearing floors*.

General

PolySteel PSI-4000 Series Insulating Concrete Forms (ICF) (PSI-4600 and PSI-4800) are for use as permanent insulated formwork to loadbearing and non-loadbearing reinforced dense concrete external, internal and separating walls in buildings up to 18 metres high, subject to structural design and limitations and fire resistance considerations.

The system can also be used below ground, subject to adherence to British or European Standards (see section 6.2) structural design, carried out by a Chartered Structural Engineer and detailing in accordance with BS 8102 : 2009. However, below-ground waterproof construction and protection against ingress of ground water has not been assessed and is outside the scope of this Certificate. Use in any structures incorporating the system is subject to design limitations in accordance with British or European Standards.

The system does not provide permanent structural assistance to the building and only contributes to the thermal insulation of the finished construction.

Technical Specification

1 Description

1.1 PolySteel PSI-4000 Series Insulating Concrete Forms (ICF) (PSI-4600 and PSI-4800) consist of two 65 mm thick panels formed from fire-retardant polystyrene beads, in accordance with BS EN 13163 : 2012. Ties, at 150 mm centres, are inserted into the panels during the moulding process, connecting the EPS panels together to give either of two concrete core thicknesses (see Table 1). Connecting ties are made from galvanized steel wire (see Figure 1) and incorporate steel furring-strips embedded into the EPS panels. Top, bottom and vertical edges of the forms have either male or female joints to allow the forms to interlock. The external form faces are lightly grooved to give a key for direct application of finishes. Six form types (see Table 1) are included in the system, with concrete core thicknesses of 150 mm (PSI-4600) or 200 mm (PSI-4800). The EPS elements of the forms are available in two specifications (white and grey) and have a nominal density of $24 \text{ kg}\cdot\text{m}^{-3}$. The formwork components⁽¹⁾ are detailed in Tables 1 and 2.

(1) Full illustrations and dimensional details of the forms are available from the Certificate holder.

Table 1 System element dimension

Element type	Long length (mm)	Short length (mm)	Height (mm)	Total formwork thickness (mm)	Concrete core thickness (mm)
PSI-4600 standard form	1200	—	300 600	280	150
PSI-4800 standard form	1200	—	300 600	330	200
PSI-4690 right-hand or left-hand corner form	980	380	300 600	280	150
PSI-4890 right-hand or left-hand corner form	1030	430	300 600	330	200

Table 2 Wall construction produced from PolySteel PSI-4000 Series forms

PolySteel form	Nominal thickness (mm)			Total formwork thickness
	Internal EPS	Concrete core	External EPS	
PSI-4600	65	150	65	280
PSI-4800	65	200	65	330

1.2 Should reinforcing bars be required, horizontal reinforcing bars are wired to the tie/spacers, vertical reinforcement is secured to horizontal reinforcement at the required centres. Each element interlocks and builds, horizontally and vertically, into a tight, rigid formwork. The wall is formed by placing or pouring concrete into the formwork.

1.3 The EPS panels are flame-retardant and are available in two grades: white (standard EPS) and grey (enhanced EPS).

1.4 Upper and lower surfaces and the vertical mating surfaces have a tongue and groove edge to form a good seal when joined together.

1.5 The steel ties are made from 2.9 mm diameter galvanized steel and 0.71 mm thick galvanized steel band to form 38 mm wide attachment strips (galvanized coating 3.25 µm thick). Tie/spacers are located 12 mm from the external surfaces of the EPS panels and set-in 33 mm from the top and bottom of the forms.

1.6 The forms are dry-laid in staggered vertical joints (brick bond). The surfaces are slightly grooved vertically on the external surface to indicate location of the furring strips.

1.7 For the purposes of this Certificate, the minimum density of concrete required is 2200 kg·m⁻³ with an S3 (or higher) slump class in accordance with BS 8500-1 : 2006. The Certificate holder recommends concrete strength class C25/30 with a slump of 125 mm to 175 mm in accordance with BS EN 206-1 : 2013 and BS EN 12350-2 : 2009 A pumpable grade should normally be specified. The recommended aggregate (rounded) size is 10 mm. An admixture complying with BS EN 934-2 : 2009 or BS EN 480-1 : 2006 should be used to allow placement by free-flow mixes where necessary.

1.8 Components supplied and specified for use with the system by the Certificate holder, and covered by this Certificate, are:

- moulded PVC form closer
- Polysteel insulating concrete formwork (ICF) clip.

1.9 Components and finishes typically specified for use with the system by the Certificate holder but not assessed or covered by this Certificate are:

- steel reinforcement — where required, should comply with BS 4449 : 2005 and be sourced from a CARES (UK Certification Authority for Reinforcing Steels) registered supplier
- external masonry — may be of brickwork or stonework fixed in accordance with the provisions of BS 5628-1 : 2005 and BS 5628-3 : 2005, or BS 8298 : 1994 respectively
- external render — in accordance with BS EN 13914-1 : 2005 and suitable for use with the system
- acrylic render — suitable acrylic render products, in accordance with BS EN 13914-1 : 2005
- brick-slip systems covered by a BBA Certificate or equivalent for this intended use — the Certificate holder’s advice should be sought
- galvanized steel ledger fixings — for casting into the concrete core as a support for intermediate floor construction
- brickwork/stonework ties to BS EN 845-1 : 2003
- bracing system as supplied by the Certificate holder
- Type A, B or C basement waterproofing membrane/coating as defined in BS 8102 : 2009 (see section 11.2 of the Certificate)
- plasterboard internal linings to BS EN 520 : 2004 and BS 8212 : 2010
- timber weatherboarding or hung tiles on treated timber battens or rails screwed to the attachment strips.

Quality controls

1.10 System components are bought-in to agreed specifications or in accordance with British or European Standards and/or current Agrément Certificates.

1.11 Quality checks are made during the EPS moulding process and on the finished EPS components.

2 Manufacture

2.1 The insulation formwork PSI-4000 Series Insulating Concrete Forms (ICF) are manufactured from fire retardant expanded polystyrene (EPS), and the connecting ties and associated attachment strips from galvanized steel.

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
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 Good site practices should be observed to prevent damage to the components.

3.2 The forms are supplied shrink-wrapped — the wrapping should not be opened until the contents are required.

3.3 The forms should be stored on their sides to protect toothed edges from damage.

3.4 Care must be taken when handling the EPS components to avoid damage and contact with solvents or materials containing volatile organic components such as newly-treated timber. The forms, although containing a flame-retardant, must not be exposed to open flame or other ignition sources.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on PolySteel PSI-4000 Series Insulating Concrete Forms (ICF).

Design Considerations

4 Use

4.1 PolySteel PSI-4000 Series Insulating Concrete Forms (ICF) are for use in loadbearing and non-loadbearing internal or external and separating walls in dwellings and in buildings of a similar occupancy.

4.2 The system provides permanent formwork for in-situ dense aggregate concrete walls and contributes to the thermal insulation of the finished construction.

4.3 The system is for use with the internal and external finishes specified in this Certificate.

4.4 Subject to design and supervision by a Chartered Structural Engineer, the formwork may be used for constructing basement and retaining walls. The BBA has not assessed the system for forming watertight construction or for forming buildings subjected to ground water or hydrostatic pressure.

5 Practicability of installation

The system should only be installed by installers who have been trained by the Certificate holder (see sections 18 and 19).

6 Structural performance

General



6.1 The system is satisfactory for use in loadbearing and non-loadbearing walls as permanent formwork for in-situ dense aggregate concrete.



6.2 Structures subject to the national Building Regulations incorporating the system should be designed to the relevant sections of BS 8007 : 1987, BS 8102 : 2009 and BS 8110-1 : 1997, or BS EN 1991-1-4 : 2005, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004, and certified by a qualified Structural Engineer.

6.3 Other buildings not subject to national Building Regulations should also be built in accordance with the same standards stated in section 6.2 of this Certificate.

6.4 The concrete is not easily examined after casting, hence, as specified in BS 8110-1 : 1997, Section 2, or BS EN 1992-1-1 : 2004, Sections 4 and 8, care must be taken to ensure full compaction. Should there be doubt over full compaction, it is best checked by removal of a section of EPS panel, observation and replacement. Particular attention should be given to basement walls and areas adjacent to formed openings. Voids may be detected during the concrete placement, by tapping the EPS panels (eg with the palm of the hand or a wooden mallet) and listening for a 'hollow' sound, otherwise concrete cores can be taken once concrete has reached initial design strength. Suitable supervision must be provided during placing and compacting of the concrete.

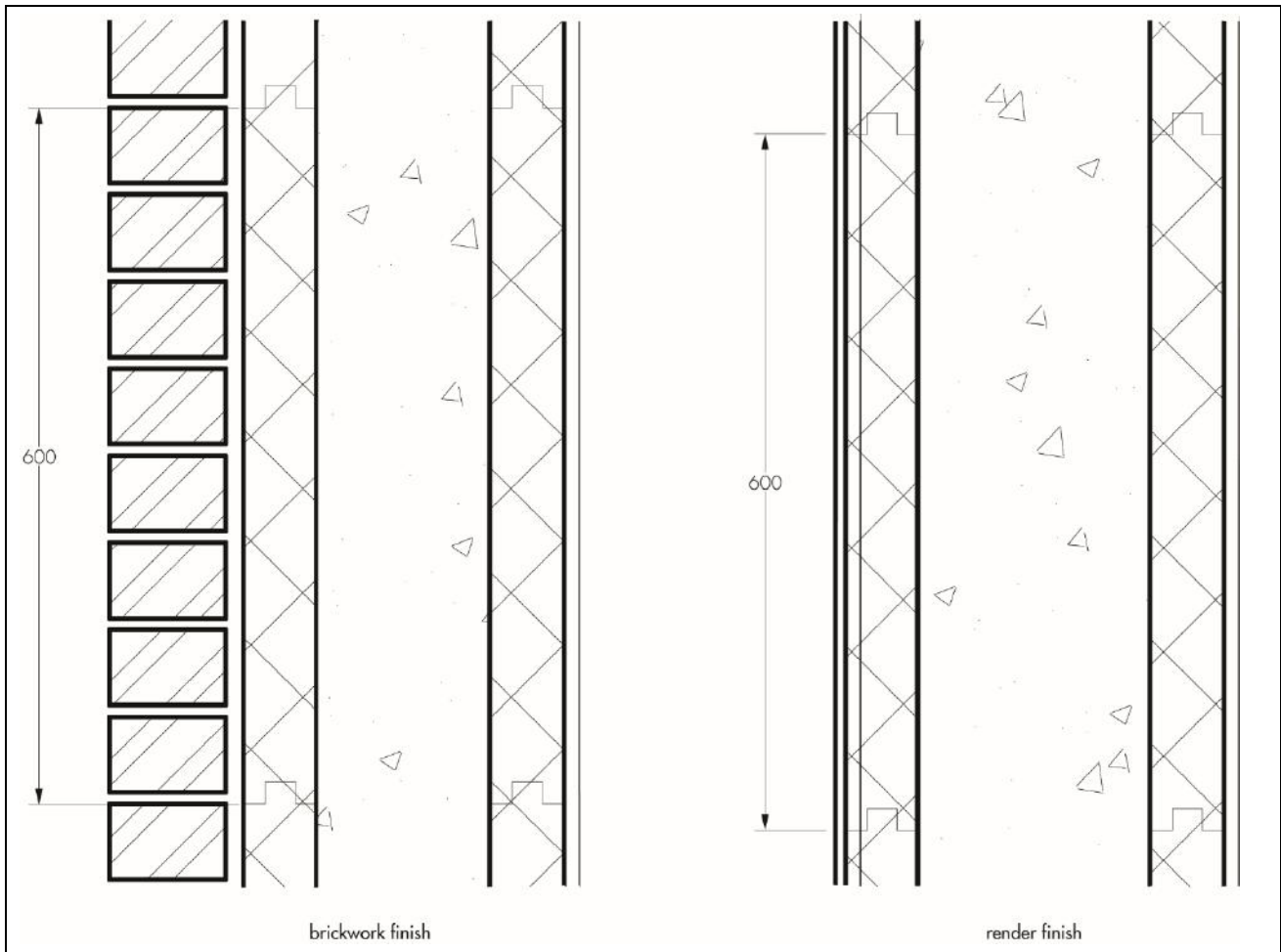
6.5 Storey-height walls using the system are normally constructed in one lift. Particular care is necessary to maintain alignment during concrete filling, and checking between lifts. Bracing systems used in conjunction with the EPS system must be checked prior to, and during, concrete filling to ensure stability and that alignment is maintained.

6.6 The *PolySteel Technical Manual* should be consulted in respect of the use of poker vibration for compaction of wet concrete.

6.7 When the system is used to construct a watertight basement or retaining wall (not covered by this Certificate), an effective waterproofing method should be employed, ensuring correct detailing and jointing methodology to the manufacturer's instructions (see Figure 3 and sections 11.1 and 11.2) and the requirements of BS 8102 : 2009 for Types A, B and C watertight construction.

6.8 Generally, facing brickwork or stonework should be attached using suitable fixings, secured through the EPS and into the concrete core (see also section 1.9). Fixings should be applied to the depth recommended by the manufacturer. A typical wall construction is shown in Figure 1.

Figure 1 Typical wall construction



6.9 Heavy attachments or finishes, fixed either internally or externally, must be attached via support systems designed to take account of the applied load, using suitable fixings or plates fixed or cast into the concrete core. The attachment strips must not be used to support any internal or external loads other than those specified in section 1.9 unless separate testing has been carried out (not covered by this Certificate) to ascertain the safe working load of the strips and any fixings used.

Strength and stability



6.10 Walls constructed using the system may be treated as conventional plain or reinforced concrete walls. Particular attention should be made to the type of concrete mix used to ensure segregation does not occur and the wet concrete is allowed to flow freely around formed openings and through congested areas of reinforcement, particularly when the system is used in basement construction.

6.11 The nominal concrete cover to reinforcement should be that appropriate to exposure classes X0 and XC1 stated in BS 8500-1 : 2006, Table A.1, and BS EN 206-1 : 2013, Table 1.

6.12 To achieve structurally stable formwork during the construction process, the system must be braced sufficiently to resist the loads imparted on the system by the wet concrete and other construction loads. The Certificate holder is able to supply a temporary bracing system (see Figure 2) designed to give lateral support during the pouring of the concrete and post-pouring stage. The system also provides a platform access for operatives and includes screw jacks for adjustment-purposes, both prior to and immediately following pouring operations.

Figure 2 Bracing system



6.13 Accurate levelling of the foundation and initial setting-out of the propping (see sections 18.15 to 18.19) should avoid the need for significant adjustments to be made at a later stage.

7 Thermal performance



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

7.2 Calculations of the thermal transmittance (U value) of a specific wall construction should be carried out in accordance with BS EN ISO 6946 : 2007 and BRE Report BR 443 : 2006, using the estimated thermal conductivity λ_D of $0.038 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (white EPS) and $0.031 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (grey EPS).

7.3 The U value will depend on the construction of the wall, the finish and the number and type of fixings used. Specific metal tie/spacers and fixings used for plasterboard and other finishes will also affect the overall U value.

7.4 To enhance the U value of the wall, the construction can include extra insulation.



7.5 Under the national Building Regulations, the system performs as follows:

England and Wales and Northern Ireland

- walls are better than the U value specified for a wall in a 'notional' building in SAP 2009 The Government's Standard Assessment Procedure for Energy Rating of Dwellings, Appendix R, Table R1, or the Simplified Building Energy Model (SBEM). Therefore, the system can contribute to enabling a building to meet the Target CO₂ Emission Rate (TER) as specified in Approved Documents L1A and L2A and Technical Booklets F1 and F2 respectively (see Tables 3 and 4).

Scotland

- walls containing the ICF system can satisfy the Limit U values specified in the Technical Handbooks, Clause 6.2.1. Therefore, the system can contribute to enabling a building to meet its TER or it can meet the U values of the simplified approach given in the Domestic Handbook, Clause 6.1.2 (see Table 5).

Table 3 Mean design U values — England and Wales⁽¹⁾

Construction	U value (W·m ⁻² ·K ⁻¹)
Notional non-domestic building	0.26
Dwelling new-build limit	0.30
Notional dwelling	0.35
Non-domestic new-build limit	0.35

(1) Flexible approaches on existing buildings are given in the Approved Documents.

Table 4 Mean design wall U values — Northern Ireland⁽¹⁾

Construction	U value (W·m ⁻² ·K ⁻¹)
Existing building – new wall	0.30
Notional dwelling	0.35
Notional non-domestic building	0.35
Building new-build limit	0.35

(1) Flexible approaches on existing buildings are given in the Technical Booklets.

Table 5 Mean design wall U values — Scotland⁽¹⁾

Construction	U value (W·m ⁻² ·K ⁻¹)
Notional dwelling	0.19
New dwelling simplified method	0.19
Extension to dwelling	0.19
Stand-alone building < 50 m ² to a dwelling	0.22
New non-dwellings limit for shell and fit-out	0.23
New dwelling limit	0.25
New non-domestic limit	0.27
Notional non-dwelling	0.30

(1) Flexible approaches on existing buildings are given in the Technical Handbooks..

7.6 The system can maintain, or contribute to maintaining, continuity of thermal insulation at junctions between the wall and other building elements. For Accredited Construction details, the corresponding ψ -values (psi) given in BRE Information Paper IP 1/06, Table 3, may be used in carbon emission calculations in Scotland and Northern Ireland. For new-build in England and Wales, these values should be increased by whichever is the greater of 0.02 or 25% for new dwellings and 0.04 or 50% for non-dwellings. Detailed guidance for other junctions and on limiting heat loss by air infiltration, can be found in:

England and Wales — Approved Documents to Part L and, for new thermal elements to existing buildings, Accredited Construction Details (version 1.0)

Scotland — Accredited Construction Details (Scotland)

Northern Ireland — Accredited Construction Details (version 1.0).

7.7 The system can maintain, or contribute to maintaining, continuity of thermal insulation at junctions between walls and other building elements. The guidance given in BRE Report BR 262 : 2002 is acceptable.

8 Risk of condensation

Surface condensation



8.1 External walls will adequately limit the risk of surface condensation. Openings in walls and junctions with other elements, designed in accordance with the relevant guidance given in section 11, will also be acceptable.

Interstitial condensation



8.2 Subject to the construction used and amount of water vapour being produced, the risk of interstitial condensation will be minimal. Any vapour build-up will be low and will dissipate during the summer months. Therefore, a vapour check is not required. For the purposes of calculating condensation risk a nominal vapour diffusion factor (μ) of 60, in accordance with BS EN 12524 : 2000, may be taken for the EPS panels.

9 Behaviour in relation to fire



9.1 The Certificate holder has not declared a reaction to fire classification for the forms in accordance with BS EN 13501-1 : 2018.

9.2 The forms are not classified as non-combustible or of limited combustibility.



9.3 In England and Wales, the forms should not be used for external walls of buildings with a storey 18 m or more above ground level and which contains: one or more dwellings, an institution, a room for residential purposes (excluding any room in a hostel, hotel or boarding house), student accommodation, care homes, sheltered housing, hospitals or dormitories in boarding schools or non-domestic buildings less than one meter from a boundary.



9.4 In England, Wales and Northern Ireland, the forms are unrestricted in terms of proximity to a boundary and, for constructions comprising an outer leave of brick or concrete at least 75 mm thick and with cavities closed (with cavity barriers in Northern Ireland) around openings and at the top of the wall, is unrestricted in terms of height, other than those described in section 9.3. For other constructions, the system should not be used in buildings with a floor more than 18 m above the ground.



9.5 In Scotland, the forms may be used without restriction on height or proximity to a relevant boundary, provided they are installed with an outer leave of masonry at least 75 mm thick, and has a cavity barrier around all openings in the wall and at the top of the wall head. For other constructions, the product should not be used 1 m or less from a boundary or in a building with a floor more than 11 m above the ground. Additional restrictions apply to separating elements.

9.6 Designers should refer to the relevant national Building Regulations and guidance for detailed conditions of use, particularly in respect of requirements for fire resistance, cavity closers and barriers, fire stopping of service penetrations and combustibility limitations for other materials and components used in the overall wall construction.



9.7 Concrete walls constructed from the system have been assessed in accordance with BS 8110-2 : 1985, Table 4.6, which show fire-resistance values for various reinforced concrete wall thicknesses formed using the system elements. Fire-resistance values achievable using the system are set out in Tables 6 and 7 of this Certificate. Alternatively, if reinforced concrete walls are designed in accordance with BS EN 1992-1-1 : 2004, fire-resistance values for various concrete wall thicknesses set out in BS EN 1992-1-2 : 2004, Table 5.4, can be used subject to cover and design load considerations. For unreinforced walls acting as fire walls, the minimum thickness requirements set out in BS EN 1992-1-2 : 2004, clause 5.4.2, must be taken into account. This assessment does not take account of any additional protection provided by the internal and external finishes. The use of the formwork with the specified finishes will not reduce the fire resistance of the concrete wall.

Table 6 Minimum concrete core thickness for walls with vertical reinforcement (BS 8110-2 : 1985 only)⁽¹⁾

Reinforcement and concrete specification	Minimum dimensions (mm) of concrete in the formwork, excluding any combustible finish, for a fire resistance (loadbearing capacity, integrity and insulation) of:				
	0.5 h	1 h	1.5 h	3 h	4 h
Walls with less than 4% reinforcement made from dense aggregate	150	150	200		
Walls with 0.4% to 1% reinforcement made from dense aggregate with 25 mm cover to reinforcement	150	150	150	200	
Walls with over 1% reinforcement made from dense aggregate with 25 mm cover to reinforcement	150	150	150	150	200

(1) Concrete walls constructed from the system have been assessed in accordance with BS 8110-2 : 1985, Table 4.6.

Table 7 Minimum concrete core thickness for loadbearing reinforced concrete walls (from BS EN 1992-1-2 : 2004, Table 5.4)

Standard fire resistance	Minimum dimensions (mm). Wall thickness/axis distance ⁽¹⁾ for			
	$\mu_{fi}^{(2)} = 0.35$		$\mu_{fi}^{(2)} = 0.7$	
	wall exposed on one side	wall exposed on two sides	wall exposed on one side	wall exposed on two sides
REI 30	100/10 ⁽³⁾	120/10 ⁽³⁾	120/10 ⁽³⁾	120/10 ⁽³⁾
REI 60	110/10 ⁽³⁾	120/10 ⁽³⁾	130/10 ⁽³⁾	140/10 ⁽³⁾
REI 90	120/20 ⁽³⁾	140/10 ⁽³⁾	140/25 ⁽³⁾	

(1) Centre of reinforcement to nearest exposed surface.

(2) The definition of μ_{fi} is given in BS EN 1992-1-1 : 2004, section 5.3.2(3).

(3) Normally, the cover specified in BS EN 1992-1-1: 2004 is more critical.

10 Weathertightness

Resistance to rain ingress is provided by the external finishes (not covered by this Certificate). Care should be taken to ensure the design and construction comply with the relevant good practice described in the applicable codes and the Certificate holder's Installation procedures.

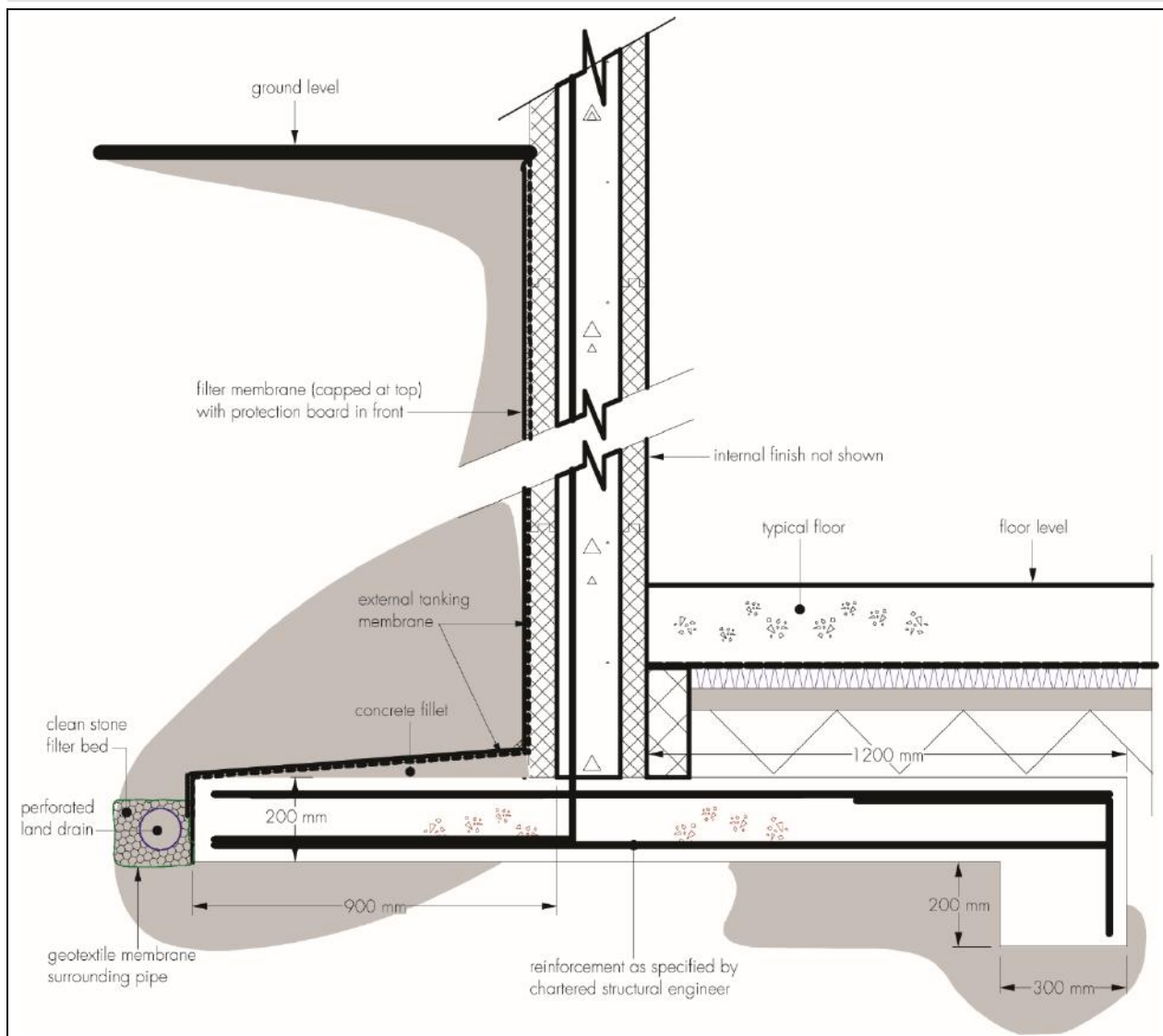
11 Damp-proofing and waterproofing



11.1 The form elements will not transmit moisture by capillary action. The concrete wall formed with the system should be constructed using the specified concrete recommended by the Certificate holder, and detailing incorporating damp-proof membranes where required (see sections 1.7, 1.9 and 6.7).

11.2 Use of the forms below ground to resist the effects of hydrostatic head or ground water ingress has not been assessed, and is not covered by this Certificate. However, for general guidance when using below ground or at formation level, eg basements or retaining walls (see Figure 3), waterproofing membranes compatible with EPS must always be used. A suitable collector drain and backfilling medium should be provided to eliminate the build-up of hydrostatic head behind the wall. The Certificate holder should be consulted for advice on suitable waterproofing materials and methods of waterproofing.

Figure 3 Typical basement/retaining wall detail



12 Proximity of flues and appliances

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

England and Wales — Approved Document J3

Scotland — Mandatory Standards 3.18, clause 3.18.5⁽¹⁾⁽²⁾, and 3.19, clause 3.19.4⁽¹⁾⁽²⁾

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).

Northern Ireland — Technical Booklet L.

13 Airtightness



13.1 Buildings can achieve adequate resistance to unwanted air infiltration provided there is effective sealing around junctions.



13.2 In England, Wales and Northern Ireland, completed buildings are subject to pre-completion testing for airtightness in accordance with the requirements of Approved Documents L1A and L2A (Regulation

20B), Technical Booklet F1 (sections 2.46 to 2.54), and Technical Booklet F2 (sections 2.57 to 2.61) respectively.



13.3 Completed buildings in Scotland are only subject to pre-completion airtightness testing if the target air permeability of the proposed building is less than $10 \text{ m}^3 \cdot \text{h}^{-1} \cdot \text{m}^{-2}$, or if the figure is between $10 \text{ m}^3 \cdot \text{h}^{-1} \cdot \text{m}^{-2}$ and $15 \text{ m}^3 \cdot \text{h}^{-1} \cdot \text{m}^{-2}$ and the designer does not wish to use the $15 \text{ m}^3 \cdot \text{h}^{-1} \cdot \text{m}^{-2}$ default figure in the proposed dwelling, in accordance with Mandatory Standard 6.2, clauses 6.2.4⁽¹⁾, 6.2.5⁽¹⁾, 6.2.6⁽²⁾ and 6.2.7⁽²⁾.

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

14 Sound insulation



14.1 Separating walls with a concrete core density greater than $2200 \text{ kg} \cdot \text{m}^{-3}$ and thickness of 150 mm, will achieve a minimum mass per unit area for the core of $330 \text{ kg} \cdot \text{m}^{-2}$. When used in conjunction with suitable independent framing, additional linings and flanking details, the wall can meet the requirements of a wall Type 3. Separating walls with a concrete core density greater than $2200 \text{ kg} \cdot \text{m}^{-3}$ and thickness of 200 mm will achieve a minimum mass per unit area for the core of $440 \text{ kg} \cdot \text{m}^{-2}$ and can meet the requirements of a wall Type 3.

14.2 Internal walls and walls flanking separating walls in new dwellings and rooms for residential purposes should have a minimum mass per unit area, excluding finishes, in excess of $120 \text{ kg} \cdot \text{m}^{-2}$.



14.3 Separating walls in dwellings and rooms for residential purposes in England and Wales are subject to pre-completion testing in accordance with Approved Document E, Section 1.

15 Maintenance and repair



Minor repairs to the formwork can be carried out prior to concrete pouring using expanded foam, supplied by the Certificate holder, to reduce leakage of wet concrete and maintain the thermal integrity of the EPS.

16 Durability



16.1 Concrete walls constructed with the forms will have a service life of not less than 60 years provided they are designed in accordance with section 5 of this Certificate. The EPS formwork will have a similar service life provided it is protected from damage by the external and internal finishes of the wall construction (constituting a 'mild' exposure environment) and these are adequately maintained.

16.2 The galvanized steel and polypropylene tie/spacers within the forms will have durability comparable with that of the EPS form panels if similarly protected.

17 Reuse and recyclability

Components from the wall formed from system can be recycled. Suitable care should be employed to separate elements of the EPS panels, concrete and reinforcement bars and steel ties at demolition sites.

Installation

18 General

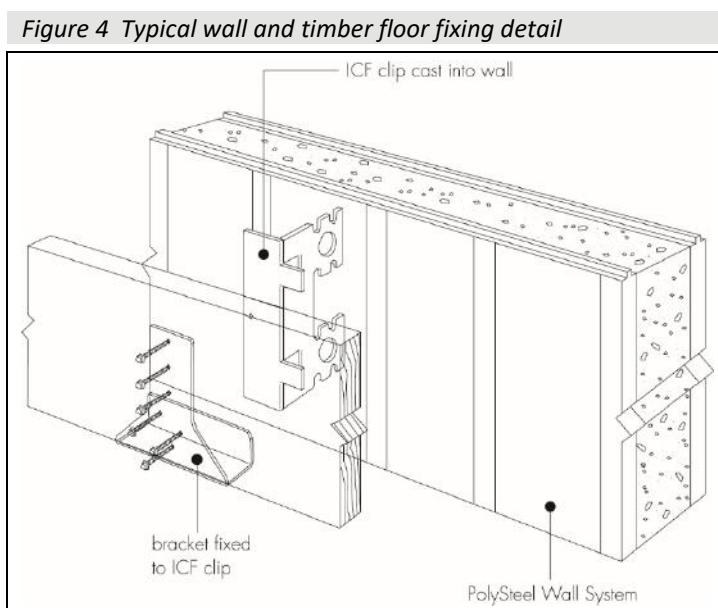
18.1 Installation of the PolySteel PSI-4000 Series Insulating Concrete Forms (ICF), insertion of any reinforcement and placing of concrete is carried out by operatives trained and registered by the Certificate holder and the requirements of

BS 5975 : 2008 and BS 8000-2.1 : 1990. The Certificate holder operates a training course for installers and retains documented procedures and a list of currently registered installers.

18.2 The panels can be cut using conventional woodworking tools, hot knife, tin snips and side cutters and, when trimmed, held together using proprietary steel clips, wire and adhesive to provide additional resistance to the hydrostatic head of the wet concrete. Adjustment to wall height can be by trimming either the top or bottom course. Forms should be suitably sealed and laterally restrained at the base to avoid leaching of concrete and movement due to concreting operations.

18.3 Generally, concrete should be placed into the form voids by line pump and nozzle although a hopper and chute can also be used; small quantities of concrete, eg to window sills, can be placed by hand. The requirements given in sections 19.8 and 19.9 must be observed during placing and compacting of the concrete.

18.4 Suitably durable and mechanically adequate fixings (see Figure 4) must be used for all structural elements or support brackets and must be post-drilled or cast into the concrete core. The EPS forming each of the system components must not be used as a structural medium although tie/spacer furring strips, as described in section 1.4, can be used. In specifying wall fixings carrying vertical loads, consideration should be given to the line of action of the load with respect to the face of the concrete wall and the effect on the strength of the fixing.



18.5 Consideration should be given at the design stage to the positioning of damp-proof courses and gas membranes, wall fixings, service pipes and joists, relative to the position of connecting assemblies. They can be incorporated by following the manufacturer's details. Care must be taken not to damage the forms, and cold bridging effects must be considered.

Electrical and plumbing installation

18.6 Electrical and plumbing services can be fixed within the formwork or into the concrete core by cutting chases into the EPS using a router or hot knife. All electrical services should be specified and installed in accordance with the Institute of Electrical Engineers' latest Wiring Regulations. Any services introduced should also conform to Building Regulation and Health and Safety requirements. Further details on fixing methods can be obtained from the Certificate holder. The Certificate holder also recommends that only electrical cable with low smoke and fume type insulation casing is used.

Wall penetrations

18.7 Sleeves for ducts for service penetrations can be positioned within the formwork prior to concrete pouring. Service entry points to basement walls should be avoided. All service entry points should be sealed to prevent ingress of water, dampness or vermin.

Intermediate floors and roof

18.8 A range of installation and floor systems can be accommodated with the system. Typical examples are shown in Figures 5 and 6.

Figure 5 Typical wall and timber floor detail

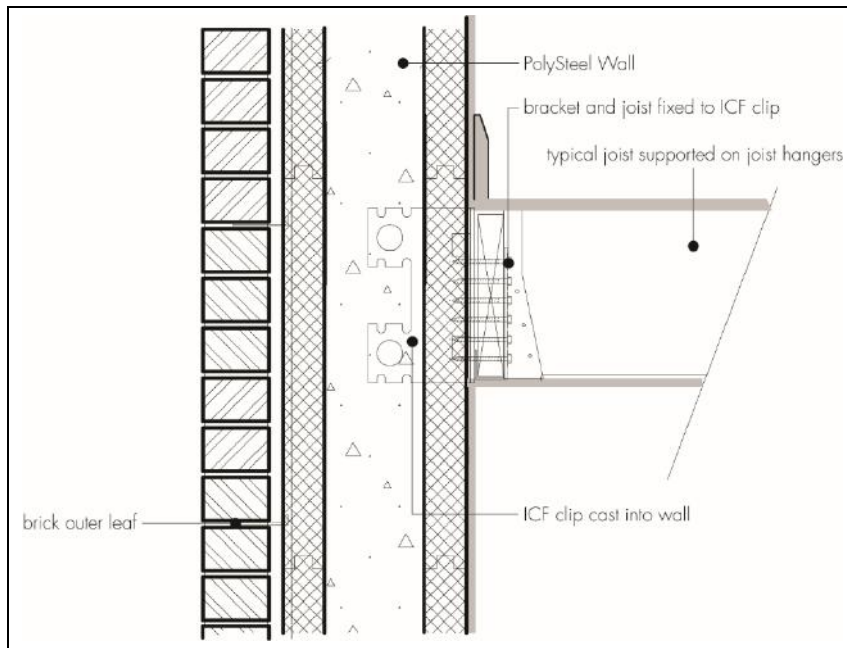
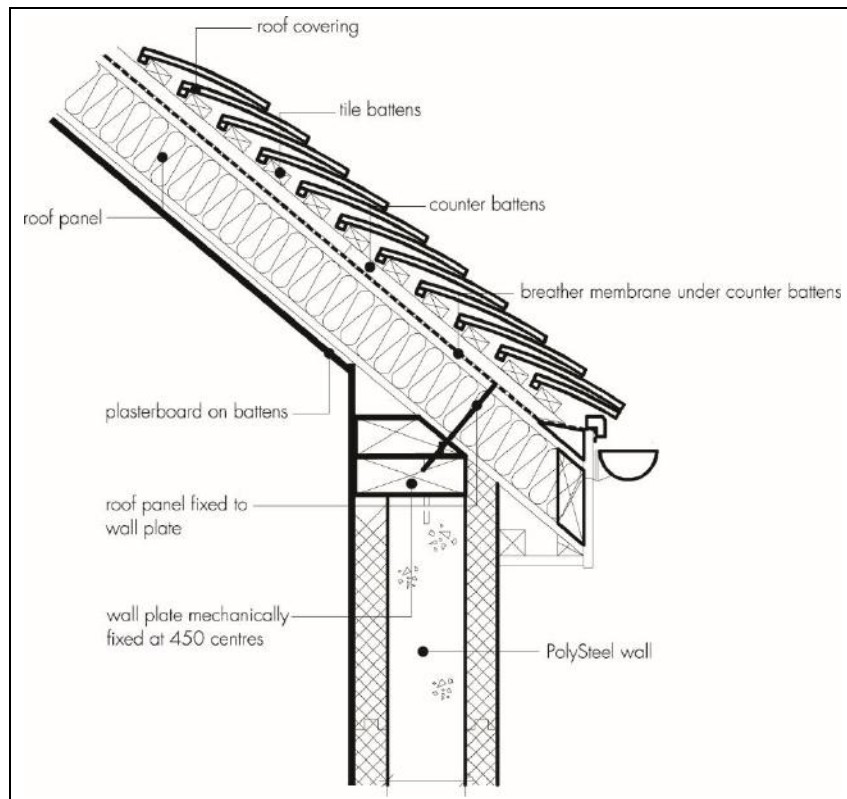


Figure 6 Typical wall and roof detail



External finishes

18.9 Subject to structural design considerations wall ties for masonry and external cladding systems (fixed via battens, rails) can be screw-fixed into form tie/spacer furring strips. Render systems (described in section 1.9) can be applied directly to the EPS surface in conjunction with metal or plastic lathing. Further details can be obtained from the Certificate holder.

Internal and other external finishes

18.10 A range of internal finishes can be applied or fixed directly to the forms. This Certificate only covers the use of conventional dry lining systems, based on gypsum plasterboard. These can be dot and dabbed but should also be screw-fixed into the form tie/spacer flanges or glued to EPS using compatible adhesive.

18.11 The recommendations given in BS 8102 : 2009 should be adopted in respect of the watertightness of the whole structure. The advice of the Certificate holder should be sought on particular applications.

18.12 Penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The advice of the Certificate holder should be sought on suitable details.

Heavy wall loads

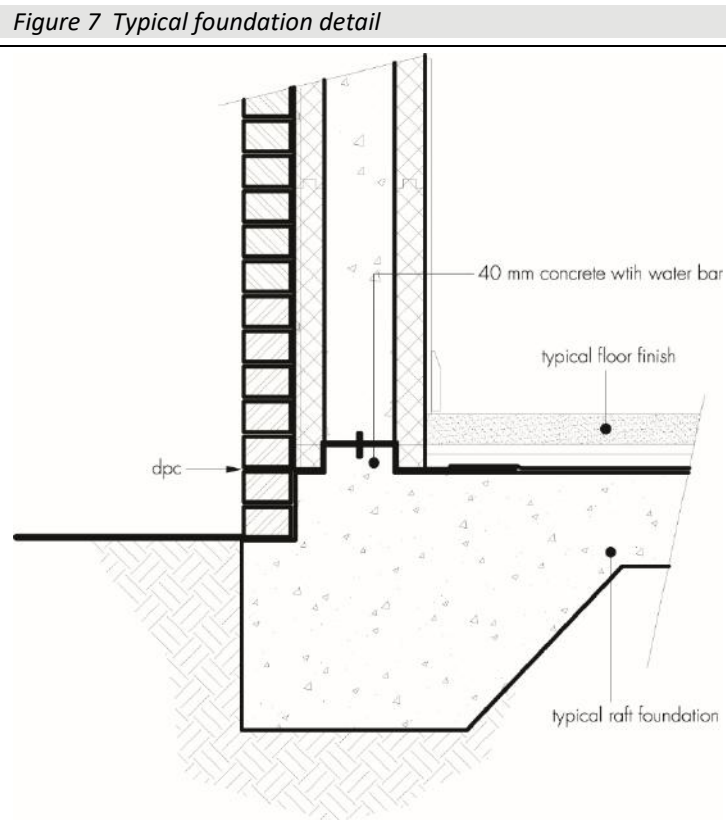
18.13 Heavy wall loads (such as central heating boilers) should be supported by the concrete core and not the form tie/spacer attachment strips. Typical methods of fixing heavy loads include timber blocks or plywood wallplates, screwed or bolted into the concrete core, cast-in anchor bolts and metal plates.

Preparation

18.14 The preparation, installation and support of the ICF panels must be in accordance with the Certificate holder's installation instructions.

18.15 The foundation must be level, smooth finished and within a tolerance of ± 5 mm in any direction. Any out-of-tolerances must be made good prior to placement of formwork. A typical foundation detail is shown in Figure 7.

18.16 The quantities of reinforcement placed within the system are dependent on design and detail requirements (see section 4) of this Certificate. Horizontal reinforcement can be placed in different locations across the concrete fill void and tied to the tie/spacers. Vertical reinforcement can then be placed against the horizontal reinforcement and secured using standard fixing methods. Bar lapping lengths in accordance with BS 8110-1 : 1997 or BS EN 1992-1-1 : 2004 should be adopted. All reinforcement should be accurately positioned to ensure that the minimum required cover to the concrete is provided. Starter or dowel bars are recommended depending on reinforcement requirements. Tie/spacers should not be cut or modified when locating reinforcement.

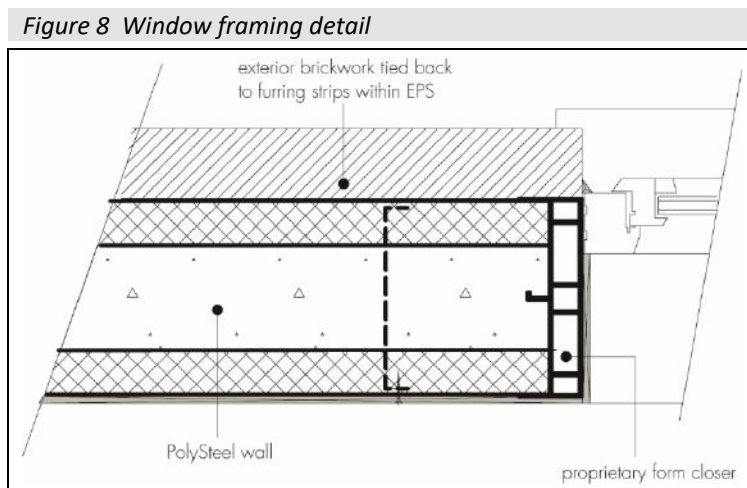


18.17 When stepped foundations are required, 600 mm steps should be provided wherever practically possible to avoid unnecessary cutting of forms.

18.18 It is essential that effective bracing and propping of walls takes place during construction to ensure stability, level, straightness and plumb of walls. Vertical bracing/support should be provided at corners and longitudinally at a minimum of 1200 mm to a maximum of 3000 mm centres depending on design requirements, exposure of site and weather conditions. The Certificate holder can advise on the provision of bracing systems.

18.19 Generally, the bracing and propping systems are placed on one side of the formwork (usually the inside face) and at external corners during construction. However, in accordance with the PolySteel and bracing instruction manuals, where forms have to be cut to suit building dimensions or where limitations in space prevent a continuous placement of bracings, it may be necessary to brace from either or both sides. Bracing must stay in place until the concrete has attained its minimum design strength.

18.20 Window and door openings (see Figure 8) are formed during construction and are carried out by cutting out the formwork at the desired locations. Once formed, the openings are lined with either timber framing, glued, screwed and propped into position, or moulded PVC form closers supplied by the Certificate holder. Generally, the timber framing is 150 mm by 50 mm or 200 mm by 50 mm treated timber. The sill of the opening can be left open to avoid the possibility of air pockets forming during concrete placement (see section 19.9). The timber framing and form closers remain and are used for subsequent fixing of finishes or for through-fixing of door and window frames.



18.21 Ideally, storey heights should be completed in one pour but, where day joints are unavoidable, the concrete pour must be finished near to the top of the forms and any cement laitance removed to expose the aggregate as soon as the initial set has occurred.

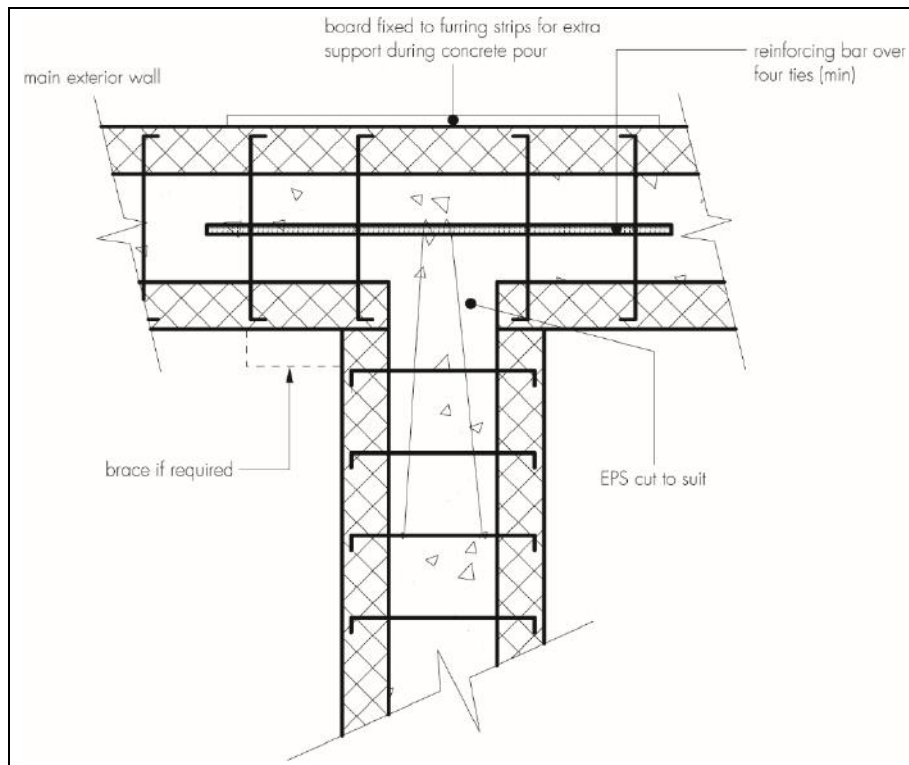
19 Procedure

Laying ICF

19.1 Construction of the first course commences by first locating the corner forms and working inwards towards the centre of each wall line or structural opening. Where a running bond is required to be maintained, the 'left' corner form is used in the first course and the 'right' corner form used in the second course. With the first course, it is advisable to run the forms through door and deep window openings (these can be cut out later) so that interlocking of forms is maintained above each opening. The forms can be cut to make up wall lengths. It is important, when constructing the formwork that the furring strips are lined vertically, this is achieved by lining up the vertical thin grooves in the EPS on the outside of the forms. Where cutting the forms is unavoidable, after butting the vertical faces together, a temporary plywood plate should be employed (screwed into the nearest furring strips either side of the joint) to strengthen the joint against the pressure from the wet concrete.

19.2 Internal wall formwork is jointed into external formwork by removal of a vertical slice (see Figure 9).

Figure 9 Internal/external wall connection



Placement of reinforcement (where required)

19.3 Horizontal reinforcement is placed, as required, across the concrete fill void and secured to the tie/spacers using standard fixing methods. Vertical reinforcement is placed against the horizontal reinforcement and secured.

Restraint and propping

19.4 Once the first lift of formwork is completed, a suitable bracing system is erected. Corner bracings are also recommended to keep corners plumb. All bracings should be anchored to the ground-floor slab or firm ground and be at 1.2-metre to 3-metre centres depending on formwork design requirements. The metal furring strips within the forms can generally be used as the temporary fixing medium for the bracing and vertical supports subject to the fixings not exceeding 400 mm centres.

19.5 Once the bracing is erected, adjustments are made for plumb and level by use of screw jacks incorporated within the braces.

Windows and doors

19.6 Window and door openings (see Figure 8) are formed and trimmed using the timber framing or the PVC form closers (bucks) supplied by the Certificate holder (see Figure 8). Openings should be made slightly oversize to allow for swelling of timber framing and building tolerances.

Concrete placement

19.7 Prior to concrete pouring, a check is carried out on the system to ensure conformity to design and layout, correct alignment and plumb, and that bracings are secured. Reinforcement should be checked for correct cover distance and rigidity.

19.8 Small volumes of concrete can be placed by hand, eg to make up small deficiencies at the end of each pour. For concrete pumping, a 75 mm nozzle should be used with two 90° bends in the pump line or a swan neck fitting to assist in the smooth flow of concrete at the delivery end and help prevent small pump surges. The concrete pump should be set at a low pumping rate to aid placement and keep excessive pressure on the sides of the formwork to a minimum. For the initial and subsequent traverses of the pump nozzle, the concrete pour height should be restricted to 1200 mm. The second traverse should not commence until the concrete has stiffened and the formwork has been checked for

alignment and plumb. The next traverse proceeds in the same manner until the first storey-height has been reached. At window and door openings, concrete should be poured either side of each opening up to sill level and the concrete allowed to stiffen before the next pour is commenced.

19.9 Generally, consolidation can be achieved by the use of special-flow concrete mixes. Where mechanical vibration is used, the diameter of the poker vibrator should be not more than 25 mm. Specific concrete mixes are dependent on individual requirements and are outside the scope of this Certificate. Other methods of consolidating the concrete are described in the Certificate holder's Installation Manual.

Backfilling

19.10 Backfilling around bottom layers of formwork to the ground floor or basement walls should not take place until the concrete has reached sufficient design strength (a minimum period of seven days is recommended by the Certificate holder). The top of basement walls must be supported by temporary supports or by utilising the floor construction on the basis that the floor/wall joint allows full transfer of loads through diaphragm action.

Technical Investigations

20 Tests

Tests on the PolySteel PSI 4000 Series Insulating Concrete Forms (ICF) were carried out in broad accordance with the requirements of ETAG 009 : 2002 as part of normal construction under site conditions. Observations were made on the resistance to filling pressure and efficiency of filling using a line pump. The overall stability of formwork due to head of wet concrete was also noted.

21 Investigations

21.1 A site visit was carried out to witness the installation process including construction of formwork, placement of reinforcement and pouring of concrete and performance of form tie/spacers.

21.2 An assessment was made on test data relating to thermal performance.

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ETAG 009 : 2002 *Guideline for European Technical Approval of non-loadbearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete*

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Conditions

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