IRISH AGRÉMENT BOARD
CERTIFICATE NO. 08/0307
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KORE Insulating Concrete Formwork System

Systéme pour construction
Bausystem

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 and subsequent revisions.**

PRODUCT DESCRIPTION:
This Certificate relates to the KORE ICF (Insulating Concrete Formwork) System, which consists of modular interlocking expanded polystyrene (EPS) building blocks for permanent formwork for the construction of in-situ concrete walls. An external render system approved by NSAI Agrément for use onto EPS which meets the requirements of Section 3 and 4 of this Certificate is applied to the external polystyrene insulation of the KORE ICF System as the external finish, and plasterboard slabs are screw-fixed to the polypropylene connectors as an internal finish. This Certificate certifies compliance with the requirements of the Irish Building Regulations 1997 and subsequent revisions.

USE:
The KORE ICF System is certified for use in the construction of two storey plus attic space (2.5 storeys) single occupancy dwellings.

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:
KORE Insulation,
Kilnaleck,
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Part One / Certification 1

1.1 ASSESSMENT
In the opinion of NSAI Agrément, the KORE ICF System if used in accordance with this Certificate can meet the requirements of the Irish Building Regulations 1997 and subsequent revisions, as indicated in Section 1.2 of this Irish Agrément Certificate.

1.2 BUILDING REGULATIONS REQUIREMENTS:

Part D – Materials and Workmanship
D3 – The KORE 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 KORE ICF System, as certified in this Certificate, meets the requirements of the building regulations for workmanship.

Part A - Structure
A1 – Loading
The KORE 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 KORE 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 KORE ICF System, as certified in this Certificate, will meet this requirement.

B4 & B9 – External Fire Spread
External renders approved for use with the KORE ICF System have a spread of flame rating equivalent to Class 0 on both face. In respect of spread of flame, this is the highest performance classification set out in the Building Regulations.

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. The KORE ICF System permits the easy incorporation of the appropriate membrane, sump and gas handling system.

C4 – Resistance to Weather and Ground Moisture
The KORE 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)
Compartment walls (i.e. party 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 KORE 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.

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 KORE 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
- **Dwellings**
- **Buildings other than Dwellings**

L1 – Conservation of Fuel and Energy
The KORE ICF System will contribute to enabling a building to meet this requirement. U-value and Psi value calculations may be based on a λ value = 0.033W/mK. The calculated U-value for the KORE ICF 150 and 200mm wall is 0.20W/m^{2}K.

Part M – Access for People with Disabilities
M1 – Access and Use
Buildings based on the KORE ICF System can be designed to meet the access, circulation and facilities requirements of this Regulation.

2.1 PRODUCT DESCRIPTION

2.1.1 General

The KORE ICF System consists of moulded panels of EPS linked together with folding linkages. When unfolded fully the panels form the KORE ICF System. The linkage system consists of three components:

- KORE Insert, high impact polystyrene, moulded within the KORE panels;
- KORE Bridge, polypropylene, variable in width (150, 200 or 300mm);
- KORE Pin, cold head high tensile steel.

The KORE panels and KORE Bridges are linked together by means of the KORE Pin forming an articulated hinge. Two KORE panels on extension create the formwork of uniform width. The KORE panels are manufactured from fire retardant grade EPS in accordance with IS EN 13163:2012 + A2:2016 *Thermal insulation products for buildings – Factory made expanded polystyrene (EPS) products – Specification*, without the use of HCFC's. The minimum density is 25kg/m^3.

Each KORE panel has a moulded interlocking tongue and groove system at the top and bottom to enable tight connection between layers of panels. The panels are placed with staggered vertical joints.

On placement of the forms, a cavity is formed for the placement of the concrete. The cavity is formed around windows and openings by insertion of KORE stops, which fit into the concrete security feature dovetails, moulded into the concrete cavity side of the KORE panel. The KORE stop is moveable within the cavity for accurate placement.

When concrete is poured into the cavity, a monolithic concrete wall is formed. The poured wall then retains the KORE formwork insulation for the life of the building. The KORE inserts provide permanent fixing points within the insulation embedded 12.5mm under the KORE logo on the panel. Their fixing area is 50mm by 412mm and each plain panel contains 6 at 200mm centres. The standard dimensions of the KORE panel are 1200mm by 417mm by 75mm.

2.1.2 Structure

The concrete specification is as follows:

- Minimum concrete strength: 25N
- Maximum aggregate size: 10-13mm for a 150mm wall and 10-19mm for a 200mm wall
- Concrete slump: 150mm
- Concrete supplier certified to IS EN 206:2013+A1:2016 *Concrete – Specification, performance, production and conformity*.

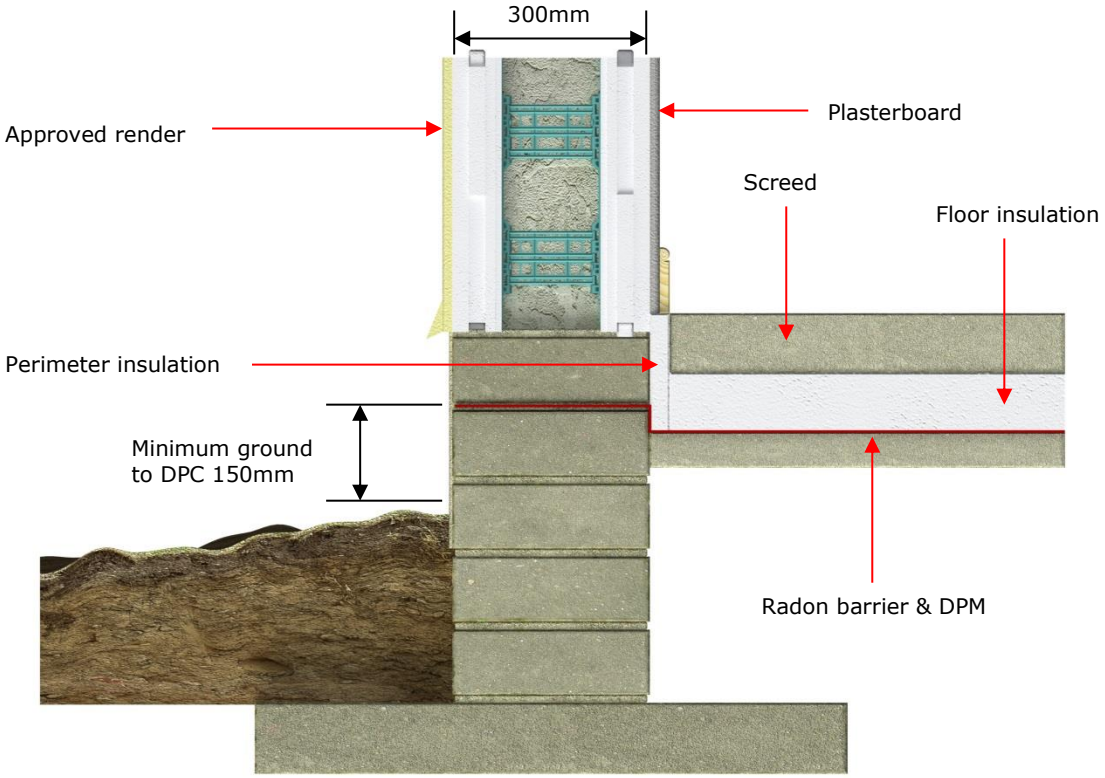

Figure 1: DPM and Radon Barrier

2.1.3 Steel Reinforcement

The steel reinforcement to be used should be 12mm diameter round or deformed bars, high tensile to BS 4449:2005+A3:2016 *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* and IS EN 10020:2000 *Definition and classification of grades of steel*, IS EN 1992-1-1:2005+A1:2015 *Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings*, and have a maximum yield strength of 500N/mm^2.

2.1.4 Foundations

The foundations are not part of the KORE ICF System and are not covered by this Certificate. Foundation design must comply with Part A of the Building Regulations. KORE Insulation will provide loading information for foundations.

2.1.5 External Walls

The different elements of the external wall are as follows:

- 12mm minimum NSAI Agrément approved external render for use with EPS
- 75mm KORE EPS panel

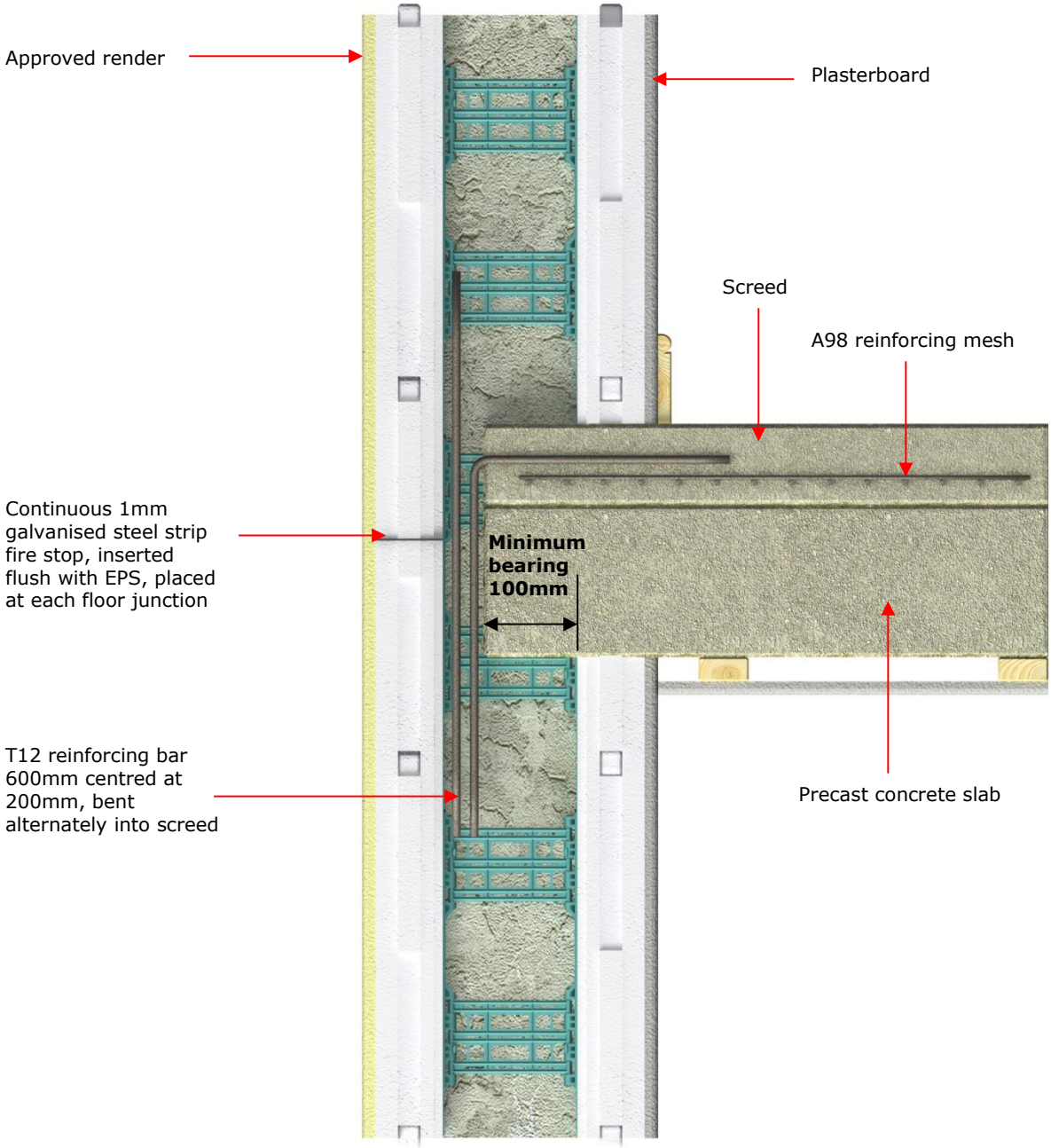

Figure 2: Precast Slab Placement

- 150, 200 or 300mm reinforced concrete core and KORE polypropylene bridges
- 75mm KORE EPS panel
- 12.5mm plasterboard slabs screw fixed to the KORE panel inserts
- 4mm gypsum skin coat plaster

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

2.1.6 Compartment Walls

The compartment wall consists of the following:

- 4mm gypsum skin coat plaster
- 12.5mm plasterboard slabs screw fixed to the KORE panel inserts
- 75mm KORE EPS panel
- 200mm reinforced concrete core and KORE polypropylene bridges
- 75mm KORE EPS panel
- 12.5mm plasterboard slabs screw fixed to the KORE panel inserts
- 4mm gypsum skin coat plaster

With regard to sound transmission, the KORE ICF 200mm wall has a mass of 490kg/m^2 and this meets the requirements of Diagram 4 of TGD to Part E of the Building Regulations.

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, and Clause 2.4 of Section B7 of TGD Volume 2 to Part B of the Building Regulations.

2.1.7 Internal Walls

Load bearing internal walls are constructed using either the 150 or 200mm KORE ICF forms, and slabbed and plastered as above for the party wall.

2.1.8 Floors

Precast with External Wall Abutment

Floor elements should be cast into the KORE wall with sufficient load bearing overlap (minimum 100mm). Reinforcing should be placed before placement of the slab, to ensure the security of the slab, restraining, and prevent lateral movement of the structure. The rebar T12 should be placed at 200mm centres and alternate bars bent down on to the concrete slab then covered with screed (75mm) containing A98 reinforcing mesh.

Precast Internal Wall Load Bearing 150mm

For internal load bearing walls, the 150mm KORE wall should be capped with a 4mm anti-spalling steel plate secured by masonry fixings into the concrete. At 500mm centres, the fixings such as concrete screws, frame fixings and rawbolts are acceptable with a minimum pull-out value of 800N (i.e. Hilti SX8L Plus and No. 12 wood screws).

Timber

Joist fixings are by ICF Connect Ltd multi-purpose hanger systems. The multi-hanger system should be used in accordance with the manufacturer's instructions and joist span and floor loading. The design loads for the ICF Connect Ltd multi-purpose hanger system are 1.9kN/m^2 live load and 0.72kN/m^2 dead load. Joist bearer plate is fixed to the KORE wall bolted directly into the concrete with M12 stud anchors (Hilti HST M12/120) fixings at a density of one per 400mm. The joists are then placed using joist hangers.

Property	Test Method	Value
Declared Thermal Conductivity (50mm)	IS EN 12667	0.033 W/mK
Compressive Strength at 10% Deformation	IS EN 826	150kN/m^2
Bending Strength	IS EN 12089	200kN/m^2
EPS Density	IS EN 1602	Min 25kg/m^3
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^2/day
Water Absorption by Partial Immersion	IS EN 12087	0.01kg/m^2
Water Absorption by Total Immersion	IS EN 12087	0.2%

Table 1: Properties of EPS used in KORE ICF

2.1.9 Roof

The KORE ICF System allows for the supply by others of a conventional timber or trussed roof with slating or tiling in accordance with SR 82:2017 *Slating and tiling – Code of practice*.

2.1.10 Stairs

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

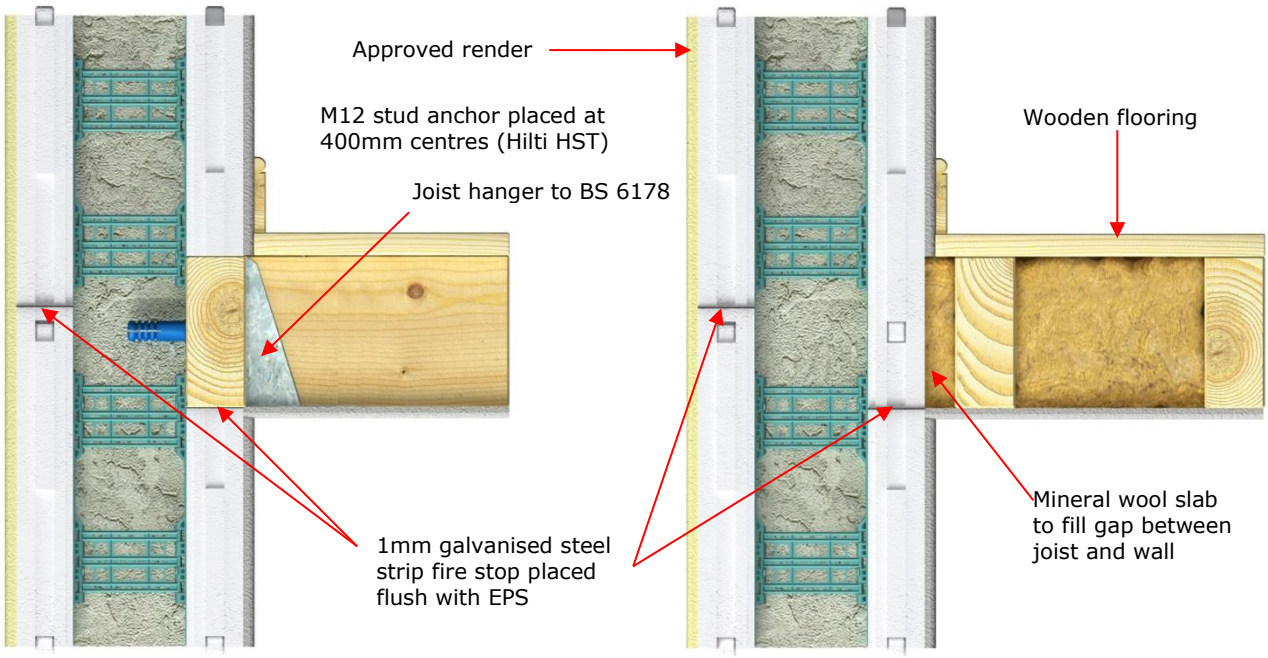

Figure 3: Floor Joist Arrangement

2.1.11 Chimney

Chimneys are not part of the KORE ICF System and are not covered by this Certificate. However, the system can incorporate an NSAI Agrément approved pre-fabricated chimney system. The requirements of Clause 2.15 of TGD to Part J of the Building Regulations require that combustible material such as polystyrene insulation have at least the following separation distance:

a) 200mm from a flue, or
b) 40mm from the outer surface of a brick or blockwork chimney or fireplace recess.

2.1.12 External Finish

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

- Fibre reinforced basecoat consisting of high polymer modified cement product, generally 6 to 8mm thick;
- Reinforcing mesh consisting of alkali resistant glass fibre mesh, 160g/m^2;
- Fibre reinforced second basecoat consisting of high polymer modified cement based product, generally 4 to 6mm thick (a total minimum thickness of 12mm of applied render must be achieved in all areas).
- 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.

2.1.13 Ancillary Items

- Anchor bolts
- ICF Connect Ltd multi-hanger system
- Brickwork/stonework ties
- PVC pipe sleeves for penetrations
- Basement waterproofing membrane
- Fire stops.

2.2 MANUFACTURE

The EPS building panels are manufactured by KORE Insulation. Modular units are moulded with the interlocks and with markings on the panel face showing the locations of the polypropylene connectors. Each EPS building panel is manufactured with its integral polypropylene connectors. Production is controlled at different stages through inspections and quality control checks..

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.

KORE 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. KORE 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 handed 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

KORE Insulation undertakes responsibility for the design and manufacture of the system. An approved Design Guide is available (see Section 3). Site construction is undertaken using approved installers in accordance with the KORE ICF Installation Manual. A pre-rendering checklist report shall be completed before rendering commences, which shall include checking that all fire barriers are correctly installed – this checklist shall be kept by the installer.

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.

2.4.2 Foundations

Foundations are not covered by this Certificate. However, foundations and substructures must comply with the relevant clauses of BS 8004:2015 *Code of practice for foundations*, IS EN 1992-3:2006 *Eurocode 2 – Design of concrete structures – Part 3: Liquid retaining and containment structures* and BS 8102:2009 *Code of practice for protection of below ground structures against water from the ground*, as appropriate, and must provide a flat and level footing for the shutting. 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 KORE ICF System is to be built must be checked to ensure it is clean, flat and level.

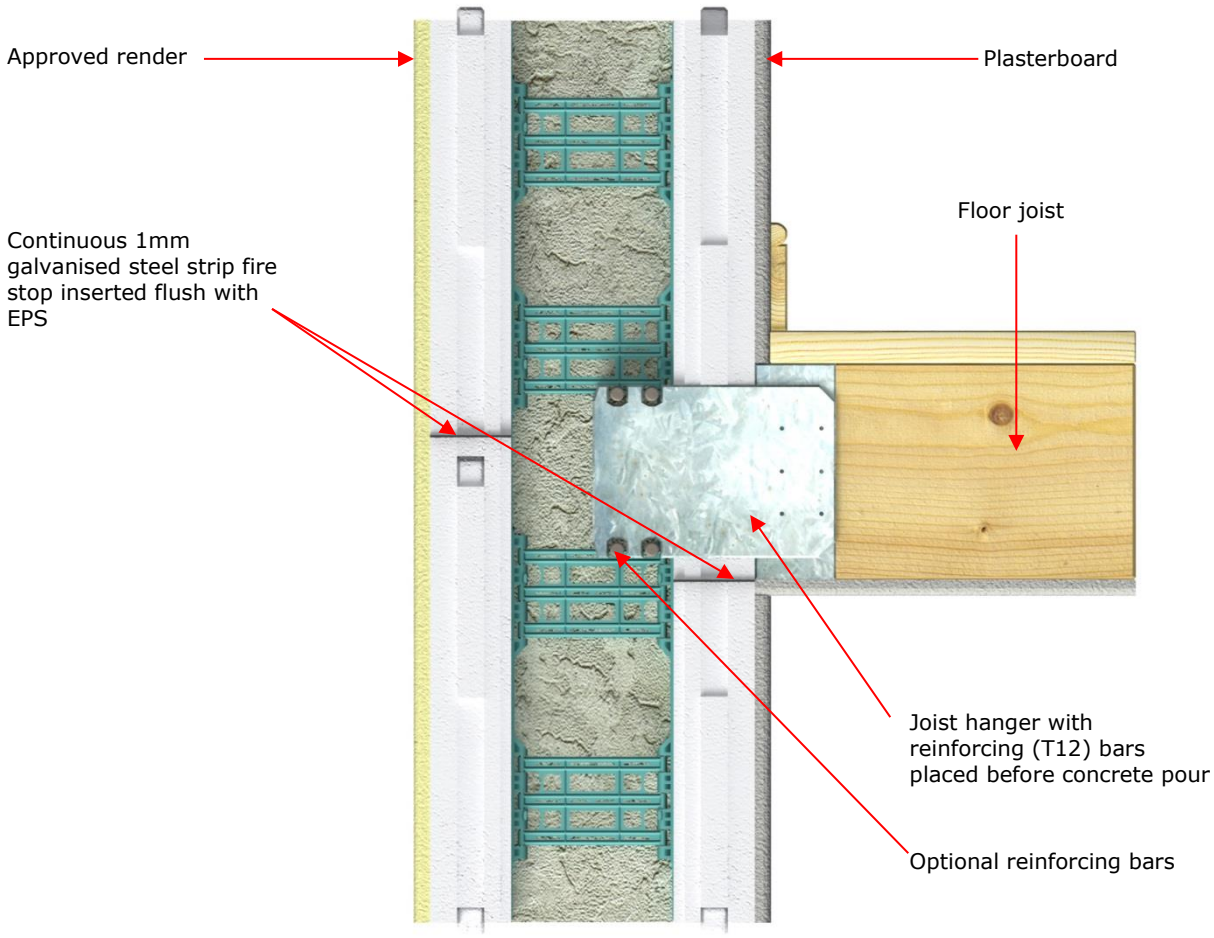

Figure 4: Joist Hanging System

The external render system shall be applied by NSAI Agrément registered installers of render

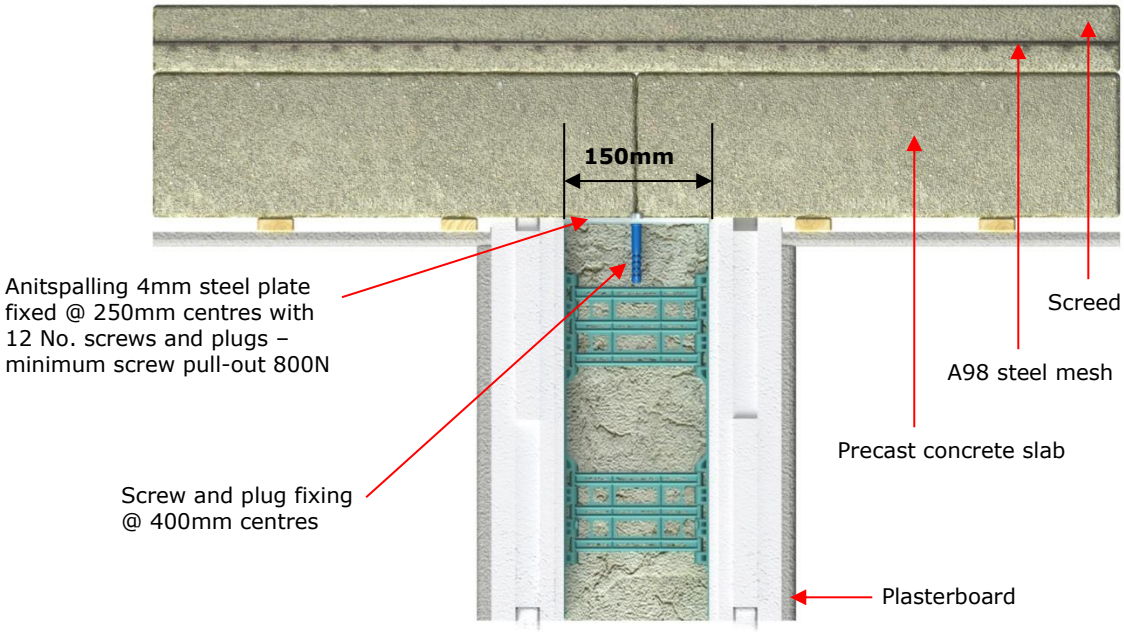

Figure 5: Internal Load Bearing Wall with Concrete Slab and Antispalling Steel Plate

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 8102:2009. 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.

2.4.4 Wall Assembly

When placing the first course, it is important to ensure that the layout is square and correct. Corner forms are placed first and then worked inwards towards the centre. This will result in any cut being near the centre of the wall. It will also ensure that KORE bridges will line up correctly, which will eliminate compression during the concrete pour.

On the second course, corner forms are stacked in the opposite direction from the first course so that the joints are staggered on each course, eliminating weak spots. Ensure tongues are firmly inserted in grooves and forms are placed end to end tightly. It is recommended that after the second course has been stacked, the forms should be levelled to account for any uneven footings. A laser level may be used to detect any problem areas. On each subsequent course, the corners should be reversed to create staggered joints.

The KORE Strut Bracing System should be installed after the second or third course has been stacked depending on the exposure of the site. It is recommended to place a KORE strut at maximum horizontal centres of 1.8m. It is important to place a strut on either side of each opening and two at every corner. The KORE Strut Bracing System must be plumbed after it has been installed. Additional support may be required if cuts or openings are near a corner, or if joints are not staggered by a minimum of 200mm.

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 1992-1-1:2005 AMD1:2015 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 used is T12 at 1200mm centres in the wall as specified or otherwise by the engineer (see Section 3.1.1).

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.

2.4.6 Bracing
Install the KORE Strut Bracing System after the second or third course has been stacked depending on the exposure of the site. 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/Services
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 by the insertion of the KORE Stop, which fit into the concrete dovetails that are moulded into the concrete cavity side of the KORE panel. Timber headers are used as an additional bracing solution for the concrete pour. 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 case directly into concrete. Refer to Section 2.1.8 of this Certificate.

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 KORE 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: 2020: *National rules for electrical installations* and ET 207 *Guide to the national rules for electrical installations as applicable to domestic and similar situations*.

2.4.8 Pre-Pour Checks
Once the bracing 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.

2.4.9 Concrete Placement
Adequate supervision and care by the installer is needed when placing concrete. Concrete can be placed using line lump 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 KORE 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 KORE 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.

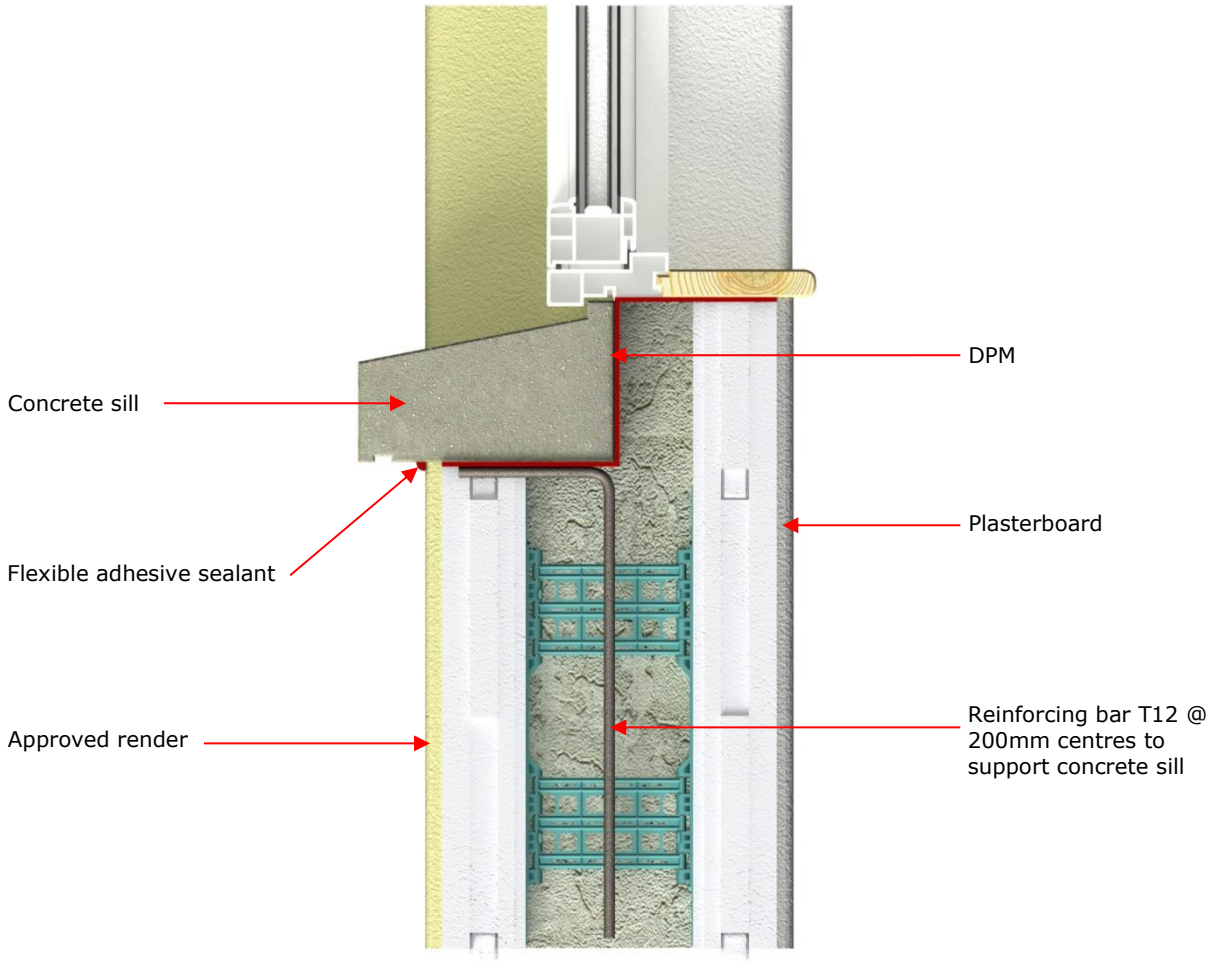

Figure 6: Cill Detail Section

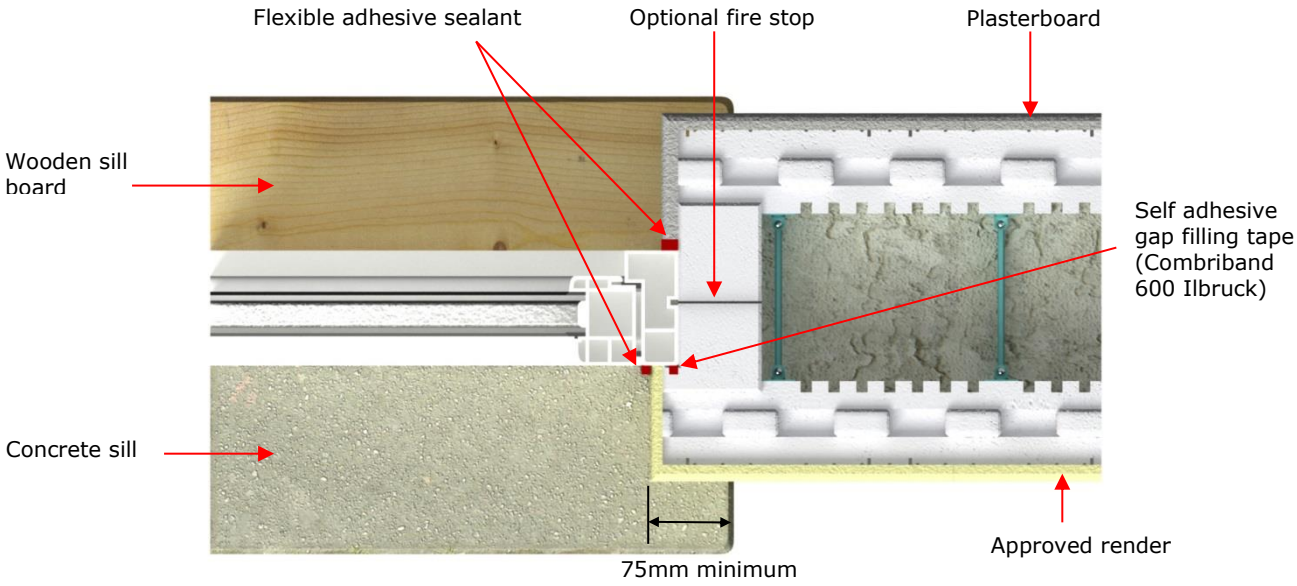

Figure 7: Cill Detail Plan View

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 KORE ICF System.

2.4.10 Concrete Compaction

Adequate consolidation/compaction of the concrete in line with IS EN 1992-1-1:2005 AMD1:2015 is essential and the concrete must be placed so that it completely fills the KORE ICF System without creating any voids. A 25mm vibrating poker should be used with care.

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.

For unreinforced walls, correct placement and specification of the concrete together with hand tamping or rodding is adequate. 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.

2.4.11 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 KORE 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 KORE ICF System must be made good prior to the application of the internal and external finishes.

Electrical and plumbing services can be fixed within the formwork or into the concrete core by cutting chases into the EPS using a router or hot knife. Where chases are made in the polystyrene they should be kept to a minimum and need to be located at appropriate distances from separating walls.

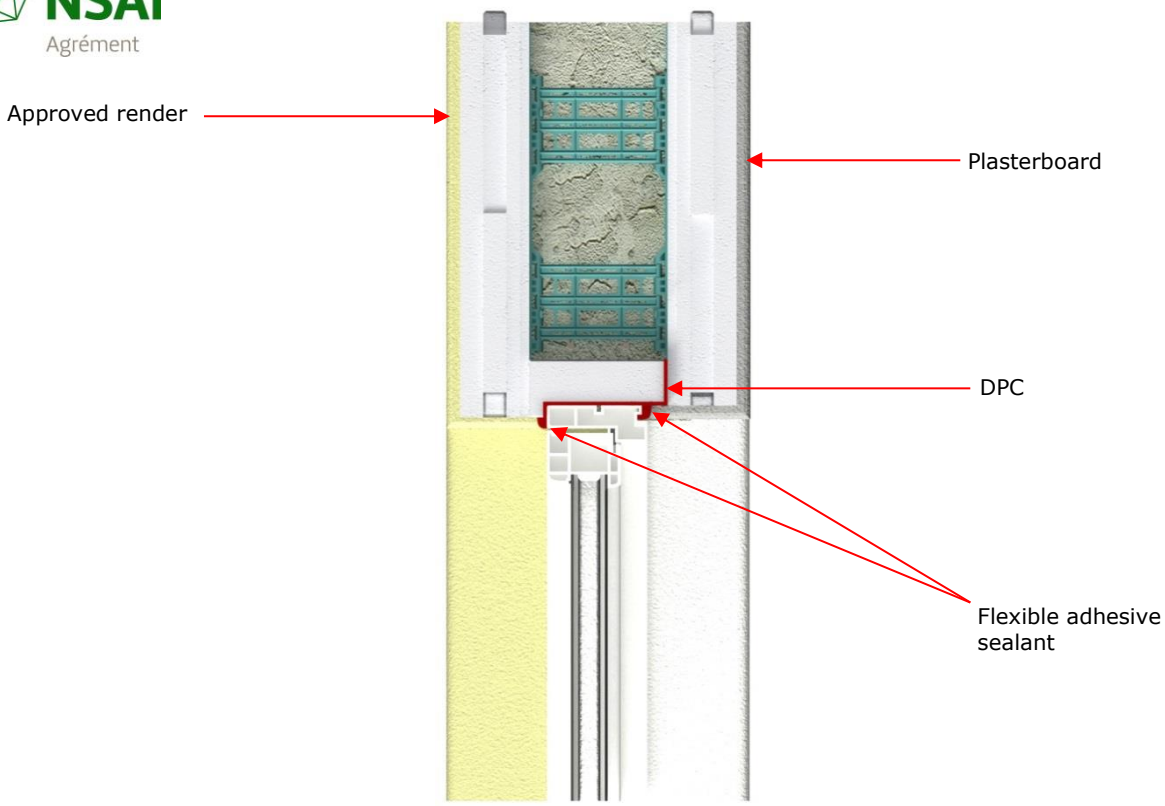

Figure 8: Header Detail

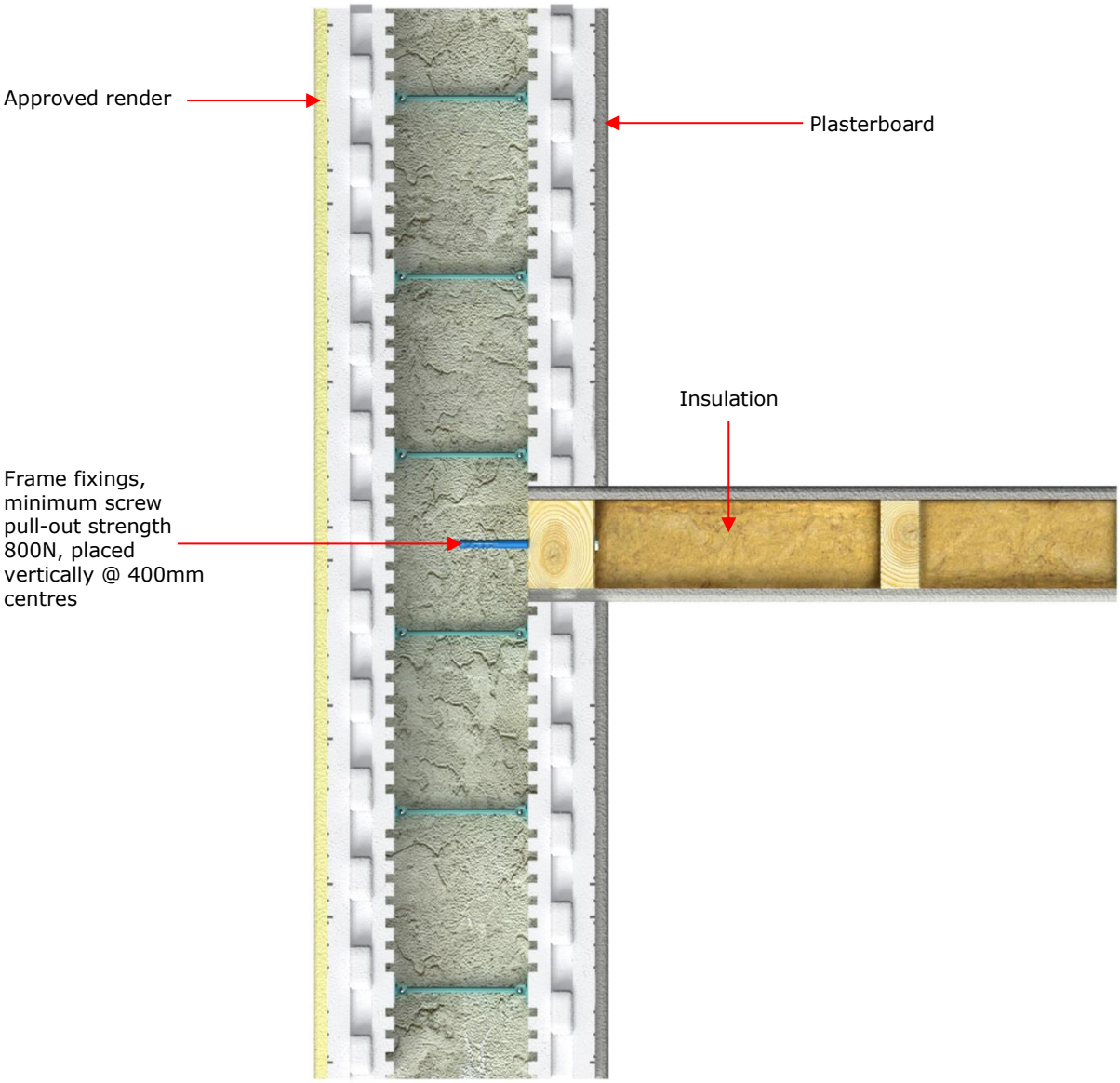

Figure 9: Internal Stooling Wall with External Abutment

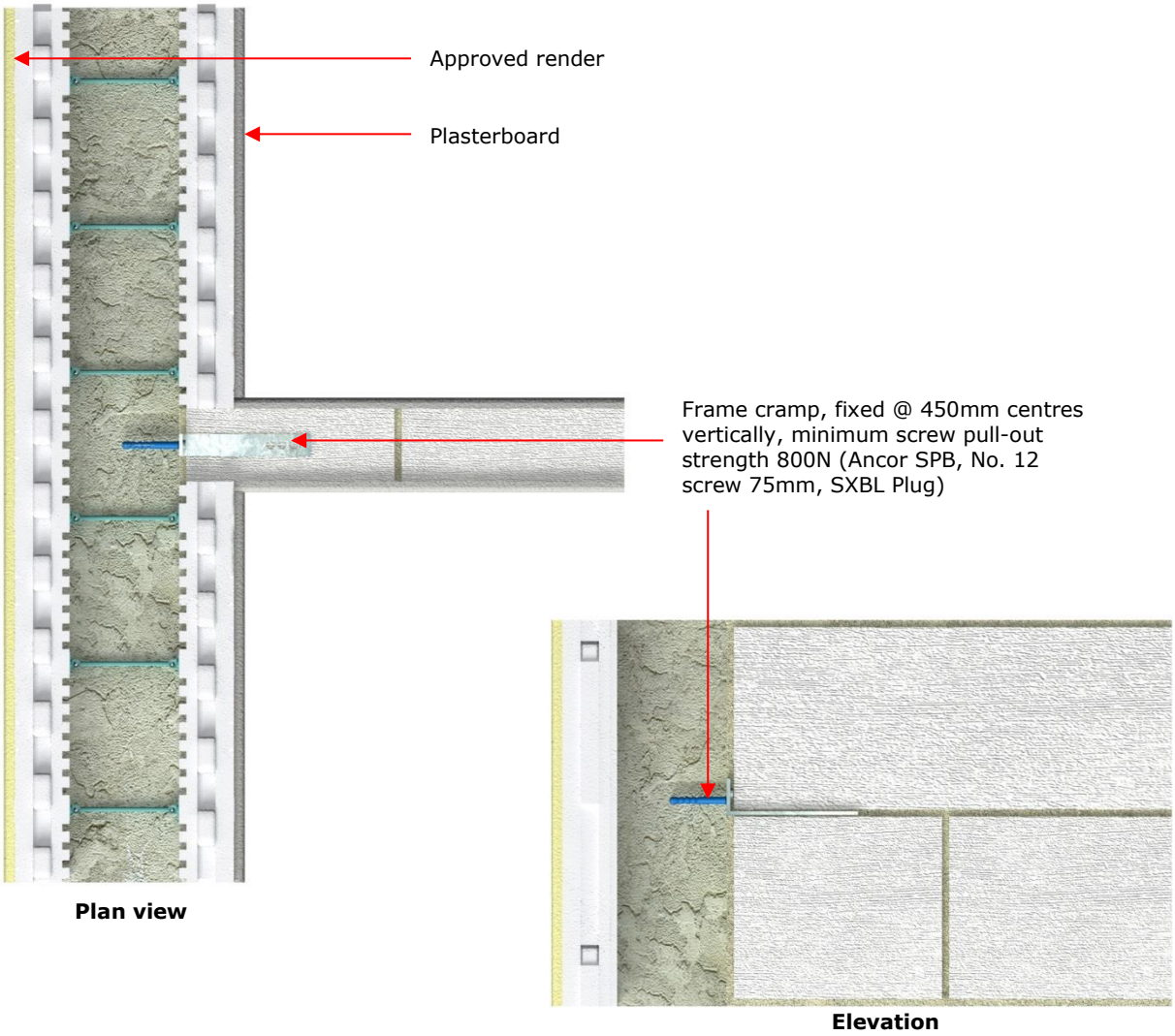

Figure 10: Block Internal Wall with External Abutment

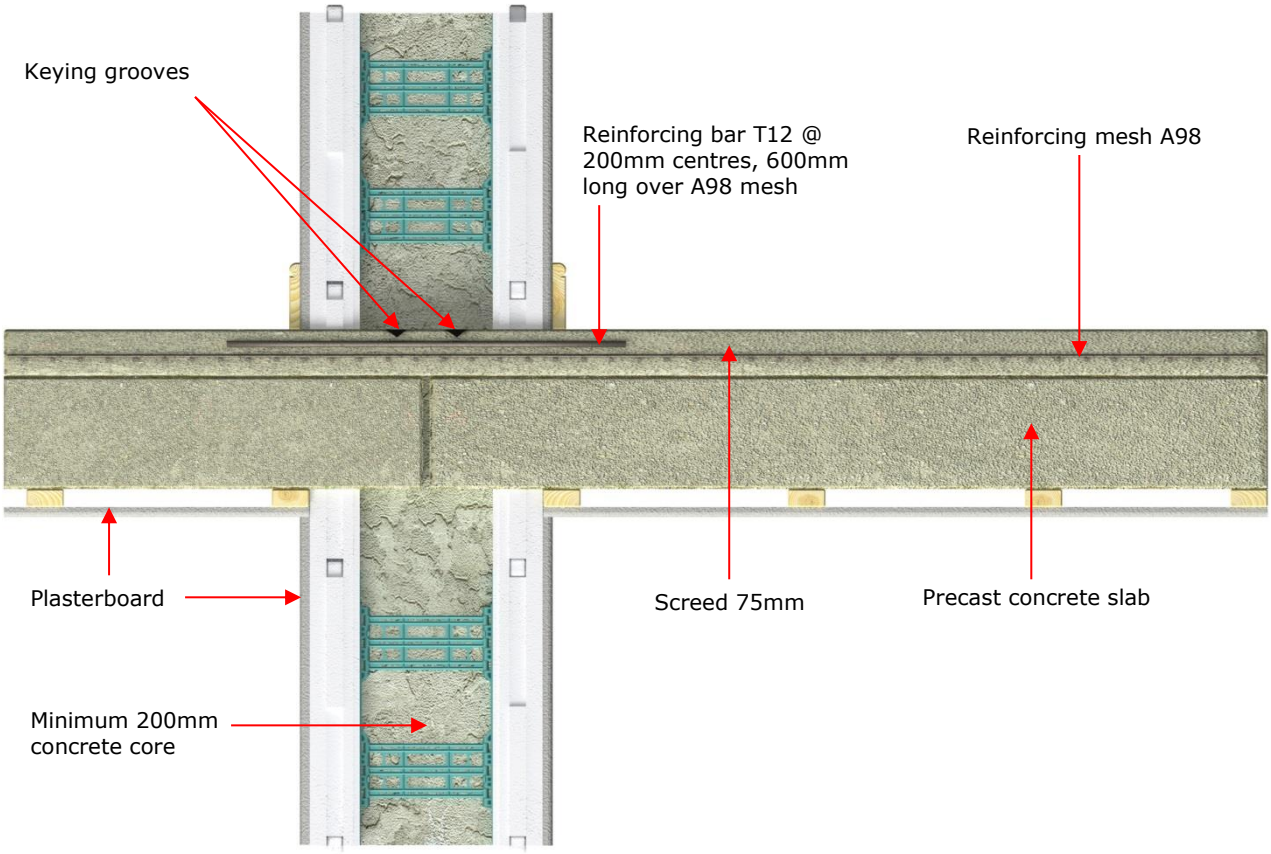

Figure 11: Party Wall with Precast Concrete

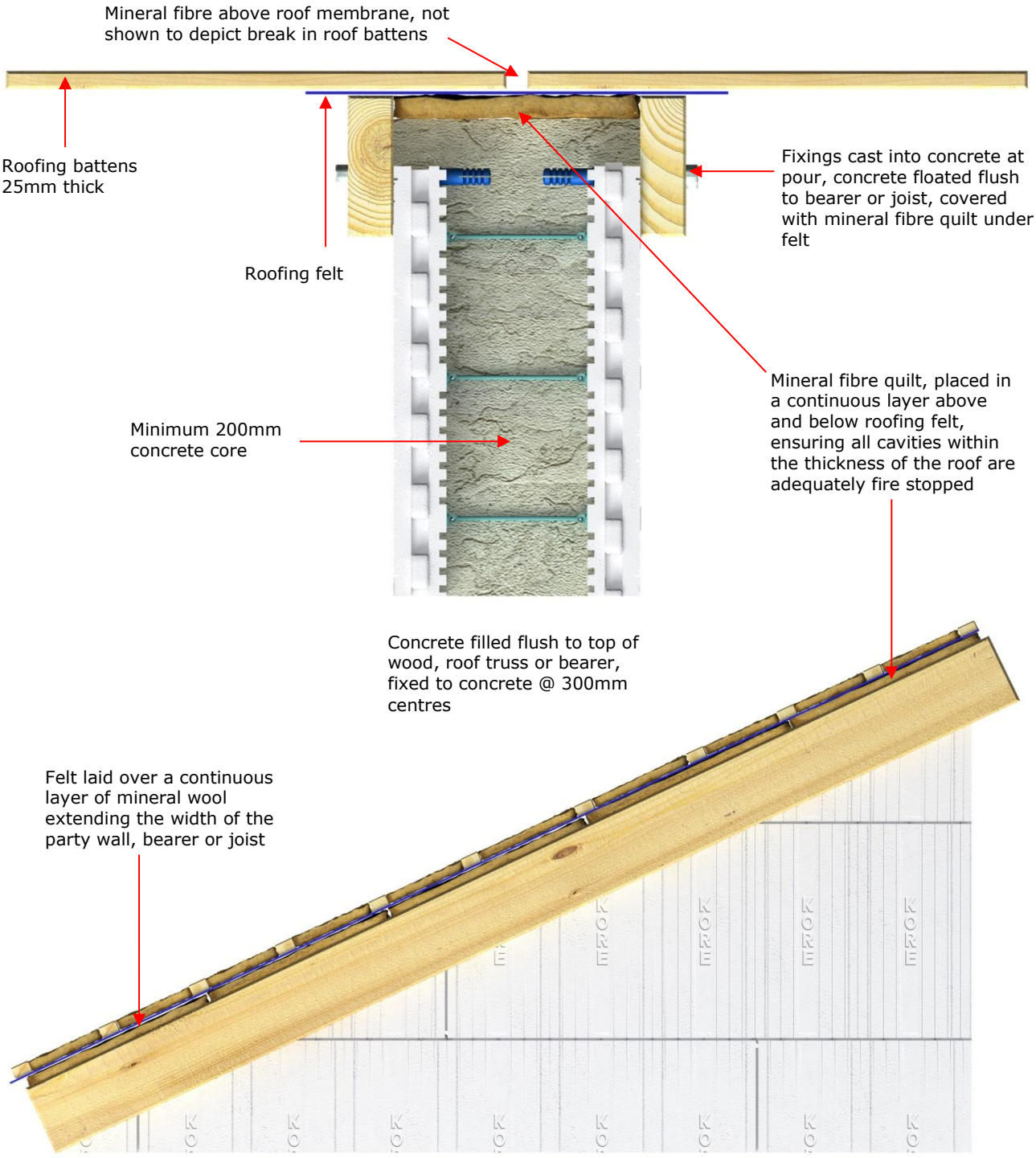

Figure 12: Party Roof Wall Junction

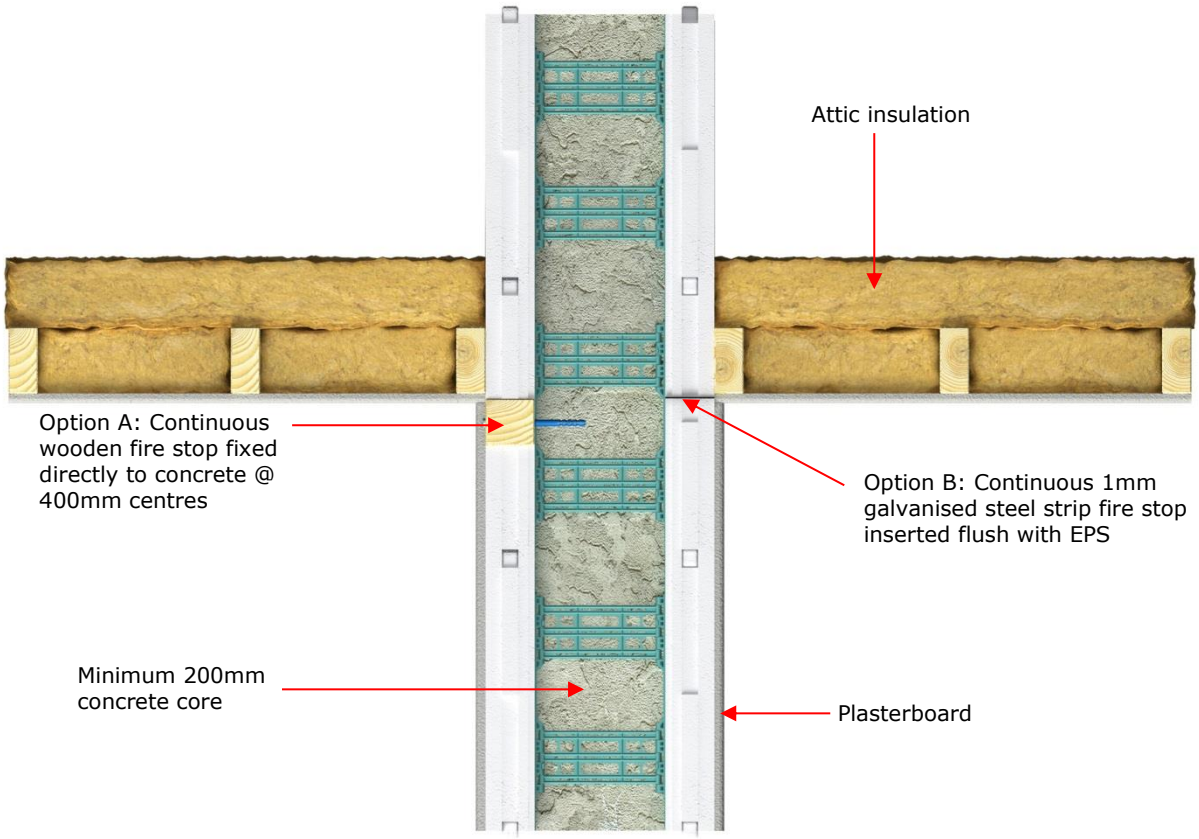

Figure 13: Sectional Elevation of Party Wall at Attic Floor Showing Fire Stop Options

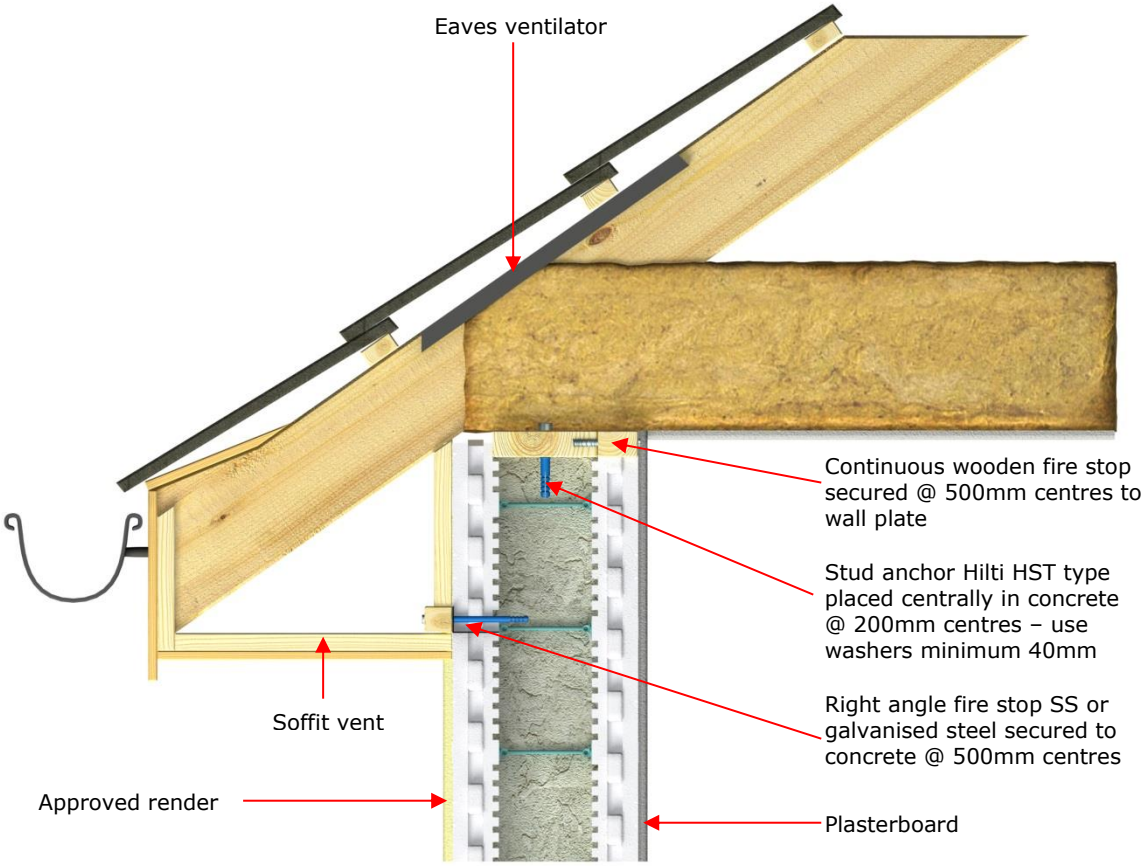

Figure 14: Roof Plate and Soffit

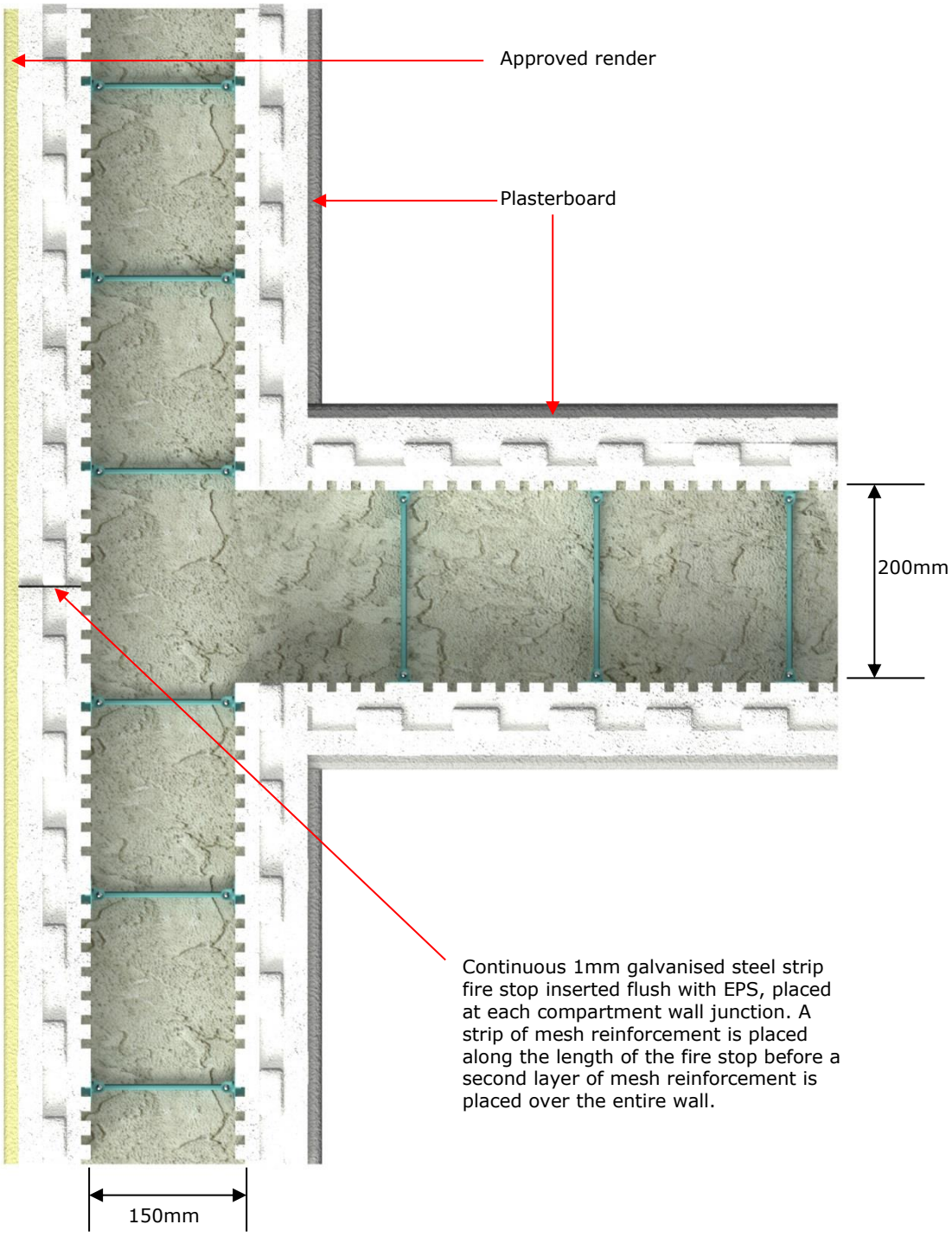

Figure 15: 200mm Party Wall with Vertical Fire Stop

3.1 STRENGTH & STABILITY

3.1.1 General

The KORE ICF System is intended for use where Architect's drawings are available and satisfy the Building Regulations– 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. KORE Insulation, through the use of an experienced Chartered Structural Engineer, are responsible for the structural design of the KORE ICF System. In the case of two storey single occupancy houses there is a prescriptive design by Chartered Structural Consulting Engineers which addresses the structural requirements for the KORE ICF System for houses meeting the criteria given. For all other cases, the Building Engineer must carry out a structural design to IS EN 1992-1-1:2005+A1:2015. The Building Engineer must also follow through with site inspections and issue a certificate of compliance at the completion of the project. The Building Engineer also liaises with the engineer for the developer and provides the necessary loading information for the design of the foundations.

The KORE ICF Design Guide applies to houses up to two storeys, where the following restrictions apply with respect to geometry:

- Max height of house = 10m to the ridge
- Width not less than half the height
- Max floor to ceiling height = 2.7m
- Max roof span = 12m
- Max span of floor = 5.0m
- Max un-buttressed wall = 9.0m
- Max supported wall bonded to a storey height wall from un-buttressed section = 5.5m
- Min pier = 490mm
- Max wall opening width = 3.0m
- Max wall opening height = 2.4m
- KORE concrete core sizes = 150, 200 and 300mm
- Horizontal and vertical steel reinforcement is T12 at 1200mm centres

Any application outside this scope of the KORE ICF Design Guide should be designed by a suitably qualified Chartered Structural Engineer for guidance.

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

3.1.2 Loading

The vertical imposed loads should not exceed the following:

Element	Loading	Value
Roof	Distributed Load	0.75kN/m^2
Floor	Distributed Load	1.50kN/m^2
Ceiling	Distributed Load	0.75kN/m^2

Table 2: 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 1991-1-1:2002+NA:2013 *Eurocode 1: Actions on structures – Part 1-1:General actions – Densities, self-weight, imposed loads for building (Including Irish National Annex 2013)* in this regard. The following self-weights apply to the KORE ICF wall thicknesses:

- 150mm wall: 0.41kN/m^3
- 200mm wall: 0.53kN/m^3
- 300mm wall: 0.77kN/m^3

These figures include the mass of the concrete insulation and internal KORE 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 1991-1-1:2002+NA:2013
- IS EN 1991-1-7:2006+A1:2014 *Eurocode 1: Actions on structures – Part 1-7: General actions – Accidental actions*
- IS EN 1991-1-7 National Annex:2008 COR 2:2015 *National Annex to Eurocode 1: Actions on structures – Part 1-7: General actions – Accidental actions*
- IS EN 1991-1-4:2005+A1:2010 *Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions (including Irish National Annex)*.

Reinforcement for lintel load spans and spacings of anchor bolts must be as per the KORE ICF Design Guide.

Design snow and wind loads must be based on Diagram 14 and 15 of TGD to Part A of the Building Regulations. The maximum characteristic wind loading pressure for the KORE ICF System has been calculated as 1.3kN/m^2, in accordance with IS EN 1991-1-7:2006+A1:2014.

Where timber elements are used they are designed in accordance with IS EN 1995-1-1: 2004+A2:2014 *Eurocode 5: Design of timber*

structures – Part 1-1: General – Common rules and rules for buildings, IS EN 1995-1-2:2005+COR:2009 *Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design (including Irish National Annex)*.

Panel designs are based on the wind exposure map provided in the TGD to Part A of the Building Regulations. 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 KORE 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 KORE 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 004:2013 *Guideline for European Technical Approval of external thermal insulation composite systems (ETICS) with rendering* as zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use.

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.

3.2.3 External Fire Spread

The NSAI Agrément certified renders approved for use onto EPS have a spread of flame rating equivalent to Class 0 on both faces. In respect of 'spread of flame', this is the highest performance classification set out in the Building Regulations.

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. In the case of aluminium window sills, they shall be provide with stop ends. In the case of concrete sills, they shall either be stooled 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, compartment wall and floor elements of the KORE ICF System in two storey construction (not more than 7m in height) is 60 minutes. Based on IS EN 1992-1-1:2005 AMD1:2015, a KORE 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 KORE 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. The polystyrene used in the wall and floor panels is flame retardant.

External walls with NSAI Agrément approved external renders for use onto EPS have been tested as Class 0 as per BS 476-7:1997 *Fire tests on building materials and structures – Method of test to determine the classification of the surface spread of flame of products*. 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, and Clause 2.4 of Section B7 of TGD Volume 2 to Part B of the Building Regulations.

4.1.1 Fire Barriers

There are no cavities in the walls. However, as the KORE ICF System has polystyrene, it must be fire stopped opposite every compartment wall. 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. KORE Insulation, through their approved installer, are responsible for the installation of fire barriers. 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^2) 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, and Section 3.6.3 of TGD Volume 2 to Part B of the Building Regulations. The fire stop must be placed level with any internal ceiling plasterboard at every floor level from the 2nd storey 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^{o}C. Ignition occurs between 350^{o}C and 450^{o}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 KORE 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 KORE ICF System of one per m^2 above two storeys. Also the mechanical fixings for the fire stopping are austenitic stainless steel. Ejot supplementary polypropylene fasteners are also used whenever necessary to fix insulation to the wall.

4.2 THERMAL INSULATION AND U-VALUES

The thermal conductivity, λ, value of the KORE ICF wall is 0.033W/mK, with allowance made for the cold bridging effect of the polypropylene connector. The calculated U-value for the standard KORE ICF 150 and 200mm wall is 0.20W/m^2K.

The linear thermal transmittance (ψ) or Psi describes the heat loss associated with junctions and around openings. The KORE 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.

'ψ' values for other junctions outside the scope of this Certificate should be assessed in accordance with BRE IP1/06 "Assessing the effects of thermal bridging at junctions and around openings" and BRE Report BR 497 "Conventions for calculating linear thermal transmittance and temperature factors" in accordance with Appendix D of TGD to Part L of the Building Regulations.

4.3 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.

4.4 SOUND

The party wall requirement is met by the wall thickness of the KORE 200mm wall which gives 490kg/m^2. This satisfies the requirement of 415kg/m^2 of Diagram 4 of TGD to Part E of the Building Regulations. With regard to compartment floors in apartments, the minimum required mass for hollowcore type floors with a screed and soft covering is 365kg/m^2 as per Diagram 32 of TGD to Part E of the Building Regulations.

4.5 DURABILITY

Buildings based on the KORE ICF System, when rendered using NSAI Agrément certified renders for use onto EPS, 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 7543:2015 *Guide to durability of buildings and building elements, products and components*.

External render systems can last in excess of 40 years in accordance with BS 7543:2015 subject to normal use, regular inspection and maintenance. 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 13914-1:2016 *Design, preparation and application of external rendering and internal plastering – Part 1: External rendering* 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 13914-1:2016 for general advice on design, in particular on the use of angle, stop and movement joint beads.

4.6 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.

4.7 PRACTICABILITY

A Design Guide and Installation Manual incorporating Health & Safety guidelines are provided by KORE Insulation for each project. Erection of the KORE ICF System must be by approved trained installers.

4.8 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
- Condensation risks for external walls
- Impact resistance for external walls
- Site erection controls

4.9 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.

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 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. **08/0307** is accordingly granted by the NSAI to **KORE Insulation** on behalf of NSAI Agrément.

Date of Issue: **March 2008**

Signed

Kevin D. Mullaney
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. www.nsai.ie

Revisions:

- **17th January 2018:** References to Building Regulations and standards updated, scope extended to cover use of the system in multi-occupancy dwellings up to six storeys in height
- **07th November 2023:** References to Building Regulations updated.