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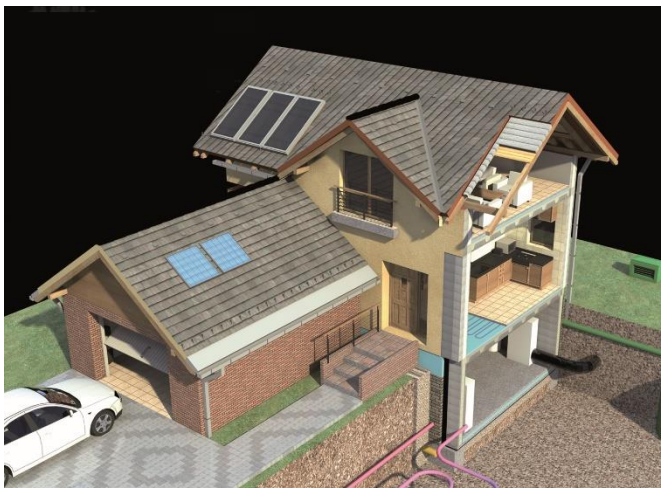
Agrément Certificate
21/5850
Product Sheet 1

CREO WALL SYSTEMS

CREO ICF WALL SYSTEM



This Agrément Certificate Product Sheet(1) relates to the CREO ICF Wall System, comprising expanded polystyrene elements with integral web spacers. The system provides permanent insulation formwork for use in the formation of loadbearing and non-loadbearing internal, external and separating walls in domestic and non-domestic buildings, subject to height restrictions.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

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

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

Risk of condensation — walls, wall junctions and openings can adequately limit the risk of condensation (see section 9).

Behaviour in relation to fire — the system's EPS components have a reaction to fire classification of E in accordance with BS EN 13501-1 : 2018 and are restricted in some cases (see section 13).

Durability — the system will have a service life in excess of 60 years (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.

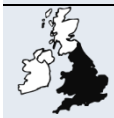
On behalf of the British Board of Agrément

Date of First issue: 26 January 2021

Hardy Giesler
Chief Executive Officer

Regulations

In the opinion of the BBA, the Creo ICF Wall System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the 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:	**B3(4)**	**Internal fire spread (structure)**
Comment:		The system is restricted by this Requirement. See sections 13.1, 13.2 and 13.7 of this Certificate.
Requirement:	**B4(1)**	**External fire spread**
Comment:		The system is restricted by this Requirement. See sections 13.1 and 13.2 of this Certificate.
Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The system can adequately limit the risk of surface condensation and contribute to minimising the risk of interstitial condensation. See sections 9.1, 9.3 and 9.4 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The system can contribute to satisfying this Requirement. See sections 7 and 8.1 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The system is acceptable. See section 16 and the *Installation* part of this Certificate.
Regulation:	**7(2)**	**Materials and workmanship**
Comment:		The system is restricted by this Regulation. See sections 13.1 and 13.2 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 sections 7 and 8.1 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 and 16 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
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 13.1, 13.3 and 13.7 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 sections 13.1 and 13.3 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 sections 13.1 and 13.3 of this Certificate.
Standard:	3.15	Condensation
Comment:		The system can adequately limit the risk of surface condensation, with reference to clauses 3.15.1(1)(2) and 3.15.4(1)(2) of this Standard. Walls can contribute to minimising the risk of interstitial condensation, with reference to clauses 3.15.1(1)(2) and 3.15.5(1)(2) of this Standard. See sections 9.2 to 9.4 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), 6.1.2(1) and 6.1.6(1). See sections 7 and 8.1 of this Certificate.
Standard:	6.2	Building insulation envelope
Comment:		The system can contribute to satisfying this Standard, with reference to clauses 6.2.1(1)(2), 6.2.3(1), 6.2.4(2) and 6.2.5(2). See sections 7 and 8.1 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 the system is can achieve higher levels of sustainability as defined in this Standard.
Regulation:	**12**	**Building standards applicable to conversions**
Comment:		Comments in relation to the system under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1(1)(2) and Schedule 6(1)(2).

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

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

Regulation:	**23(a)(i) (iii)(b)(ii)**	**Fitness of materials and workmanship**
Comment:		The system is acceptable. See section 16 and the *Installation* part of this Certificate.
Regulation:	**29**	**Condensation**
Comment:		The system can contribute to minimising the risk of interstitial condensation. See sections 9.3 and 9.4 of this Certificate.
Regulation:	**35(4)**	**Internal fire spread – Structure**
Comment:		The system is restricted by this Regulation. See sections 13.1, 13.2 and 13.7 of this Certificate.
Regulation:	**36(a)**	**External fire spread**
Comment:		The system is restricted by this Regulation. See sections 13.1 and 13.2 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Comment:		The system can contribute to satisfying this Regulation. See sections 7 and 8.1 of this Certificate.
Regulation:	**40(2)**	**Target carbon dioxide emission rate**
Comment:		The system can contribute to satisfying this Regulation. See sections 7 and 8.1 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 section: 3 *Delivery and site handling* (3.4) and the *Installation* part of this Certificate.

Technical Specification

1 Description

1.1 The Creo ICF Wall System comprises blocks of grey expanded polystyrene (EPS) moulded into formwork elements (see Figures 1 and 2). The wall is formed by placing or pouring concrete into the formwork. The formwork components are detailed below:

- standard wall elements (known as Creo 35)
- end elements
- corner elements
- ring beam elements
- lintel elements
- insulation spacers
- end piece.

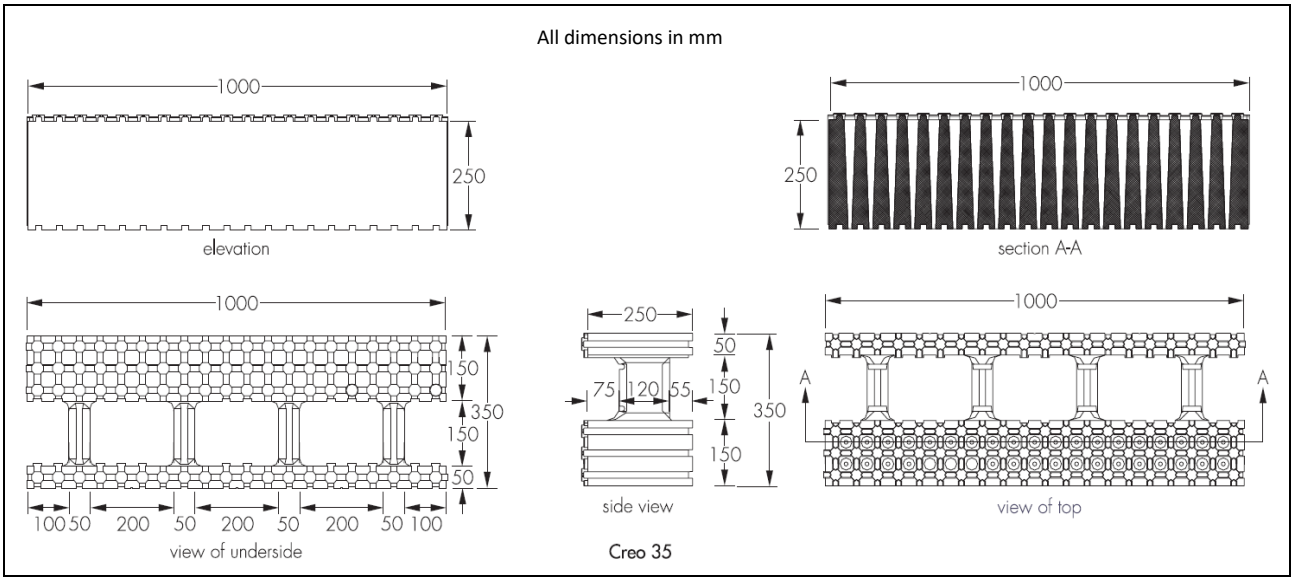
1.2 The minimum density of the EPS is 28 $kg \cdot m^{-3}$, with a minimum compressive strength of 140 kPa(1) at 10% deformation and minimum bending strength of 290 kPa(1).

(1) The declared compressive strength and bending strength are not assessed.

1.3 The Creo 35 standard wall elements (shown in Figure 1 of this Certificate) are 250 mm high and 1000 mm long – however, the length can be cut to suit depending on function – and consist of an inner (50 mm thickness) and outer skin (150 mm thickness) of EPS with an integral EPS web connecting both skins. Together, the inner and outer skin create a total wall thickness of 350 mm, which includes a 150 mm concrete core. The webs are 50 mm thick by 120 mm deep, and are slotted at the top to accommodate horizontal reinforcement as required by the designer. The outer skins incorporate vertical conical air channels in two rows. The voids formed by the skins and webs are 150 mm wide by 200 mm long and, once filled with concrete, create a structural pattern of interlinking columns that act as the structural element of the system. Blocks are stacked vertically using a castellated horizontal joint, with the perpendicular joints being butted together.

1.4 The end piece, corner and ring beam elements have a standard width of 250 mm. Where the width of the standard wall element is wider than 250 mm, the insulation spacers will increase the width of these elements to balance the difference. The insulation spacers are 250 mm high by 50 mm thick and their length can vary. The number of the spacers required depends on the width difference to be balanced.

Figure 1 Standard wall elements (Creo 35)

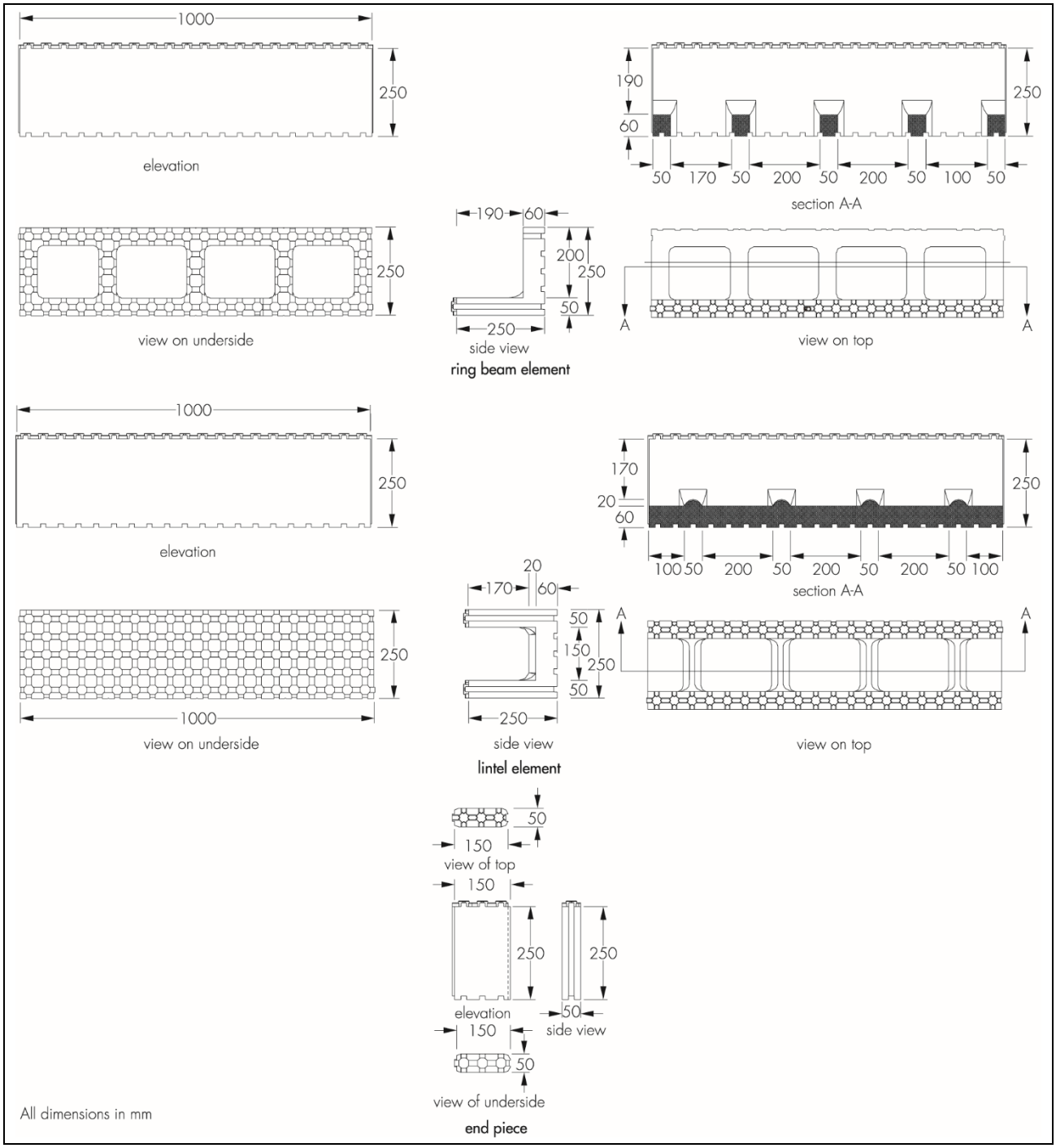


1.5 The end elements close wall sections at the side of openings. They are available in right- and left-hand versions, with a height of 250 mm, a width of 250 mm and a length of 500 mm. The thickness of the inner and outer skin is 50 mm.

1.6 Corners are formed using the corner elements. They are available in right- and left-hand versions, with a height of 250 mm and leg lengths of 100 mm and 250 mm measured inside.

1.7 The ring beam elements are used at the junctions of wall and floor structures, and are 250 mm wide by 1000 mm long by 250 mm high.

Figure 2 Other wall elements



1.8 The lintel elements are used above openings, and are 250 mm wide by 1000 mm long by 250 mm high.

1.9 End pieces can be inserted into the standard wall elements to close the gap at openings and at the end of freestanding walls. They can also be used to curtail the length of standard wall elements and, as an alternative, for creating corners and wall ends from standard wall elements. Each piece is 150 mm long by 250 mm high by 50 mm thick.

1.10 The elements are dry laid in brick-bond formation and interlocked to form a tight joint. Where a storey-height formwork is built, it must be supported during the concrete filling operation.

1.11 The formwork components are detailed in Table 1.

Table 1 Formwork components

Components	Material	Dimensions (mm)			
		Length	Width	Height	Thickness
Standard blocks (Creo 35)	EPS	1000	350	250	-
End elements	EPS	500	250	250	50
Corners	EPS	100 (inside leg)	250	250	50
Ring beam elements	EPS	1000	250	250	-
Lintel elements	EPS	1000	250	250	-
End Pieces	EPS	150	-	250	50

1.12 Concrete, typically strength class C28/C35 for basement work (1) and C20/C25 elsewhere, specified to BS EN 8500-1 : 2015 and BS EN 206 : 2013 is recommended. The recommended aggregate size is 10 mm. It should contain an admixture complying with BS EN 934-2 : 2009 to allow placement by free flow only. In relation to consistence of the concrete, the recommended slump is 170 mm when tested to BS EN 12350-2 : 2019. Specific concrete mixes are dependent on individual requirements and are outside the scope of this Certificate.

(1) outside the scope this Certificate

1.13 Components and finishes specified for use with the system, but outside the scope of this Certificate, are:

- concrete core — as specified in section 1.12
- steel reinforcement, where required – should comply with BS 4449 : 2005
- external masonry — may be of brickwork or stonework fixed in accordance with the provisions of BS EN 1996-2 : 2006, or BS 8298-1 : 2010, BS EN 8298-2 : 2020 and BS EN 8298-3 : 2020 as appropriate
- waterproofing membrane as required (see section 12.2)
- brickwork/stonework ties — to BS EN 845-1 : 2013
- bracing and alignment support system as supplied or specified by the Certificate holder
- external render — in accordance with BS EN 13914-1 : 2016 and suitable for use with the system
- brick slip systems with third-party certification — the Certificate holder's advice should be sought
- cladding — timber, cement board or metal sheet
- internal finish — typically 12.5 mm thick plasterboard or a dry-lined finish, with or without a plaster skim coat conforming to BS 8212 : 1995

2 Manufacture

2.1 The elements are manufactured from grey expanded polystyrene (EPS) in accordance with BS EN 13163 : 2012.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

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

3.2 The system components are supplied loose or on pallets, bearing a label with details of the products including component type and dimensions, and the BBA logo incorporating the number of this Certificate.

3.3 The system components should be stored upright and protected from damage to the toothed edges.

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 components must not be exposed to open flame or other ignition sources. The components must be protected from wind and rain until they are used.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Creo ICF Wall System.

Design Considerations

4 Use

4.1 The Creo ICF Wall System is for use in loadbearing and non-loadbearing internal, external and separating walls in domestic and commercial buildings with up to a five-storey superstructure.

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 Walls formed from the system are subject to design and supervision by a suitably qualified and competent individual, and adherence to structural design to British or European Standards (see section 6.1).

5 Practicability of installation

Construction of the system must be carried out by trained operatives or installers experienced with this type of system, in accordance with the Certificate holder's installation manual.

6 Structural performance

General

6.1 Walls formed from the system which are subject to the national Building Regulations should be designed in accordance with the relevant recommendations of BS 8102 : 2009 and limit principles set out in BS EN 1990 : 2002 to loadings in BS EN 1991-1-1 : 2002, BS EN 1991-1-2 : 2002, BS EN 1991-1-3 : 2003, BS EN 1991-1-4 : 2005, BS EN 1991-1-5 : 2003, BS EN 1991-1-6 : 2005, BS EN 1991-1-7 : 2006, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004. A suitably qualified individual such as a Chartered Structural Engineer must also ensure that foundations (outside the scope of this Certificate) are adequate to support the intended loads.

6.2 Walls formed from the system which are not subject to the national Building Regulations should also be designed in accordance with the Standards listed in section 6.1.

6.3 The concrete is not easily examined after casting. Hence, as specified in BS EN 1992-1-1 : 2004, Sections 4 and 8, care must be taken to ensure full compaction. Compaction may be checked by removal, observation and replacement of a section of EPS panel. Particular attention should be given to areas adjacent to formed openings.

6.4 The formwork is normally filled with concrete in layers of two courses of the formwork.

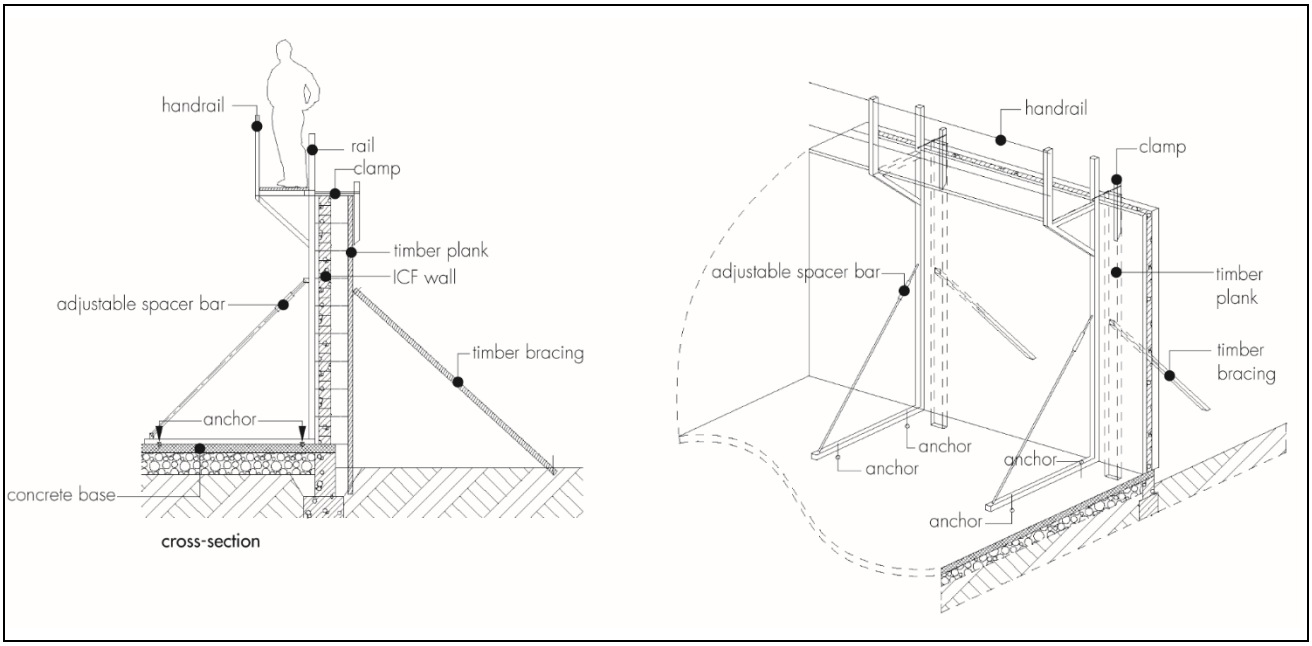
6.5 Storey-height walls using the system are normally constructed in one lift. Particular care is necessary to maintain alignment during concrete filling, and checking of alignment is required between lifts. Propping systems used in conjunction with the system must be checked prior to and during the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

6.6 Particular attention should be paid to the type of concrete mix used, to ensure segregation does not occur and that the wet concrete is allowed to flow freely around formed openings and through congested areas of reinforcement. It is recommended that a pumpable concrete of grade C20/C25, with a cement content of 300 $kg \cdot m^{-3}$, a maximum water/cement ratio of 0.7 and aggregate with a maximum size of 10 mm, is used.

6.7 The nominal concrete cover to reinforcement should be suitable for the environmental exposure condition (XC1 and XC3 for internal and external walls, respectively).

6.8 To achieve structurally stable formwork during the construction process, the system must be braced sufficiently to resist the loads imparted on it by wet concrete, wind loads and other construction loads acting on both faces of the wall. The Certificate holder recommends a specific propping/support system (see Figure 3 and section 18.20), designed to give lateral support during the pouring of the concrete and curing stage. The propping/support system also provides platform access for operatives and includes screw props for adjustment purposes, both prior to and immediately following pouring operations.

Figure 3 Propping / support system



6.9 Attention is drawn to the need for accurate levelling of the foundation and, where necessary, initial setting out of the propping (see sections 18.20, 18.21 and 18.22) which should prevent the need for significant adjustments to be made.

7 Thermal performance

7.1 Calculations of thermal transmittance (U value) should be carried out in accordance with BS EN ISO 6946 : 2017 and BRE Report BR 443 : 2006, using the declared thermal conductivity (λ_D) value given in Table 2.

Table 2 Thermal conductivity for CREO 35

Insulation Component	**Declared thermal conductivity λ_D ($W \cdot m^{-1} \cdot K^{-1}$)**
Grey EPS	0.031

7.2 The U value will depend on the construction of the wall, the external finish and the number and type of fixings used. As examples, a construction comprising (external to internal):

Creo 35 Wall block

- minimum of 8 mm thick render coat applied directly to the outer face, 150 mm thick external grey EPS, 150 mm thick concrete(1), 50 mm thick internal grey EPS and 12.5 mm thick dense plasterboard bonded to the EPS achieves a U value(2)(3) of 0.15 $W \cdot m^{-2} \cdot K^{-1}$

- 102.5 mm thick brick external skin and 50 mm wide air cavity, 150 mm thick external grey EPS, 150 mm thick concrete, 50 mm thick internal grey EPS and 12.5 mm thick dense plasterboard bonded to the EPS achieves a U value(3) of 0.14 $W \cdot m^{-2} \cdot K^{-1}$

(1) maximum 1% steel-reinforced concrete (λ = 2.30 $W \cdot m^{-1} \cdot K^{-1}$)
(2) approximately the same U value for walls without external and internal finishes.
(3) thermal modelling indicates that the fixing method used for plasterboard and other finishes may affect the U value of walls.

Junctions

7.3 The system can contribute to maintaining continuity of thermal insulation at junctions with other elements, and minimise thermal bridges and air infiltration. Detailed guidance can be found in the documents supporting the national Building Regulations.

8 Airtightness

8.1 Walls formed from the system can achieve adequate resistance to unwanted air infiltration provided there is effective sealing around junctions**.**

8.2 Completed buildings are subject to pre-completion testing in accordance with the national Building Regulations.

8.3 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 $m^3 \cdot h^{-1} \cdot m^{-2}$, or if the figure is between 10 and 15 $m^3 \cdot h^{-1} \cdot m^{-2}$ and the designer does not wish to use the 15 $m^3 \cdot h^{-1} \cdot m^{-2}$ default figure in the proposed dwelling, in accordance with the national Building Regulations.

9 Risk of condensation

Surface condensation

9.1 Walls will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.7 $W \cdot m \cdot^{-2} K^{-1}$ at any point, and the junctions with other elements are designed in accordance with the guidance referred to in section 7.3 of this Certificate.

9.2 For buildings in Scotland, wall constructions will be acceptable when the thermal transmittance (U value) does not exceed 1.2 $W \cdot m \cdot^{-2} K^{-1}$ at any point, and the junctions with other elements are designed in accordance with the guidance referred to in BS 5250 : 2011, Annex G. Further guidance may be obtained from BRE Report BR 262 : 2002 and section 7.3 of this Certificate.

Interstitial condensation

9.3 Walls will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Annexes D and G, and the relevant guidance.

9.4 The EPS grade of the insulation is minimum EPS 100. The water vapour diffusion resistance factor (μ) taken from BS EN 13163 : 2012, Table F2, is 60.

10 Sound insulation

10.1 Separating walls with a concrete core density greater than 2200 $kg \cdot m^{-3}$ and thickness of 150 mm, together with a single layer of plasterboard on each side, will achieve a required minimum mass per unit area for the core of 300 $kg \cdot m^{-2}$. When used in conjunction with suitable framing, lining and flanking details, the wall can satisfy the requirements of a Type 3 wall, as described in Approved Document E, Sections 2 and 3 of the England and Wales Regulations.

10.2 Separating walls are subject to pre-completion testing in accordance with the documents supporting the national Building Regulations.

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

11 Weathertightness

11.1 Resistance to rain ingress is provided by the external finishes but this has not been assessed by the BBA and is outside the scope of 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.

11.2 On NHBC sites, only external finishes incorporating a ventilated and drained cavity are acceptable.

12 Damp-proofing and waterproofing

12.1 The system's elements will not transmit moisture by capillary action. Concrete walls formed with the system should be constructed using the specified concrete recommended by the Certificate holder (see sections 1.12 and 6.6).

12.2 Use of the system below ground to resist the effect of hydrostatic head or ground water ingress has not been assessed and is outside the scope of this Certificate. However, for general guidance, when used below ground or at formation level, eg basements or retaining walls, waterproofing membranes compatible with EPS should be used. A suitable collector drain and backfilling medium should be provided to eliminate the build-up of hydrostatic head behind the wall, where required. The Certificate holder should be consulted for advice on suitable waterproofing materials and methods of waterproofing.

13 Behaviour in relation to fire

13.1 The EPS component of the system has a reaction to fire classification of E in accordance with BS EN 13501-1 : 2018; therefore, the system is limited for use in buildings subject to height restrictions.

13.2 In England, Wales and Northern Ireland, the system should not be used in buildings with floors or external walls of buildings more than 18 m above the ground level.

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

13.4 The risk of fire spread over the internal wall surface will depend on the finishes used. The relevant requirements of the national Building Regulations must be observed. Internal finishes are not covered by this Certificate.

13.5 To limit the risk of fire spread between floors in buildings subject to the national Building Regulations, fire barriers (outside the scope of this Certificate) must be installed as required in the documents supporting the national Building Regulations. Fire barriers must completely seal the cavity and be chased into the outer EPS formwork.

13.6 Care must be taken to ensure that all detailing at junctions (including internal wall/floor junctions) adequately maintains the required periods of fire resistance, any cavities formed in the completed walls or service entry points are appropriately fire stopped and detailing around any openings provide sufficient protection to the EPS. The EPS on the interior face should be discontinuous across wall / floor junctions.

Fire resistance of concrete core

13.7 The fire resistance classification, based on tests to EN 1365-1 : 1999 with a test load of 120 $kN \cdot m^{-1}$ and following assessment of concrete walls constructed from the system with different finishes, are summarised in Table 3 of this Certificate. During design, the relevant requirements of the national Building Regulations should be observed. (Test report M-426/2008 by EMI, dated 10 December 2008, available from the Certificate holder)

Table 3 Resistance to fire

Wall type	REI classification (1)	Internal finish (2)	External finish
Internal	REI 30	15 mm fire protection gypsum board each side	-
Internal	REI 60	2 No. 15 mm fire protection gypsum board each side	-
Internal	REI 90	15 mm fire protection gypsum board + 20 mm air gap + 50 mm rockwool (min 30 kg m^{-3} density) + Knauf CW 50 steel frame + wire mesh	15 mm fire protection gypsum board
External	REI 30	15 mm fire protection gypsum board	Thin render
External	REI 60	15 mm fire protection gypsum board + 15 mm standard gypsum board	Thin render
External	REI 60	15 mm fire protection gypsum board + 20 mm air gap + 50 mm rockwool (min 30 kg m^{-3} density) + Knauf CW 50 steel frame + wire mesh	Thin render
External	REI 90	15 mm fire protection gypsum board + 15 mm standard gypsum board + 15 mm fire protection gypsum board	Thin render
External	REI 120	3 No. 15 mm fire protection gypsum	Thin render
External	REI 120	3 No. 15 mm fire protection gypsum + 20 mm air gap + 60 mm rockwool (min 100 kg m^{-3} density) + Knauf CW 50 steel frame + wire mesh	Thin render

(1) Fire from inside.
(2) Construction in sequence listed, starting from internal surface.

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

14 Proximity of flues and appliances

Detailed guidance can be found in the documents supporting the national Building Regulations for the provisions that are applicable when the system is installed in close proximity to certain flue pipes and/or heat-producing appliances.

15 Maintenance and repair

Minor repairs to the formwork can be carried out prior to concrete pouring using suitable expanded foam, to reduce leakage of wet concrete and maintain the thermal integrity of the EPS. Further guidance on maintenance is given in the Certificate holder's *Maintenance and Repair Manual.*

16 Durability

16.1 The EPS formwork will have a service life in excess of 60 years, provided it is protected from damage by the external and internal finishes of the wall construction (the presence of the finishes ensures a 'mild' exposure environment), and these are adequately maintained.

16.2 Concrete walls constructed with the system will have a design life in excess of 60 years provided they are designed in accordance with section 6 of this Certificate.

17 Reuse and recyclability

The system components comprise EPS, which can be recycled.

18 General

18.1 Installation of the Creo ICF Wall System should be carried out by trained operatives or installers.

18.2 In general, concrete is placed by pump using concrete from a batching plant. Small volumes can also be placed by hand or skip with adapted neck or pump, if necessary.

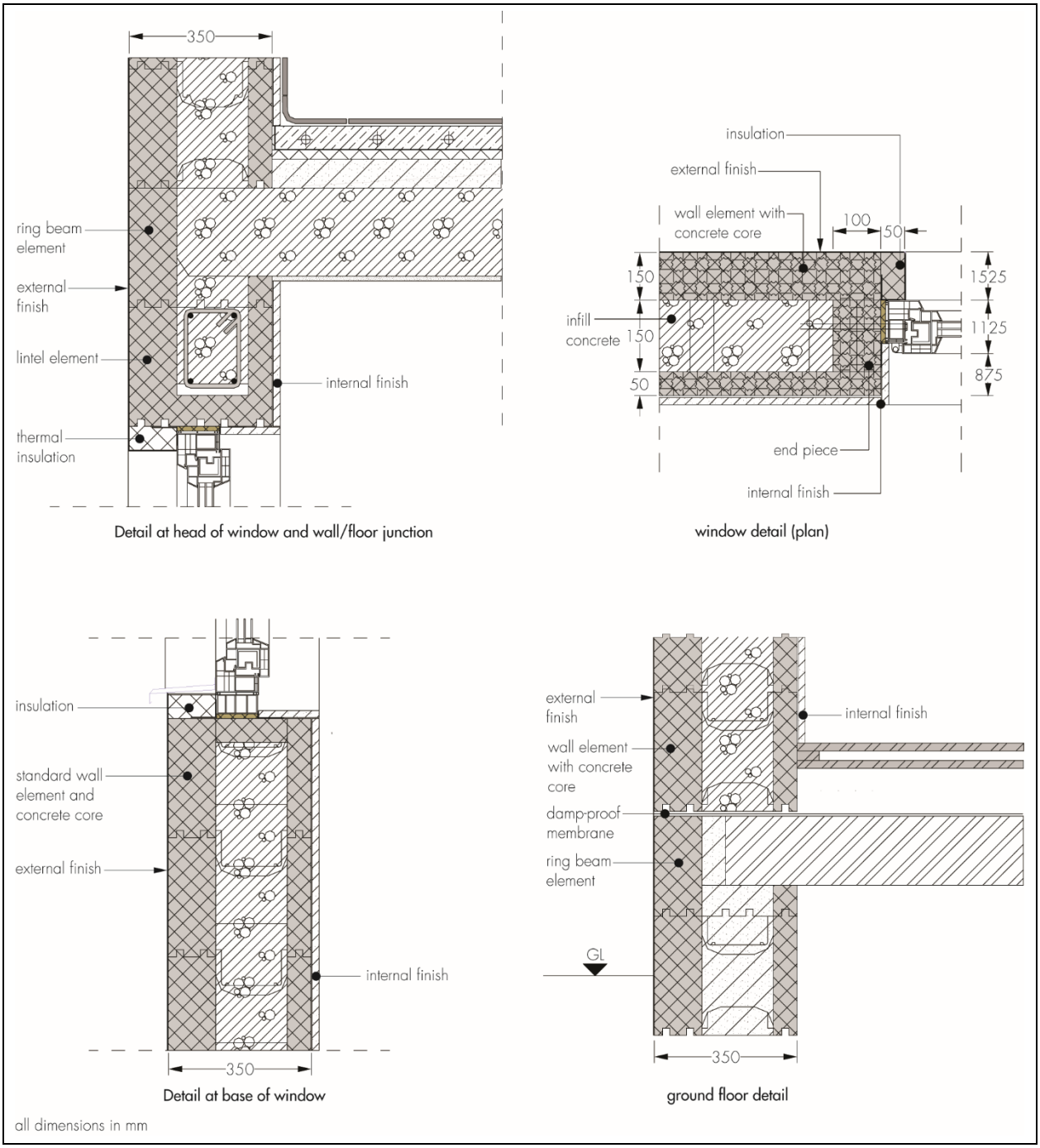
18.3 Consideration should be given at the design stage to the incorporation of wall fixings, support brackets, service entry points, ducting, pipework and other building elements, to minimise post-construction cutting out or chasing of the concrete core. Suitably durable and mechanically adequate fixings must be used for all structural elements 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. In specifying wall fixings carrying vertical loads, consideration should be given to the effect of bending between the face of the concrete core and outer edge of the EPS.

18.4 Other detailing can also be incorporated in the construction of the formwork subject to the Certificate holder's recommendations. In carrying out any cutting or modifications to the system, care must be taken not to damage or weaken the formwork elements that could result in the loss of integrity or overall stability of the temporary construction. Cold bridging effects must also be considered where any services pass through the wall construction.

18.5 The preparation, installation and support of the system and application of any specified finishes must be in accordance with the Certificate holder's installation manual. The Certificate holder can also give guidance on the use of a suitable propping system.

18.6 Typical construction details are shown in Figure 4.

Figure 4 Typical installation of the ICF system



Foundation

18.7 The system requires that the foundation is level, smooth finished and within a tolerance of +10 mm. Any out-of-tolerances must be made good prior to placement of formwork.

18.8 All reinforcement should be accurately positioned to ensure that the minimum required concrete cover is provided. Starter or dowel bars, where required, must be to the engineer's design.

18.9 When stepped foundations are required, they should be provided in 250 mm steps, subject to foundation depth, so as to avoid cutting forms.

18.10 A damp-proof membrane (dpm) is laid through the wall or under the slab (depending on the detailing) to prevent the ingress of dampness during the construction process. The external detail must be such that protection is provided to at least 150 mm above the external ground level. For ground bearing floors, the slab dpm should link to the wall

damp-proof course (dpc) to provide complete protection and eliminate the possibility of capillary action between the slab and wall.

Laying

18.11 If the dpc under the first course of the EPS formwork cannot be made even enough, an additional concrete levelling course should be applied.

18.12 Construction commences by forming the corners and working inwards towards the mid-point of each wall line. The longer end of the corner element should be used to start the first course, maintaining a running bond. It is important to run the elements through door and deep window openings to preserve dimensional accuracy. In the second course, the shorter end should be used to ensure staggered joints, and this process is followed to complete the formwork. Alternatively, standard wall elements can be used to create the corners using end pieces but parts of the adjoining standard wall elements need to be cut out to provide continuity of the concrete core.

18.13 Following completion of the first course, concrete is poured up to half the depth of the form, and the subsequent two courses are laid in a running bond.

18.14 At openings, end elements are used to close the sides of wall sections. In the subsequent course, an end piece is inserted into the standard wall element.

18.15 T-junctions are formed from standard wall elements. Parts of the connecting wall elements need to be cut out to provide a continuous concrete core.

18.16 Above openings, U-shaped lintel elements are used. The lintel element should overhang the opening by 250 mm at either side, and the bottom of the lintel element cut out where it rests on the standard wall elements to ensure a continuous concrete core is cast over the opening. Lintel elements spanning an opening more than 500 mm wide must be supported when the concrete is poured.

18.17 At wall and floor junctions, L-shaped ring beam elements are used. At corners, the ring beam elements need to be cut at an angle of 45°. The ring beam elements need to be supported from outside when the concrete is poured.

Reinforcement

18.18 All reinforcement should be accurately positioned to ensure that the minimum required concrete cover is provided (see Figure 4). Starter, dowel bars and bar lapping lengths, where required, must be to the engineer's design and in accordance with BS EN 1992-1-1 : 2004. If the EPS webs are cut or modified during construction, additional form support will be required.

18.19 The quantities of reinforcement placed within the system are dependent on design and detail requirements. Horizontal reinforcement (see Figure 4) can be placed in the centre or adjacent to core edges using the preformed slots in the webs. In plain walls, appropriate horizontal reinforcement should be provided at lintels in accordance with engineering requirements, and the reinforcing bars must extend an anchorage length past the opening to suit the bar diameter.

Restraint and propping

18.20 It is essential that effective bracing and propping of walls takes place during construction to ensure stability, alignment, straightness and plumb of walls. The Certificate holder recommends and can provide a suitable propping system (not covered by this Certificate). The system includes a vertical support channel, a horizontal rail anchored to the concrete slab and a diagonal adjustable brace.

18.21 Typically, the bracing and alignment systems are placed on one side of the formwork (usually the inside face) during construction. Consideration should be given to additional bracing to the outside face where stability could be compromised.

18.22 Once the bracing and propping is erected, adjustments are made for plumb and level by use of the diagonal brace.

Windows and doors

18.23 Window and door openings are formed during construction of the formwork with wall end elements, end pieces and lintel elements. Door and window frames are mechanically fixed through the EPS skins into the concrete core.

Concrete placement

18.24 Prior to the concrete pour, a check should be carried out on the system to ensure conformity with design and layout, correct alignment, and that bracings and props are secured. Reinforcement should be checked for correct cover distance and rigidity. Horizontal joints should also be protected from concrete overspill.

18.25 The concrete mix and slump must be checked to ensure they are to specification, in accordance with normal practice.

18.26 After the first course has been half filled with concrete and it has hardened, the subsequent two courses of the formwork are laid and concrete placed up to half height of the third course and allowed to harden. The next two courses are placed and concrete poured up to the half-height of the top course. This process is repeated until full height is reached. Alternatively, using a suitable bracing system, a storey-height formwork can be built, the first two courses filled with concrete and allowed to harden before pouring the next two courses. The process is repeated until full height is reached.

18.27 Concrete placement should be directed away from corners, allowing concrete to free-flow into corners and below window openings. The concrete must be poured onto the EPS webs to prevent uplift of the elements. Only manual compaction should be used — mechanical vibration must not be used.

Backfilling

18.28 Backfilling around bottom layers of formwork to the ground floor should not take place until the concrete has reached sufficient design strength (after 28 days, is recommended by the Certificate holder).

Partitions

18.29 Any type of partition wall can be jointed to the system. Partitions need to be attached to the concrete core after removing the EPS skin, and using suitable fixing methods.

Electrical and plumbing installation

18.30 Electrical and plumbing services can be fixed within the formwork by cutting chases into the EPS using a router, knife, saw or hot-wire knife. Any services introduced should conform to the national Building Regulations and Health and Safety requirements. Further details on fixing methods can be obtained from the Certificate holder.

Wall penetrations

18.31 Openings or ducts for service penetrations can be positioned within the formwork prior to concrete pouring. Service entry points to basement walls should be avoided.

Intermediate floors and roof

18.32 A range of roof and floor systems can be accommodated with the system. Further details can be obtained from the Certificate holder.

Internal finishes

18.33 A range of internal finishes can be applied to the system. Common dry lining systems, such as gypsum plasterboard, can be screw-fixed on a separate frame or bonded to EPS using compatible adhesive.

18.34 Penetrations through 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.

External finishes

18.35 External cladding systems can be installed on battens or rails fixed to the concrete core, or suitable renders can be applied directly to the EPS surface in conjunction with metal or plastic lathing, but these are outside the scope of this Certificate. The EPS surface contains vertical grooves to assist bonding of external render systems. Further details of suitable systems can be obtained from the Certificate holder.

Waterproofing

18.36 The ICF system relies on an externally applied compatible waterproofing membrane (applied to the surface of the EPS), together with effective detailing, to provide a barrier to the ingress of groundwater to basement walls. The waterproofing method is not covered by the Certificate but full details can be obtained from the Certificate holder.

18.37 A dpc must always be installed below the first course of the EPS formwork.

Heavy wall loads

18.38 All structural point loads (such as wall units) should be supported by the concrete core and not the EPS flanges or web. Typical methods include the use of timber blocks screwed or bolted into the concrete core or cast-in anchor bolts and metal plates.

Technical Investigations

19 Tests

Tests were carried out on the EPS and the results assessed to determine:

- density
- thermal conductivity.

20 Investigations

20.1 A site visit was carried out to witness a completed building and its performance in use

20.2 An assessment was made on technical data relating to :

- mechanical resistance of the EPS elements against concrete pressure
- structural design
- risk of condensation
- behaviour in relation to fire
- thermal performance.

20.3 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

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21 Conditions

21.1 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.

21.2 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.

21.3 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.

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

21.5 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.

21.6 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.