



## IRISH AGRÉMENT BOARD CERTIFICATE NO. 07/0277

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# Amvic Insulating Concrete Formwork System

**NSAI Agrément (Irish Agrément Board)** is designated by Government to issue European Technical Approvals.

NSAI Agrément Certificates establish proof that the certified products are '**proper materials**' suitable for their intended use under Irish site conditions, and in accordance with the **Building Regulations 1997 to 2019**.



### PRODUCT DESCRIPTION:

This Certificate relates to the Amvic Insulating Concrete Formwork (ICF) System, which consists of modular interlocking expanded polystyrene (EPS) building blocks (graphite enhanced) for permanent formwork for the construction of in-situ concrete walls. Each block (form) is based on two EPS panels with polypropylene connectors moulded into the polystyrene panels and spaced 150/200mm vertically. The forms come in straight and 90° plan sections. An external render system approved by NSAI Agrément for use onto EPS for new build which meets the requirements of Section 3 and 4 of this Certificate is applied to the external polystyrene insulation of the Amvic ICF System as the external finish. Plasterboard slabs are screw-fixed to the polypropylene connectors as an internal finish.

In the opinion of NSAI, the Amvic ICF System, as described in this Certificate, complies with the requirements of the Building Regulations 1997 to 2019.

### USE:

The Amvic ICF System is certified for use in the construction of buildings of up to five storeys (15m) in height in purpose groups 1(a), 1(b) and 1(d) as defined in TGD to Part B Volume 2 of the Building Regulations 1997 to 2019, and for use up to six storeys (18m) in height in purpose groups 1(c), 2(a), 2(b), 3, 4(a) and 5 as defined in TGD to Part B of the Building Regulations 1997 to 2019. The system has been assessed for use as load bearing and non-load bearing walls in the construction of specifically designed buildings. Fire and sound rated walls may also be constructed using the system.

### MANUFACTURE AND MARKETING:

The product is manufactured and marketed by:  
Amvic Ireland,  
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**Readers are advised to check that this Certificate has not been withdrawn or superseded by a later issue by contacting NSAI Agrément, NSAI, Santry, Dublin 9 or online at <http://www.nσαι.ie>**

### 1.1 ASSESSMENT

In the opinion of NSAI Agrément, the Amvic ICF System if used in accordance with this Certificate can meet the requirements of the Building Regulations 1997 to 2019, as indicated in Section 1.2 of this Irish Agrément Certificate.

### 1.2 BUILDING REGULATIONS 1997 to 2019 REQUIREMENTS:

#### **Part D – Materials and Workmanship**

**D3** – The Amvic ICF System, as certified in this Certificate, is comprised of ‘proper materials’ fit for their intended use (see Part 4 of this Certificate).

**D1** – The Amvic ICF System, as certified in this Certificate, meets the requirements of the building regulations for workmanship.

#### **Part A - Structure**

##### **A1 – Loading**

The Amvic ICF System, as certified in this Certificate, has adequate strength and stability (see Parts 3 and 4 of this Certificate).

#### **Part B – Fire Safety**

##### **Part B Vol 2- Fire Safety**

##### **B1 & B6 – Means of Escape in Case of Fire**

The Amvic ICF System can be designed to meet the requirements in respect of means of escape in case of fire.

##### **B2 & B7 – Internal Fire Spread (Linings)**

The plasterboard slabs used on the internal finish are non-combustible and have a Class 0 spread of flame rating. Surface spread of flame rating of the finished construction will be determined by the surface spread of flame rating of the lining materials used.

##### **B3 & B8 – Internal Fire Spread (Structure)**

The Amvic ICF System, as certified in this Certificate, will meet this requirement.

##### **B4 & B9 – External Fire Spread**

External renders approved for use with the Amvic ICF System have a spread of flame rating equivalent to Class B-s1, d0 on both faces. In respect of spread of flame, this is the highest performance classification set out in the Building Regulations 1997 to 2019.

#### **Part C – Site Preparation and Resistance to Moisture**

##### **C3 – Dangerous Substances**

Every ground floor must include a radon sump and be provided with a facility for extracting Radon gas. Where it is shown that protection from

dangerous substances such as Radon is required, an approved gas resistant membrane and gas handling system must be provided under the ground floor, in accordance with TGD to Part C of the Building Regulations 1997 to 2019. The Amvic ICF System permits the easy incorporation of the appropriate membrane, sump and gas handling system.

#### **C4 – Resistance to Weather and Ground Moisture**

The Amvic ICF System, used in accordance with Part 3 of this Certificate, will have adequate weather resistance in all exposures, will resist the passage of moisture from whatever source and will prevent surface or interstitial condensation.

#### **Part E – Sound**

##### **E1 – Airborne Sound (Walls)**

Separating walls are designed and constructed to meet the airborne sound requirements of this Regulation.

##### **E2 & E3 – Airborne and Impact Sound (Floors)**

Intermediate and separating floors can be constructed to meet the airborne and impact sound requirements of this Regulation.

#### **Part F – Ventilation**

##### **F1 – Means of Ventilation**

Adequate building ventilation openings can be provided in walls constructed with the Amvic ICF System. It is essential that ventilation ducts through such walls are fully sealed within the walls or from contact with the cut edges of adjacent materials. Alternatively, a mechanical ventilation system can be installed into the thermal airtight envelope which the Amvic ICF System provides.

##### **F2 – Condensation in Roofs**

Adequate ventilation can be provided in roofs to meet this requirement in respect of the prevention of condensation.

#### **Part J – Heat Producing Appliances**

##### **J3 – Protection of Building**

When the Amvic ICF System is used in accordance with Section 4.1 of this Certificate, wall lining, insulation and separation distances meet the Regulation requirements.

#### **Part L – Conservation of Fuel and Energy**

##### **L1 – Conservation of Fuel and Energy**

The Amvic ICF System will contribute to enabling a building to meet this requirement. U-value and Psi value calculations may be based on a  $\lambda$  value = 0.031W/mK for graphite-enhanced EPS.

**Part M – Access for People with Disabilities**  
**M1 – Access and Use**

Buildings based on the Amvic ICF System can be designed to meet the access, circulation and facilities requirements of this Regulation.

Amvic Product	Overall Thickness (mm)	Insulation (mm)	Concrete Core (mm)	U-value (W/m <sup>2</sup> K)
<b>350</b>	350	2 x 100	150	0.15
<b>330</b>	330	2 x 64	200	0.23
<b>300</b>	300	2 x 75	150	0.20
<b>280</b>	280	2 x 64	150	0.23

**Table 1: Product Range**

**2.1 PRODUCT DESCRIPTION**

**2.1.1 General**

Each Amvic ICF form consists of two moulded flame-retardant EPS panels separated by polypropylene webs. The polypropylene web ties/spacers are sized to maintain core widths of 150 and 200mm. The forms come in straight and 90° plan sections. The units are erected as a formwork into which vertical and horizontal reinforcement is placed and then filled with concrete, resulting in an insulated, monolithic concrete wall of uniform thickness.

The standard EPS panels are 400mm high and 1200mm in length, with a thickness of 64mm, 75mm or 100mm. The panels are manufactured from fire retardant grade EPS in accordance with IS EN 13163<sup>[1]</sup> without the use of HCFC's. The minimum density is 24kg/m<sup>3</sup>.

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

The web flanges are embedded at least 12.5mm behind the outside surface of the EPS panels during manufacture. The location of the web end plates is indicated on external surfaces of the panels through recessed grooves in the panel surface at 150/200mm vertical centres. The top edges of the polypropylene webs have clips that give support to horizontal reinforcing bars where required. The embedded flat sections of the webs can be used as furring strips to provide a fixing for bracing during construction and provide attachment for interior plasterboard slab wall finish. Corner rods may be installed during site installation at the internal corners of the forms to assist in the attachment of internal lining finish materials.

**2.1.2 Structure**

The required concrete strength will be specified by a chartered structural engineer and will depend on building height and load take down. The standard concrete specification is as follows:

- Minimum concrete strength: C25 (C30 recommended)
- Maximum aggregate size: 10mm
- Concrete slump: 100-120mm
- Concrete supplier certified to IS EN 206<sup>[2]</sup>.

**2.1.3 Steel Reinforcement**

The steel reinforcement to be used should be 12mm diameter round or deformed bars, high tensile to BS 4449<sup>[3]</sup>, BS 4482<sup>[4]</sup>, BS 4483<sup>[5]</sup>, IS EN 10020<sup>[6]</sup>, and IS EN 1992-1-1<sup>[7]</sup> and have a maximum yield strength of 500N/mm<sup>2</sup>.

**2.1.4 Foundations**

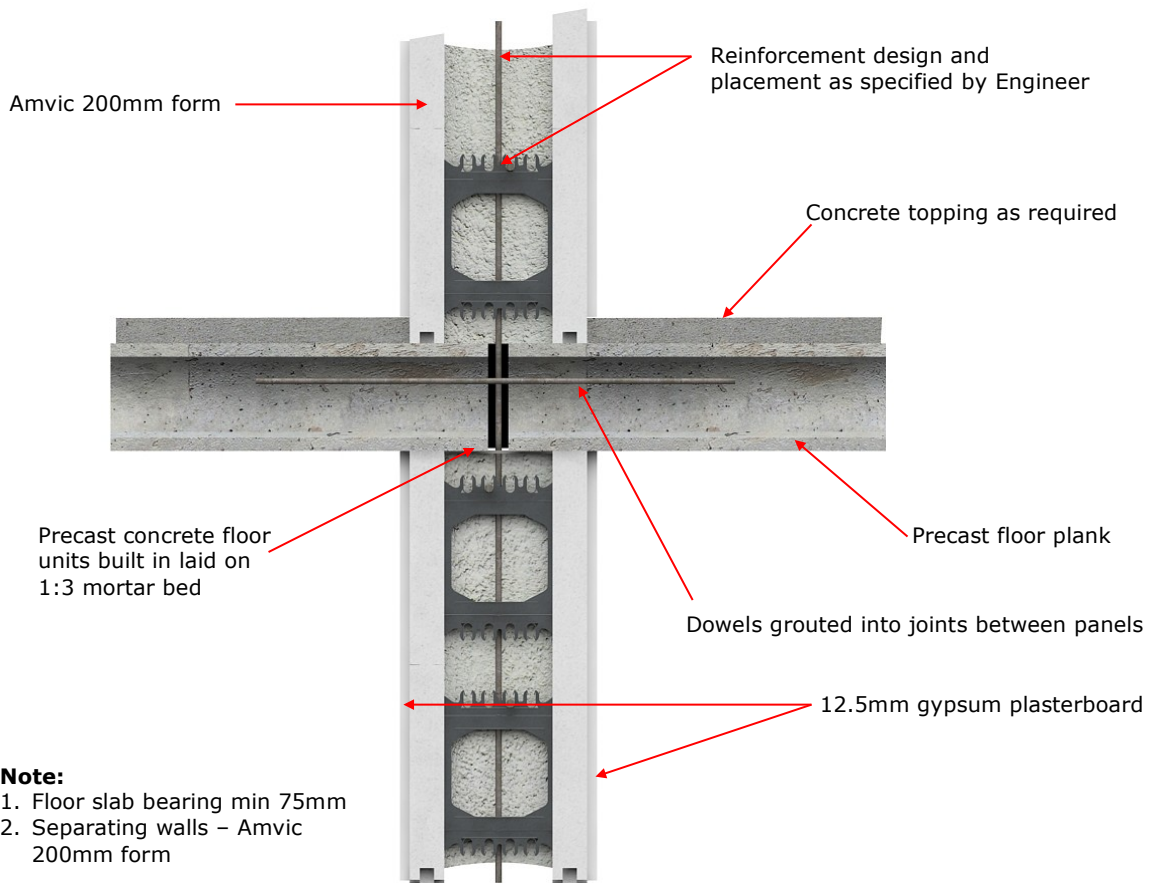
The foundations are not part of the Amvic ICF System and are not covered by this Certificate. Foundation design must comply with TGD to Part A of the Building Regulations 1997 to 2019. Amvic Ireland will provide loading information for foundations.

**2.1.5 External Walls**

The different elements of the external wall are as follows, from external surface to internal:

- External render system thickness per certificate holder's requirements
- 64mm/75mm/100mm EPS board (outer leaf)
- Amvic ICF form with 150mm reinforced concrete core width
- 64mm/75mm/100mm EPS board (inner leaf)
- 12.5mm plasterboard slabs screw fixed to the polypropylene connectors
- 4mm gypsum skin coat plaster

The external renders certified for use onto EPS for new build are described in their own Certificates and Section 2.1.12.



**Figure 1: Precast Hollowcore Floor on Interior Separating Wall**

### 2.1.6 Separating Walls

The separating wall consists of the following:

- 4mm gypsum skin coat plaster
- 12.5mm plasterboard slabs screw fixed to the polypropylene connectors
- 64mm/75mm/100mm EPS board
- Amvic ICF form with 150/200mm reinforced concrete core width
- 64mm/75mm/100mm EPS board
- 12.5mm plasterboard slabs screw fixed to the polypropylene connectors
- 4mm gypsum skin coat plaster

With regard to sound transmission, the Amvic ICF 200mm wall has a mass of 480kg/m<sup>2</sup> and this meets the requirements of Diagram 4 of TGD to Part E of the Building Regulations 1997 to 2019. The 150mm wall has been tested and found to meet the 53dBa requirement and can also be used

With regard to fire, as the design is for use of 12.5mm gypsum plasterboard slabs screwed to the webs of the polypropylene connectors, the internal walls have a Class 0 rating and are acceptable for all areas according to the general provisions of Clause 2.1 of Section B2 of TGD to Part B of the Building Regulations 1997 to 2019, and Clause 2.4 of Section B7 of TGD Volume 2 to Part B of the Building Regulations 1997 to 2019.

Plasterboard lining may be omitted in the attic space of two storey housing, provided the space is a non-habitable area. (see Figure 5).

### 2.1.7 Internal Walls

Load bearing internal walls are constructed using either the 150 or 200mm Amvic ICF forms, and slabbed and plastered as per Section 2.1.6. Traditional masonry block internal walls and timber or metal stud internal walls can also be used with the system.

### 2.1.8 Floors

Generally ground floors will be floating concrete slabs with insulation below or above the slab, with the upper floors in timber or hollowcore. All compartment floors must be constructed using hollowcore slabs.

#### Suspended Ground Floor Slabs

When the depth of fill under the ground floor slab exceeds 900mm it will normally be necessary to suspend the ground floor slab, either using an in-situ reinforced concrete slab or a precast system.

#### Precast Floor/External Wall Connection

The bearing surface should be nominally 100mm, minimum 75mm, as specified in IS EN 1992-1-1<sup>[7]</sup>. The slabs are bedded in 1:3 mortar placed on top of the wall. The minimum cover to the vertical reinforcing steel must be at least 30mm, as



specified. The form straddling the transition between the walls and the floor is cut as required to allow the smooth transition between the floors. This form is filled with concrete of the same specification as the rest of the wall. The floor/wall dowels may be bent as shown or alternatively connection bars can be hooked around the vertical bars to secure the structure.

#### Timber Floors

In two storey construction, first floors are assumed to be formed using timber floor joists fixed into the load bearing walls using the Simpson Strong Ties or a ledger board secured to the concrete using the Amvic standard heavy load fixing detail. Interior fire stops, where required (see Section 4.1.1), must be installed at the top of the 12.5mm gypsum plasterboard, immediately below ceiling level.

#### 2.1.9 Roof

The Amvic ICF System allows for the supply by others of a conventional timber or trussed roof with slating or tiling in accordance with SR 82<sup>[8]</sup>.

#### 2.1.10 Stairs

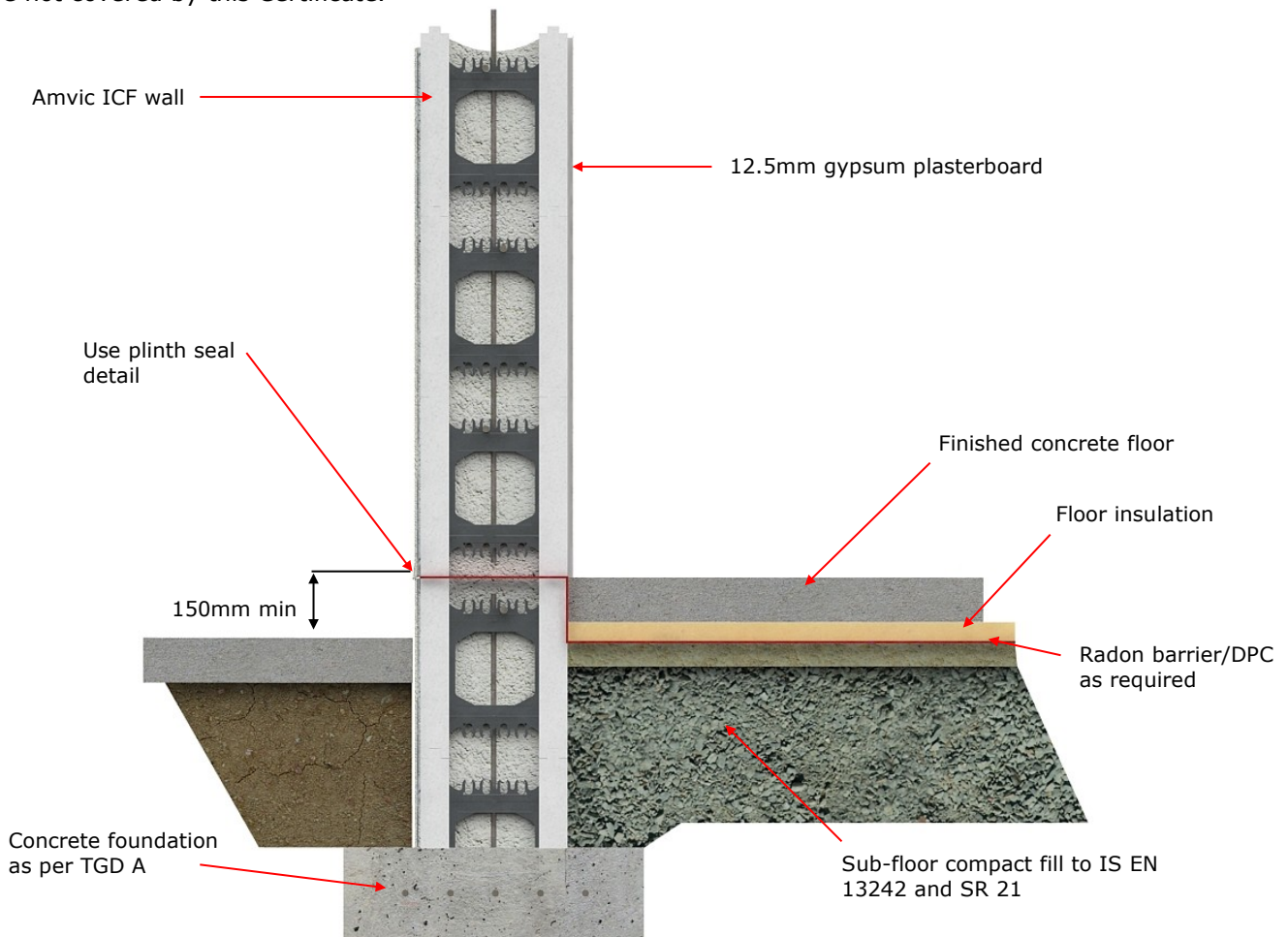
Stairs are not part of the Amvic ICF System and are not covered by this Certificate.

Chimneys are not part of the Amvic ICF System and are not covered by this Certificate.

#### 2.1.12 External Finish

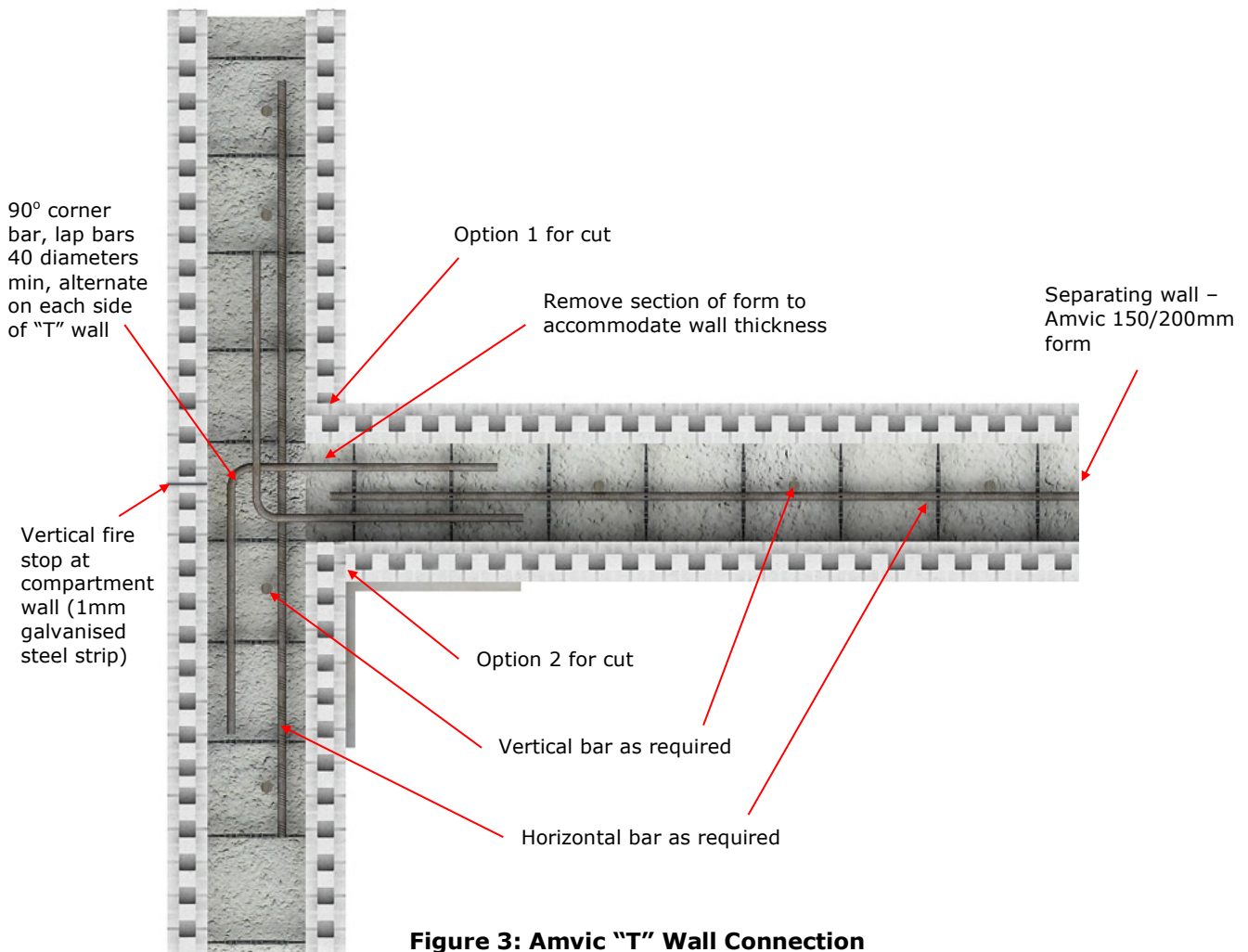
An external render certified by NSAI Agrément for use onto EPS for new build which meets the requirements of Section 3 and 4 of this Certificate is applied to the external polystyrene insulation of the Amvic ICF System. Before this can proceed, the fire barriers must be fitted opposite all separating walls and floors (see Section 4.1.1). A standard external render system consists of the following:

- Fibre reinforced first basecoat layer consisting of high polymer modified cement product;
- Reinforcing mesh consisting of alkali resistant glass fibre mesh, 160g/m<sup>2</sup>;
- Fibre reinforced second basecoat layer consisting of high polymer modified cement based product;
- Primer consisting of topcoat primer.
- Render topcoat finish consisting of silicone topcoat, available in a variety of colours and grain sizes up to 3mm.
- Ancillary items such as PVC beads, fixings and mineral wool fire stops.



**Figure 2: Typical Floor to Wall Amvic ICF Detail**

#### 2.1.11 Chimney



**Figure 3: Amvic "T" Wall Connection**

For impact resistance of external walls, see Section 3.1.5.

Property	Test Method	Value
Declared Thermal Conductivity (50mm)	IS EN 12667	0.031 W/mK
Compressive Strength at 10% Deformation	IS EN 826	150kN/m <sup>2</sup>
Bending Strength	IS EN 12089	200kN/m <sup>2</sup>
EPS Density	IS EN 1602	Min 24kg/m <sup>3</sup>
Reaction to Fire	IS EN ISO 11925-2, IS EN 13501-1	Euroclass E
Water Vapour Permeability	IS EN 12086, IS EN ISO 12572	33g/m <sup>2</sup> /day
Water Absorption by Partial Immersion	IS EN 12087	0.04kg/m <sup>2</sup>
Water Absorption by Total Immersion	IS EN 12087	1.8%

**Table 2: Properties of EPS used in Amvic ICF System**

### 2.1.13 Ancillary Items

- Anchor bolts
- Simpson Strong Tie Ledger connection
- Brickwork/stonework ties

- PVC pipe sleeves for penetrations
- Basement waterproofing membrane
- Course thread drywall screws 75/32mm
- Corner rods – hollow polypropylene rods
- Plumbwall ICF push/pull braces
- Fire stops

The ancillary products listed have not been assessed by NSAI Agrément and remain under the manufacturer's responsibility.

### 2.2 MANUFACTURE

The EPS building blocks are manufactured by Amvic Ireland. The modular units are moulded with the interlocks and with markings on the block face showing the locations of the polypropylene connectors. Each EPS building block is manufactured with its integral polypropylene connectors. Production is controlled at different stages through inspections and quality control checks per the Amvic Ireland Quality Manual and Inspection Schedule.

### 2.3 DELIVERY, STORAGE AND MARKING

Forms are delivered to site in suitable protective packaging. All packaged components are clearly labelled with product type and production date allowing full traceability of supply.

Amvic ICF System components should not deteriorate in normal storage conditions so long as they remain in their packaging protected from the environment prior to use. Storage must be on firm, level and dry ground, and if the components are to be stored outside, they may be further protected from the weather by a secured covering. Amvic ICF System materials should be protected from prolonged exposure to direct sunlight and must not be exposed to plastic materials containing plasticizers or to volatile aggressive solvents. The polystyrene must not come into contact with aggressive chemicals or deleterious agents, e.g. diesel oil, petrol, various cleaning solvents, hydrocarbons, membranes containing coal tar pitches or building products containing solvents.

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.

## **2.4 INSTALLATION**

### **2.4.1 General**

Amvic Ireland undertakes responsibility for the design and manufacture of the system. An approved Amvic Design Guideline for Housing is available (see Section 3). Site construction is undertaken using approved installers in accordance with the Amvic Installation Manual. A pre-render checklist report shall be completed before rendering commences, which shall include checking that all fire barriers are correctly installed. The external render system shall be applied by NSAI Agrément registered installers of render onto ICF systems in accordance with the render specification. Concrete working best practice should be followed in both hot and cold conditions. The concrete may be placed when the air temperature is between 5°C and 30°C.

This Certificate does not contain a full set of installation instructions, but an overview of the procedures involved. For a full list of these instructions, refer to the Certificate holder's manuals. Should a conflict arise between this Certificate and the Certificate holder's manuals, this Certificate shall take precedence.

### **2.4.2 Foundations**

Foundations are not covered by this Certificate. However, foundations and substructures must comply with the relevant clauses of BS 8004<sup>[9]</sup>, IS EN 1992-3<sup>[10]</sup> and BS 8102<sup>[11]</sup> as appropriate, and must provide a flat and level footing for the first course of ICF blocks. Any reinforcing bars cast into the substructure must be positioned such that they allow for compaction and located in the system with adequate concrete cover for protection. The foundation base from which the

Amvic ICF System is to be built must be checked to ensure it is clean, flat and level.

### **2.4.3 Damp Proof Course (DPC)**

Forms with appropriate materials and workmanship can produce adequately damp proof structures by using a layer of water resisting concrete, a minimum of 150mm above external ground level, in accordance with Type B structures defined in BS 8102<sup>[11]</sup>. Alternatively install a dpc, e.g. brush applied liquid membrane. The external detail must be such that protection is provided up to a minimum of 150mm above the external ground level. The system also permits the easy incorporation of an NSAI Agrément approved radon membrane where required, and also a sump and gas handling system. For Amvic ICF foundation walls, the DPC may also be formed as shown in Figure 2. The minimum standard concrete specification, as outlined in Section 2.1.2, is also application for the foundation walls.

### **2.4.4 Wall Assembly**

The castellations of the first course forms are cut off. Assembly of the forms starts at the corners and works into the centre of an elevation, with the units interlocking tightly together. The Amvic ICF System must be raised course by course in a stretcher bond construction. The interlocking mechanism must be fully engaged, and checking as the work proceeds must be carried out to ensure that correct line and level is maintained.

Construction of the first course commences by first locating the corner forms and then working inwards towards the centre of each wall line of structural opening. The long end of the corner form should be kept in the same direction to maintain a running bond. Cut final form to be placed. Run the forms through the door and deep window openings (cut out later) so that interlocking for forms is maintained above each opening. The line of the walls to be built must be set out and checked.

Segments (cut from standard forms) are used to make up wall lengths and should ideally be placed adjacent to large openings. Cuts should be made along the grooves on the face of the forms, so that successive courses will interlock correctly. Reinforce or glue all cuts and weak spots.

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 300mm stagger. After the second course is in place, secure the forms to the footing using low expansion foam. Install horizontal reinforcing as coursing progresses. Corner rods are inserted into the corner forms, if required.

Internal wall formwork is jointed into external formwork by removal of a vertical slice.

Where the specified elevation height is not a multiple of the standard form, units may be trimmed using woodworking tools.

The formation of door and window openings using timber framing must be carefully carried out. Remove forms at openings, cutting 25mm smaller to allow for adjustments. The inside of the opening is lined with 50mm x 150mm treated timber frame or the Amvic EPS insulated closer and glued/screwed into position and propped/braced as required.

#### **2.4.5 Reinforcement Placement**

Horizontal reinforcement can be placed in different locations across the concrete fill void 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 500mm. Vertical reinforcement can then be secured to horizontal reinforcement at required centres using standard fixing methods. Bar lapping lengths as per IS EN 1992-1-1<sup>[7]</sup> should be adopted. The system requires that in plain walls horizontal reinforcement be provided in top and bottom courses of every wall lift. The reinforcement is checked to ensure there is adequate concrete cover for protection and that compaction can take place. The horizontal and vertical reinforcement shall be as specified by the chartered structural engineer (see Section 3.1.1).

#### **2.4.6 Bracing**

Install bracing system following installation 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 installer is responsible for ensuring the adequacy of all temporary bracing. As a minimum, the full height of the assembled formwork system must be supported 700mm from corners and along the length of each wall at maximum horizontal centres of 1.8m. 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. 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 recommended.

#### **2.4.7 Openings**

The rigidity of the formwork is reduced by window and door openings, but is increased by the incidence of corner and crosswall details. Openings are formed during construction of the formwork. EPS inserts/closers are inserted prior to the timber formwork being placed around openings between the EPS panels to seal

openings, which is then secured in place and braced before pouring concrete. 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. Where joists are installed they must be adequately supported by the wall. The joists must not penetrate the external face of the formwork system. Locate and set items to be cast directly into concrete. Refer to Section 2.1.9 of this Certificate.

#### **2.4.8 Services**

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

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). The cables must be placed in PVC conduit and must be sized to minimise heat build-up with resulting fire risk, in accordance with ETCI (Electro-Technical Council of Ireland) requirements documents I.S. 10101<sup>[12]</sup> and ET 207<sup>[13]</sup>.

#### **2.4.9 Pre-Pour Checks**

Once the bracing and propping is erected, adjustments are made for plumb, alignment and level by use of the push/pull screws. Reinforcement should be checked for correct cover distance and rigidity. Before the initial pour and between concrete pours, care must be taken to remove any debris from inside the formwork. All reinforcement must be checked by registered installer.

#### **2.4.10 Concrete Placement**

Adequate supervision and care by the installer is needed when placing concrete. 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 1.2m lift height 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 storey lifts. When forming construction joints between concrete pours, these should be located within 100mm of the top of the Amvic ICF System for ease of access and visual



checking. Construction joints should be horizontal rather than vertical.

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. To prevent damage to the system, the use of poker vibrators above 25mm diameter is not recommended.

In very hot or freezing conditions, the top of the Amvic ICF System must be covered to protect the concrete from adverse curing conditions.

The recommended concrete pour rate is 1000 to 1200mm/hr with a maximum of 1500mm/hr in warm temperatures. The formwork system is filled and compacted progressively in layers not exceeding 1.3m lifts with a total daily concrete pour height not exceeding 3m (i.e. one storey height). This is to ensure adequate compaction is achievable and to avoid possible displacement of any reinforcement and excessive pressure being exerted on the Amvic ICF System.

#### **2.4.11 Concrete Compaction**

Adequate consolidation/compaction of the concrete in line with IS EN 1992-1-1<sup>[7]</sup> is essential and the concrete must be placed so that it completely fills the Amvic ICF System without creating any voids. A 25mm vibrating poker should be used with care and kept back from the corners by approximately 1m.

Particular attention should be given to basement walls and areas around openings. Particular attention should also be paid to the window and door openings where the steel 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.

Where reinforcement is present for structural purposes, mechanical vibration is essential with internal poker vibrators smaller than 25mm diameter. Special care is required to avoid touching the formwork when using this equipment. Where internal poker vibrators are used, these should be confined to the central concrete core between reinforcement layers and used in accordance with the Certificate holder's instructions.

The formation of construction joints between concrete pours should be located as close to the top of the form wherever possible for the formwork wall to enable visual checking and ease of access for the formation of these joints. The

construction joints formed should be horizontal rather than vertical.

The completeness of filling of the formwork can be easily confirmed by tapping its surface (with the palm of the hand or a wooden mallet) – any voids will be detected by a distinctive hollow sound. This should be done as the concrete is placed so that any voids detected can be easily corrected. The compaction of the concrete can be confirmed by tapping the surface as described up to 2.8m high walls. For load bearing walls above this height, the EPS can be removed to inspect the concrete core or alternatively, normal concrete cores can be taken as required.

#### **2.4.12 Post-Pour Tasks**

After pouring is complete, immediately check the walls are straight and vertical adjusting the bracing support as required.

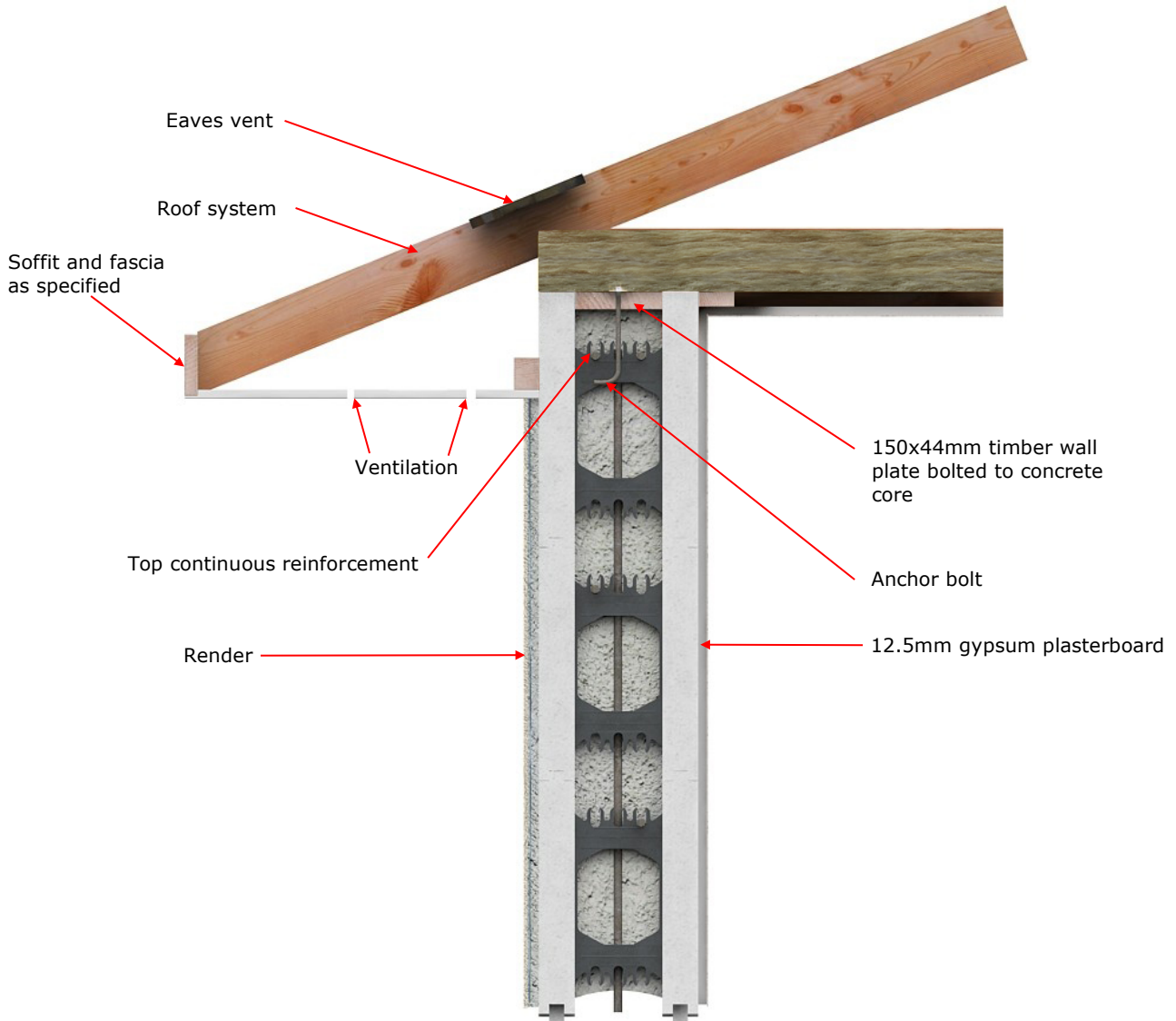
Any damage to the forms should be repaired immediately and any concrete spillage or leakage of grout may be removed by hosing down the exposed face of the system before it sets.

The concrete in the Amvic ICF System must be left to cure until it has achieved a specified minimum strength, usually after two or three days, for construction to continue. Structural fixings should not be loaded until the concrete has achieved a sufficient strength, and supports should be left in place as long as required.

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.

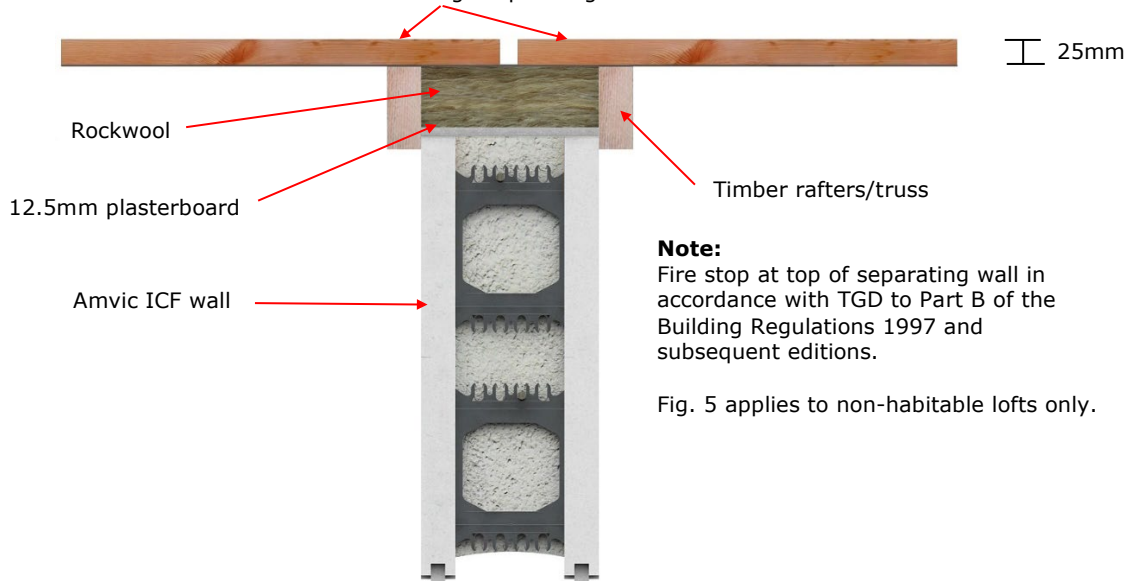
Backfilling around bottom layers of formwork to the ground floor walls should not take place until the concrete has reached sufficient design strength, i.e. a minimum period of seven days.

Any damage to the faces of the Amvic ICF System must be made good prior to the application of the internal and external finishes.



**Figure 4: Amvic Wall/Roof Connection**

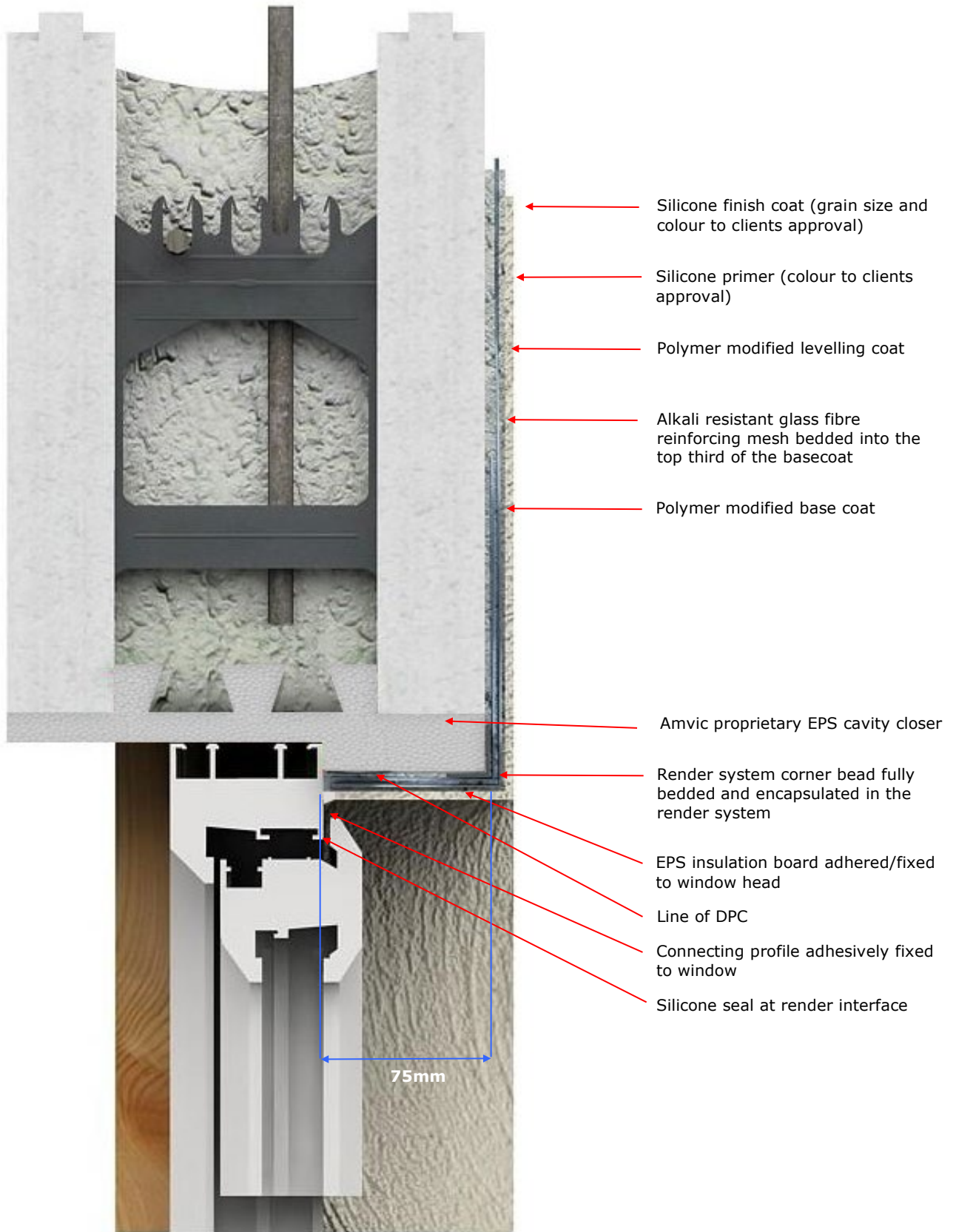
Roof laths & felt do not bridge separating wall



**Figure 5: Top of Separating Wall Detail in Attic Space with no Permanent Access**



**Figure 6: Simpson Strong Tie Ledger System**



**Figure 7: Window Head Detail**



Silicone finish coat (grain size and colour to clients approval)

Silicone primer (colour to clients approval)

Polymer modified levelling coat

Alkali resistant glass fibre reinforcing mesh bedded into the top third of the basecoat

Polymer modified base coat

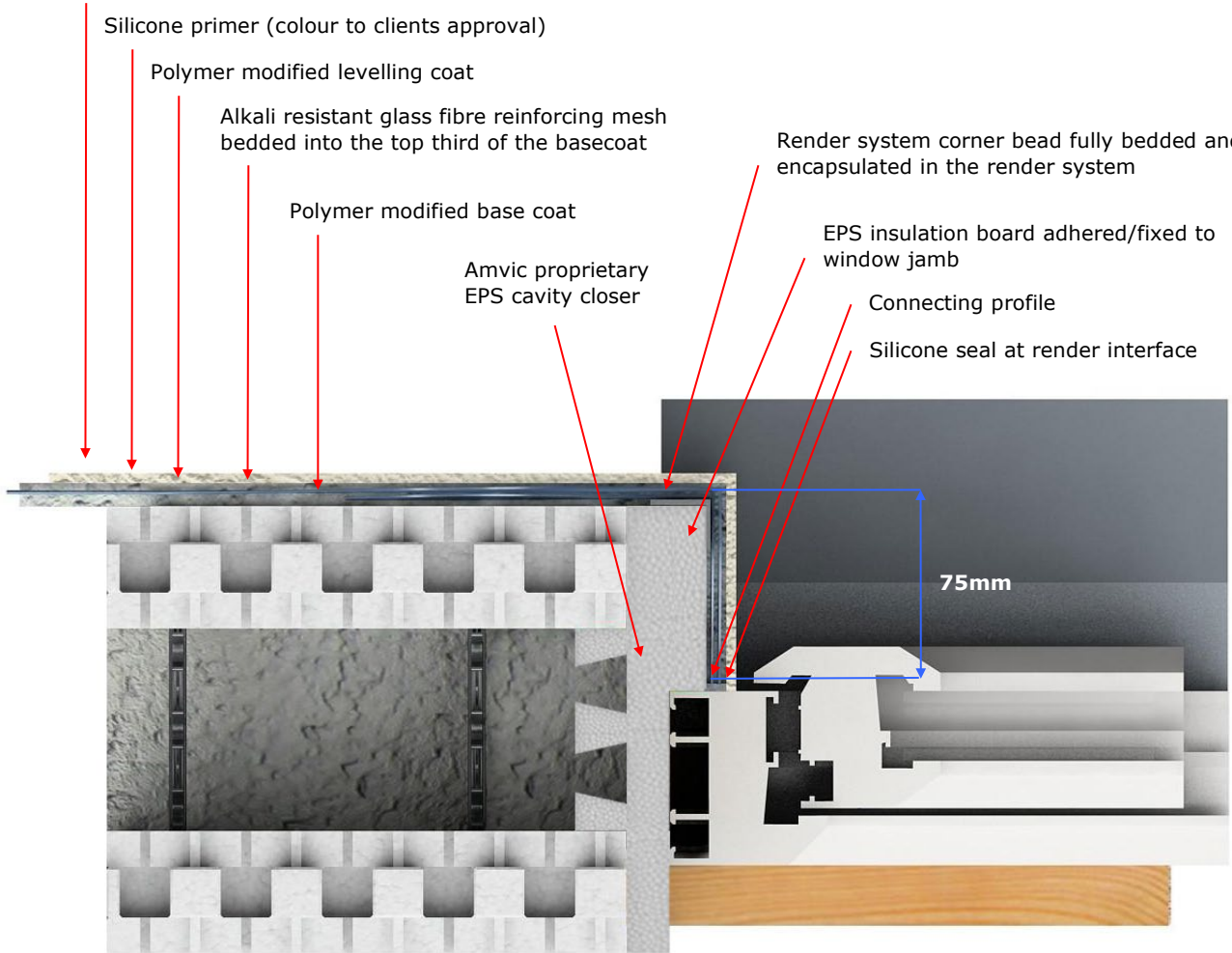
Amvic proprietary EPS cavity closer

Render system corner bead fully bedded and encapsulated in the render system

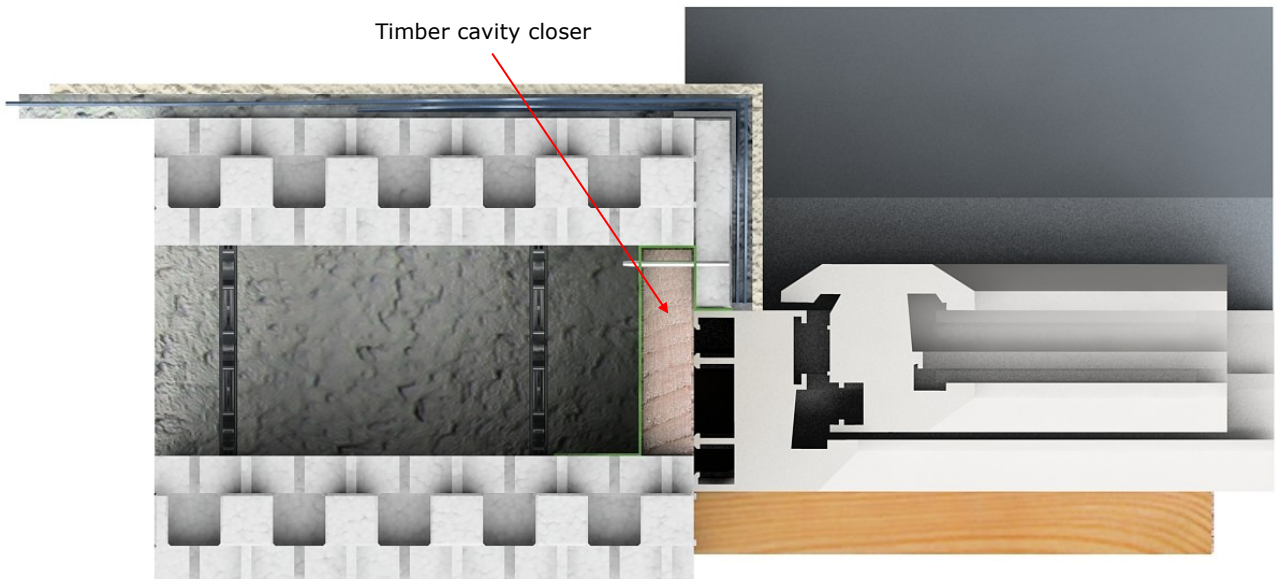
EPS insulation board adhered/fixed to window jamb

Connecting profile

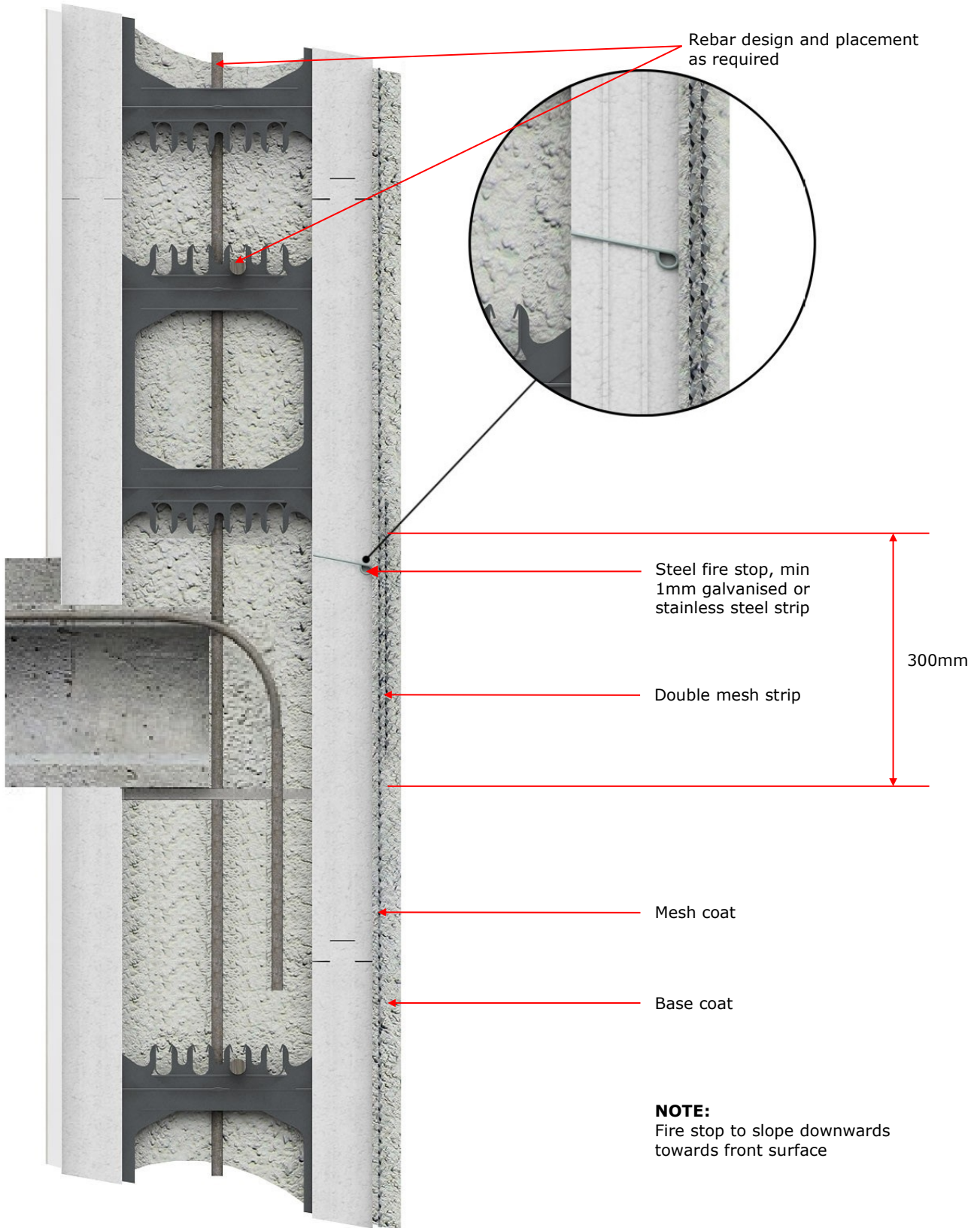
Silicone seal at render interface



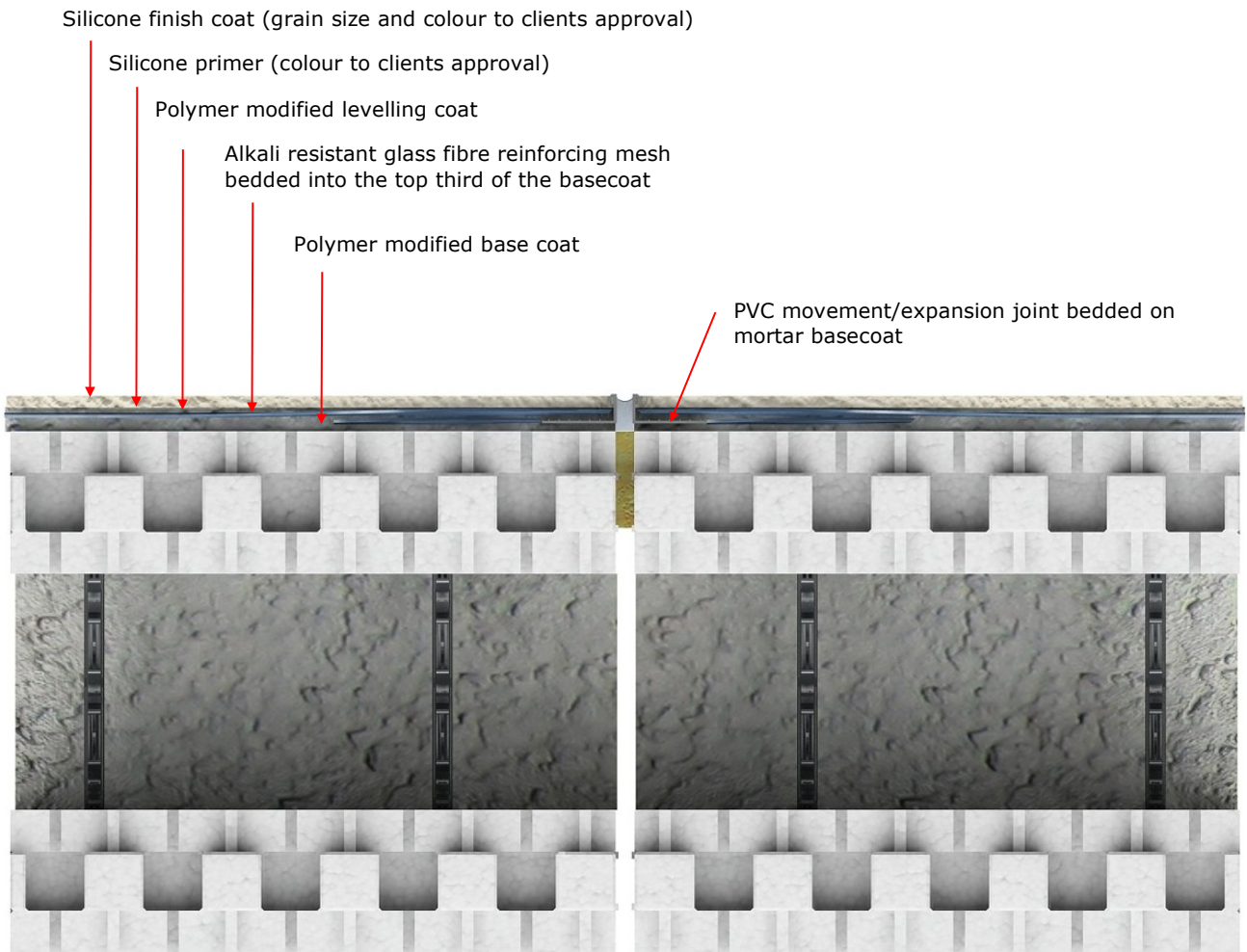
Timber cavity closer



**Figure 8: Window Jamb Detail**



**Figure 9: Fire Stop Detail**



**Figure 10: Movement/Expansion Joint Detail**



### 3.1 STRENGTH & STABILITY

#### 3.1.1 General

The Amvic ICF System is intended for use where Architect's drawings are available and satisfy the Building Regulations 1997 to 2019 – the Architect and Engineer design team of the developer are responsible for the architectural drawings and overall building design to comply with the Building Regulations.

Buildings constructed using the Amvic ICF System shall be certified by a competent, chartered civil or structural engineer, with experience in design of buildings and structures incorporating the Amvic ICF System, as being in accordance with Part A of the Building Regulations 1997 to 2019.

The Amvic Ireland Design Guide for Housing provides guidance for the structural design of dwelling houses up to 3 storeys (10m) in height.

#### 3.1.2 Loading

The vertical imposed loads within the scope of the Design Guide are detailed in Table 3. Higher loads are possible subject to a structural design by a chartered structural engineer.

Element	Loading	Value
Roof	Distributed Load	0.75kN/m <sup>2</sup>
Floor	Distributed Load	1.50kN/m <sup>2</sup>
Ceiling	Distributed Load	0.75kN/m <sup>2</sup>

**Table 3: Vertical Imposed Loads**

The vertical dead loads should be calculated based on the self-weight of materials to be used in construction, and reference should be made to IS EN 1991-1-1<sup>[14]</sup> in this regard. The following self-weights apply to the Amvic ICF wall thicknesses:

- 150mm wall: 3.7kN/m<sup>2</sup>
- 200mm wall: 4.9kN/m<sup>2</sup>

These figures include the mass of the concrete, insulation and internal Amvic ICF System fixings.

Designs for typical dwellings which have been completed have been examined by NSAI Agrément and comply with the following standards:

- IS EN 1991-1-1<sup>[14]</sup>
- IS EN 1991-1-7<sup>[15]</sup>
- IS EN 1991-1-4<sup>[16]</sup>

Reinforcement for lintel load spans and spacings of anchor bolts for the Simpson Strong Tie Ledger

System must be as per the Amvic Ireland Design Guide for Housing.

Design snow and wind loads must be based on Diagram 14 and 15 of TGD to Part A of the Building Regulations 1997 to 2019. The maximum characteristic wind loading pressure for the Amvic ICF System has been calculated as 1.2kN/m<sup>2</sup>, in accordance with IS EN 1991-1-7<sup>[15]</sup>.

Where timber elements are used they are designed in accordance with IS EN 1995-1-1<sup>[17]</sup> and IS EN 1995-1-2<sup>[18]</sup>.

Panel designs are based on the wind exposure map provided in the TGD to Part A of the Building Regulations 1997 to 2019. For very exposed sites on hills above the general level of the surrounding terrain, the system can be specifically designed to withstand the unusually high wind loading. This is likely to involve the provision of additional ground anchorage and increased lateral bracing, both of which can be readily provided in the system.

#### 3.1.3 Retained Earth

Differences in the final level of ground or floor slabs between one side of a wall and the other should not exceed four times the wall thickness.

#### 3.1.4 Stability

Because of the homogeneous and boxed nature of the form of construction, domestic structures built using the Amvic ICF System will be stable in themselves. Normally the elements requiring particular care are the tying-in of floors and roofs into walls and the bracing of any free standing or unbutressed sections of wall.

#### 3.1.5 Impact Resistance

The Amvic ICF System provides a robust system that has a high resistance to hard and soft body impacts likely to be associated with normal use situations. The rendered wall is acceptable for all normal situations and is classed as Category I, which is described in ETAG 004<sup>[19]</sup> as zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use. Other stronger solutions are available if required – the Certificate holder must be contacted for details.

### 3.2 STRUCTURAL FIRE SAFETY

#### 3.2.1 Internal Fire Spread (Linings)

The plasterboard slabs used on the internal finish are non-combustible and have a Class 0 'spread of flame' rating. Surface spread of flame rating of the finished construction will be determined by the



surface spread of flame rating of the lining materials used.

### **3.2.2 Internal Fire Spread (Structure)**

When the building has been designed and installed in accordance with the requirements of this Certificate, the walls are capable of withstanding the effects of fire for 60 minutes without loss of stability. Further structural fire resistance can be achieved by the incorporation of additional reinforcing steel in accordance with IS EN 1992-1-2<sup>[25]</sup> Table 5.4.

### **3.2.3 External Fire Spread**

The NSAI Agrément certified render approved for use onto EPS for new build must have a spread of flame rating of B-s1, d0 to I.S. EN 13501-1<sup>[20]</sup>.

### **3.3 WEATHERTIGHTNESS**

Externally the walls are protected by an approved render. A DPC/radon barrier is installed at ground level to prevent rising damp. A DPC is also used around window sills, and a double seal is used at window reveals (see Figure 7). In the case of aluminium window sills, they shall be provide with stop ends. In the case of concrete sills, they shall either be stooped or be 75mm wider than the window ope and be provided with the wraparound DPC.

#### 4.1 BEHAVIOUR IN FIRE

The fire resistance of load bearing wall, separating wall and floor elements of the Amvic ICF System in two storey construction (not more than 7m in height) is 60 minutes. Based on IS EN 1992-1-1<sup>[7]</sup>, an Amvic ICF 150mm wall has over 60 minutes fire performance. Minimum cover to reinforcement is 30mm (for durability), which exceeds the required cover of 25mm for fire protection.

Escape stairways constructed using the Amvic ICF System must be lined with fire retardant linings.

The concrete in the walls has a Class 0 rating and is non-combustible as per TGD to Part B of the Building Regulations 1997 to 2019. The polystyrene used in the wall and floor panels is flame retardant.

External walls with an NSAI Agrément approved external render for use onto EPS for new build have been tested as B-s1, d0 per IS EN 13501-1<sup>[20]</sup>. In the case of the internal wall, as the design is for use of 12.5mm gypsum plasterboard slabs screwed to the webs of the polypropylene connectors, the internal walls have a Class 0 rating and are acceptable for all areas according to the general provisions of Clause 2.1 of Section B2 of TGD to Part B of the Building Regulations 1997 to 2019, and Clause 2.4 of Section B7 of TGD Volume 2 to Part B of the Building Regulations 1997 to 2019.

##### 4.1.1 Fire Barriers

There are no cavities in the walls. However, as the Amvic ICF System has polystyrene, it must be fire stopped opposite every separating wall, and every compartment floor. The external render fire stops the insulation around the window and door openings. In the case of timber floors, a fire barrier must be provided at the top of plasterboard slabs, placed level with the internal ceiling plasterboard from the second floor and at every subsequent floor level. The location of fire barriers should be agreed with the Architect.

Fire barriers are created by placing strips of galvanised steel 1mm thick (weight 2.68kg/m<sup>2</sup>) to the full depth of the expanded polystyrene, installed as shown in Figure 9 or as described in Section 3.3.4 of TGD to Part B of the Building Regulations 1997 to 2019, and Section 3.6.3 of TGD Volume 2 to Part B of the Building Regulations 1997 to 2019. The fire stop must be placed level with any internal ceiling plasterboard from the second and at every floor level from there up. A strip of mesh reinforcement is placed along the

length of the fire stop before a second layer of mesh reinforcement is placed over the entire wall.

##### 4.1.2 Toxicity

The system is non-toxic in normal conditions. In fire conditions, the polystyrene will begin to soften, to contract, and final melt above 100°C. Ignition occurs between 350°C and 450°C. The mass of material present is low and hence the amount of heat released is low. When burning, EPS behaves like other hydrocarbons such as wood and paper. The products of combustion are basically carbon monoxide and styrene; during a fire, the styrene may be further decomposed, giving off oxides of carbon, water and a certain amount of smoke. The polystyrene used in the Amvic ICF System is flame retarded.

##### 4.1.3 Security of Fixings

With regard to security of fixings, there is the mechanical fire fixing for the Amvic ICF System of one per m<sup>2</sup> above two storeys. Ejoy supplementary polypropylene fasteners are also used whenever necessary to fix insulation to the internal wall.

#### 4.2 THERMAL INSULATION AND U-VALUES

The thermal conductivity,  $\lambda$ , value of the Amvic ICF wall is 0.031W/mK for graphite enhanced EPS, with allowance made for the cold bridging effect of the polypropylene connector. The calculated U-value for the Amvic ICF 150 and 200mm wall can meet or exceed the required U-value of 0.18 W/m<sup>2</sup>K (see Table 1). Lower U-values can be achieved by using additional energy improvement measures such as internal drylining board.

#### 4.3 LIMITING THERMAL BRIDGING

The linear thermal transmittance ( $\psi$ ) or Psi describes the heat loss associated with junctions and around openings. The Amvic ICF System has been assessed and when detailed in accordance with this Certificate, these thermally bridged junctions can be compared with the requirements of Table D2 of Appendix D of TGD to Part L of the Building Regulations 1997 to 2019. ' $\psi$ ' values for bridged junctions as outlined in Table 4 can be used for calculating the ' $\gamma$ ' factor for a dwelling.

' $\psi$ ' values for other junctions outside the scope of this Certificate should be assessed in accordance with BRE IP1/06<sup>[21]</sup> and BRE Report BR 497<sup>[22]</sup> in accordance with Appendix D of TGD to Part L of the Building Regulations 1997 to 2019.

#### 4.4 CONDENSATION

The system was subjected to an interstitial condensation risk analysis, which concluded that

the risk of condensation is minimal and that no vapour barrier is required.

#### **4.5 SOUND**

The separating wall requirement is met by the wall thickness of the Amvic 200mm wall which gives 490kg/m<sup>2</sup>. This satisfies the requirement of 415kg/m<sup>2</sup> of Diagram 4 of TGD to Part E of the Building Regulations 1997 to 2019. The 150mm wall can also be used as this has been tested to meet the 53dBa requirement. With regard to compartment floors in apartments, the minimum required mass for hollowcore type floors with a screed and soft covering is 365kg/m<sup>2</sup> as per Diagram 32 of TGD to Part E of the Building Regulations 1997 to 2019.

#### **4.6 DURABILITY**

Buildings based on the Amvic ICF System, when rendered using an NSAI Agrément certified renders for use onto EPS for new build, subject to maintenance, when constructed in accordance with the manufacturer's instructions and this Certificate, will have a minimum design life of at least 60 years in accordance with BS 7543<sup>[23]</sup>.

It is important to note that the durability of the render system is entirely dependent on the correct installation of the product in accordance with its NSAI Agrément Certificate, the manufacturer's instructions, IS EN 13914-1<sup>[24]</sup> and ongoing care and maintenance as described in Section 4 of their NSAI Agrément Certificates. Critical details include rendering at window sills, raised features, junctions with eaves and verges, and the use of suitably designed overhangs and flashings. Reference should be made to IS EN 13914-1<sup>[24]</sup> for general advice on design, in particular on the use of angle, stop and movement joint beads.

#### **4.7 MAINTENANCE**

The rendering/concrete in the wall panels is maintenance free. However, the coloured rendering may discolour with time. It is considered that periodic re-coating of the silicone top coat may be necessary every 18 to 20 years to improve the appearance. The external sealants around window and door frames should be inspected periodically and replaced when necessary.

#### **4.8 PRACTICABILITY**

A Design Guide and Installation Manual incorporating Health & Safety guidelines is provided by Amvic Ireland. Erection of the Amvic ICF System must be by approved trained installers.

#### **4.9 TESTS AND ASSESSMENTS WERE CARRIED OUT TO DETERMINE THE FOLLOWING:**

- Structural strength and stability
- Behaviour in fire

- Resistance to airborne and impact sound transmission
- Thermal transmittance values
- Impact resistance for external walls
- Site erection controls

#### **4.10 OTHER INVESTIGATIONS**

- (i) Existing data on product properties in relation to fire, toxicity, environmental impact and the effect on mechanical strength/stability and durability were assessed.
- (ii) The manufacturing process was examined including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.
- (iii) Site visits were conducted to assess the practicability of installation and the history of performance in use of the product.
- (iv) Bought-in components were assessed for suitability in use.
- (v) No failures of the product in use have been reported to NSAI Agrément.

Target linear thermal transmittance ( $\psi$ ) for different types of junctions	Amvic ICF $\psi$ value		
	64mm block	75mm block	100mm block
	Target U-value Wall: 0.23W/m <sup>2</sup> K Warm Roof: 0.12W/m <sup>2</sup> K Cold Roof: 0.08W/m <sup>2</sup> K Ground Floor: 0.11W/m <sup>2</sup> K	Target U-value Wall: 0.20W/m <sup>2</sup> K Warm Roof: 0.12W/m <sup>2</sup> K Cold Roof: 0.08W/m <sup>2</sup> K Ground Floor: 0.11W/m <sup>2</sup> K	Target U-value Wall: 0.15W/m <sup>2</sup> K Warm Roof: 0.12W/m <sup>2</sup> K Cold Roof: 0.08W/m <sup>2</sup> K Ground Floor: 0.11W/m <sup>2</sup> K
Description	(W/mK)	(W/mK)	(W/mK)
Warm Roof Eaves (insulation between and below rafter level)	-0.019	-0.013	-0.002
External Corner	0.046	0.042	0.037
Inward Facing Corner	-0.093	-0.084	-0.072
Internal Wall In Plan	-0.001	-0.001	-0.001
Intermediate Floor	0.208	0.185	0.212
Ground Floor Perimeter	0.052	0.052	0.048
Window Sill Concrete	0.089	0.053	0.132
Window Sill Pressed Metal Sill	0.005	0.007	0.017
Window Sill 78mm Pressed Metal Sill	0.009	0.013	0.021
Window Sill Timber Support	0.010	-	-
Window Head 113mm Frame	0.001	0.003	0.040
Window Head 78mm Frame	0.020	0.019	0.055
Window Jamb 113mm Frame	0.001	0.003	0.040
Window Jamb 78mm Frame	0.019	0.019	0.054
Eaves with Window Head	-0.003	0.008	0.023
Separating Wall In Plan	0.149	0.216	0.184
T Separating Wall In Plan	0.143	0.192	0.168
Cold Roof Eaves (insulation at ceiling level)	0.033	0.031	0.028
Cold Roof Eaves With Window Head (insulation at ceiling level)	0.057	0.055	0.055
Intermediate Floor Parallel Joists	0.011	0.013	0.034
Intermediate Floor Perpendicular Joists	-0.006	-0.004	0.094
Barge Detail	0.067	0.064	0.059
Intermediate Floor Between Dwellings	0.247	0.222	0.249
Gable Wall to Cold Ventilated Attic Space	0.079	-	0.070
$\psi$ -values for additional and improved junctions are available from the Certificate holder.			
Installation details and thermal modelling calculations for these junctions are available from the Certificate holder.			

**Table 4: Linear thermal transmittance ( $\psi$ )**



**5.1** National Standards Authority of Ireland ("NSAI") following consultation with NSAI Agrément has assessed the performance and method of installation of the product/process and the quality of the materials used in its manufacture and certifies the product/process to be fit for the use for which it is certified provided that it is manufactured, installed, used and maintained in accordance with the descriptions and specifications set out in this Certificate and in accordance with the manufacturer's instructions and usual trade practice. This Certificate shall remain valid for five years from date of latest revision so long as:

- (a) the specification of the product is unchanged.
- (b) the Building Regulations 1997 to 2019 and any other regulation or standard applicable to the product/process, its use or installation remains unchanged.
- (c) the product continues to be assessed for the quality of its manufacture and marking by NSAI.
- (d) no new information becomes available which in the opinion of the NSAI, would preclude the granting of the Certificate.
- (e) the product or process continues to be manufactured, installed, used and maintained in accordance with the description, specifications and safety recommendations set out in this certificate.
- (f) the registration and/or surveillance fees due to NSAI are paid.

**5.2** The NSAI Agrément mark and certification number may only be used on or in relation to product/processes in respect of which a valid Certificate exists. If the Certificate becomes invalid the Certificate holder must not use the NSAI Agrément mark and certification number and must remove them from the products already marked.

**5.3** In granting Certification, the NSAI makes no representation as to;

- (a) the absence or presence of patent rights subsisting in the product/process; or
- (b) the legal right of the Certificate holder to market, install or maintain the product/process; or

(c) whether individual products have been manufactured or installed by the Certificate holder in accordance with the descriptions and specifications set out in this Certificate.

**5.4** This Certificate does not comprise installation instructions and does not replace the manufacturer's directions or any professional or trade advice relating to use and installation which may be appropriate.

**5.5** Any recommendations contained in this Certificate relating to the safe use of the certified product/process are preconditions to the validity of the Certificate. However the NSAI does not certify that the manufacture or installation of the certified product or process in accordance with the descriptions and specifications set out in this Certificate will satisfy the requirements of the Safety, Health and Welfare at Work Act 2005, or of any other current or future common law duty of care owed by the manufacturer or by the Certificate holder.

**5.6** The NSAI is not responsible to any person or body for loss or damage including personal injury arising as a direct or indirect result of the use of this product or process.

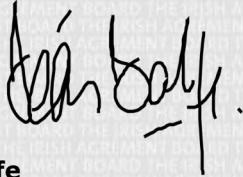
**5.7** Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is in force at the date of this Certification.

## NSAI Agrément

This Certificate No. **07/0277** is accordingly granted by the NSAI to **Amvic Ireland** on behalf of NSAI Agrément.

Date of Issue: **May 2007**

Signed



**Seán Balfe**  
**Director of NSAI Agrément**

Readers may check that the status of this Certificate has not changed by contacting NSAI Agrément, NSAI, 1 Swift Square, Northwood, Santry, Dublin 9, Ireland. Telephone: (01) 807 3800. Fax: (01) 807 3842. [www.nsai.ie](http://www.nsai.ie)

### Revisions:

**December 2007:** Scope extended to cover use of the system up to six storeys in height.

**27<sup>th</sup> October 2017:** References to Building Regulations and standards updated, addition of 75mm thick block.

**07<sup>th</sup> February 2022:** Addition of 100mm thick block, references to Building Regulations and standards updated, general text changes.

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- [18] I.S. EN 1995-1-2:2005 COR 2009 *Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design (including Irish National Annex).*
- [19] ETAG 004 Edition 2000 Amended August 2011 Amended February 2013 *Guideline for European Technical Approval of External Thermal Insulation Composite Systems (ETICS) with Rendering.*
- [20] I.S. EN 13501-1:2018 *Fire classification of construction products and building elements – Classification using data from reaction to fire tests.*
- [21] BRE IP1/06 *Assessing the effects of thermal bridging at junctions and around openings.*
- [22] BRE BR 497 *Conventions for calculating linear thermal transmittance and temperature factors.*
- [23] BS 7543:2015 *Guide to durability of buildings and building elements, products and components.*
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- [25] I.S. EN 1992-1-2:2004+AC:2008+A1:2019 *Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design.*