

BRE CERTIFICATION

CERTIFICATE NUMBER

131/07

MAY 2007

PRODUCT

SUPPLIED BY

AMVIC INSULATING CONCRETE FORMWORK SYSTEM

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SUMMARY

Amvic Insulating Concrete Formwork System (Amvic ICF System) has been assessed to confirm its suitability, within limitations, as a permanent insulating concrete formwork (shuttering) system. The forms are assembled on site and filled with a defined concrete mix and steel reinforcement, where required, to form cast-in-place external and internal concrete walls.

Amvic ICF System is used to form 150 mm and 200 mm thick insulated structural loadbearing and non-loadbearing concrete external and internal walls for use in residential and commercial buildings. The forms contribute to the thermal insulation of the finished wall.

The Amvic ICF System forms comprise two rectangular expanded polystyrene panels with a 150 mm or 200 mm wide internal cavity spanned at defined intervals by interconnecting polypropylene spacer webs. The forms are made in straight, 45° and 90° plan sections.

Amvic Ireland approved internal and external finishes (not assessed) provide the necessary damage, weather and fire protection.

The characteristics of the product and the method of application have been reviewed with respect to the Building Regulations current in the UK and Ireland. The assessment has referred to British Standards and other publications current in May 2007.

The assessment is described in the following pages which form integral parts of this certificate.

CONDITIONS OF USE

Amvic ICF System has been assessed for use as a construction method for forming vertical concrete walls of up to 5 storeys where the height of the top floor above ground is not more than 18 m and the maximum storey height is 3050 mm. The building height is limited by considerations of fire and structural performance as

dictated by the building use, detailed design and this certificate. Only walls are covered by this certificate.

The certificate includes the 'straight block', 'reversible 45° corner block' and 'left hand' and 'right hand reversible 90° corner blocks' only. Other forms are available but are not included within the scope of this certificate.

The performance of the system depends on correct installation. Amvic ICF System must be installed strictly in accordance with the Certificate holder's installation instructions, as inspected by BRE Certification and the requirements of this certificate. The quality of installation achieved on site is not covered by this certificate. It is therefore recommended that the quality of installation and workmanship is subject to appropriate checks by a competent person for each installation.

Only Amvic Ireland approved installers may install the system, and place and compact the concrete.

The Amvic ICF System can be finished with a variety of cladding or sealed render systems (including directly applied finishes), but these alternatives have not been assessed by BRE Certification other than to the extent that specific construction details have been assumed for fire, thermal and acoustic assessments. Claddings and their method of installation are outside the scope of this Certificate.

Foundations are outside the scope of this certificate.

For each design, the total structure (including the foundations and reinforcement) must be designed and specified by a competent and suitably qualified and experienced Structural Engineer in accordance with the current requirements of the relevant Building Regulations. The Structural Engineer must provide all relevant design and construction information to the Amvic Ireland approved installer. The Amvic ICF System forms must not be considered as providing any contribution to the overall structural performance of the walls. They must not be used to support scaffolding, chutes, or pumping equipment for conveying fresh concrete during pouring or any other structures.

The in-situ concrete is to be designed, specified and constructed in accordance with the minimum requirements for fire resistance and durability for external or party walls as set out by BS 8110-1 *Structural use of concrete. Code of practice for design and construction*, BS 8500-1 *Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier* and BS 8500-2 *Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete*.

Concrete should be sourced from a QSRMC (Quality Scheme for Ready Mixed Concrete) registered or BSI Kitemarked supplier. Steel reinforcement should be supplied by a CARES (UK Certification Authority for Reinforcing Steels) accredited supplier and be in accordance with BS 4449 *Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar coil and decoiled product. Specification*.

Where reinforcement is present for structural purposes mechanical vibration is essential. Mechanical vibrators or pokers above 25 mm diameter are not recommended with the Amvic ICF System. If reinforced concrete walls are required the Structural Engineer should be satisfied, taking into account the thickness of the wall and the nature of the building, that sufficient space is left around all reinforcement for the concrete to be adequately compacted.

So long as adequate compaction and correct design and installation is ensured, the Amvic ICF Forms may be used for basement construction, however the system has not been assessed by BRE Certification for forming watertight construction or for forming buildings subjected to ground water hydrostatic pressure.

STATEMENT

It is the opinion of BRE Certification that Amvic ICF System is satisfactory for use within the stated limitations provided that it is used in accordance with the supplier's instructions and the requirements of this certificate.

CONFIRMATION

For and on behalf of BRE Certification

Director:

Date: May 2007



1. TECHNICAL SPECIFICATION

1.1 Description of Product

1.1.1 General

1.1.1.1 Each Amvic ICF System form consists of two moulded flame-retardant expanded polystyrene (EPS) panels separated by polypropylene webs. Webs are partially embedded into the EPS panels during manufacture and are spaced at 150 mm horizontal centres. The polypropylene web ties/spacers are sized to maintain core widths of 150 and 200 mm. The forms interlock horizontally and vertically into a tight and rigid formwork.

1.1.1.2 Steel reinforcement is incorporated where required, <0.4 % reinforcement density for plain concrete or >0.4 % reinforcement density for reinforced concrete. The wall is formed by pouring concrete into the formwork.

1.1.1.3 This approval is for the 'straight block', 'reversible 45° corner block' and 'left hand' and 'right hand reversible 90° corner blocks' only (see Figure 1). Other available forms are not included in this approval.

1.1.2 EPS Panels

1.1.2.1 EPS panels are 400 mm high and 1200 mm in length and have a nominal thickness of 64 mm. They are manufactured from fire retardant grade EPS in accordance with BS EN 13163 *Thermal insulation products for buildings. Factory made products of expanded polystyrene. Specification*, without the use of HCFCs. The minimum density is 24 kg/m³.

Figure 1 straight, 45° and 90° corner blocks





1.1.2.2 The panels have castellated top and bottom edges to enable the forms to interlock. Vertical edges are grooved to form a flush fit when joined together. Forms are interlocked with staggered vertical joints.

1.1.2.3 The web flanges are embedded 12.7 mm behind the outside surface of the panels. The location of the web end plate is marked on external surfaces of the panels through recessed grooves in the panel surface at 150 mm centres.

1.1.3 Webs

1.1.3.1 The top and bottom edges of the polypropylene webs have clips that give support to horizontal reinforcing bars where required

1.1.3.2 The embedded flat sections of the webs can be used as furring strips to provide a fixing for bracing during construction and provide a means of attachment for exterior and interior wall finishes.

1.1.3.3 Polypropylene rods (outside the scope of the certificate) can be located at internal corners during site installation to provide a fixing point for internal lining finish materials.

1.1.4 Other components for use with Amvic ICF System

1.1.4.1 Concrete (Section 1.1.5) and Reinforcement (Section 1.1.6) (both outside the scope of the certificate) shall be designed, supplied and installed in accordance with Amvic Ireland's specifications and the requirements of this certificate. Other items (Section 1.1.7) and Claddings (Section 1.1.8) should comply with the

requirements of the relevant Section but their supply and method of installation are outside the scope of this Certificate.

1.1.5 Concrete

1.1.5.1 The minimum concrete grade, mix proportion limits and any reinforcement design including requirements for cover, must be specified by a suitably qualified and experienced Structural Engineer. Guidance is available from BRE Report 347 *Energy-efficient in-situ concrete housing using EPS permanent formwork*, BS 8110-1, BS 8500 and BS EN 206-1 *Concrete. Specification, performance, production and conformity*. Concrete should be pumpable (i.e. a minimum slump of 75 to 100 mm).

1.1.5.2 Concrete, typically Ordinary Portland Cement (OPC) CEM 1 normal weight Grade C30/35 for basement work and minimum C20/25 above ground, is specified to BS EN 206-1, BS 8500-1 and -2. The recommended maximum aggregate size is 15 mm for the 150 mm core form and 20 mm for the 200 mm core form. When using pumped concrete it is recommended that rounded aggregate should be used rather than angular aggregate to assist the flow properties. Concrete should have a minimum compressive strength 20 MPa at 28 days with water/cement ratio less than 0.55. Recommended slump S3, consistence 100 -120 mm. Admixtures if used should comply with BS EN 480 *Admixtures for concrete, mortar and grout. Test methods* or BS EN 934-2 *Admixtures for concrete, mortar and grout. Concrete admixtures. Definitions, requirements, conformity, marking and labelling* to allow placement either by rodding or by free flow. The concrete must be supplied by a QSRMC registered or BSI Kitemarked supplier. Concrete in Ireland must be supplied by a National Standards Authority of Ireland (NASI) registered supplier.

1.1.6 Reinforcement

1.1.6.1 Steel reinforcement, having a recommended max 12 mm diameter, shall be round or deformed bars, high tensile to BS 4449, BS 4482 *Steel wire for the reinforcement of concrete products. Specification*, BS 4483 *Steel fabric for the reinforcement of concrete. Specification* and BS EN 10020 *Definition and classification of grades of steel*, maximum yield strength 500 N/mm². Amvic Ireland recommend a maximum 1% reinforcement density with typically 200 mm vertical and horizontal centres. Steel reinforcement shall be supplied by a UK Certification Authority for Reinforcing Steels (CARES) accredited supplier. Steel reinforcement in Ireland must be supplied by a NASI registered supplier.

1.1.7 Other items

1.1.7.1 The following items are for use in conjunction with Amvic ICF System forms but are outside the scope of the certificate.

- Wall bracing ledger board systems
- Trestle Support System as supplied by the certificate holder
- Anchor bolts
- Brickwork/stonework ties to BS EN 845-1 *Specification for ancillary components for masonry. Ties, tension straps, hangers and brackets*
- PVC pipe sleeves for penetrations
- Basement waterproofing membrane
- Corner rods – hollow polypropylene rods

1.1.8 Claddings

Generally

1.1.8.1 Cladding should comply with all relevant clauses in supporting documents of the Building Regulations current in the UK and Ireland and recognised codes of practice and should be mounted and finished in accordance with wall cladding manufacturer's requirements or recognised codes of practice. Claddings and their method of installation are outside the scope of this certificate.

1.1.8.2 Claddings specified for use with the system by the certificate holder but not assessed or covered by this certificate are:

External claddings:

1.1.8.3 Silicone/acrylic render in accordance with BS EN 13914-1 *Design, preparation and application of external rendering and internal plastering. External rendering*, typically a basecoat of cement, sand and polymer reinforced with an embedded stainless or galvanized steel reinforcing lath, polypropylene mesh, or alkaline-resistant glass-fibre mesh.

- 1.1.8.4 Brickwork/blockwork or stonework with cavity, fixed in accordance with the provisions of BS 5628-1 *Code of practice for use of masonry. Structural use of unreinforced masonry* or BS 5628-3 *Code of practice for use of masonry. Materials and components, design and workmanship*
- 1.1.8.5 Stone in accordance with BS 8298 *Code of practice for design and installation of natural stone cladding and lining* respectively.
- 1.1.8.6 Brick slip system having third party certification for the intended use.
- 1.1.8.7 Timber weather boarding or hung tiles fixed on treated battens or rails screwed to the webs
- Internal cladding:
 - 1.1.8.8 12.5 mm thick plasterboard to BS EN 520 *Gypsum plasterboards. Definitions, requirements and test methods* installed vertically and attached to the web flanges with coarse-thread gypsum wallboard screws or glued with EPS compatible adhesive, in conformance with BS 8212 *Code of practice for dry lining and partitioning using gypsum plasterboard*.
 - 1.1.8.9 Directly applied in-situ plaster.

1.2 Product Performance

1.2.1 General

- 1.2.1.1 The Amvic ICF System comprises permanent insulating formwork which, when filled with dense aggregate concrete, forms loadbearing and non-loadbearing monolithic vertical walls on appropriate foundations.
- 1.2.1.2 The examples of external and internal claddings in Section 1.1.8 are considered, for information only, to indicate the weathertightness, fire and thermal performance levels that can be achieved in typical constructions. Typical details are shown in Figures 2 to 6.
- 1.2.1.3 The successful use of this product is very dependent on design and installation.

1.2.2. Structure

- 1.2.2.1 The Amvic ICF System, is considered suitable for use for external and internal walls on adequate foundations (not assessed) for residential and commercial buildings, provided that the requirements of this certificate are complied with. Total building height is limited by considerations of fire (see clause 1.2.3.6) and structural performance as dictated by the building use and detailed design.
- 1.2.2.2 The finished wall design (including the foundations and location of any steel reinforcement), design analysis and drawings must be certified by a competent and suitably qualified and experienced Structural Engineer as meeting the current requirements of the relevant Building Regulations. Calculations showing some procedures, load tables and indicative connection details are available from the certificate holder as an aid to this process.
- 1.2.2.3 The forms do not provide any contribution to the overall structural performance of the building.
- 1.2.2.4 Walls formed using the Amvic ICF System can be considered as being conventional monolithic concrete walls and as such should be designed and constructed in accordance with:
 - BS 8110-1, -2 *Structural use of concrete. Code of practice for special circumstances* to attain the necessary fire and durability performance
 - BS 6399-1 *Loading for buildings. Code of practice for dead and imposed loads*
 - BS 6399-2 *Loading for buildings. Code of practice for wind loads* thickness to withstand wind loads.
 - BS 6399-3 *Loading for buildings. Code of practice for imposed roof loads*.
- 1.2.2.5 So long as adequate compaction and correct design and installation is ensured, the Amvic ICF Forms may be used for basement construction, however the system has not been assessed by BRE Certification for forming watertight construction or for forming buildings subjected to ground water hydrostatic pressure. Basements can be constructed in accordance with the Approved Document 'Basements for dwellings' to The Building Regulations 2000, BS 8102 *Code of practice for protection of structures against water from the ground* and CP 102 *Code of practice for protection of buildings against water from the ground* subject to design by a Structural Engineer.

- 1.2.2.6 The concrete must have adequate flow characteristics to fill the formwork and be compliant with BS 8110-1. The concrete mix should ensure segregation does not occur and the wet concrete should flow freely through any congested area of reinforcement.
- 1.2.2.7 The size of steel rebar, placement and spacing shall be as required by BS 8110. The minimum concrete cover to any reinforcement shall be 25 mm. Excessive reinforcement should be avoided in the interest of adequate compaction. Scheduling, dimensioning, bending and cutting of rebar should be in accordance with BS 8666 *Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification.*
- 1.2.2.8 The nominal concrete cover to reinforcement should be that appropriate to 'mild' exposure in accordance with BS 8110-1, Tables 3.2 and 3.4, or as required for fire resistance in accordance with clause 1.2.3.1 and 1.2.3.2, whichever is greater.
- 1.2.2.9 Durable fixings appropriate to the intended use must be used for structural connections or supports and must be cast into the concrete or post-drilled. Heavy objects must be fixed back to the concrete in accordance with the Amvic Ireland Installation Manual.
- 1.2.2.10 Facing brick, block or stonework must be fixed to the concrete with stainless steel ties having fixing depths in accordance with tie manufacturer's recommendations.

1.2.3 Fire

- 1.2.3.1 Fire resistance periods (loadbearing capacity, insulation and integrity) are dependent upon the type of concrete used, type and location of reinforcement and quality of the concrete placing and compaction. The EPS makes no contribution to the fire resistance performance. When filled with correctly placed and compacted concrete, fire resistance periods as shown in Table 1 should be achieved.

Table 1. Fire resistance periods in accordance with BS 8110-2

Reinforcement specification using dense aggregate concrete (density 2000 to 2600 kg/m ³)	Fire resistance (load bearing capacity, integrity and insulation (minutes))	
	Amvic 150 mm	Amvic 200 mm
(a) Walls with less than 0.4% reinforcement.	60	90
(b) Walls with 0.4% to 1% reinforcement with cover to the reinforcement of 25 mm	90	180
(c) Walls with over 1% reinforcement with cover to the reinforcement of 25 mm	180	240
NB: where walls contain no reinforcement, they are included in type (a)		

- 1.2.3.2 This assessment does not assume any additional protection from the internal linings and external finishes. Cavity barriers, fire stops and compartmentation of the finished structure shall be in accordance with the relevant Building Regulations.
- 1.2.3.3 Although EPS is a combustible material its use in the Amvic ICF System is recognised and covered by BS 6203 *Guide to fire characteristics and fire performance of expanded polystyrene materials (EPS and XPS) used in building applications.* The panels are fire retardant grade (fire classification of Class E to BS EN 13501-1 *Fire classification of construction products and building elements. Classification using test data from reaction to fire tests*).
- 1.2.3.4 The risk of fire spread over the internal and external wall surfaces will depend on the finishes used. The relevant requirements of the national Building Regulations should be observed.
- 1.2.3.5 Internal faces of the Amvic ICF system must either be lined with minimum 12.5 mm plasterboard, fixed in line with the board manufacturer's recommendations or provided with equivalent construction (e.g. directly applied in-situ plaster), so as to achieve Class '0' (National) or class B (European) reaction to fire performance. If ignited they must have a reasonable rate of heat release or rate of fire growth. All board joints and other penetrations to be adequately sealed and fire stopped.
- 1.2.3.6 External finishes should resist spread of flame from one building to another and comply with the maximum surface area restrictions where installed near boundaries. Maximum surface area restrictions

apply for any combustible external finishes that may be used, near to (notional) boundaries (see Section 2.2.3). Only walls where the height of the top floor above ground is less than 18 m are covered by this approval.

- 1.2.3.7 External walls must be mechanically fixed to adjacent separating or compartment walls with non-combustible materials, or the junction must be adequately fire stopped to maintain the required periods of fire resistance. Any cavities formed in the wall must be fire stopped. Guidance can be found in Approved Document B (England & Wales).
- 1.2.3.8 The internal EPS must be provided with horizontal cavity barriers at each floor level above the first floor, i.e. starting with the second storey, in accordance with the requirements of the relevant Building Regulations. Cavity barriers should completely seal the cavity and be chased through the outer EPS formwork.
- 1.2.3.9 EPS on the interior shall be discontinuous at floor lines. Floor-to-wall intersections shall be fire stopped.
- 1.2.3.10 Cavity barriers must be provided around all openings through walls required to be fire resisting, including for services meter boxes and must be installed strictly in accordance with the requirements of the relevant Building Regulations. Services penetrating a wall required to be fire resisting, must be fire stopped where they penetrate the fire resisting construction with a suitably tested proprietary fire-stopping system.
- 1.2.3.11 Forms that are in close proximity to flue pipes and/or heat-producing appliances must be fire-stopped.

1.2.4 Condensation

- 1.2.4.1 Walls, openings and junctions with other elements can adequately limit the risk of surface condensation. Calculations in accordance with BS 5250 *Code of practice for control of condensation in buildings* and BS EN ISO 13788 *Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods*, show that external walls using the Amvic ICF System are not liable to either internal surface or interstitial condensation, when subjected to conditions anticipated in the UK and Ireland provided that the requirements of this certificate and of the relevant clauses of BS 5250 are complied with.
- 1.2.4.2 In rooms where the possibility of an internal environment above 65% relative humidity (at 25°C) and an external temperature below 0°C exist for periods longer than 24 hours (i.e. kitchens and bathrooms), then a suitably-positioned vapour check should be used to avoid the possibility of interstitial condensation. Alternatively, adequate forced mechanical ventilation can be incorporated into the design of these rooms.

1.2.5 Weathertightness

- 1.2.5.1 External walls utilising the Amvic ICF System and a conventional external masonry skin can be made to adequately resist the passage of moisture into a building such that they can be weathertight for the design life of the building. The masonry design, including fixing to the concrete wall and detailing at openings, shall be in accordance with the relevant clauses of BS 5628. A variety of other impervious cladding or render systems can be employed with the Amvic ICF System but have not been assessed for weathertightness by BRE Certification.
- 1.2.5.2 Resistance to rain ingress is provided by the external weatherproof finish. Typical options are described in Section 1.1.8 and care should be taken to ensure that design and construction are suitable for use with the EPS form and comply with good practice and the certificate holder's instructions. The cladding shall be installed and maintained so as to prevent moisture from penetrating to the forms.

1.2.6 Ground moisture

- 1.2.6.1 Concrete walls, formed using the Amvic ICF System forms, in conjunction with ground floors (not assessed) can achieve adequate damp proofing by using a traditional damp proof membrane below the ICF, waterproof concrete foundations, brush applied liquid membranes or tanked foundations.
- 1.2.6.2 Foundations formed from waterproof concrete should be constructed to a minimum height of 150 mm above external ground level, in accordance with Type B structures – structures without membrane in BS 8102.
- 1.2.6.3 The formwork will not transmit moisture by capillary action.

1.2.6.4 Walls formed using the Amvic ICF System have not been assessed by BRE Certification for use as retaining or basement walls subject to hydrostatic pressure from ground water.

1.2.7 Sound insulation

1.2.7.1 Walls with a concrete core of minimum density 2300 kg/m³ and 150 mm thickness, with 12.5 mm plasterboard on each face will achieve a mass for the core in excess of 345 kg/m². 200 mm thick walls will achieve a mass in excess of 460 kg/m².

1.2.7.2 A wall with a mass of 345 kg/m² meets the minimum mass per unit area requirement for internal wall type C,3 described in Approved Document E (E & W) (concrete block wall, plaster or plasterboard finish on both sides, minimum mass per unit area excluding finish 120 kg/m²). The 200 mm thick 460 kg/m² wall meets the guidance for the minimum mass per unit area of Approved Document E (England & Wales) separating wall type 1.

1.2.7.3 The airborne sound insulation between dwellings separated by walls depends partly on the connections between the separating walls and the walls and floors to which they are attached. Flanking constructions have not been assessed and compliance with the performance standard for airborne sound insulation required by the Building Regulations of England & Wales will need to be demonstrated.

1.2.7.4 In England and Wales, for dwellings with separating walls that are not included in Robust Details Part E and that are constructed on developments that are not registered with Robust Details Limited, compliance with sound insulation performance standards must be demonstrated. These walls will require pre-completion testing and assessment in accordance with Approved Document E. Separating walls between dwellings are to be tested in accordance with BS EN ISO 140-4 *Acoustics. Measurement of sound insulation in buildings and of building elements. Field measurements of airborne sound insulation between rooms.*

1.2.8 Thermal insulation

1.2.8.1 When calculating the thermal transmittance (U-values) of external walls, the thermal resistance of the filled 150 mm Amvic ICF form should be taken as 3.72 m²K/W and that of the filled 200 mm form taken as 3.75 m²K/W. The U-value of an external wall construction, using the product will typically not be greater than 0.25 W/m²K, depending on the type of internal and external finishes used. Calculations for specific constructions should be carried out in accordance with BS EN ISO 6946 *Building components and building elements, thermal resistance and thermal transmittance, calculation method* and BR 443 *Conventions for U-value calculations.*

Table 2: Calculated U-values for typical Amvic ICF wall constructions

Typical wall construction	U-value (W/m ² K)
12.5 mm plasterboard/ICF with (150/200 mm) concrete with up to 15 mm thick render - including the effect of polypropylene ties and furring strips.	0.25
Required values specified in supporting documents	
Requirement for England and Wales	0.35
Requirement for walls in Scotland	0.30/0.27
Requirement for walls in Northern Ireland	0.35
Requirement for walls in Ireland	0.27

1.2.8.2 The effect of the web bridging the concrete can be ignored as its effect upon the U-value is insignificant. External walls can satisfy the Elemental U value of 0.30 W/m²K for Scotland, 0.35 W/m²K for Northern Ireland and 0.27 W/m²K for Ireland. The U-values for a given construction will depend on the applied finishes and other components e.g. fixings.

1.2.8.3 Junctions between external walls and between external walls and party walls will maintain insulation continuity and the default linear thermal transmittance (Ψ) values from BRE IP 1/06 *Assessing the*

effects of thermal bridging at junctions and around openings in the external elements of buildings, Table 3 and SAP 2005 The Government's Standard Assessment Procedure for Energy Rating of Dwellings, Table K1, may be used in Emission Rate calculations to SAP 2005 or the Simplified Building Energy Model (SBEM).

1.2.8.4 Junctions with other elements and openings in external walls, should be designed to limit heat loss in accordance with the relevant guidance given in Government publication *Accredited Construction Details* (England & Wales) or *Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings*, BR 262 *Thermal insulation: avoiding risks* and BRE IP 1/06 (S, NI and Ireland).

1.2.8.5 External concrete walls formed using the Amvic IFC System can provide adequate resistance to heat loss by air infiltration. Care should be taken to ensure that junctions with other elements and openings in external walls, comply with the relevant guidance on airtightness given in Government publication *Accredited Construction Details* (E & W) or TSO 2002 publication *Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings* and BRE IP 1/06 (S, NI and Ireland). Completed buildings are subject to pre-completion testing for airtightness in accordance with the requirements of Approved Documents L1A and L2A, Section 20B of the Building Regulations (England & Wales).

1.2.9 Services

1.2.9.1 Services can be taken through walls constructed using the forms. All service penetrations should be pre-formed prior to placing concrete. Fire stopping and/or penetration seals should be installed around penetrations through compartment walls.

1.2.9.2 Electrical cabling can be installed in conduit thus isolating the PVC cable from the polystyrene. Further advice can be obtained from Amvic Ireland. Where chases are made in the polystyrene they should be kept to a minimum and positioned so that they comply with electrical installation regulations.

1.2.10 Maintenance

1.2.10.1 Cladding or applied finishes will require periodic maintenance, depending on the finish. The frequency and level of intervention will depend on the nature of the installed product and the service environment. Regular checks should be carried out on finishes and any damage repaired promptly.

1.2.11 Durability

1.2.11.1 Concrete walls constructed with Amvic ICF forms are considered to have a service life of at least 60 years when protected by suitable external and internal finishes, provided they are designed and installed in accordance with this certificate and the manufacturer's instructions. The combination of an appropriate external finish and the external polystyrene layer is considered to reduce the exposure rating of the concrete to "mild" as defined in Table 3.2 of BS 8110-1 and BS EN 206-1.

2. BUILDING REGULATIONS

2.1 In the opinion of BRE Certification, Amvic ICF System forms with appropriately detailed concrete core and claddings, when designed and constructed in accordance with the requirements and limitations of this certificate, can contribute towards satisfying the following relevant Building Regulations, Requirements and Standards:

- The Building Regulations (England and Wales) 2000 (as amended) (E & W)
Requirement A Structure
Requirement B Fire Safety
Requirement C Site Preparation and resistance to moisture
Requirement E Resistance to the passage of sound
Requirement L Conservation of fuel and power
Requirement Regulation 7 Materials and workmanship

Approved Documents (AD) supporting each Requirement.

- The Building (Scotland) Regulations 2004 (S)
Regulation 8 (1) Fitness and durability of materials and workmanship
Regulation 9: Building standards - construction

Standard 1: Structure
Standard 2: Fire
Standard 3: Environment
Standard 4: Safety
Standard 5: Noise
Standard 6: Energy

Technical Handbooks (TH) (Domestic and Non-Domestic) supporting each Standard.

- The Building Regulations (Northern Ireland) 2000 (NI)
Regulation B: Materials and Workmanship
Regulation C: Preparation of site and resistance to moisture
Regulation D: Structure
Regulation E: Fire safety
Regulation F: Conservation of fuel and power
Regulation G: Sound insulation of dwellings
Technical Booklets (TB) supporting each Regulation.

- The Building Regulations 1997 Ireland (as amended) (I)

Requirement A: Structure
Requirement B: Fire safety
Requirement C: Site preparation and resistance to moisture
Requirement E: Sound
Requirement F: Conservation of fuel and energy
Materials and Workmanship
Technical Guidance Documents (TGD) supporting each Requirement.

2.2 Justification for compliance with Building Regulations.

The following tables state the justification for compliance with the Requirements, Regulations and Standards of the Building Regulations.

2.2.1 Mechanical resistance - Loading, stability, disproportionate collapse

Country	Requirement	Opinion
E & W	A1 Loading	Walls correctly designed and constructed using the Amvic ICF System, can sustain and transmit loads to the ground, satisfying this Requirement. See clause 1.2.2.1, 1.2.2.2, 1.2.2.4 to 1.2.2.8.
	A2 Ground movement	Walls designed and constructed using the Amvic ICF System can have adequate stability. See clause 1.2.2.4.
	A3 Disproportionate collapse	Walls designed and constructed using the Amvic ICF System can have adequate strength and stiffness to satisfy this Requirement. See clause 1.2.2.4.
S	1.1(a)(b) Structure	Walls, designed and constructed using the Amvic ICF System, can have adequate strength and stiffness to satisfy this Standard. See clause 1.2.2.1, 1.2.2.2, 1.2.2.4 to 1.2.2.8.
	1.2 Disproportionate collapse	Walls formed using the Amvic ICF System can have adequate strength and stiffness to satisfy this standard. See clause 1.2.2.4.
NI	D1 Stability	Walls designed and constructed using the Amvic ICF System, can sustain and transmit loads to the ground and satisfy this Requirement. See clause 1.2.2.1, 1.2.2.2, 1.2.2.4 to 1.2.2.8.
	D2 Disproportionate collapse	Walls formed using the Amvic ICF System when reinforced, can have adequate strength and stiffness to satisfy this Regulation. See clause 1.2.2.4.
I	A1 (1) Structure – Loading	Walls designed and constructed using the Amvic ICF System, can sustain and transmit loads to the ground and satisfy this Regulation. See clause 1.2.2.1, 1.2.2.2, 1.2.2.4 to 1.2.2.8.
	A2 Ground movement	Walls designed and constructed using the Amvic ICF System can have adequate stability. See clause 1.2.2.4.
	A3 (1) Disproportionate collapse	Walls designed and constructed formed using the Amvic ICF System when reinforced, can have adequate strength and stiffness to satisfy this Regulation. See clause 1.2.2.4.

2.2.2 Internal fire spread (structure), separation

Country	Requirement	Opinion
E & W	B3(1)(2)(3)(4) Internal fire spread (structure)	Appropriately clad walls designed and constructed using the Amvic ICF System with fire stops can meet this Requirement. See clauses 1.2.3.1 to 1.2.3.5, 1.2.3.8 to 1.2.3.11.
S	2.2 Separation	Walls formed using the Amvic ICF System and junctions between the walls can inhibit the spread of fire and smoke from the original area of occupation. See clauses 1.2.3.1 to 1.2.3.5 and 1.2.3.9.
	2.3 Structural protection	Walls formed using the Amvic ICF System and junctions between the walls can satisfy the load bearing capacity of the building. See clauses 1.2.3.1 to 1.2.3.6 and 1.2.3.9.
NI	E4(1)(2)(3)(4) Internal fire spread - Structure	Walls formed using the Amvic ICF System with undecorated internal lining materials can satisfy this Regulation. See clauses 1.2.3.5, 1.2.3.8 to 1.2.3.11.
I	B3 (1)(3) Internal fire spread (structure)	Appropriately clad walls designed and constructed using the Amvic ICF System with fire stops can meet this Requirement for all purpose groups. See clauses 1.2.3.5, 1.2.3.8 to 1.2.3.11.

2.2.3 External fire spread - spread to adjoining buildings

Country	Requirement	Opinion
E & W	B4(1) External fire spread	Appropriately clad walls designed and constructed using the Amvic ICF System can adequately resist spread of fire over the walls. See clauses 1.2.3.6 to 1.2.3.8 and 1.2.3.11.
S	2.6 Spread to neighbouring buildings	Walls formed using the Amvic ICF System and junctions between the walls can inhibit spread of fire to neighbouring buildings. See clauses 1.2.3.7, 1.2.3.8 and 1.2.3.11.
	2.7 Spread on external walls	Walls formed using the Amvic ICF System and junctions between the walls can inhibit spread of fire on the external walls of the building. See clauses 1.2.3.6 to 1.2.3.8 and 1.2.3.11.
NI	E5(a) External fire spread	Walls formed using the Amvic ICF System and junctions between the walls can adequately resist the spread of fire over the walls. See clauses 1.2.3.6 to 1.2.3.8 and 1.2.3.11.
I	B4 External fire spread	Appropriately clad walls designed and constructed using the Amvic ICF System can adequately resist spread of fire over the walls. See clauses 1.2.3.6 to 1.2.3.8 and 1.2.3.11.

2.2.4 Resistance to moisture - ground moisture, condensation and weather

Country	Requirement	Opinion
E & W	C2(a) ground moisture	The Amvic ICF System can be detailed to limit moisture ingress from the ground. See clause 1.2.6.1 to 1.2.6.3.
	C2(c) interstitial and surface condensation	Walls formed using the Amvic ICF System can limit the risk of surface condensation and minimize the risk of interstitial condensation. See clause 1.2.4.1 and 1.2.4.2.
S	3.4 Moisture from the ground	Walls formed using the Amvic ICF System can resist moisture penetration from the ground. See clause 1.2.6.1 to 1.2.6.3.
	3.10 Precipitation	Walls formed using the Amvic ICF System can resist precipitation affecting the inner face. See clause 1.2.5.1 and 1.2.5.2.
	3.15 Condensation (D)	Walls formed using the Amvic ICF System can limit the risk of surface or interstitial condensation. See clause 1.2.4.1 and 1.2.4.2.
NI	C4(a) Resistance to ground moisture	Walls formed using the Amvic ICF System can be detailed to adequately limit the passage of moisture from the ground and weather. See clause 1.2.6.1 to 1.2.6.3.
	C5 Condensation	Walls formed using the Amvic ICF System can limit the risk of interstitial condensation. See clause 1.2.4.1 and 1.2.4.2.
I	C4 Resistance to weather and ground moisture	Walls formed using the Amvic ICF System can be adequately detailed to limit moisture ingress from the ground. See clause 1.2.5.1, 1.2.5.2, 1.2.6.1 to 1.2.6.3.

2.2.5 Airborne sound insulation

Country	Requirement	Opinion
E & W	E1 Protection against sound from other parts of the building and adjoining buildings	Walls formed using the Amvic ICF System can resist sound from other parts of the building. See clause 1.2.7.1 to 1.2.7.4.
	E2 Protection against sound within a dwelling-house etc	Internal walls formed using the Amvic ICF System can provide reasonable resistance to sound. See clause 1.2.7.1 to 1.2.7.4.
S	5.1 Resisting sound transmission to dwellings	Walls formed using the Amvic ICF System can limit the transmission of noise. See clause 1.2.7.1 to 1.2.7.4.
NI	G2(1) Separating walls and separating floors	Walls formed using the Amvic ICF System can resist airborne sound transmission. See clause 1.2.7.1 to 1.2.7.4.
I	E1 (1) Airborne sound (walls)	Wall formed using the Amvic ICF System can satisfy this sound insulation Regulation. See clause 1.2.7.1 to 1.2.7.4.

2.2.6 Conservation of fuel and power - building fabric – dwellings and other than dwellings

Country	Requirement	Opinion
E & W	L1A Conservation of fuel and power in dwellings	Walls formed using the Amvic ICF System can contribute to a building meeting the Target Energy Rating. The walls can limit heat gain and loss by air infiltration and additional heat loss at junctions between walls, with other elements and around openings. See clause 1.2.8.1 to 1.2.8.5.
	L2A Conservation of fuel and power in new buildings other than dwellings	
S	6.2 Building insulation envelope	Walls formed using the Amvic ICF System can meet the requirements of the Elemental Method for limiting heat loss. The walls can adequately limit heat loss by unwanted air infiltration and additional heat loss around openings and at junctions between walls and with other elements. See clause 1.2.8.1 to 1.2.8.5.
NI	F2 Building fabric	Walls formed using the Amvic ICF System can meet the requirements of the Elemental Method for limiting heat loss. The walls can also adequately limit heat loss by unwanted air infiltration and excessive additional heat loss around openings. See clause 1.2.8.1 to 1.2.8.5.
I	L1 Conservation of fuel and energy	Walls formed using the Amvic ICF System can meet the requirements of the Elemental Method for limiting heat loss. The walls can also adequately limit heat loss by unwanted air infiltration and excessive additional heat loss around openings. See clause 1.2.8.1 to 1.2.8.5.

2.2.7 Fitness and durability of materials and workmanship

Country	Requirement	Opinion
E & W	Regulation 7 Materials and workmanship	The Amvic ICF System forms are manufactured from suitable materials and can be so installed as to perform satisfactorily. See clause 1.2.11.1.
S	8(1) Fitness and durability of materials and workmanship	
NI	B2 Fitness of materials and workmanship	
I	D1 Materials and workmanship	

2.3 CDM Regulations

- 2.3.1 Construction (Design and Management) Regulations 1994 (as amended)
Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)
The Certificate should form part of the information used by the client, planning supervisor, designer and contractors to discharge their responsibilities under these Regulations.

3. INSTALLATION/PRACTICAL APPLICATION

3.1 Storage and Handling

- 3.1.1 Forms are delivered to site in suitable protective packaging. All packaged components are clearly labelled with product type and production date allowing traceability of supply.
- 3.1.2 Amvic ICF System components should not deteriorate in storage as long as they remain in their packaging protected from the environment prior to use. The forms are stretch-wrapped and should not be opened until required for use. Storage must be on firm, level and dry ground, and if the components are to be stored outside, they must be further protected from the weather by a secured or ballasted opaque sheet.
- 3.1.3 Amvic ICF System materials should be protected from prolonged exposure to direct sunlight and must not be exposed to plastics materials containing plasticisers or to volatile aggressive solvents. The polystyrene forms must not come into contact with materials containing volatile organic compounds such as newly treated timber, aggressive chemicals or deleterious agents e.g. diesel oil, petrol, various cleaning solvents and acids, hydrocarbons, membranes containing coal tar pitches or building products containing solvents. The elements must not be exposed to open flame or other ignition sources.
- 3.1.4 The forms are easily handled on site and may be readily cut or trimmed with a knife or fine toothed saw. Reasonable care must be taken, however, to prevent damage to forms before, during and after installation. The forms must not be punctured, split, deformed or unduly compressed before use.

3.2 Installation

3.2.1 General

- 3.2.1.1 The performance of the Amvic ICF System depends on correct installation. It must be installed strictly in accordance with the certificate holder's installation instructions, as reviewed by BRE Certification, and the requirements of this certificate. The quality of installation achieved on site is not covered by this certificate. Therefore it is recommended that the quality of installation and workmanship is subject to appropriate checks by a competent person for each installation.

- 3.2.1.2 The following instructions (3.2.1.3 to 3.2.10.7) are informative and based on guidance in the Amvic Ireland Installation Manual.

- 3.2.1.3 The installation, wall support, reinforcement insertion, concrete placement and compaction must be carried out by approved installers in accordance with the certificate holder's instructions and BS 5975 *Code of practice for falsework*. All workmanship on site should comply with the recommendations of BS 8000-2.1 *Workmanship on building sites. Code of practice for concrete work. Mixing and transporting concrete*, BS 8000-4 *Workmanship on building sites. Code of practice for waterproofing* and BS 8110.

3.2.2 Foundations and damp proof course

- 3.2.2.1 Although outside the scope of this certificate, foundations and substructures must comply with the relevant clauses of BS 8004 *Code of practice for foundations*, BS 8007 *Code of practice for design of concrete structures for retaining aqueous liquids* and BS 8102 as appropriate, and must provide a flat and level footing for the shuttering. A damp proof course is installed as appropriate.

3.2.3 Wall assembly

- 3.2.3.1 The castellations of the first course forms are cut off. Construction of the first course commences by locating the corner forms and then working inwards towards the centre of each wall line or structural opening, with the units interlocking tightly together. The long end of the corner form should be kept in the

same direction to maintain a running bond. The final form may require cutting to size. The forms must be raised course by course in a stretcher bond construction.

- 3.2.3.2 Forms should be placed through door and deep window openings (to be cut out later) so that interlocking of forms is maintained above each opening. Walls are checked as the work proceeds to ensure that correct line and level is maintained.
- 3.2.3.3 Segments (cut from standard form lengths) are used to make up wall lengths and should ideally be placed adjacent to large openings. Cuts should be made immediately adjacent to edges so that successive courses will interlock correctly. All cuts and weak spots shall be reinforced or glued.
- 3.2.3.4 Following completion of the first course, subsequent courses are laid in a running bond, this being achieved by reversing the corner forms to create a 300 mm stagger. After the second course is in place the forms are secured to the footing using low expansion foam. Horizontal reinforcing is included as coursing progresses.
- 3.2.3.5 Corner rods are inserted into the corner forms.
- 3.2.3.6 Internal wall formwork is jointed into external formwork by removal of a vertical slice of the form.
- 3.2.3.7 Where the specified elevation height is not a multiple of the standard form, units may be trimmed using woodworking tools.
- 3.2.3.8 The formation of door and window openings using timber framing must be carefully carried out. Remove forms at openings, cutting 25 mm smaller to allow for adjustments. The inside of the opening should be lined with 150mm x 50mm treated timber, framed and glued/screwed into position, propped/braced as necessary.
- 3.2.4 Reinforcement
 - 3.2.4.1 Horizontal reinforcement can be placed in different locations using the form tie/spacer toothed slots. Horizontal reinforcing bars for lintels must be located within the lintel as specified in the structural design, the minimum length of bar being equivalent to the width of opening in the structure plus 500 mm. Vertical reinforcement is then be secured to horizontal reinforcement at required centres using standard fixing methods. Bar lapping lengths as defined in BS 8110-1 should be adopted. The system requires that in plain walls horizontal reinforcement be provided in top and bottom courses of every wall lift.
 - 3.2.4.2 Heavy wall loads (such as wall units) should be supported by the concrete core and not the form tie/spacer flanges. This can be achieved by the use of timber blocks screwed or bolted into the concrete core or cast-in anchor bolts and metal plates as described in the Amvic Ireland Installation Manual.
- 3.2.5 Bracing
 - 3.2.5.1 Bracing is installed following erection of the fourth course of forms. Temporary bracing and propping during construction is essential to maintain alignment and adequate lateral stability during concrete filling. The Amvic ICF System installer is responsible for ensuring the adequacy of all temporary bracing. The Certificate Holder provides a bracing system (not covered by this certificate). As a minimum, the full height of the assembled formwork system must be supported 700 mm from corners and along the length of each wall at maximum horizontal centres of 1.8 m (see the Amvic Ireland Installation Manual). All lintels must be adequately supported until the concrete has attained its minimum working strength. On exposed sites or in adverse weather conditions further support may be necessary.
 - 3.2.5.2 Typically the bracing and alignment systems are placed on one side of the formwork (usually the inside face) during construction, however, for very long or walls greater than one storey height, bracing on two sides is required.
- 3.2.6 Openings/Services
 - 3.2.6.1 Openings are either formed during construction of the formwork or cut out of the completed formwork. Timber framework or proprietary plastic block-outs are inserted in the sides of openings between the EPS panels to seal openings, secured in place and braced before pouring concrete.

3.2.6.2 Where joists are installed they must be adequately supported by the wall. Joists can be cast directly into the concrete but must not penetrate the external face of the formwork system. Amvic Ireland can supply a tie ledger connection for mounting joists.

3.2.6.3 Where services or flues are to penetrate the wall, a duct or sleeve through the Amvic ICF System should be inserted prior to placing the concrete. Electrical cables should be ducted (to avoid plasticizer migration). Any services introduced should conform to Building Regulation and Health and Safety requirements. Fire stopping and/or penetration seals should be installed around penetrations through compartment walls.

3.2.6.4 At all service entry points, care must be taken to effect a properly sealed joint to prevent the ingress of vermin or moisture. Gaps in the insulation may be made good by filling and sealing with a self-expanding polyurethane foam.

3.2.7 Pre-pour checks

3.2.7.1 After erecting the bracing and propping adjustments can be made for plumb, line and level. Reinforcement should be checked for correct cover distance and rigidity.

3.2.7.2 Before the initial pour and between concrete pours, care must be taken to remove any debris from inside the formwork by flushing with water.

3.2.8 Concrete placement

3.2.8.1 Lintels must be filled with concrete in a single operation ensuring that the concrete integrates fully with the concrete in the walls at both ends. Particular attention should be paid at opening/lintel reinforcement as the steel can impede the flow of concrete around these sections.

3.2.8.2 Continuous supervision during placing and compacting of the concrete must be provided. Concrete can be placed using line pump or overhead boom from a concrete pump lorry. Small volumes of concrete can be placed by hand, e.g. to make up small deficiencies at the end of each pour or to the sill of window openings. The concrete should be directed into the central cavity away from corners and not directly against the polystyrene units in 1300 mm lift heights allowing concrete to free-flow into corners and below window openings. The first lift is allowed to stiffen before placing the second lift of concrete. Typically, storey heights should be placed in two or three lifts. When forming construction joints between concrete pours, these should be located within 100 mm of the top of forms for ease of access and visual checking. Construction joints should be horizontal rather than vertical.

3.2.8.3 The recommended concrete pour rate is 1000 to 1200 mm/hr with a maximum of 1500 mm/hr in warm temperatures.

3.2.9 Concrete compaction

3.2.9.1 Adequate consolidation/compaction of the concrete in line with BS 8110-1 is essential and the concrete must be placed so that it completely fills the Amvic ICF System without creating any voids.

3.2.9.2 Particular attention should be paid to window and door openings where reinforcement can impede the flow of concrete beneath these sections. Concrete in lintels must be mechanically tamped or vibrated to ensure proper compaction around any steel reinforcement. All lintels must be adequately supported until the concrete has attained its minimum working strength.

3.2.9.3 For unreinforced walls, hand tamping or rodding is adequate. Where reinforcement is present for structural purposes, mechanical vibration is essential with internal poker vibrators no greater than 25 mm diameter. Special care is required to avoid touching the formwork when using poker vibrators and their use should be confined to the central concrete core between reinforcement layers. If reinforced concrete walls are required, the Structural Engineer should be satisfied, taking into account the thickness of the wall and the nature of the building, that sufficient space is left around all reinforcement for the concrete to be adequately compacted. The use of self-compacting concrete avoids the need for internal poker vibration.

3.2.10 Post pour tasks

3.2.10.1 After pouring is complete, the walls should be checked immediately to ensure that they are true to line and level. If necessary the support bracing can be adjusted.

- 3.2.10.2 Any damage to the forms should be repaired immediately and any concrete spillage or leakage of grout removed by hosing down the exposed face of the system before it sets.
- 3.2.10.3 The concrete must be left to cure until it has achieved its specified minimum strength, usually after two to three days, before construction continues. Structural fixings should not be loaded until the concrete has achieved a sufficient strength, and supports should be left in place as long as is required.
- 3.2.10.4 Where lateral bracing walls and other structures are intended to act in concert with the concrete filled forms, the polystyrene face must be removed to allow the required structural connection between the concrete core and the supplementary structure.
- 3.2.10.5 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, typically a minimum of seven days. Temporary supports must be retained as required by the individual project design.
- 3.2.10.6 Local damage to the form faces should be made good prior to the application of finishes.
- 3.2.10.7 Electrical and plumbing services can be fixed within the formwork by cutting chases into the EPS using a router or hot knife. Chases should be kept to a minimum and need to be located at appropriate distances from separating walls.

Figure 2 Typical floor to wall detail

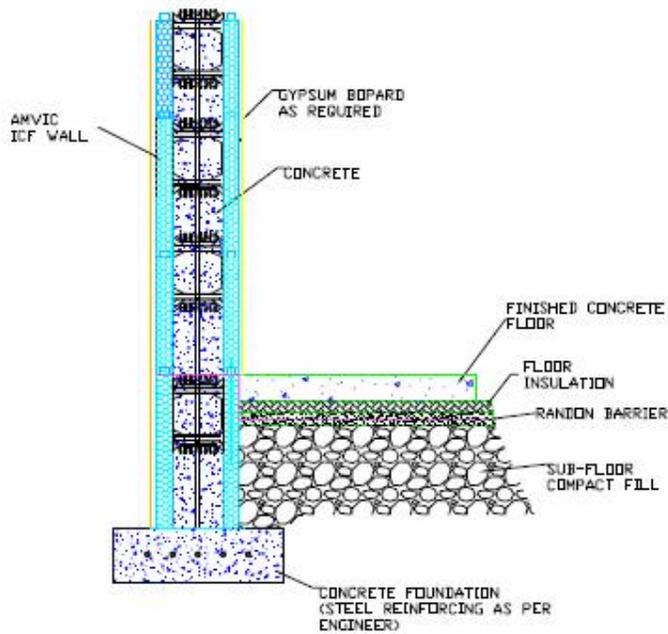


Figure 3 Perpendicular precast hollowcore floor bearing

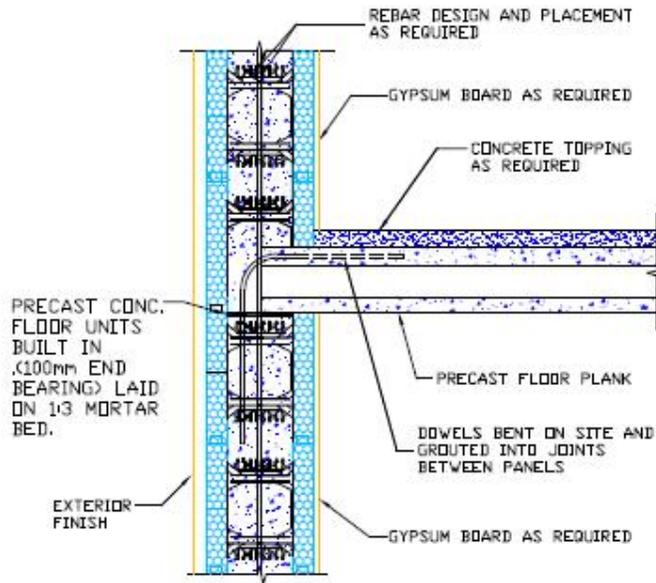


Figure 4 'T' wall connection

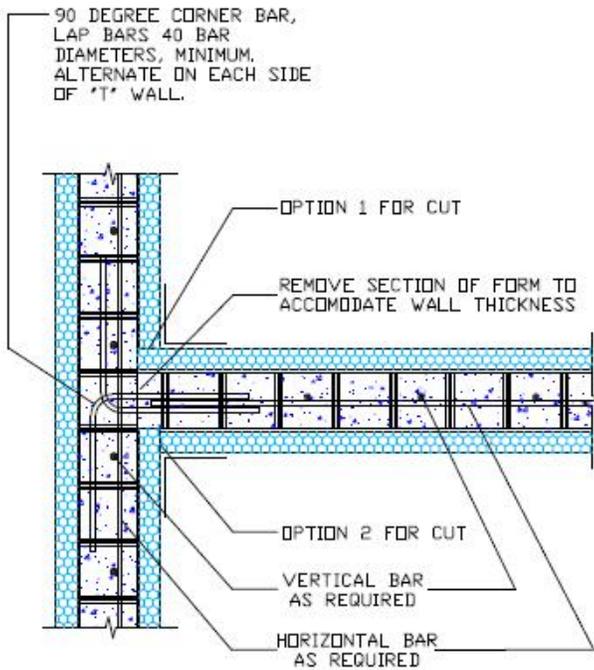


Figure 5 Typical window opening detail

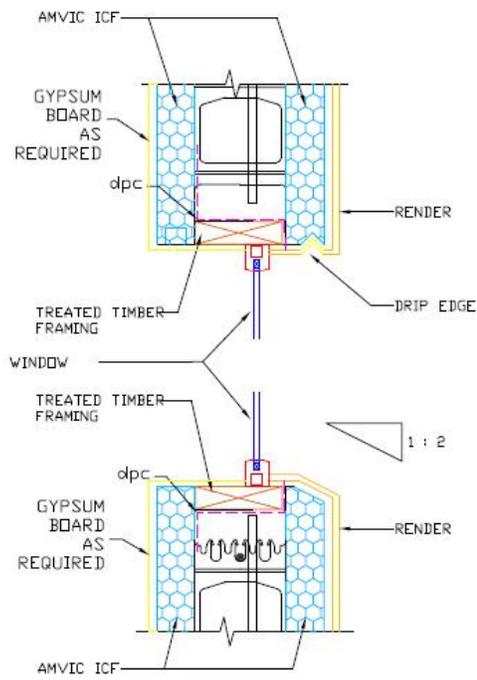
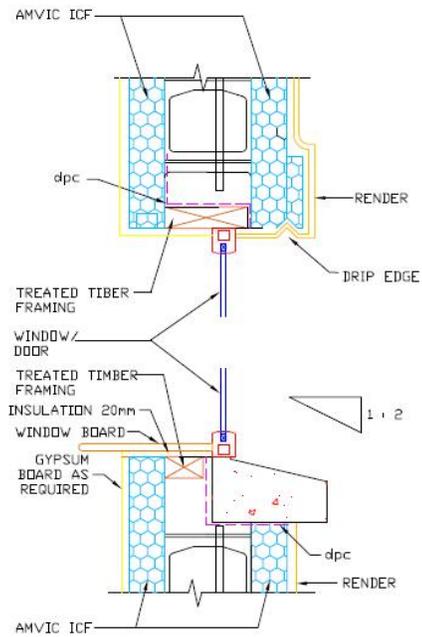


Figure 6 Typical window detail with trim



4. TECHNICAL APPRAISAL

4.1 Technical assessments and site inspections have been undertaken in broad accordance with the requirements of ETAG 009 *Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete.*

4.2 An examination was made of existing test data on the forms and webs.

4.3 Performance tests have been undertaken on the following components:

EPS panel:

- Water vapour permeability
- Water absorption by immersion – partial and total

Polypropylene web:

- Coarse and fine thread Dry wall Screw pull-out
- Tensile strength

4.4 Technical assessments have been undertaken to determine:

- Mechanical resistance – examination of structural calculations
- Condensation risk – calculations based on BS 5250
- Thermal insulation – U-values, assessment of junction and opening details
- Durability - based on concrete specification and exposure environments. Assessment of resistance to physical, chemical and biological agents.

4.5 Site inspections have been carried out on the procedures and practicality of installation to establish that installation in accordance with the Amvic ICF System Manual is possible.

4.6 A site visit and site trial inspection was carried out to witness the installation process of the 150 mm forms including:

- Construction of formwork
- Placement of reinforcement and structural pattern
- Incorporation of ducts/service penetrations
- Wall alignment, form support and bracing
- Bracing around window and door openings
- Pouring of concrete
- Ability to compact concrete around reinforcement
- Performance of form tie/spacers
- Resistance to filling pressure and compaction forces using mechanical vibration
- T-wall joints
- Efficiency of filling
- Treatment of blowouts
- Deflection of formwork due to head of wet concrete
- Alignment checks and adjustments before concrete reached its initial set.

4.7 Quality Control

Traceable quality records are maintained by the manufacturer. In the opinion of BRE Certification the materials and procedures of the manufacturer are suitable for the products. The manufacturer carries out checks at regular intervals to ensure that the quality of the Amvic ICF System is maintained within the product specification as defined to BRE Certification. BRE Certification undertakes monitoring of the product by auditing at regular intervals against an agreed Quality Plan for the product.

4.8 Typical values for properties of the polystyrene used in the Amvic ICF System are given in Table 3 and test results for the webs are given in Table 4.

Table 3 Properties of Polystyrene used in Amvic ICF System

Property	Test Method	EPS to BS EN 13163
Declared Thermal conductivity	BS EN 12667 <i>Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high</i>	0.034 W/mK

(50 mm)	<i>and medium thermal resistance</i>	
Compressive strength at 10% deformation	BS EN 826 <i>Thermal insulating products for building applications. Determination of compression behaviour</i>	150 kN/m ²
Bending strength	BS EN 12089 <i>Thermal insulating products for building applications. Determination of bending behaviour</i>	200 kN/m ²
EPS density	BS EN 1602 <i>Thermal insulating products for building applications. Determination of the apparent density</i>	Min 24 kg/m ³
Water vapour permeability	BS EN 12086 <i>Thermal insulating products for building applications. Determination of water vapour transmission properties</i> BS EN ISO 12572 <i>Hygrothermal performance of building materials and products. Determination of water vapour transmission properties</i>	33 g/m ² /day
Water absorption by partial immersion	BS EN 12087 <i>Thermal insulating products for building applications. Determination of long term water absorption by immersion</i>	0.04 kg/m ²
Water absorption by total immersion	BS EN 12087	1.8 %

Table 4 Webs

Tensile strength	In-house test	250 kg
Coarse screw pull-out	In-house test	15 kg

4.9 British Standards and other technical references

The following British Standards and Codes of Practice have been referred to for this assessment:

BS 4449:2005	Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification
BS 4482:2005	Steel wire for the reinforcement of concrete products. Specification
BS 4483:2005	Steel fabric for the reinforcement of concrete. Specification
BS 5250:2002	Code of practice for control of condensation in buildings
BS 5628-1:2005	Code of practice for use of masonry. Structural use of unreinforced masonry
BS 5628-3: 2005	Code of practice for use of masonry. Materials and components, design and workmanship
BS 5975:1996	Code of practice for falsework
BS 6203: 2003	Guide to fire characteristics and fire performance of expanded polystyrene materials (EPS and XPS) used in building applications
BS 6399-1:1996	Loading for buildings. Code of practice for dead and imposed loads
BS 6399-2:1997	Loading for buildings. Code of practice for wind loads
BS 6399-3:1988	Loading for buildings. Code of practice for imposed roof loads
BS 8000-2.1:1990	Workmanship on building sites. Code of practice for concrete work. Mixing and transporting concrete
BS 8000-4:1989	Workmanship on building sites. Code of practice for waterproofing

BS 8004:1986	Code of practice for foundations
BS 8007:1987	Code of practice for design of concrete structures for retaining aqueous liquids
BS 8102:1990	Code of practice for protection of structures against water from the ground
BS 8110-1:1997	Structural use of concrete. Code of practice for design and construction
BS 8110-2:1985	Structural use of concrete. Code of practice for special circumstances
BS 8212:1995	Code of practice for dry lining and partitioning using gypsum plasterboard
BS 8298:1994	Code of practice for design and installation of natural stone cladding and lining
BS 8500-1:2002	Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier
BS 8500-2:2002	Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete
BS 8666:2005	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification
CP 102:1973	Code of practice for protection of buildings against water from the ground
BS EN 206-1:2000	Concrete. Specification, performance, production and conformity
BS EN 480:1997	Admixtures for concrete, mortar and grout. Test methods
BS EN 520:2004	Gypsum plasterboards. Definitions, requirements and test methods
BS EN 826:1996	Thermal insulating products for building applications. Determination of compression behaviour
BS EN 845-1:2003	Specification for ancillary components for masonry. Ties, tension straps, hangers and brackets
BS EN 934-2:2001	Admixtures for concrete, mortar and grout. Concrete admixtures. D Definitions, requirements, conformity, marking and labelling
BS EN 1602:1997	Thermal insulating products for building applications. Determination of the apparent density
BS EN 10020:2000	Definition and classification of grades of steel
BS EN 12086:1997	Thermal insulating products for building applications. Determination of water vapour transmission properties
BS EN 12087:1997	Thermal insulating products for building applications. Determination of long term water absorption by immersion
BS EN 12089:1997	Thermal insulating products for building applications. Determination of bending behaviour
BS EN 12667:2001	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance
BS EN 13163:2001	Thermal insulation products for buildings. Factory made products of expanded polystyrene. Specification
BS EN 13501-1: 2002	Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

BS EN 13914-1:2005	Design, preparation and application of external rendering and internal plastering. External rendering
BS EN ISO 140-4:1998	Acoustics. Measurement of sound insulation in buildings and of building elements. Field measurements of airborne sound insulation between rooms
BS EN ISO 6946:1997	Building components and building elements. Thermal resistance and thermal transmittance. Calculation method
BS EN ISO 11925-2:2002	Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single-flame source test
BS EN ISO 12572:2001	Hygrothermal performance of building materials and products. Determination of water vapour transmission properties
BS EN ISO 13788:2002	Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods
BR 262:2006	Thermal insulation: avoiding risks
BRE Report 347:1998	Energy efficient in-situ concrete housing using EPS permanent formwork
BR 443:2006	Conventions for U-value calculations
BR IP 1/06:2006	Assessing the effects of thermal bridging at junctions and around openings
ETAG 009 June 2002	Non load-bearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete
TSO 2002 publication	Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings
SAP 2005	Standard Assessment Procedure for Energy Rating of Dwellings
SBEM v1.1.a, 11 May 2006	Simplified Building Energy Model

5. CONDITIONS OF CERTIFICATE ISSUE

5.1 Validity

This certificate will be valid for a period of three years. It will remain valid in so far as:

- a) The materials and methods of manufacture are unchanged or BRE Certification has assessed any changes and found them to be satisfactory.
- b) The design and specification are unaltered from those examined by BRE Certification
- c) Amvic Ireland continues to have the product regularly checked by BRE Certification

5.2 Health and Safety

This certificate and the recommendations herein do not purport in any way to restate the requirements of the Health and Safety at Work Act 1974 or any statutory or common law duty of care which exists now or in the future; nor is compliance with these recommendations to be assumed as satisfying the requirements of the said Act or any existing or future statutory or common law duty of care.

5.3 Reference to Other Documentation

Where reference is made in this certificate to any Act of Parliament, Regulation, Code of Practice, British or other Standard or other publication, it shall be construed as reference to such publication in the form in which it is in force at the date of the certificate.

5.4 Patents

BRE Certification makes no representational warranty that any patent or similar industrial property right is valid or that the manufacture, use, sale, lease or any other dealing or disposition of the product in whole or in part is not an infringement of any patent or industrial property right not owned by Amvic Ireland.

Confirmation that a certificate is current may be obtained from the BRE Certification website (www.redbooklive.com)

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