



Bord Agrément na hÉireann
Irish Agrément Board

CERTIFICATE NO. 05/0174

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Fortress Walling System

Système de mur; Wandsystem.

The Irish **Agrément Board** is designated by Government to issue European Technical Approvals.

Irish Agrément Board 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 2002**.

The Irish Agrément Board operates in association with the **National Standards Authority of Ireland (NSAI)** as the National Member of UEAtc.



PRODUCT DESCRIPTION

The Fortress Walling System is comprised of the following essential elements:

- precast concrete panels, for use as external or internal loading bearing walls. External wall panels are available with fair faced concrete or brick faced finish.
- vertical structural connections between panels;
- vertical structural connections to foundations;
- horizontal structural connections to concrete floor/roof slabs through a structural screed
- external weather tight joint seals using SEAL'N'FLEX and Fireban One
- provision to prevent cold bridging at external wall/compartment wall junctions
- provision for fire stopping at external wall/compartment wall junctions

The Fortress Walling System is designed in accordance with BS 8110-1: 1997 *Structural use of concrete. Code of practice for design and construction*

The system is based on an Australian building system, which has been modified to suit Irish requirements.

The system was developed for the Irish market by Concrete Building Systems Ltd (**CBS Ltd**), a joint venture company comprised of Roadstone Dublin Limited, Asset Precast Ireland Limited and Commercial Design Concepts Ltd.

Asset Precast Ireland Ltd represents the Australian partners, who have lengthy expertise and experience in this system.

Commercial Design Concepts Ltd are consulting engineers, also with relevant expertise and experience in concrete panel design in Ireland.

The fair faced concrete panels are manufactured by Roadstone Dublin Ltd and the brick faced panels are manufactured by AKA Keraba-Albert GmbH. The panels are manufactured, to a project specific design, by Concrete Building Systems Ltd. The panels are delivered to site by Roadstone Dublin Ltd. The system is assembled by Concrete Building Systems Ltd.

Readers are advised to check that this Certificate has not been withdrawn or superseded by a later issue by contacting the Irish Agrément Board, NSAI, Glasnevin, Dublin 9 or online at www.nsa.ie/iab/05-0174

USE

The system is intended for use in residential and commercial buildings, up to 10 storeys high, which are designed to meet the requirements of the Building Regulations 1997 to 2002.

The Fortress Walling System may be used in conjunction with concrete floors/structural screeds, to form a single skin structural concrete frame or superstructure. The superstructure should be supported on foundations designed and supplied by others. Roof design and construction is by others. The system can be used in conjunction with typical traditional roof construction (see Figure 1). Provision is made, during panel design and casting, for the inclusion of door, window and service openings, in accordance with the Architect's and Engineers drawings.

Windows and doors, when properly designed and installed, can be incorporated into the finished system, such that the relevant water and air permeability requirements are satisfied (see Figures 11 & 12).

Fair faced concrete external wall panels can be finished with an applied acrylic application throughout. Use of approved cementitious renders is permitted up to two stories, in accordance with BS 5262: 1991 *Code of practice for external renderings*.

The use of external cladding, other than Fortress Walling, is outside the scope of this Certificate. It should be discussed with Concrete Building Systems Ltd at the design stage, to ensure that it is compatible with the Fortress Walling System, and that adequate provision is made for fixing cladding to the structure as appropriate, in accordance with relevant Building Regulations.

Buildings which incorporate the Fortress Walling System are insulated on site, by others. The requisite thickness of insulated, vapour impermeable, framed plasterboard panels is fixed to the internal panel face of external walls, so as to achieve a cavity between the insulation and the wall panel face. The insulating layer shall be designed, installed and maintained so as to achieve the required thermal conductivity value, and to achieve a vapour impermeable layer between the insulating layer and the internal face of the wall panel. Likewise, incorporation of services shall be such as to maintain the integrity of any vapour impermeable layer provided (see Figures 4, 8 & 9).

DESIGN, MANUFACTURE, ERECTION AND MARKETING

Fair faced concrete wall panels are manufactured by:

Roadstone Dublin Ltd
Belgard Road
Tallaght
Dublin 24

Brick faced panels are manufactured by:

AKA Keraba-Albert GmbH
Wellie
Steyerberg
Germany

The Fortress Walling System is marketed by:

Roadstone Dublin Limited,
Belgard Road,
Tallaght,
Dublin 24.

The Fortress Walling System is designed, and erected on site, on a contract specific basis, by:

Concrete Building Systems Limited,
Belgard Road,
Tallaght,
Dublin 24.

The wall panels are transported to site by:

Roadstone Dublin Limited,
Belgard Road,
Tallaght,
Dublin 24.

REVISIONS

May 2005 Certificate revised to include precast reinforced concrete panels with integral brick facing.

1.1 ASSESSMENT

In the opinion of the Irish Agrément Board (IAB), the Fortress Walling System when used as specified in this Irish Agrément certificate is satisfactory for the purpose defined above, and meets the requirements of the Building Regulations 1997 - 2002 as indicated in Section 1.2 of this Certificate.

1.2 BUILDING REGULATIONS 1997 to 2002

REQUIREMENT:

Part A – Structure

A1 – Loading

The Fortress Walling System, as certified in this Agrément Board Certificate, has adequate strength and stability. See Parts 3 and 4 of this certificate.

A2 – Ground Movement

The Fortress Walling System, as certified in this Agrément Board Certificate, can be readily incorporated into structures which will meet the requirement. See Parts 3 and 4 of this certificate.

A3 - Disproportionate Collapse

The Fortress Walling System, as certified in this Agrément Board Certificate, can be incorporated into structures that will meet the requirement. See Parts 3 and 4 of this certificate.

Part B - Fire Safety

B2 – Internal Fire Spread (linings)

The panels are non-combustible and have a Class o '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. See Part 3 and 4 of this certificate.

B3 – Internal fire spread (structure)

The Fortress Walling System, as certified in this Agrément Board Certificate, will meet the requirement. See Parts 3 and 4 of this certificate.

B4 – External Fire Spread

The Fortress Walling System, as certified in this Agrément Board Certificate, will meet the requirement. See Parts 3 and 4 of this certificate.

Part C – Site Preparation and Resistance to Moisture

C4 – Resistance to Weather and Ground Moisture

The Fortress Walling System, as certified in this Agrément Board Certificate, will meet the requirement. See Parts 3 and 4 of this certificate.

Part D - Materials and Workmanship

D3 – The Fortress Walling System, as certified in this Irish Agrément Board Certificate, is comprised of proper materials fit for their intended use. See Parts 3 and 4 of this Certificate.

D1 – The Fortress Walling System, used in accordance with this Irish Agrément Board Certificate, meets the requirements for workmanship.

Part E – Sound

E1 – Airborne Sound (walls)

The Fortress Walling System, as certified in this Agrément Board Certificate, will meet the requirement. See Parts 3 and 4 of this certificate.

E2 and E3 – Airborne and Impact Sound (floors)

The Fortress Walling System, as certified in this Agrément Board Certificate, will meet the requirement. See Parts 3 and 4 of this certificate.

Part L – Conservation of Fuel and Energy

L1 – Conservation of Fuel and Energy

The Fortress Walling System will contribute to enabling a building to meet the requirement. See Part 4 of this certificate.

2.1 DESCRIPTION

2.1.1 General

2.1.1.1 The Fortress Walling System incorporates the following elements:

- a. precast reinforced concrete wall panels; concrete specification is by Concrete Building Systems Limited to satisfy design requirements. Typically walls panels are 200mm thick, Grade 40 N concrete, designed in accordance with BS 8110-1. Panels are available in thicknesses of up to 300mm, lengths of up to 13 m and in heights of up to 3.6m or brick faced pre-cast reinforced concrete panels to BS 8110-1. Concrete specification is by Concrete Building Systems Ltd, to satisfy design requirements. Typically, panels are minimum 200 mm thick (formed from 20 mm to 35 mm brick slips with minimum 180 mm thick reinforced C35/45 concrete to IS EN 206-1:2000 *Concrete – Part 1: Specification, performance, production and conformity*). Brick faced panels are available in thickness up to 300 mm, in lengths of up to 9.0 m and in heights of up to 3.6 m. Bricks shall be frost resistant to draft EN 2871, when tested in accordance with NEN 2872: 1989 *Testing of stony materials – Determination of frost resistance – Single sided freezing in fresh water environment*;
- b. steel reinforcing and dowel bars: reinforcing bars to BS 4449: 1997 *Specification for carbon steel bars for the reinforcement of concrete*;
- c. non-shrink grout: Conbextra HF Grout, Fosroc or similar approved;
- d. vertical seal – external panels: The external and internal vertical seals between panels are formed using polyurethane sealant with backing rods, which are separated by a vertical air gap to permit drainage. The external sealant (SEAL'N'FLEX) and internal sealant (Fireban One) are supplied by Bostik Finlay SA and installed by their approved applicators.
- e. vertical seal – internal panels: These are sealed with Fireban One.
- f. horizontal seal: the external panels are sealed along the horizontal joint using SEAL'N'FLEX polyurethane sealant.

Note 1

The polyurethane sealant complies with BS 6213: 2000 *Selection of construction sealants. Guide*.

Note 2

Concrete Building Systems Ltd provide a 15 year guarantee to the customer in respect of both vertical and horizontal seals. (see Figure 8)

2.1.1.2 These elements are combined to form:

- a. external walls: single skin fair faced concrete or brick faced solid concrete wall panel construction (see Figure 2, 4 & 5);
- b. compartment/party walls: solid concrete wall panel construction typically faced with 12 mm plasterboard (by others) (see Figures 6 & 7);
- c. internal walls: Load-bearing internal walls, similar in construction to compartment walls. Non-load bearing walls are by others (see Figure 6);
- d. vertical structural connections between panels; storey panels connected by grouted steel dowel bar connections (see Figure 4);
- e. vertical structural connections to foundations; ground floor panels fixed to foundations using grouted steel dowel bar connections (see Figure 3);
- f. horizontal structural connections: panels fixed to concrete floor/roof slabs through ties and dowel bars fixed into a structural screed (see Figure 4, 5 & 6);
- g. external weather tight joints (see Figure 8, 10 & 13).

Provision is also made for:

- a. prevention of cold bridging at external wall/compartment wall junctions, and
- b. fire stopping at external wall/compartment wall junctions (see Figure 9).

2.1.2 Responsibilities

The responsibilities of the various parties are summarised in Table 1.

Table 1: Responsibility

| | |
|--------------------------------------|---|
| Roadstone Dublin Limited | a. manufacture; b. supply the wall panels to site. |
| AKA Keraba-Albert GmbH | Manufacture of brick faced reinforced pre-cast concrete external wall panels |
| Concrete Building Systems Ltd | a. Marketing; b. supplying the structural solution for that part of the building superstructure specified in the contract ¹ and liaising with Developer/Project Architect/Engineer as appropriate; c. design of structural wall panels to BS 8110-1: 1997; d. integration of structural wall, floor, foundation and roof engineering design and detailing as appropriate; e. supply of dowel bars and ties for vertical and horizontal connections; f. erection of system on site; g. co-ordination of structural design and detailing with floor and stairs suppliers; h. Inspection and sign off pre-pour, post pour and pre-plasterboard slabbing out; i. Vertical and horizontal weather seals between panels; j. Provision of cold bridging and firestopping in specified locations. |
| Developer/Project Architect/Engineer | Overall responsibility for compliance with Building Regulations. |

Refer also to CBS Ltd Fortress Walling Systems Project Flow Chart for further information.

2.2 INSTALLATION

2.2.1 General

Erection and installation of the Fortress Walling System is carried out by Concrete Building Systems Ltd, using a trained and experienced team of operators, in accordance with a project specific quality plan.

1. This will include concrete elements manufactured by Roadstone Dublin Limited and concrete elements that may or may not be provided by Roadstone Dublin Limited but are part of the structural solution for a particular development; typical examples of these would include floor slabs, prefabricated stairs and structural screeds. These elements are not covered by this certificate.

2.2.2 Foundations

The Fortress Walling System may be used with a variety of foundation types. Design and construction of foundations are by others. They should be in conformity with the Architect's and Engineer's specifications.

The foundations shall be dimensionally accurate, square and level, so that the system can be assembled and erected to within the required tolerances (maximum permissible vertical tolerance +0/-20 mm). Dowel pin positions are agreed with main contractor prior to contract commencing. Small variations in slab level are accommodated using fibre cement or polymer shims to support the wall panels. Any remaining gaps are filled with non-shrink grout by Concrete Building Systems Ltd (see Figure 3).

2.2.3 Ground floor

The design and construction of the ground floor is by others.

2.2.4 Panel connections

2.2.4.1 Panel anchorage at foundation level

Steel dowel bars are placed vertically in pre-formed ducts and grouted in position with non-shrink grout by Concrete Building Systems Ltd. Minimum embedment required is 300 mm or as specified on the drawings. Minimum cover required is 30mm. The wall panels are slotted onto the protruding dowel bars and the connection is grouted via pre-formed grout tubes cast into the panels (see Figure 3).

Dowel bar spacing is determined as part of the design process; typically dowel bars are spaced at 2000mm centres, at both sides of door openings, at building corners and at other high stress locations.

2.2.4.2 Panel connections at storey level

Panels at upper floor levels are grout anchored together across horizontal joints via vertical tie bars. They are also tied horizontally to the floor plate around the building perimeter through L shaped tie bars that have the vertical leg grouted into preformed ducts in the wall panels and the horizontal leg lapped with the internal tie reinforcement in the structural screeds (see Figures 6 & 7).

In general there are no structural connections across vertical joints between concrete panels unless required by job specific calculations and noted on the corresponding drawings.

2.2.5 Fire stops

Fire stops are incorporated as detailed, and as required by the particular building design. Typical details of these are shown in Figure 9. Concrete Building Systems Ltd installs fire stops in accordance with the project requirements.

2.2.6 Internal linings and services

2.2.6.1 General

It is critical in single leaf construction to control moisture movement and to prevent the build up of moisture, or condensation, within the wall construction. This must be considered when designing and installing thermal insulation and services. The integrity of any impermeable membrane or vapour barrier must be protected and maintained for the design life. The Architect should refer to the Certificate holder's manual for further guidance (see Figure 8).

2.2.6.2 Internal linings

The installation of linings, to external and load bearing internal walls, is the responsibility of the main contractor. It should be in accordance with the Architect's specification and meet the following specific requirements:

- external walls shall have the required thickness of insulation to meet the requirements of Part L of the 'Building Regulations 1997 to 2002;
- external walls shall have an effective vapour impermeable barrier, to prevent interstitial condensation. Board joints should be taped and filled in accordance with manufacturer's specifications.
- all wall linings in moisture-prone areas, bathrooms, kitchens, and utility rooms, and all ceiling linings at roof level, should be lined with a continuous impermeable vapour barrier fixed to the walls with metal or timber battens; board joints should be taped and filled in accordance with manufacturer's specifications.

2.2.6.3 Services

The provision of services is outside the scope of the Fortress Walling System. It is recommended that services shall not be placed in the cavity of external walls, between the insulation and the wall panel. Where this is unavoidable, the integrity of the cavity barrier must be protected.

Generally, services can be installed along traditional lines, either on the internal surface of walls or within the internal insulated panels; for this, ducts and conduits can be installed at predetermined positions when panels are being manufactured; this will necessitate taking full account of the services requirements at the design stage.

2.2.7 External weather seal at panel joints

When all wall panels and floor units are erected and all structural connections are completed, external panel joints, both horizontal and vertical, are sealed using the SEAL'N'FLEX/Fireban One system, supplied and installed by Bostik Finlay SA, under the supervision of Concrete Building Systems Ltd (see Figure 8, 10 & 13).

2.2.8 External finishes

2.2.8.1 Rendering

External fair faced concrete wall panels can be finished with an acrylic based polymer applied finish in accordance with manufacturer's recommendations. Approved cementitious rendering can also be used but is generally not permitted above two storeys high. Rendering of brick faced panels is not permitted.

2.2.8.2 Cladding

The use of external cladding, other than Fortress Walling, is outside the scope of this Certificate. It should be discussed with Concrete Building Systems Ltd at the design stage, to ensure that it is compatible with the Fortress Walling System, and that adequate provision is made for fixing cladding to the structure as appropriate, in accordance with relevant Building Regulations.

2.2.9 Doors and windows

These should be installed in accordance with manufacturer's instructions (see Figure 11).

2.2.10 Roof construction

The design and construction of the roof is by others.

2.3 QUALITY CONTROL OF PANEL MANUFACTURE, HANDLING AND DELIVERY

2.3.1 a. Manufacture of precast panels – Roadstone Dublin Ltd

The panels are manufactured by Roadstone Dublin Ltd in accordance with a Concrete Building Systems Ltd, project specific, quality plan and workshop drawings, under a quality control system certified to I.S. EN ISO 9001: 2000 *Quality Systems – Requirements*. Concrete production is in accordance with I.S. EN 206-1: 2002 *Concrete - Part 1: Specification, performance, production and conformity*.

The pre-cast concrete wall panels are produced on steel flat bed moulds. The mould is modified to produce an individual panel to the length, height and thickness required, with window and door openings where appropriate. The panels are cured in temperature-controlled ovens.

Quality control checks include raw material testing, pre and post pour inspections, cube testing, dimensional checks and final inspection.

b. Manufacture of brick faced panels – AKA Keraba-Albert GmbH

The panels are manufactured by AKA Keraba-Albert GmbH, using 20 mm to 35mm brick slips which are cut from whole bricks. L-shaped bricks are cut to provide for reveals eg at windows. The slips are placed face down in an horizontal mould. Foam rubber dividers are inserted between the bricks. A self compacting C35/45 concrete (maximum aggregate size 4mm), with improved bonding characteristics, is poured onto the brick slips, filling the joints to a minimum depth of 5mm.

A second layer of C35/45 concrete (maximum aggregate size 8mm) is then poured. When the concrete has cured sufficiently, the panels are raised vertically. The bricks are then pointed to a minimum depth of 15 mm (flushed or bucket handle joint) in the factory. Raked joints are not permitted.

Quality control checks include checking of brick and concrete specifications, reinforcing cage and cover, brick slip layout, quality of pointing etc, against design drawings and specification.

2.3.2 Handling and delivery of panels

Each panel has integral lifting points and is designed to resist the loads imposed during lifting, handling, transport and erection. Panels are handled within the factory and transported to site by Roadstone Dublin Ltd, using a specially designed stillage system. The panels are handled on site by Concrete Building Systems Ltd, using cranes as appropriate.

The panels are supplied to site in accordance with a predefined programme to suit the construction sequence. Storage requirements should be agreed prior to contract commencing.

2.3.3 Marking and labelling of panels

Each panel is marked with the panel reference number, job number, proposed level, panel weight, the IAB logo and the number of this Certificate.

2.3.4 Ancillary items

All ancillary items should be stored and used in accordance with the manufacturer's instructions.

2.3.5 Fortress Walling System - installation

Concrete Building Systems Ltd. is responsible for the quality of the Fortress Walling System when installed, including quality of inter-panel and panel/floor connections and the quality of external joints.

Concrete Building Systems Ltd carry out pre-pour, post-pour and pre-slabbing inspections in accordance with the project quality plan, to ensure that the system is properly integrated into the structural frame, and that design features unique to and/or critical to the performance of the system, are to specification.

Part Three / Design Data

3

3.1 STRENGTH AND STABILITY

3.1.1 General

Buildings constructed using the Fortress Walling System, shall be certified by a competent, chartered civil or structural engineer, as being in accordance with Part A of the Building Regulations 1997 to 2002. The design of each Fortress Walling System solution shall be carried out by a suitably qualified, competent, chartered, civil, or structural engineer.

3.1.2 Structural Principles

The Fortress Walling System is designed in accordance with BS 8110-1 and will, when assembled on site in conjunction with concrete floor panels, supplied and erected by others, and a structural screed incorporating ties, fixings and connections, form the vertical element of a concrete structural frame (see Figure 1).

Vertical dead and imposed loads are carried by external and internal load bearing wall panels; horizontal wind loading and other racking forces are distributed to shear stiff wall panels by the floor/roof system, acting as a diaphragm at each floor/ storey level. Load transfer from the roof is directly through wall members.

The structural solution for that element of the building superstructure for which Concrete Building Systems Ltd is responsible, may include concrete elements that are additional to those covered by this certificate.

3.1.3 Design Loads

The loads to be taken into account at design stage should be determined in accordance with Part A of the Building Regulations 1997 to 2002.

3.1.4 Robustness and ties/connections

For each individual building, anchorage of floors and roof members, internal horizontal ties, peripheral ties, external wall ties and vertical ties are designed in accordance with the principles and requirements of BS 8110-1.

The notional horizontal load is calculated for each building and transferred to the foundations. The recommendations of Clause 2.2.2.2 of BS 8110-1 are observed. Each building is provided with an effective tying/connection system with the reinforcement calculated in accordance with the appropriate clause in BS 8110-1 as shown in Table 2.

A full wind analysis is applied to each building. If the analysis indicates an overturning force, the dowel length is increased, and foundation depth adjusted, as appropriate.

Table 2: Design of Connections

| | |
|-------------------------------------|----------|
| Internal horizontal ties | 3.12.3.4 |
| Peripheral ties | 3.12.3.5 |
| External wall ties | 3.12.3.6 |
| Vertical ties | 3.12.3.7 |
| Anchorage of roof and floor members | 5.1.8.3 |

3.1.5 Design against disproportionate collapse

The system is based on structural wall and floor panels, with continuous robust joints, and a binding structural screed over all floors and roof. The risks of excessive concentrated accidental loads, leading to disproportionate collapse, are considerably reduced. In respect of the design of structural joints, the system is well conditioned for the avoidance of disproportionate progressive collapse.

3.1.6 Foundation design

Foundation design is by others, with input from Concrete Building Systems Ltd as required, eg in relation to loads to be transferred or dowel pin locations.

3.1.7 Roof design

Roof design is by others. The Fortress Walling System can accommodate both pitched roof construction for low rise buildings and flat roof construction for higher buildings; provision of roof and roof structure, is outside the scope of the system but generally follows traditional roofing practices. For flat roofs, the structural provisions are similar to those for intermediate floor construction, in that the roof slab is secured similarly to the external walls and load-bearing internal walls, with appropriately designed dowel bars. Typical construction details are shown in Figures 5, 6 & 7.

3.2 STRUCTURAL FIRE SAFETY

3.2.1 Internal fire spread (linings)

The wall panels have a Class O rating in accordance with Building Regulations Technical Guidance Document B Appendix A Cl. A10.

3.2.2 Internal fire spread (structure)

When incorporated into a structural concrete frame, which 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. If required, the fire resistance of the panels can be increased to 90 minutes by designing reinforcement cover in accordance with BS 8110-2.

The single skin wall construction does not include concealed spaces.

The insitu concrete joints between wall and floor/roof panels ensure that a horizontal fire-stop/cavity-barrier is achieved at all floor/roof levels. Vertical fire stopping is provided by Concrete Building Systems Ltd, where internal concrete panel walls butt up against external panel walls (see Figure 9).

In all other situations, responsibility for the provision of fire stops remains with the developer.

Where the wall construction acts as a fire-separating element, any openings shall be suitably protected to maintain the fire integrity of the panel, in accordance with the Building Regulations Part B.

3.2.3 External fire spread

The wall panels are non-combustible, and have a Class O rating (see Cl 3.2.1). External panels can be designed to meet the requirements of Building Regulations Technical Guidance Document B Table 4.1.

3.3 WEATHERTIGHTNESS

The external walls will prevent transfer of water through the concrete or brick/concrete fabric.

The vertical and horizontal joint seals will prevent water ingress. The vertical butt joint design allows for vertical drainage, via the air space, to the base of the building (see Figures 8 & 10).

The weathertight seal between brick faced panels is designed to prevent ingress of water through the brick, into the cavity, at the rear of the sealant (see Figure 13)

3.4 THERMAL INSULATION AND U VALUES

Design is outside the scope of this certificate. However, the panels can be incorporated into a design that will meet the requirements of Part L, Conservation of Fuel and Energy, 'Building Regulations 1997 to 2002'.

The external walls of the Fortress Walling System typically have a 200mm thick concrete outer leaf, a residual air space (25mm minimum) between floors and a 50mm thick (minimum) inner vapour impermeable insulating layer (see Cl 2.2.4).

The thickness of the insulating layer is determined at the design stage, and will depend on the type of insulation used. For example, to achieve the required elemental 'U' value of 0.27 W/mK with polyurethane, a thickness of 85mm of polyurethane is required. Typical section details of the external walls are shown in Figures 4 and 8.

To avoid cold bridging, at floor/external wall junctions, Concrete Building Systems Ltd supply and fix insulation within the joint (see Figure 4).

Insulation is also required at the wall/ceiling interface. This insulation should extend along the underside of the floor slab for a minimum distance of 900mm. It is provided and installed by others.

Thermal insulation performances of ground floor, windows, doors, roof, or other components are outside the scope of this certificate and are the responsibility of the developers and their technical advisers.

3.5 CONDENSATION

A condensation analysis has been carried out on the system. Effective vapour barriers or seals must be provided.

Consideration should be given to provision for removal of condensation in window design.

The integrity of vapour barriers must be protected and maintained for the design life.

Part Four / Technical Investigations

4

4.1 BEHAVIOUR IN RELATION TO FIRE

Assessments in respect of fire resistance, surface spread of flame, combustibility and the need for cavity barriers, were undertaken and reported on in Part 3 of this Agrément certificate.

4.2 THERMAL INSULATION AND U VALUES

Assessments were carried out to verify that the requirements of Part L can be achieved using the Fortress walling system in typical designs.

4.3 CONDENSATION

The system was subjected to a condensation analysis, which concluded that effective vapour barriers must be provided. Assessments were carried out to verify that the risk of surface or interstitial condensation is minimal when using the Fortress Walling System in typical designs, with an effective vapour barrier/vapour impermeable membrane.

Calculations in accordance with BS 5250: 1989(1995) *Code of practice for control of condensation in buildings*, show that with the level of insulation provided and the material properties of the external walls, the risk of surface or interstitial condensation, in all normal environments in dwellings, is minimal.

4.4 SOUND

4.4.1 Assessments

The Fortress Walling System has good sound insulation performance and can meet the requirements of Part E of the *Building Regulations 1997 to 2002*. For example, a 200mm thick concrete wall with dry lining is defined in *Building Regulations 1997 to 2002 Technical Guidance Document E* as meeting the requirements of Part E for separating walls.

The system is for use with concrete floors; floors with a minimum mass of 365 kg/m² can meet the requirement for separating floors, when used with resilient material beneath the wearing surface.

Table 3 gives mass values for compartment walls and floor slabs for residential buildings. Mass values for walls and floors in buildings based on the Fortress Walling System are likely to be significantly in excess of these minimum values and can meet the requirements of the regulations.

Service stacks, eg soil and vent pipes, or other vertical ducts, should be insulated with sound insulation and should be fully separated from habitable areas.

Table 3: Mass values for structural elements

| Element of Building | Minimum required mass as prescribed in Technical Guidance Document to Part E of the Building Regulations 1997 to 2002 | Actual Mass |
|--------------------------------|---|-----------------------|
| Compartment wall or party wall | 415 kg/m ² (Diagram 5 of Part E for a single leaf wall) | 460 kg/m ² |
| Floor slab | 365 kg/m ² As set out in Diagram 9 of Part E. Only required in floors between two dwellings. Soft resilient covering also required to reduce direct transmission. | 472 kg/m ² |

4.4.2 External walls and walls between rooms

Other aspects of sound insulation were also assessed. This included an analytical study of the likely sound insulation performance of single leaf precast concrete partitions without lining panels.

The estimated average sound reduction for the unglazed part of the external walls is likely to be in excess of 40 dB. For the concrete panel partitions it will be at least 40 dB. Estimates are based on BS 8233: 1997 *Code of practice for sound insulation and noise reduction for buildings*.

4.5 WEATHERTIGHTNESS AND DAMP-PROOFING

4.5.1 DPCs and DPM's

The design and provision of damp proof courses and damp proof membranes is by others.

4.5.2 Weathertightness of External Walls

The vertical joints between adjacent external concrete panels include a vertical drained air space between the outer and inner joint seals. This detail, shown in Figures 8, 10 & 13, presents a back up water management solution in the event of failure of the external joint sealant and provides a practical and reliable method of draining water away from the building.

The horizontal joint between the panels is sealed with grout and a polyurethane sealant.

The dense concrete external wall panels are highly resistant to water penetration.

Joint design and sealant specification are selected to give maximum resistance to ingress of water, subject to regular maintenance in accordance with the Certificate holder's instructions. Concrete Building Systems Ltd provide a 15 year guarantee to the supplier, in respect of the vertical joint.

4.5.3 Windows and Doors

The performance of windows or doors is not covered by this certificate.

The Certificate holder's recommendations, for detailing at windows and doors, has been assessed. The recommendations are considered adequate to ensure that water penetration will not occur, assuming that the windows and doors are properly designed, and installed in accordance with the manufacturer's instructions.

4.6 DURABILITY

Buildings based on the Fortress Walling System, 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: 1992, 'Guide to Durability of Building Elements, products and components'.

The Certificate holder provides a 15 year guarantee covering panel defects. Buildings based on the system, provided they are designed and constructed in accordance with best practice, should perform well throughout their working life.

The reinforced concrete walls are designed, manufactured and installed using high quality materials and workmanship. Concrete cover to reinforcement meets the requirements of BS 8110 ensuring satisfactory corrosion protection for the reinforcement.

To prevent interstitial condensation, the integrity of the impermeable membrane and any vapour barrier, must be maintained during the design life. Reference should be made to the Certificate holder's manual for further details.

4.7 MAINTENANCE

Maintenance for buildings built with the Fortress Walling System will be required at the same level as that for buildings of conventional construction.

Maintenance shall be in accordance with the Certificate holder's instructions.

Acrylic paints are likely to give up to ten years before replacement or maintenance is necessary; painted surfaces near ground level are likely to require maintenance more frequently.

The external joint shall be inspected periodically in accordance with the Certificate holder's instructions.

4.8 PRACTICABILITY

The practicability of construction and the adequacy of site supervision arrangements were assessed. Method statements, addressing cold bending of reinforcement on site, and patch repairing of wall panels, were reviewed.

The Certificate holder's manual addresses the following: typical construction details, joint sealant details and guarantee, applied finishes, guidance on insulation and condensation control, repair/patching instructions, health and safety, quality control on site, maintenance, method statements, information for safety file etc.

Relevant completion certificates will be provided. Concrete Building Systems Ltd will also co-operate with the project designer on the certification of the structural element of the finished building, for which it holds responsibility.

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
- Condensation risks for external walls
- Site erection controls
- Adequacy of brick slip specification
- Pull out resistance of brick slips
- Structural integrity of brick faced panels

4.10 OTHER INVESTIGATIONS

- 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
- site visits were conducted to assess the practicability of installation
- bought-in components were assessed for suitability for use
- Site visits were conducted to assess performance in use of brick faced panels

No failures of the product in use have been reported to the IAB.

Part Five / Conditions of Certification

5

- 5.1** National Standards Authority of Ireland ("NSAI") following consultation with the Irish Agrément Board ("IAB") has assessed the performance and method of installation of the product/process/system and the quality of the materials used in its manufacture and certifies the product/process/system 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 issue so long as:
- the specification of the product/process/system is unchanged;
 - the Building Regulations 1997 to 2000 and any other regulation or standard applicable to the product/process/system, its use or installation remains unchanged;
 - the product continues to be assessed for the quality of its manufacture and marking by NSAI;
 - no new information becomes available which, in the opinion of the NSAI, would preclude the granting of the Certificate;
 - the product or process or system continues to be manufactured, installed, used and maintained in accordance with the description, specifications and safety recommendations set out in this certificate;
 - the registration and/or surveillance fees due to IAB are paid.
- 5.2** The IAB 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 IAB 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;
- the absence or presence of patent rights subsisting in the product/process; or
 - the legal right of the Certificate holder to market, install or maintain the product/process; or
- 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, 1989, 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.

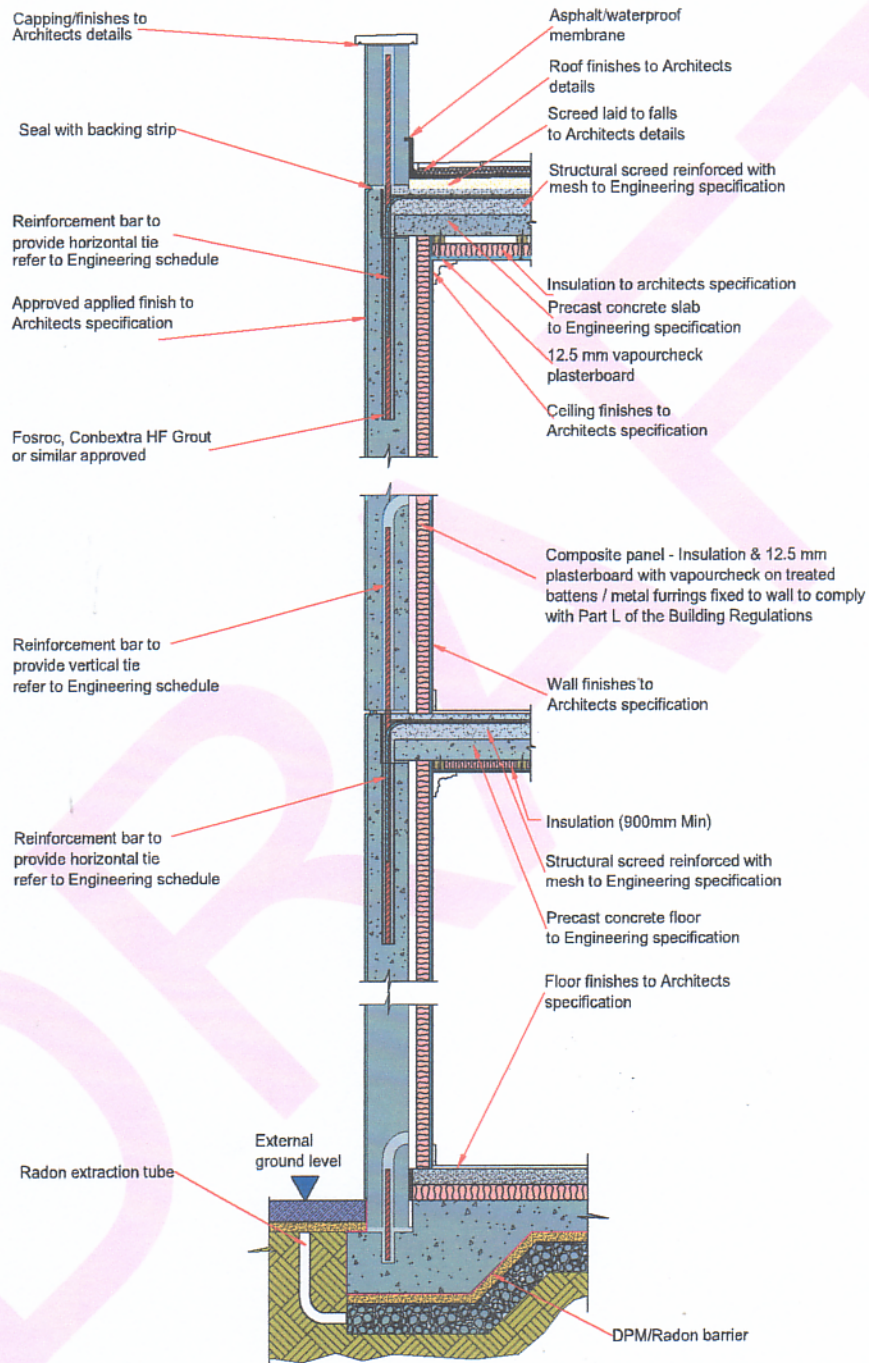
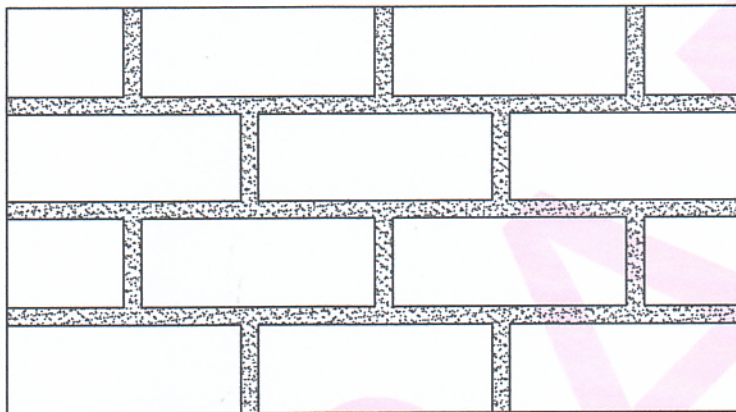
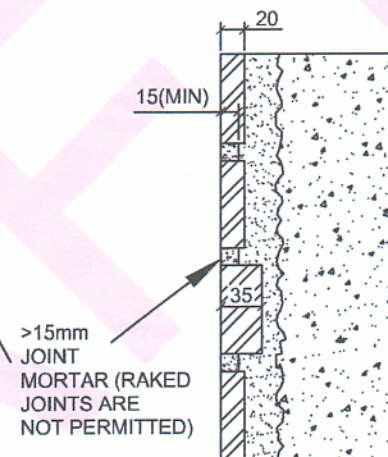


Figure 1: Typical section through the Fortress Walling – Concrete Panel

ELEVATION



SECTION 1



SECTION 2

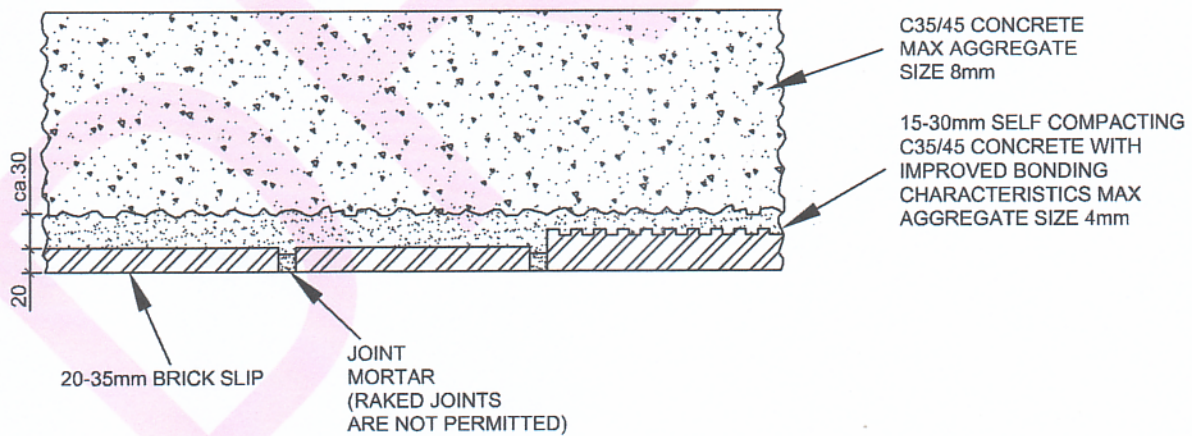


Figure 2: Typical Section -brick faced panel

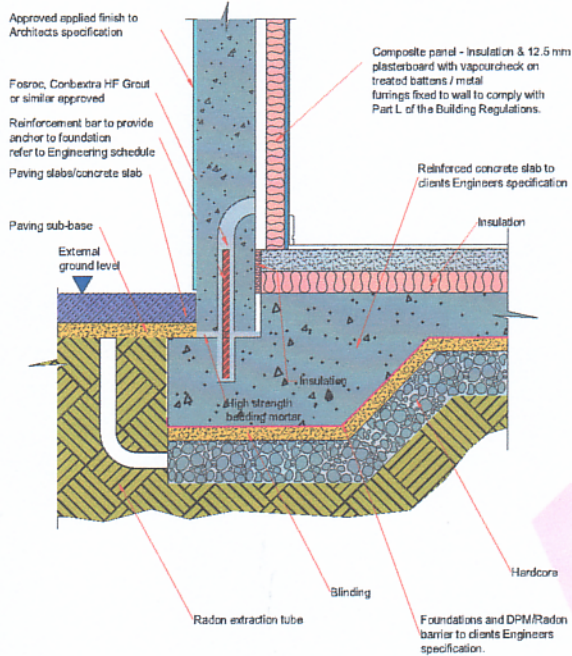


Figure 3: Typical detail at Foundation Level

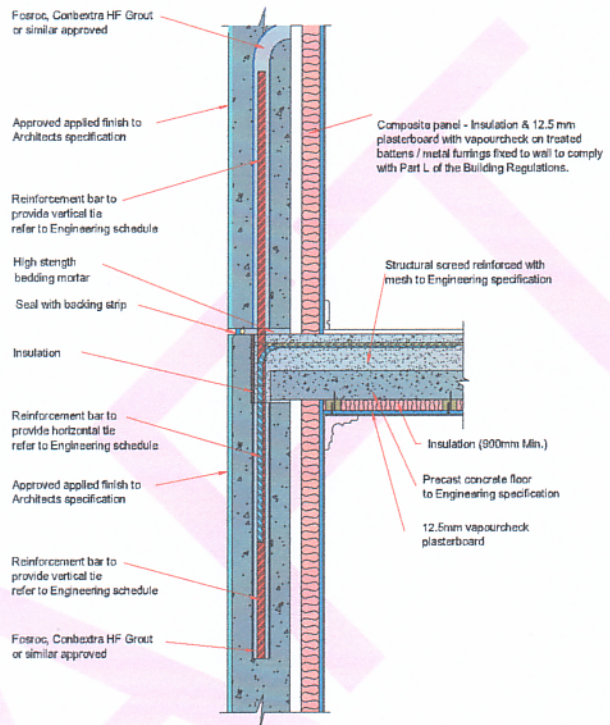


Figure 4: Typical Detail at Upper Floor Level Perimeter Wall

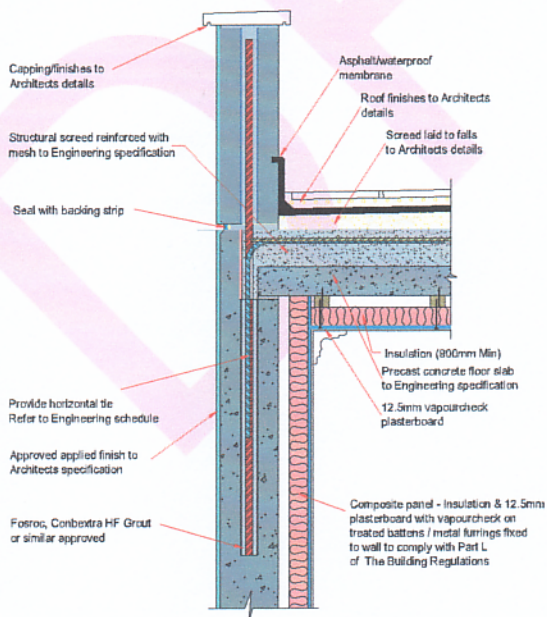


Figure 5: Typical detail at Parapet Level Flat Roof

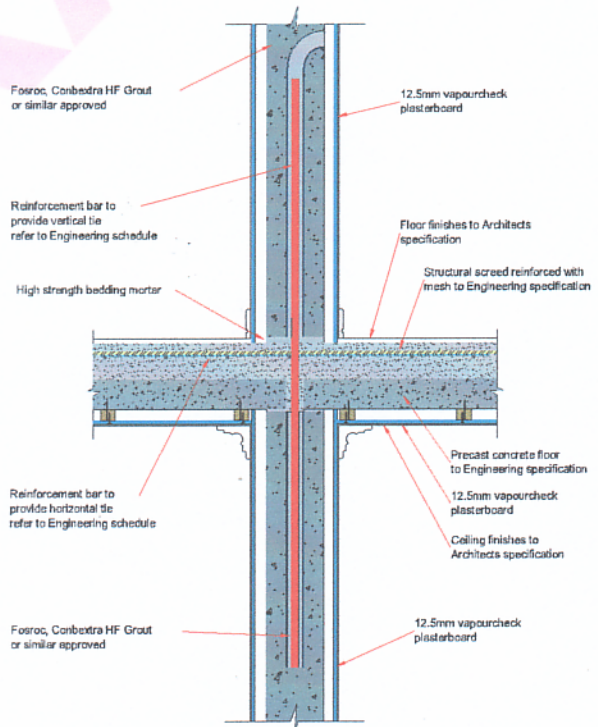


Figure 6: Typical detail at Upper Floor Level Internal Wall

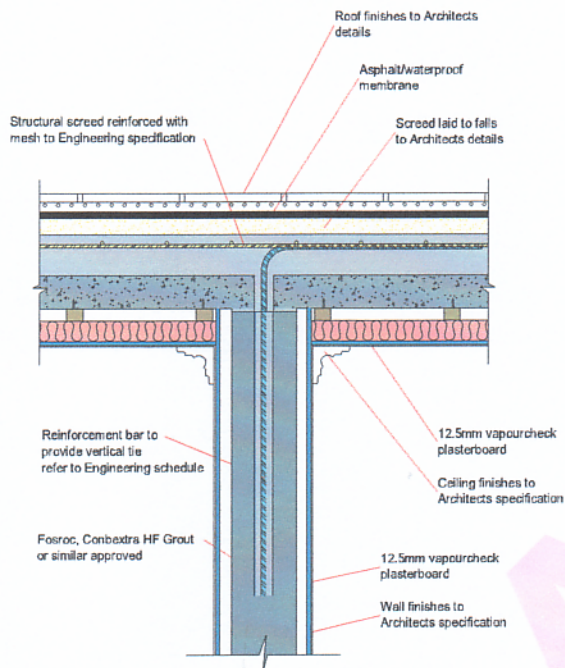


Figure 7: Typical detail at flat roof level/internal wall

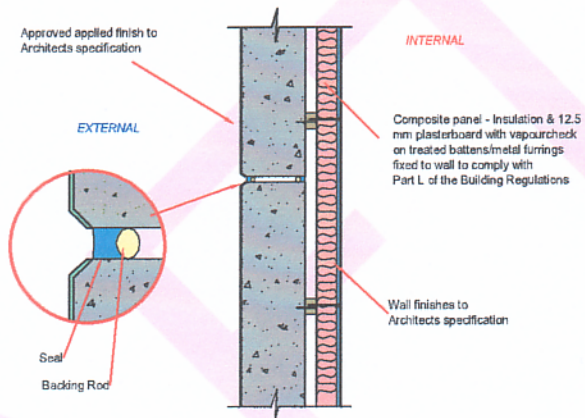


Figure 8: Typical detail at butt joint/Perimeter wall

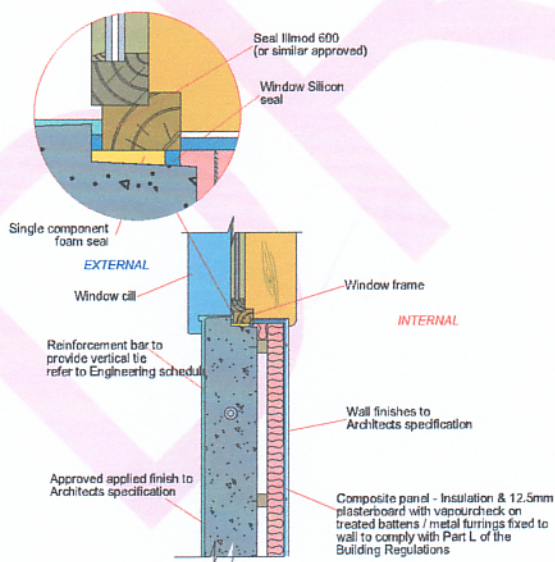


Figure 11: Typical rebated window detail fitted internal

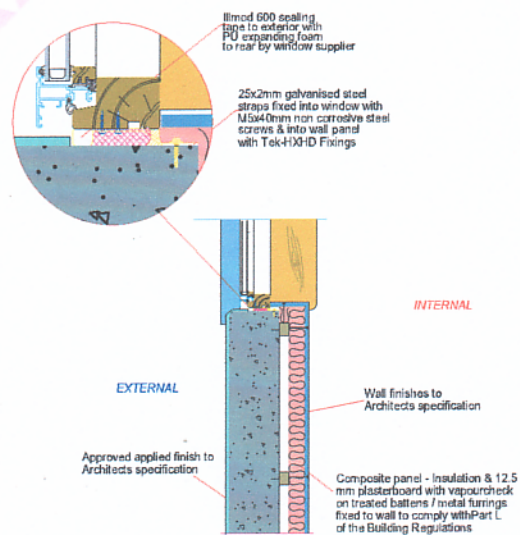


Figure 12: Typical window detail fitted internal (Section at side)

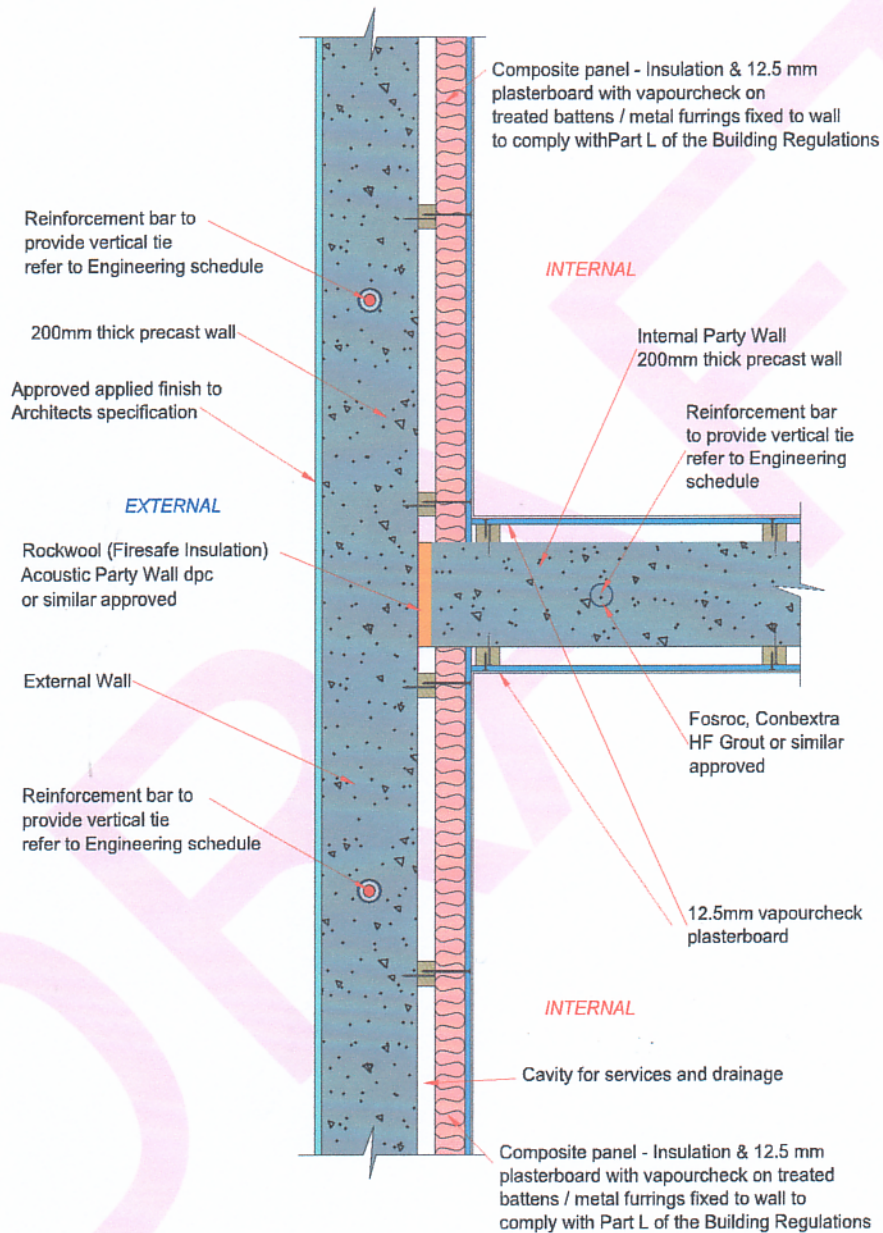


Figure 9: Typical Vertical Joint Detail at Party / Perimeter Wall (Plan)

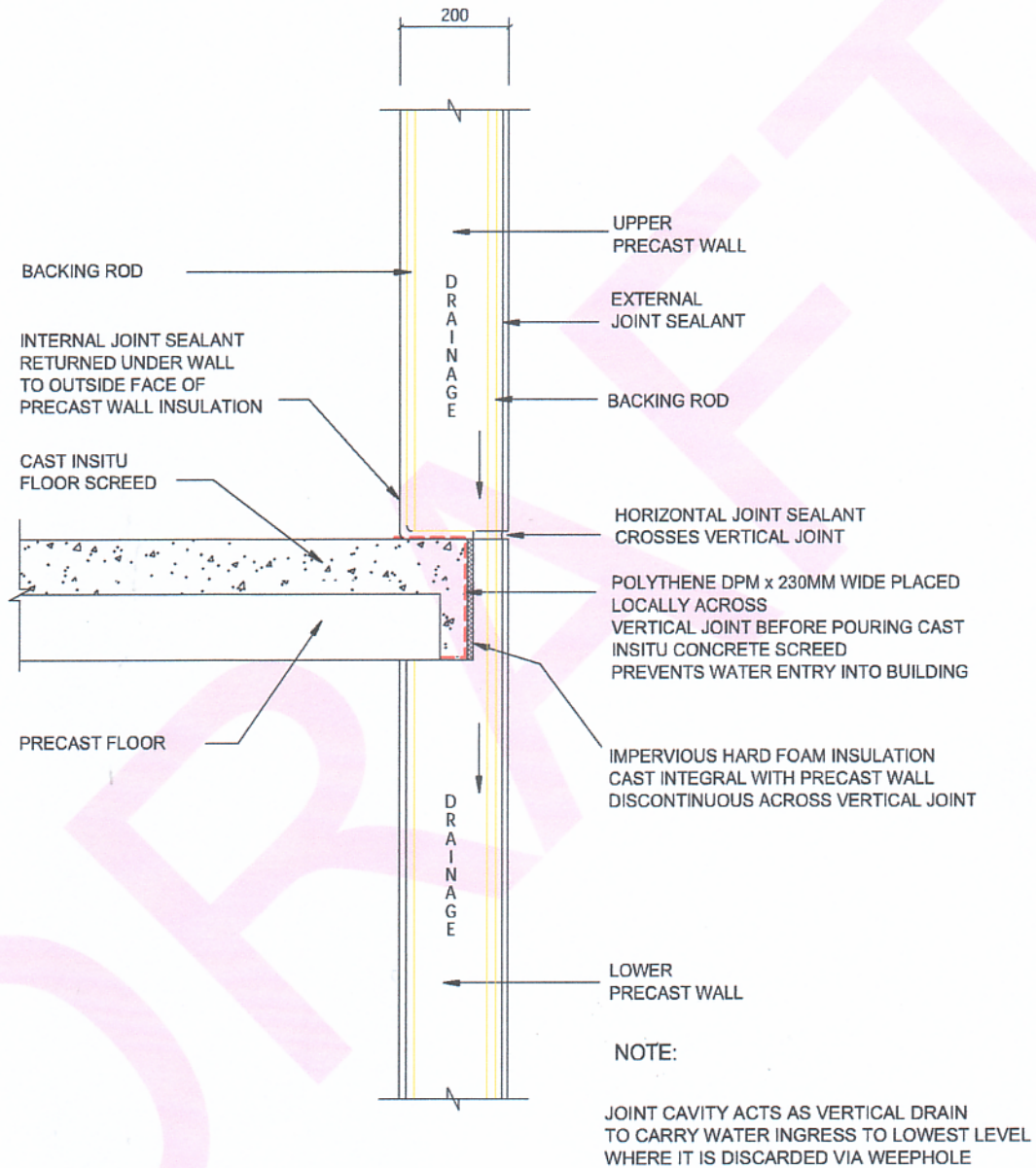


Figure 10: Crossection through vertical butt joint (water management detail)

BRICK CLAD PANEL 200mm THICK MINIMUM - REGULAR JOINT

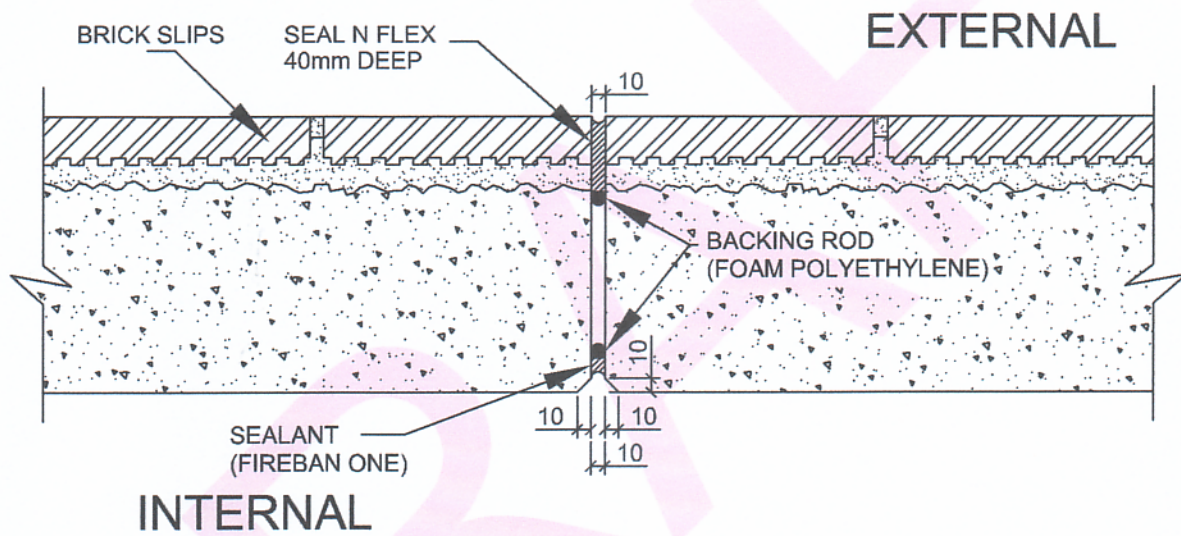


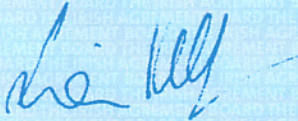
Figure 13: Typical joint detail - brick faced panel

The Irish Agrément Board

This Certificate No. **05/0174** is accordingly granted by the NSAI to **Roadstone Dublin Ltd.** on behalf of The Irish Agrément Board.

Date of Issue: **October 2005**

Signed



Chief Executive, NSAI

Readers may check that the status of this Certificate has not changed by contacting the Irish Agrément Board, NSAI, Glasnevin, Dublin 9, Ireland. Telephone: (01) 807 3800. Fax: (01) 807 3842. www.nsaie