

DAU

22/130 A

Document of assessment of fitness for use (DAU)

Trade name

4wall SIP System

Generic type and use

Load-bearing wall system with prefabricated sandwich panels with a polyurethane foam core and magnesium oxide boards on the outside.

Holder of DAU

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| A | 18.07.2022 | Creation of the document. |

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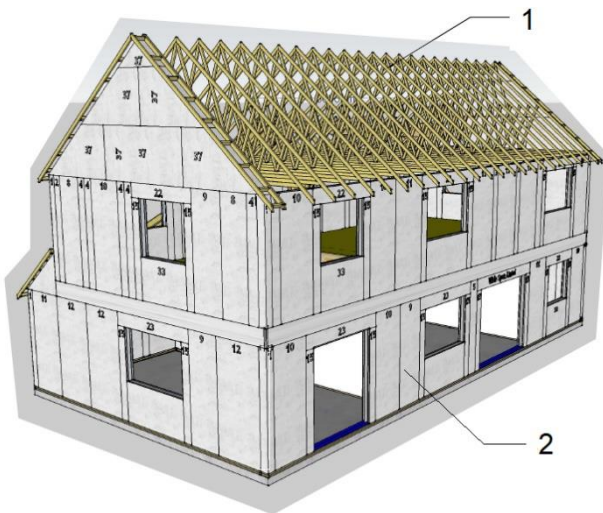
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1. Description of the system and intended uses

1.1. Definition of the construction system

4wall SIP is a modular system for the construction of load-bearing walls (facades and interior walls) made up of prefabricated sandwich panels with a polyurethane foam core, magnesium oxide boards and metal profiles around its entire perimeter. The 4wall SIP system is completed on site with magnesium oxide splines in the vertical joints between panels and soleplates and headbinders of 1 mm thick galvanized steel.

Figure 1.1 shows an example of a building built with the 4wall SIP system.



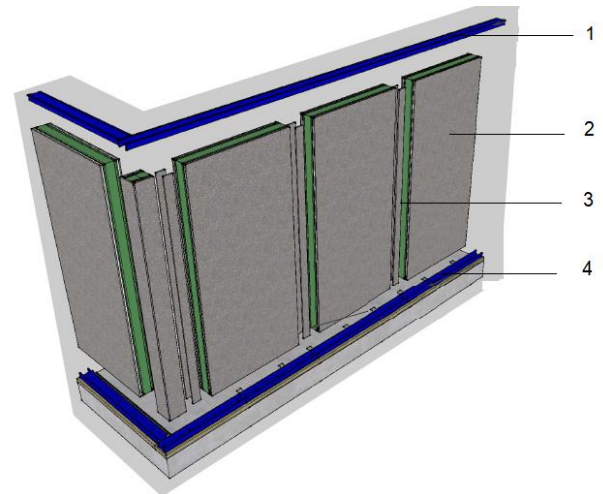
Key:

1. Roof trusses (not included in the DAU).
2. Building walls built with the 4wall SIP system.

Note: The roof enclosure and the facade cladding or finishes are not shown.

Figure 1.1: Example of a building built with the 4wall SIP system.

The panels are made up of a perimeter structure of 1 mm thick galvanized steel profiles, two 12 mm thick Euroform Versaliner magnesium oxide boards and polyurethane foam injected during the manufacture of the panels.



Key:

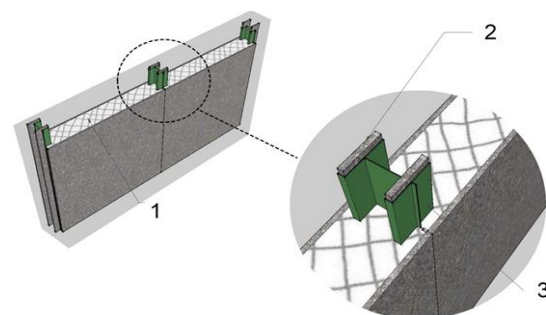
1. Headbinder in galvanized steel.
2. 4wall SIP system panel.
3. Magnesium oxide panel spline.
4. Soleplate in galvanized steel.

Figure 1.2: Diagram of the layout of the components of the 4wall SIP system.

The thickness of the panels is 185 mm, their width varies between 185 mm and 2,912 mm, and their height varies between 300 mm and 2,400 mm. There are 38 different sizes of panel depending on its height and width. The dimensions are shown in table 2.1.

The connection between panels and between panels and soleplates and headbinders is carried out on site by applying Insubond A1399 adhesive from Apollo Roofing Solutions Ltd (see section 2.4). For the connection between panels and soleplates, stainless steel screws of 65 mm in length and 5.5 mm in diameter are used as well as the adhesive to prevent movement of the panel while the adhesive is drying.

The lateral connection between panels is carried out by means of 12 mm x 95 mm magnesium oxide board splines (2 splines per joint), which are incorporated on site between the two vertical profiles on the side of the panels (see figure 1.3).



Key:

1. Polyurethane foam.
2. Magnesium oxide splines of 12 mm x 95 mm.
3. Galvanized steel profiles around the perimeter of the panel.

Figure 1.3: Diagram of the lateral connection between panels.

The panel has a 3 mm thick aluminium conduit to facilitate the passage of electrical cables, which is incorporated into the panel during its manufacture. The water pipes must be fixed to the outside of the 4wall SIP system panels.

Joints between panels are treated with joint paste in accordance with standard EN 13963. Optionally, Nullifire FS703 fire resistant sealant (see section 2.5) can be placed in the joints between panels.

The dimensions of the openings for doors and windows are created by the combination of the different panels. It is possible to obtain openings from 450 mm to 1,800 mm in width and from 1,000 mm to 2,200 mm in height. Doors, windows, etc., are not part of the system being assessed.

A final cladding or finish must be applied to the 4wall SIP system to withstand outdoor exposure conditions. This final cladding or finish is not part of the 4wall SIP system.

The panels, the magnesium oxide splines and the galvanized steel soleplates and headbinders arrive at the site ready to be installed, in accordance with the plan established in the project. It is not necessary to carry out modifications or adjustments on site. The only actions that must be carried out on site are fixing the soleplates to the foundation slab and gluing and joining the components of the 4wall SIP system (perimeter of the panels, splines for vertical joints and soleplates and headbinders).

1.2. Intended uses

The 4wall SIP system is intended for the construction of load-bearing walls (facades and interior walls) in residential, non-residential, industrial and commercial buildings.

1.3. Limitations of use

There are no limitations of the Istdama 4wall SIP system for the uses considered in this DAU. Only the resistance limitations defined in section 5.2 should be taken into account. However, the general design refers to buildings with 3 floors (not including basements).

There are no limitations related to the foundation, as long as the connections defined in section 7.3.1 are fully implemented in the foundation or in the floor slab.

2. System components

2.1. Istdama 4wall panels

Istdama 4wall panels are made up of two 12 mm thick Versaliner Euroform magnesium oxide boards, a 161 mm thick polyurethane foam core and a galvanized steel perimeter connection on all four sides.

Adhesion between the polyurethane foam core, the magnesium oxide boards and the galvanized steel perimeter connection that make up the panel occurs during the foaming process and without using adhesive.

The dimensions of the Istdama 4wall panels are shown in tables 2.1.a, 2.1.b and 2.1.c, and their description is shown in figures 2.1.a, 2.1.b and 2.1.c.

| Number of panel | Height [mm] | Width [mm] |
|-----------------|-------------|------------|
| 1 | 2,400 | 185 |
| 2 | 2,400 | 215 |
| 3 | 2,400 | 225 |
| 4 | 2,400 | 235 |
| 5 | 2,400 | 347 |
| 6 | 2,400 | 450 |
| 7 | 2,400 | 562 |
| 8 | 2,400 | 675 |
| 9 | 2,400 | 787 |
| 10 | 2,400 | 900 |
| 11 | 2,400 | 1.012 |
| 12 | 2,400 | 1.125 |
| 13 | 2,400 | 265 |
| 14 | 2,400 | 281 |
| 15 | 2,100 | 215 |
| 16 | 2,100 | 327 |
| 17 | 2,100 | 440 |

Table 2.1.a: Dimensions of standard wall panels.

| Number of panel | Height [mm] | Width [mm] |
|-----------------|-------------|------------|
| 18 | 300 | 880 |
| 19 | 300 | 1,105 |
| 20 | 300 | 1,330 |
| 21 | 300 | 1,555 |
| 22 | 300 | 1,780 |
| 23 | 300 | 2,240 |
| 24 | 300 | 1,452 |
| 25 | 1,200 | 450 |

Table 2.1.b: Dimensions of standard lintels.

| Number of panel | Height [mm] | Width [mm] |
|------------------|-------------|------------|
| 26 | 1,050 | 450 |
| 27 | 1,200 | 675 |
| 28 | 1,050 | 675 |
| 29 | 1,200 | 900 |
| 30 | 1,050 | 900 |
| 31 | 1,200 | 1,125 |
| 32 | 1,050 | 1,125 |
| 33 | 1,200 | 1,350 |
| 34 | 1,050 | 1,350 |
| 35 | 1,200 | 1,800 |
| 36 | 1,050 | 1,800 |
| Wide span lintel | 300 | 2,912 |

Table 2.1.c: Dimensions of standard window ledges.



Note: Panels 15 to 17 are not shown in the figure because the only difference to the panels displayed here is their lower height. (2,100 mm instead of 2,400 mm).

Figure 2.1.a: Standard wall panels of the Istdama 4wall SIP system.



Figure 2.1.b: Standard lintels of the Istdama 4wall SIP system.

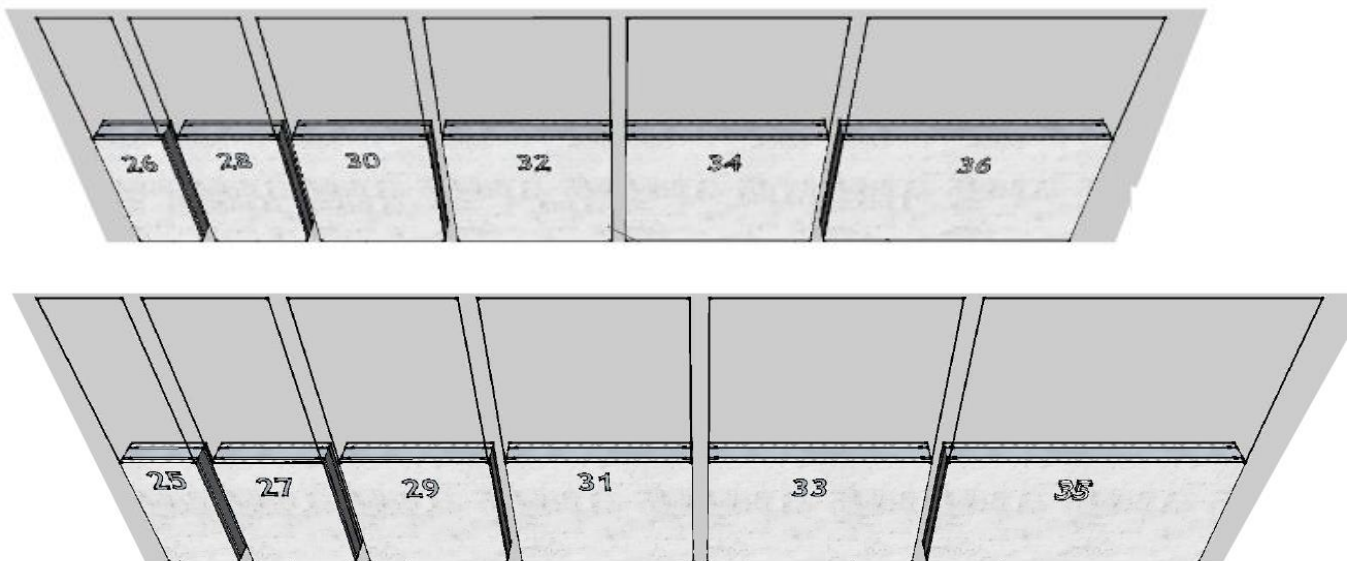


Figure 2.1.c: Standard window panels of the Istdama 4wall SIP system.

2.1.1. Magnesium oxide boards

Euroform Versaliner magnesium oxide boards benefit from the BDA Agrément BAW 18-085/01/A of 28-06-2018.

The characteristics of the magnesium oxide boards are shown in the following table.

| Characteristic | Method of verification | Value |
|---|------------------------|-----------|
| Chemical composition | -- | MgO |
| Colour | -- | Off-white |
| Thickness [mm] | -- | 12 ± 1 |
| Density [kg/m ³] | EN 322 | 900 ± 90 |
| Modulus of elasticity [MPa] | EN 310 | 3,596 (*) |
| Flexural strength [MPa] | EN 310 | 4.97 (*) |
| Tensile strength [MPa] | EN 319 | 1.64 (*) |
| Thermal conductivity [W/m·K] | -- | 0.27 |
| Compressive strength [MPa] | -- | 7.07 |
| Moisture content [% by mass] | EN 323 | 12 ± 5 |
| Reaction to fire | EN 13501-1 | Class A1 |
| Swelling [%] | EN 317 | 0.6 |
| Dimensional stability against air RH variations [%] | -- | < 0.1 |
| Acoustic absorption (α_w) | -- | 0.10 |
| Water vapour tightness [g·m/MN·s] | -- | 0.0124 |
| Vapour resistivity [MN·s/g·m] | -- | 80 |
| Vapour resistance [MN·s/g] | -- | 1.0 |

(*) Characteristics determined for 9 mm thick magnesium oxide boards.

Table 2.2: Characteristics of magnesium oxide boards.

2.1.2. Polyurethane foam core

The polyurethane foam is composed of Elastopor® H 1236/3 and BASF ISO PMDI 92140, with pentane as a foaming agent.

The characteristics of polyurethane foam are shown in table 2.3.

| Characteristic | Method of verification | Value |
|--|------------------------|--------------|
| Chemical composition | -- | Polyurethane |
| Thickness [mm] | -- | 161 |
| Density [kg/m ³] | -- | 42.0 – 44.0 |
| Compressive strength at 10% [kPa] | EN 826 | 200 |
| Thermal conductivity [W/(m·K)] (1) | EN 13165 | 0.029 |
| Thermal resistance [(m ² ·K)/W] (2) | EN 13165 | 5.55 |

Notes:

(1) Declared value of thermal conductivity after ageing.

(2) Declared value of thermal resistance for a polyurethane foam thickness of 161 mm and using the declared value of thermal conductivity after ageing.

Table 2.3: Characteristics of BASF polyurethane foam.

2.1.3. Galvanized steel perimeter profile

The perimeter profiles have a thickness of 1.1 mm ± 0.1 mm and are made of galvanized steel DX51D+Z275 (1.0917), HX220YD+Z275 (1.0923) or HX220BD+Z275 (1.0919) according to EN 10346.

| Type of steel | Mechanical characteristics according to EN 10346 | | |
|--|--|--|---|
| | Elastic limit (R _{po.2}) [MPa] | Tensile strength (R _m) [MPa] | Minimum elongation (A ₈₀) [%] |
| DX51D+Z275 (1.0917) | -- (1) | 270 to 500 | 22 |
| HX220YD+Z275 (1.0923) | 220 to 280 | 340 to 420 | 32 |
| HX220BD+Z275 (1.0919) | 220 to 280 | 340 to 400 | 32 |
| Minimum mechanical characteristics upon arrival at the manufacturing plant | | | |
| DX51D+Z275 (1.0917) | | | |
| HX220YD+Z275 (1.0923) | 245 | 350 | 32 |
| HX220BD+Z275 (1.0919) | | | |

Note:

(1) The EN 10346 standard does not establish a minimum value for the elastic limit of DX51D steel.

Table 2.4: Mechanical characteristics of the steel of the perimeter profiles.

2.1.4. Aluminium conduit for electrical cables

The aluminium conduit for electrical cables has a thickness of approximately 3 mm and variable cross-sectional dimensions depending on the project. This conduit is arranged vertically in the core of the panel, in contact with the interior board.

2.2. Galvanized steel headbinders and soleplates

The headbinders and soleplates have a thickness of 1.1 mm ± 0.1 mm and are made of galvanized steel DX51D+Z275 (1.0917), HX220YD+Z275 (1.0923) or HX220BD+Z275 (1.0919) according to EN 10346. The mechanical properties are set out in section 2.1.3.

2.3. Magnesium oxide splines

Magnesium oxide splines are 12 mm thick, 95 mm wide and 2,400 mm long, and are used vertically in the joints between panels. Two splines of magnesium oxide per joint are required, which are glued to the joints of the panels by means of adhesive.

The characteristics of the magnesium oxide splines are the same as those of the magnesium oxide boards of the panels.

2.4. InsuBond Joint Adhesive (A1399)

InsuBond (A1399) from Apollo Roofing Solutions Ltd is a moisture curing solvent-free polyurethane adhesive, supplied in a kit and in a pressurized canister.

The characteristics of InsuBond Adhesive (A1399) are listed in Table 2.5.

| Characteristic | Value |
|--|---------------|
| Colour | Green |
| Temperature resistance [°C] | - 30 to + 150 |
| Curing time at 20 °C [min] | 15 |
| Application temperature [°C] | 5 to 30 |
| Time open at 20 °C [min] | 1 to 5 |
| Storage temperature [°C] | 5 to 30 |
| Coverage ratio per container [m ²] | 250 |
| Wind load resistance [Pa] | - 5,500 |

Table 2.5: Characteristics of InsuBond Adhesive (A1399).

2.5. Nullifire FS703 linear joint and gap seal

Nullifire FS703 from Tremco CPG UK Limited is a fire stopping linear joints seal in wall and floor partitions.

Nullifire FS703 has the CE marking in accordance with ETA 20/1215 issued according to EAD 350141-00-1106 *Linear joint and gap seals*.

The declared performance of Nullifire FS703 is shown in table 2.6.

| Essential characteristics | Features | Technical specification |
|---------------------------|---|-------------------------|
| Reaction to fire | Class E | EN 13501-1 |
| Resistance to fire | Up to EI 240 | EN 13501-2 EN 1366-4 |
| Dangerous substances | Does not contain dangerous substances | -- |
| Airtightness | Test pressure differential of 600 Pa | EN 1026 |
| Service and durability | Intended use under conditions of wear and tear in accordance with EOTA TR 024, clause 3.3.1 | EAD 340141-00-1106 |

Table 2.6: Characteristics of Nullifire FS703.

3. Manufacture and production control

3.1. Manufacture

The manufacturing process of the panels is carried out at the Istdama Ltd plant in Cheshire, according to the specifications and the Control Plan agreed with the DAU holder.

3.1.1. Raw materials

The magnesium oxide boards and the magnesium oxide board splines are manufactured by Euroform.

The components of the polyurethane foam (Elastopor H 1236/3 and BASF ISO PMDI 92140) are manufactured by BASF Polyurethanes U.K. LTD.

The galvanized steel perimeter profiles of the panel, the galvanized steel headbinders and soleplates and the aluminium conduits for electrical cables are manufactured by Istdama Ltd at its Liverpool plant.

The InsuBond Joint Adhesive (A1399) is manufactured by Apollo Roofing Solutions Ltd.

3.1.2. Manufacturing process

The manufacturing process of the 4wall SIP system panels consists of the following main actions:

- Formation of perimeter profiles, headbinders and soleplates from steel coils by cutting and rolling steel strips.
- Cutting of MgO boards according to production requirements.
- Formation of the panel by assembling the perimeter steel profiles and the MgO boards. Includes internal heating to facilitate the formation of polyurethane foam.
- Foaming: mixture of the polyol and the isocyanate and injection inside the panel.
- Curing and disassembly of the moulds. Printing of the batch code, date and time of manufacture.
- Packaging the panels.

3.1.3. Presentation of the product

3.1.3.1. Panel packaging

The packaging of the panels consists of a wooden pallet and a polyethylene sheet placed on the top and on the sides of the pallet. The entire packaging is strapped before being covered with a new polyethylene sheet which is shrink-wrapped applying heat.

3.1.3.2. Labelling

Labels on each package include batch number, package weight, date of manufacture, content (quantity and type of panel), order of manufacture, and shipping details.

3.1.3.3. Panel weight

The unit weight of each panel is shown in the following table.

| Number of panel | Height [mm] | Width [mm] | Weight [kg] |
|------------------|-------------|------------|-------------|
| 1 | 2,400 | 185 | 26,9 |
| 2 | 2,400 | 215 | 30,0 |
| 3 | 2,400 | 225 | 30,8 |
| 4 | 2,400 | 235 | 31,6 |
| 5 | 2,400 | 347 | 39,9 |
| 6 | 2,400 | 450 | 49,0 |
| 7 | 2,400 | 562 | 58,2 |
| 8 | 2,400 | 675 | 67,3 |
| 9 | 2,400 | 787 | 76,4 |
| 10 | 2,400 | 900 | 85,5 |
| 11 | 2,400 | 1,012 | 94,6 |
| 12 | 2,400 | 1,125 | 10,8 |
| 13 | 2,400 | 265 | 34,1 |
| 14 | 2,400 | 281 | 35,4 |
| 15 | 2,100 | 215 | 26,4 |
| 16 | 2,100 | 327 | 34,4 |
| 17 | 2,100 | 440 | 41,6 |
| 18 | 300 | 880 | 14,7 |
| 19 | 300 | 1,105 | 17,9 |
| 20 | 300 | 1,330 | 21,4 |
| 21 | 300 | 1,555 | 24,7 |
| 22 | 300 | 1,780 | 28,1 |
| 23 | 300 | 2,230 | 34,7 |
| 24 | 300 | 1,452 | 23,1 |
| 25 | 1,200 | 450 | 20,2 |
| 26 | 1,050 | 450 | 23,2 |
| 27 | 1,200 | 675 | 27,4 |
| 28 | 1,050 | 675 | 31,4 |
| 29 | 1,200 | 900 | 35,4 |
| 30 | 1,050 | 900 | 40,5 |
| 31 | 1,200 | 1,125 | 42,7 |
| 32 | 1,050 | 1,125 | 48,8 |
| 33 | 1,200 | 1,350 | 50,5 |
| 34 | 1,050 | 1,350 | 57,7 |
| 35 | 1,200 | 1,800 | 65,7 |
| 36 | 1,050 | 1,800 | 75,0 |
| Wide span lintel | 300 | 2,912 | 31,8 |

Table 3.1: Panel weight

3.2. Production control

The production control implemented by Istadama Ltd covers the phases of issuing manufacturing orders, receiving raw materials, manufacturing and shipping the finished panels.

3.2.1. Issuance of manufacturing orders

Panel manufacturing orders are issued once the design plans provided by the client have been reviewed. Manufacturing orders are reviewed by the head of the technical department prior to their entry into the production line and the purchase of raw materials.

3.2.2. Control of the raw materials

When the panel components are received, it is verified that they comply with the specifications described in section 2 of the DAU.

3.2.3. Control of the manufacturing process

For each of the following manufacturing sub-processes, the following aspects are carried out under control:

- Formation of the perimeter profiles, headbinders and soleplates: final dimensions of the profiles.
- Cutting of MgO boards: final dimensions of the boards.
- Foaming: injection time and volume parameters, and foam density.
- Curing and disassembly of the moulds: absence of damage.
- Panel packaging: adjustment to the manufacturing order.

3.2.4. Control of the final finished product

The following characteristics of the final product are controlled, at the frequency established in the Control Plan.

- Tensile strength between the MgO board and the polyurethane foam.
- Compressive strength and compressive modulus of elasticity of the polyurethane foam.
- Dimensions of the panels
- Thermal conductivity of the polyurethane foam.

4. Storage, transport and reception on site

4.1. Storage

The panels and the different types of profiles are stored in a horizontal position, packed and strapped on pallets.

A label is placed on the pallet, so that its contents are correctly identified.

4.2. Transport

Before each supply, all pallets are checked to ensure that they are properly labelled, and their external appearance is inspected to verify that they are not dented or swollen.

The shipping conditions of the products until their delivery to the customer are established according to:

- The legal conditions of the product and transport.
- The technical conditions of transport.

The transportation of the product is carried out by trucks that meet the load and safety standards required by Project Etopia Group Limited.

Once the delivery truck arrives at the location, it needs to be parked safely so that it can be unloaded with no risk whatsoever using the method that has been prearranged. If the delivery transport cannot safely access the location, it is the customer's responsibility to ensure that the transport can be safely parked.

All system components are non-hazardous according to transport regulations. Special precautions are not required.

4.3. Control of reception on site

4.3.1. Protection

Verify that the materials are properly packed, placed in pallets and covered with shrink-wrap.

4.3.2. Appearance

No major dents, swelling, or packaging blemishes.

4.3.3. Identification and labelling

The containers are properly labelled with the name of the product, its components, the batch number and the date of manufacture.

4.3.4. Quantity

The number of components received corresponds to the delivery note.

5. Project criteria

5.1. Design criteria

5.1.1. Dimensions and modulation

The dimensional and modulation criteria that must be taken into account in the design of the building as follows.

- The design and layout of panels, openings, etc., must conform to the dimensions of the available panel types in order to avoid cutting or fitting panels.
- The panels are connected at angles of only 90° or 180° between them.
- The height of the panels defines the height between floors.
- The number of floors of the building is limited by the structural capacity of the walls and must be verified on a case-by-case basis in the building project according to the structural calculations made based on the acting forces and the resistance and final disposition of the walls.

The maximum number of floors in buildings for residential use is three floors (not including basements).

- The list of available panels of the 4wall SIP system (see section 2.1) allows the building's walls to be completed without the need for additional elements (pillars, etc.).
- 4wall SIP walls experience expansions and contractions due to temperature and humidity that are negligible due to the nature of the panel components (magnesium oxide boards and polyurethane foam). However, the expansion and contraction of the elements fixed to the wall (ventilated facades, additional cladding, etc.) must be considered in accordance with the cladding manufacturer's recommendations.
- It is not necessary to use additional elements such as support structures or load distribution plates.

5.2. Structural criteria

The given calculations of the resistance of the 4wall SIP walls according to the modulation used must be the object of a construction project that includes a technical report prepared under the responsibility of a competent technician.

5.2.1. Structural modelling

The horizontal joints between the wall and the foundation, and between the wall and the slab, can be

¹ A slab is considered to act as a rigid diaphragm when it has sufficient rigidity and resistance in its plane to gather and transmit the forces of inertia to the vertical structural systems, ensuring that they act together. A diaphragm is taken as being rigid if, when it is modelled with its actual in-plane flexibility, its horizontal displacements nowhere exceed those resulting from the rigid diaphragm

modelled for design purposes as articulation points (they offer resistance to vertical and horizontal actions, but not to bending moments).

The stability of the building against horizontal actions (wind and earthquake) is achieved thanks to the resistance to misalignment and uplift provided by the walls (see table 5.4), as long as the slabs act as a rigid diaphragm¹ on their plane, transmitting the load to the walls, together with the correct anchoring of the walls to the foundation.

5.2.2. Structural features

The structural features of the 4wall SIP walls are shown in the following tables according to the type of stress applied, differentiating, when appropriate, between walls with and without openings.

The values apply to the entire range of panel widths and maximum height considered (2,400 mm) (see section 2.1).

| Stress | Design strength | Compressive modulus of elasticity [N/mm ²] | |
|--|--|--|-----|
| Axial compression. Evenly distributed load (3) | 60.0 kN/m | 1.051 | |
| Evenly distributed load (3) | 60.0 kN/m | 989 | |
| Eccentric compression (1) | Point load on the joint between panels (2) | 30.0 kN | 181 |
| | Point load on the intermediate panel joint (2) | 30.0 kN | 521 |

Notes:

- (1) The load rests on the polyurethane foam section and on one of the two MgO boards that make up the panel, leaving the other without load.
- (2) Load applied by a 200 mm wide beam.
- (3) Resistance defined by the manufacturer and confirmed by tests that provide a sufficient safety margin in both load situations.

Table 5.1: Design compressive strength of panels without openings.

The compressive strength of the panels with openings is expressed by the flexural strength against uniform load and shear resistance against point load of the lintels, since these are the end elements of the panels with openings.

| Stress | Design strength | |
|----------|-------------------------|----------|
| Flexural | Evenly distributed load | 5.0 kN/m |
| | Point load | 5.0 kN |
| Shear | 5.0 kN/m | |

Table 5.2: Design shear and flexural strength of the lintels

assumption by more than 10% of the corresponding absolute horizontal displacements in the seismic design situation.

UNE-EN 1998-1 (2018) *Design of structures for earthquake resistance. Part 1: General rules, seismic actions and rules for buildings.*

The wall's design flexural strength during horizontal actions is shown in the following table.

| Stress | Design strength [kN/m ²] |
|----------|--------------------------------------|
| Flexural | 5.0 |

Table 5.3: Design flexural strength of the wall.

The design compressive strength combined with the flexural strength of the 4wall SIP system is determined according to the following formula:

$$\frac{F_{vd}}{R_{vd}} + \frac{F_{hd}}{R_{hd}} \leq 1.0$$

Where:

F_{vd} : Design vertical force applied

R_{vd} : Design compressive strength (tables 5.1 and 5.2)

F_{hd} : Design horizontal force

R_{hd} : Design flexural strength (table 5.3)

The characteristic strength and the rigidity to misalignment of the 4wall SIP wall with panels without openings against horizontal loads, with and without applied vertical load, is shown in the following table.

| Stress | Characteristic strength [kN] | Rigidity to misalignment [N/mm] |
|---|------------------------------|---------------------------------|
| Misalignment without vertical load | 17.33 | 2,258 |
| Misalignment with vertical load (8,33 kN/m) | 30.62 | 2,465 |

Table 5.4: Results of the test of resistance to misalignment.

From the assessment carried out on the strength of the vertical joint between panels (see section 8.2.6), it can be affirmed that the performance and behaviour of the vertical joint between panels is adequate for the intended uses of the system.

5.3. Safety in case of fire

5.3.1. Reaction to fire

The reaction to fire of the magnesium oxide boards is A1.

The reaction to fire of the 4wall SIP system panels that include the polyurethane foam, the perimeter structure of steel profiles and the magnesium oxide boards on both sides has not been assessed.

The regulatory requirement set out in DB-SI 1 Internal propagation is expressed by means of the limit value of reaction to fire for the cladding of construction elements. The interior of dwellings is excluded from occupiable zones². The walls of the 4wall SIP system are not used in the rest of the situations for which there are

requirements (protected corridors and stairs, car parks and special risk areas, and non-watertight or watertight hidden spaces that contain installations capable of starting or spreading a fire).

The regulatory requirement set out in DB-SI 2 *Exterior propagation* for the reaction to fire of façade construction systems that occupy more than 10% of its surface must be met, along with the façade cladding that is incorporated into the 4wall SIP wall.

5.3.2. Resistance to fire

The fire resistance of the walls built with the 4wall SIP system is shown below with the classification obtained according to the EN 13501-2 standard from a test according to the EN 1365-1 and EN 1363-1 standards, together with the direct field of application of test results in accordance with section 13 of standard EN 1365-1.

| Specimen description | Resistance to fire (according to EN 13501-2) |
|--|--|
| Wall section made up of three panels, a central one with the maximum dimensions of the system and two lateral ones that complete the opening of the test chamber. Total dimensions (height x width x thickness) [mm]: 2,400 x 2,949 x 185. Treatment of joints between panels with joint paste according to EN 13963. Applied load: 40 kN (13.56 kN/m). | REI 60 |

Table 5.5: Resistance to fire of the 4wall SIP walls.

Direct field of application of test results:

- Decrease in height.
- Decrease in the linear measurements of the panels or dimensions of the plates, but not in thickness.
- Decrease in applied load.
- Increase in width.

² This includes both those for the permanent presence of people and those for circulation that are not protected. Excludes inside homes.

In hospital use, the same conditions apply as in protected corridors and stairs.

5.4. Hygiene, health and environment

5.4.1. Water vapour tightness of the panels

The water vapour tightness of the 4wall SIP system is determined by the water vapour tightness of its components.

The water vapour tightness of the panel components, expressed by the water vapour diffusion resistance factor, is shown in the following table.

| Component | Water vapour diffusion resistance factor (μ) |
|-----------------------------------|--|
| 12 mm thick magnesium oxide board | 16.1 |
| Polyurethane foam | 60 |
| Steel profiles | ∞ |

Table 5.6: Water vapour diffusion resistance factor of the components of the 4wall SIP system.

The verification of the limitation of surface condensation is based on the comparison of the internal surface temperature factor $f_{R_{Si}}$ and the minimum internal surface temperature factor $f_{R_{Si,min}}$ for the internal and external conditions corresponding to the month of January in the test location.

The value of $f_{R_{Si}}$ must be greater than the value of $f_{R_{Si,min}}$. The value of $f_{R_{Si,min}}$ can be obtained from table 1 of the DA DB-HE / 2 based on the hygrometry class of each space and the winter climate zone where the building is located, or by means of the formula included in section 4.1.3 of DA DB-HE / 2.

The $f_{R_{Si}}$ value for the thermal bridges generated by the presence of metal profiles around the perimeter of the 4wall SIP system panels is obtained from the calculations carried out according to the EN ISO 10211 standard and is shown in the following table.

| Component | Internal surface temperature factor ($f_{R_{Si}}$) |
|--|--|
| Thermal bridge around the perimeter of the 4wall SIP system panels | 0,946 |

Table 5.7: Internal surface temperature factor $f_{R_{Si}}$.

5.4.2. Watertightness

4wall SIP walls without external cladding show a favourable response to rainwater, as can be seen from the test results according to EN 12865 under a maximum pressure of 1,200 Pa before and after accelerated ageing according to ETAG 017³.

³ The ETAG 017 *Veture kits* has been replaced by the EAD 040914-00-0404 *Veture kits- prefabricated units for external wall insulation and their fixing devices*, of November 2018.

⁴ Protected enclosure according to DB HR: interior enclosure intended for the use of people whose occupancy density and length of stay require adequate acoustic, thermal and health conditions. The

5.5. Safety in use

5.5.1. Ability to withstand point loads

The characteristic pull-out resistance of BS-S 4.8 mm fasteners on 12 mm thick magnesium oxide boards is shown in the following table.

| Configuration | Number and dimension of the fasteners | Characteristic pull-out resistance [kN] |
|------------------------|---------------------------------------|---|
| 4wall SIP system board | 1 x BS-S 4.8 mm | 1.39 |

Table 5.8: Fastener pull-out resistance.

5.6. Protection against noise

5.6.1. Airborne sound insulation

The airborne sound insulation, $D_{2m,nT,Atr}$, between a protected enclosure⁴ and the exterior in façades built with the 4wall SIP system must be determined using the calculation method in section 3.1.3.4 of the DB HR, based on the global index of apparent A-weighted acoustic reduction (R'_A), the improvement in insulation or difference in levels due to the shape of the façade (ΔL_{fs}), the volume of the receiving enclosure (V), the total area of the façade seen from the inside of the enclosure (S) and the reference reverberation time (T_0).

The calculated value of $D_{2m,nT,Atr}$ for the façade must be equal to or greater than the limit values indicated in table 2.1 of the DB HR depending on the use of the building and the values of the daytime noise index, L_d , of the area where the building is located. In addition, the influence of the percentage of openings must be considered as indicated in table 3.4 of the DB HR.

The calculation of the R'_A must be carried out in accordance with the formula indicated in section 3.1.3.4 of the DB HR, using the values of the global index of acoustic reduction of the mixed constructive element, A-weighted, ($R_{m,A}$), the calculation for which is detailed in annex G of the DB HR.

In the calculation of $R_{m,A}$, the airborne sound insulation of the façade identified in the tests and indicated in the following table is used.

following are considered protected enclosures: rooms (bedrooms, dining rooms, libraries, lounges, etc.) in residential buildings; classrooms, conference rooms, libraries, offices, in buildings for educational use; operating rooms, rooms, waiting rooms, in buildings for sanitary or hospital use; offices, meeting rooms in buildings for administrative use.

| Facade configuration | R_w (C; C_{tr}) [dB] |
|---|---------------------------|
| 4wall SIP wall (exposure to emission room) | 32 (-3; -5) |
| Wall with 4wall SIP panels + 50 mm layer with wooden posts at 600 mm and 50 mm of Rockwool RWA45 mineral wool with a density of 45 kg/m ³ + magnesium oxide board 12 mm thick (exposure to reception room) | 50 (-6; -14) |

Table 5.9: Airborne sound insulation.

5.7. Energy saving and thermal insulation

5.7.1. Resistance and thermal transmittance

The thermal transmittance of the central section of the 4wall SIP wall without including the metal perimeter profiles is shown in the following table.

| | Thermal transmittance (U) [W/(m ² ·K)] | |
|--|--|--|
| | Without taking superficial thermal resistance into account | Taking superficial thermal resistance into account |
| Section of the 4wall SIP wall without including the metal perimeter profiles | 0.18 | 0.17 |

Table 5.10: Thermal transmittance of the central section of the 4wall SIP wall.

The thermal transmittance of the 4wall SIP wall sections with perimeter profiles and the linear thermal transmittance have not been assessed in this DAU.

The thermal transmittance of the central section of the 4wall SIP façades without including the metal perimeter profiles satisfies the thermal transmittance requirements for walls in contact with the outside air belonging to the thermal envelope, included in the DB HE for the most unfavourable climatic zone (zone E): U_{lim} (zone E) = 0.37 W/(m²·K) < U = 0.17 W/(m²·K).

Satisfaction of the requirements for the limit value of the global coefficient of heat transmission through the thermal envelope (K) included in the DB HE must be justified based on the parameters of each of the elements that make up the thermal envelope of the building, taking into account the contribution of the exterior cladding, not contemplated in the DAU, and of the metal perimeter profiles.

5.7.2. Airtightness

This characteristic has not been assessed.

5.8. Durability and service aspects

5.8.1. Risk of corrosion of metal parts

The cold-formed galvanized steel profiles that make up the perimeter of the panel and the soleplates and headbinders are made of DX51D+Z275 (1.0917), HX220YD+Z275 (1.0923) or HX220BD+Z275 (1.0919) galvanized steel according to EN 10346.

The Z275 cladding provides a minimum total mass of zinc coating between both surfaces of 275 g/m² (three-point test) and 235 g/m² (one-point test), equivalent to a theoretical thickness of 20 µm.

The atmospheric corrosivity categories, the loss of mass per surface unit or the loss of thickness for each corrosivity category and the classification of exposure environments linked to the corrosivity category are shown in table 1 of EN ISO 12944-2 standard, displayed below.

| Atmospheric corrosivity category | Zinc | |
|--|---|---|
| | Loss per unit area (after the first year of exposure) [g/m ²] | Loss of thickness (after the first year of exposure) [µm] |
| C1 (very low) | ≤ 0.7 | ≤ 0.1 |
| C2 (low) | > 0.7 and up to 5 | > 0.1 and up to 0.7 |
| C3 (medium) | > 5 and up to 15 | > 0.7 and up to 2.1 |
| C4 (high) | > 15 and up to 30 | > 2.1 and up to 4.2 |
| C5 (very high) | > 30 and up to 60 | > 4.2 and up to 8.4 |

Table 5.11: Loss of mass or thickness depending on the atmospheric corrosivity category.

| Atmospheric corrosivity category | Examples of common environments (only informative) | |
|--|--|---|
| | Exterior | Interior |
| C1 (very low) | -- | Buildings fitted with clean atmospheres, for example, offices, shops, schools, hotels. |
| C2 (low) | Atmospheres with a low level of pollution: basically rural areas. | Buildings without fittings where condensation can occur, for example, warehouses, sports centres. |
| C3 (medium) | Urban and industrial atmospheres, moderate sulphur dioxide pollution: coastal areas with low salinity. | Production areas with high humidity and some pollution, e.g. food processing plants, dry cleaners, dairies. |
| C4 (high) | Industrial areas and coastal areas with moderate salinity. | Chemical plants, swimming pools, quays and shipyards |
| C5 (very high) | Industrial areas with high humidity and aggressive atmosphere and coastal areas with high salinity. | Buildings or areas with almost permanent condensation and high pollution. |

Table 5.12: Examples of typical environments for corrosivity categories.

The zinc covering ensures sufficient protection of the metal structure for its intended use if the total zinc loss for the category of atmospheric corrosivity in which the building is installed is less than the zinc coating provided by the profiles.

5.8.2. Durability of the panel

The durability of the 4wall SIP system panels against exposure to the temperature and humidity of the outdoor environment, and which is expressed by the reduction of the tensile strength between the PUR layer and the magnesium oxide boards, is considered appropriate when using a foaming agent included in the EN 13165 standard in the manufacture of PUR insulation, as indicated in the EN 14509 standard.

The behaviour of the adhesive bond between the magnesium oxide panels and the steel profiles is considered adequate based on the results of the watertightness tests before and after ageing cycles.

The magnesium oxide board provides adequate durability as long as it is protected by an additional covering.

6. Execution, maintenance and conservation criteria

6.1. Execution criteria

6.1.1. Workers and necessary means

The instructions indicated in the manufacturer's manual must be followed.

The team of workers in charge of the assembly must be properly trained for the assembly of the system, and subject to the supervision and approval by the Project Etopia structural engineer or the authorized technician delegated.

Project Etopia will keep a record with the list of workers who have passed the training.

6.1.2. Pre-execution checks

Before starting the installation of the panels, it must be checked that the support surface of the 4wall SIP system (concrete slab or structural wall) does not present irregularities or imperfections.

The maximum permissible deviations of the support surface are the following:

- Plan dimensions (length, width and diagonals): ± 10 mm
- Level: ± 5 mm.

The use of a wooden sleeper interposed between the support surface and the soleplate allows the level tolerance of the slab to be increased up to ± 10 mm.

To correct level deviations, non-compressible filler material can be used (for example: low shrinkage mortar).

These deviations apply to the support surface on the foundation and to the upper face of the slabs between floors.

6.1.3. Installation conditions

The installation of scaffolding or exterior perimeter platforms is necessary prior to the start of the assembly of the panels.

Said scaffolding or platforms must allow access for workers to assemble the panels. The specifications of the scaffolding or platforms will be provided by Project Etopia to the project managers.

6.1.4. Gluing process

Being monolithic is key to the performance of the system and requires correct on-site gluing between the panels, and between the panels and the soleplates and headbinders using InsuBond A1399 adhesive. The gluing process must follow the following procedure:

- The surfaces to be joined must be dry and free of grease, dirt or other contaminants prior to applying the adhesive.
- Prepare the container of adhesive according to the adhesive manufacturer's instructions.
- Adjust the width of the adhesive bead to a minimum of 30 mm using the valve on the container (figure 6.1).



Figure 6.1: Connecting the braided hose to the container valve.

- Apply the bead of adhesive to the surfaces to be bonded ensuring a minimum bead thickness of 30 mm, then immediately bond the surfaces and apply pressure to ensure full contact with the adhesive. At 20°C the open time is between 1 and 5 minutes, and the curing time is 15 minutes.
- Once the application of the adhesive is finished, it must be ensured that the container valve remains open to avoid clogging of the hose. The application gun must be closed, and its end cleaned with a nylon brush using Apollo 9 solvent until the opening is clean.
- The container and application gun can be used for one month after opening. It is recommended to review the instructions of the adhesive supplier for specific details and any additional aspects.

6.2. Installation of the panels

6.2.1. Connection to the foundation

The galvanized steel soleplate must be fixed to the support surface directly or by interposing a single or double sleeper made of wood treated against biotic and abiotic agents for use class 4⁵, according to EN 335 standard.

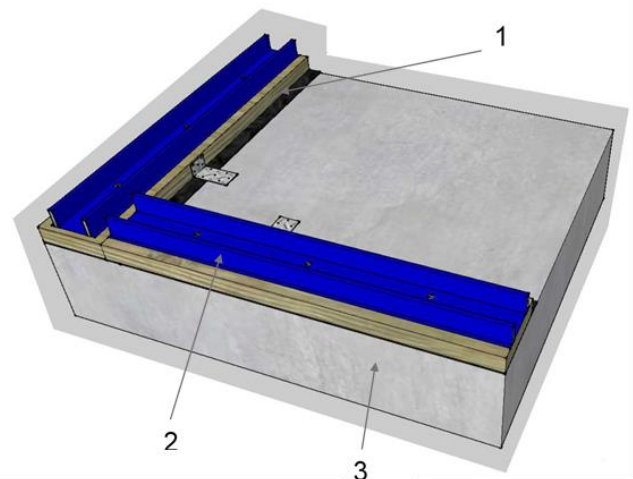
This 38 mm or 48 mm thick sleeper is not part of the system components and must be supplied by the builder of the work project. The sleeper must be levelled according to the tolerances indicated in section 6.1.2.

A moisture barrier must be provided between the support surface on the foundation and the sleeper, said support surface and the soleplate when intermediate sleepers are not provided.

The soleplate will be fixed to the support (sleeper or support surface) by means of the fastenings defined by the structural engineer, depending on the strength of the support. The specification of the fastenings includes the type, depth, dimensions and distribution.

The use of sleepers between the profiles and the support surface requires the use of metal clips in the form of an angle between the sleeper and the slab. These clips are 1 mm thick and their dimensions and arrangement are defined based on the project requirements.

The placement of the soleplates begins at the corners, with the arrangement shown in figure 6.2.



Key:

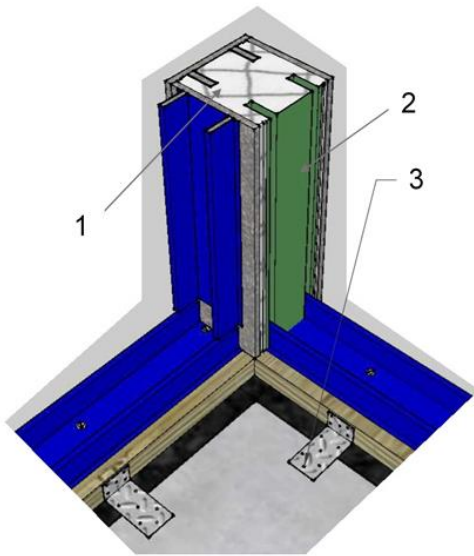
1. Treated wood sleeper.
2. Galvanized steel soleplate.
3. Support surface.

Figure 6.2: Diagram of connection of the soleplates in the corners.

Panel number 1 (see table 2.1), which has a profile on one side for later placement of the slots, is placed in the corners. On the other side, a vertical galvanized steel profile is fixed to allow the subsequent fitting of the panel (see figure 6.3).

⁵ Situation in which the wood is in direct contact with the ground and/or fresh water. Attack by chromogenic fungi and xylophagous fungi can occur. Attack by xylophagous insects including termites is possible,

although the frequency and importance of the risk depend on the location of the site.



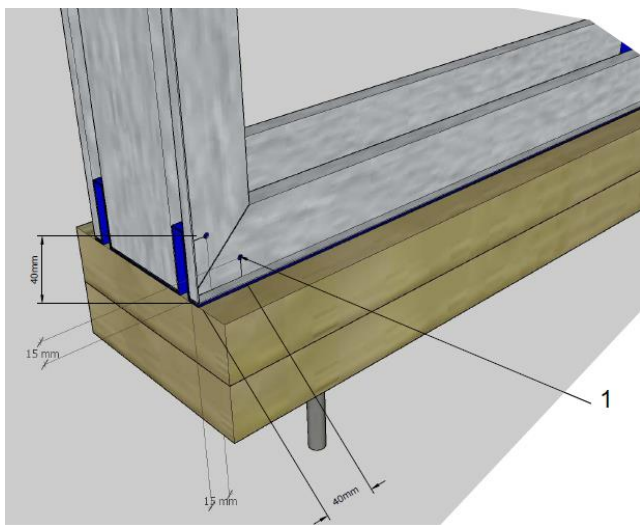
Key:

1. Corner panel (panel number 1).
2. Female galvanized steel profile.
3. Angular metallic clip.

Figure 6.3: Diagram of the corner connection.

6.2.2. Panel assembly

The panels are joined to the soleplate through the galvanized steel profile incorporated in the perimeter of the panel. This tongue and groove joint is made by gluing both surfaces with Insubond A1399 adhesive and stainless steel screws 65 mm long and 5.5 mm in diameter that sew the joint. The screws are arranged horizontally 150 mm apart, while the first screw is located 40 mm from the edge of the panel (see figure 6.4).



Key:

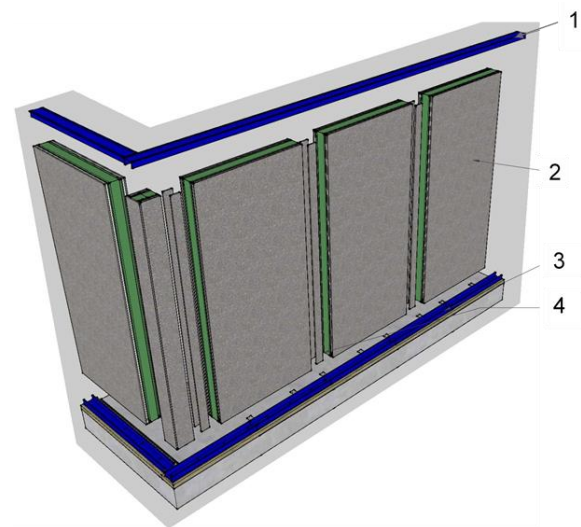
1. 65 mm long and Ø 5.5 mm stainless steel screws.

Figure 6.4: Arrangement of connection screws with the soleplate in the corner of the panel.

The lateral connection between panels is made by means of a tongue and groove formed by the interposition of magnesium oxide panel splines that connect the galvanized steel perimeter profiles of the panels. The joint is glued with Insubond A1399 adhesive.

The panels are joined to each other at the top by means of a 2,500 mm nominal length galvanized steel headbinder, which provides continuity and is glued with the Insubond A1399 adhesive to the galvanized steel profile found inside the panel.

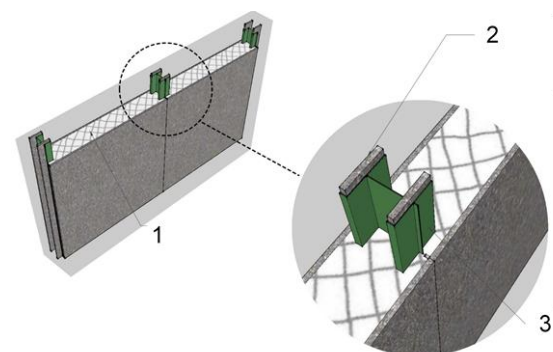
The arrangement of profiles and panels, as well as the splines in the lateral joints between panels, can be seen in figures 6.5 and 6.6.



Key:

1. Headbinder in galvanized steel.
2. 4wall SIP system panel.
3. Soleplate in galvanized steel.
4. Magnesium oxide panel spline.

Figure 6.5: Diagram of the arrangement of profiles, panels and splines.



Key:

1. Polyurethane foam.
2. Magnesium oxide splines with dimensions 12 mm x 95 mm.
3. Galvanized steel profiles around the perimeter of the panel.

Figure 6.6: Diagram of the lateral connection between panels.

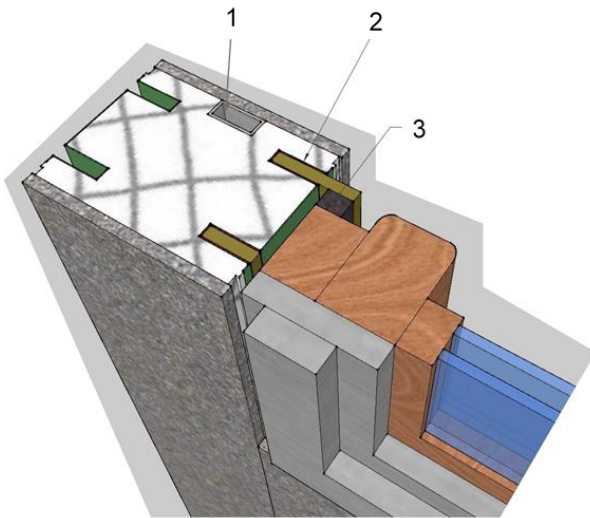
6.2.3. Treatment of openings

With the 4wall SIP panel system, any combination of door and window dimensions can be created, thanks to the modulation of panels.

When making a door or window opening, a grooved edge is created due to the grooves of the galvanized steel profiles incorporated into the panels. These grooves are filled with strips of plywood that are glued together, enabling the placement of the door or window frame. Between the window or door frame and the panel, a band of compressed foam is placed (see figure 6.7).

The doors and windows are fixed to the perimeter profile by means of metal fixtures.

The window can be arranged flush with the inside face or with the outside face of the wall.



Key:

1. Aluminium conduit for electrical cables.
2. Strip of plywood.
3. Band of compressed foam.

Figure 6.7: Diagram of the window frame.

6.2.4. Cladding

The walls built with the 4wall SIP system allow the application of the following types of cladding:

- Wooden slats arranged on battens fixed on the panels.
- External self-supporting sheet of brick, block or stone, fixed to the panels with flexible stainless steel anchors.

6.2.5. Connections to slab and roof

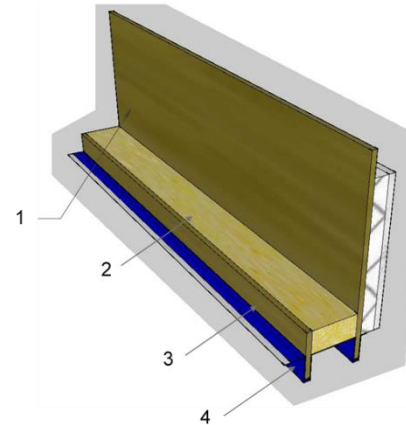
The connections from the wall to the slab and roof can be made by the following two methods, depending on whether or not the insulation is placed on the slab face:

1. With insulation on the front of the slab (see figure 6.9): two 9 mm thick plywood boards are inserted into the grooves of the steel headbinders, and nailed and glued to the timber soleplates with a thickness

of 38 mm or 45 mm. Subsequently, a 25 mm sheet of rigid polyurethane foam of the same density as that used inside the panel is glued and nailed to the side in contact with the external environment of the plywood board.

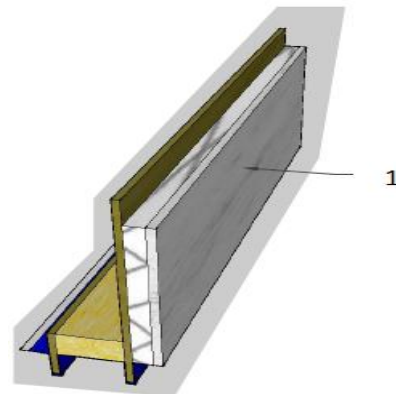
A 12 mm thick magnesium oxide board is fixed on the polyurethane foam sheet.

The height of the plywood board that acts as the front of the slab (see figure 6.8) must be adjusted to the edge of the slab.



Key:

1. 9 mm thick plywood board.
2. Timber headbinder 38 mm or 45 mm thick.
3. 9 mm thick plywood board.
4. Galvanized steel headbinder.



Key:

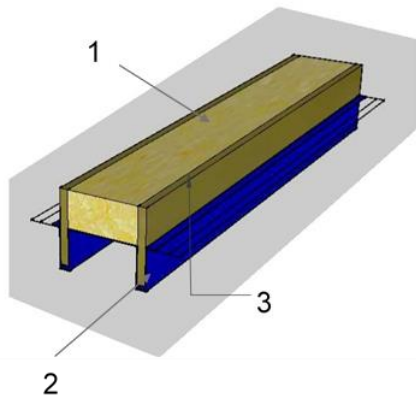
1. 12 mm thick magnesium oxide board.

Figure 6.8: Connection with insulation of the front of the slab.

2. Without insulation on the front of the slab (see figure 6.19): on the steel headbinder, a wooden headbinder with a thickness of 38 mm or 45 mm is arranged, both elements are joined by means of 9 mm thick plywood boards that are inserted into the grooves of the steel profile.

The plywood boards are glued to the steel profile and glued and nailed to the timber headbinder.

This solution applies to roofs in which the trusses are expected to protrude from the wall (see figure 6.10).



Key:

1. Timber headbinder 38 mm or 45 mm thick.
2. Galvanized steel headbinder.
3. 9 mm thick plywood board.

Figure 6.9: Connection without insulation of the front of the slab.

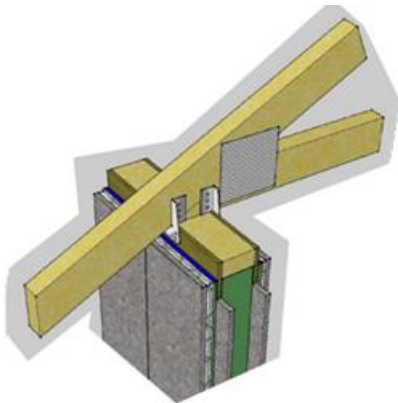
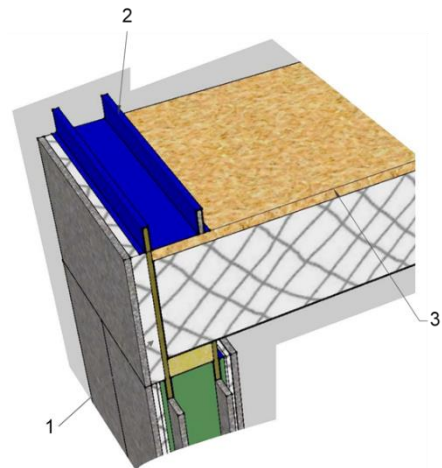


Figure 6.10: Wooden truss connection to wall.

After placing the headbinders of the wall, the slab is constructed, either by means of wooden beams, reinforced concrete beams or concrete slabs.

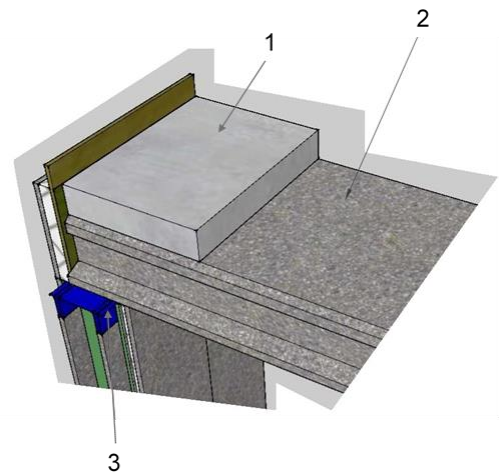
The panels that make up the walls of the upper floor are installed in the same way as the panels of the first floor, that is, on a soleplate, with the difference that the soleplate is fixed to the slab instead of being fixed to the foundation (see figures 6.11 and 6.12).



Key:

1. 4wall SIP panel.
2. Soleplate for the wall of the upper floor.
3. Floor decking board.

Figure 6.11: Upper floor wall soleplate.



Key:

1. Compression layer
2. Hollow core concrete slab
3. Headbinder.

Figure 6.12: Meeting of wall and hollow core concrete slab

6.2.6. Wire routing

Each panel of the 4wall SIP system has an aluminium conduit integrated in the panel for electric cables to pass through. This conduit is incorporated into the panel when it is manufactured.

The conduit runs vertically and is centred in width behind the magnesium oxide board. The conduit is open at both ends.

When it is necessary to install several electrical outlets on the side, two 4wall SIP panels with a reduced width can be used side by side to facilitate the routing of the wiring, since each one has an electrical conduit.

No water supply pipes will be installed inside the panels.

6.3. Maintenance and repair criteria

Periodic visual inspections of the good condition of the vertical joint glued between panels will be carried out, where the possible existence of cracks and fissures or other deformations will be checked. These inspections will be carried out with the frequency established for facades (5 years) in table 6.1 of DB-HS 1. Cladding, windows and doors must follow the maintenance prescribed by the supplier.

6.4. Measures for the protection of the environment

6.4.1. Waste treatment

By virtue of Decision 2014/955/EU, amending Decision 200/523/EC, on the list of waste, and pursuant to Directive 2008/98/EC, and the modifications thereof, a European Waste Catalogue (EWC) has been established that provides that all products must be assigned an EWC code that enables the users to know the type of waste management that corresponds thereto.

The EWC codes declared for the components of the 4wall SIP system are:

- Magnesium oxide boards: 06 03 16
- PUR insulation: 17 06 04
- Adhesive waste: 08 04 10
- Metal profiles: 17 04 05
- Wood based boards: 03 01 05
- Paper and cardboard packaging: 15 01 01
- Plastic containers: 15 01 02

The waste generated during the installation must be managed in accordance with applicable waste management regulations by a waste management company authorised for said purposes (see Royal Decree 105/2008 that governs the production and management of construction and demolition waste).

6.4.2. Conditions to be fulfilled by installer companies

4wall SIP system installers must have specific training provided by Project Etopia.

7. References of use and site visits

7.1. References of use

The 4wall SIP system has been carried out since the year 2019.

The following list of building works has been provided as references for use:

| Type of work | Location | Completion date (year) |
|------------------------|---|------------------------|
| Primary school | Eastern Road, Colchester, Essex (United Kingdom) | 2019 |
| Single-family building | Bucknalls Lane, Watford, (United Kingdom) | 2019 |
| 31 single-family homes | The Avenue, Priors Hall Park, Corby, (United Kingdom) | 2020 |

Table 7.1: Work references.

7.2. Site visits

The installation instructions of the 4wall SIP system and the videos recorded by Project Etopia during the building construction process have been reviewed. It has been verified that the installation instructions cover the main aspects involved.

The relevant aspects identified during the review process have been included within the project and execution criteria set out in this document.

8. Testing and calculation assessments

The suitability for use of the 4wall SIP system by Istdama has been assessed in relation to compliance with the *Specific Assessment Procedure of the DAU 22/130*.

Said procedure has been drafted by the ITeC taking into consideration the Spanish construction regulations applicable in each case:

- for buildings, the basic requirements established by the CTE shall be taken into account for each of the basic requirements,
- in other construction areas, the specific regulations applicable thereto shall be taken into consideration,

as well as other additional requirements related to the durability and service conditions of the system.

The tests that form part of this assessment have been carried out in the laboratories of Exova Warrington, Lucideon Limited and at the University of Salford, all of them located in the United Kingdom.

All test and calculation reports, as well as the sampling report, are set out in the Technical Dossier of DAU 22/130.

8.1. Characterisation tests

The tests carried out to characterize the mechanical behaviour of the panels of the Istdama 4wall SIP system and their results are shown below:

- Density
- Tensile strength between MgO boards and polyurethane foam
- Compressive strength at 10% deformation of polyurethane foam

8.2. Mechanical strength and stability

8.2.1. Axial and eccentric compressive strength and compressive modulus

8.2.1.1. Axial compressive strength and compressive modulus

The strength and the compressive modulus against axial loads of the Istdama 4wall SIP system have been assessed by the tests carried out based on the EN 1052-1 standard, where a section of wall is subjected to a vertical load which is evenly distributed along its entire length.

The most unfavourable configuration of the system has been tested, and that has allowed the results obtained to be extended to the rest of the configurations. The specimen is made up of a panel of maximum width (1,125 mm) flanked on both sides by a panel of

intermediate width (562 mm), simulating a section of wall. The height of the panels is the maximum possible (2,400 mm) (test report 164372 (QT-42277/SL)/Ref. 4).

The maximum load reached, the maximum displacement and the compressive modulus of elasticity obtained in the test are shown in the following table:

| Loading arrangement | Maximum load [kN/m] | Maximum displacement [mm] (1) | Compressive modulus of elasticity [N/mm ²] (2) |
|----------------------------------|---------------------|-------------------------------|--|
| Evenly distributed vertical load | 366.92 | 2.21 | 1,051 |

Notes:

- (1) Mean value of the vertical displacement at break point.
- (2) Secant modulus from the average of the deformations at one third of the maximum load.

Table 8.1: Results of the axial compressive strength test.

The maximum load reached in the test (366.92 kN/m) is of the order of 6 times the maximum predicted design strength (60.0 kN/m).

The design strength to axial compression per linear metre of 4wall SIP wall is limited to 60.0 kN/m.

The result obtained in the compressive strength test against evenly distributed eccentric load (section 8.1.1.2) confirms the result obtained in the compressive strength test against axial load.

Therefore, a design strength to axial compression of 60.0 kN/m can be assigned per linear metre wall to all the possible wall configurations of the system, because the tested configuration is the most unfavourable of all of them.

Likewise, a compressive modulus of elasticity of 1.05 kN/mm² can be assigned.

8.2.1.2. Eccentric compressive strength and compressive modulus

The strength and compressive modulus against eccentric loads of the 4wall SIP system have been assessed by the tests carried out according to the EN 1052-1 standard on a wall section with the following loading arrangements:

- Eccentric vertical load evenly distributed along the entire length of the wall.
- Point load on the vertical joint between panels.
- Point load on the central part of the intermediate panel.

The three loading arrangements have been tested on specimens with the same configuration, which corresponds to the configuration with the worst system performance. The specimen is made up of a panel of maximum width (1,125 mm) flanked on both sides by a panel of intermediate width (562 mm), simulating a

section of wall. The height of the panels is the maximum possible (2,400 mm).

The support of the load on the wall in all loading arrangements has reproduced the final conditions of use, in which the load rests on the polyurethane foam section and on the internal MgO board, leaving the external MgO board free of load.

The point load has been applied to the wall by means of a 200 mm wide beam.

A specimen has been tested for each loading arrangement. The maximum load, the deformation and the compressive modulus of elasticity are shown in the following table:

| Loading arrangement | Maximum load | Maximum displacement [mm] (1) | Compressive modulus of elasticity [N/mm ²] (2) |
|--|--------------|-------------------------------|--|
| Evenly distributed eccentric vertical load | 267.43 kN/m | 1.30 | 989 |
| Point load on the joint between panels | 107.94 kN | 1.99 | 181 |
| Point load on the central part of the intermediate panel | 149.07 kN | 0.61 | 521 |

Notes:

- (1) Mean value of vertical displacement at break point.
 (2) Secant modulus from the average of the deformations at one third of the maximum load.

Table 8.2: Results of the eccentric compressive strength tests.

The results achieved are indicated in test report 164372 (QT-42277/SL)/Ref. 4.

The maximum load in the evenly distributed eccentric vertical load test (267.43 kN/m) is 4.5 times higher than the maximum predicted design strength (60 kN/m), while the maximum load in the point load tests on the joint and on the central part of the intermediate panel is 107.94 kN and 149.07 kN, respectively, much higher than the maximum predicted design strength (30 kN in both arrangements).

The design strengths were limited to 60 kN/m and 30 kN, for eccentric load arrangements and point loads.

Design strengths of 60.0 kN/m and 30.0 kN can be assigned for eccentric compression and point loads, respectively, to all the possible wall configurations, since the tested configuration is the most unfavourable one possible.

8.2.2. Compressive strength of panels with openings

The compressive strength of panels with openings has been assessed from the flexural strength and shear strength of the lintels. Tests have been carried out according to the EN 846-9 standard on the lintels with the most unfavourable configuration possible (test report 164372 (QT-42277/SL)/Ref. 1).

8.2.2.1. Flexural strength of lintels

The tested specimens correspond to the largest panel used as a lintel: 2,240 mm in length, 300 mm in height and 185 mm in thickness.

The results of the flexural strength test of lintels against evenly distributed loads, as well as the characteristic value obtained, are shown in the following table:

| Specimen | Maximum load [kN] | Mean value [kN] | Deviation [kN] | Characteristic value (1) | |
|----------|-------------------|-----------------|----------------|--------------------------|--------|
| | | | | [kN] | [kN/m] |
| 1 | 41.43 | | | | |
| 2 | 41.38 | 42.27 | 1.50 | 37.82 | 16.88 |
| 3 | 44.01 | | | | |

Note:

- (1) 5% fractile for a 75% confidence level with a log-normal distribution.

Table 8.3: Results of flexural strength tests on lintels against evenly distributed load.

The results of the flexural strength test of lintels against point loads are shown in the following table:

| Specimen | Maximum load [kN] |
|----------|-------------------|
| 1 | 34,70 |
| 2 | 36,20 |

Table 8.4: Results of flexural strength tests on lintels against point loads.

The flexural design strength of the lintels, against evenly distributed load and point load, was limited to 5.0 kN/m and 5.0 kN, respectively.

8.2.2.2. Shear strength of lintels

The tested specimen corresponds to the largest panel used as a lintel: 2,240 mm in length, 300 mm in height and 185 mm in thickness.

The maximum load reached in the test was 36.25 kN.

The shear design strength of the lintels was limited to 5.0 kN/m.

8.2.3. Flexural strength of the system

The flexural strength of the Istdama 4wall SIP system was assessed by a flexural test on a section of wall made with the system's own panels.

A flexural test was carried out using air pockets on the entire surface of a specimen made up of two panels 1,125 mm long, 2,400 mm high and 185 mm thick each. The two panels, placed consecutively, result in a 2,250 mm long specimen. The specimen is completed with the lower and upper profiles, and the 12 mm thick MgO splines between panels, configuring a wall in final conditions of use (test report 164372 (QT-42277/SL)/Ref. 2/Supp1).

The result of the flexural strength test is shown in the following table:

| Maximum load [kN/m ²] (1) | Maximum displacement in the joint between panels [mm] (mean values) | | |
|--|---|--------------|------------|
| | Lower zone | Central zone | Upper zone |
| 27.40 | 54.96 | 40.66 | 25.44 |

Note:

(1) The test was stopped due to a ruptured air bag. The wall continued to bear the load.

Table 8.5: Results of the flexural strength test.

The maximum load reached is much higher than the usual wind stress value on a 3-storey building, which is less than 1.5 kN/m².

For this reason, it can be affirmed that the Istdama 4wall SIP system can withstand usual wind loads for buildings of a moderate height (of 3 floors) under non-extreme exposure.

The flexural design strength of the 4wall SIP walls is limited to 5.0 kN/m², 5.5 times the value reached in the test.

8.2.4. Compressive strength combined with flexural strength of the system

The compressive strength combined with the flexural strength of the Istdama 4wall SIP system is determined by the formula indicated in section 5.2.2, based on the eccentric compressive strength (see section 8.2.1.2) and the flexural strength (see 8.2.3).

8.2.5. Resistance to misalignment of the system

The resistance to misalignment of the Istdama 4wall SIP system has been assessed by means of tests according to the EN 594 standard.

Tests have been carried out on six specimens. Three of them have been tested without vertical load and the other three with a vertical force of 5.0 kN every 600 mm.

The specimens are made up of two panels of 1,125 mm in length, 2,400 mm in height and 185 mm in thickness. The specimen is completed with the lower and upper profiles, and the 12 mm thick MgO splines between panels, configuring a 2,250 mm long wall in final conditions of use.

In the tests, 9 mm thick magnesium oxide boards were used, instead of the 12 mm boards that make up the 4wall panels. The features when using 12 mm thick boards would be equal to or higher than those obtained with 9 mm thick boards (test report 142526 (QT-31594/1/SL)/Ref 1/CR1).

The maximum load and rigidity to misalignment values for each specimen obtained from the tests are shown in the following table.

| Specimen | Maximum load [kN] | Rigidity to misalignment [N/mm] |
|---------------------------------------|-------------------|---------------------------------|
| Without vertical load | | |
| 1 | 26.84 | 3,334 |
| 2 | 22.07 | 1,766 |
| 3 | 23.10 | 1,674 |
| Mean value | 24.00 | 2,258 |
| With vertical load (8.33 kN/m) | | |
| 1 | 34.30 | 2,192 |
| 2 | 33.13 | 2,217 |
| 3 | 32.54 | 2,985 |
| Mean value | 33.32 | 2,465 |

Table 8.6: Results of the test of resistance to misalignment.

8.2.6. Strength of the vertical joint between panels

The behaviour of the joint between panels has been assessed using the results of the flexural strength and resistance to misalignment of the system tests.

The vertical joint between panels has been analysed in relation to the following characteristics:

- Shear strength perpendicular to the face of the panels: this characteristic is only relevant if the panel is used in overhangs or if it rests on uneven ground. None of these situations is expected to occur in the final conditions of use. However, the high values of resistance to misalignment point to a good response of the vertical joint between panels for this characteristic.
- Shear strength parallel to the face of the panels: the high result of the flexural strength test of the system is indicative of the high performance of the shear

strength parallel to the face of the panels, although this test does not specifically assess this characteristic.

- Tensile strength of the joint between panels: the performance of this characteristic is expected to be high in view of the behaviour observed in the resistance to misalignment test. In this test, a compression combined with a parallel shear stress is exerted on the vertical joint.

In conclusion, it can be stated that the performance and the behaviour of the vertical joint between panels are adequate for the intended uses of the system.

8.2.7. Tensile strength perpendicular to the face of the panels (between MgO board and PUR)

The tensile strength perpendicular to the face of the panels (between the MgO board and PUR) has been assessed by tests according to the EN 1607 standard.

The results are shown in the following table:

| Specimen | Maximum load [MPa] | Tensile characteristic strength [MPa] (f_{ct}) (1) | Lower limit value ($f_{ct,lim}$) [MPa] (2) | $f_{ct} > f_{ct,lim}$ |
|----------|--------------------|--|--|-----------------------|
| 1 | 0.247 | | | |
| 2 | 0.200 | | | |
| 3 | 0.190 | 0.144 | 0.018 | Yes |
| 4 | 0.170 | | | |
| 5 | 0.208 | | | |

Note:

- (1) 5% fractile for a 75% confidence level with a log-normal distribution.
- (2) Lower limit value of tensile strength perpendicular to the faces according to section 5.2.1.6 of the standard UNE-EN 14509.

Table 8.7: Results of the tensile strength test perpendicular to the face of the panels.

8.3. Safety in case of fire

8.3.1. Reaction to fire

The reaction to fire of the 4wall SIP system panels has not been assessed.

The reaction to fire of magnesium oxide boards is A1 according to EN 13501-1, according to test report no. 243953 and classification report no. 243977.

8.3.2. Resistance to fire

The resistance to fire of the 4wall SIP system has been assessed by testing according to the standards EN 1365-1 and EN 1363-1, on a specimen made up of a central panel with dimensions 2,400 mm x 1,125 mm x 185 mm (height x width x thickness), and two panels with dimensions 2,400 mm x 912 mm x 185 mm (height x width x thickness) one on each side of the central panel.

The specimen includes joint paste according to EN 13963 between the magnesium oxide boards exposed to fire. This tested case is more unfavourable than if the Nullifire FS703 joint sealant specified in section 2.5 is used.

A load of 40 kN was applied to the specimen during the test, which for a total length of 2,949 mm is equivalent to 13.56 kN/m.

The results are set out in test report no. 380052 from Exova Warringtonfire.

| Behaviour criteria | Performance [min] (1) |
|------------------------------------|-----------------------|
| Bearing capacity | 77 |
| Withstanding flames | 77 |
| Structural integrity | 77 |
| Penetration of the measuring gauge | 77 |
| Cotton plug ignition | 77 |
| Insulation | 66 |

Note:

- (1) The test was stopped at 77 minutes.

Table 8.8: Results of the resistance to fire test.

Consequently, the resistance to fire of the 4wall SIP system is REI 60 for a load of 13.56 kN/m.

8.4. Hygiene, health and environment

8.4.1. Water vapour tightness of the panels

The water vapour tightness of the 4wall SIP system is determined by the water vapour permeability of its components.

The water vapour tightness of the panel components, expressed by the water vapour diffusion resistance factor, has been identified based on the values indicated in the technical data sheets or tabulated values.

The bonding between the board and the polyurethane foam is carried out by means of a self-adhesion process, without the presence of glues.

| Component | Water vapour diffusion resistance factor (μ) | Reference |
|-----------------------------------|--|----------------------|
| 12 mm thick magnesium oxide board | 16.1 | Technical data sheet |
| Polyurethane foam | 60 | EN ISO 10456 |
| Steel profiles | ∞ | EN ISO 10456 |

Table 8.9: Water vapour diffusion resistance factor of the components of the 4wall SIP system.

The temperature factor of the internal surface f_{Rsi} of the thermal bridges that are generated by the presence of metallic profiles in the perimeter of the panels of the 4wall SIP system has been obtained from the simulation by means of calculations in accordance with the EN ISO 10211 standard, with the result shown in the table below.

| Component | Internal surface temperature factor (f_{Rsi}) |
|--|---|
| Thermal bridge around the perimeter of the 4wall SIP system panels | 0,946 |

Table 8.10: Internal surface temperature factor f_{Rsi} .

8.4.2. Watertightness

The watertightness of the 4wall SIP system has been assessed by means of tests according to the EN 12865 standard.

Watertightness tests have been carried out on a specimen before and after accelerated ageing cycles according to ETAG 017.

The specimen consists of the union of three panels. A 2,400 mm x 1,125 mm x 185 mm (height x width x thickness) central panel, complemented by a 2,400 mm x 900 mm x 185 mm (height x width x thickness) panel to each side.

The tests have been carried out according to the following sequence:

1. Test to determine the resistance to rainwater of exterior walls under air pressure pulses (according to EN 12865).
2. Accelerated ageing (according to ETAG 017).
3. Test to determine the resistance to rainwater of exterior walls under pulsed air pressure (according to EN 12865).

Accelerated ageing heat - rain and heat - cold according to ETAG 017 consists of the following hygrothermal cycles.

- Heat – rain cycles:

The specimen is subjected to a series of 80 cycles, where each cycle includes the following phases:

- Heat to 70 °C (for one hour) and maintain at (70 + 5) °C and between 10% RH and 30% RH for two hours (3 hours total).

- Spray water at a temperature of (15 ± 5) °C with a flow of (1.5 ± 0.5) $\ell/(m^2 \cdot \text{min})$ for one hour.
- Allow to dry for 2 hours at a temperature of (20 ± 5) °C.

- Heat – cold cycles:

After at least 48 hours of conditioning at (20 ± 10) °C and a minimum relative humidity of 50%, the specimen is exposed to 5 heat – cold cycles of 24 hours that include the following phases:

- Heat to (50 ± 5) °C (reached after one hour) and maintain at that temperature and a maximum relative humidity of 30% for 7 hours (8 hours in total).
- Cool to (-20 ± 5) °C (reached after two hours) and maintain for 14 hours (16 hours in total).

The specimen is inspected every 4 heat – rain cycles and daily in the heat – cold cycles to detect possible changes in the visual characteristics of the specimen. Once the hygrothermal cycles have been completed, the specimen is left to dry for 7 days.

The test results are shown in the following table:

| Characteristic | Result |
|---|---|
| Rainwater resistance of external walls under air pressure pulses (according to EN 12865) before hygrothermal cycles | Maximum pressure of 1,200 Pa. No water penetration. No visible damage. |
| Hygrothermal cycles | No cracks or delamination of the board. No detachment from the board. No irreversible deformation. No water penetration. |
| Rainwater resistance of exterior walls under air pressure pulses (according to EN 12865) after hygrothermal cycles | Maximum pressure of 1,200 Pa. No water penetration. No visible damage. |

Table 8.11: Results of the watertightness tests.

The results are included in test report no. 164372 (QT-42277/2/SL)/Ref.6 by Lucideon.

8.5. Safety in use

8.5.1. Ability to withstand point loads

The pull-out resistance of BS-S 4.8 mm fasteners on 12 mm thick magnesium oxide boards has been assessed by tests.

The characteristic pull-out resistance (5% fractile with a 75% confidence level) was obtained from 12 test results, with a normal distribution.

| Mean value [N] | Standard deviation [N] | Characteristic resistance [N] |
|----------------|------------------------|-------------------------------|
| 1.637 | 122 | 1.389 |

Table 8.12: Pull-out resistance of BS-S 4.8 mm fasteners.

8.6. Protection against noise

8.6.1. Airborne sound insulation

Two tests have been carried out to determine the airborne sound insulation of façades in accordance with the EN ISO 10140-2 standard against noise from outside. The configurations tested and the results obtained according to ISO 717-1 are displayed in the following table.

| Facade configuration | $R_w (C; C_{tr})$ [dB] |
|--|------------------------|
| 4wall SIP wall | 32 (-3; -5) |
| (exposure to emission room) | |
| 4wall SIP wall | |
| + | |
| 50 mm layer with wooden posts at 600 mm and 50 mm of mineral wool with a density of 45 kg/m ³ | 50 (-6; -14) |
| + | |
| magnesium oxide board 12 mm thick | |
| (exposure to reception room) | |

Table 8.13: Airborne sound insulation test results.

The results are included in test report no. 2881-2524 to 2525 of the *Acoustic Testing Laboratory* of the University of Salford.

8.7. Energy saving and thermal insulation

8.7.1. Resistance and thermal transmittance

The thermal resistance of the 4wall SIP system has been assessed according to the EN ISO 6946 standard based on the thermal conductivity values of the panel components as shown in table 8.14.

| Component | Declared thermal conductivity (λ) [W/m·K] |
|--------------------------------|---|
| Magnesium oxide board | 0.27 |
| Polyurethane foam after ageing | 0.029 |
| Steel profile | 50 |

Table 8.14: Declared thermal conductivity of panel components.

The declared values of thermal conductivity of the polyurethane foam (λ_D) have been obtained from the calculated values ($\lambda_{90/90}$) determined in accordance with the indications of annex A and annex C of the UNE-EN 13165 standard, taking into account the fixed ageing increment ($\Delta\lambda_f$) according to chapter C.5.

The increase to calculate the value of thermal conductivity after ageing for polyurethane foams that use pentane as foaming agent, and that have a nominal thickness greater than 120 mm as they are not diffusion-tight, is 0.0038 W/(m K).

The thermal transmittance of the central section of the 4wall SIP wall without including the metal perimeter profiles has been calculated according to the EN ISO 6946 standard and is shown in the table below.

| | Thermal transmittance (U) [W/(m ² ·K)] | |
|--|--|--|
| | Without taking superficial thermal resistance into account | Taking superficial thermal resistance into account |
| Section of the 4wall SIP wall without including the metal perimeter profiles | 0.18 | 0.17 |

Table 8.15: Thermal transmittance of the central section of the 4wall SIP wall.

The thermal transmittance of the 4wall SIP wall sections with perimeter profiles and the linear thermal transmittance have not been assessed in this DAU.

The thermal transmittance of the wall assembly must be completed with the external cladding.

8.7.2. Airtightness

This characteristic has not been assessed.

8.8. Durability and serviceability aspects

8.8.1. Risk of corrosion of metal parts

The risk of corrosion of the metal parts has been assessed based on the data on the protective coating of the metal profiles that are part of the system, and the loss of mass per surface unit or loss of thickness of said coating depending on the corrosivity category that applies to it (see section 5.8.1).

8.8.2. Durability of the panel

The influence of ageing on the panels is determined from the reduction in tensile strength over time between the PUR insulation layer and the magnesium oxide boards.

According to the standard EN 14509, PUR panels made using the foaming agents covered by EN 13165 and their combinations must be considered to satisfy the durability requirements without the need for testing. The foaming agent used in the manufacture of the 4wall SIP system panels is included in the standard EN 13165, so the feature is considered adequate.

The behaviour of the adhesive bonding between the magnesium oxide panels and the steel profiles is considered adequate based on the results of the watertightness tests before and after ageing cycles.

The magnesium oxide board provides adequate durability as long as it is protected by an additional coating.

9. Expert commission

This DAU has been submitted to the opinion of an Expert Commission, as indicated in the *DAU Regulation* and in the Work Instruction for the elaboration of the DAU.

The Expert Commission was constituted by representatives of different organizations and institutions, which have been chosen for their knowledge, independence and impartiality to give a technical opinion regarding the scope of this DAU.

The general list of experts that have made up the expert commissions of DAUs is available on the website of ITeC, itec.es.

Comments and observations raised by members of this Commission have been included in the text of the present DAU.

10. Reference documents

- EN 13963: 2014 Jointing materials for gypsum boards - Definitions, requirements and test methods.
- BDA Agrément® BAW 18-085/01/A Versaliner® de 28-06-2018.
- EN 322: 1993 Wood-based panels - Determination of moisture content.
- EN 310: 1993 Wood-based panels - Determination of modulus of elasticity in bending and of bending strength.
- EN 319: 1993 Particleboards and fibreboards - Determination of tensile strength perpendicular to the plane of the board.
- EN 319: 1993 Wood-based panels - Determination of density.
- EN 13501-1: 2018 Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
- EN 319: 1993 Wood-based panels - Determination of density.
- EN 317: 1993 Particleboards and fibreboards - Determination of swelling in thickness after immersion in water.
- EN 826: 2013 Thermal insulating products for building applications - Determination of compression behaviour.
- EN 13165: 2012+A2:2016 Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products – Specification.
- EN 10346: 2015 Continuously hot-dip coated steel flat products for cold forming - Technical delivery conditions.
- ETA 20/1215 Nullifire FS703 Intusil.
- EAD 350141-00-1106 Linear joint and gap seals.
- EN 13501-2: 2016 Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services.
- EOTA TR 024 Technical description and assessment of reactive products effective in case of fire.
- DB-SI 1: Basic Document Safety in case of fire of the Technical Building Code. Section SI 1 Indoor propagation.

- DB-SI 2: Basic Document Safety in case of fire of the Technical Building Code. Section SI 2 Outdoor propagation.
- EN 1365-1: 2012/AC:2013 Fire resistance tests for loadbearing elements - Part 1: Walls
- EN 1363-1: 2020 Fire resistance tests - Part 1: General Requirements.
- DA DB-HE / 2 Support document for the DB-HE Basic Document Energy saving of the Technical Building Code. Verification of limitation of superficial and interstitial condensation in the enclosures.
- EN ISO 10211: 2007 Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations.
- EN 12865: 2001 Hygrothermal performance of building components and building elements - Determination of the resistance of external wall systems to driving rain under pulsating air pressure.
- ETAG 017 Vecture Kits.
- DB HR Basic Document of the Technical Building Code. Protection against sound.
- DB HE Basic Document of the Technical Building Code. Energy saving.
- EN ISO 12944-2: 2017 Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments.
- EN 14509: 2013 Self-supporting double skin metal faced insulating panels - Factory made products – Specifications.
- EN 335: 2013 Durability of wood and wood-based products - Use classes: definitions, application to solid wood and wood-based products.
- DB-HS 1: Basic Document Salubrity of the Technical Building Code. Section HS 1 Protection against moisture.
- 2014/955/EU Commission Decision of 18 December 2014 amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European Parliament and of the Council.
- Royal Decree 105/2008 of 1 February, on the production and management of construction and demolition waste.
- EN 1052-1: 1998 Methods of test for masonry – Part 1: Determination of compressive strength.
- EN 846-9: 2016 Methods of test for ancillary components for masonry - Part 9: Determination of flexural strength and shear resistance of lintels.
- EN 594: 2011 Timber structures - Test methods - Racking strength and stiffness of timber frame wall panels
- EN 1607: 2013 Thermal insulating products for building applications - Determination of tensile strength perpendicular to faces.
- EN ISO 10456: 2007/AC:2009 Building materials and products - Hygrothermal properties -Tabulated design values and procedures for determining declared and design thermal values.
- EN ISO 10140-2: 2021 Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation.
- ISO 717-1: 2020 Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation.
- EN ISO 6946: 2017 Building components and building elements - Thermal resistance and thermal transmittance - Calculation methods.

11. Assessment of fitness for use

Based on the following technical test results obtained during the preparation of the DAU 22/130 according to the criteria defined in the *Specific Assessment Procedure of DAU 22/130*, prepared by ITeC:

- tests and calculations results,
- information obtained from site visits,
- factory production control,
- instructions for the installation and execution of the system,
- project and execution criteria of the system,

and taking into account the methodology prescribed in the *DAU Regulation*, the authorization and the register of ITeC for awarding the DAU* and the indications in section 5.2 of article 5 of the *Technical Building Code (CTE)*, regarding the assessment of innovative building

products and systems, it is considered that ITeC has the evidence to declare that the construction system 4wall SIP system, manufactured at the Cheshire production plant (United Kingdom), and built according to the instructions contained in this DAU, is appropriate for the construction of load-bearing walls in residential, non-residential, industrial and commercial building, since it fulfils the relevant regulatory requirements in terms of mechanical resistance and stability, protection against fire, acoustic and thermal insulation, health and hygiene, as well as durability and serviceability requirements.

As a result, and once this document has been submitted to the Expert Commission and their comments have been included in it, ITeC awards the DAU to the product manufactured by Project Etopia Group Limited.

The validity of the DAU is subject to the actions and monitoring conditions specified in chapter 12 and to the use conditions of chapter 13.

(*) ITeC is an authorized organism for awarding the DAU (BOE 94, 19 April 2002) for construction products (building and civil engineering) registered in the General Register of the CTE: <https://www.codigotecnico.org/RegistroCTE/OrganismosAutorizados.html>.

DAU 22/130
Documento
de adecuación al uso



A handwritten signature in black ink, appearing to be 'Serrano', written over a circular stamp or seal.

El Director Técnico del ITeC



12. DAU monitoring

The present DAU is subject to the monitoring actions that ITeC carries out periodically, in accordance with the provisions of the *DAU Regulation*. The purpose of this monitoring is to check that the characteristics of the product and the construction system, as well as the execution and manufacturing conditions, are still valid for the envisaged intended uses.

If relevant changes affecting the DAU validity occur, these will result in a new DAU edition that will supersede the previous one (this new edition will take the same DAU code as the superseded one and a new letter edition).

When changes are of minor importance and they do not affect the DAU validity, these will be specified in a list of changes that will be incorporated as chapter 14 of the DAU; furthermore, these changes will be included as well in the DAU text.

The DAU user must always look up the DAU electronic version available in pdf format on the website of ITeC itec.es, in order to make certain of its possible revisions that may occur during its validity. This document is also available through the QR code included in the DAU stamp.

13. DAU conditions of use

In granting the DAU, the ITeC is not responsible for:

- The potential presence or absence of any patent, intellectual property or similar existing rights subsisting in the product the subject matter of the DAU or any other product, nor rights that affect third parties or the fulfilment of obligations to any of these third parties.
- The right of the DAU holder to manufacture, supply, install or maintain the product the subject matter of the DAU.
- The actual works or individual batches in which the product is installed, used and maintained; including its nature, design or execution.

In addition, the DAU cannot be ever interpreted as a guarantee, commitment or responsibility of the ITeC relating to the commercial viability, patentability, registrability or innovation of the results derived from the preparation of the DAU. It is, then, the holder's responsibility to check the viability, patentability and registrability of the product.

The assessment of the DAU does not imply the conformity of the product with the requirements foreseen by the health and safety or occupational risk prevention regulations, in relation to the manufacture, distribution, installation, use and maintenance of the product. Therefore, ITeC is not responsible for any loss or personal injury that may occur due to non-compliance with the requirements of the aforementioned regulatory framework.

14. List of changes to the present edition

The electronic version of the DAU includes, if any, the updating, changes and corrections of the present edition A of the DAU 22/130, indicating, for each of them, the date of incorporation, according to the format of the following table. The changes shown in the table will also be included in the text of the DAU, which is available on the Institute's website, itec.es.

The DAU user must always consult this DAU electronic version to be aware of any possible revisions which may occur during its validity.

| Number | Page and chapter | Where it said... | It says... |
|--------|------------------|------------------|------------|
| | | • | • |



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