NSAI Agrément

IRISH AGRÉMENT BOARD
CERTIFICATE NO. 22/0432

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FrameForm Steel Frame Building System

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

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

SCOPE

This Certificate relates to the FrameForm Steel Frame Building System, for the manufacture and installation of structural cold-formed Light Gauge Steel (LGS) Frame Buildings. The FrameForm Steel Frame Building System is certified to be used in the construction of buildings up to 10 storeys (maximum 30m) in height to the top storey in purpose groups 1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5 as defined in TGD to Part B Volume 1 and Volume 2 of the Building. The system is used for structural walls and floors in the above purpose groups up to 30m in height to the top storey or as part of a building where the building is not more than 30m in height. The FrameForm Steel Frame Building System can be used for external walls that are 1m or more from the relevant boundary as in accordance with TGD to Part B Volume 1 and Volume 2 of the Building Regulations.

The FrameForm Steel Systems' nominated Chartered Structural Engineer is responsible for the final structural design of the FrameForm Steel Frame Building System.

FrameForm Steel Frame Building System is designed, manufactured and supplied by FrameForm Steel Systems Limited. The installation of the system is carried out by trained and approved subcontractors which are supervised by FrameForm. The building system is inspected and certified by FrameForm Steel Systems Limited.

The system is designed for use in buildings with traditional brick and block outer leaf cladding or NSAI certified external wall cladding systems and roof coverings as per Section 2.1.6 of this Certificate. Other claddings systems may be suitable but have not been considered as part of this certification.

The load-bearing system can be installed on a podium structure and be used to construct rooftop extensions. Lightweight nature of the system is advantageous for these types of construction.

Podium slab and other supporting structures are outside the scope of this certificate. The FrameForm Steel Frame Building System is also approved for use as non-loadbearing infill panels. The infill panels are used within reinforced concrete, steel frames and traditional construction that possess their own independent lateral stability systems.

In the opinion of NSAI, the FrameForm Steel Frame Building System, as described in this Certificate, complies with the requirements of the Building Regulations.

RESPONSIBILITIES

Prior to the commencement of the contract, the responsibilities are determined and agreed between FrameForm Steel Systems and the main contractor, including foundations, fire stopping, cavity barriers, roof completion and other elements.

MANUFACTURE, MARKETING, INSTALLATION & DESIGN

The product is manufactured, marketed, designed and erected by:

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Part D – Materials and Workmanship
D3 – Proper Materials
D1 – Materials and Workmanship

The FrameForm Steel Frame Building System is comprised of 'proper materials' i.e. materials which are fit for their intended use and for the conditions in which they are to be used.

Note: Nothing in this Certificate is intended to prevent the use of materials of equivalent or superior quality, strength, fire resistance, effectiveness, durability and safety over those described in this Certificate.

Buildings incorporating the FrameForm Steel Frame Building System can be designed to meet the requirements of the following clauses of the Building Regulations:

Part A - Structure
A1 – Loading
A2 – Ground Movement
A3 – Disproportionate Collapse

Part B – Fire Safety
For purpose groups 1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5, the fire safety requirements are laid out in TGD to Part B of the Building Regulations.

B1 & B6 – Means of Escape in Case of Fire
B2 & B7 – Internal Fire Spread (Linings)
B3 & B8 – Internal Fire Spread (Structure)
B4 & B9 – External Fire Spread

Note 1: In a building more than 18m high, all external wall cladding, including insulation material used in drained and/or ventilated cavities in the external wall construction should be of limited combustibility A2-s1, d0 rating to IS EN 13501-1[1].

Note 2: The FrameForm Steel Frame Building System can be used for external walls that are 1m or more from the relevant boundary as in accordance with TGD to Part B Volume 1 and Volume 2 of the Building Regulations.

B5 & B10 – Access and Facilities for the Fire Service

Part C – Site Preparation and Resistance to Moisture
C3 – Dangerous Substances
C4 – Resistance to Weather and Ground Moisture

Part E – Sound
E1 – Airborne Sound (Walls)
E2 & E3 – Airborne and Impact Sound (Floors)

Part L – Conservation of Fuel and Energy
L1 – Conservation of Fuel and Energy

2.1 PRODUCT DESCRIPTION

This Certificate relates to the FrameForm Steel Frame Building System for the design, manufacture and erection of cold-formed light gauge steel (LGS) buildings.

The system is supplied as panelised prefabricated wall and floor elements. Additional layers of the building fabric may be pre-installed such as exterior boarding and external wall insulation.

FrameForm Steel Systems' Chartered Engineer is responsible for design, specification, inspection and sign off of all components of the building system described in this Certificate.

This Certificate contains illustrations to explain the various elements of the FrameForm Steel Frame Building System – these illustrations are not intended to be used as construction drawings. FrameForm Steel Systems, in conjunction with the design team on a project, will produce a set of project specific details on a project-by-project basis. All drawings should be compliant with the relevant codes of practice and relevant standards, along with current Building Regulations.

2.1.1 Ground Floor & Foundations

The construction of the foundations and ground floor slab are outside the scope of this certificate. Ground floor and foundations shall be designed by Client's Engineer for structural load criteria specified by FrameForm Steel Systems' Engineer. Tolerances for the system installation on foundations, ground floor or podium slab are defined in FrameForm Steel installation manual.

2.1.2 Structural Floors

FrameForm Steel Systems provides 2No. options for floor structures: intermediate floors and compartment floors. The definitions of different floor structures can be found in TGD to Part B Volume 1 of the Building Regulations.

Further information on compartment floors is provided in Section 2.4.1 and intermediate floors in Section 2.1.3 of this Certificate.

2.1.3 Intermediate Floors

Intermediate floors can be constructed using (the build-ups are outlined in Table 2):

- Lipped C-section joists
- Light steel lattice trusses

Lipped C-section joists

The lipped C-section joists are rolled formed similarly as vertical studs. Their depth varies between 150 to 350mm, and the gauge of the joists can range from 1.8mm to 3.0mm in thickness. The joists are spaced typically between 300mm and 600mm centres and supported using joists hangers or Z-hangers on a wall panel. Joists can be delivered to site to be 'stick built' installed or can be prefabricated forming floor panels.

Light steel lattice truss

The light steel lipped C-sections (typically 89mm deep sections) are forming the top and bottom chord of the lattice truss as well as internal/diagonal members. The truss is assembled using self-tapping screws in the factory environment and floor units delivered to site as whole floor panels or separate truss members. Spacing of the trusses varies between 300mm and 600mm centres. Trusses are supported on wall panels similarly as C-section joists.

Typical intermediate floor consists of:

- Floor build up, installed by others
- OSB boarding, installed by others (or alternatively applied by FrameForm Steel Systems)
- FrameForm lipped C-section joists or light steel lattice truss with/without mineral wool insulation
- Plasterboard, installed by others and in accordance with this Certificate (refer to Table 2)

2.1.4 Load Bearing Walls

The load bearing walls are prefabricated in the factory and formed using cold rolled lipped C-sections. The lipped C-sections may vary in depth and thickness, to accommodate a range of structural loadings and Client's requirements. Studs are swaged each end to fit snug into a track. Dimples are formed at each connection indicating a precise location of a fixing point. Self-drilling pan head screws are used for fixings between members. Vertical studs are spaced typically at 300, 400 or 600mm centres to allow the fixing of boarding to each face of the wall. Horizontal restraint typically at mid-height of the panel as well as bracing may be incorporated into the panel. Steel grade S390 or S450 is used for load-bearing panels. All panel assembly is done in factory environment by FrameForm Steel Systems.

2.1.5 Non-Load Bearing Walls (Infill Panels)

Non-load bearing panels and partitions are formed using a lipped C-section, similar to load bearing studs described in the Section 2.1.4. The studs of a non-load bearing panels have generally slimmer section sizes between 50mm to 90mm. The gauge of infill panels varies between 0.5m to 0.8mm in

thickness and steel grade S250 is used for their production.

Non-load bearing studs may be in a form of a panelised unit or can be stick built. Non-load bearing panels shall have a deflection head between the top of the panel and the floor/structure to ensure no load distribution is provided between the floor/structure and the infill panel.

2.1.6 External Walls

The external walls can be load bearing or non-load bearing as described in Sections 2.1.4 and 2.1.5.

The system was assessed as a hybrid and warm frame. The wall panels are clad with the required thickness and grade of plasterboard as per Table 2 to achieve the appropriate fire rating required for the building. The plasterboards are screw fixed to the cold formed steel stud and track members.

The requirements for the provision of an Air and Vapour Control Layer (AVCL) on external walls are outlined in Section 3 of this certificate.

Typical external wall for buildings below 18m in height with traditional facade brickwork outer leaf consists of:

- Plasterboard, installed by others and in accordance with this Certificate (refer to Table 2)
- Air barrier, installed by others
- FrameForm galvanised studs (89mm-150mm) with/without mineral wool insulation between the studs
- External insulation layer (PIR), installed by others (or alternatively applied by FrameForm Steel Systems)
- Stainless steel wall ties and brickwork outer leaf, installed by others

Typical external wall for buildings above 18m in height with traditional facade brickwork outer leaf consists of:

- Plasterboard, installed by others and in accordance with this Certificate (refer to Table 2)
- Air barrier, installed by others
- FrameForm galvanised studs (89mm-150mm) with/without mineral wool insulation between the studs
- External sheathing board, installed by others (or alternatively applied by FrameForm Steel Systems)
- External insulation layer (mineral wool), installed by others
- Stainless steel wall ties and brickwork outer leaf by others

The system has been assessed with traditional brick and block outer leaf cladding and NSAI certified external wall cladding systems. Other external façade claddings systems may be suitable but have not been considered as part of this certification.

2.1.7 Internal Walls

The internal load bearing and non-load bearing wall panels are made from cold-formed LGS as described in sections 2.1.4 and 2.1.5. When internal wall panels provide lateral support to external walls, diagonal wind bracing members shall be incorporated into the panel to successfully transfer the horizontal loads safely through the building structure in accordance with structural design requirements.

Typical internal load-bearing wall consists of:

- Plasterboard, installed by others and in accordance with this Certificate (refer to Table 2)
- FrameForm galvanised studs (89mm-150mm) with/without mineral wool insulation between the studs by others
- Plasterboard, installed by others and in accordance with this Certificate (refer to Table 2)

All internal load bearing panels must be sufficiently supported directly under the panels with rising blockwork or equivalent. Plasterboard specifications on the steel panels should be in accordance with Table 2 of this certificate, which shows the plasterboard fire resistance requirements for wall, floor and ceiling elements. The plasterboard linings and AVCL are fixed to the walls and ceilings by means of self-drill/self-tap screws; all joints are then taped and filled where required for decoration.

2.1.8 Roof Structure

The roof trusses can be either a traditional timber cut roof, prefabricated roof truss made from timber or steel or a steel prefabricated roof module. The roofing solution chosen for a particular building is project specific and must be assessed and signed off by a nominated FrameForm Steel Systems' chartered structural engineer.

2.1.9 Internal Linings and Finishes

Linings to walls and ceilings are of plasterboard as specified in Table 2, manufactured to I.S. EN 520[4]. They are attached by means of self-drill/self-tap screws into steel members. For fire resistant construction, fasteners must be used as specified in Table 2 of this certificate. In areas prone to high levels of humidity, moisture resistant plasterboard should be used. Joints in plasterboard can be taped and filled in accordance with the plasterboard manufacturer's instructions. Alternatively skim coat plaster can be applied.

2.1.10 Services

Services are outside the scope of this Certificate. Electrical installation should be designed and installed in accordance with I.S. 10101[5]. Heating and plumbing services must be designed and installed by competent professional engineers.

Care shall be taken to avoid dissimilar metals coming into contact to avoid risk of galvanic corrosion. Local earth connection to the steel frame shall be avoided. The structural frame should be earthed in accordance with the current regulations I.S. 10101[5].

Electrical installations and recessed lights may not be accommodated within any of the compartment floor build ups. All electrical installations must be accommodated by creating a separate service void under the compartment floor. All services are installed with reference to Section 3.2.5.7 and 3.4 of TGD to Part B for all purpose groups to which this certificate applies. Penetrations through compartment floors should be minimised. Mechanical ventilation extraction ducts are allowed to pass vertically through the floor but must be appropriately fire sealed where they enter and exit and comply with the recommendations contained within BS 9999[6].

Services can pass through a compartment wall when they are appropriately protected with reference to Section 3.2.5.7 and 3.4 of TGD B of Building Regulations for all purpose groups to which this Certificate applies. Services passing through compartment walls should be kept to a minimum and avoided where possible.

2.2 DESIGN AND MANUFACTURE

The FrameForm Steel Frame Building System must be designed in accordance I.S. EN 1993-1[7], and manufactured in accordance with I.S. EN 1090-1[8] to EXC2. The design and manufacture is the responsibility of FrameForm Steel Systems Limited.

The components of the FrameForm Steel Frame Building System are manufactured by either roll forming or brake pressing sheet metal. The primary structural component of the system is the lipped c-section, which typically varies in depth from 89mm to 150mm. All structural components of the system use a structural grade of steel of S390 or S450 and are coated with layer of Z275 zinc. All non-structural members for infill panels are manufactured from S250 steel grade and coated similarly with Z275 zinc.

2.3 STRUCTURAL PRINCIPLES

2.3.1 LGS Structure

The basis of the typical FrameForm Steel Systems' structure is a cold-formed light gauge steel frame, which is assembled into structural panels in the factory and installed on site. Alternatively the system can be stick built if required.

2.3.2 Protective Coatings

The LGS members are all coated with a protective zinc-rich metal coating. The LGS members are manufactured from galvanized coil steel to I.S. EN 10346[9] and coated with 275 g/m^2 zinc.

In addition to the steel members in the system being protected by zinc rich protective coatings, further protection against corrosion and longer design life is given to the steel by providing the following:

- The bottom channel on all ground floor LGS panels is additionally protected by a DPC.
- The insulation keeps the steel in a "warmframe" environment, which, in conjunction with an internal AVCL prevents the formation of condensation within the wall structure.
- Studs shall be located minimum 150mm above ground level.
- An increase in grade of zinc layer is provided where there is an increased risk of corrosion. Where the studs cannot be installed minimum 150mm above the ground level, the protective layer on zinc shall be increase to z600.
- All fasteners have been assessed and tested for use with the system, to ensure the minimum 60-year design life of the system.

2.3.3 Fasteners and Connection Joints

The design of the FrameForm Steel Frame Building System allows for no welding of joints in the system. The system is assembled using fasteners such as self-tapping screws. On-site structural connections such as panel to panel connections, OSB boarding to floor joist, floor joist to panel, composite deck to panel and wind bracing are fastened using approved Tek screws and bolted connections.

All fasteners used in the LGS system are adequately protected against corrosion i.e. galvanising/zinc coating and made from a suitable metal to ensure the design life of the system is maintained. FrameForm Steel Systems provides a full specification of all fasteners, where they are to be used and how they are to be installed during the construction of the system. Only system fasteners approved or supplied by FrameForm Steel Systems may be used with the system. It is important to ensure that protective coatings on fasteners are not removed, i.e. to assist the fitting of a connection, as this would severely

compromise the corrosion performance of the fastener.

2.3.4 Racking

Resistance to horizontal loading (racking) is provided by the horizontal diaphragm action of the approved floor sheeting and roof in conjunction with the metal diagonal X-bracing or K-bracing in the wall panels transferring lateral loads to the foundations, stability cores or other lateral stability system. All X-bracing or K-bracing is preassembled in the factory and has the dual function of ensuring squareness of factory produced panels in addition to providing lateral stability for the overall structure.

Foundations and lateral stability systems such as concrete cores are outside of the scope of this certificate. All structural criteria and load transfer to lateral stability system will be determined by FrameForm Steel Systems' chartered engineer and communicated to Client's structural engineer.

2.3.5 Holding Down Fixings

The bottom channel of the external panels is fixed to the ground floor slab, podium slab or rising wall with approved holding down fixings. The type of fixing used to hold down the panels of the system will be dependent on what substrate it is being fixed to. The fixings are designed by the FrameForm Steel Systems to I.S. EN 1992-4[11] and are installed in accordance with the HSA *Code of Practice for the Design and Installation of Anchors*[10]. The positions of the fixings are project specific and are determined by the FrameForm Steel Systems.

2.4 COMPARTMENTATION

2.4.1 Compartment Floors

The compartment floors can be constructed using steel concrete composite deck structure. The build is outlined in Table 2. The FrameForm Steel Frame Building System compartment floor can be designed to provide up to 90mins fire resistance from the underside. The compartment floor is non-combustible and is suitable for use in buildings of any purpose group up to the maximum height allowed in this Certificate.

The steel concrete composite deck adopts the use of steel decking as both permanent shutter for concrete and as a structural element forming composite action between steel and concrete.

Two different profiles of metal decking are used within the system, these being the dovetail and trapezoidal profile. The dovetail metal deck usually adopts the profile height of 51mm (R51 profile), while the trapezoidal metal deck may range in depth but typically 60mm and 80mm high profiles are used (TR60, TR80, etc.). The type of the profile to be used is selected by FrameForm Steel Systems on project-by project basis to suit best the Client's and Engineer's requirements.

Typical steel concrete composite deck consists of:

- Floor finishes, installed by others
- Resilient layer (cork matting or similar), installed by others
- FrameForm steel concrete composite floor system
- Mineral wool (if required), installed by others
- Plasterboard supported on proprietary metal frame, installed by others and in accordance with this Certificate (refer to Table 2)

An additional layer of resilient material is added to the top of the composite slab to meet the requirements outlined in Section 4.4 of TGD to Part E of the Building Regulations (see Section 4.4.2.1 of TGD to Part E for definition of resilient material). The underside of the deck is fitted with the ceiling type required by the specific project.

Steel metal deck may be supported directly on top track or via the use of Z-hangers. Z-hangers are fixed to the top track of the panel.

2.4.2 Compartment Wall

Separating walls are constructed using a minimum of two independent cold formed steel framed leaves with a recommended minimum cavity of 50mm between both frames. The individual frames are boarded (on site or in the factory) with the appropriate level of boarding required to provide the acoustic and fire properties, as illustrated in Table 2.

Where the attic space is habitable the mineral wool insulation must go up to the underside of the roof for acoustic purposes. Where the party wall abuts an external wall, the mineral wool insulation within the cavity of the party wall extends through the inner leaf of the external wall and abuts the external leaf of the system and forms the fire stop in the wall. This detail seals air gaps and minimises flanking sound transmission.

The head of the party wall must also be fire stopped and cavity closed as specified by the FrameForm Steel Systems' construction details. Where services are required in a party wall, they can be accommodated by creating a service cavity to the party wall with timber battens or metal top hat sections and plasterboard. All battens used with the FrameForm Steel Frame Building System are treated in accordance with BS 8417[12]. Design must comply with the requirements of Section 3.5 of TGD B 2017 Volume 2 of Building Regulations for all purpose classes to which this certificate applies.

A compartment wall within the FrameForm Steel Frame Building System can be also constructed of a single frame wall and can be designed and specified to meet the acoustic, fire and structural requirements of the Building Regulations. This compartment wall must not be used where a wall is common to two or more buildings (separating wall) or where a compartment wall is used to separate dwellings from each other within a building.

2.4.3 Cavity Barriers and Fire Stops

To meet the requirements of TGD to Part B Volume 2 of the Building Regulations, the correct specification and placement of cavity barriers and fire stops shall be detailed and shown on a schedule for the project. Typically, cavity barriers and fire stops should be provided in the construction of LGS walls as follows:

- Separating/compartment walls shall have a vertical cavity barrier sealing the cavity at the wall ends, running from DPC level to the underside of the fire stopping at the top of the wall.
- At a separating/compartment wall junction with the external wall, the vertical cavity barrier runs out to the inner face of the external cladding to form the cavity barrier.
- Horizontal cavity barriers shall be placed at the perimeter of all compartment floors. The cavity barrier should be appropriate for the external cladding that is intended to cavity close in the event of a fire and smoke entering the cavity.
- A cavity barrier shall cover the full floor depth as well as the upper wall panel rail and lower wall panel head plate.
- Cavity barriers are required around all openings in external walls such as doors, windows, vents, extractor fans, meter cupboards, etc.

The method of fire stopping should be in accordance with guidance given in Diagram 10 and section 3.6 of TGD to Part B Volume 2 of the Building Regulations for purpose groups 1(a), 1(b) and 1(d), and Diagram 13 and section 3.3 of TGD to Part B of the Building Regulations for all other purpose groups for which this Certificate applies.

The FrameForm Steel Systems' site install manager will inspect all cavity barriers and fire stops prior to the closing up of the cavities and ceilings and will record it in the quality control file for that site. The fire stopping must be installed correctly before FrameForm Steel Systems will issue the certificate for the building.

2.5 DELIVERY, STORAGE AND SITE HANDLING

2.5.1 Delivery of Panels

FrameForm panels are delivered to site on flat bed trailers. Panels are horizontally bundled together with certified lifting brackets located close to the four corners. Each bundle contains panels located in a similar location on site. This enables the placement of bundles close to their installation location on site, minimising lifting time. Bundles are typically densely packed onto flatbed trailers and should be clearly labelled/marked bases on their preconceived placement on site.

2.5.2 Storage of Panels

To minimise any risk of damage or deterioration of the FrameForm Steel Systems' products on site the following precautions shall be followed:

- Panels which are stored on site should be kept off the wet ground, using steel studs or timber skids.
- While in storage, packs of panels should be covered from the rain, using a plastic tarpaulin or similar waterproof membrane.
- Where panels do get wet, the bottom track of the panel should be inspected for moisture entrapment. If water exists, a hole between studs should be drilled in the corner of the track.
- FrameForm Steel Systems' products should not be stored near lime, dry cement, plaster, mortar or salt.
- Where FrameForm Steel Systems has supplied boarding to site, be it orientated strand board, cement board, insulation boards, these products should be protected from exposure to rain/ moisture.

2.5.3 Safe Handling

For every site a specific risk assessment must be created in order to access the risks involved with the handling and installation of the steel frame panels and any ancillary products. Panels come to site in packed bundles, which may be screwed together using offcut stud sections or banded together bands of metal or plastic. For the latter, care should be taken when cutting away these straps as the strap will likely spring back/forward.

Panels should always me moved using a crane supplied by the steel frame installer or contractor (project specific) using the pre-attached lifting eyes on each panel or via slings. The only exception to this is small panels below a safe weight limit as specified in the risk assessment, typically un-boarded internal walls. The ends of all steel sections are sharp, gloves must always be worn when moving steel products.

2.5.4 Traceability

When the panel is completed and passed quality control in the factory, the label is attached to it stating typically:

- Project name and number
- Reference number of the panel in the project
- Quality check
- Total weight
- Individual barcode

2.5.5 Typical Material List Supplied to Site

With each customised delivery to site, a comprehensive bill of materials is supplied. This bill of materials gives a detailed list of all components delivered to site to complete the installation of the FrameForm Steel Building System.

All panels are individually numbered using the pre-marking system during production to correspond with the erection drawings supplied with the bill of materials. This pre-marking system facilitates speed and accuracy during assembly and erection on site.

2.6 INSTALLATION

2.6.1 General

All off-loading and erection shall be in accordance with the FrameForm Steel Systems' method statement and erection procedures. Site installation must only be carried out by approved and trained installers employed by FrameForm Steel Systems or by a specialist sub-contractor under the supervision of FrameForm Steel Systems and in accordance with the FrameForm Steel Systems' Installation Manual. In any scenario, the FrameForm Steel Systems is responsible for site inspections and sign off in accordance with Building Regulations.

2.6.2 Tolerances

Prior to installation of the wall panels, the tolerances are checked at the base of the wall frame by the main contractor and FrameForm Steel Systems. The required tolerances can be found in the FrameForm Steel Systems' Installation Manual including frame tolerances depending on storey height and façade construction.

2.6.3 Panels Lifting

All lifting shall be carried out by competent personnel in accordance with the FrameForm Steel Systems' Installation Manual and site-specific safety statement. Installers are approved once they have undergone on-site training, and understand the fundamental structural principals of the system, fire stopping requirements, tolerances, importance of weathering, storage and handling of the LGS panels and all other relevant information. Installers must have installed panels under the guidance of a qualified installer and shall have a signed record of training.

The placement of a panel should be carried out using a crane or teleporter. Using chains, the panel is attached to the crane using the two certified lifting eyes located along the top of the panel. It is typical that these lifting eyes are pre-attached upon delivery for ease of installation. Prior to the commencement of any lift, the total weight of each individual lift should be checked and verified that that it is below the maximum capacity of the crane or teleporter. The weight of each panel can be found on the panel label, attached to the sides of the panel.

2.6.4 Panels Fixing

Permanent anchorage of the panel may commence as soon as the connecting subassembly surrounding the panel are set (hot rolled steel/floor etc.). Anchorage of the panel should follow the specification stated within the detailed drawings provided. Any grouting of shimming shall be carried out prior to panels fixings (refer to FrameForm Steel Systems' Installation Manual). Anchorage of the panel is typically required at the following locations:

- At braced ends
- At panel ends
- At specified centres along the panel (1200mm c/c etc.)
- At jamb studs

2.6.5 Floors Fixing

<u>Lipped C-section joists and light steel lattice trusses</u>

Intermediate floors may be formed using either a lattice steel truss or a steel C-joist. The trusses are typically supplied to site as individual elements, which are then placed between supporting wall frames using the z-hangers attached to the top of the panels. Steel C-Joists are commonly supplied to site in cassettes which can be placed between frames according to the plan drawings. Once the structural elements are in place, they must be immediately fixed in place according to the FrameForm Steel Systems' drawings and details. Once fixed in place OSB or cement board shall be fixed in place as shown on project's drawings.

<u>Steel concrete composite floor deck</u>

Compartment floors can be constructed using steel concrete composite floor deck. Metal decking should be delivered to site in bundles strapped together according to their location and size. These bundles should be positioned in place next to their position on plan for ease of access. The steel sheets shall be slid into place on the Z-hangers or atop the LGS steel frame. First steel sheet shall be fixed in place before placing further sheets to avoid unwanted movement. Sheets shall be fixed at shown on project's drawings.

Temporary propping may be required for sheets typically in excess of 3.5m in length. All propping locations are indicated on FrameForm Steel Systems' drawings. Propping shall remain in place during construction for a specified time by FrameForm Steel Systems.

Reinforcement shall be installed as per FrameForm Steel Systems' drawings and specification. Once reinforcement is installed the concrete pour may commence. All materials and components specification will be supplied by FrameForm Steel Systems.

2.6.6 Plasterboard Installation

The proper application of plasterboard to the steel frame members is critical for both fire and sound performance. Attention shall be given to proper and practical detailing on the part of the designer and a high standard of workmanship on behalf of FrameForm Steel Systems. Plasterboard, in addition to all cavity barriers and fire stops on all walls and floors must be fully checked on site and signed off in accordance with project specific details by the appropriate personnel. All boarding and its fixing that provides fire resistance must conform to the specification given in Table 2.

If alternative boarding is proposed, then an independent fire test report, from an Accredited Laboratory, must be provided and assessed by a competent Fire Engineer.

2.6.7 Infill Panels Installation

Infill panels installation shall be in accordance with FrameForm Steel Systems' SFS Installation Manual and Sections 2.6.1 to 2.6.3 of this Certificate.

Infill panels shall be installed on supporting structure with minimum bearing width and fixings as stated on FrameForm Steel Systems' drawings. Typical fixings are as below:

- For the connection of tracks to steel beams, use 5.5mm self-drilling TEK screws or powder-actuated nails.
- For the connection of tracks to concrete slab or soffit, use a 6mm diameter concrete screw with a 5mm predrilled hole (typically manufactured with this hole).

Fixings are typically required at stud centres and should not exceed 600mm. Additional fixings are required at track ends and split points and likely required at jamb stud locations. Fixings manufacturer specifications should be followed as to minimum embedment depth and edge distances. When fixing a ground floor slab a DPC layer should position underneath the base track.

Fixings between members of infill panels and components are achieved by:

- Fixing together infill wall panels with 5.5mm self-drilling Tek screws at centres as per drawing specification
- Fixing studs to bottom and top track with a 5.5mm pan head screw

The minimum edge distance for a screw fixing into light steel sections should be three times the fixing diameter and not less than 10mm. The fixing centres for any compound section, such as back-to-back studs or built-up jamb studs should follow the fixing specification shown on FrameForm Steel Systems' drawings.

Deflection head shall be installed at the top of the infill panel to take account of deflection of the structure overhead. Deflection criteria shall be identified by Client's structural engineer.

2.6.8 Installation of NSAI Agrément certified external wall insulation façade system

Where NSAI Agrément certified external façade will be installed on FrameForm Steel Frame Building System, it shall be installed in accordance with cladding manufacturer's installation manual. The build-up of external wall shall match as certified NSAI Agrément external façade system. Refer to external façade system NSAI Agrément certificate for further information.

All claddings fixed to the LGS frame shall be agreed with FrameForm Steel Systems' structural engineer to ensure that LGS system structure is designed to support cladding loads.

2.6.9 Site Supervision

The approved installation contractors are subject to supervision by a FrameForm Steel Systems' site manager. Typically, the FrameForm Steel Systems' site manager will agree a schedule of inspections with the erection contractor.

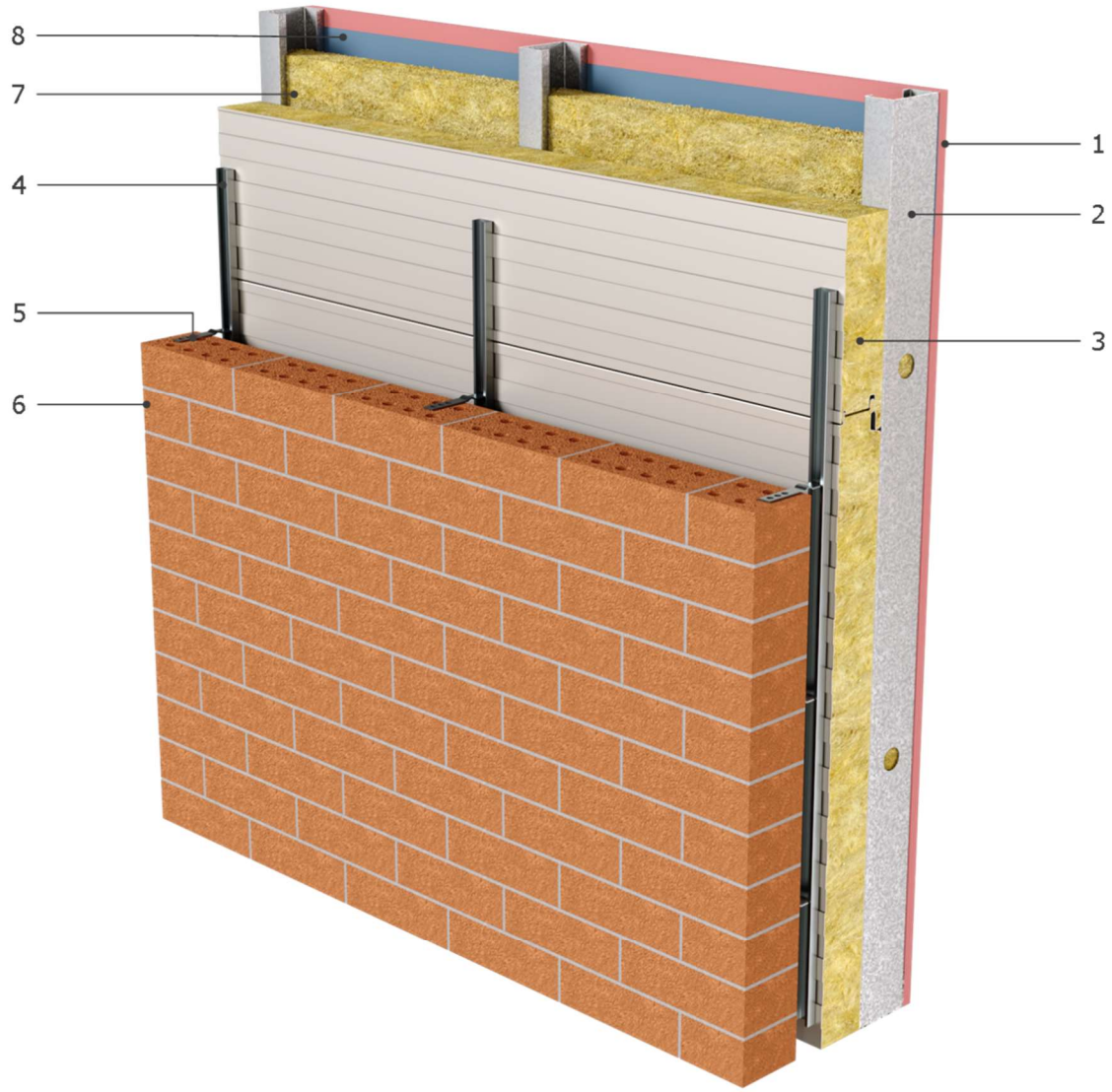
Each building has its own quality control file which is kept on site by the FrameForm Steel Systems' site manager. All fixings and brackets between panels are visually inspected, periodically photographed and recorded in the quality control file. The site manager also inspects and records all fire stopping performed on site. Any defects noted are recorded, photographed where possible and notified in writing to the erection supervisor. The site manager will inspect and approve the remediation before work can proceed.

2.6.10 Main Contractor Responsibilities

The Main Contractor is generally responsible for the construction of all facade claddings, roof claddings and the installation of fire stopping and cavity barriers where it is impractical for FrameForm Steel Systems to install prior to these claddings being applied. All other fire stopping,

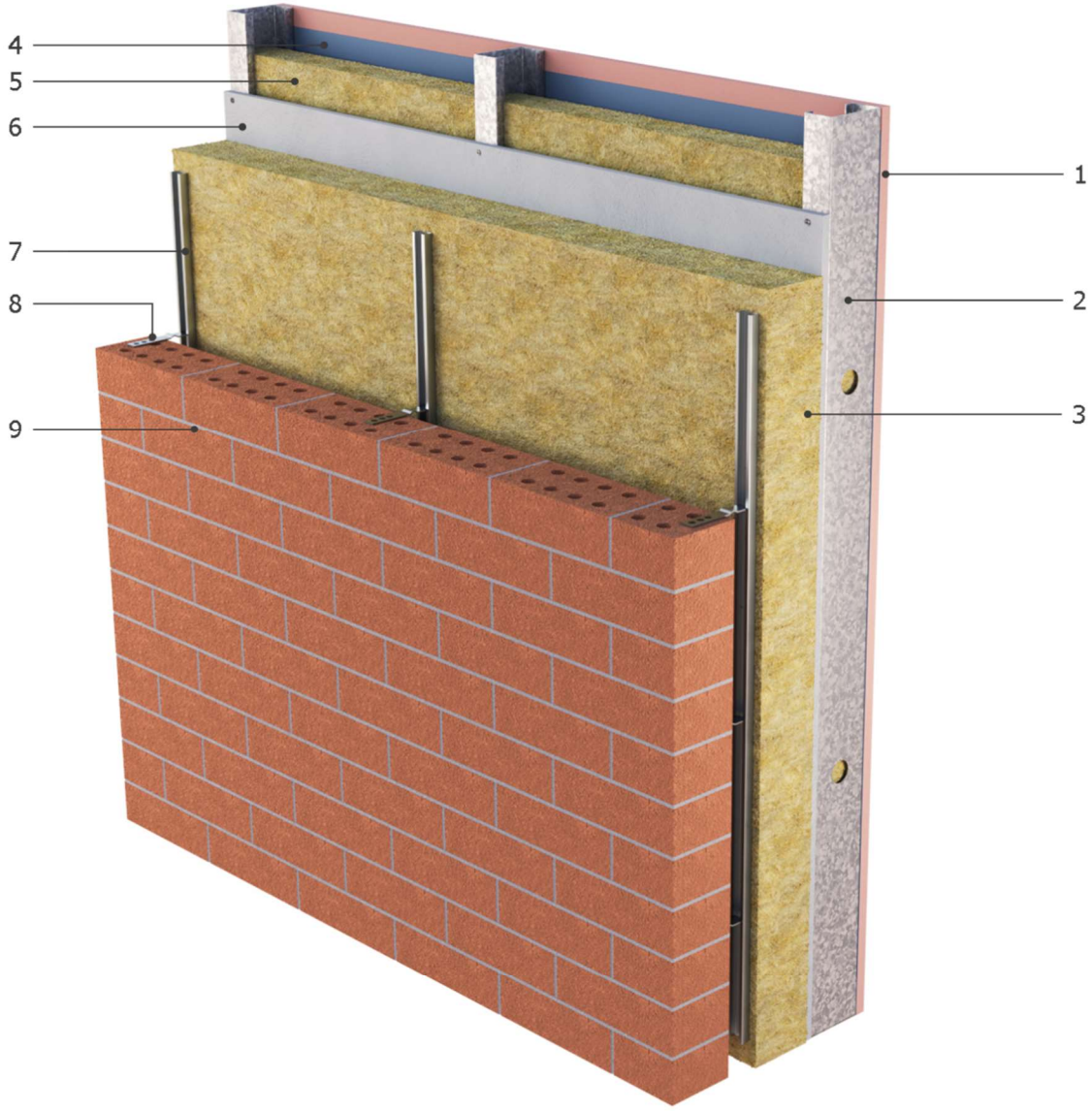
and cavity barriers are the responsibility of FrameForm Steel Systems.

Table 1: LGS Profiles and properties					
FrameForm Steel – LGS Frame Profile					
Component Type	**Grade of steel**	**Typical Section Details (mm)**			
		Depth (h)	**Width (b)**	**Lip (c)**	**Thickness (t)**
Wall Stud (load bearing, infill panels)	S390, S450	89-350	50	15	1.2 - 2.8
Wall Stud (non-load bearing)	S250	50-90	50	15	0.5-0.8
C-joists	S390, S450	150-350	50	15	1.2 - 2.8
Lattice Joists	S390, S450	200-350	50	15	1.0 - 2.0



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate
(2) FrameForm Steel Frame Panel
(3) Pre-Fabricated Mineral Wool Insulated Panel, Factory Applied
(4) FrameForm Stainless Steel Wall Tie Channel, Factory Applied
(5) FrameForm Stainless Steel Wall Tie, Supplied Only
(6) Masonry External Leaf, installed by others
(7) Mineral wool insulation fitted between frames, installed by others
(8) AVCL Layer, installed by others

Figure 1 External Wall with Mineral Wool Insulated Panel and Masonry Outer Leaf – Hybrid Frame



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) Frameform Steel Frame Panel

(3) Semi-rigid mineral wool insulation

(4) AVCL Layer, installed by others

(5) Mineral wool insulation fitted between studs, installed by others

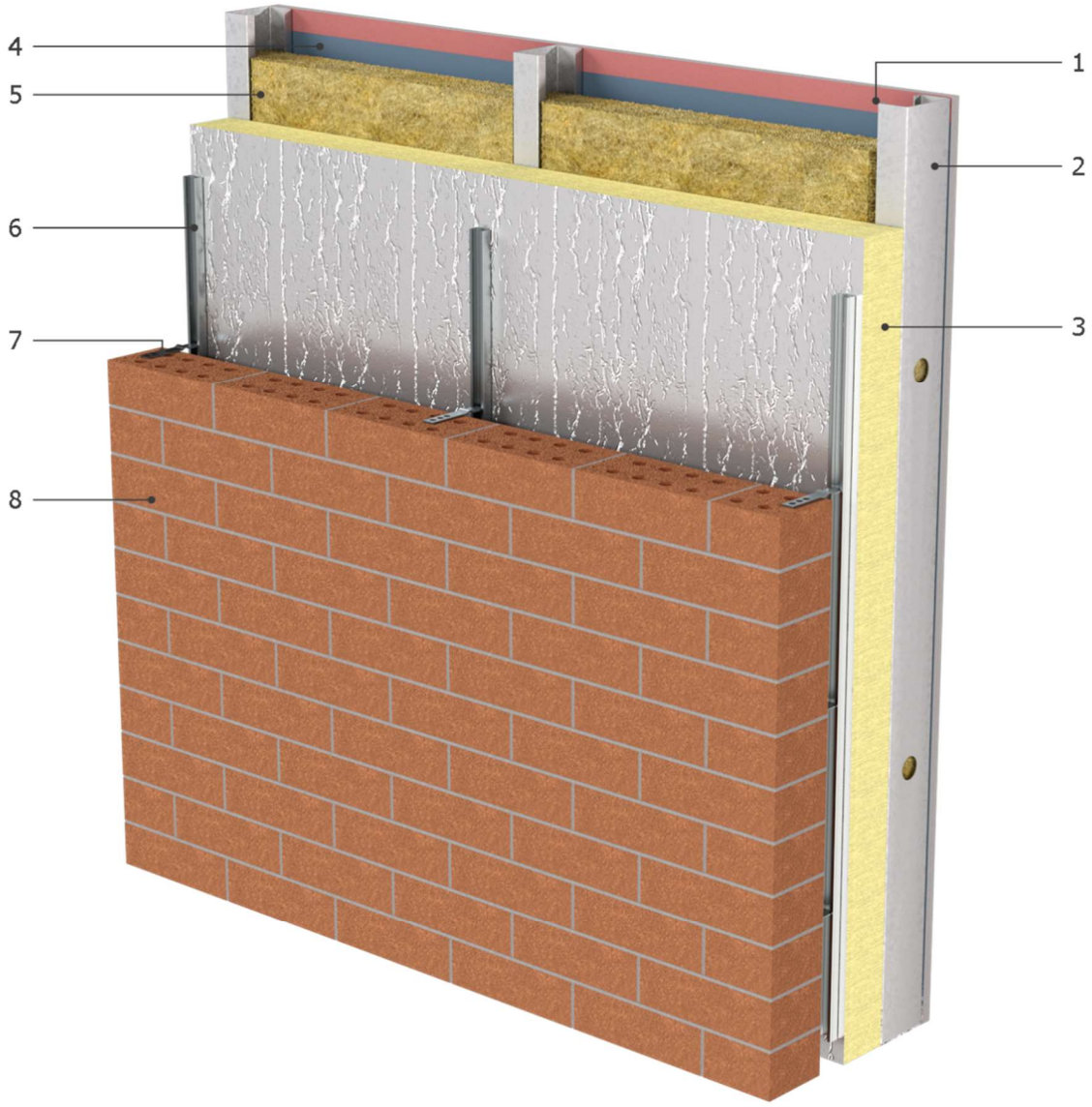
(6) External sheathing board

(7) Stainless steel wall tie channel

(8) Stainless steel wall tie, installed by others

(9) Masonry outer leaf, installed by others

Figure 2 External Wall with Mineral Wool on Sheathing Board and Masonry Outer Leaf – Hybrid Frame



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) Frameform Steel Frame Panel

(3) PIR Insulation Board

(4) AVCL Layer, installed by others

(5) Mineral wool insulation fitted between studs, installed by others

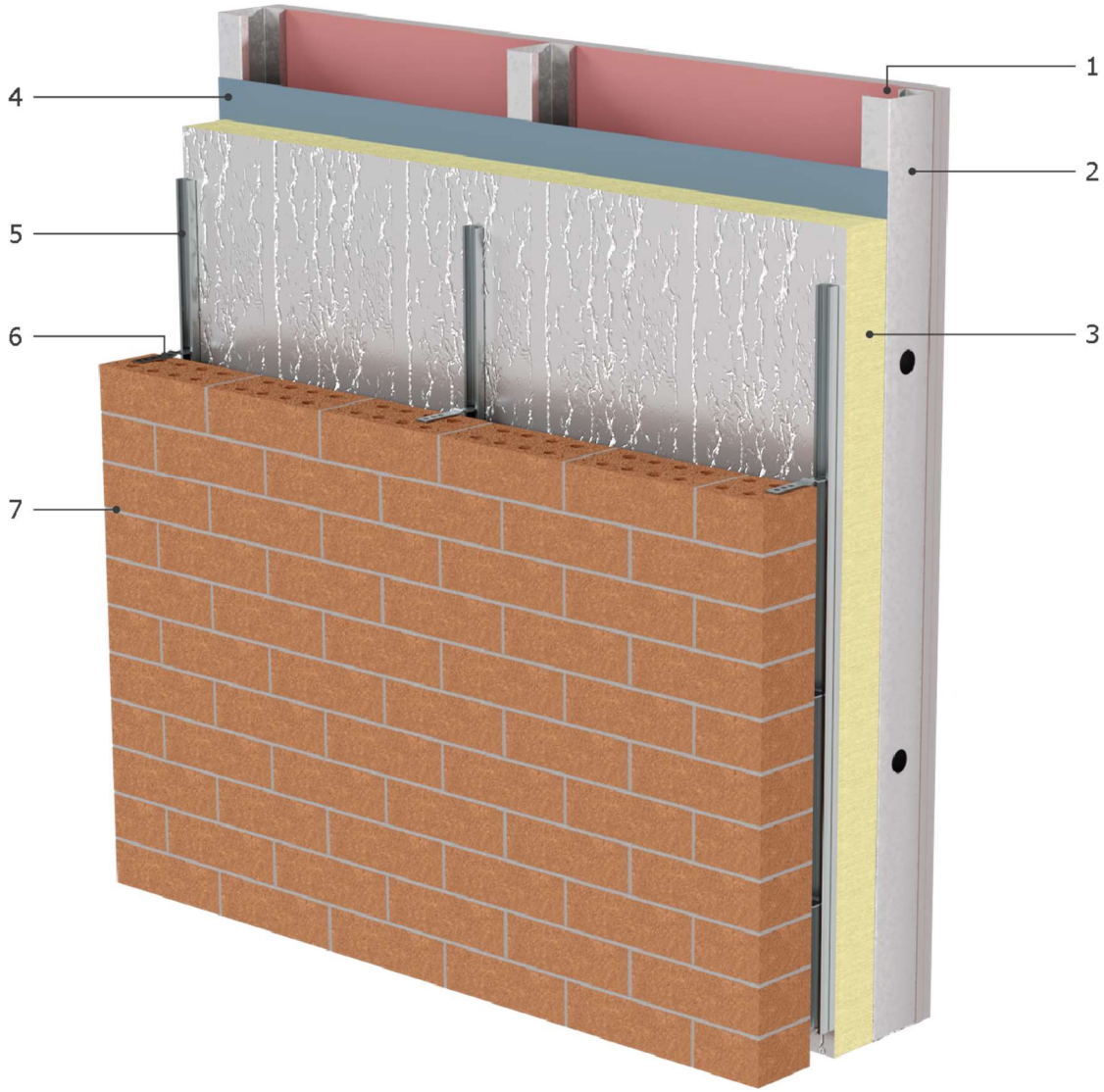
(6) Stainless Steel Wall Tie Channel

(7) Stainless Steel Wall Tie, installed by others

(8) Masonry Outer Leaf, installed by others

Figure 3 External Wall with PIR or Phenolic Insulation and Masonry Outer Leaf – Hybrid Frame

(Note: For walls up to 18m high)



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) Frameform Steel Frame Panel

(3) PIR Insulation Board

(4) AVCL Layer

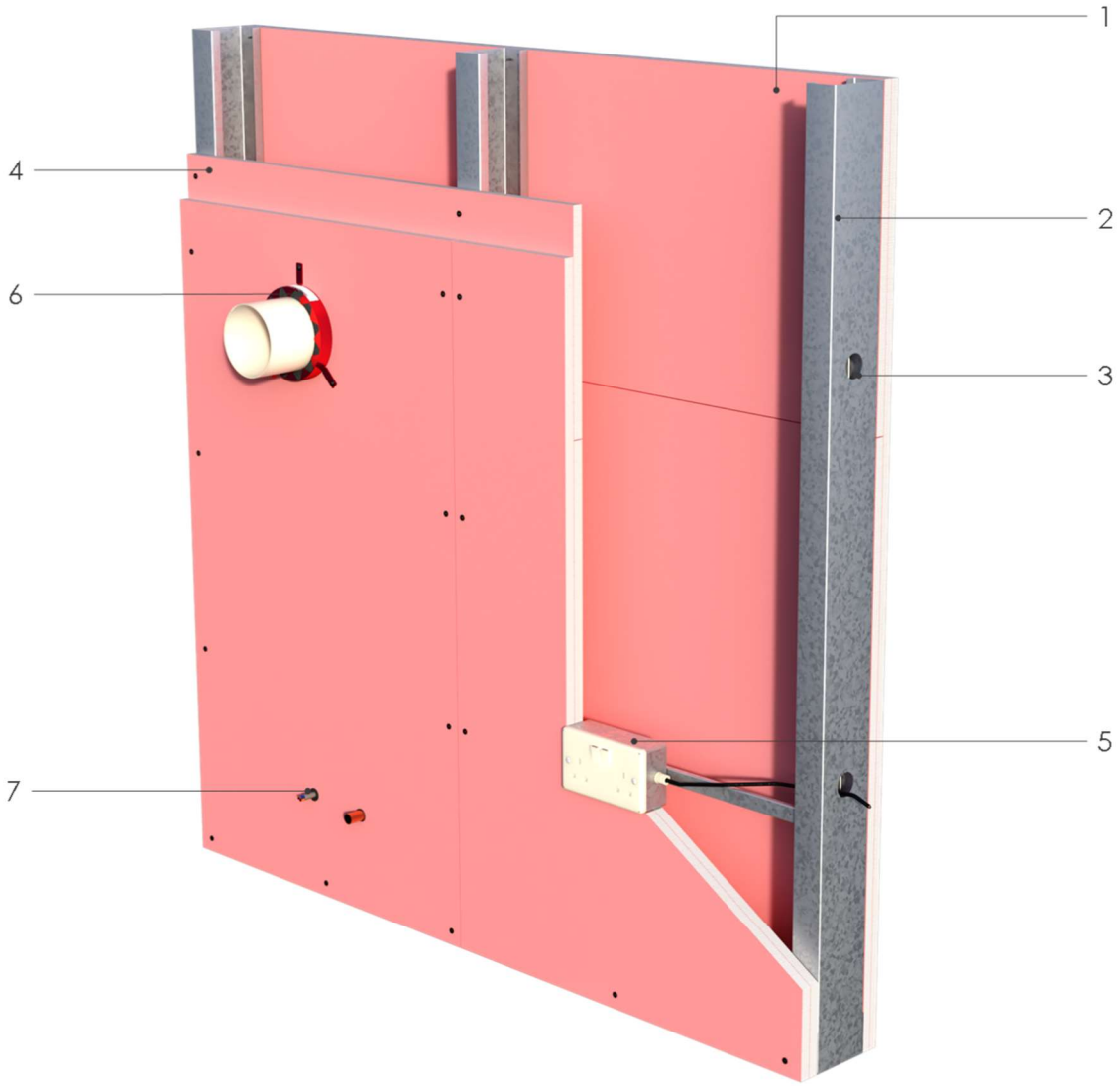
(5) Stainless Steel Wall Tie Channel

(6) Stainless Steel Wall Tie, installed by others

(7) Masonry Outer Leaf, installed by others

Figure 4 External Wall with PIR or Phenolic Insulation and Masonry Outer Leaf – Warm Frame

(Note: For walls up to 18m high)



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) Frameform Steel Frame Panel

(3) Service hole cut out in steel stud

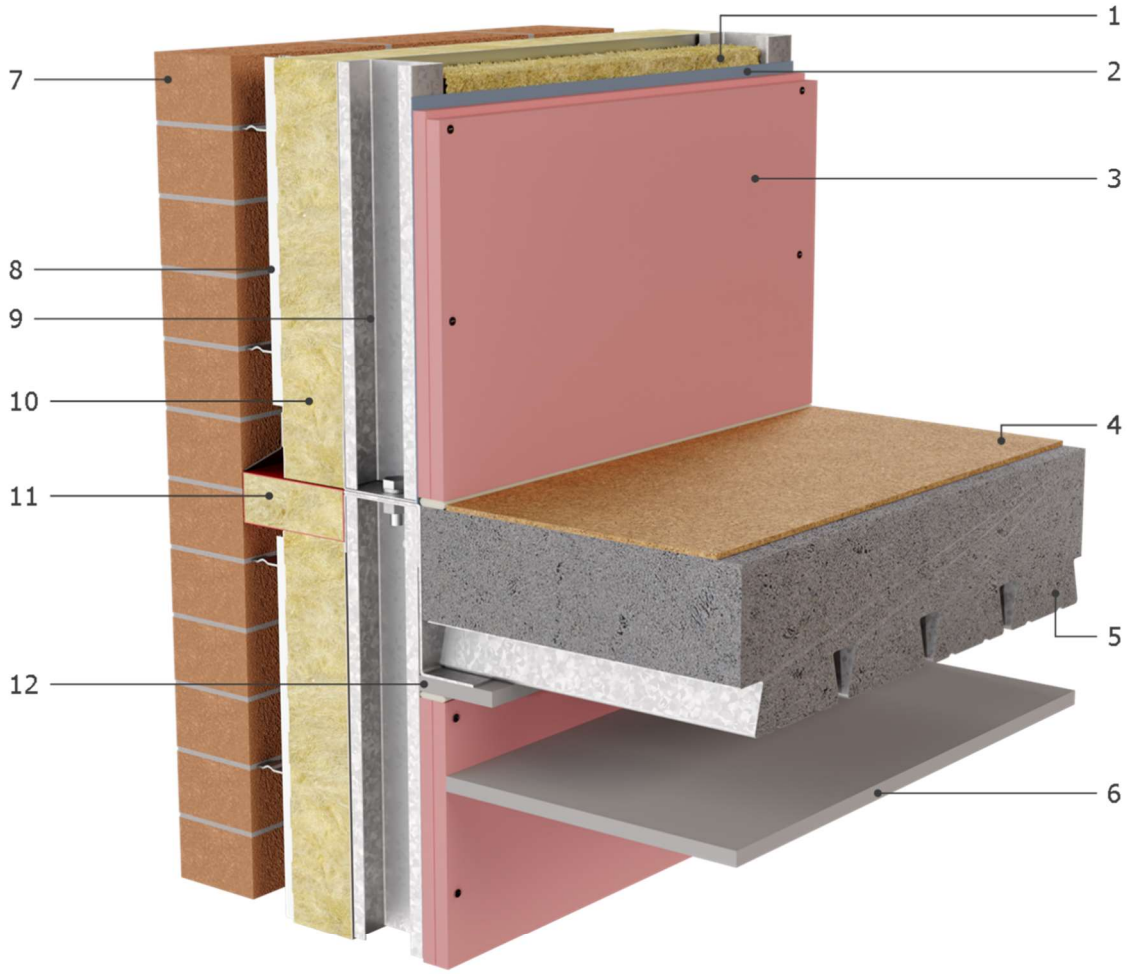
(4) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(5) Electrical Socket with Steel Backing Box, installed by others

(6) Suitably Rated Fire Collar where Service penetrates fire Lining, installed by others

(7) Small Penetrations (<40mm Diameter) to be sealed with Intumescent Sealant

Figure 5 Internal Wall



(1) Mineral wool insulation fitted between steel studs, installed by others

(2) AVCL Layer, installed by others

(3) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(4) Cork Boarding, installed by others

(5) Composite metal decking

(6) Ceiling Board, installed by others

(7) Stainless Steel Wall Tie Channel

(8) Stainless Steel Wall Tie, installed by others

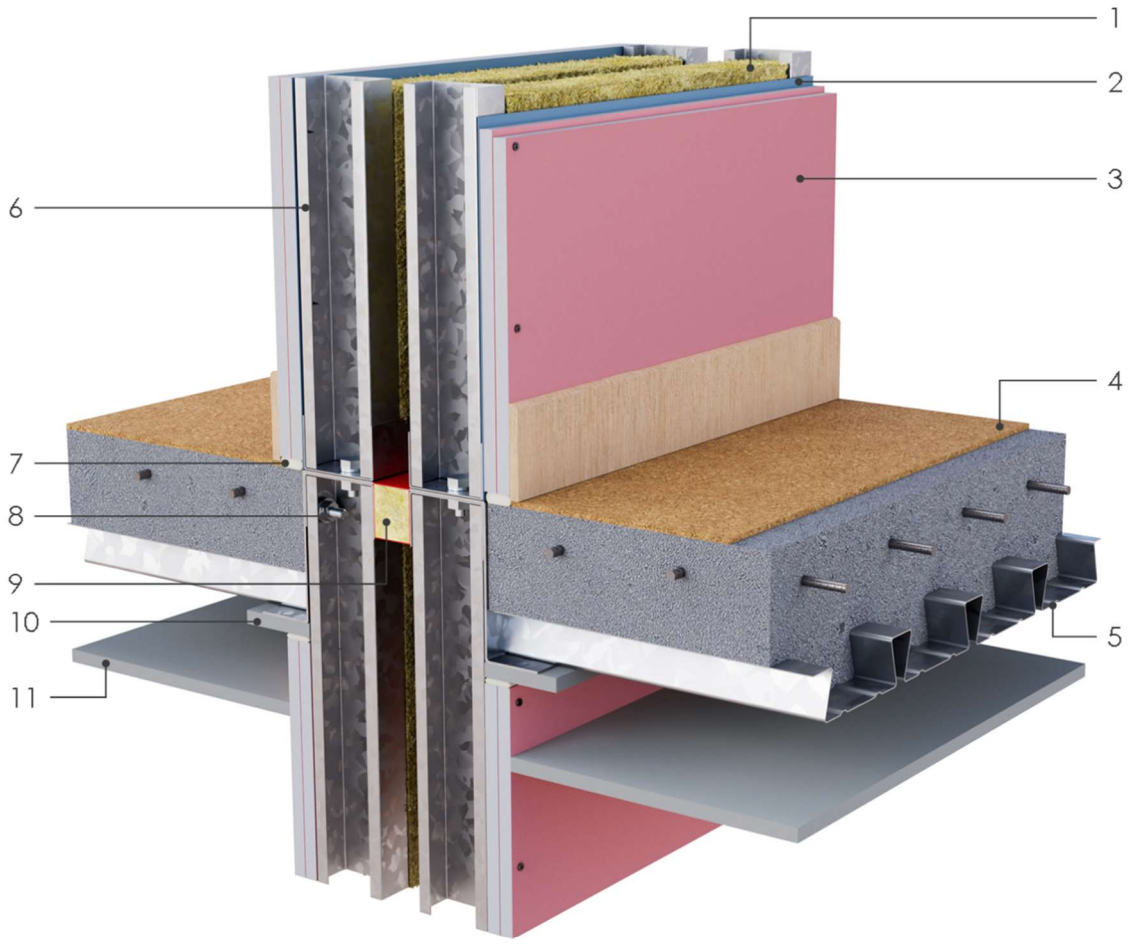
(9) Masonry Outer Leaf, installed by others

(10) External Wall insulation

(11) Cavity Barrier, installed by others

(12) Fire board to underside of Z-Hanger, installed by others

Figure 6 External Wall and Compartment Floor Junction



(1) Mineral wool insulation fitted between steel studs, installed by others

(2) AVCL Layer, installed by others

(3) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(4) Cork Boarding, installed by others

(5) Composite metal decking

(6) FrameForm Steel Frame Panel

(7) Intumescent Acoustic Sealant, installed by others

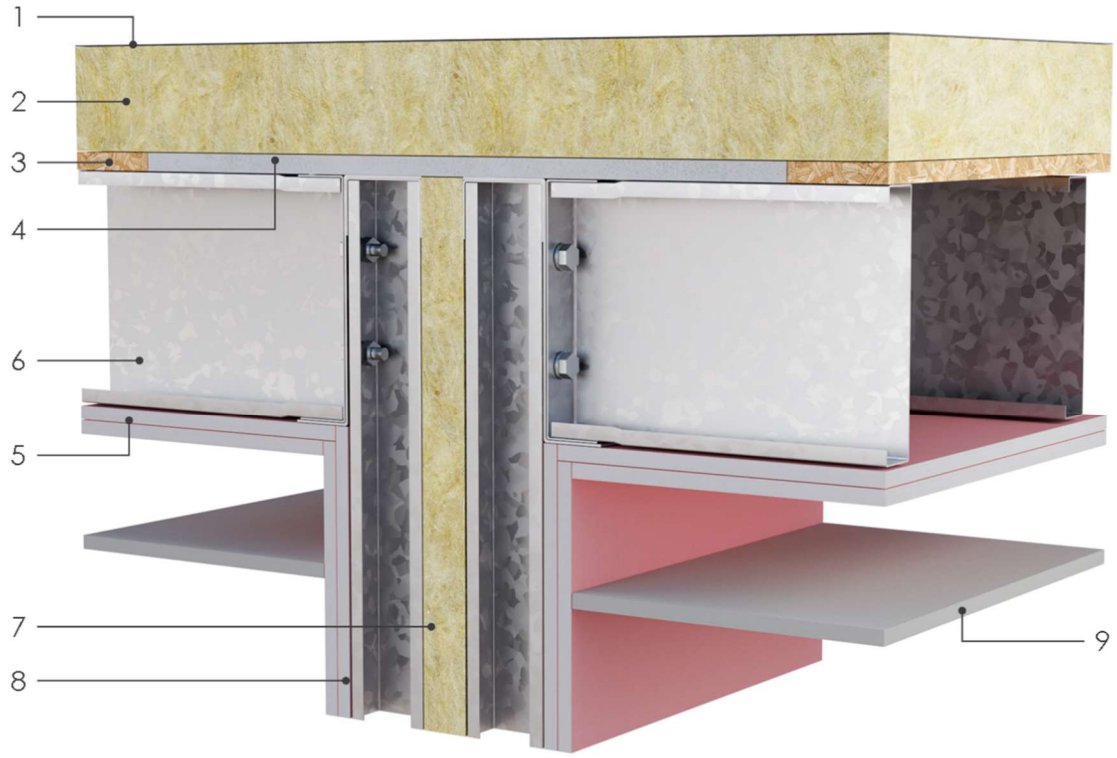
(8) Horizontal Robustness Tie

(9) Cavity Barrier, installed by others

(10) Fire Board to underside of Z-Hanger, installed by others

(11) Ceiling Board, installed by others

Figure 7 Compartment Wall and Compartment Floor Junction



(1) Roof Build-Up, installed by others

(2) External Roof Insulation, installed by others

(3) Roof Boarding Substrate, minimum 18mm OSB3 or Plywood

(4) Cement Board over Party Wall Junction where required

(5) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

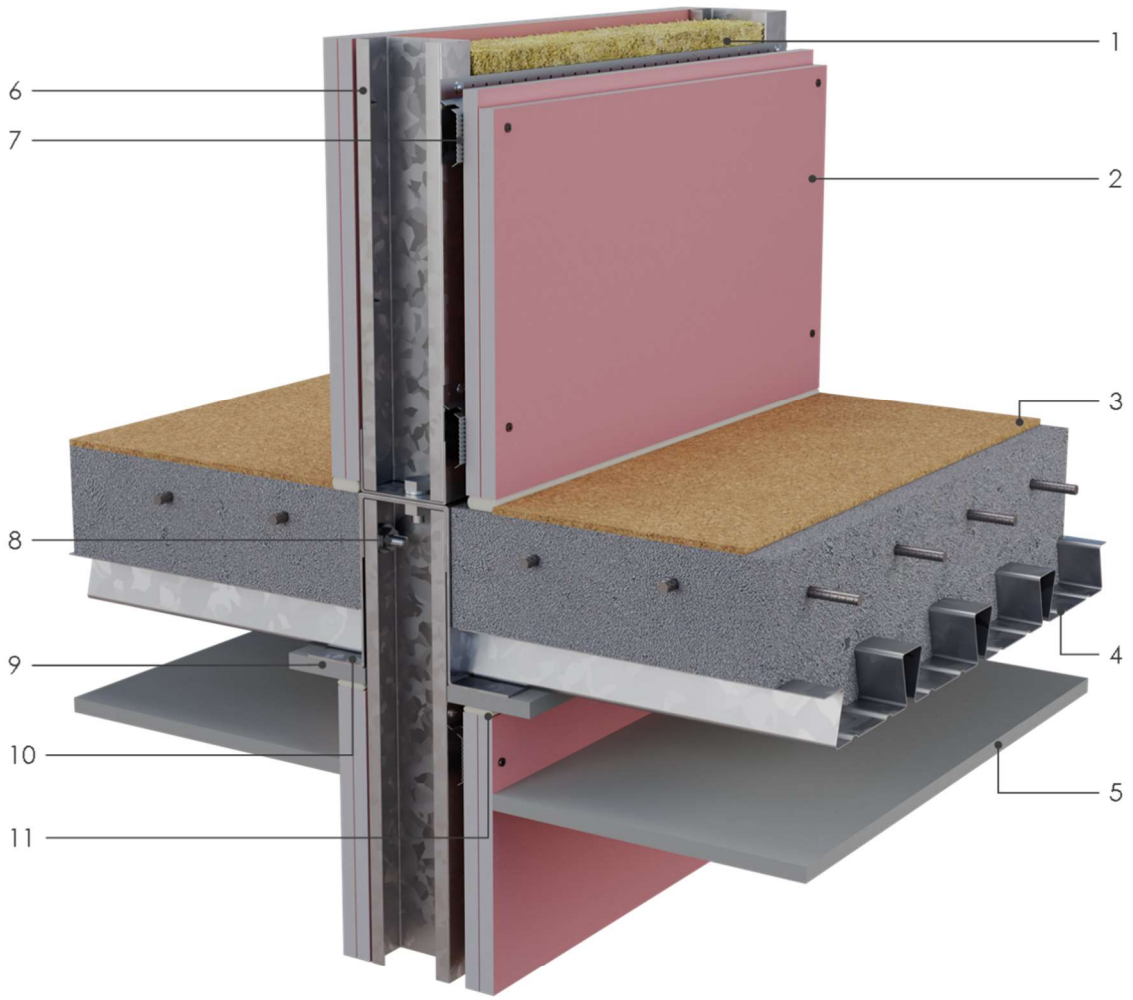
(6) Frameform Steel C-Joist or Lattice Truss Roof Structure

(7) Mineral wool insulation fitted between panels, installed by others

(8) FrameForm Steel Frame Panel

(9) Ceiling Board, installed by others

Figure 8 Compartment Wall and Flat Roof Junction



(1) Mineral wool fitted between studs, installed by others

(2) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(3) Cork Matting, installed by others

(4) Composite metal Deck

(5) Ceiling Board, installed by others

(6) FrameForm Steel Frame Panel

(7) Resilient Bar, installed by others

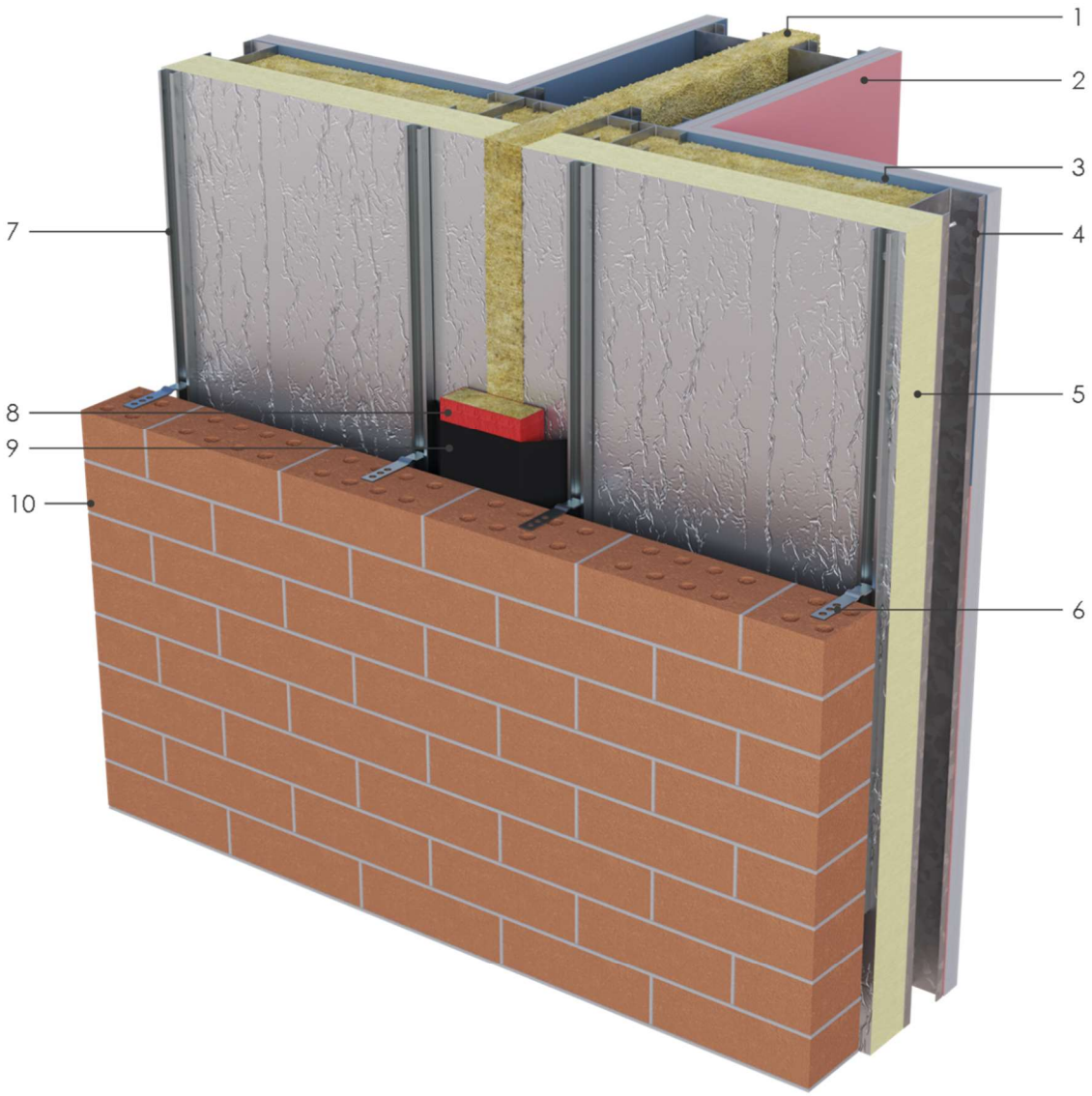
(8) Horizontal robustness tie

(9) Fire board to underside of steel z-hanger, installed by others

(10) Steel Z-Hanger to support Metal Deck

(11) Intumescent acoustic mastic, installed by others

Figure 9 Single Leaf Separating Wall to Compartment Floor Junction



(1) Mineral wool insulation fitted between panels, installed by others

(2) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(3) AVCL Layer, installed by others

(4) FrameForm Steel Panel

(5) External wall insulation

(6) Stainless steel wall tie, installed by others

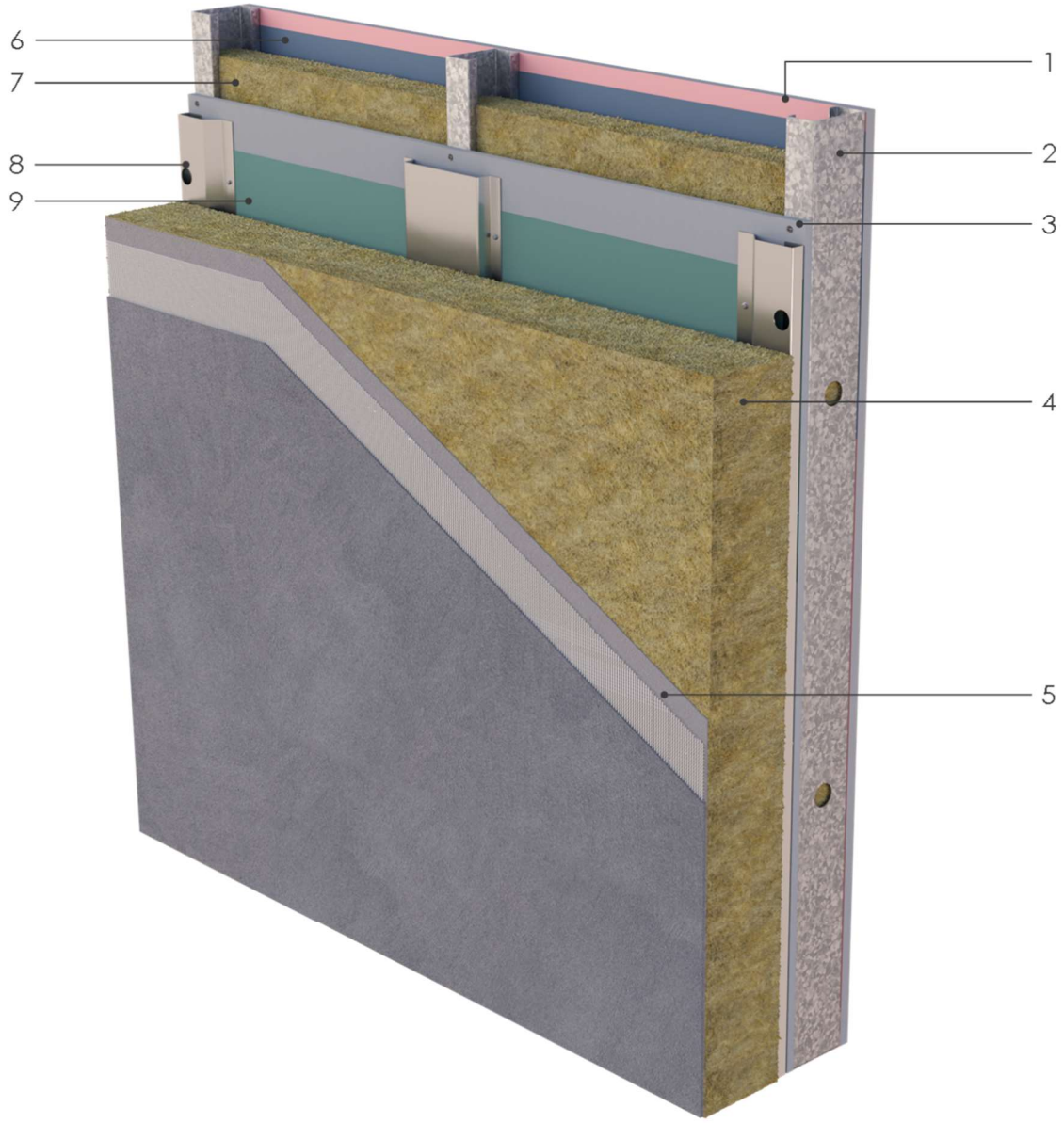
(7) Stainless steel wall tie channel

(8) Vertical Cavity Barrier, installed by others

(9) DPC fitted over cavity barrier, installed by others

(10) External masonry outer leaf, installed by others

Figure 10 External Wall to Compartment Wall Junction



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) FrameForm Steel Frame Panel

(3) Exterior Board as per NSAI Agrément Certified External Wall Insulation System specification

(4) Exterior Mineral Wool Insulation as per NSAI Agrément Certified External Wall Insulation System specification

(5) External render as per NSAI Agrément Certified External Wall Insulation System specification

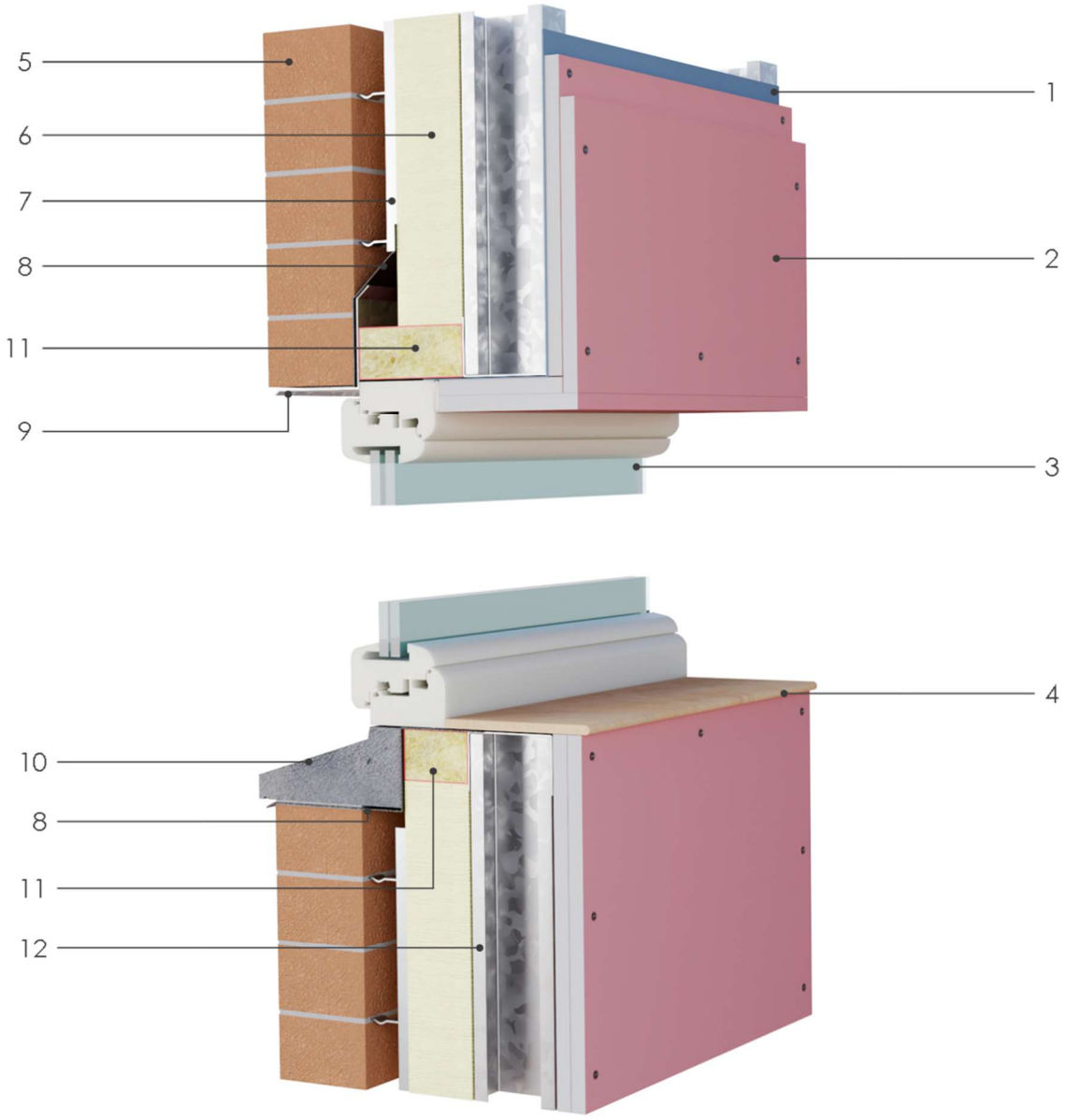
(6) AVCL membrane, installed by others

(7) Mineral wool insulation fitted between studs, installed by others

(8) Render systems vertical rails as per NSAI Agrément Certified External Wall Insulation System specification

(9) Breather membrane as per NSAI Agrément Certified External Wall Insulation System specification

Figure 11 External Wall with Agrément Certified External Wall Insulation Facade System



(1) AVCL Layer, installed by others

(2) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(3) Window fitted into Frame, installed by others

(4) Cillboard, installed by others

(5) External masonry outer leaf, installed by others

(6) External wall insulation

(7) Stainless steel wall tie channel

(8) DPC, installed by others

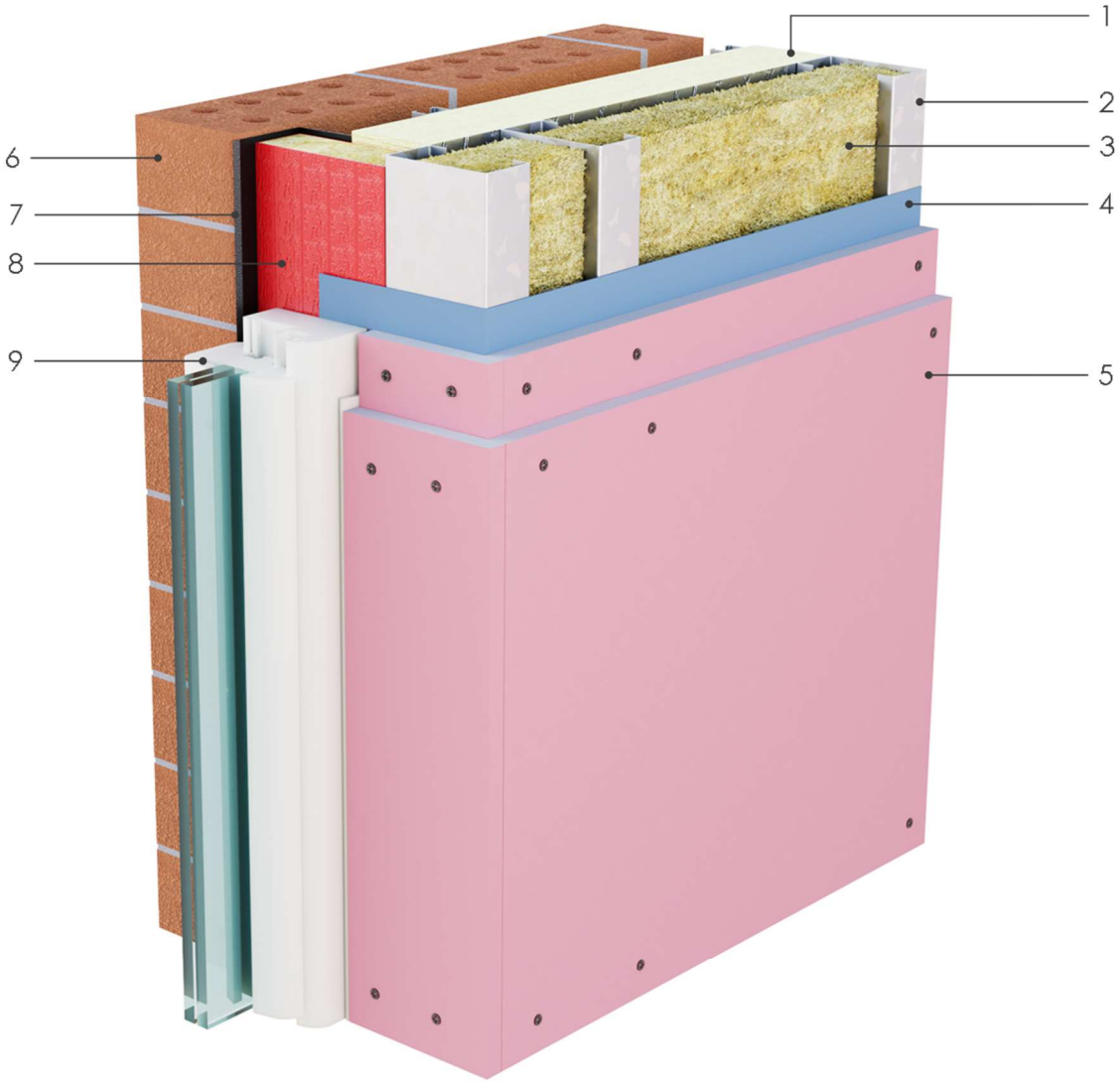
(9) Steel Lintel, installed by others

(10) External Cill, installed by others

(11) Cavity Barrier

(12) FrameForm Steel Frame Panel

Figure 12 Cill and Lintel Junction



(1) External wall insulation

(2) FrameForm Steel Frame Panel

(3) Mineral wool insulation fitted between frames, installed by others

(4) AVCL Layer, installed by others

(5) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

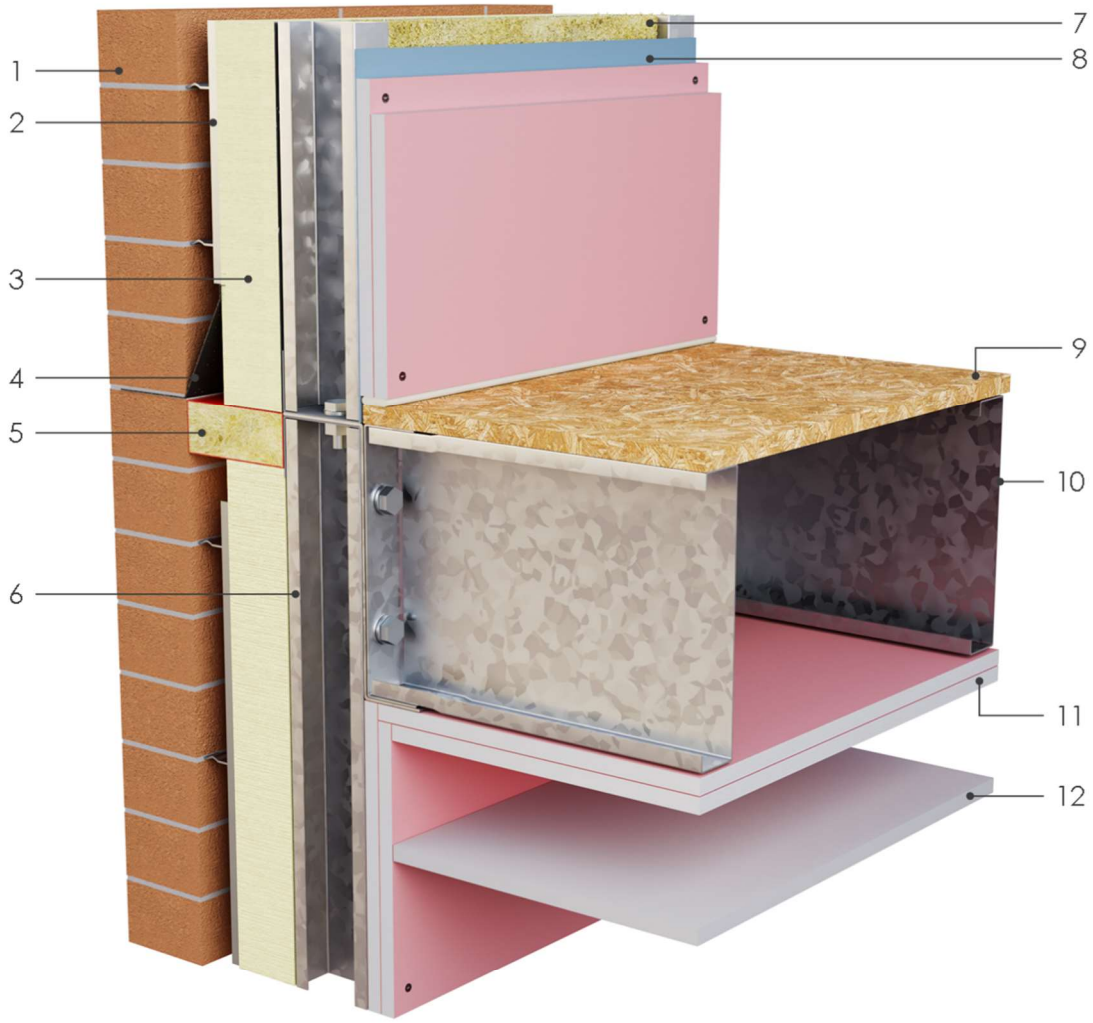
(6) External masonry outer leaf, installed by others

(7) DPC, installed by others

(8) Cavity Barrier

(9) Window fitted within frame, installed by others

Figure 13 Jamb Detail



(1) External masonry outer leaf, installed by others

(2) Stainless steel wall tie channel

(3) External insulation board

(4) DPC layer, installed by others

(5) Cavity Barrier, installed by others

(6) FrameForm steel frame panel

(7) Mineral wool insulation fitted between studs, installed by others

(8) AVCL layer, installed by others

(9) OSB3 or Plywood with a minimum thickness of 18mm

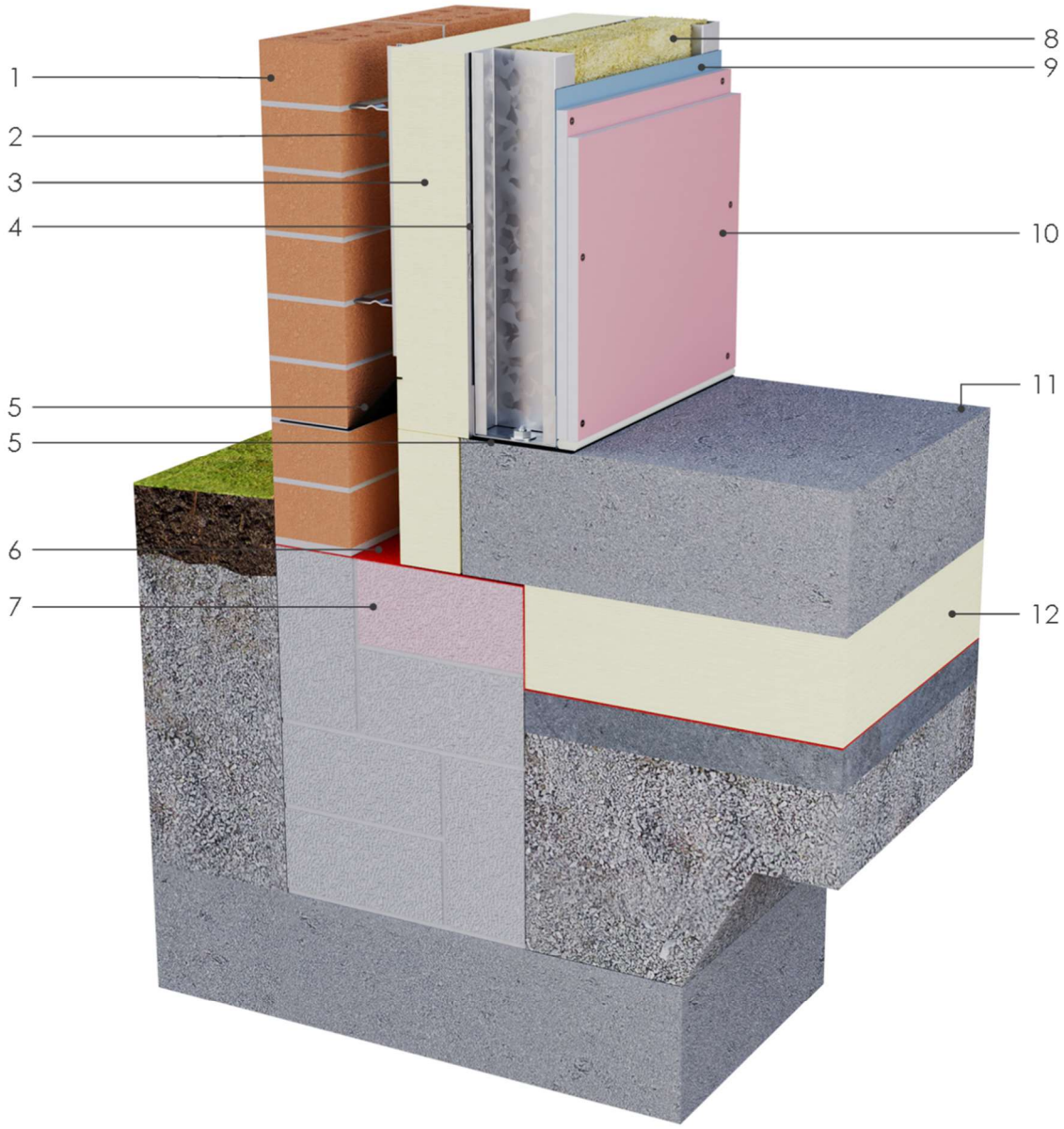
(10) FrameForm Steel C-Joist or Lattice truss

(11) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(12) Ceiling board, installed by others

Figure 14 External Wall and Intermediate Floor Junction

(Note: Floor finishes and acoustic insulation by others)



(1) External masonry outer leaf, installed by others

(2) Stainless steel wall tie channel

(3) External insulation board

(4) FrameForm Steel Frame Panel

(5) DPC layer

(6) Radon Barrier, installed by others

(7) Thermal Block, installed by others

(8) Mineral wool insulation fitted between studs, installed by others

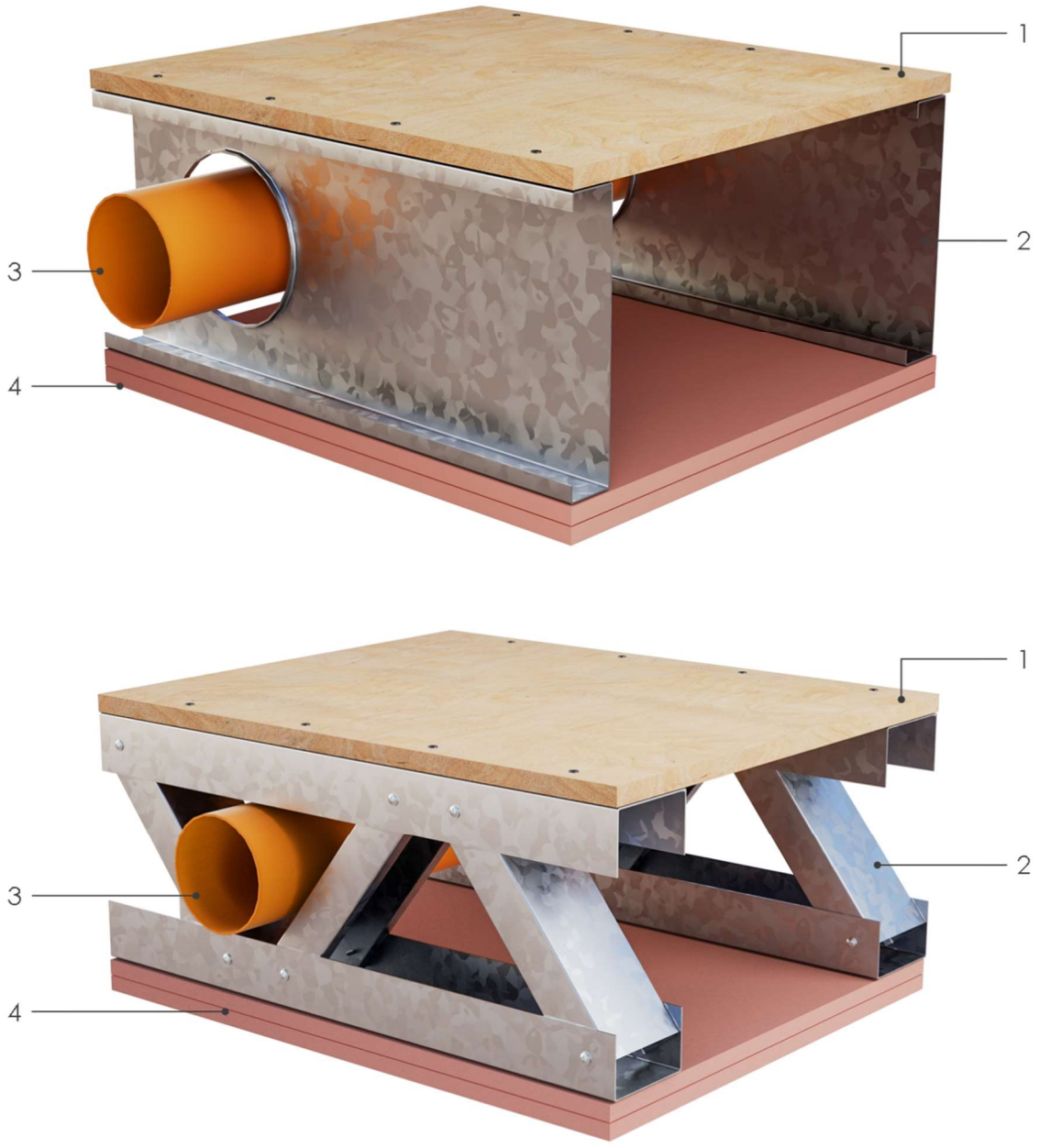
(9) AVCL layer, installed by others

(10) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(11) Ground floor concrete slab, installed by others

(12) Ground floor insulation, installed by others

Figure 15 External Wall and Foundation Junction



(1) OSB3 or Plywood, minimum thickness of 18mm

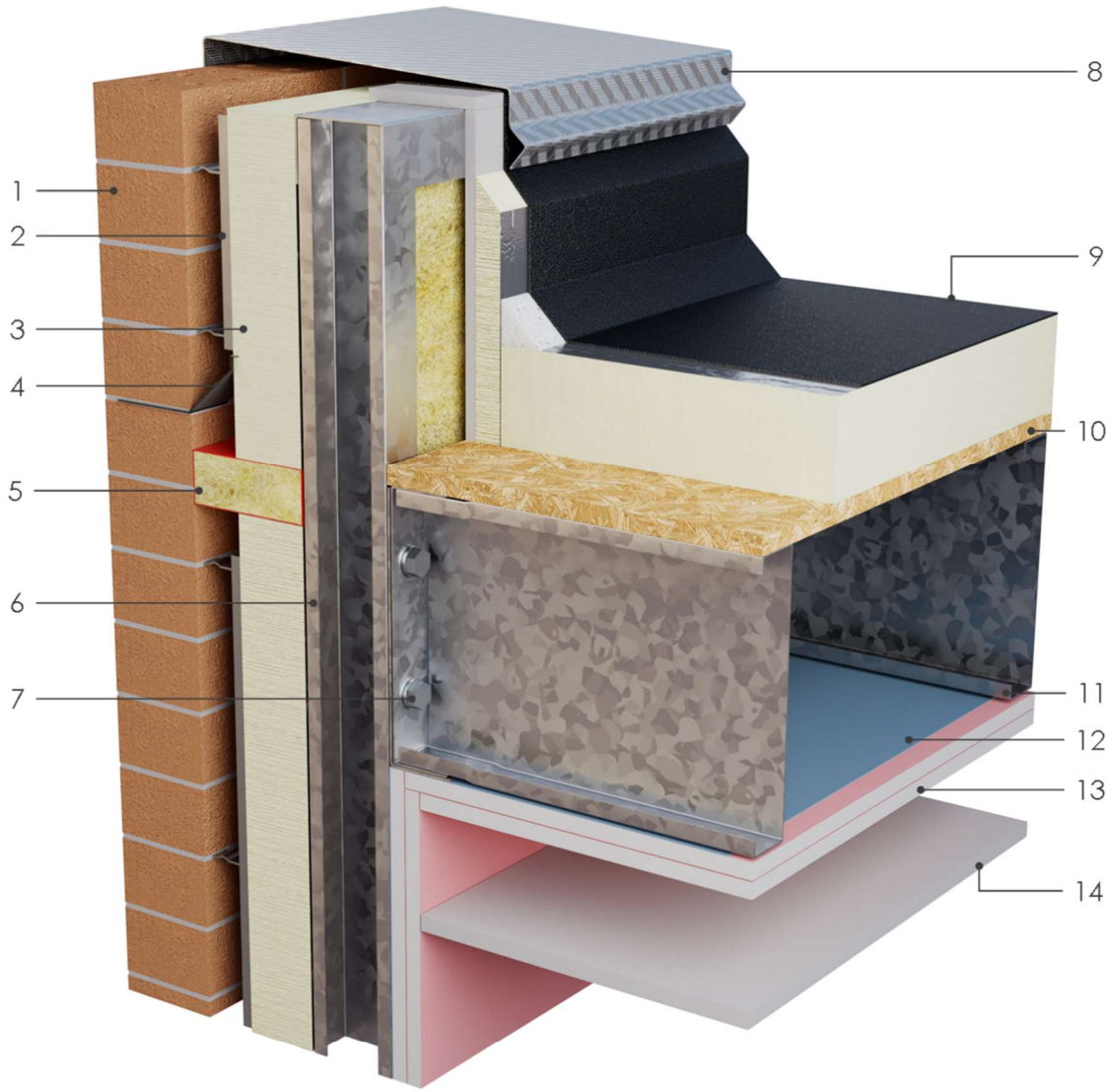
(2) 1.2mm - 3.0mm FrameForm Steel C-joist or lattice floor truss

(3) Services may run trough floor in pre-punched cutouts in C-Joist or between chords in Lattice truss

(4) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

Figure 16 Intermediate Floors Options with Service Penetrations

(Note: Floor finishes and acoustic insulation by others)



(1) External masonry outer leaf, installed by others

(2) Stainless steel wall tie channel

(3) External insulation board

(4) DPC, installed by others

(5) Cavity Barrier, installed by others

(6) FrameForm Steel Panel to form parapet

(7) FrameForm roof joists or trusses bolted to external wall panel

(8) Architectural parapet capping piece, installed by others

(9) Roof build-up, installed by others

(10) OSB3 or plywood, minimum thickness of 18mm

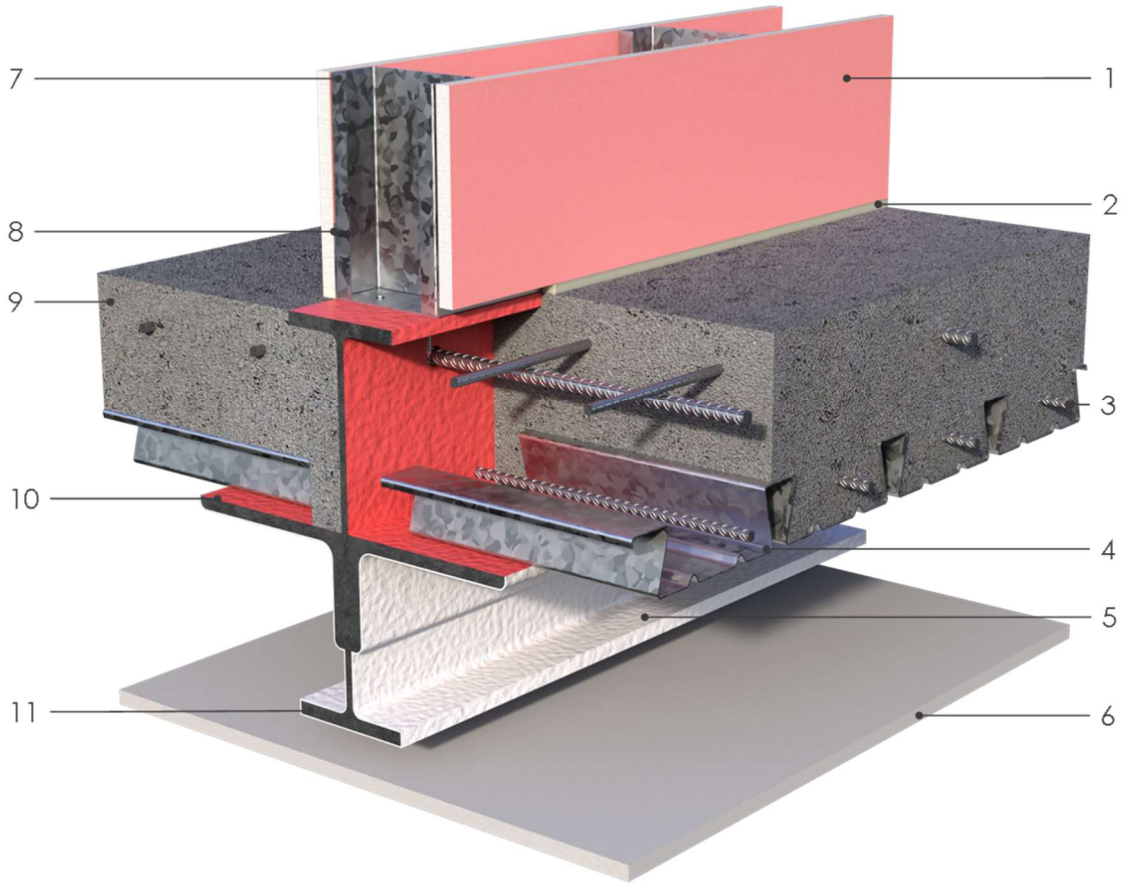
(11) FrameForm Steel C-joist or lattice truss

(12) AVCL layer, installed by others

(13) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(14) Ceiling board, installed by others

Figure 17 Roof Parapet Detail



(1) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(2) Intumescent acoustic mastic, installed by others

(3) Steel reinforcement to engineers specification

(4) Composite metal deck

(5) Intumescent paint to be of sufficient thickness to provide adequate fire protection to exposed beam

(6) Plasterboard ceiling, installed by others

(7) Frameform Steel Panel

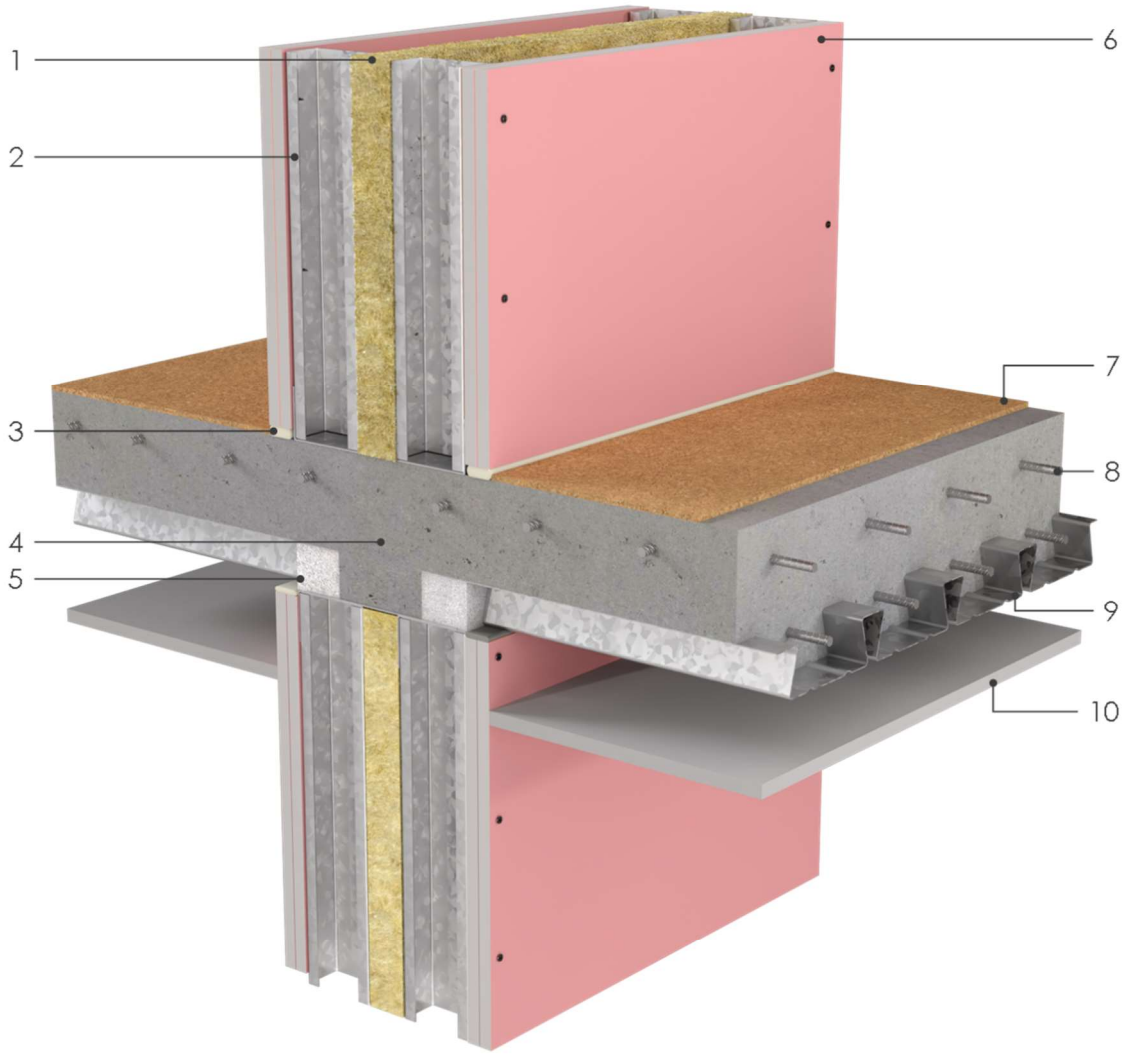
(8) FrameForm Steel bottom track fixed to steel beam

(9) Concrete to engineers specification

(10) Hot roll steel shelf angle welded to steel beam to support composite deck

(11) Hot roll steel beam within floor depth

Figure 18 LGS System and Compartment Floor Supported on Steel Frame



(1) Mineral wool insulation fitted between panels, installed by others

(2) FrameForm steel frame panel

(3) Intumescent acoustic mastic, installed by others

(4) Full concrete infill between compartment floors

(5) Fire resistant infill within voids of metal deck, installed by others

(6) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

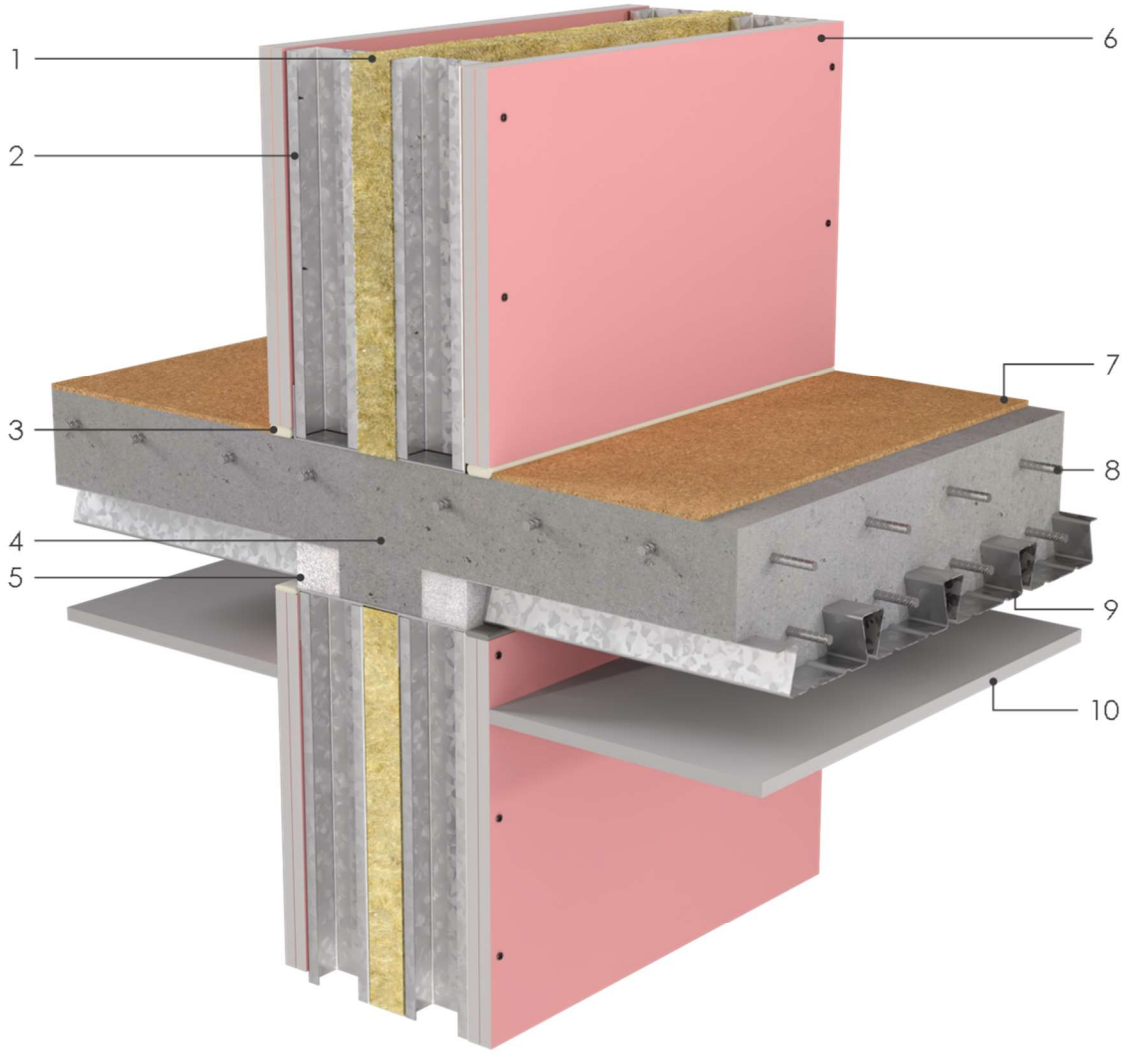
(7) 4-6mm Cork matting, installed by others

(8) Steel reinforcement to engineers specification

(9) Composite metal deck

(10) Ceiling board, installed by others

Figure 19 Compartment Floor Options



(1) Mineral wool insulation fitted between panels, installed by others

(2) FrameForm steel frame panel

(3) Intumescent acoustic mastic, installed by others

(4) Full concrete infill between compartment floors

(5) Fire resistant infill within voids of metal deck, installed by others

(6) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

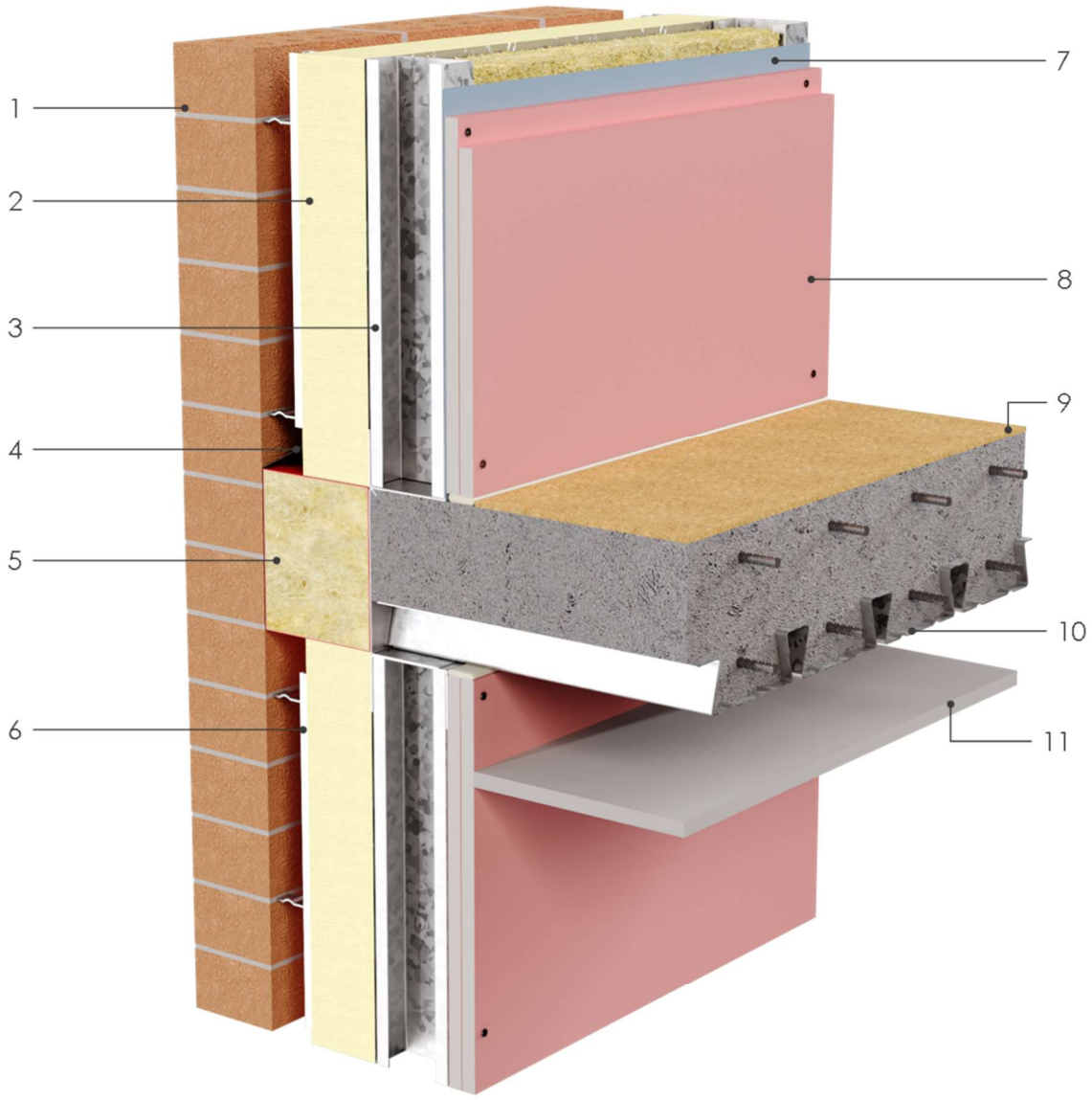
(7) 4-6mm Cork matting, installed by others

(8) Steel reinforcement to engineers specification

(9) Composite metal deck

(10) Ceiling board, installed by others

Figure 20 Compartment Wall Directly Supported on Compartment Wall



(1) External masonry outer leaf, installed by others

(2) External wall insulation

(3) FrameForm steel frame panel

(4) DPC over cavity barrier, installed by others

(5) Full fill cavity barrier, installed by others

(6) Stainless steel wall tie channel

(7) AVCL Layer, installed by others

(8) Type F plasterboard lining to provide adequate protection to steel frame, installed by others and in accordance with this Certificate

(9) 4-6mm Cork matting, installed by others

(10) Composite metal deck

(11) Ceiling board, installed by others

Figure 21 Compartment Floor Directly Supported on External Wall

3.1 STRENGTH AND STABILITY

3.1.1 General

The architectural and engineering design team are responsible for ensuring that architectural drawings and overall building design comply with the Building Regulations. FrameForm Steel, using an experienced chartered structural engineer, are responsible for the structural design of the FrameForm Steel Frame Building System.

3.1.2 Certificate of Structural Compliance

FrameForm Steel are responsible for the design, manufacture, supply, installation, and certification of the system.

3.1.3 Superstructure Design

The design must be in accordance with I.S. EN 1990[13], IS EN 1993-1[7] and Part A to Building Regulations.

The design of a typical building has been examined by the NSAI Agrément and demonstrates compliance with the as above Codes of Practice.

3.1.4 Infill Panels Design

Non-load bearing partitions and walls are designed in conformance with the criteria set out in I.S. EN 1993-1[7], BS 5234-1[14] and I.S. EN 10143[15].

3.1.5 Substructure Design

The design of the building's substructure is outside the scope of this certificate.

3.1.6 Design Loads

During the design process, loads are determined by FrameForm Steel depending on the intended use of the building and client's requirements, using I.S. EN 1991-1 suite and designed with reference to:

- Dead and imposed load to I.S. EN 1991-1-1[16]
- Snow load to I.S. EN 1991-1-3[18]
- Wind loads based on I.S. EN 1991-1-4[17]

Design wind and snow loads should be based on Diagrams 1 and 14 of TGD to Part A of the Building Regulations.

3.1.7 Structural Testing

Where it is required, structural testing can be used to verify the relevant aspects of the structure where the design falls outside the scope of I.S. EN 1993-1-1[7]. No structural testing has been carried out as part of NSAI Agrément certification assessment.

3.2 FIRE

3.2.1 General

Buildings using the FrameForm Steel Frame Building System must be designed to comply with the relevant requirements of TGD to Part B of the Building Regulations.

The building details of the system incorporate suitable cavity barriers and fire stops to satisfy the requirements of Section 3.3 of Volume 1 to TGD B of the Building Regulations. Additional guidance is contained in BS 9991[19] & BS 9999[6].

The FrameForm Steel Frame Building System must be designed with the required boarding specification to meet the minimum requirements of Table A1 and Table A2 of Volume 1 to TGD B of the Building Regulations for all purpose groups to which this certificate applies, and any other building specific structural fire performance requirements.

The system was assessed with external wall that is 1m or more from the relevant boundary as per TGD to Part B of the Building Regulations. It is outside of the scope of this Certificate where the relevant boundary is less than 1m from the external wall.

All roof coverings in conjunction with the system shall be designated AA/B_{ROOF} per Table A5 of TGD to Part B of Building Regulations.

3.2.2 Fire Resistance of Compartment Walls

Table 2 lists the fire resistance tests for non-loadbearing and loadbearing elements, in accordance with I.S. EN 1364-1[22], I.S. EN 1365-1[20] and I.S. EN 1365-2[21]. All fire testing has been carried out with service penetrations in the walls.

Any compartment wall providing fire compartmentation shall be carried up through any roof space and brought up to the underside of the roof cladding to provide adequate fire stopping.

3.2.3 Fire Resistance of Compartment Floor (Steel/Concrete Composite Deck)

The fire resistance of the composite deck is provided from the underside of the deck as detailed in Table 2 of this Certificate. The composite deck can provide up to 90 minutes load bearing fire resistance from a combination of the reinforcement steel bars within the trough of the decking and adequate concrete cover to the

reinforcement steel bars.

All electrical and ventilation services are installed to the underside of the deck. The fire stopping of holes in the composite deck floor slab to accommodate pipes passing through a compartment floor (unless the pipe is in a protected shaft) should comply with Section 3.4 of Volume 1 to TGD Part B of the Building Regulations for all purpose groups to which this certificate relates.

3.3 AIRTIGHTNESS

Airtightness testing is a mandatory requirement of TGD to Part L of the Building Regulations. Testing must be carried out as specified in I.S. EN ISO 9972[23] with additional guidance given in the NSAI's "Certified Air Tightness Tester Scheme Master Document" and clause 1.5.4 of TGD Part L of the Building Regulations.

The air tight tape must be installed as per FrameForm Steel Systems' Installation Manual between external wall and party wall panels and the foundations, external to external wall junctions, external wall to party wall junctions and at roof junction.

3.4 WEATHERTIGHTNESS AND DAMP PROOFING

The system has adequate DPCs and DPMs to resist the passage of moisture. Roof coverings will provide adequate weather resistance when completed in accordance with this Certificate and the manufacturer's instructions.

Buildings constructed using the FrameForm Steel Frame Building System can readily accommodate adequate rainwater gutters and down pipes.

3.4.1 External Cladding

Where the external facade is constructed of a masonry/brick outer leaf it must incorporate a minimum 40mm clear cavity, to minimise the risk of water reaching the cavity face of the inner leaf. The external leaf of the FrameForm Steel Frame Building System can be constructed of traditional brick/block to I.S. 325-1[24] and I.S. EN 1996-1-1[2], or NSAI Agrément approved external cladding system.

Non-traditional facades, certified by NSAI Agrément, can be used within the parameters set out in the scope of their certificate.

3.5 WINDOWS AND DOORS

Windows and doors are outside the scope of this Certificate. However, Figures 11 and 12 give indicative details of how they can be installed to limit heat loss and moisture penetration.

Other considerations for the design of windows and doors include:

- Escape in the event of fire,
- Safety and security,
- Thermal performance.

Note: NSAI's Window Energy Performance (WEP) Scheme gives full details of the energy performance aspects of window systems.

3.6 THERMAL PERFORMANCE

The panels were assessed as a hybrid and warm frame system. In warm frame construction the insulation is outside the frame and in hybrid construction the insulation is included both outside of the steel structure and in between the steel components. The FrameForm LGS building system can be provided for a wide range of required elemental U-values.

Some building elements, namely the roof, ground floor, windows and doors may be site and project specific. Therefore, the U-value of these elements must be calculated before overall compliance with Part L of the Building Regulations can be determined.

TGD Part L of the Building Regulations directs users to Digest 465 "U-values for light steel construction" published by BRE[36]. A more precise result is obtained by using a numerical method which conforms to I.S. EN ISO 10211[25].

3.6.1 Limiting Thermal Bridging

The linear thermal transmittance ψ-value (Psi-value) describes the heat loss associated with junctions and around openings. The certificate holder has carried out ψ-value calculations for a range of thermally bridged junctions as well as used Acceptable Construction Details to meet the requirements of Building Regulations.

The Dwelling Energy Assessment Procedure (DEAP) used to produce the Building Energy Rating (BER) for a dwelling takes account of the total effects of thermal bridging through the input of the "y" value, which is a multiplier applied to the total exposed area of the building.

Where limited provisions are made to eliminate any risk of surface condensation or mould growth, the default "y" value of 0.15 should be taken. When all building junctions are demonstrated to be equivalent to or better than the corresponding Acceptable Construction Details (ACD), then the "y" value can be taken as 0.08.

Alternatively, the transmission heat loss coefficient due to thermal bridging (HTB) can be calculated out by summing up the ψ-values for each junction and multiplying by the linear length of each junction. The "y" value is calculated by dividing HTB by the exposed surface area.

ψ-values for other junctions outside the scope of this certificate should be assessed in accordance with the BRE IP 1/06[26] and BRE Report BR 497[27] in accordance with Appendix D of TGD to Part L of the Building Regulations.

3.6.2 Internal Surface Condensation

As part of the assessment carried out to determine the 'Ψ' values, internal surface temperatures (fRsi) are also checked. When internal surface temperatures (fRsi) are greater than 0.75, best practice will have been adopted to safeguard against the risk of surface condensation occurring under normal occupancy and humidity class levels.

3.7 INTERSTITIAL CONDENSATION

3.7.1 Condensation in Walls

It is recommended to provide an AVCL behind the plasterboard to protection against interstitial condensation. This can be either in the form of a foil backed plasterboard or a continuous AVCL membrane with joints sealed. In situations where an AVCL is omitted, a condensation risk calculation must be provided by the client's design team to assess the build-up proposed, considering the location of the building, the buildings occupancy and purpose class.

3.7.2 Condensation in Roofs

In both cold (insulation at ceiling level) and warm (insulation along the slope) roofs, it is recommended that an AVCL is provided on the warm side of the insulation to limit the migration of moisture laden air from the dwelling, entering the roof structure through diffusion. The AVCL can double as the airtight barrier.

Roof ventilation should be provided in accordance with TGD Part F of the Building Regulations and the recommendations of BS 5250[28].

In the case of cold flat roofs, a cross-ventilated void, not less than 50mm deep, between the slab or deck and insulation should be provided in conjunction with the AVCL being provided on the warm side of the insulation. Ventilation openings should be provided to every roof void along two opposite sides of the roof and should be equivalent in area to a continuous opening of not less than 25mm at each side. It should also be noted that the dimensions of the cross-ventilated void and the ventilation depends on the size of the roof.

In the case of warm flat roofs, the risk of surface condensation is dependent on the nature of the supporting structure. With all flat roofs, there is a risk of interstitial condensation forming between the thermal insulation and the waterproof covering. To avoid this risk, an AVCL should be provided immediately above the supporting structure.

In the case of inverted flat roofs, it is essential that the thermal insulation used resists water absorption and is sufficiently load bearing to support the protective finish of ballast, paving or soil.

3.8 SOUND

3.8.1 Compartment Floor Steel Concrete Composite Deck

The composite deck can meet either the requirements of a Type 1 floor concrete base with a soft covering or a Type 2 Floor concrete base with a floating floor as described in Part E of the Building Regulations.

In both floor types the resistance to airborne sound depends mainly on the mass of the concrete base, plasterboard ceiling and good flanking detailing.

In a Type 1 floor the soft covering reduces the impact sound at source. The impact sound reduction is achieved with the use of a suitable approved layer of soft floor covering. The covering is not intended to be the final finished floor but is intended to act as a resilient layer beneath different floor finishes such as vinyl, carpet, timber flooring, tiles etc.

In the Type 2 floor with a concrete base and a floating layer, the floating layer reduces the transmission of impact sound to the base and to the surrounding construction.

As per TGD Part E to Building Regulation, all building, post completion must be subjected to acoustic testing. In all cases, where applicable, the values achieved for buildings incorporating the FrameForm Steel separating floors design must meet TGD Part E requirements.

3.9 MAINTENANCE

Maintenance will be required at a level comparable with that for buildings of traditional construction. The elimination of wet trades in the construction of the inner leaf of external walls reduces drying time and can reduce the incidence of superficial cracking early in the life of the building.

As the plasterboard is screwed into the steel structure, there is much less likelihood of nail popping in plasterwork, which results in less maintenance of plasterwork, than that of a traditionally constructed building.

Repainting should be carried out in accordance with the relevant recommendations of BS 6150[29]. Timber boarding, fascia, soffits etc. where used, should be treated with an appropriate paint system or translucent stain and should be maintained by periodic re-coating using a paint or stain suitable for external applications, applied in accordance with the manufacturer's instructions.

It shall be the responsibility of the building owner to monitor the condition of the building and commission maintenance and repairs as required. It is envisaged these will be carried out by the building owner in accordance with BS 8210[30].

4.1 BEHAVIOUR IN FIRE

4.1.1 Fire Resistance

Assessment of test results shows that buildings constructed using the FrameForm Steel Frame Building System can meet the Building Regulation requirements in relation to fire resistance as shown in Table 2.

4.2 THERMAL PROPERTIES

Assessment of U-value calculations shows that the FrameForm Steel Frame Building System meets and can exceed the maximum back-stop elemental U-value requirements of Table 1 of TGD Part L of the Building Regulations. Tables 3 – 5 of this certificate gives the various elemental wall U-values in W/m^{2}K with different cladding systems.

4.2.1 Limiting Thermal Bridging

Table 6 of this certificate gives ψ-values for a range of the building system junctions. A full listing of ψ-value calculations, along with the building details on which calculations are based, are contained within the certificate holder's technical data sheets for ψ-values.

Where the junction is covered by Acceptable Construction Details, their ψ-value was taken from Table D5 of the Acceptable Construction Details 2021.

U-values and Ψ-values are to be calculated by an NSAI approved thermal modeller – a register of these can be found at https://www.nsai.ie/certification/agrement-certification/thermal-modellers-scheme/.

4.2.2 Internal Surface Condensation

Table 6 of this Certificate gives internal surface temperature factors (fRsi) for a range of building junctions.

The junctions of the FrameForm Steel Building System have been assessed to comply with the requirements of Section D.2 of Appendix D of TGD Part L of the Building Regulations.

4.3 INTERSTITIAL CONDENSATION

4.3.1 Condensation in Walls

Calculations to BS 5250[28] have been carried out for all external wall build ups as covered by this certificate. They predict no interstitial condensation within the external wall and pass the risk criteria in I.S. EN ISO 13788[31].

4.4 SOUND

4.4.1 Separating Walls

The acoustic performance of the separating wall has been assessed by both on-site testing and comparison with Robust Standard Details for Separating Wall - Steel Frame E-WS-1 and SCI P372[32] and through adopting best practice at salient junctions to minimise the effects of airborne, impact and flanking sound.

The separating wall in the FrameForm Steel Frame Building System has been assessed and when constructed in accordance with this certificate can meet the requirements of TGD Part E of the Building Regulations.

4.4.2 Separating/Compartment Floors

Separating floor build up was assessed using SCI P322[33], TGD Part E to Building Regulations, acoustic calculations and by on-site acoustic testing.

The mass per unit area of the FrameForm Steel Systems' dovetail composite floor structure, finishes and ceilings meet the specification for a Type 1 separating floor when complying with the guidelines in Section 4 of TGD to Part E of the Building Regulations.

4.4.3 Acoustic Testing

Successful on-site acoustic tests were carried out on the FrameForm Steel Frame Building System. The testing included sound insulation tests on separating walls and separating floors in accordance with I.S. EN ISO 16283-1[34] and impact sound insulation to I.S. EN ISO 16283-2[35].

4.5 DURABILITY

The LGS structure has been assessed as capable of achieving a minimum design life of 60 years. The steel structure is constructed from steel members having a minimum 275g/m^2 zinc galvanised coating which will provide adequate protection to the steel members. In addition to this, the steel is kept in a "warmframe" environment, which should prolong the life of the steel.

The DPC and the galvanising will provide adequate protection to ensure that the bottom channel has a life equal to that of the other frame members.

The insulation is durable material and will remain effective as an insulant for the life of the building. The roof, internal wall and ceiling linings and the outer leaf of the external wall are all constructed from conventional durable materials.

4.6 TESTS AND ASSESSMENTS WERE CARRIED OUT TO DETERMINE THE FOLLOWING

- Structural strength and stability (racking resistance, load bearing capacity),
- Behaviour in relation to fire,
- System specific load bearing fire testing to I.S. EN 1365-1[20],
- On-site acoustic performance,
- Thermal insulation performance calculations,
- Desktop study on corrosion of fasteners in normal conditions with a view to a minimum 60-year design life,
- Compatibility with other materials,
- Risk of condensation both surface and interstitial,
- 3D thermal modelling of junction details in accordance with BRE IP 1/06[26].

4.7 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 visit of mock up unit to assess the practicability of installation, constructability and quality control

Table 2: Fire Protection Requirements for Loadbearing Wall, Floor and Ceiling Elements				
Type	**Element:**	**Test Standard**	**Results**	**Purpose Class**
External Load Bearing Walls - Inside to Outside				
1	• Test conducted on 2920mm x 3000mm x 183mm (w x h x th) panel with total vertical load of 42kN • 6 No. LGS C-Studs (89x45x1.2mm) • 90mm stone mineral wool (22kg/m3 density) fitted between studs • Fire side: Single layer of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm long drywall screws at 300mm centres. • Non-fire side: 80mm thick PIR Quinntherm panel fixed to the vertical studs by stainless steel wall tie 1.2mm thick channel and spaced at 600mm ctrs, and screws 110mm long • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	30 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
2	• Test conducted on 2920mm x 3000mm x 196mm (w x h x th) panel with total vertical load of 72kN • 6 No. LGS C-Studs (89x45x1.2mm) • 90mm stone mineral wool (22kg/m3 density) fitted between studs • Fire side: Two layers of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm and 42mm long drywall screws at 300mm centres. • Non-fire side: 80mm thick PIR Quinntherm panel fixed to the vertical studs by stainless steel wall tie 1.2mm thick channel and spaced at 600mm ctrs, and screws 110mm long • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	60 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
3	• Test conducted on 2980mm x 3000mm x 194mm (w x h x th) panel with total vertical load of 78kN • 6 No. LGS C-Studs (89x45x1.2mm) • Air vapour barrier (ABCL Class 1) • Fire side: Two layers of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm and 50mm long drywall screws at 300mm centres • Non-fire side: 80mm thick PIR XTRATHERM panel fixed by Tek screws at 450mm centres • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	60 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

4	• Fire Assessment on 2920mm x 3000mm (w x h) panel with total vertical load of 42kN • 6 No. LGS C-Studs (89x45x1.2mm) • 90mm stone mineral wool (22kg/m3 density) fitted between studs • Fire side: Two layers of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm long drywall screws at 300mm centres. • Non-fire side: 1 No. Layer of 12mm A2 Versapanel Fibre cement board using 38mm long drywall screws at 300mm centres; 20mm Hadley spacer rail, 120mm Rockwool Rainscreen Duo Slab Insulation fixed using 140mm Torque bugle head fixings; Basecoat render with Glass fibre mesh (8mm thick) – NSAI Agremént certified cladding system • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	30 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
5	• Fire Assessment on 2920mm x 3000mm (w x h) panel with total vertical load of 42kN • 6 No. LGS C-Studs (89x45x1.2mm) • 90mm stone mineral wool (22kg/m3 density) fitted between studs • Fire side: Single layer of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm long drywall screws at 300mm centres. • Non-fire side: 1 No. Layer of 12mm A2 Versapanel Fibre cement board using 38mm long drywall screws at 300mm centres; 20mm Hadley spacer rail, 120mm Rockwool Rainscreen Duo Slab Insulation fixed using 140mm Torque bugle head fixings; Basecoat render with Glass fibre mesh (8mm thick) – NSAI Agremént certified cladding system • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	60 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
6	• Fire Assessment on 2920mm x 3000mm (w x h) panel with total vertical load of 72kN • 6 No. LGS C-Studs (89x45x1.2mm) • 90mm stone mineral wool (22kg/m3 density) fitted between studs • Fire side: Single layer of SINIAT GTEC Fireline Type F 15 mm thick using 32mm long drywall screws at 300mm centres. • Non-fire side: 1 No. Layer of 12mm A2 Versapanel Fibre cement board using 38mm long drywall screws at 300mm centres; 20mm Hadley spacer rail, 120mm Rockwool Rainscreen Duo Slab Insulation fixed using 140mm Torque bugle head fixings; Basecoat render with Glass fibre mesh (8mm thick) – NSAI Agremént certified cladding system • 2 No. Double Sockets were fitted on the fire side	I.S. EN 1365-1[20]	90 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

Internal Load Bearing Walls				
7	• Test conducted on a 2920 mm x 3000 mm x 114 mm (w x h x th) test panel with total vertical load of 42kN • 6 No. LGS C-studs (89x45x1.2mm) • Fire side: Single layer of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm long drywall screws at 300mm centres. • Non-fire side: Single layer of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm long drywall screws at 300mm centres. • (2 No. Double Sockets fitted on the fire side) • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) Assessment Report was provided to assess the inclusion of 50mm mineral wool the two steel frames. The inclusion of mineral wool between the studs does not affect as shown fire test result	I.S. EN 1365-1[20]	30 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
8	• Test conducted on a 2920 mm x 3000 mm x 139 mm (w x h x th) test panel with total vertical load of 72kN • 6 No. LGS C-studs (89x45x1.2mm) • Fire side: Two layers of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm and 42mm long drywall screws at 300mm centres. • Non-fire side: Two layers of SINIAT GTEC Fireline Type F 12.5 mm thick using 32mm and 42mm long drywall screws at 300mm centres. • (2 No. Double Sockets fitted on the fire side) • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) Assessment Report was provided to assess the inclusion of 80mm mineral wool between the studs. The inclusion of mineral wool between the studs does not affect as shown fire test result	I.S. EN 1365-1[20]	60 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
9	• Test conducted on a 2920 mm x 3000 mm x 149 mm (w x h x th) test panel with total vertical load of 90kN • 6 No. LGS C-studs (89x45x1.2mm) • Fire side: Two layers of SINIAT GTEC Fireline Type F 15 mm thick using 32mm and 42mm long drywall screws at 300mm centres. • Non-fire side: Two layers of SINIAT GTEC Fireline Type F 15 mm thick using 32mm and 42mm long drywall screws at 300mm centres. • (2 No. Double Sockets fitted on the fire side) • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) Assessment Report was provided to assess the inclusion of 80mm mineral wool between the	I.S. EN 1365-1[20]	90 mins from inside	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

	studs. The inclusion of mineral wool between the studs does not affect as shown fire test result			
Compartment Walls				
10	• Test conducted on 2920mm x 3000mm x 288mm (w x h x th) panel with total vertical load of 90kN • A double steel frame, made of 6 No. LGS C-studs (89x45x1.2mm) at each leaf • Fire side: Two layers of SINIAT GTEC Fireline Type F 15 mm thick using 32mm and 50mm long drywall screws at 300mm centres. • Non-fire side: Two layers of SINIAT GTEC Fireline Type F 15 mm thick using 32mm and 50mm long drywall screws at 300mm centres. • 50mm stone mineral wool (8-10kg/m3 density) fitted between studs • (2 No. Double Sockets fitted on the fire side) • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape) Assessment Report was provided to assess the inclusion of 50mm mineral wool the two steel frames. The inclusion of mineral wool between the studs does not affect as shown fire test result	I.S. EN 1365-1[20]	90 mins from either side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
Non-Load Bearing Walls				
11*	**Internal Non-Load Bearing Partition Wall** Panel dimensions and build up as per No.7: LGS C-Studs (89x45x1.2mm) with 1No. layers of 12.5mm SINIAT GTEC Fireline fixed to each face of the LGS C-	I.S. EN 1365-1[20]	30 mins from exposed side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
12*	**Internal Non-Load Bearing Partition Wall** Panel dimensions and build up as per No.8: LGS C-Studs (89x45x1.2mm) with 2No. layers of 12.5mm SINIAT GTEC Fireline fixed each face of the LGS C-studs with 50mm stone mineral wool insulation between the studs.	I.S. EN 1365-1[20]	60 mins from exposed side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
13*	Panel dimensions and build up as per No.9: LGS C-Studs (89x45x1.2mm) with 2No. layers of 15mm SINIAT GTEC Fireline fixed each face of the LGS C-studs with 50mm stone mineral wool insulation between the studs.	I.S. EN 1365-1[20]	90 mins from exposed side	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
Intermediate floor				
14	**Floor supporting a Uniformly Distributed Load of 1.5kN/m2** • Test conducted on 4600mm x 3000mm x (l x w x h) 280.5mm thick floor with a uniformly distributed load of 1.5kN/m^2 • 9 No. LGS floor C-Joists 250mm deep x 65mm x 2mm thick at 400mm nominal centres • Fire side:: 1No. layers of 12.5mm SINIAT GTEC Fireline Type F fixed on fire side face using GTEC Self Drilling coated steel screws 3.5x32mm at 200mm max centres • Non-fire side:1No. layer of OSB 18mm thick (SMARTPLY OSB) • On the exposed side only, every junction and screw heads of the last layer were treated by a	I.S. EN 1365-2[21]	30 mins from below ceiling level **	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

	joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape)			
15	**Floor supporting a Uniformly Distributed Load of 2.0kN/m2** • Test conducted on 4600mm x 3000mm x (l x w x h) 293mm thick floor with a uniformly distributed load of 2.0kN/m^2 • 9 No. LGS floor C-Joists 250mm deep x 65mm x 2mm thick at 400mm nominal centres • Fire side:: 2No. layers of 12.5mm SINIAT GTEC Fireline Type F fixed on fire side face using GTEC Self Drilling coated steel screws 3.5x32mm and 3.5x42mm at 200mm max centres • Non-fire side:1No. layer of OSB 18mm thick (SMARTPLY OSB) • On the exposed side only, every junction and screw heads of the last layer were treated by a joint filler (GTEC Joint Filler) bonded to a joint tape (GTEC Joint Tape)	I.S. EN 1365-2[21]	60 mins from below ceiling level **	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
Compartment floors: Loaded Floors Composite Metal Deck				
16	**Loaded Floor supporting Imposed Load of 2.0kN/m^2** 160mm normal weight concrete with 1.0mm dovetail metal deck. Concrete reinforced with 2xA252 Mesh and rebar in each trough (minimum 25mm cover to the top of the reinforcing mesh). 4600mm span. (additional build up required to meet acoustic requirements)	Eurocode Design	60 mins from below deck **	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5
17	**Loaded Floor supporting Imposed Load of 2.0kN/m^2** 160mm normal weight concrete with 1.0mm trapezoidal metal deck. Concrete reinforced with 1xA193 Mesh and rebar in each trough (minimum 25mm cover to the top of the reinforcing mesh). 4600mm span. (additional build up required to meet acoustic requirements)	Eurocode Design	60 mins from below deck **	1(a), 1(b), 1(c), 1(d), 2(a), 2(b), 3, 4(a) and 5

Notes:

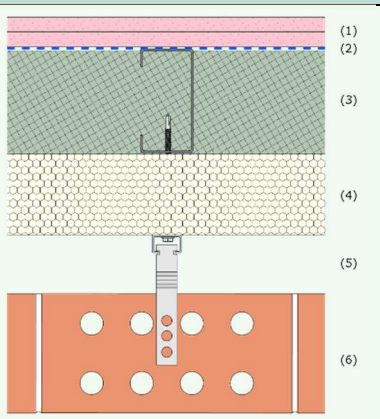
- The above build-ups are summaries of those tested to the referenced standards – they should not be taken as an exhaustive list. For full details of test reports, the Certificate holder should be contacted.
- For alternative approaches to fire safety requirements, refer to 0.2 of TGD B 2006 of the Building Regulations.
- In situations where there is no fire requirement for non-loadbearing walls, alternative non-loadbearing wall boarding specifications can be used once they have been agreed and signed off on by FrameForm Steel Systems Ltd where the boarding supplier has provided supporting fire test data.

* Non-load bearing wall fire resistance data is provided from the load bearing data and can be utilised under the Field of Direct Application whereby the load can be decreased on the specimen.

**Design to be dictated by project specific loading requirements on a case by case basis to meet the requirements of Part B of Building Regulations

Table 3: External walls U-value for variable PIR thickness – Hybrid Frame

Wall build-up:
Layer 6: Brick/masonry cladding
Layer 5: 50mm cavity
Layer 4: Variable PIR layer [2][3] (see below)
Layer 3: LGS/MW insulation (100mm)
Layer 2: Polythene, VCL and Air leakage barrier
Layer 1: 12.5mm Siniat GTEC Fireline (1No. layer)



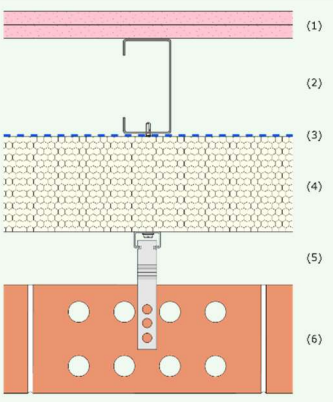
Wall thickness	PIR variable thickness:	Calculated U-value (W/m²K)
355.5mm	90mm	0.15
345.5mm	80mm	0.16
325.5mm	60mm	0.18

Calculation complies with BRE Digest 465 *U-values for light steel-frame construction.*
[1] Corrections have been made for 1.2mm LGS studs @ 600mm c/c bridging layer 3.
[2] A level 0 correction for air voids has been applied to layer 4 (IS EN ISO 6946 Table D.1)
[3] Correction for mechanical fasteners have been applied to layer 4 equating to 5 No. 4.0mm Ø Stainless steel fixing to connect brick tie channel to LGS section.

Note: All U-value calculations illustrated in the above U-value tables should be taken as examples of performance that can be achieved. It is strongly recommended that U-value calculations are produced on a project specific basis by a competent person as U-value calculations may increase or decrease depending on a wide range of parameters such as number of fixings per square meter, size of fixing, emissivity of PIR surface facing into cavity etc. therefore U-values should be recalculated if the build-ups differ from those described in the Table 3.

Table 4: External walls U-value for variable PIR thickness – Warm Frame

Wall build-up:
Layer 6: Brick/masonry cladding
Layer 5: 50mm cavity
Layer 4: Variable PIR layer [2][3] (see below)
Layer 3: Polythene, VCL and Air leakage barrier
Layer 2: Airspace with LGS (100mm)
Layer 1: 12.5mm Siniat GTEC Fireline (2No. layers)



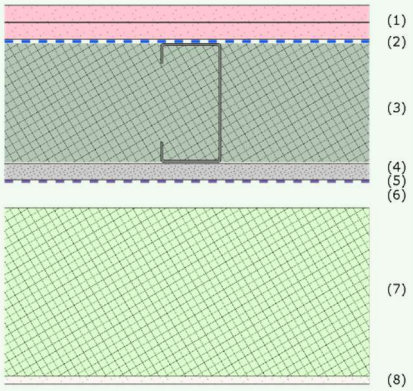
Wall thickness	PIR variable thickness:	Calculated U-value (W/m²K)
398.0mm	120mm	0.14
388.0mm	110mm	0.15
368.0mm	90mm	0.18

Calculation complies with BRE Digest 465 *U-values for light steel-frame construction.*
[1] Corrections have been made for 1.2mm LGS studs @ 600mm c/c bridging layer 2.
[2] A level 0 correction for air voids has been applied to layer 4 (IS EN ISO 6946 Table D.1)
[3] Correction for mechanical fasteners have been applied to layer 4 equating to 5 No. 4.0mm Ø Stainless steel fixing to connect brick tie channel to LGS section.

Note: All U-value calculations illustrated in the above U-value tables should be taken as examples of performance that can be achieved. It is strongly recommended that U-value calculations are produced on a project specific basis by a competent person as U-value calculations may increase or decrease depending on a wide range of parameters such as number of fixings per square meter, size of fixing, emissivity of PIR surface facing into cavity etc. therefore U-values should be recalculated if the build-ups differ from those described in the Table 4.

Table 5: External walls U-value for variable external wall insulation system

Wall build-up:
Layer 9: 7mm render
Layer 8: Insulation – mineral wool (see below)
Layer 7: 20mm cavity
Layer 6: Carrier board
Layer 5: Breather membrane
Layer 4: LGS/MW insulation (89mm)
Layer 3: Polythene, VCL and Air leakage barrier
Layer 2: 15mm Gyproc Board
Layer 1: 3mm skimcoat



Wall thickness	Mineral wool variable thickness:	Calculated U-value (W/m²K)
296mm	120mm	0.21
326mm	150mm	0.18
346mm	170mm	0.15

Calculation complies with BRE Digest 465 *U-values for light steel-frame construction.*
(1) Corrections have been made for 1.2mm LGS studs @ 600mm c/c bridging layer 3.
(2) A level 0 correction for air voids has been applied to layer 7 (IS EN ISO 6946 Table D.1)

Note: All U-value calculations illustrated in the above U-value tables should be taken as examples of performance that can be achieved. It is strongly recommended that U-value calculations are produced on a project specific basis by a competent person as U-value calculations may increase or decrease depending on a wide range of parameters such as number of fixings per square meter, size of fixing, emissivity of PIR surface facing into cavity etc. therefore U-values should be recalculated if the build-ups differ from those described in the Table 5.

Table 6: Sample U-value Calculation for 60mm PIR – Hybrid Frame

Layer	Description	% Bridged	Thickness [mm]	Thermal conductivity **λ** [W/m K]	Thermal resistance **R** [W/m²K]
	Rsi				0.13
1	Siniat GTEC Fireline		12.5	0.24	0.052
2	VCL and air leakage barrier		-	-	-
3	Steel Stud with Mineral Wool	0.002	100	0.038	2.6
4	PIR		60	0.022	2.700
5	Cavity		50		0.665
6	Brickwork Outer Leaf		103	0.77	0.134
	Rse				0.04

	Ru Total =	6.308	
	RL Total =	4.439	
From BRE Digest 465	P = 0.643, $R_T = pR_{max} + (1 - p)R_{min}$ =	5.64	
	Correction term, ΔU =	0.006	
	Corrected U-Value (2DP) =	**0.18**	W/m²K

Correction as described in Table 3 apply.

Table 6: Typical ψ-Value W/mK			
Target linear thermal transmittance (ψ) for different types of junctions.			
Ref:	**Junction Description**	**Temperature Factor f_{Rsi} (Min = 0.75)**	**FrameForm Ψ-value (W/m.K)**
1	Typical foundation detail (Figure 14)	0.89	0.192
2	Timber roof truss to external wall detail (Eaves)	0.93	0.053
* Flanking element U-values for walls, roof and floor thermal models above were based on U_W = 0.16 W/m^{2}k, U_F = 0.13 W/m^{2}k, U_R = 0.10 W/m^{2}k. * Modelled junction ψ-values are based on typical FrameForm Steel Systems' details above can be used in y-value calculations, if relevant detail is applicable.			
Refer to Table D5 of the Acceptable Construction Details 2021 for other junctions.			

Table 7: Acoustic results *				
Separating construction	**Airborne sound insulation DnT,w dB**		**Impact sound insulation L'nT,w dB**	
	Performance Target	**Result**	**Performance Target**	**Result**
Walls (compartment wall as per Table 2, item 9)	≥53dB DnT,w	60-66	N/A	N/A
Floors (compartment floor as per Table 2, item 15)	≥53dB DnT,w	61-65	≤58dB L'nT,w	40-45
* The results above were obtained from on-site project specific testing, Results may vary based on project specific conditions but must always meet or exceed TGD Part E performance requirements.				

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 IAB 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.

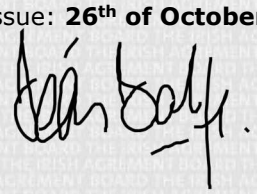
5.7 Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is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

NSAI Agrément

This Certificate No. **22/0432** is accordingly granted by the NSAI to **FrameForm Steel Systems Ltd** on behalf of NSAI Agrément.

Date of Issue: **26th of October 2022**

Signed



Seán Balfe
Director of NSAI Agrément

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

NSAI Agrément

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