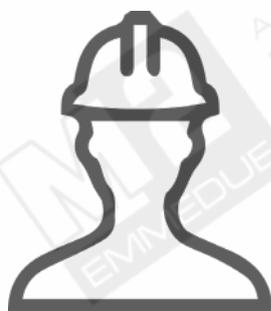




Advanced
Building
System



REV. 12 - 2023



OPERATOR'S HANDBOOK



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INDEX

1. INSTALLATION MANUAL.....	7
1.1 WALL BUILT WITH PSM PANEL.....	7
1.1.1 FOUNDATION ANCHORING.....	7
1.1.2 STORAGE ON THE CONSTRUCTION SITE.....	8
1.1.3 IDENTIFICATION OF COMPONENTS.....	9
1.1.4 ASSEMBLING OF THE PANELS.....	10
1.1.5 FURTHER INSTALLATION GUIDELINES.....	11
1.1.6 PLACEMENT OF REINFORCEMENT MESHES.....	12
1.1.7 ELECTRICAL AND PLUMBING INSTALLATION.....	15
1.2 SHOTCRETE APPLICATION.....	17
1.2.1 INTRODUCTION.....	17
1.2.2 SHOTCRETE MIX DESIGN.....	17
1.2.3 APPLICATION OF SHOTCRETE ON WALLS.....	17
1.2.4 SHOTCRETE CURING.....	20
1.2.5 FINISHES.....	20
1.2.6 OTHER RECOMMENDATIONS.....	21
1.2.7 PRECAUTIONS.....	21
1.2.8 FASTENING OBJECTS TO THE WALL.....	22
1.3 WALLS BUILT WITH PDM DOUBLE PANELS.....	23
1.3.1 FOUNDATIONS.....	24
1.3.2 INSTALLATION OF DOUBLE PANELS.....	25
1.3.3 PLACING REINFORCEMENTS ON DOUBLE PANELS.....	27
1.3.4 COMPLETION OF PDM PANELS.....	28
1.3.5 CASTING OPERATIONS.....	29
1.4 SLABS WITH PSS PANELS.....	31
1.4.1 INSTALLATION OF SINGLE PANEL SLABS.....	31
1.4.2 COMPLETION OF SINGLE PANEL SLABS.....	32
1.5 SLABS WITH PSG PANEL.....	33
1.5.1 JOIST SLABS WITH PSG SLAB PANEL.....	33
1.5.2 INSTALLATION OF THE PSG SLAB PANELS.....	34
1.5.3 COMPLETION OF PSG SLAB PANELS.....	35
1.5.4 CALCULATION AND CHECKS OF PSG SLAB PANEL.....	35
1.6 STAIRCASES AND LANDINGS.....	37
1.6.1 USE OF STAIRCASE AND LANDING PANEL.....	37
1.7 CLADDING AND PARTITION WALLS.....	38
1.7.1 PANEL INSTALLATION.....	38
1.7.2 COMPLETION ON SITE.....	40
1.8 INSULATING COVERS MADE WITH PST PANEL.....	41
1.8.1 INSTALLATION OF THE EMMEDUE INSULATING COVER PANEL.....	41

INDEX

2. OPERATING STEPS SUMMARY	43
2.1 WALL BUILT WITH PSM PANEL	43
2.1.1 MAIN OPERATIONAL STEPS.....	43
2.1.2 PREPARATION OF REBARS IN THE FOUNDATION.....	43
2.1.3 ASSEMBLING OF THE PANELS.....	46
2.1.4 WALL PLUMBING AND SCAFFOLDING.....	51
2.1.5 PLACEMENT OF DOOR AND WINDOW FRAMES.....	52
2.1.6 INSERTION OF INSTALLATION CHANNELS.....	54
2.2 SHOTCRETE APPLICATION	55
2.2.1 BEFORE THE SHOTCRETE APPLICATION.....	55
2.2.2 PLACING SCREEDS.....	56
2.2.3 WALL PLUMBING AND SCAFFOLDING.....	57
2.2.4 VARIOUS RECOMMENDATIONS.....	58
2.3 WALL BUILT WITH PDM DOUBLE PANEL	59
2.3.1 MAIN OPERATING STEPS.....	59
2.3.2 POSITIONING OF ANCHOR REBARS IN THE FOUNDATIONS.....	59
2.3.3 ASSEMBLING OF THE PANELS.....	60
2.3.4 CONNECTING ADJACENT PANELS.....	62
2.3.5 VARIOUS ADDITIONS.....	63
2.3.6 PANEL CUTTING.....	64
2.3.7 WALL PLUMBING AND SCAFFOLDING.....	65
2.3.8 FILLING THE WALL PANELS WITH CONCRETE.....	66
2.3.9 INSTALLATIONS AND RENDERING.....	66
2.4 SLABS WITH PSS SINGLE PANEL	67
2.4.1 INSTALLATION OF PSS SINGLE PANEL SLABS.....	67
2.5 SLABS WITH PSG PANEL	69
2.5.1 INSTALLATION OF THE PSG PANEL SLABS.....	69
2.5.2 COMPLETION OF THE PSG PANEL SLABS.....	71
2.6 STAIRCASES AND LANDINGS	72
2.6.1 STAIRCASE AND LANDING PANELS.....	72
2.7 CLADDING AND PARTITION WALLS	74
2.7.1 PANEL INSTALLATION.....	74
2.8 INSULATING COVERS WITH PST PANEL	76
2.8.1 MAIN APPLICATION PHASES.....	76

INDEX

3. CONSTRUCTION DETAILS.....	78
3.1 PLAN VIEW.....	78
3.1.1 GENERAL SCHEME.....	78
3.2 SINGLE PANEL ANCHORAGE.....	79
3.2.1 ANCHORING SINGLE PANEL TO RAFT FOUNDATION.....	79
3.2.2 ANCHORING SINGLE PANEL TO BEAM FOUNDATION.....	80
3.3 DETAIL OF ANCHORAGE OF WALL/FLOOR (PSG PANEL).....	81
3.3.1 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PSG PANEL).....	81
3.3.2 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PSG PANEL).....	83
3.4 OPENING REINFORCEMENT (PSM).....	86
3.4.1 OPENING REINFORCEMENT DETAIL.....	86
3.4.2 WINDOW REINFORCEMENT DETAIL.....	87
3.4.3 DOOR REINFORCEMENT DETAIL.....	88
3.4.4 REINFORCEMENT MESHES LAYOUT.....	89
3.5 STAIRCASE ANCHORAGE.....	90
3.5.1 LANDING/WALL AND LANDING/STAIRS ANCHORAGE DETAILS.....	90
3.5.2 SECTION AND 3D EMMEDUE STAIRS-PSM PANEL.....	91
3.6 WALL PANEL JOINTS (PSM PANEL).....	92
3.6.1 HORIZONTAL SECTION OF WALL PANEL JOINTS (PSM PANEL).....	92
3.6.2 WALL PANEL JOINTS IN HIGH SEISMIC ZONE (PSM PANEL).....	93
3.7 DETAIL OF ANCHORAGE OF WALL/FLOOR (PSS PANEL).....	94
3.7.1 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PSS PANEL).....	94
3.7.2 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PSS PANEL).....	95
3.8 EAVE AND RIDGE DETAIL (PSM-PSS PANEL).....	96
3.8.1 DETAIL OF EAVE AND RIDGE WITH PSM-PSS PANEL.....	96
3.9 CLADDING WALLS SOLUTIONS.....	97
3.9.1 SOLUTION 1: PANEL BAKED TO STRUCTURE WITH PROTRUDING PILLAR.....	97
3.9.2 SOLUTION 2: CONTINUOUS EXTERNAL PANEL.....	98
3.9.3 SOLUTION 3: PANEL BAKED TO STRUCTURE WITH PLASTERBOARD.....	99
3.10 DOUBLE PANEL ANCHORAGE.....	100
3.10.1 ANCHORING DOUBLE PANEL TO RAFT FOUNDATION.....	100
3.10.2 ANCHORING DOUBLE PANEL TO BEAM FOUNDATION.....	101
3.11 WALL PANEL JOINTS (PDM PANEL).....	102
3.11.1 HORIZONTAL SECTION OF WALL PANEL JOINTS (PDM PANEL).....	102
3.12 DETAIL OF ANCHORAGE OF WALL/FLOOR (PDM/PDME PANEL - PSG PANEL).....	103
3.12.1 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PDM/PDME PANEL - PSG PANEL).....	103
3.12.2 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PDM/PDME PANEL - PSG PANEL).....	104

INDEX

3.13 OPENING REINFORCEMENT (PDM).....	105
3.13.1 WINDOW REINFORCEMENT DETAIL.....	105
3.13.2 DOOR REINFORCEMENT DETAIL.....	106
3.14 LINTEL OVER DOOR AND WINDOW (DOUBLE PANEL).....	107
3.14.1 LINTEL OVER DOOR AND WINDOW.....	107
3.14.2 DETAIL OF ROOF SLAB ANCHORAGE.....	108
3.15 EAVE AND RIDGE DETAIL (PDM-PSG PANEL).....	109
3.15.1 DETAIL OF EAVE AND RIDGE WITH PDM-PSG PANEL.....	109
3.16 STAIRCASE ANCHORAGE.....	110
3.16.1 SECTION AND 3D EMMEDUE STAIRS-PDM PANEL.....	110

1 INSTALLATION MANUAL

1.1 WALL BUILT WITH PSM PANEL

➤ 1.1.1 FOUNDATION ANCHORING

The anchoring of the panels to the foundations should be carried out by determining the placement of reinforcing bars (rebars) with a specific number, length, and diameter based on the calculated stress at the base of the panel. As a guideline, rebars with a diameter of 6-8mm (0.24-0.32 in) can be used at intervals of 30-40 cm (12-16 in), with an exterior length of 40 cm (16 in).



➤ 1.1.2 STORAGE ON THE CONSTRUCTION SITE

An area inside the construction site, preferably covered, should be designated for storing panels received from the manufacturer. The panels must be laid down carefully on a flat, non-pliable surface to allow for vertical stacking. It is recommended not to place the elements directly on the ground to prevent them from getting dirty, which could lead to problems with plaster adhesion.

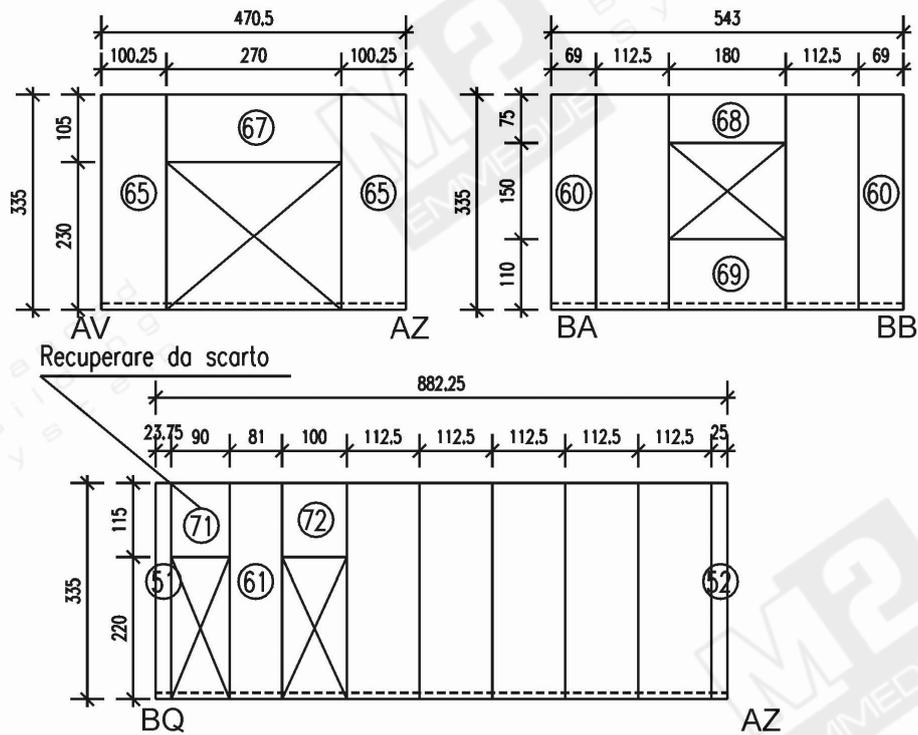
The panels should not be exposed to prolonged sunlight to avoid changes in the appearance of the polystyrene. Furthermore, the panels should be securely bound to prevent them from being accidentally moved by the wind.



➤ 1.1.3 IDENTIFICATION OF COMPONENTS

The panels are delivered to the site with an identification label issued by the manufacturer that includes the element's height. Additionally, the panel layout is provided with the panels, offering instructions for the proper installation of the components.

For each elevation, the panel layout contains the design for various structural alignments and floor panel plans. It also provides instructions for cutting to achieve non-standard dimensions when necessary.



Panel Layout

➤ 1.1.4 ASSEMBLING OF THE PANELS

EMMEDUE panels are secured to the foundation bars using clamps and steel wires.



To ensure continuity among the components, panels are equipped with overlapping mesh wings on both sides, facilitating the joining of adjacent panels.

At this stage, to ensure proper heat insulation and prevent differential shrinkage of the shotcrete, it's important to avoid leaving any empty spaces between the joints of the polystyrene cores.

When assembling the panels, it's essential to plan for the main openings such as doors and balconies in advance. Any openings not accounted for in the panel layout can be easily created by cutting the panels at the end of the assembly process.



The connection between one panel and the adjacent one can be accomplished through manual ties or by using pneumatic machines available from EMMEDUE. These connections should be made along the overlapping wires at intervals of 25 cm (one mesh every four).



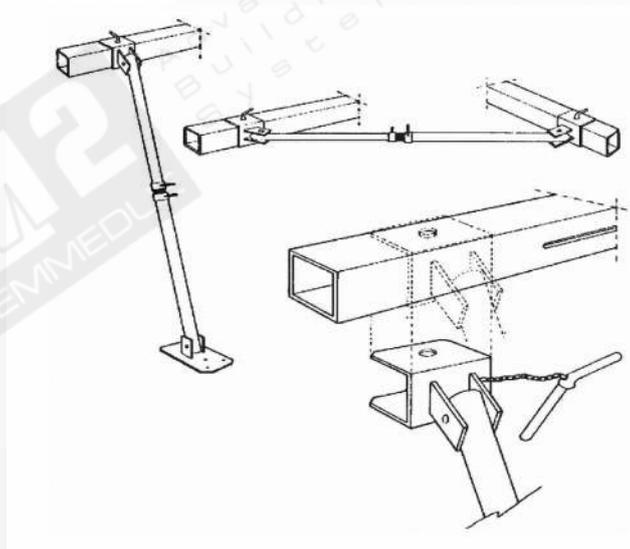
➔ 1.1.5 FURTHER INSTALLATION GUIDELINES

We recommend starting the layout from a corner of the building and progressing by completing each individual room that comprises the project.

For proper assembly, it's essential to meticulously check the wall's flatness and the corner's verticality using a plumb line.

To ensure flatness, we suggest using aluminum profiles and adjustable diagonal props that can be securely anchored into the ground. Specifically, for standard interstories, placing one support box near the top of each panel, along with plates and diagonal pillars at intervals of approximately one every 3 meters (10 feet), is sufficient.

We recommend positioning diagonal props on one side to completely clear the other side, which allows for faster progress during the shotcreting process.

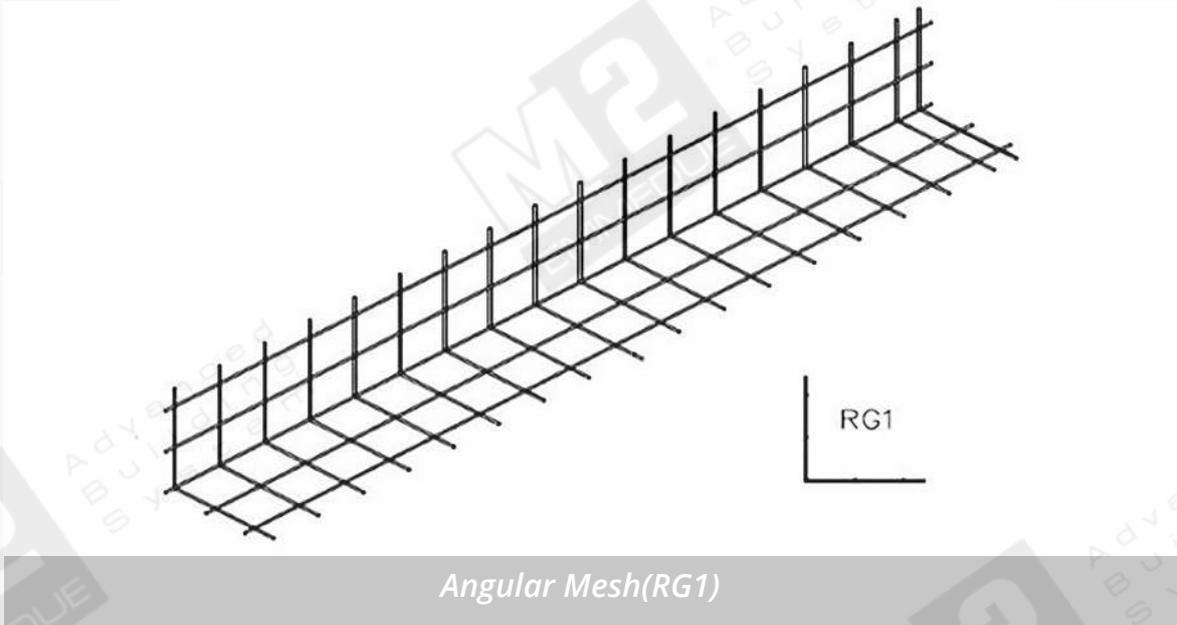




1.1.6 PLACEMENT OF REINFORCEMENT MESHES

Angular meshes (RG1)

All the internal and external corners of the building, whether vertical or horizontal, should be reinforced with angular meshes (RG1). These meshes are attached to the structural mesh of the panels (refer to the picture below).

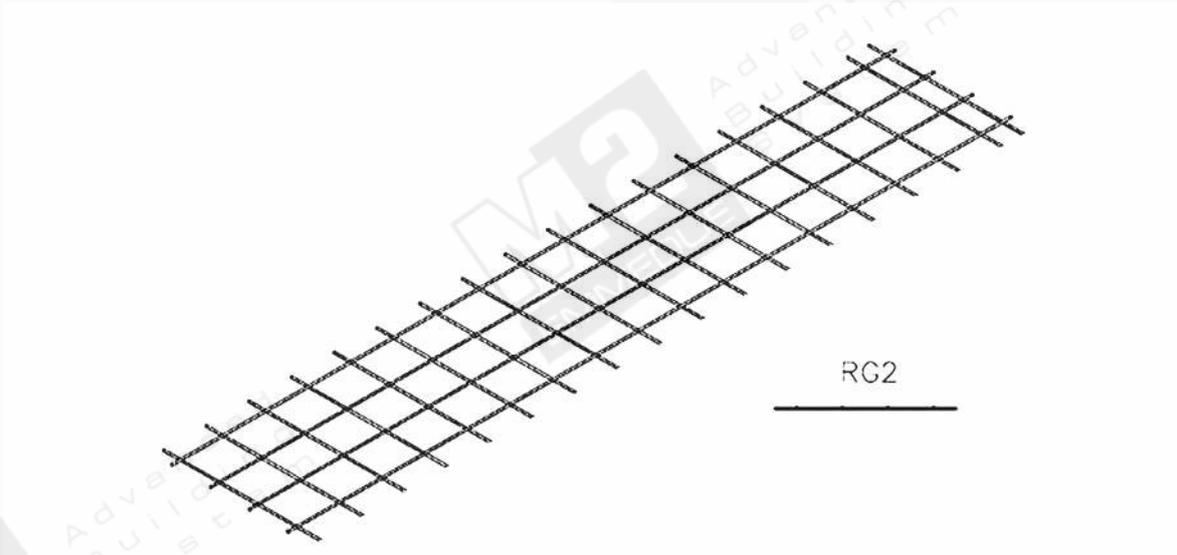


Positioning of Angular Meshes

Flat meshes (RG2)

For all openings, it is essential to provide bracing on both sides by positioning a flat mesh (RG2) at a 45° angle on each corner.

Depending on the geometry (length and height) of lintels, additional reinforcement may be required on both sides based on structural calculations.



Flat Mesh (RG2)

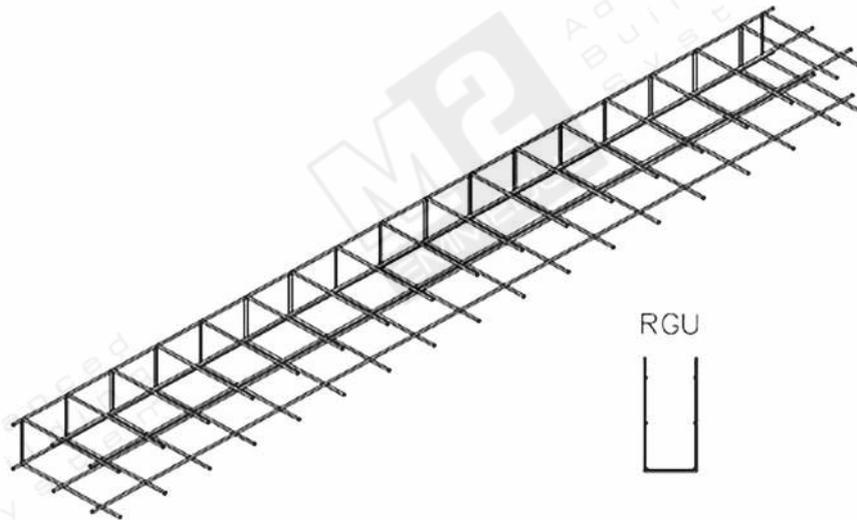


Positioning of Flat Meshes

U meshes (RU)

Around the perimeter of door and window openings, reinforcement U meshes (RU) or, alternatively, double angular meshes (RG1) should be installed along with sealing panels.

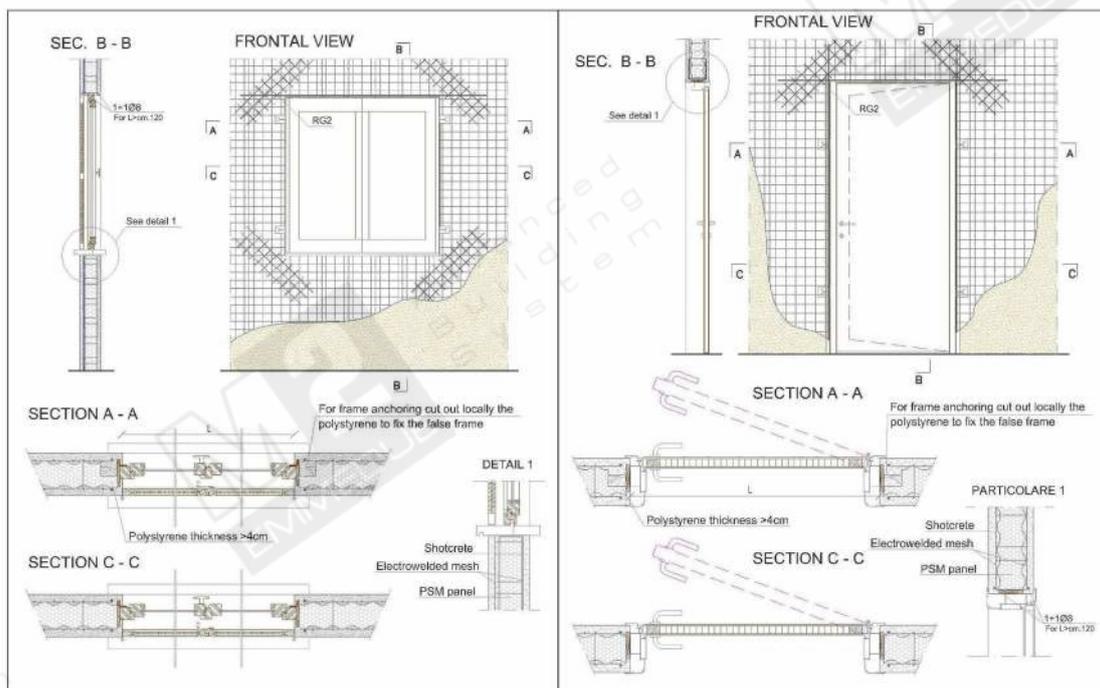
When assembling the frames, it is necessary to cut out the polystyrene in the areas where the frame fastening points are located. This allows for the proper insertion of metallic clamps into the panel's mesh.



U Mesh

WINDOW detail

DOOR detail



Positioning of U Meshes

For special requirements or for specific types of doors or windows that necessitate special measures, custom anchorages may be created.

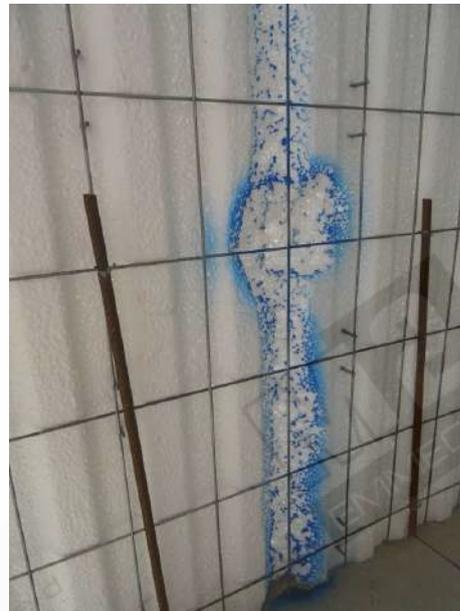
➤ 1.1.7 ELECTRICAL AND PLUMBING INSTALLATION

The installation of flexible electrical piping and rigid plumbing piping is carried out after completing the assembly of the panels and before applying the structural plaster.

The conduits should be created directly within the polystyrene core, preferably using a jet of hot air rather than an open flame. This ensures that the thickness of the polystyrene is not excessively reduced, maintaining a minimum wall insulation thickness of at least 4 cm (1.6 in).

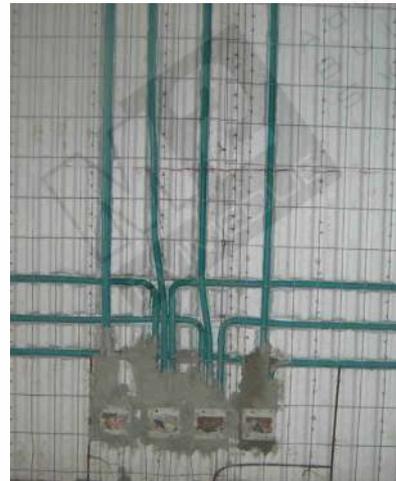
In extraordinary circumstances where it is not possible to insert the units into the walls, casings must be constructed.

Any cuts made in the mesh to accommodate electric boxes or other accessories with dimensions larger than standard should be repaired with flat reinforcement mesh RG2 before applying the structural plaster.



Flexible pipes can be easily positioned beneath the meshwork, while rigid pipes should be placed after cutting the mesh. As a result, the meshwork area should be reinstated by incorporating an additional reinforcement mesh (RG2) connected to the panel's meshwork.

Note: Copper pipes should be insulated from the steel mesh using materials such as felt, PVC, or a similar insulating material.



1.2 SHOTCRETE APPLICATION

➤ 1.2.1 INTRODUCTION

The EMMEDUE single panel, used as a supporting element, is completed by applying cement-sand structural plaster on both sides, with an average thickness of 3.5 cm (1.38 inches). This process results in the formation of a reinforced concrete wall with an expanded polystyrene core.

➤ 1.2.2 SHOTCRETE MIX DESIGN

The cement-sand plaster is proportioned with a volumetric ratio of 1:4. The sand used should have a grain size ranging from 0 to 6 mm. Considering the cement-sand ratio and the maximum sand diameter, it is determined that approximately 350 Kg (589 lbs.) of cement should be used for each cubic meter of mix.

For each cubic meter, the specified weights for each of the materials in the mixture are as follows:

Cement :	350 Kg (772 lbs)
Sand :	1600 Kg (3527 lbs)
Water :	160 liters

The quantity of water should be adjusted according to the moisture content of the aggregates. In any case, the workability, as measured by the Abram's cone, should be S2 (with a slump of 5 cm or 2 inches).

If you are using a premixed product, ensure that the percentage of lime is less than 5% of the cement's weight.

➤ 1.2.3 APPLICATION OF SHOTCRETE ON WALLS

The shotcrete should be applied using special EMMEDUE hopper guns or continuous spray pumps. The workability of the mix and the pressure at which it is sprayed are crucial for achieving the necessary consistency.

To achieve the final thickness on each side, it is recommended to apply at least two layers. The first layer should be approximately 2.5 cm thick to cover the wire mesh, while the final layer should be a finishing layer made with fine sand. Avoid excessively thick applications.

Once the panels are assembled, vertically aligned, and the reinforcement meshes are in place, including the replacement of cut meshes for electrical and plumbing installations to maintain structural continuity, the shotcrete application can commence.

On both sides of the vertical panels, a layer of structural plaster (Rck = 25 MPa or 3556 PSI) should be sprayed, with an average thickness of approximately 2.5 cm (1 inch).

The second layer should only be applied once the first one has sufficiently hardened. After the curing process, the resulting structural plaster should have a strength of 25 MPa.



In case of rain, it is advisable to halt work and cover the completed sections to prevent fresh structural plaster from being washed away. The shotcrete application should not take place when the outside temperature is below 4°C, in high temperatures exceeding 35°C, or in windy conditions. The layer of structural plaster should be kept damp or protected with anti-evaporating materials for a minimum of 2 days.

To ensure the perfect thickness of the shotcrete, it is recommended to have guides in place. These guides can be created on-site using the same material as the shotcrete or by using metal profiles. Care should be taken to remove them when the material is still fresh.

This practice helps prevent the formation of cracks, and the guides should be positioned at intervals of approximately 1.50 meters.

The day after completing the shotcrete, the supports used for aligning and plumbing the panels can be removed. However, supports used in structurally weak areas, such as between two openings, should be left in place until the curing process reaches a higher degree of completion.



➤ 1.2.4 SHOTCRETE CURING

A proper curing process is essential to achieve the required structural quality of the elements. To prevent excessive evaporation from the plaster surfaces, it is important to keep the walls and ceilings consistently moist for at least 2 days from the moment the plaster layer is applied.

This approach promotes the natural hydration process of the cement and helps minimize hairline cracks caused by hydraulic shrinkage. When using anti-evaporation films, it is crucial to conduct a preliminary check to ensure there are no adhesion issues for the subsequent finishing application.



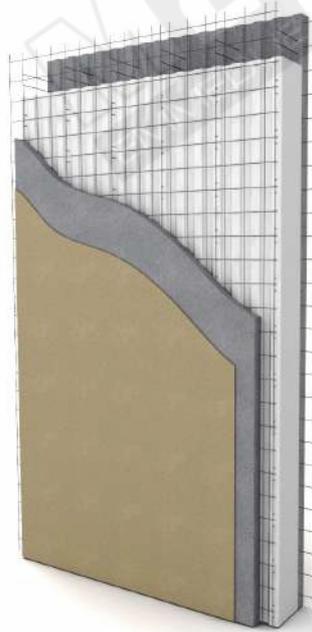
➤ 1.2.5 FINISHES

To prevent or, if necessary, address the appearance of hairline cracks, it is advisable to apply the finishing layer only after the curing process has been completed.

➔ 1.2.6 OTHER RECOMMENDATIONS

The use of a plaster sprayer for applying structural plaster enhances compactness and uniformity, reducing shrinkage levels and improving the structure's water resistance and durability.

Polystyrene is not considered special waste and can be disposed of in bins designated for RSU plastics. Steel components can be recycled and taken to authorized collection centers.

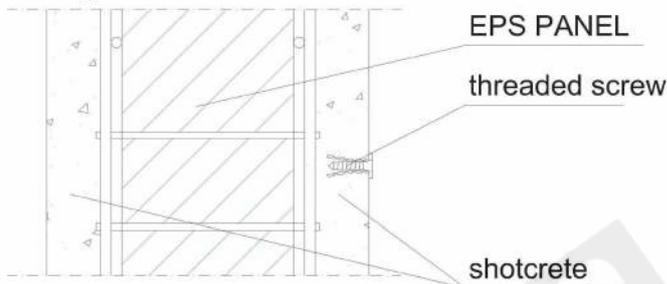


➔ 1.2.7 PRECAUTIONS

- ❗ Avoid overloading partition walls on one side only. Instead, apply plaster alternately on both sides.
- ❗ If a panel lacks an overlapping mesh due to necessary cuts, it is important to restore continuity with adjacent panels using a flat mesh with a minimum width of 23 cm (9 inches).
- ❗ The use of additional plasticizers generally reduces the risk of cracks.
- ❗ The inclusion of additional polypropylene fibers typically reduces the risk of cracks.
- ❗ Using highly flexible coverings or paints may help prevent the formation of cracks on the plaster.

➤ 1.2.8 FASTENING OBJECTS TO THE WALL

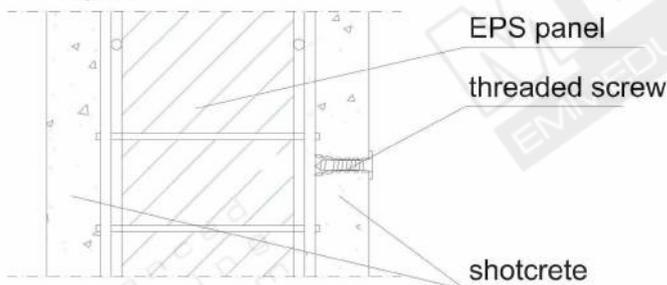
Fig. 1:



1. **Light objects:**

For lightweight objects, screws, pins, or similar devices that are 2.5 cm (1 inch) in length may be used (Fig. 1).

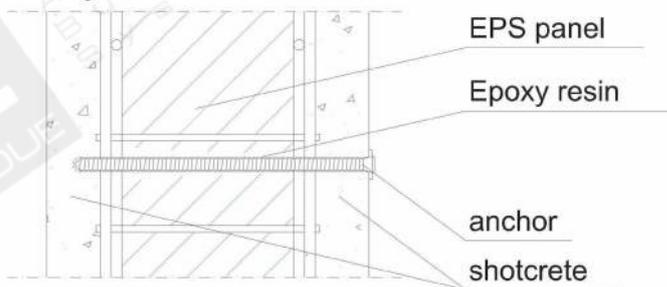
Fig. 2:



2. **Heavy objects:**

When securing heavy items such as shelves, water tanks, toilets, etc., it is recommended to use plastic anchors with 2-2.5 cm (1-3/4 inches) long screws or similar devices (Fig. 2).

Fig. 3:



3. **Very heavy objects:**

For very heavy objects, during construction, metal pins can be inserted into plaster anchors. Threaded pins can also be fastened with epoxy resin (Fig. 3).

1.3 WALLS BUILT WITH PDM DOUBLE PANELS

Load-bearing walls can also be constructed using double panels where additional reinforcement can be inserted, preferably on-site.

The preliminary phases are similar to those for single PSM panels. One can refer to the respective instructions for storing, identification, conservation, assembly, and so on.

Double panels create a permanent formwork system with thermal-insulating properties. After fastening, placing, and vertically aligning the panels, concrete is poured inside.



➤ 1.3.1 FOUNDATIONS

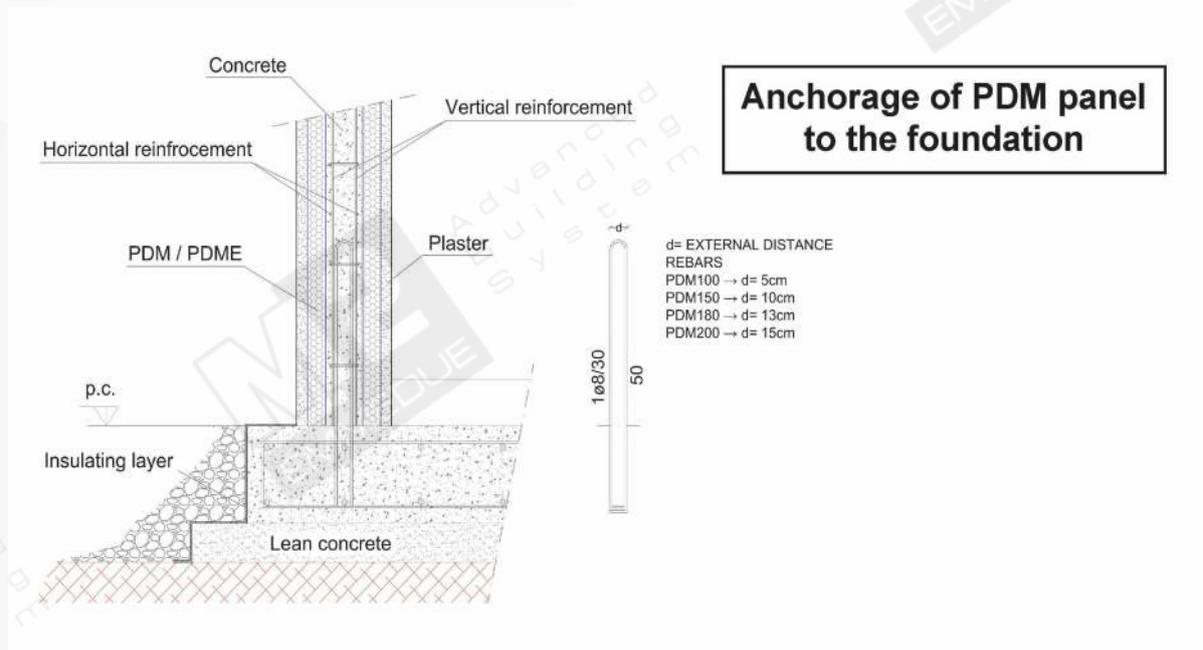
When placing reinforcements, special care must be taken to ensure proper alignment, especially due to the moderate thickness of the gaps (ranging from 10-30 cm or 3.9 to 11.8 in) in the double panels typically used.

The number, diameter, and length of the reinforcement bars should be determined based on the calculated stress at the base of the panels. The spacing of the external rebars should be meticulously maintained to avoid issues during panel installation. It's advisable to use closed reinforcements at the top to facilitate the insertion of the panels from above.

Correctly positioned rebars contribute to keeping the panels properly aligned and upright.

If the panels are in contact with the earth or subjected to vertical stresses, the rebar design should always consider this in accordance with the structural analysis.

At the base of the panels, regulator boards should be securely placed in the ground to ensure alignment and assist in positioning the reinforcement elements.



➤ 1.3.2 INSTALLATION OF DOUBLE PANELS

The assembly of panels should only commence after confirming compliance with the project instructions and the assembly guidelines provided for the supplied elements.

It is essential to verify that, following transportation and storage procedures, the panels and internal mesh remain intact and properly positioned with the correct spacing.

The panels are originally equipped with appropriate steel reinforcement during production. If additional reinforcement is required as per the structural designs, it is recommended to install it on-site and secure it at both the base and head of the panel. Additional bars should be placed inside the mesh to ensure sufficient coverage.

All procedures should strictly adhere to the instructions outlined in the structural designs, and they must be carried out under the supervision of the project supervisor.

The panels should be placed on-site one by one from above, avoiding any horizontal movement that may be hindered or complicated by the presence of reinforcement bars.

During panel placement, horizontal reinforcement should be inserted in alignment with the project design to ensure the continuous flow of subsequent concrete filling.

At this stage, particular attention should be given to maintaining the alignment and verticality of the panels. Ensuring a perfect fit between consecutive panels is crucial. Panels that are not plumb can create structural weak points, and gaps between adjacent panels can create thermal bridges.

To ensure the continuity of the components, EMMEDUE panels are equipped on both sides with overlapping mesh that facilitates the joining of adjacent panels.



Sealing between one panel and the next can be accomplished using pneumatic machines produced by EMMEDUE or by manual binding. The connections should be made along the overlapped wires at intervals of approximately 25 cm (10 inches) (one connection every four).

The above-mentioned instructions are designed to prevent detrimental eccentricities during the completion of the structure. Uncontrolled eccentricities could lead to an undesirable out-of-plumb effect that induces bending action (the P-Delta effect). Moreover, correcting the finished wall to restore its vertical position would require excessive finishing material, resulting in a time-consuming and wasteful process.

During assembly procedures, it's crucial to consider the project's designated openings according to the assembly guidelines. Any alterations to the openings or the creation of new ones should be approached with caution, as they constitute structural modifications with significant implications.

To insert additional reinforcements at the top of doors and windows, the support of transversal connectors can be utilized.

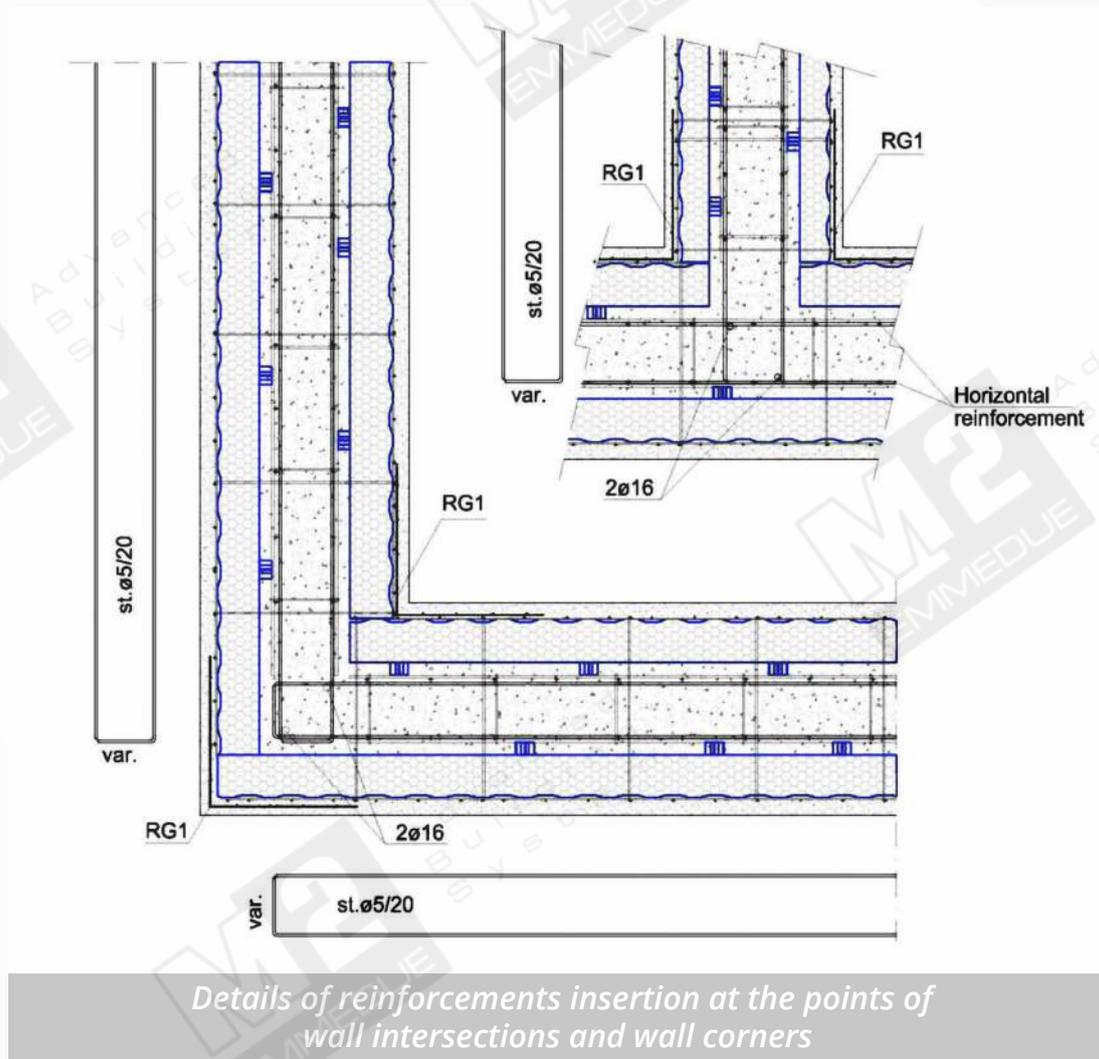


➤ 1.3.3 PLACING REINFORCEMENTS ON DOUBLE PANELS

Adequate reinforcements must be placed at all junctions, as well as next to the openings and end portions of the walls, using vertical reinforcement bars. These reinforcements can be clamped and entirely inserted into the panel or secured with U rods and placed externally.

In any case, it is essential to ensure wall continuity, even at joints, to withstand the shear forces as determined by the structural analysis.

In addition to horizontal and vertical reinforcements that need to be positioned within the wall panels and/or cross panels, the typical reinforcements used for PSM constructions, including flat and angular meshes, should be installed.



➤ 1.3.4 COMPLETION OF PDM PANELS

Before casting procedures, it is crucial to ensure that the walls are correctly positioned, perfectly aligned, plumb, and adequately braced to withstand the dynamic forces generated during concrete casting. It's worth noting that the PDM's polystyrene, with a density of 30 kg/m³, is capable of withstanding most of the pressure from the concrete casting process. Additional reinforcement can be achieved by using metallic trusses that encase the panel from both sides.

Therefore, it is necessary to place supports on both sides that not only ensure verticality but also provide stability during the casting process. The spacing between these components can be approximately 10 feet. The role of the trusses can be fulfilled by aluminum box profiles, wooden walls, boards connected with metal ties, iron wires, or round bars with clamps. If slabs or bars pass through the panels, it is advisable to cover them with plastic sheaths to minimize exposure to the casting and facilitate removal once the procedure is completed, avoiding the need for cutting.

It is essential that the first row of reinforcement is placed at the base of the panel where the pressure is greatest. For a typical wall height of 2.7 meters (8.9 feet), four horizontal rows of reinforcement can be positioned, starting from the base and proceeding at subsequent intervals of 0.4, 0.7, and 1 meter (1.3, 2.3, and 3.3 feet). The stiffeners should be connected to each other at an average interval of 50 cm (1.6 feet).



The use of a panel with EPS density equals to or major than 30 kg/m³ (Compressive strength > 250 kPa) allows to avoid the installation of the stiffener elements as previously described, with the consequent reduction of the realization time.

Usually, the concrete level does not reach the top of the panel but stops at approximately 30 cm (1.1 ft) below it. This is done to allow for the placement of reinforcement bars that extend from one panel to the next level. The filling will be completed simultaneously with the floor casting.

If a casting block is present, the exposed part of the panel must be secured at intervals of approximately 1.6 ft to the mesh and/or upper rods of the floor to prevent potential damage from concrete pressure.

At the edges of the panels, covers with boards and securely anchored inclined pillars must be installed. The same should be done at the openings for doors and windows, where reinforcement, supported by pillars (both horizontal and vertical), should be placed at intervals of approximately 1 meter (3.3 ft).

➤ 1.3.5 CASTING OPERATIONS

The instructions well-known to technicians regarding the correct casting procedures and all the required inspections to be conducted before, during, and after the process will not be detailed here. However, there are other aspects specific to using EMMEDUE panels that should be kept in mind.

First and foremost, the mix design should incorporate aggregates with a maximum diameter of 1.2 cm (0.47 in), possess high workability (slump S5), and exhibit mechanical resistance typically exceeding 30 MPa (3556 PSI), corresponding to the project's design requirements.



Casting procedures can be executed using buckets or with the assistance of an auto-pump. In the latter case, it may be advantageous to fabricate an appropriate rectangular section casting tube to efficiently convey concrete between the walls, minimizing material wastage.

The casting should progress gradually, with concrete being filled into the panels in layers, each with a maximum thickness of 80 cm (2.6 ft) per pass, allowing it to set for a few minutes. The casting speed along the walls should not exceed 3 meters of height per hour (9 feet of height per hour).

1.4 SLABS WITH PSS PANELS

➤ 1.4.1 INSTALLATION OF SINGLE PANEL SLABS

The same basic instructions that apply to the vertical single panels are generally relevant to the installation of single panel slabs. This means that it is necessary to begin by correctly positioning the components and subsequently joining them along the overlapping meshes.

In the end, the connection of walls is carried out using steel bars and/or reinforcement meshes RG1.

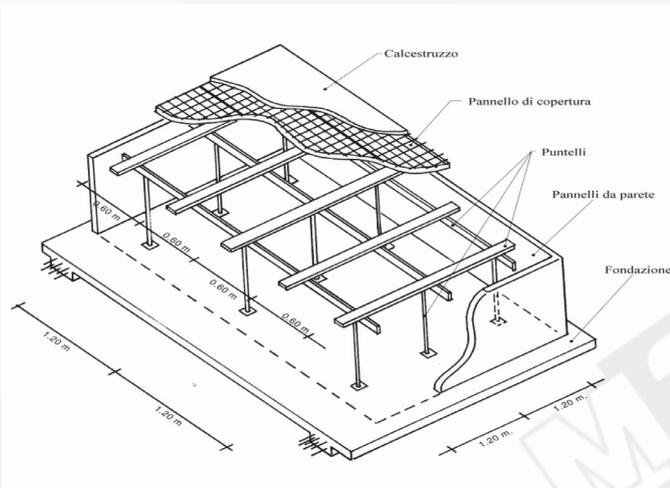


The panels that serve as slabs should be placed with the waves parallel to the minimum span of the coverage area.

These panels are supported by bridges constructed from boards and props, which are positioned at intervals of approximately 60 cm (23.62 inches). A camber of 0.25 cm (0.1 inch) should be created for every meter of slab length.



➤ 1.4.2 COMPLETION OF SINGLE PANEL SLABS



After the shotcrete application and at least 24 hours following the mortar application, the concrete casting for the floor can commence. During the casting process, operators should remember to walk only on the board bridges supported by the props underneath.

In advance, the designer should verify the slab reinforcements, which may be supplemented with additional steel bars as needed, following the structural analysis.



The concrete to be used should have a minimum strength of $R_{ck} \geq 30$ MPa, with a maximum aggregate diameter of 12 mm (0.5 in) and a workability grade of S4. The concrete slab thickness will vary between 4 and 6 cm (1.6 and 2.4 in).

Once the concrete slab has cured, the props can be removed. For slabs with lengths exceeding 4 meters, central props should be retained. After this, the shotcrete application on the ceiling can be completed, following the same method used for the walls.

1.5 SLABS WITH PSG PANEL

➤ 1.5.1 JOIST SLABS WITH PSG SLAB PANEL

This type of panel extends the range of applications of the single wavy PSS1 panel, enabling the construction of larger span structures, up to 8-9 meters (26-30 feet). These panels serve as lightweight formwork, creating components with unidirectional behavior that are finished on-site. Concrete is poured into the joists, forming an upper slab with a variable thickness of 4 to 6 cm (1.6 to 2.4 inches), depending on specific conditions such as loads and spans.

Concrete with a minimum strength of 30 MPa should be used, in accordance with the structural design, and with aggregates having a maximum diameter of 12 mm (0.47 inches).

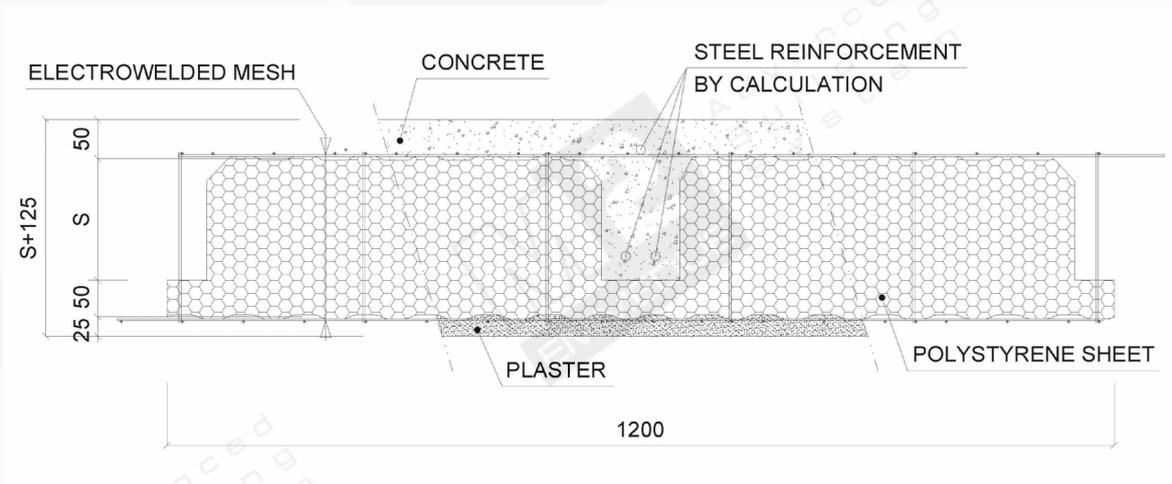




1.5.2 INSTALLATION OF THE PSG SLAB PANELS

For PSG floors, shoring must also be employed, and the distance between the props should be a maximum of 60-70 cm.

The height of the props at the center of the slab should be increased to create a camber of approximately 0.25 cm (0.1 in) for every meter (3.3 ft) of span.



➤ 1.5.3 COMPLETION OF PSG SLAB PANELS

Please refer to the instructions provided for the single slab panel. This means that it is necessary to begin by joining the individual components and then connecting them to the walls using steel bars and/or reinforcement meshes.

Joist reinforcements, to be placed before casting the concrete, must be checked for specific conditions related to loads or structural formations, such as cantilevers and slabs. In addition to these reinforcements, RG1 reinforcing meshes must be placed at the wall joints before the application of shotcrete.

Once the concrete casting is complete, and the props are gradually removed (the timing of removal should follow the project supervisor's recommendations), the application of plaster on the ceiling can proceed.

➤ 1.5.4 CALCULATION AND CHECKS OF PSG SLAB PANEL

Here are a series of graphs and tables useful for floor design. The calculations and checks were performed following the theory of limit states.

According to Italian standards, for sizing slabs, the minimum thickness should be greater than 1/25 of the length of the slab and should consider the loads to ensure deformations are compatible with the operational conditions of the slab.

Resistant moment and shear of PSG panel LIMIT STATE CHECKS

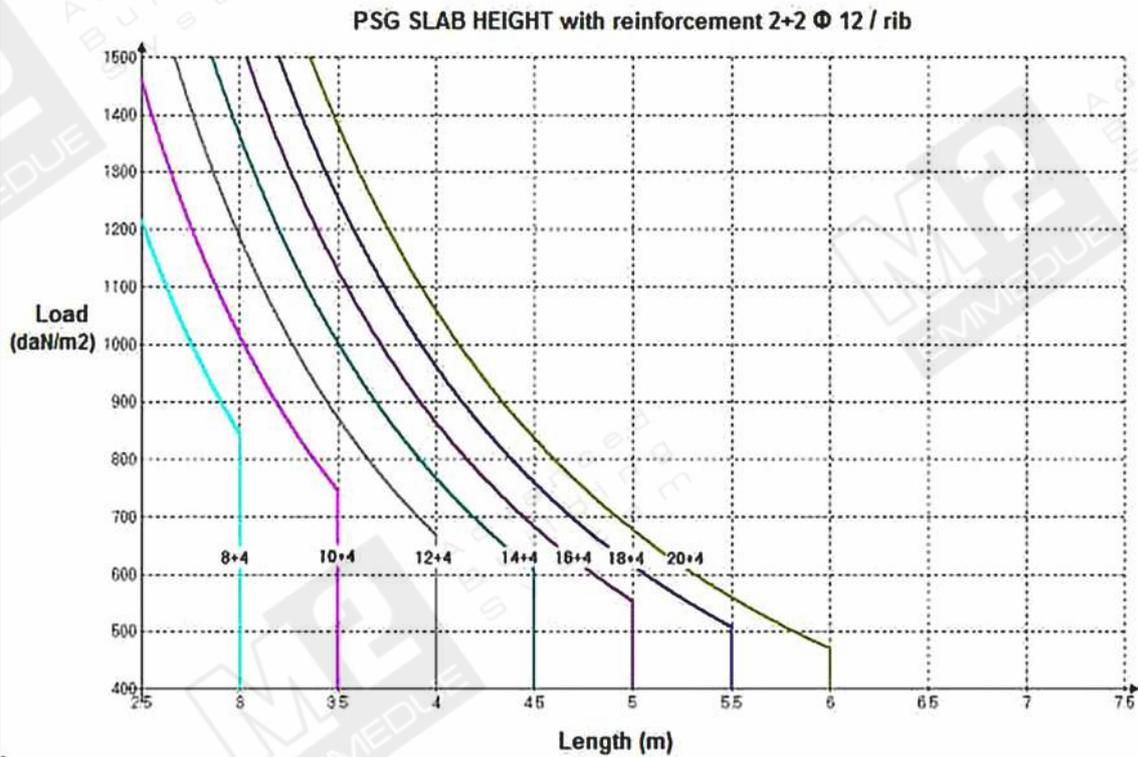
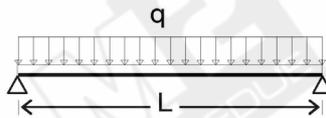
Distance between ribs $i = \text{cm } 60$
 Ribs width $l = \text{cm } 10$
 Hypothesised reinforcement $2+2 \text{ } \varnothing 12 / \text{travetto}$
 Concrete: $R_{ck} = 30 \text{ Mpa}$

TYPE OF SLAB	SLAB HEIGHT		Self weight (whitout plaster) Kg/m2	Limit moment		Limit shear	
	Height S (cm)	Concrete slab (cm)		single rib		single rib	
			MRd+	MRd-	VRd1	VRd2	
			(kNm)	(kNm)	(kN)	(kN)	
PSG 12+5	12	5	160	11,2	-10,4	10,8	56,4
PSG 14+5	14	5	170	12,9	-12	11,6	64,5
PSG 16+5	16	5	180	14,5	-13,7	12,4	72,5
PSG 18+5	18	5	190	16,2	-15,4	13,2	80,6
PSG 20+5	20	5	200	17,8	-17,1	13,9	88,7
PSG 22+5	22	5	210	19,5	-18,8	14,7	96,7
PSG 24+5	24	5	220	21,1	-20,4	15,4	104,5
PSG 26+5	26	5	230	22,8	-22,1	16	112,8

Graph for the pre-dimensioning of an EMMEDUE PSG slab

This graph provides a method for immediate pre-dimensioning of an EMMEDUE floor.

The sizing of the slab is estimated based on its length and the loads it will bear. The curves on the graph represent sections of the PSSG panel. The first number indicates the height of the polystyrene sheet (S), and the second number represents the thickness of the concrete slab. The recommended reinforcement is 2+2 Ø 12/rib.



1.6 STAIRCASES AND LANDINGS

➤ 1.6.1 USE OF STAIRCASE AND LANDING PANEL



The staircase panel is used to construct staircase slabs for spans of up to 6 meters (19.7 feet) with a live load of 400 kg/m² (81 lbs/ft²). Initially, the staircase panel is placed, reinforcement bars are positioned in its cavities, and the panel is secured to the ends of the upper mesh. Subsequently, the cavities are filled with concrete containing aggregates with a maximum diameter of 12 mm (0.47 inches) and a strength of Rck³ 30 MPa (3556 PSI) or as determined by the designer.

Concrete casting in the joists should only occur after suitable supports have been placed beneath the stair slab. The supports are typically made of boards or wooden beams at intervals of 80-100 cm (2.7-3.3 inches).

Following this, plaster is applied to the lower surface of the stair slab, and mortar is cast on the upper surface with an average thickness of 2.5 cm (1 inch), providing a base for further finishing such as marble, tiles, etc.

For spans exceeding 4 meters (13.12 feet), it is advisable to create points of continuity between the beam and the upper mortar by cutting out portions of polystyrene at the junction of the tread and riser to form the tread.

The staircase panel allows the construction of staircases with conventional dimensions and is particularly appreciated for its ease of installation and structural lightweight design.



1.7 CLADDING AND PARTITION WALLS

➤ 1.7.1 PANEL INSTALLATION

A preliminary marking of partition tracks is necessary along all sides of the wall. Special attention should be given to plumbing and alignment.

To fix the panels, you can use C-shaped steel sections with a width equal to the thickness of the panel.

These sections are secured to the supporting structure using pressure nails or rebars.

If using rebars, they should be fixed to the supporting structure at an adequate depth and sealed with epoxy resin at intervals of approximately 40 cm (1.3 ft).



The rebars are then fastened to both sides of the panel perimeter. The rebars can have a diameter of approximately 6 mm (1/4 in) and a length of approximately 50 cm (19.7 in). The anchorage length, diameter, and spacing of the rebars must be verified according to structural calculations.

Please note that these instructions should be verified for specific types of partition walls or loads that deviate from standard requirements.

The panels should preferably be installed before casting the screed. When using rebars, they are first placed on one side of the future position of the panel. Then, holes are drilled for the rebars on the other side, and finally, the panel is placed. After securing the panels on the rebars on one side, proceed to anchor the rebars on the other side and fasten them to the panels.

For the positioning of reinforcement meshes and the installation of piping, refer to the previous paragraphs regarding PSM.

Extra attention should be paid to the plumbing and alignment of the panels before applying the finishing render.

To ensure the necessary durability, it is advisable to use zinc-coated steel for exterior walls.





1.7.2 COMPLETION ON SITE

To render the walls, any type of cement-based plaster, including premixed options, can be used, with a thickness of 2-2.5 cm (0.8-1 in). Follow standard procedures and the manufacturer's recommendations.

To prevent the appearance of cracks, it is advisable to apply the plaster in two consecutive layers.

The first layer should slightly cover the mesh, and the second layer should be applied only after the first layer has gained some resistance. Any final rendering layer should be applied only after the plaster has fully cured.



1.8 INSULATING COVERS MADE WITH PST PANEL

➔ 1.8.1 INSTALLATION OF THE EMMEDUE INSULATING COVER PANEL

The panels are fixed in place using cement-based adhesive mortar, applied in stripes and points.

Additionally, mechanical fixing is achieved through tailspin anchoring using steel nails with plastic heads suitable for the supporting structure.

The length of the nail should be sufficient to penetrate the supporting layer by at least 70 mm (2.75 in).

Always follow the manufacturer's recommendations for the use of anchorings.



Flat meshes should be placed at each corner at a 45° angle. When there are interruptions in the mesh, it is necessary to restore continuity by attaching strips of flat meshes to the specific area. The same procedure should be followed where panels lack overlapping meshes.

To ensure proper rendering, it is advisable to work within temperature ranges of no less than +5°C or more than +35°C. Keep supporting surfaces clean from dirt, dust, and any incoherent particles, ensuring correct alignment in advance.

Once the plaster has completed its curing period, proceed with the application of the final smoothing layer, which may include a thin mesh of glass fiber or plastic material.



2 OPERATING STEPS SUMMARY

2.1 WALL BUILT WITH PSM PANEL

➤ 2.1.1 MAIN OPERATIONAL STEPS

1. Anchoring to foundations
2. Assembling the panels
 - connecting panels at the rebars
 - connecting adjacent panels
 - placing of reinforcement meshes
3. Plumbing and scaffolding walls
4. Placing doors and windows false frames
5. Electrical and plumbing installation
6. Shotcrete application

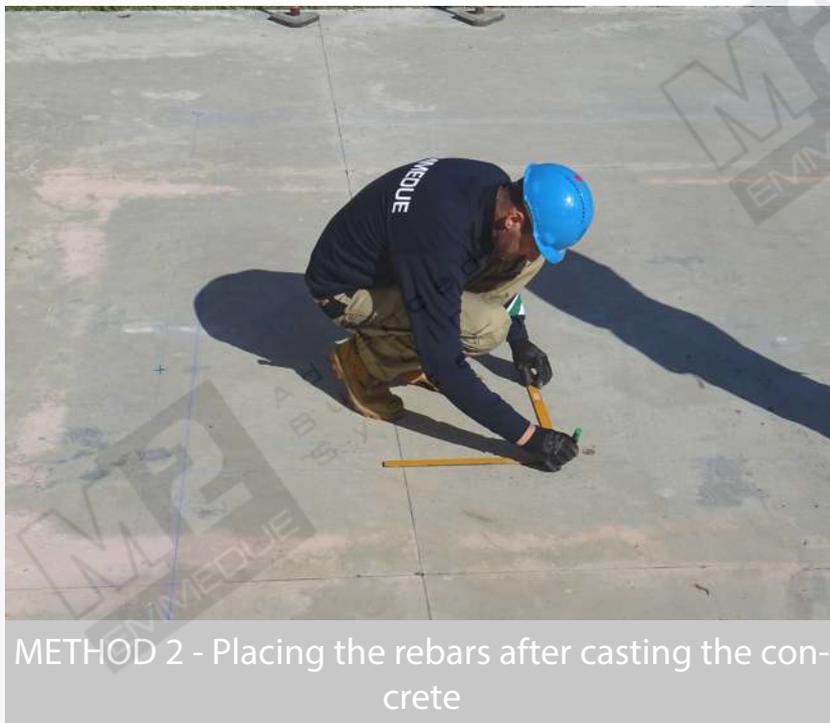
➤ 2.1.2 PREPARATION OF REBARS IN THE FOUNDATION

The panels are placed over a reinforced concrete foundation slab or strip foundation beam. The size and characteristics of the foundations should be determined by specific structural calculations based on the geotechnical analysis of the site.





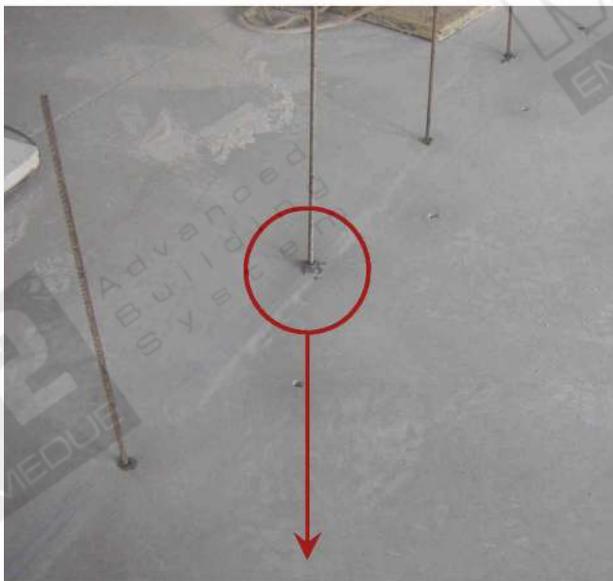
METHOD 1 - Placing the rebars before casting the concrete



METHOD 2 - Placing the rebars after casting the concrete



For the correct positioning of the rebars, consider a distance equal to:
Panel thickness +2 cm (0.8 in) for $\varnothing 2,5$ mesh



1. INSERT REBARS ONLY ON ONE SIDE
2. PLACE THE PANEL
3. INSERT THE REBARS ON THE OTHER SIDE



Make sure of the correct alignment of the rebars.



The bars are to be placed on both sides of the panel in a zigzag pattern and fixed with epoxy.

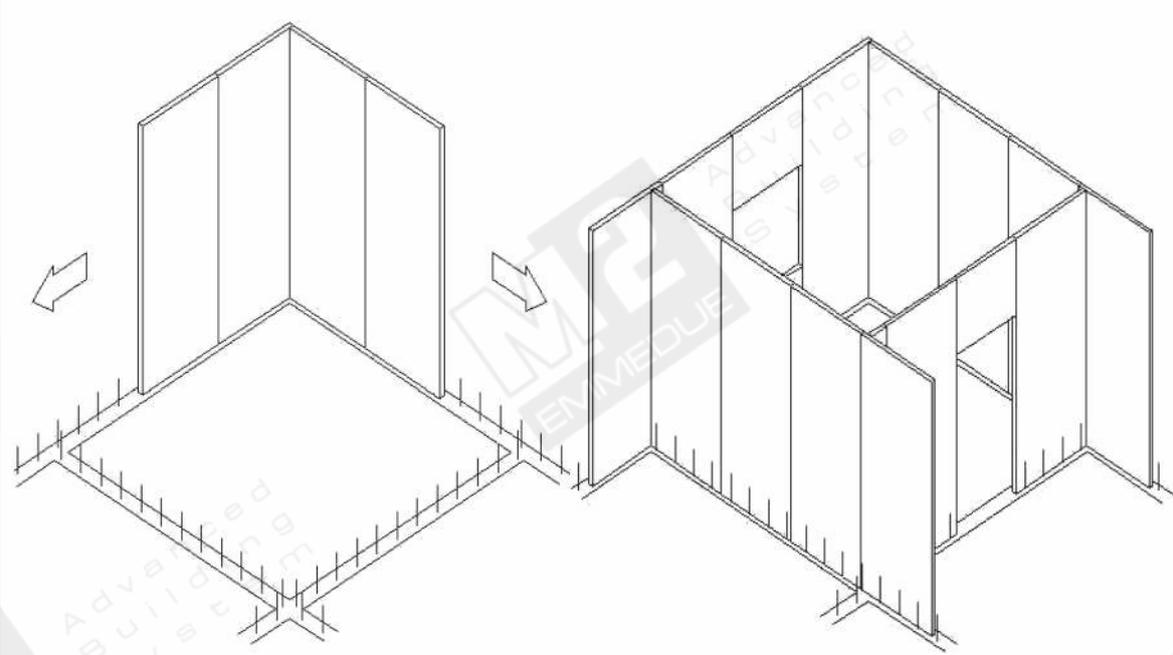
Rebars: number, diameter and length according to calculations.

For example:

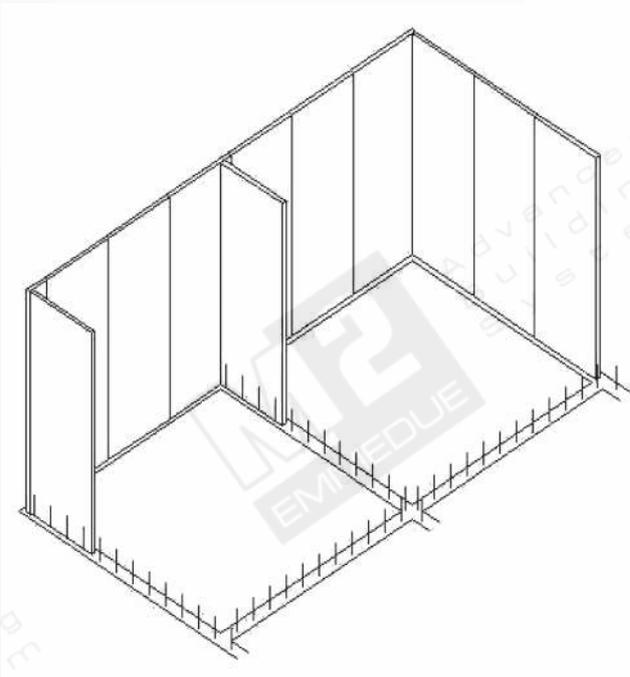
- diameter 6-8 mm (1/4-1/3 in)
- interval 30 (11.8 in)/40cm(15.75 in)
- height 40cm (15.75 in)

➔ 2.1.3 ASSEMBLING THE PANELS

You can start from a corner and proceed along both sides, ensuring perpendicularity. When adopting this method, it's essential to complete single rooms.



For long walls, another procedure is recommended. Start from one wall and continue by placing perpendicular walls with each frontal advancement.



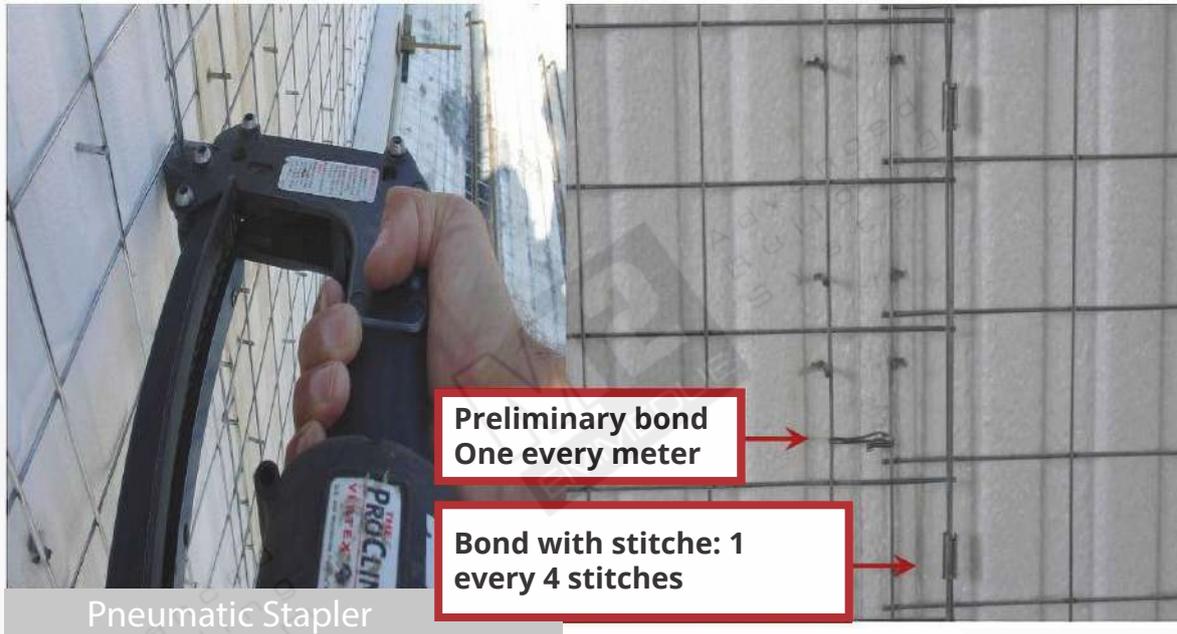
- Connecting panels to the rebars



- **Cuts:** When making cuts according to the panel layout, you can use instruments like bolt cutters or angle grinders.



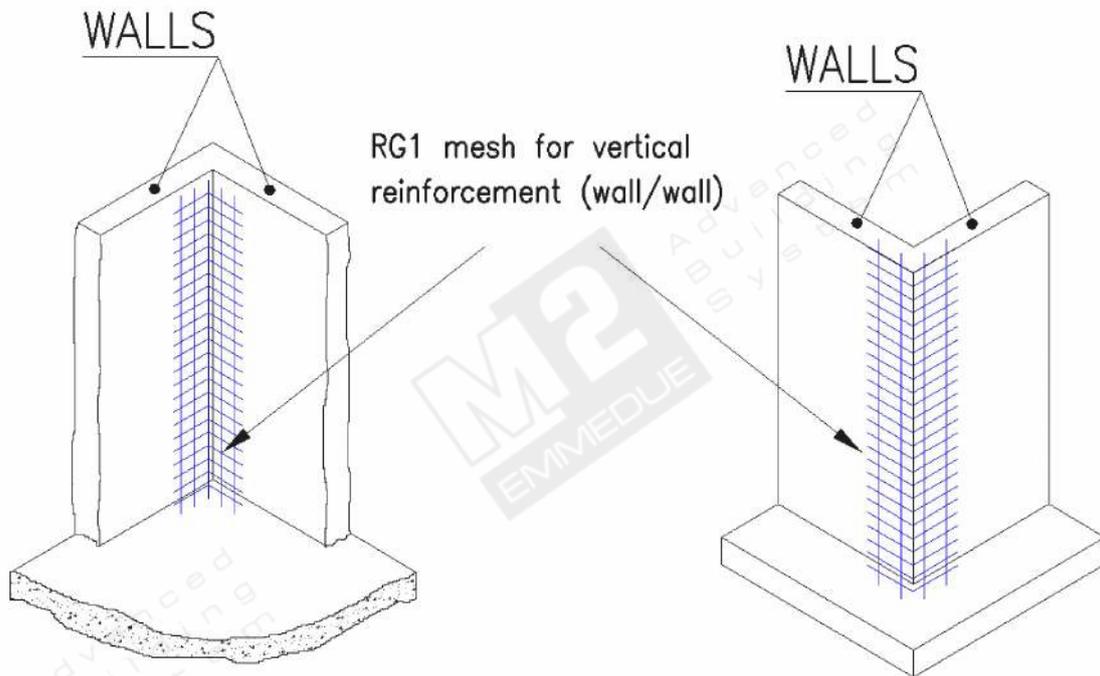
- **Connecting adjacent panels:** Before applying the stitches, ensure that the panels fit perfectly.



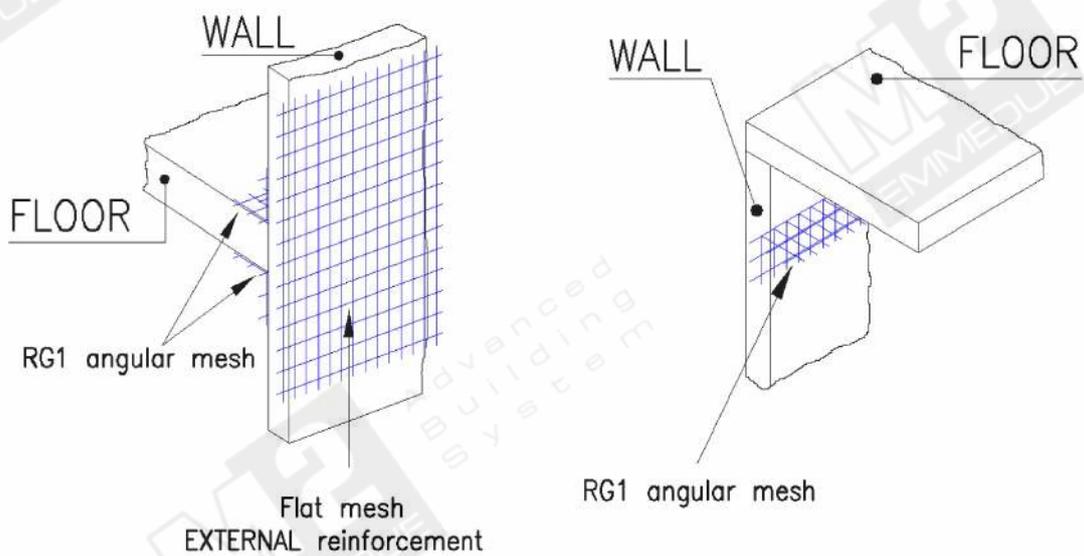
It's possible to pre-assemble multiple consecutive panels and place them all together.



- Placement of reinforcement meshes



Angular mesh for walls connection



Angular mesh for wall/floor connection and flat mesh for external reinforcement

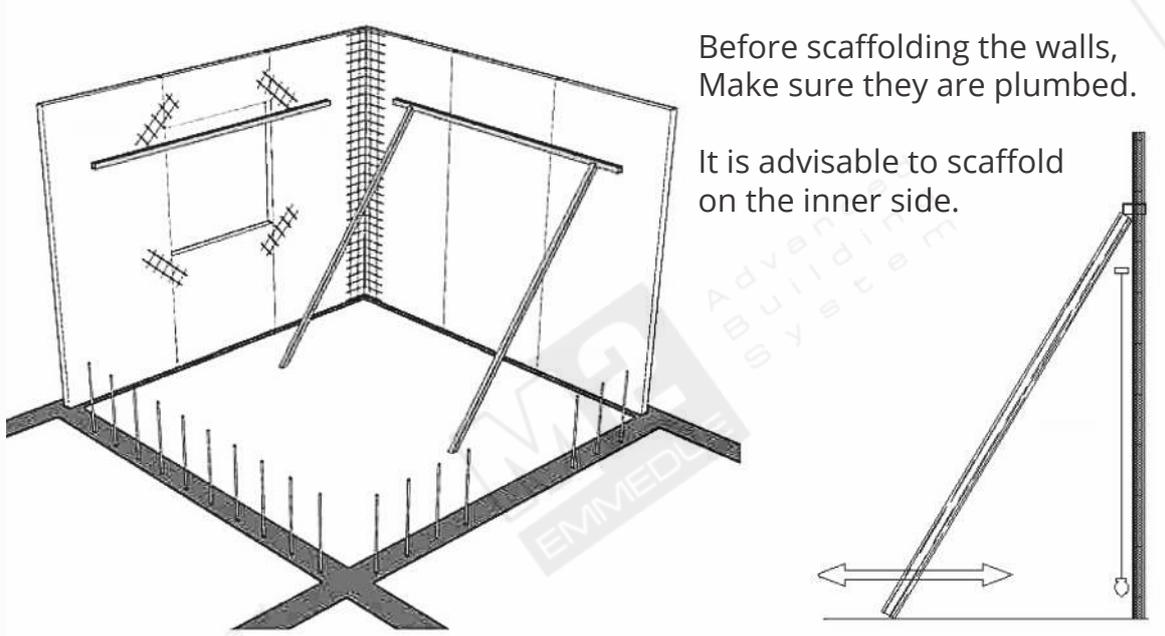


Placing reinforcement meshes

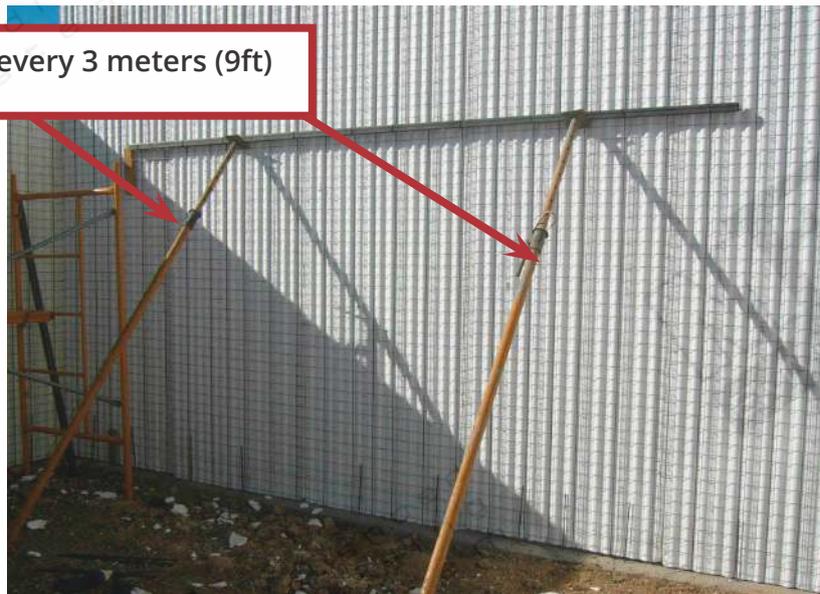


Various types of manual staplers

➤ 2.1.4 WALL PLUMBING AND SCAFFOLDING



1 scaffold every 3 meters (9ft)

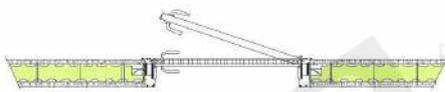
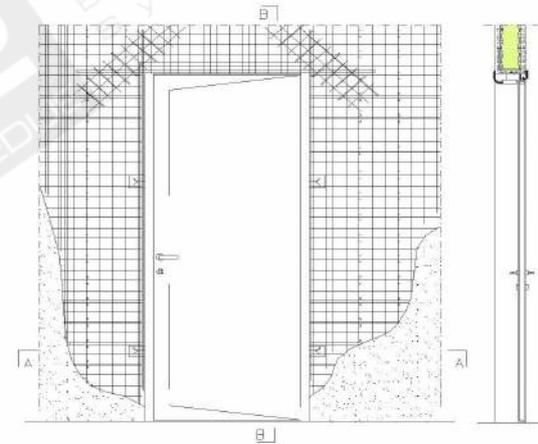


➤ 2.1.5 PLACEMENT OF DOOR AND WINDOW FRAMES

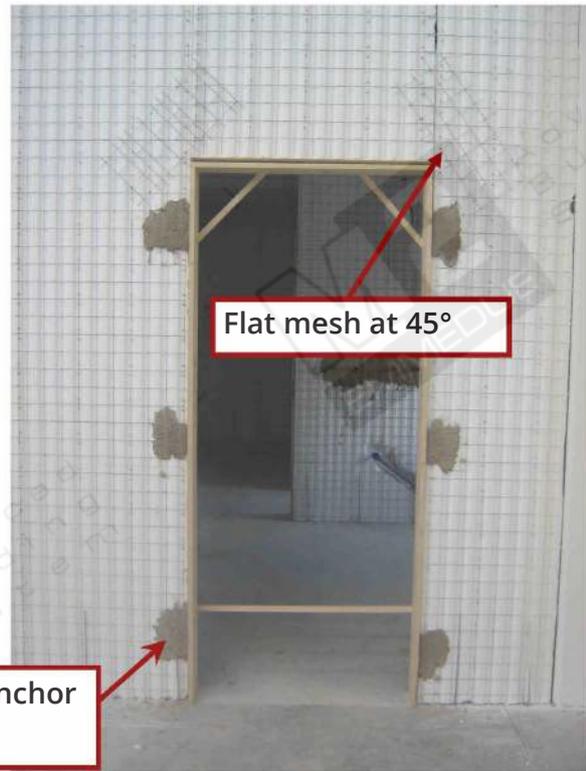
- **Placement of flat meshes:** Position flat meshes at a 45° angle, maintaining a distance of less than 1 cm (0.4 in.) from the opening's edge.



Doors

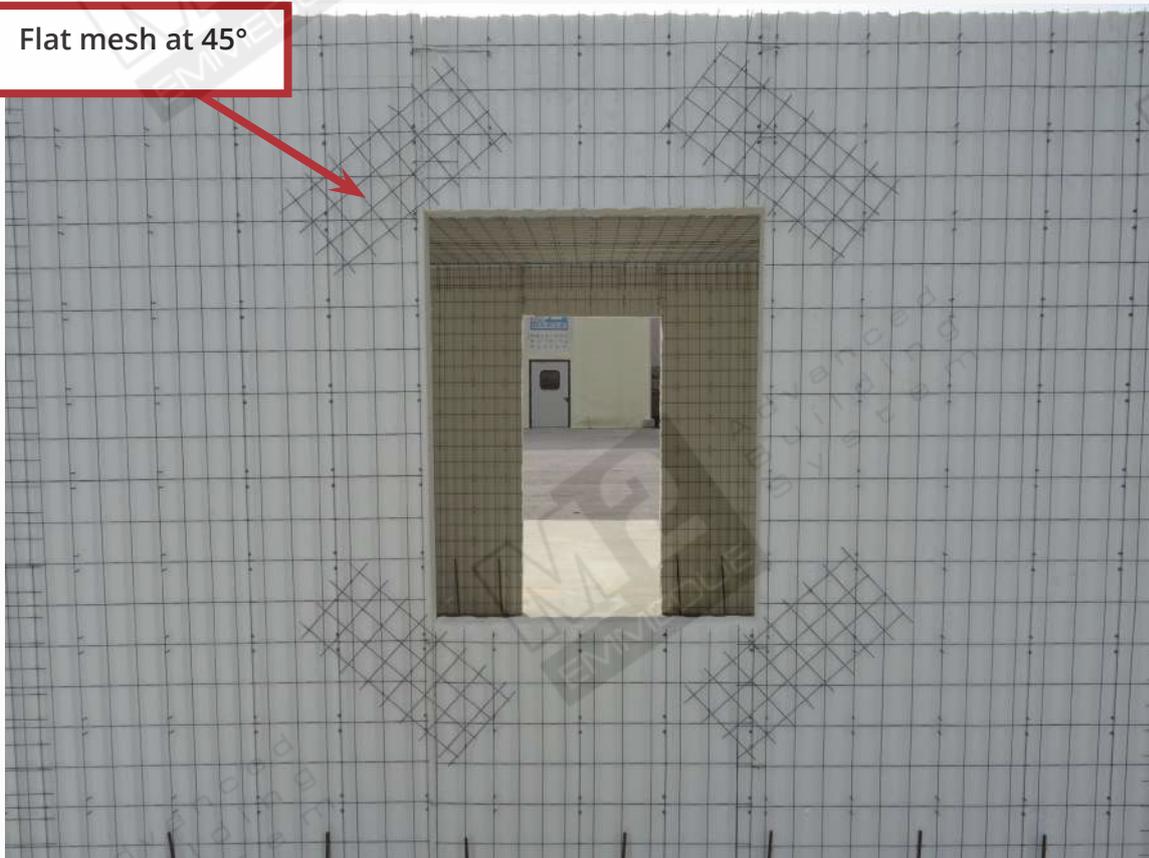


Locally remove polystyrene to anchor subframe

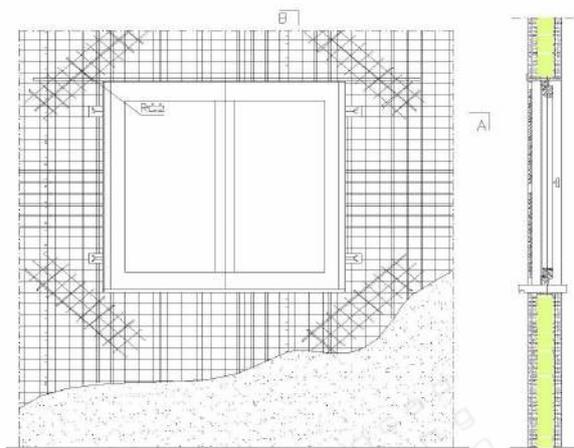


In case of external doors, leave at least 4 cm (1.6 in.) of polystyrene to avoid thermal bridges.

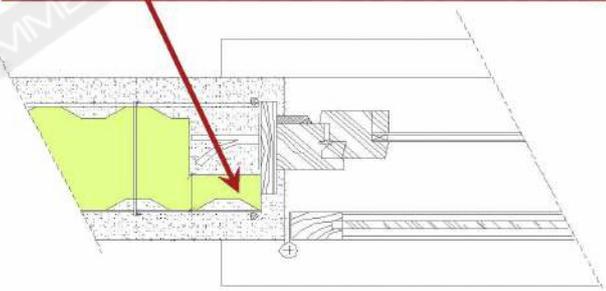
Flat mesh at 45°



Windows



Leave at least 4 cm (1.6 in) of polystyrene to avoid thermal bridges.



➤ 2.1.6 INSERTION OF INSTALLATION CHANNELS

The polystyrene should be melted using a hot air jet.



Afterward, the installation channels are positioned.

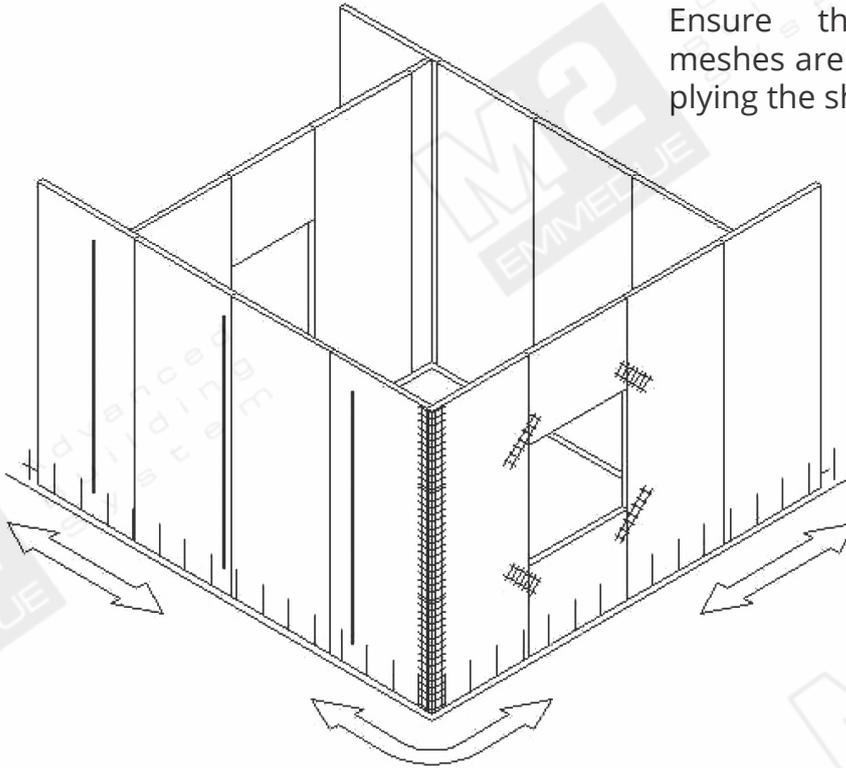
When it is necessary to cut the mesh, restoration with a flat mesh is required after inserting the channels.



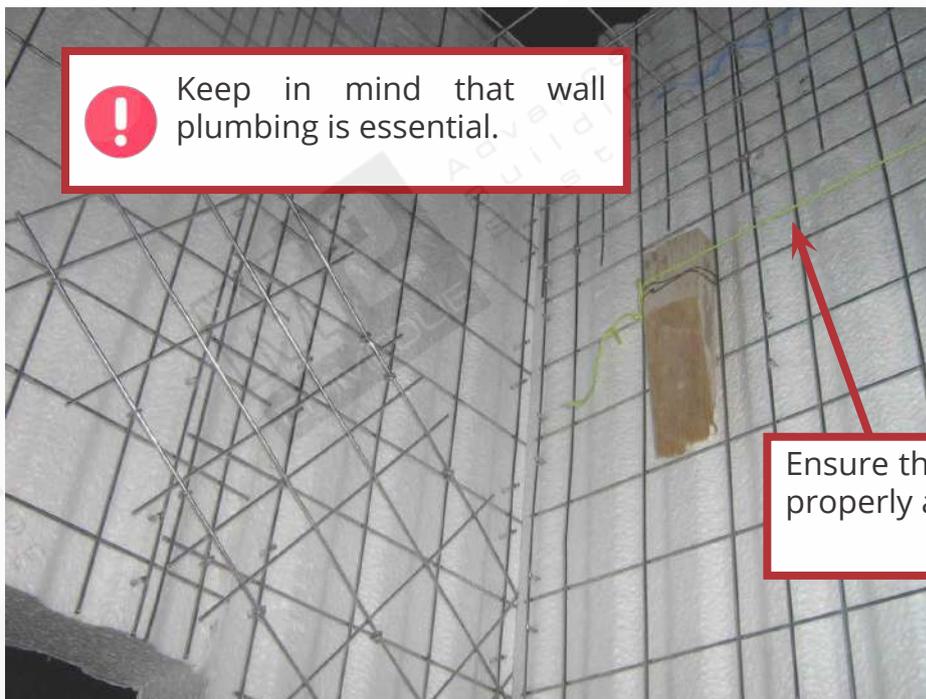
2.2 SHOTCRETE APPLICATION

➔ 2.2.1. BEFORE THE SHOTCRETE APPLICATION

Placing the scaffolds on the internal side allows for a more efficient shotcrete application on the external side.



Ensure that reinforcement meshes are in place before applying the shotcrete.

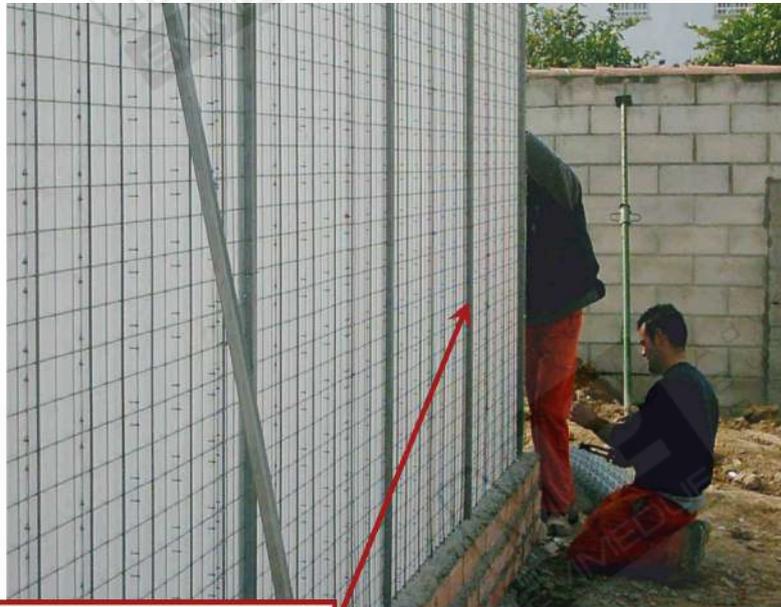
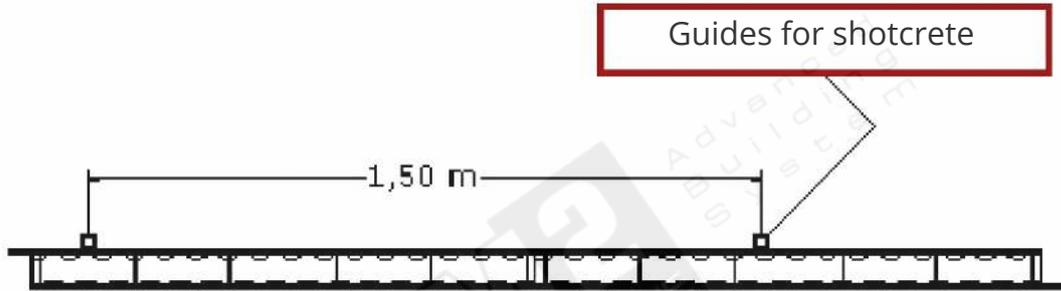


Keep in mind that wall plumbing is essential.

Ensure the walls are properly aligned.

➤ 2.2.2 PLACING SCREEDS

Position the guides to measure the thickness of the plaster. The spacing between them will vary based on the length of the screed used for smoothing the shotcrete.



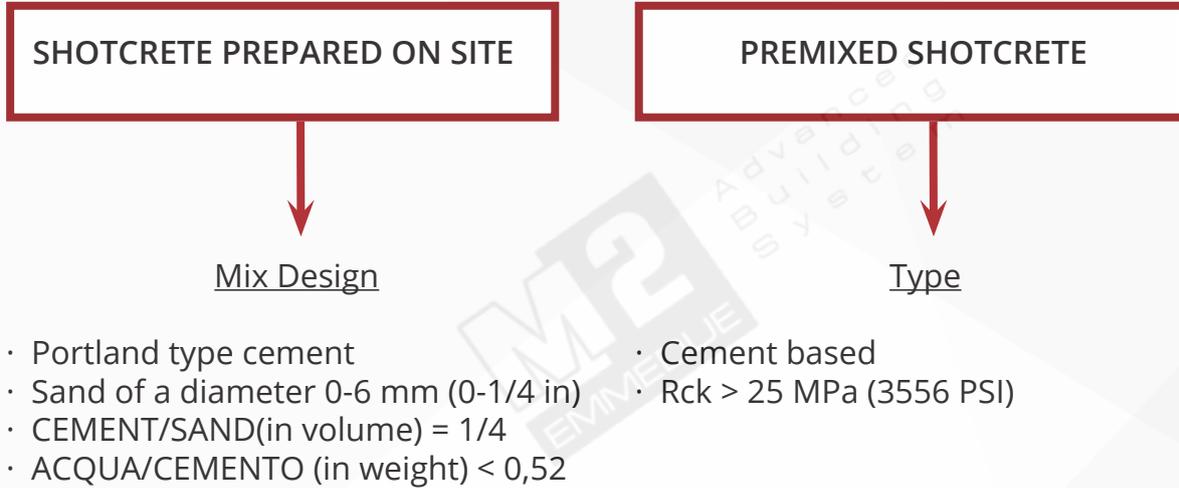
Guides made with shotcrete

Guides for shotcrete



➤ 2.2.3 WALL PLUMBING AND SCAFFOLDING

The shotcrete to be applied can be either pre-mixed or prepared on-site. In either case, it must meet the following specifications:



Eventual admixtures

- Fluidifiers
- Hydro repellers
- Polypropylene fibers

The shotcrete should be applied to the walls in two successive layers, with the first layer covering the steel mesh adequately.

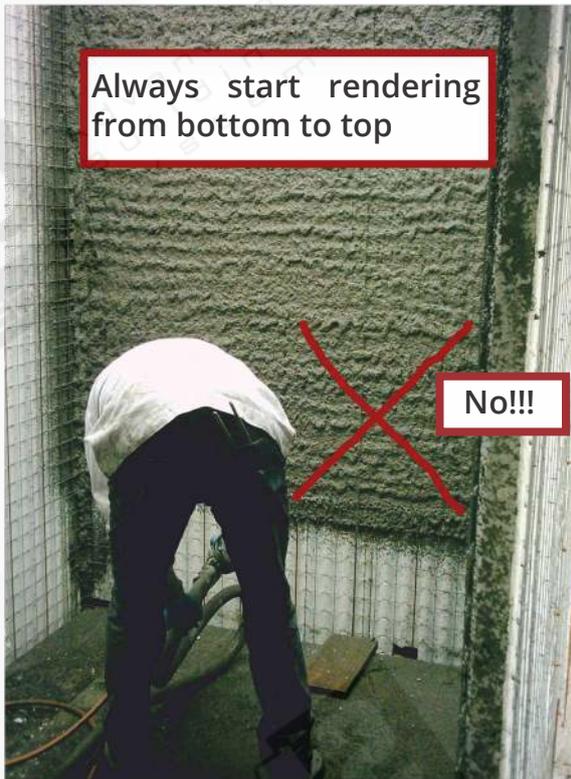
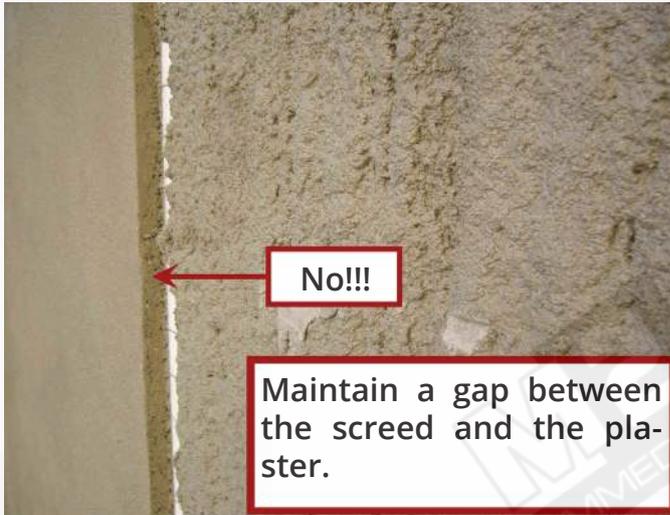


Use of a spray pump



Use of hooper gun

➤ 2.2.4 VARIOUS RECOMMENDATIONS



After completing the plastering process, keep the walls moist for a minimum of 48 hours.

2.3 WALLS BUILT WITH PDM DOUBLE PANEL

➤ 2.3.1. MAIN OPERATING STEPS

1. Placement of anchoring rebars in the foundations;
2. Assembling of panels;
 - preliminary step
 - initial step
 - connecting adjacent panels
 - various additions
 - Cutting the panels
3. Scaffolding the panels;
4. Filling the walls with concrete;
5. Placing the M2 slab panel on-site;
6. Installation and rendering.

➤ 2.3.2. POSITIONING OF ANCHOR REBARS IN THE FOUNDATIONS



The dimensions and reinforcement requirements of the foundations are determined through structural calculations. The smoothness of the foundation surface is critical for proper panel placement.

The anchoring rebars must have the following characteristics:

- Filleted U-type shape for easier panel insertion.
- Diameter determined by structural calculations.
- Height determined by structural calculations.
- Intervals as per structural calculations.
- Width equal to the concrete wall width minus 5 cm (2 in).



The external width should not exceed the concrete wall width minus 5 cm (2 in).

Ensure the correct alignment of the rebars, with a tolerance of +/- 1 cm (0.4 in). Alignment errors can make panel placement difficult.



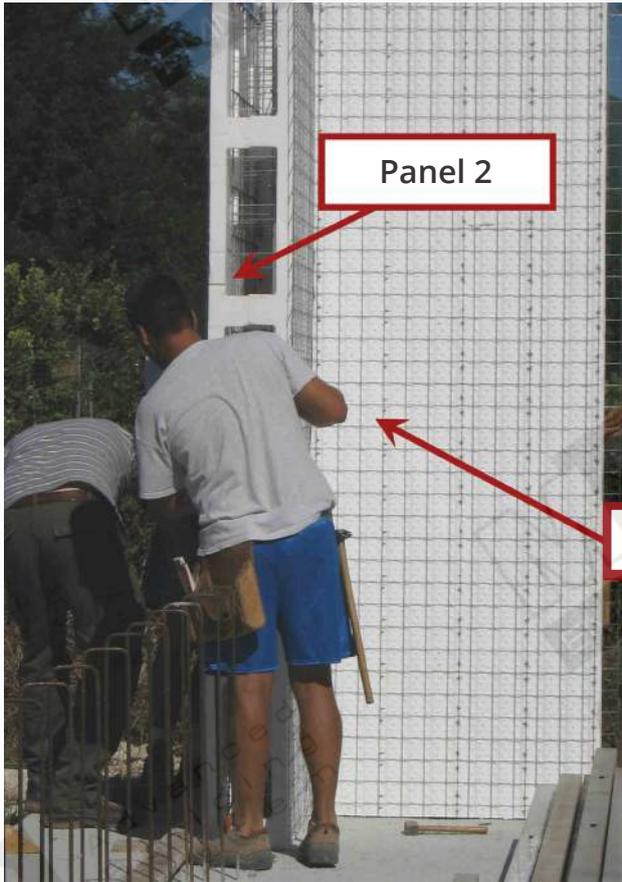
➔ 2.3.3. ASSEMBLING OF THE PANELS

Preliminary Phase

Lay the tracks of at least one of the external perimeters of the panel on the foundation plane.

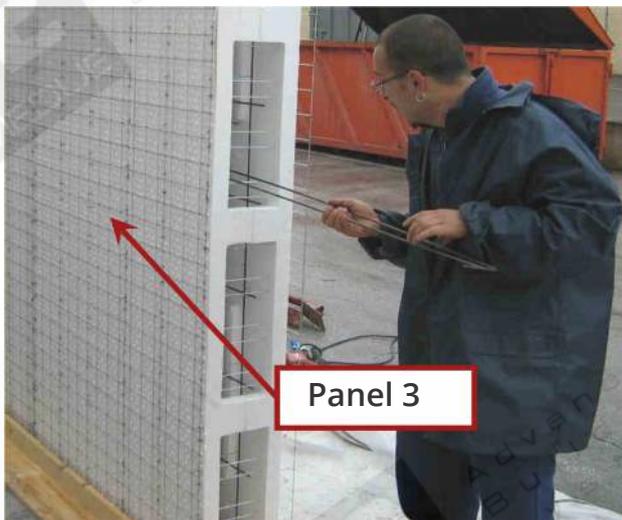
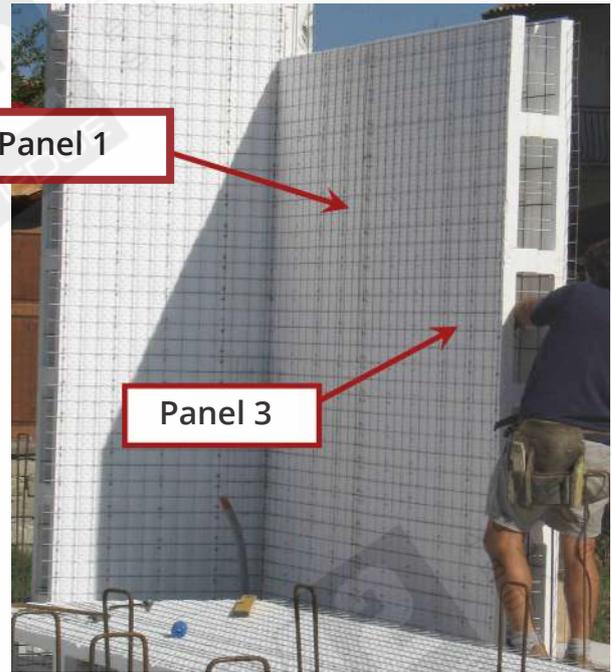


Guide boards



Initial Phase

Begin assembling the panels, preferably starting from a corner. Once corner panels 1 and 2 are in place (cuts should be made on the panels), proceed by placing panel 3.



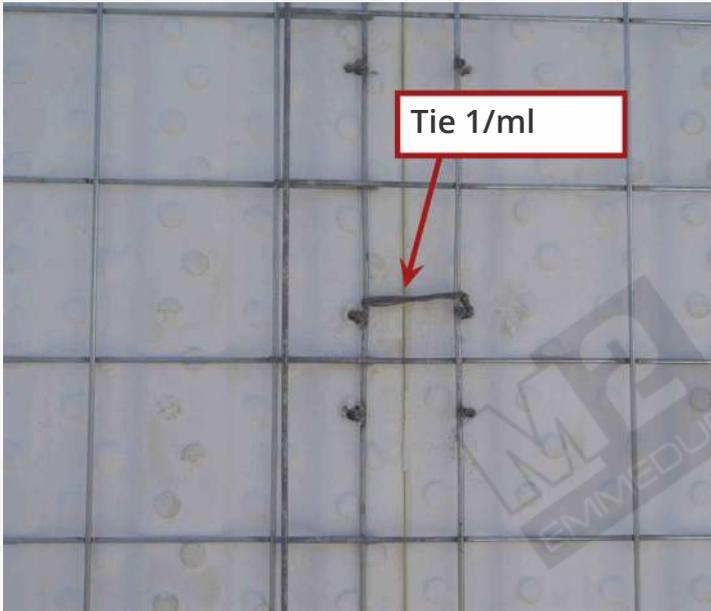
At this point, insert the additional reinforcements (the parts supplied by the manufacturer) to connect panel 3 with panel 1.

Ensure the panels are aligned and plumbed from the beginning.

 Insert any vertical additional reinforcements as per structural calculations.



➤ 2.3.4 CONNECTING ADJACENT PANELS



Start by connecting the panels with wire, ensuring that the connections match the connectors.

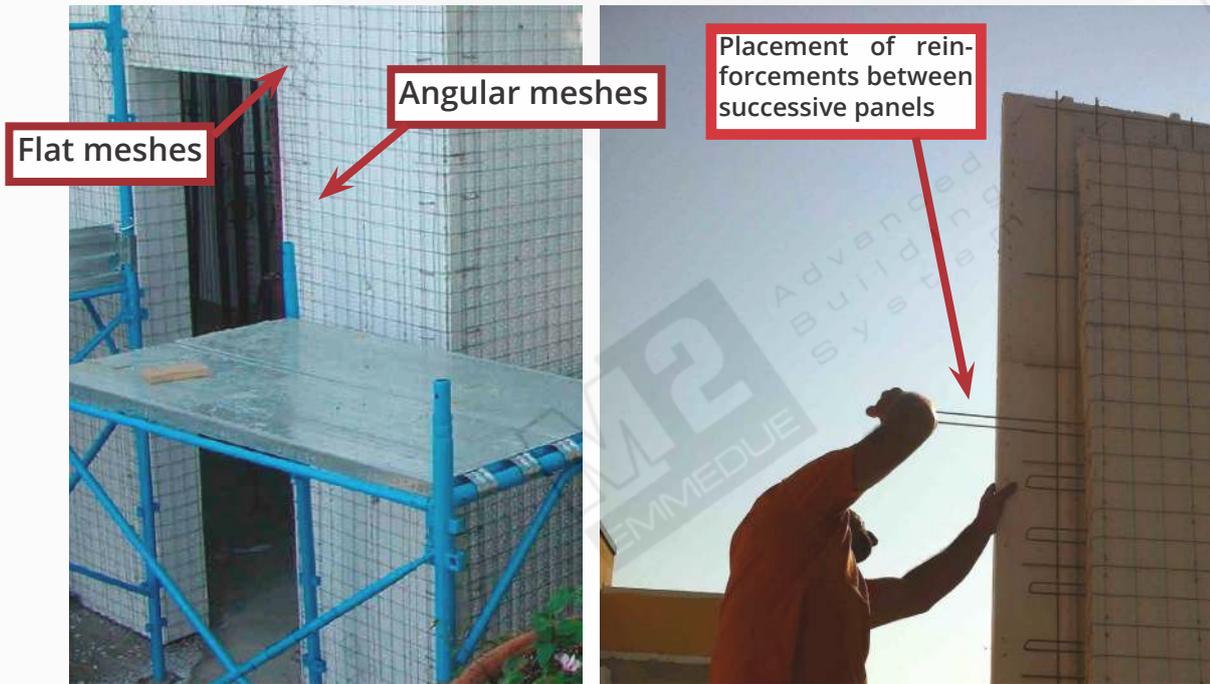


Then, use manual or pneumatic staplers to connect the panels with one stitch every 4 meshes. For proper panel placement, refer to the panel layout.



Additionally, place scaffolds on the walls to counteract the effects of the wind.

➤ 2.3.5 VARIOUS ADDITIONS



Insert connection reinforcements (supplied by the panel manufacturer) and vertical 2Ø16 reinforcements at every intersection and corner.

Place flat meshes at a 45° angle at the edges of openings and angular meshes at the corners and intersections.



➤ 2.3.6 PANEL CUTTING

To make necessary cuts according to the panel layout, you may use angle grinders with appropriate discs to cut through the steel.

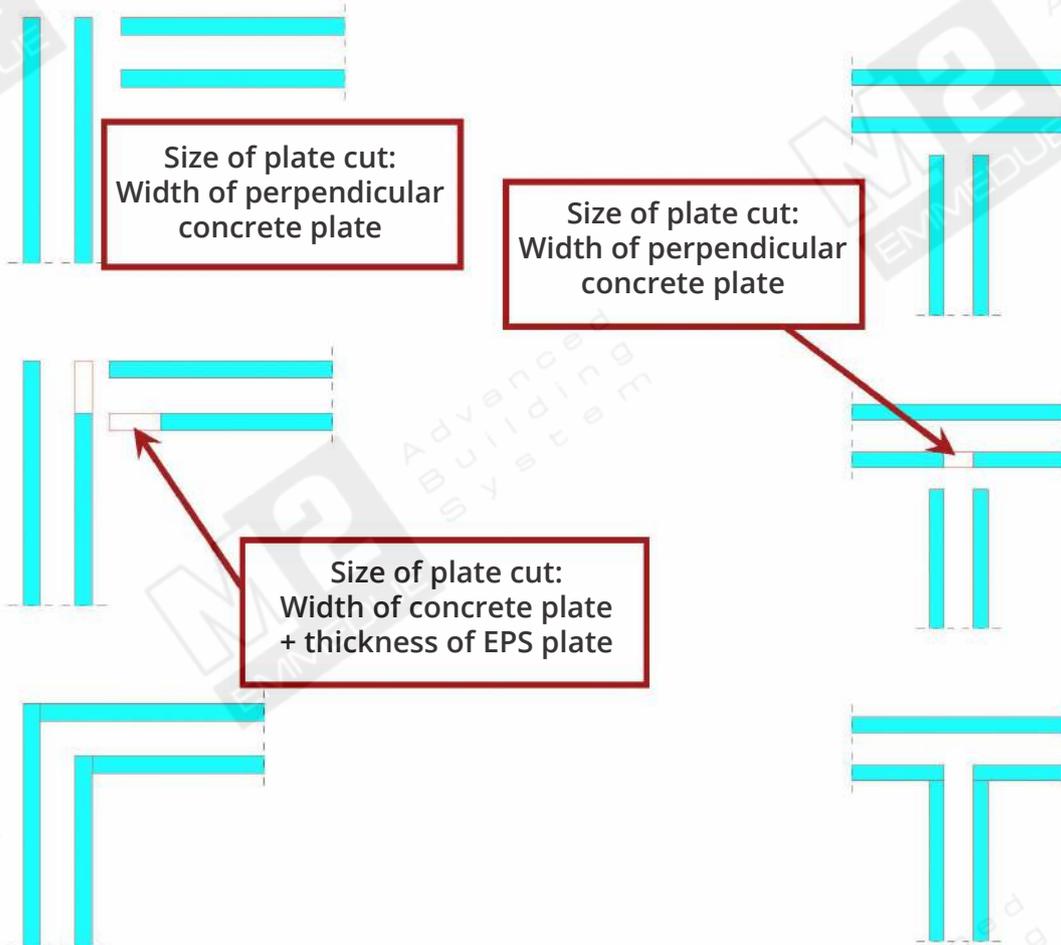


CORNER CONSTRUCTION PHASE

- Cut the internal panel plates and the internal mesh.
- Assemble the panels.
- Connect through angular meshes.

INTERSECTION CONSTRUCTION PHASE

- Cut the polystyrene plates.
- Assemble the panels.
- Connect through angular meshes.



➤ 2.3.7 WALL PLUMBING AND SCAFFOLDING



1. Verify the walls are perfectly plumb.
2. Place supporting components for the casting phase.
3. Install scaffolds for the walls.

The use of a panel with EPS density equal to or greater than 30 kg/m³ (compressive strength > 250 kPa) eliminates the need for stiffer elements, reducing construction time.



Frame to seal the openings

To minimize thermal bridges, consider covering the perimeter of all openings with polystyrene plates that are 2-3 cm (0.8-1.2 in) thick. If these plates are rendered, ensure they are covered with meshes. In any case, before casting, always prepare frames for conventional sealing.



➤ 2.3.8 FILLING THE WALL PANELS WITH CONCRETE

To facilitate the filling operation and prevent concrete segregation, it's advisable to use a casting tube of adequate size.



Recommended concrete characteristics:

- Maximum diameter of 12 mm
- Workability S5
- Rck > 30 MPa (3556 PSI)

The casting should be interrupted at a point 30 cm (11.8 in) below the ceiling level to secure the anchorage of the rebars.

➤ 2.3.9 INSTALLATIONS AND RENDERING

For information on installations, please refer to chapters 2.1 and 2.2 in this manual.

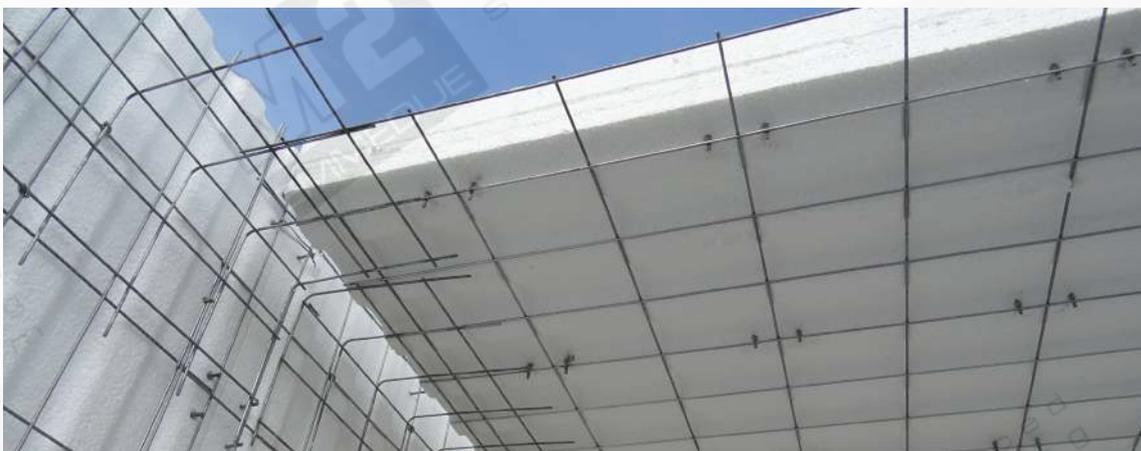
2.4 SLABS BUILT WITH PSS SINGLE PANEL

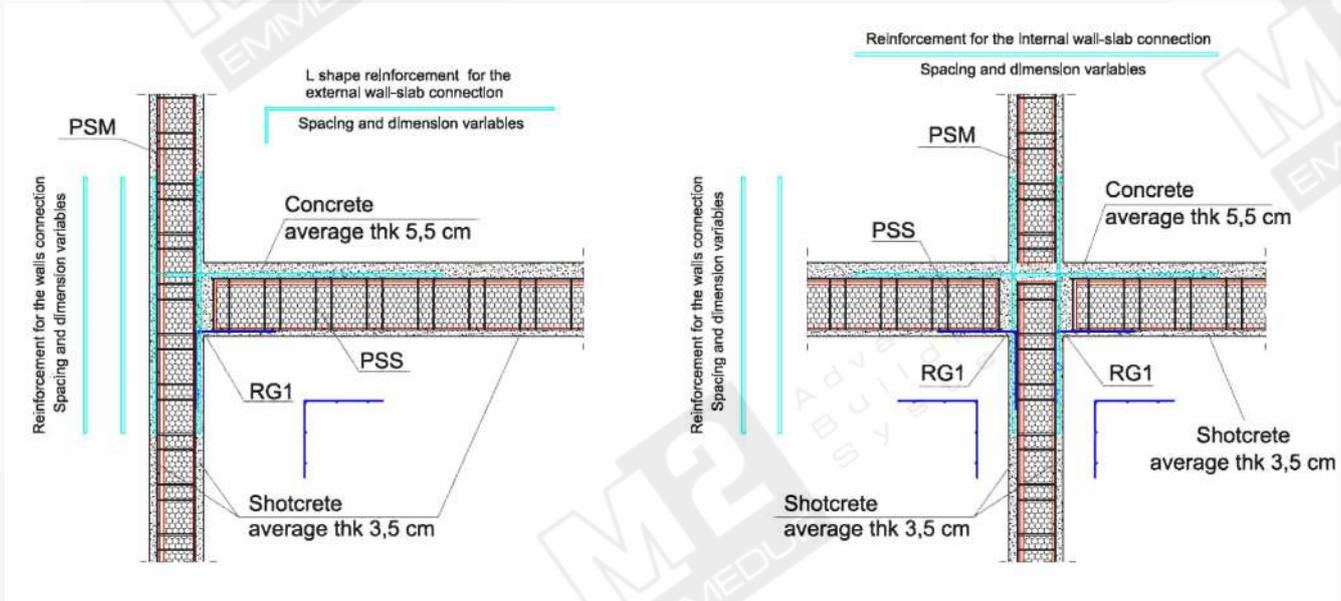
➤ 2.4.1. INSTALLATION OF PSS SINGLE PANEL SLABS



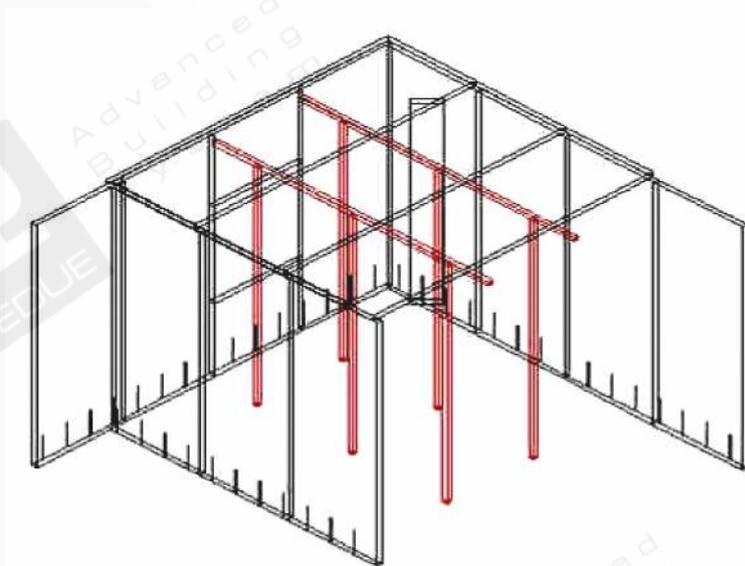
The installation of the PSS panel is similar to that of the single panel.

The slab is connected to the walls using steel bars and/or reinforcement meshes.





All connections to the walls are made using flat or angular meshes and/or steel bars.



Place the panels on supports at intervals of 60 cm (23.6 in).

Walk exclusively on wooden bridge boards placed on the supports.

The single panel allows for the construction of curved roofs with ease.



2.5 SLABS WITH PSG PANEL

➔ 2.5.1. INSTALLATION OF THE PSG PANEL SLAB



For proper panel placement, follow the panel layout.



Position the slab on the internal plate of the double panel.



Before casting the slab concrete, insert the wall rebars.



It is advisable to use omega-shaped steel bars to ensure adequate reinforcement cover.

➤ 2.5.2 COMPLETION OF PSG PANEL SLABS



Insert an EPS strip to ensure the uniformity of thermal insulation.

Insert joint reinforcements according to structural calculations.



Position suitable supports corresponding to beams and/or slab interruptions.



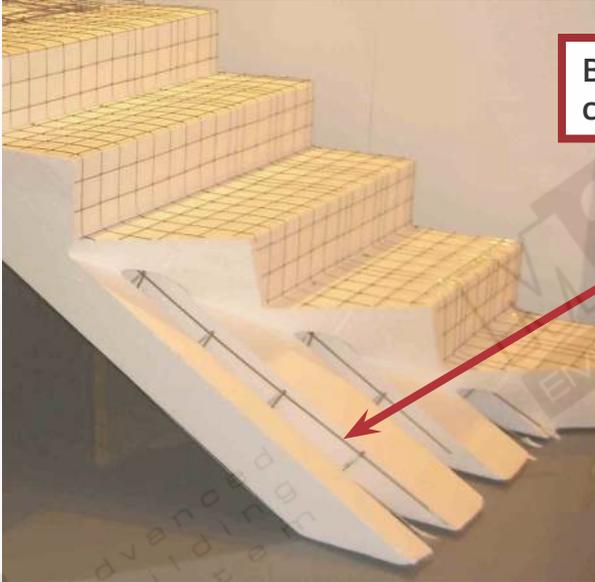
Complete the slab by casting the concrete.



Install reinforcement bars for the upper-level walls.

2.6 STAIRCASES AND LANDINGS

➤ 2.6.1 STAIRCASES AND LANDINGS



Beam to be reinforced and cast on site.

Before installing the staircase panel, insert appropriate reinforcements in each beam.



Before casting, place slab interruption components at intervals of 1 meter (3.3 ft).



Finish by applying cement-based plaster.



2.7 CLADDING AND PARTITION WALLS

➤ 2.7.1 PANEL INSTALLATION

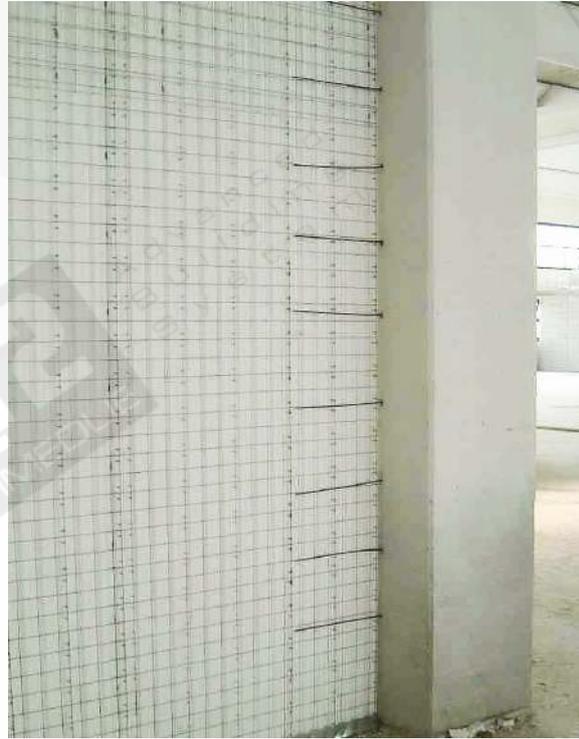
For the installation of cladding and partitioning panels, apply the same indications provided for the PSM single panel.



The panels will be securely anchored to the supporting structure using one of the following methods:



Welded steel bars



Anchored steel bars



C-shaped steel plates



L-shaped steel plates

2.8 INSULATING COVERS WITH PST PANEL

➤ 2.8.1 MAIN APPLICATION PHASES

Phase 1: Application of Adhesive Mortar on the Panel

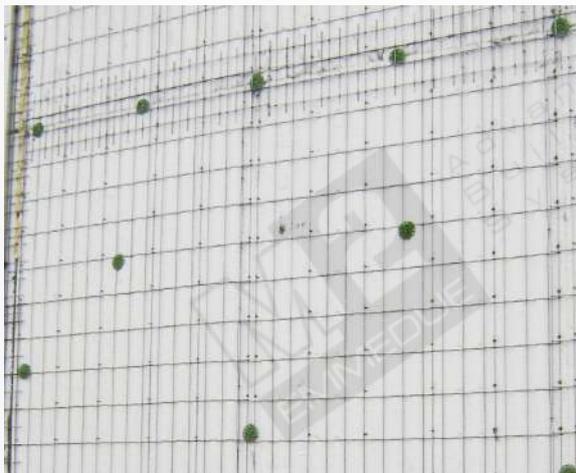
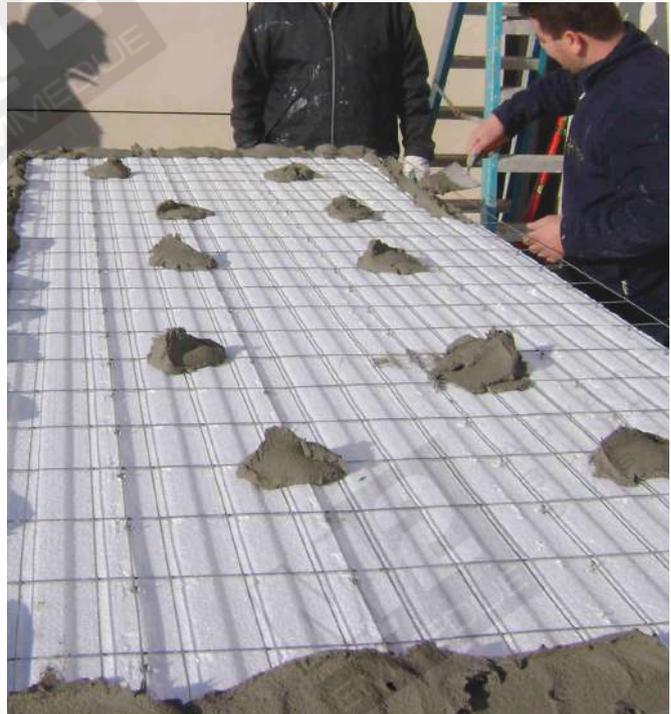
Apply mortar in stripes along the perimeter and in spots in the central area. Avoid applying excessive quantities of mortar on the borders, which could cause fitting problems when assembling the panels (see pic.1).

Phase 2: Panel Placement

Ensure a perfect fit of the panels and proceed by securely fastening the overlapping meshes at intervals of one bond every four stitches along the vertical direction of the mesh.

Phase 3: Mechanical fixing

Before the adhesive mortar starts to harden, apply the appropriate anchorings in the form of steel nails with plastic discs. Use 5 anchorings for every square meter. The anchoring depth on the support should be at least 5 cm (2 in) (see pic. 2 and 3).



Phase 4: Placement of Additional Meshes

Position flat meshes at a 45° angle along all edges. Wherever there is a mesh interruption, restore mesh continuity with strips of flat meshes.



Phase 5: Application of Plaster

Apply the first layer of plaster using a screed pump. The layer thickness should be sufficient to cover the mesh. After the necessary hardening time has passed, apply the second layer to achieve a total thickness of 2 cm (0.78 in) (see pic. 4).

Phase 6: Application of the Finishing Layer

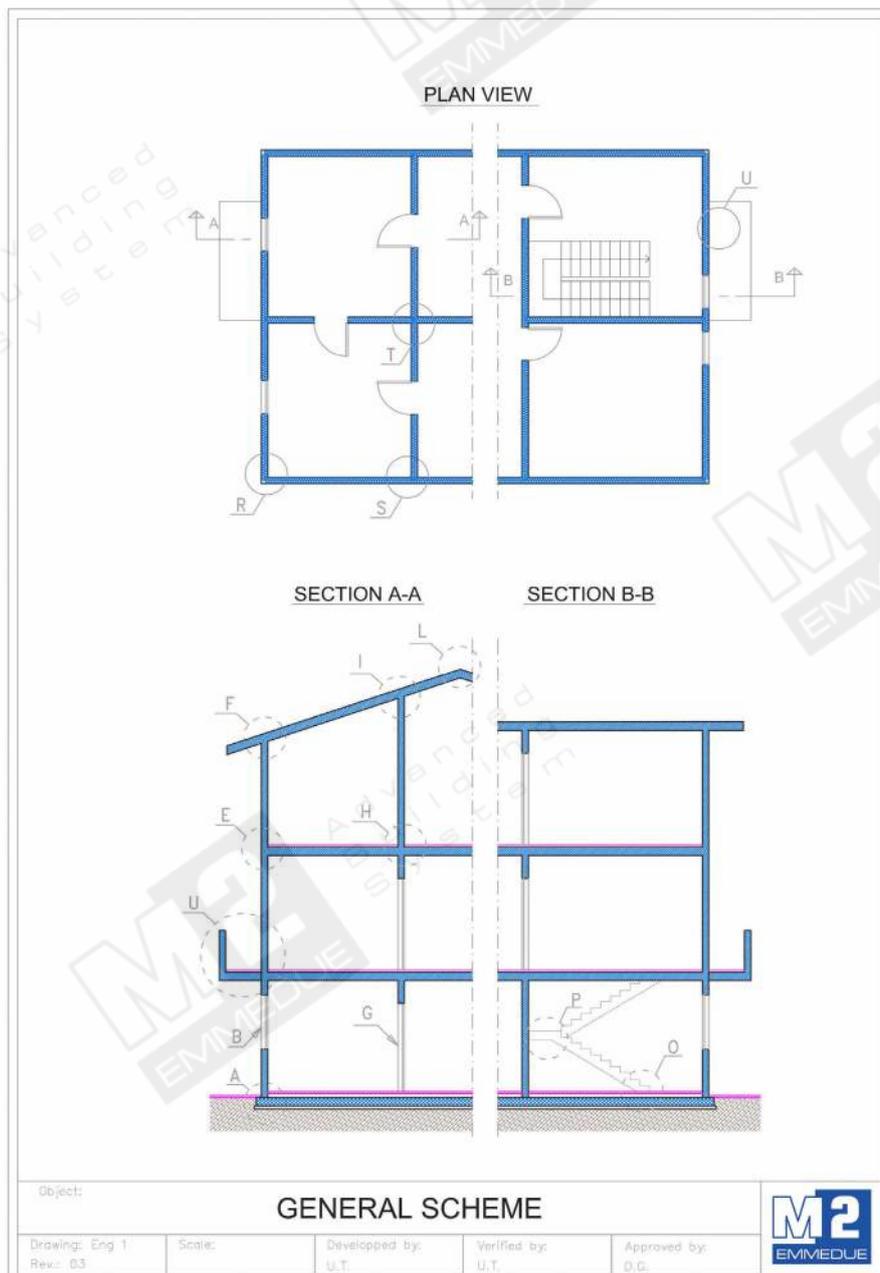
Once the plaster has fully cured, apply a final thin smoothing layer.



3 CONSTRUCTION DETAILS

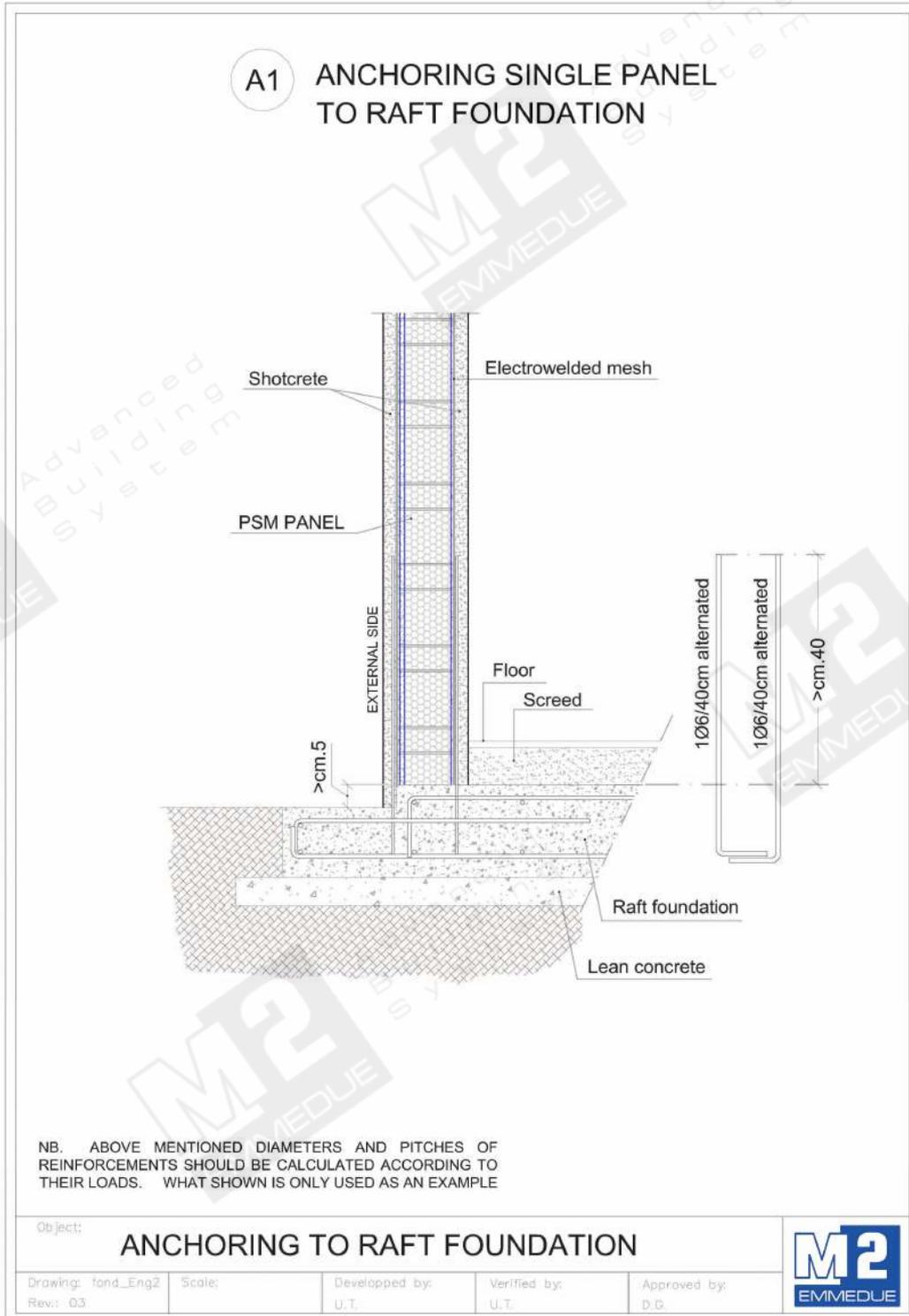
3.1 PLAN VIEW

➔ 3.1.1 GENERAL SCHEME

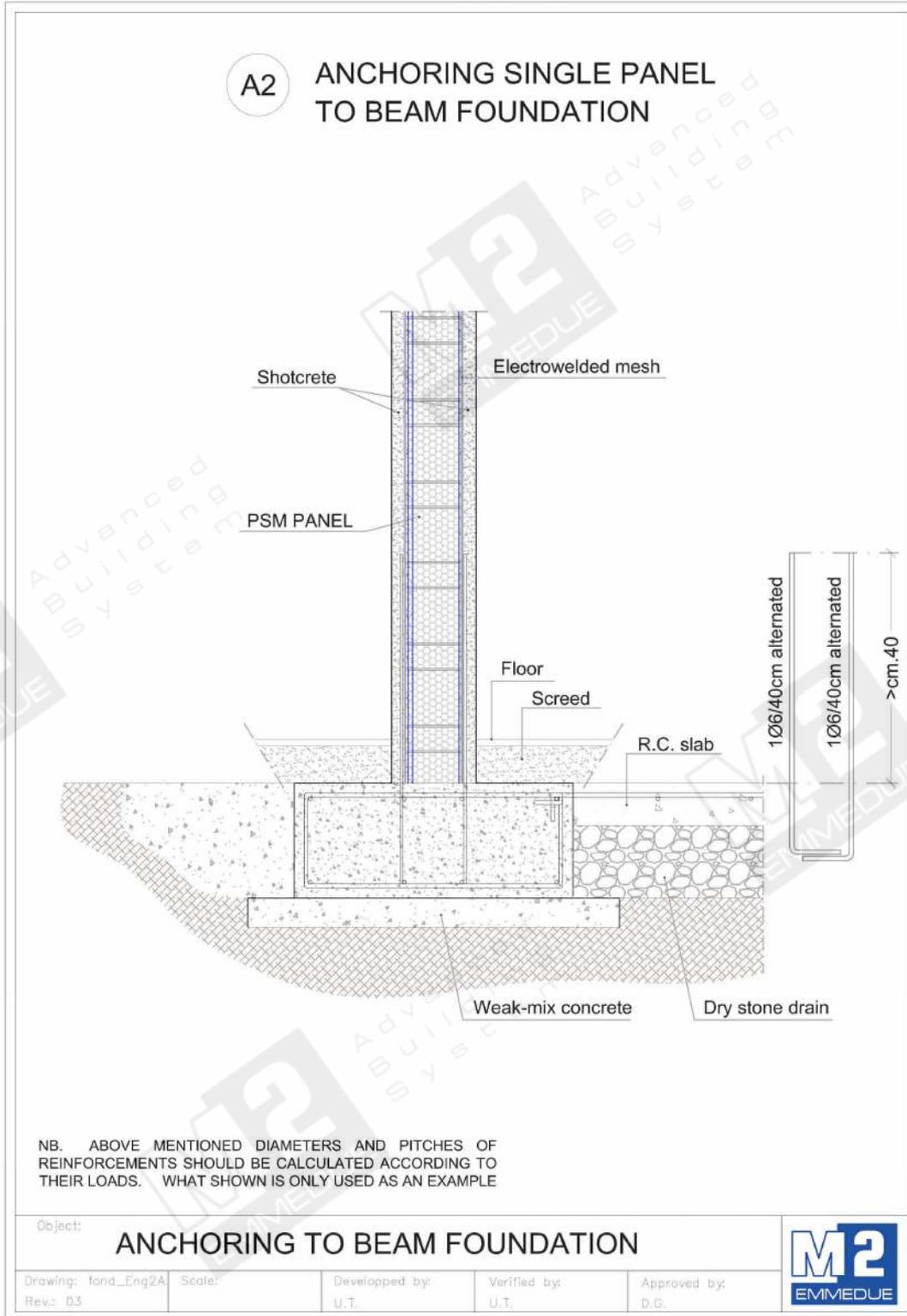


3.2 SINGLE PANEL ANCHORAGE

➤ 3.2.1 ANCHORING SINGLE PANEL TO RAFT FOUNDATION

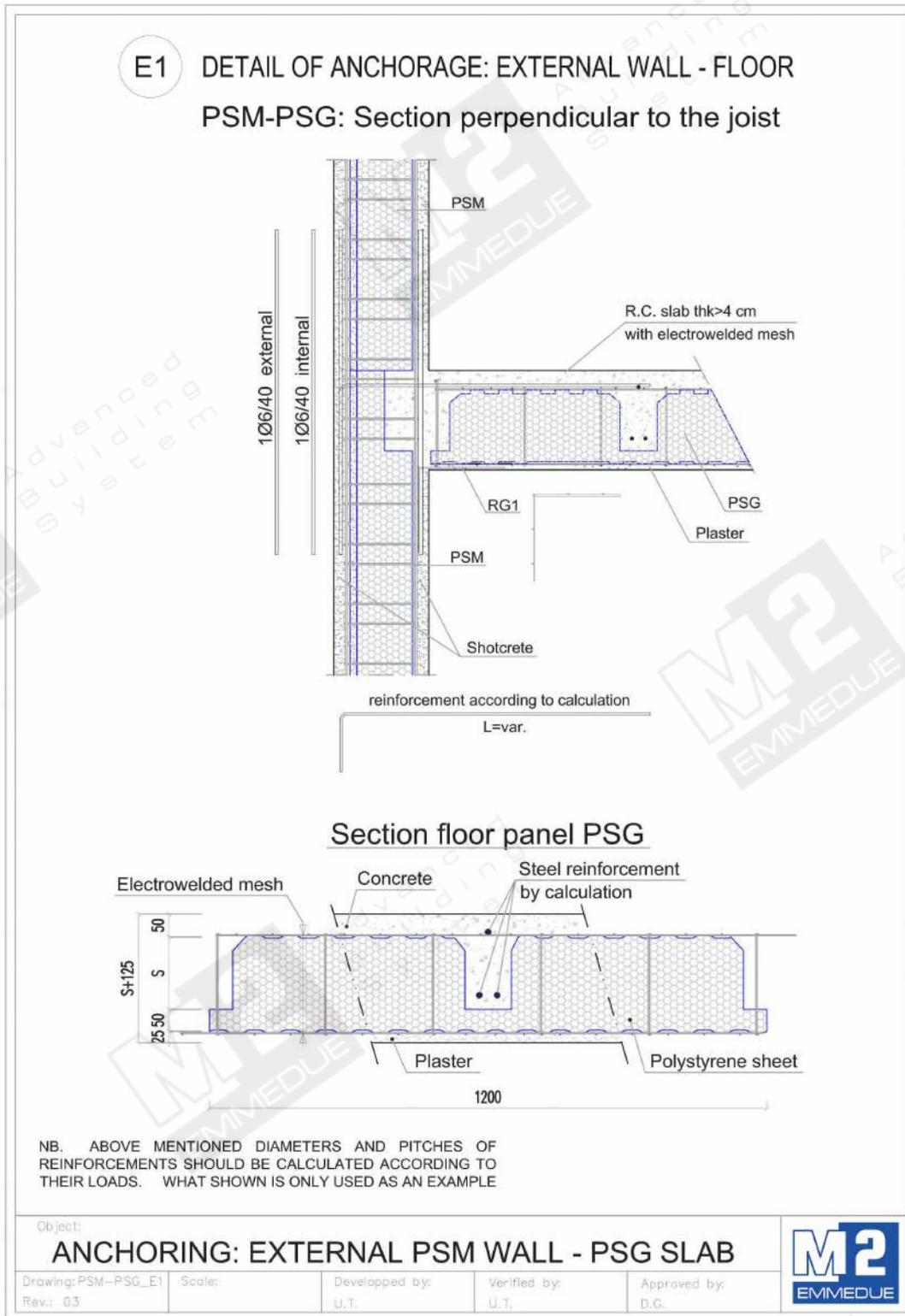


➤ 3.2.2 ANCHORING SINGLE PANEL TO BEAM FOUNDATION

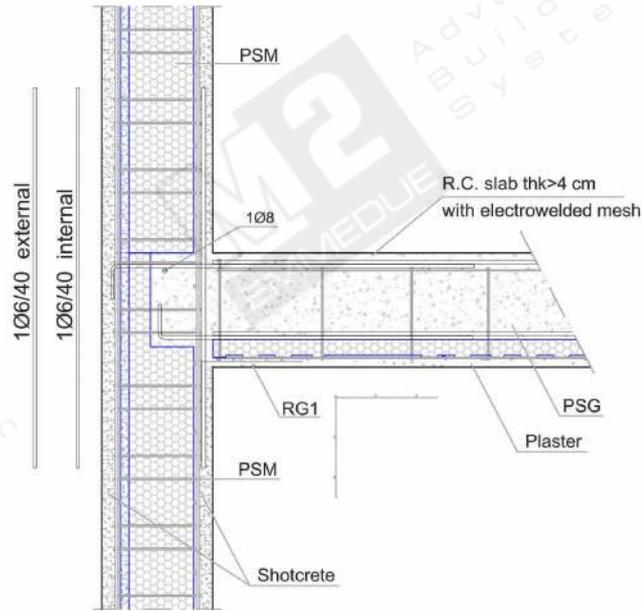


3.3 DETAIL OF ANCHORAGE OF WALL/FLOOR (PSG PANEL)

➤ 3.3.1 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PSG PANEL)

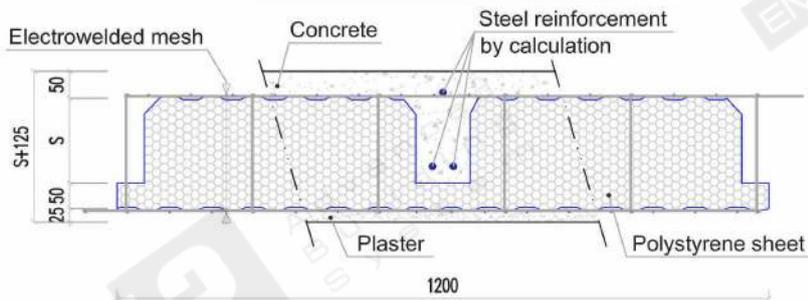


E2 DETAIL OF ANCHORAGE: EXTERNAL WALL - FLOOR
PSM-PSG: Section on the joist



Joist reinforcement according to calculation

Section floor panel PSG



NB. ABOVE MENTIONED DIAMETERS AND PITCHES OF REINFORCEMENTS SHOULD BE CALCULATED ACCORDING TO THEIR LOADS. WHAT SHOWN IS ONLY USED AS AN EXAMPLE

Object:

ANCHORING: EXTERNAL PSM WALL - PSG SLAB

Drawing: PSM-PSG_E2
Rev.: 03

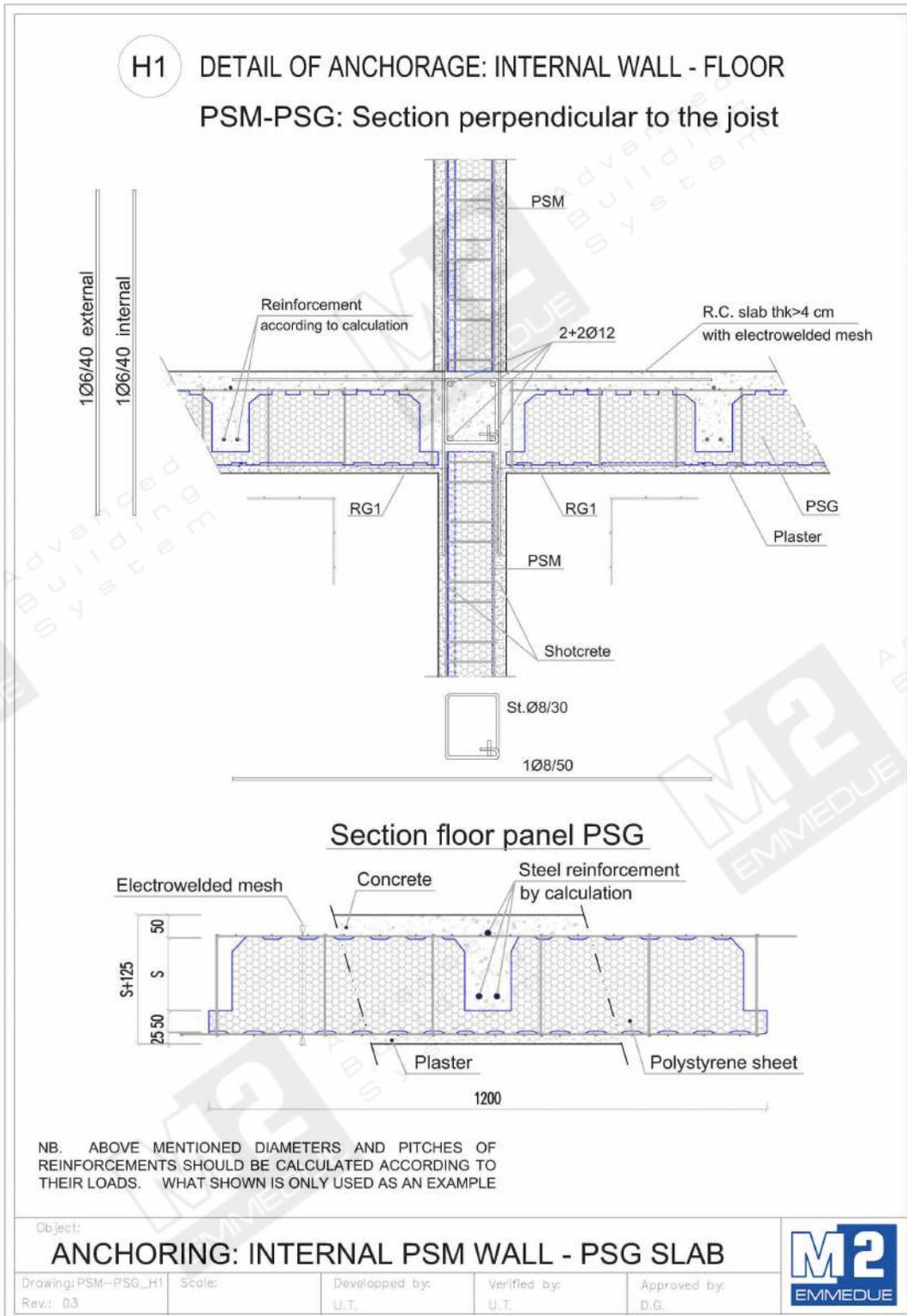
Scale:

Developed by:
U.T.

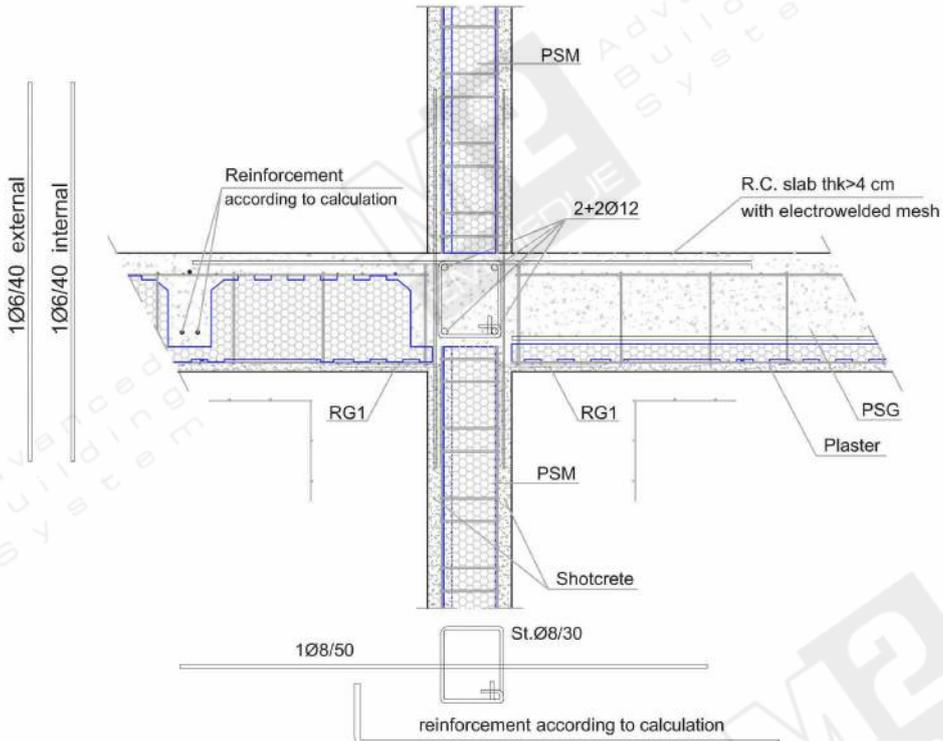
Verified by:
U.T.

Approved by:
D.G.

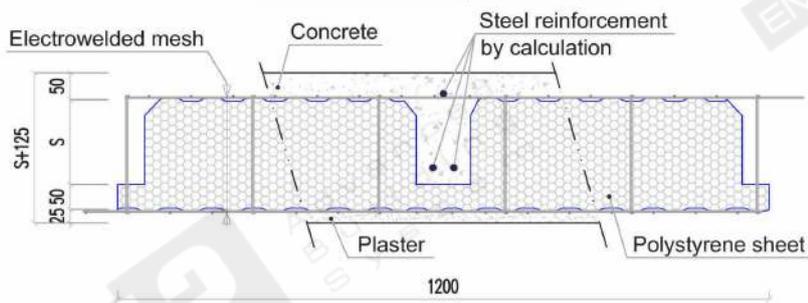
➔ 3.3.2 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PSG PANEL)



H2 DETAIL OF ANCHORAGE: INTERNAL WALL - FLOOR
PSM-PSG



Section floor panel PSG



NB. ABOVE MENTIONED DIAMETERS AND PITCHES OF REINFORCEMENTS SHOULD BE CALCULATED ACCORDING TO THEIR LOADS. WHAT SHOWN IS ONLY USED AS AN EXAMPLE

Object:

ANCHORING: INTERNAL PSM WALL - PSG SLAB

Drawing: PSM-PSG_H2
Rev.: 03

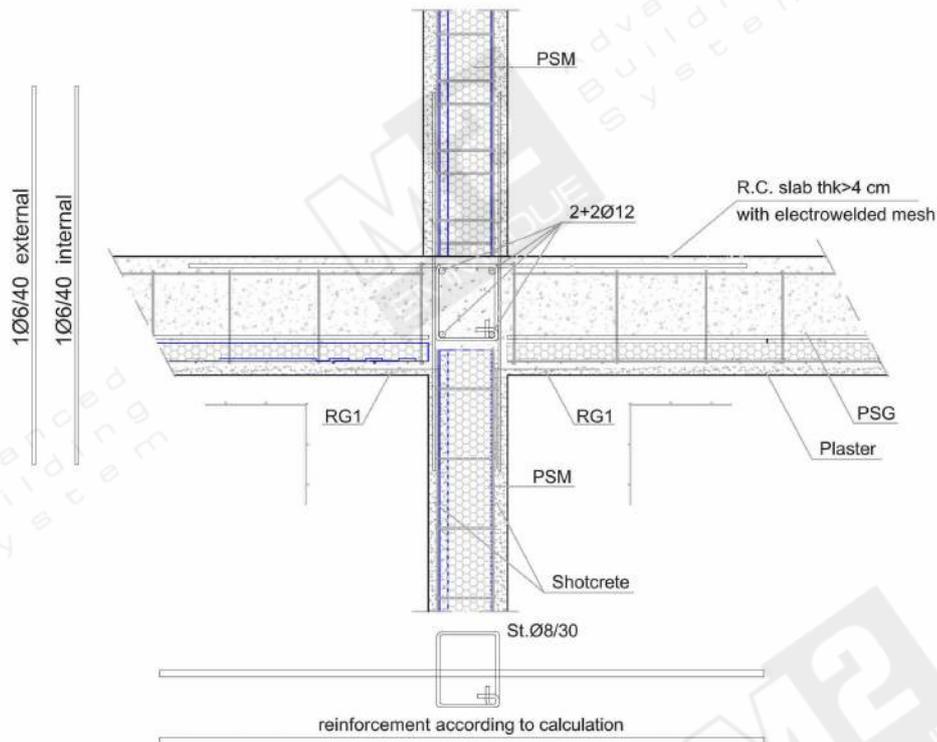
Scale:

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U.T.

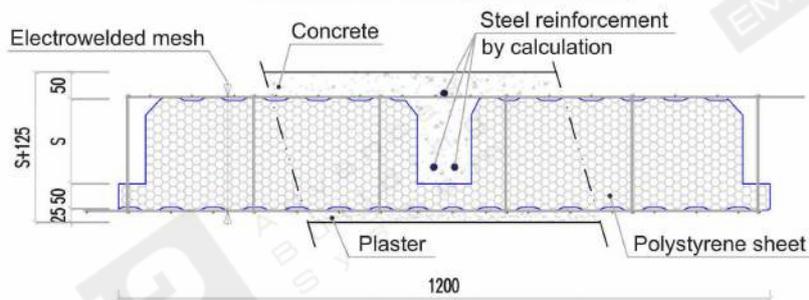
Verified by:
U.T.

Approved by:
D.G.

H3 DETAIL OF ANCHORAGE: INTERNAL WALL - FLOOR
PSM-PSG: Section on the joist



Section floor panel PSG



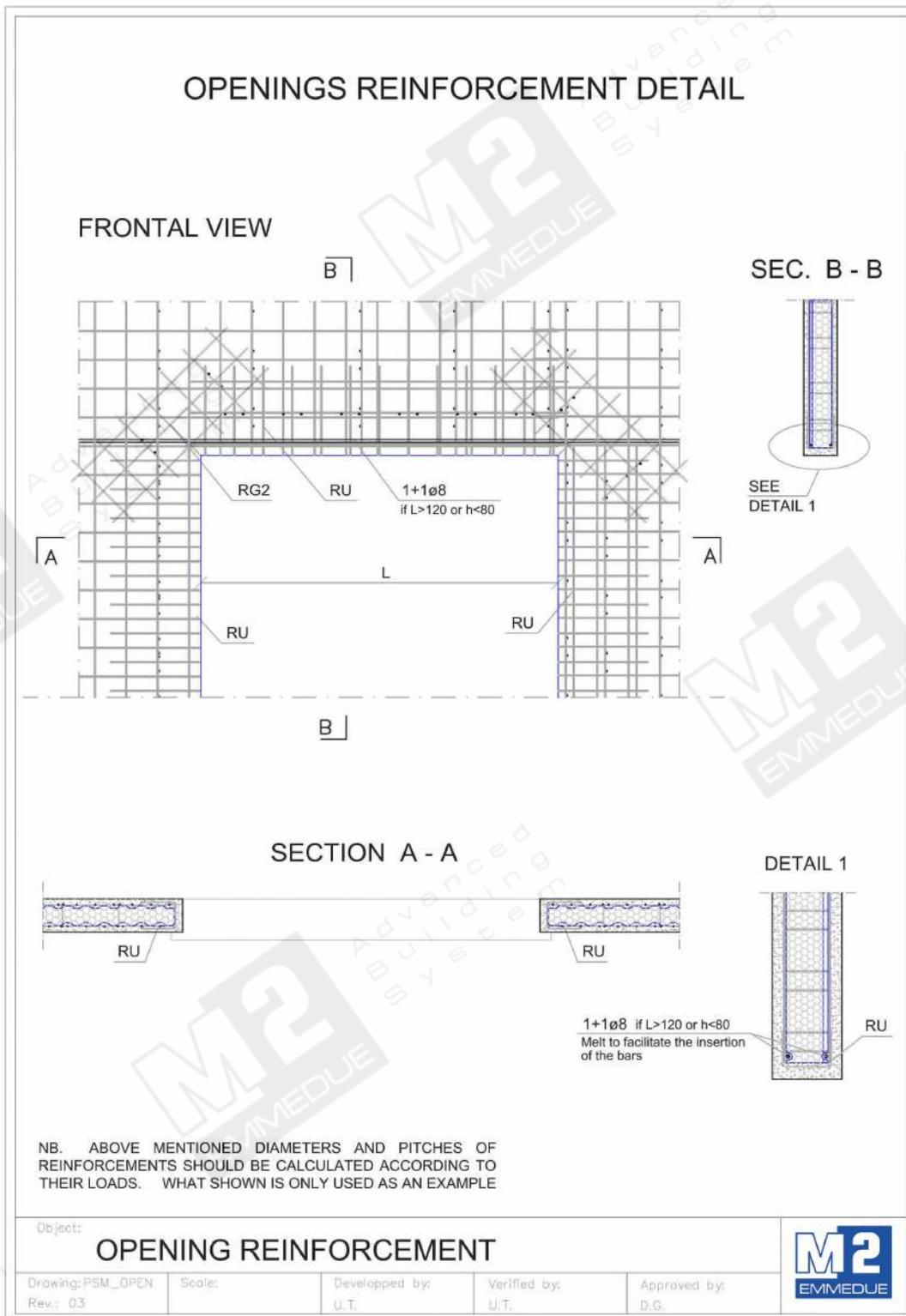
NB. ABOVE MENTIONED DIAMETERS AND PITCHES OF REINFORCEMENTS SHOULD BE CALCULATED ACCORDING TO THEIR LOADS. WHAT SHOWN IS ONLY USED AS AN EXAMPLE

Object:				M2 EMMEDUE
ANCHORING: INTERNAL PSM WALL - PSG SLAB				
Drawing: PSM-PSG_H3	Scale:	Developped by:	Verified by:	Approved by:
Rev: 03		U.T.	U.T.	D.G.

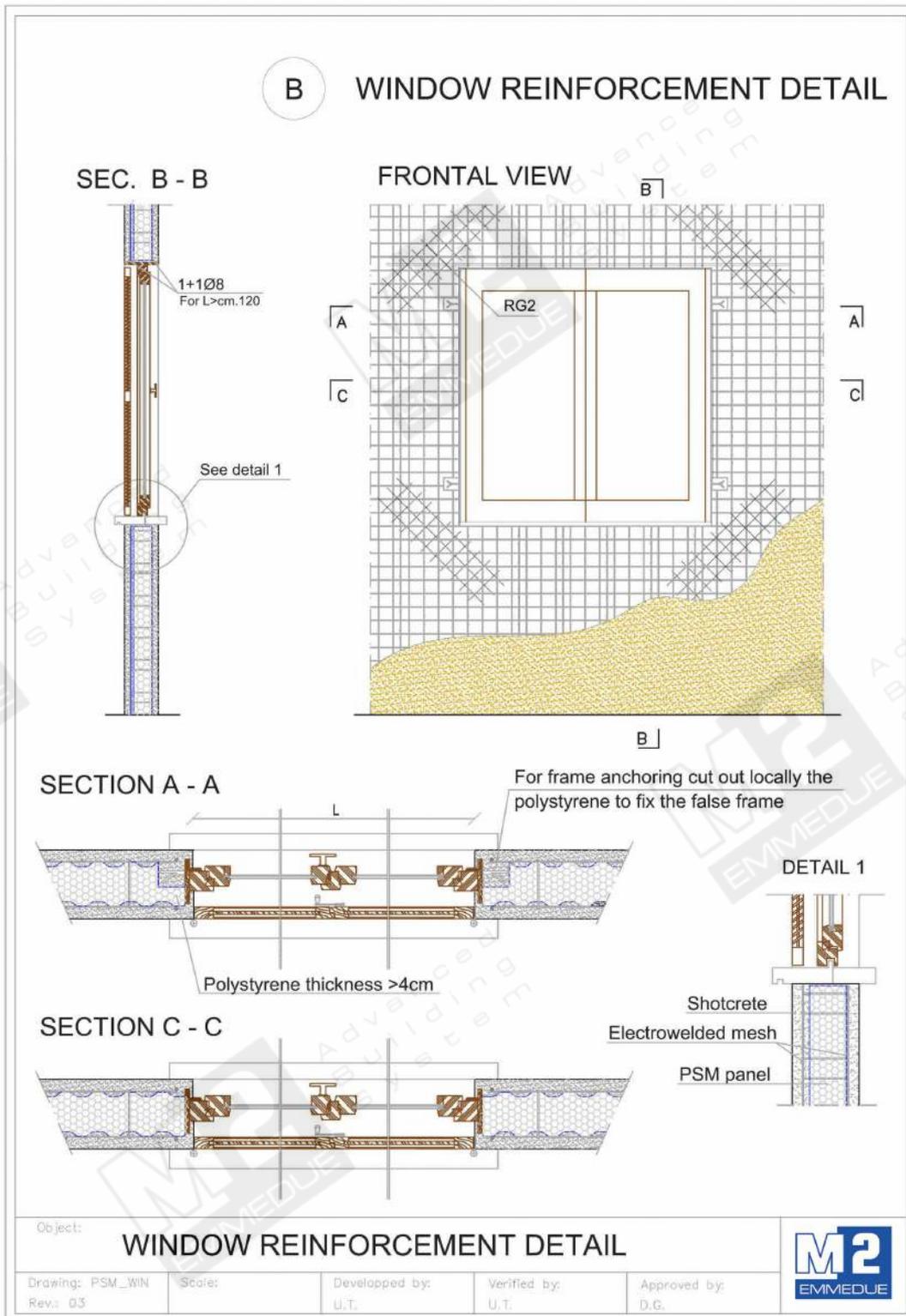
3.4 OPENING REINFORCEMENT (PSM)

➔ 3.4.1 OPENING REINFORCEMENT DETAIL

OPERATOR'S HANDBOOK

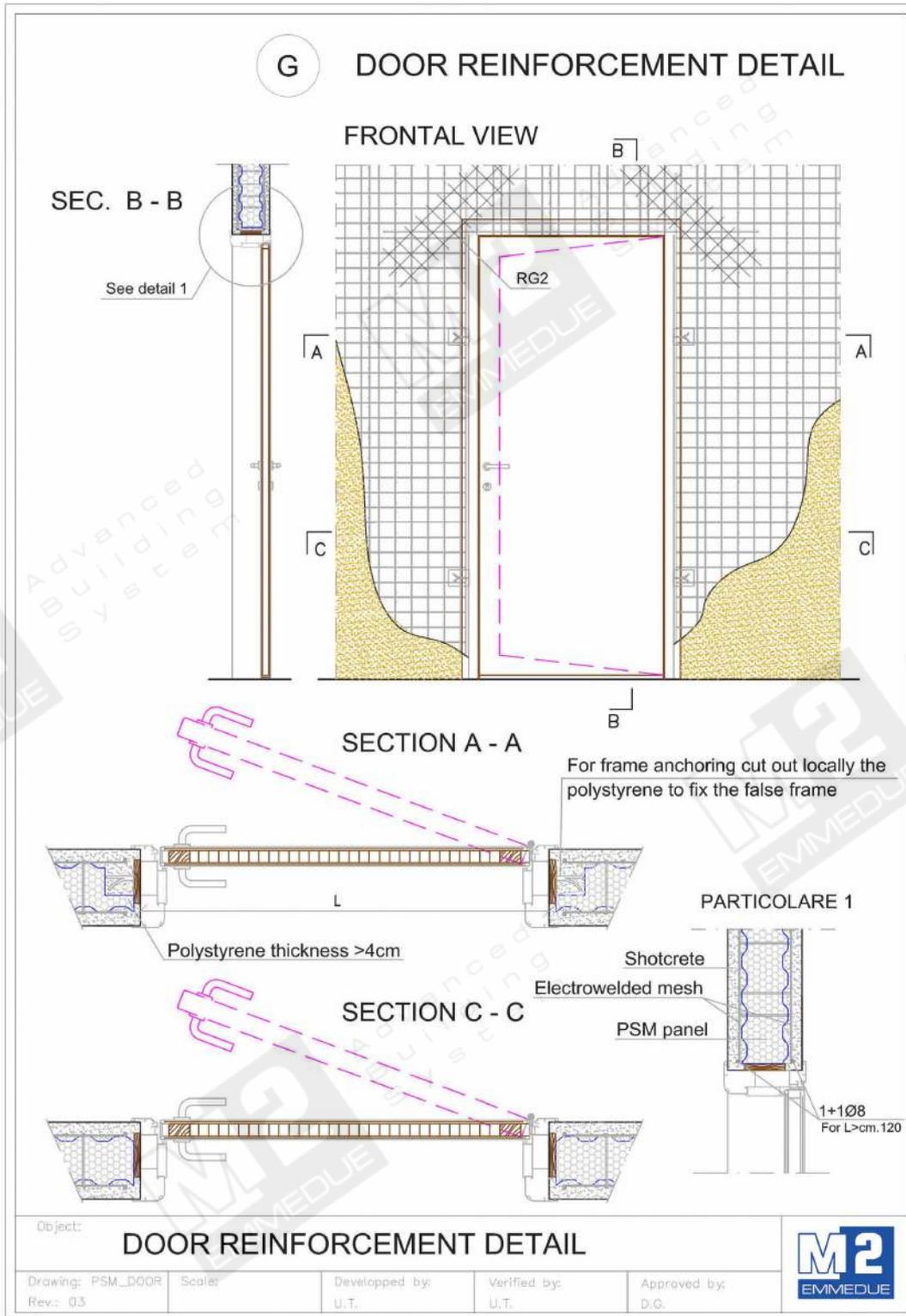


➔ 3.4.2 WINDOW REINFORCEMENT DETAIL

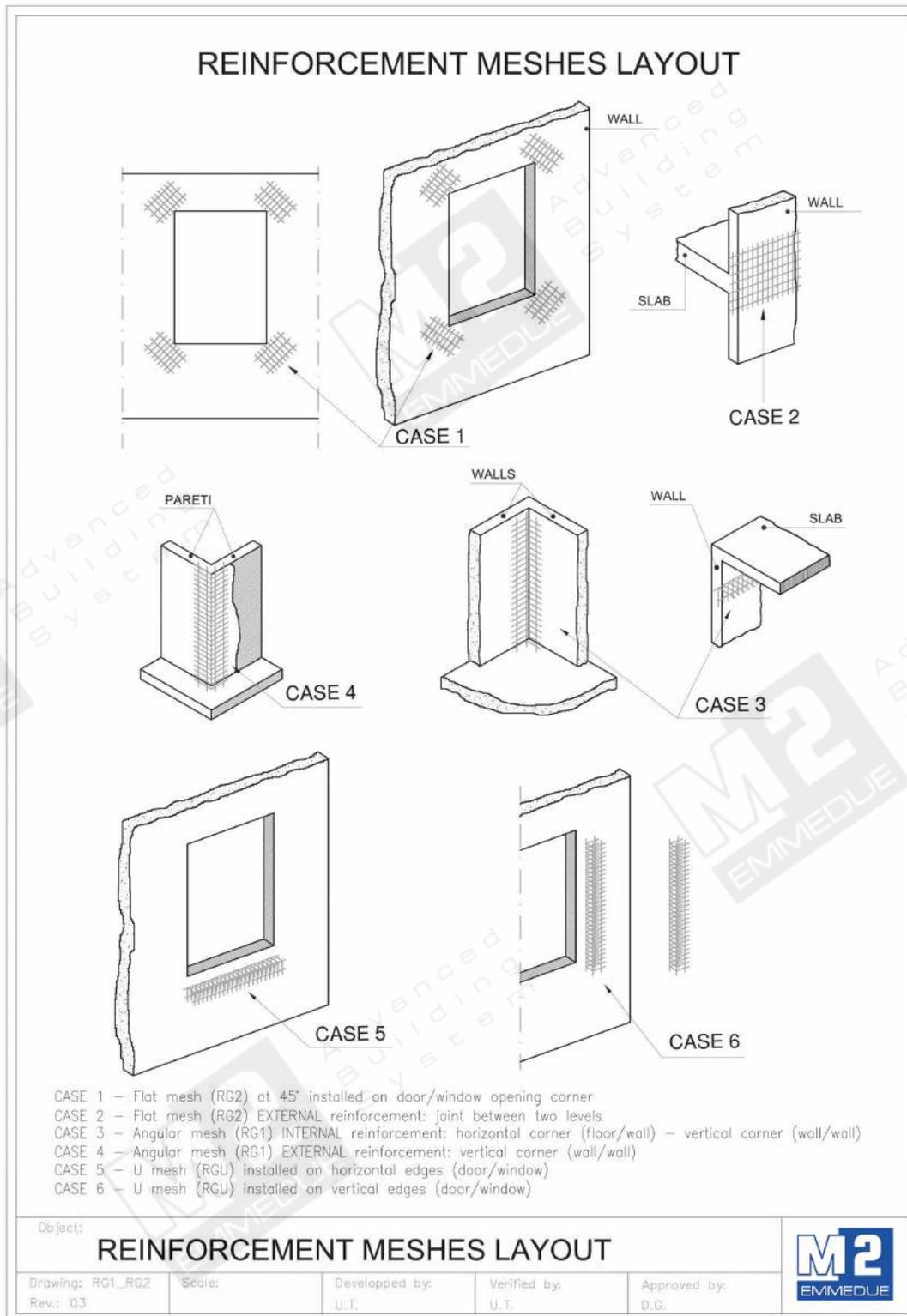




3.4.3 DOOR REINFORCEMENT DETAIL

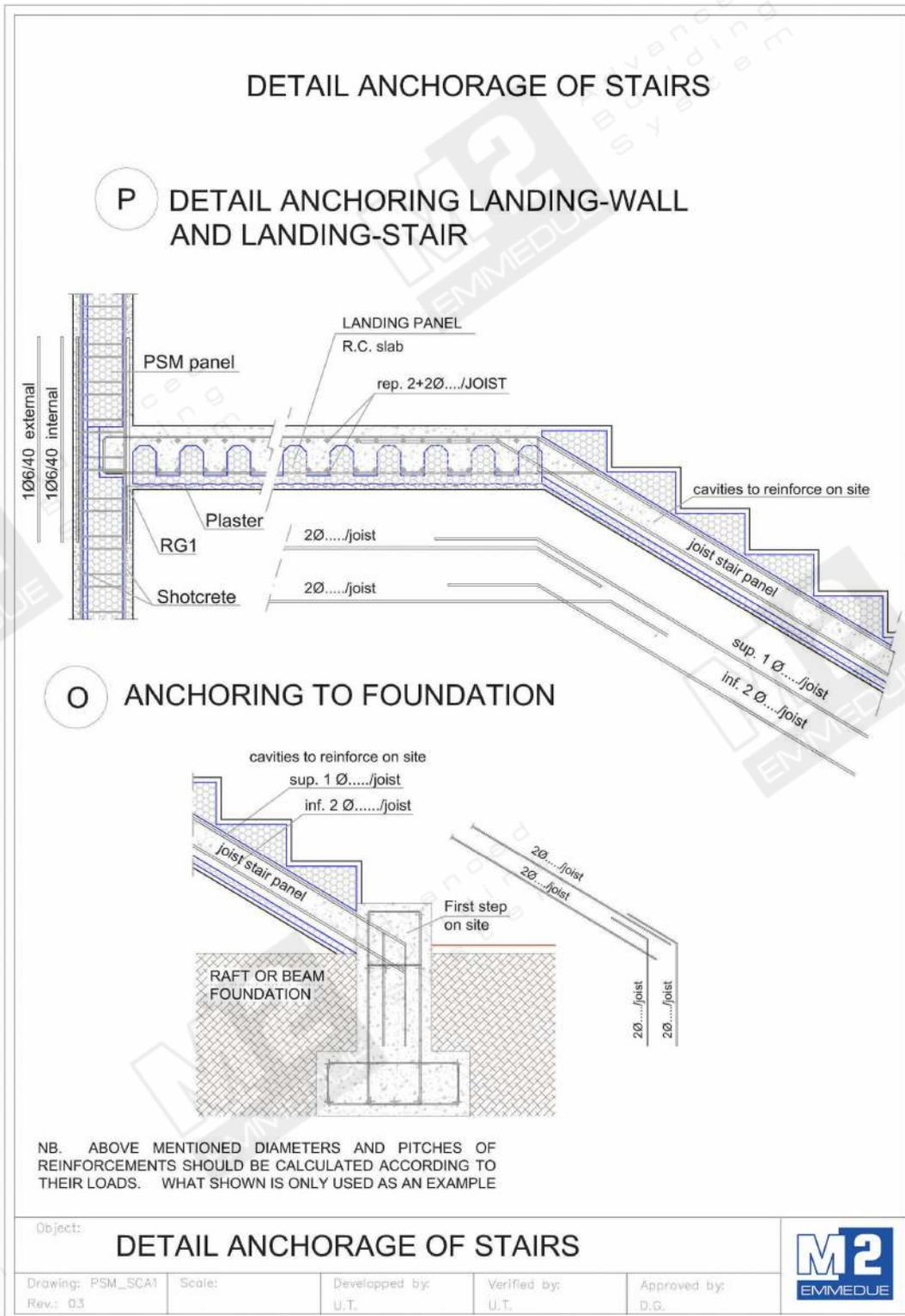


➤ 3.4.4 REINFORCEMENT MESHES LAYOUT

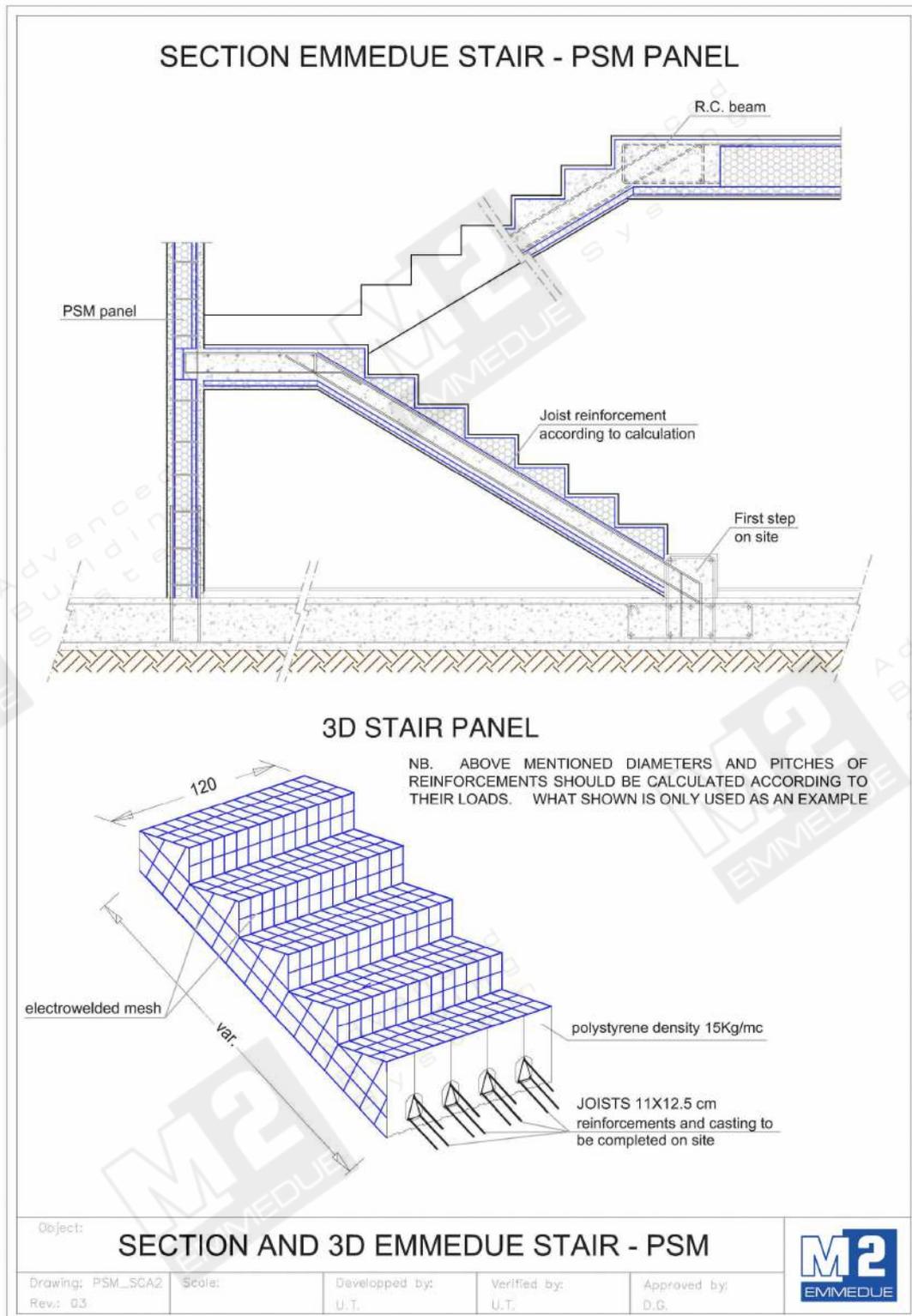


3.5 STAIRCASE ANCHORAGE

3.5.1 LANDING/WALL AND LANDING/STAIRS ANCHORAGE DETAILS



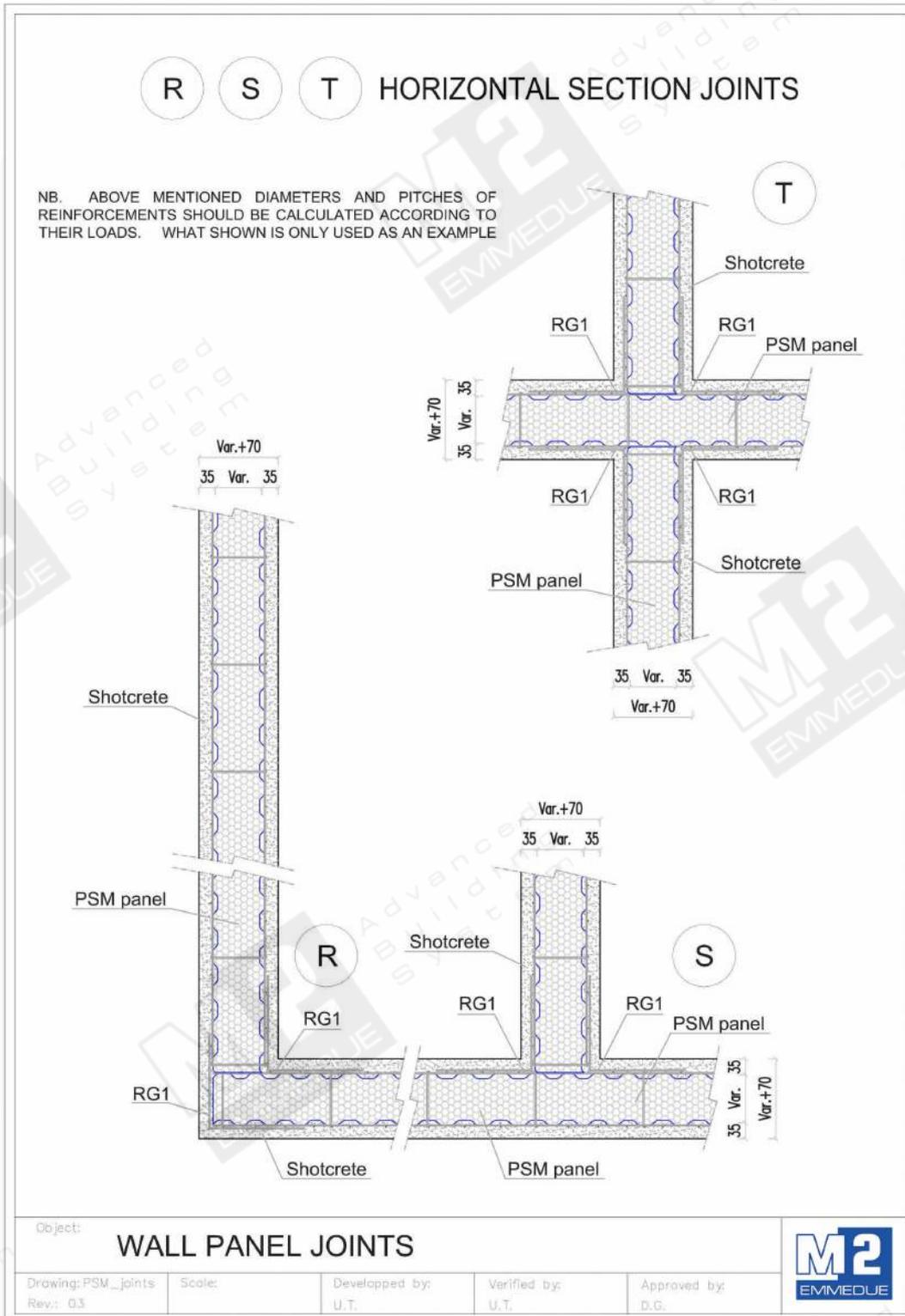
➔ 3.5.2 SECTION AND 3D EMMEDUE STAIRS-PSM PANEL



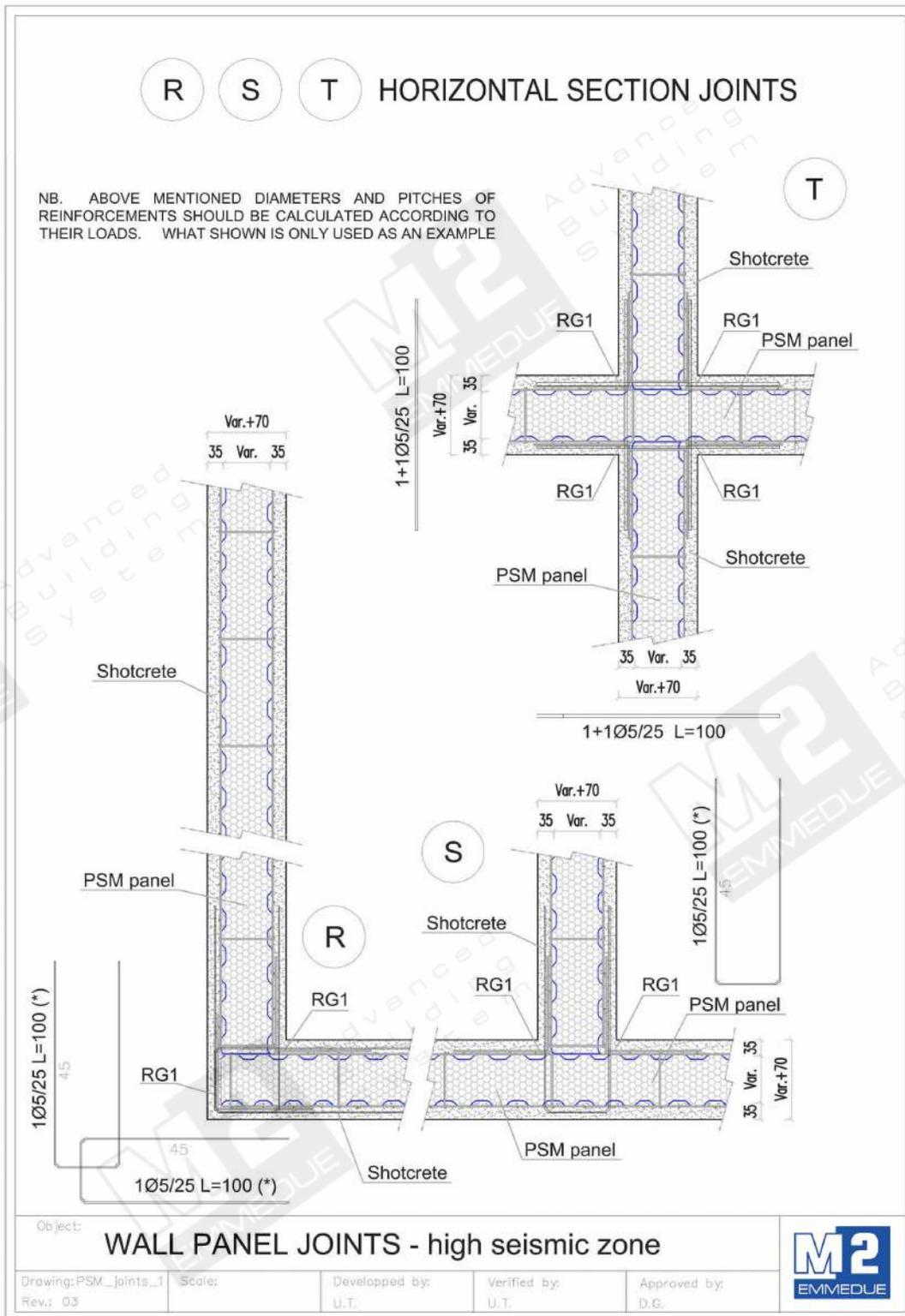
3.6 WALL PANEL JOINTS (PSM PANEL)



3.6.1 HORIZONTAL SECTION OF WALL PANEL JOINTS (PSM PANEL)



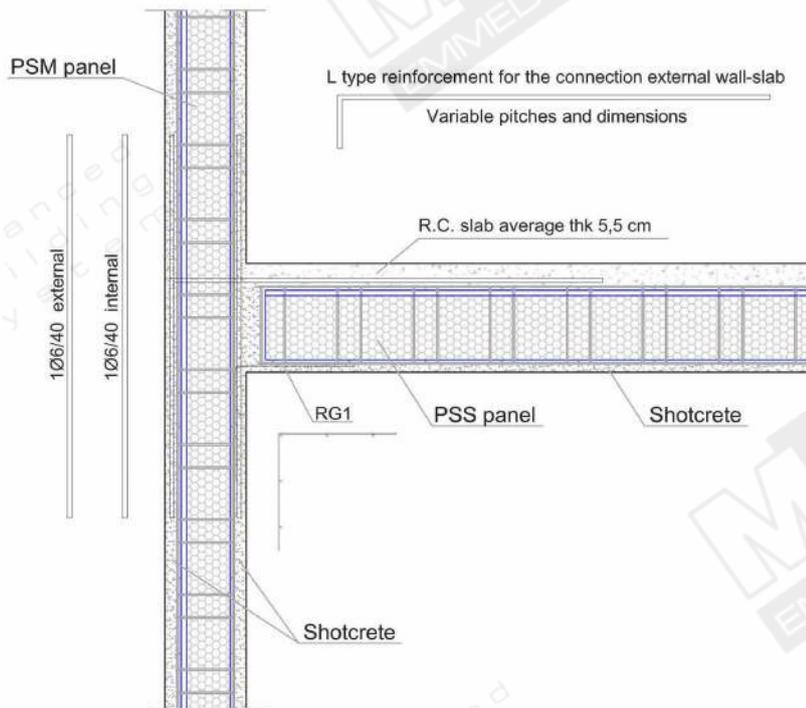
➔ 3.6.2 WALL PANEL JOINTS IN HIGH SEISMIC ZONE
(PSM PANEL)



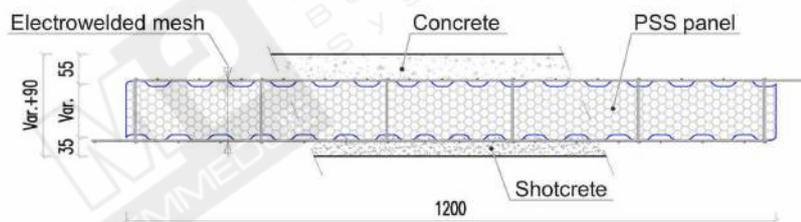
3.7 DETAIL OF ANCHORAGE OF WALL/FLOOR (PSS PANEL)

➤ 3.7.1 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PSS PANEL)

E3 DETAIL OF ANCHORAGE: EXTERNAL WALL - FLOOR
PSM-PSS: Vertical section

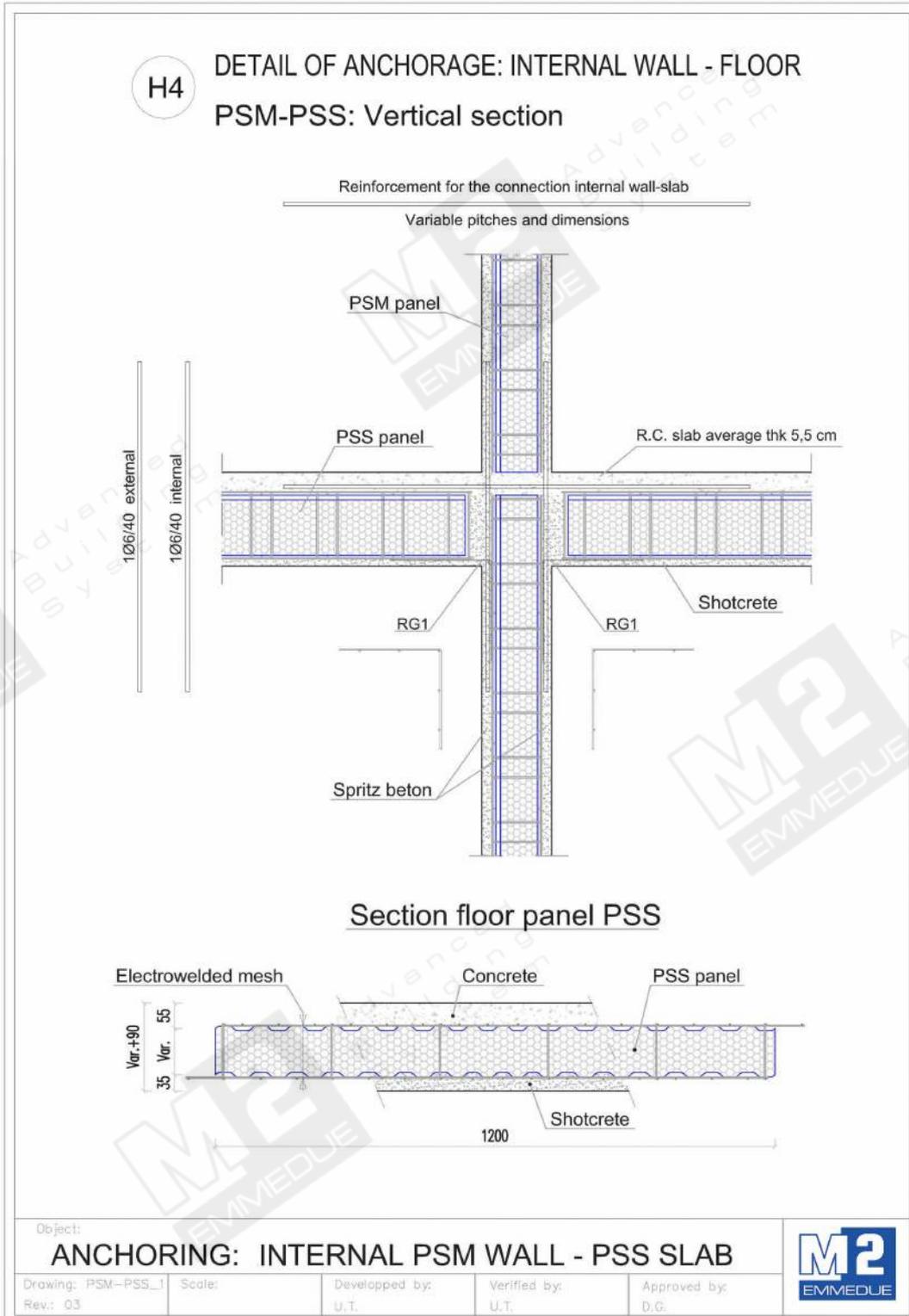


Section floor panel PSS



Object: ANCHORING: EXTERNAL PSM WALL - PSS SLAB					M2 EMMEDUE
Drawing: PSM-PSS Rev.: 0.3	Scale:	Developped by: U.T.	Verified by: U.T.	Approved by: D.G.	

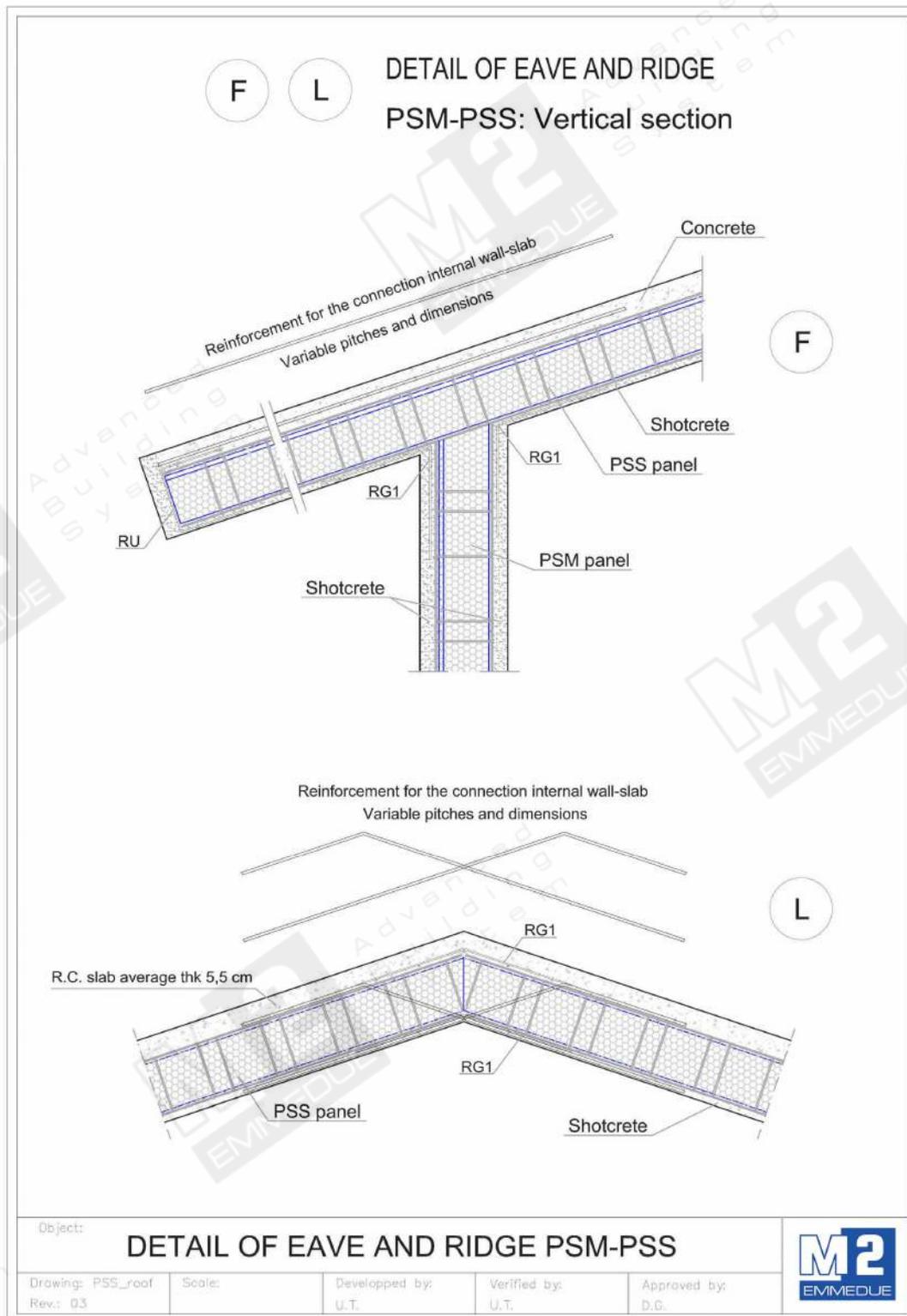
➔ 3.7.2 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PSS PANEL)



3.8 EAVE AND RIDGE DETAIL (PSM-PSS PANEL)

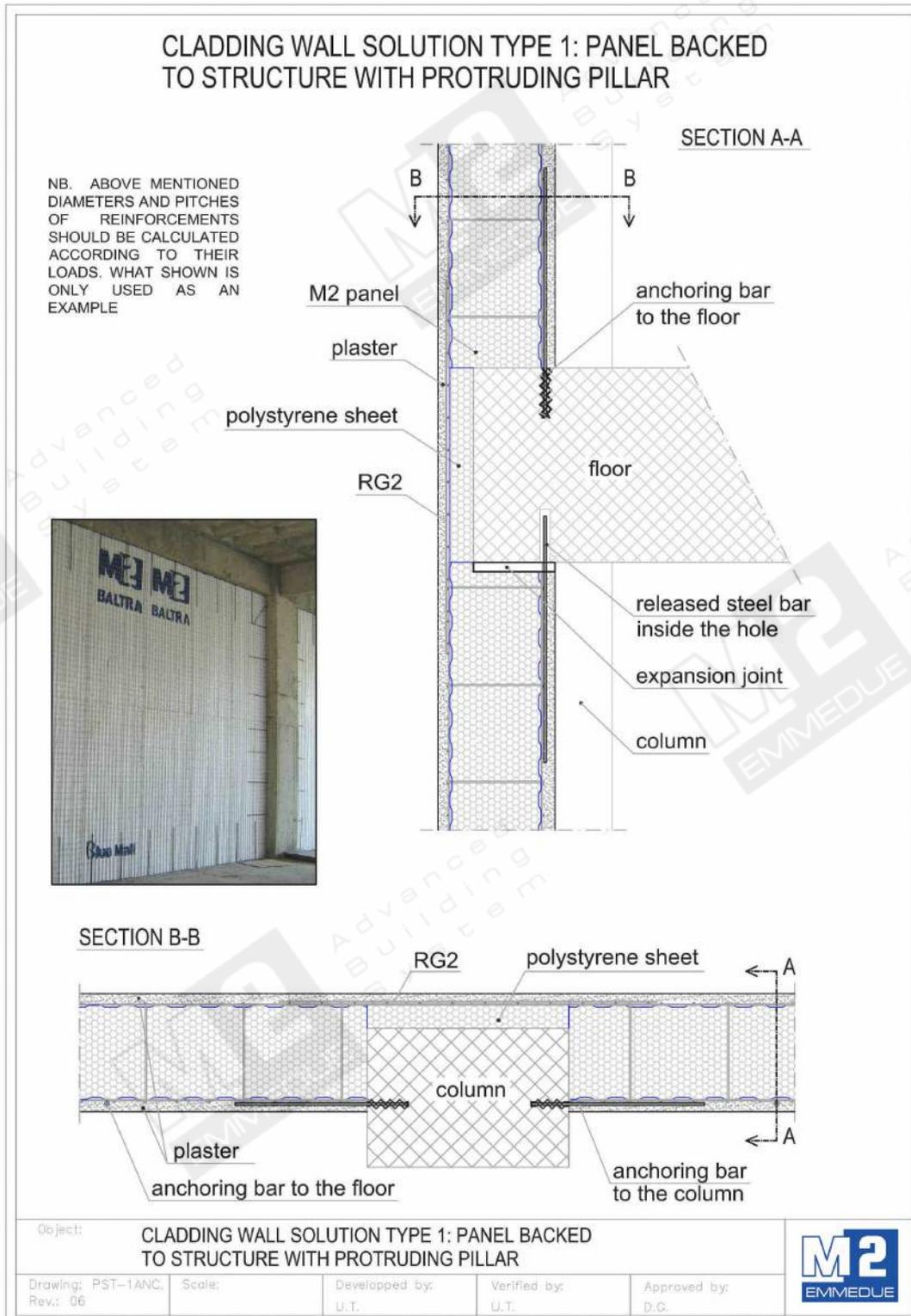
➤ 3.8.1 DETAIL OF EAVE AND RIDGE WITH PSM-PSS PANEL

OPERATOR'S HANDBOOK

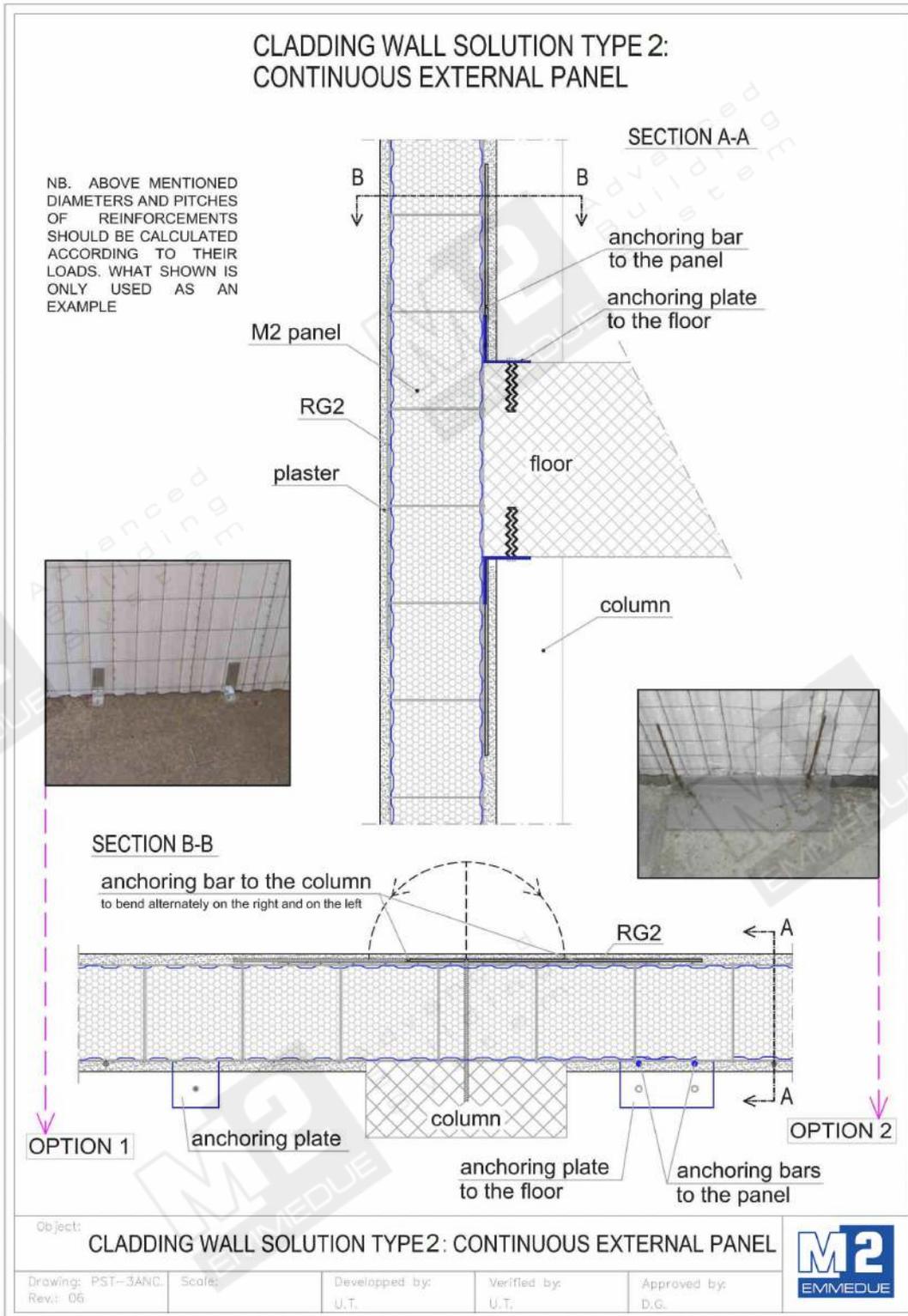


3.9 CLADDING WALL SOLUTIONS

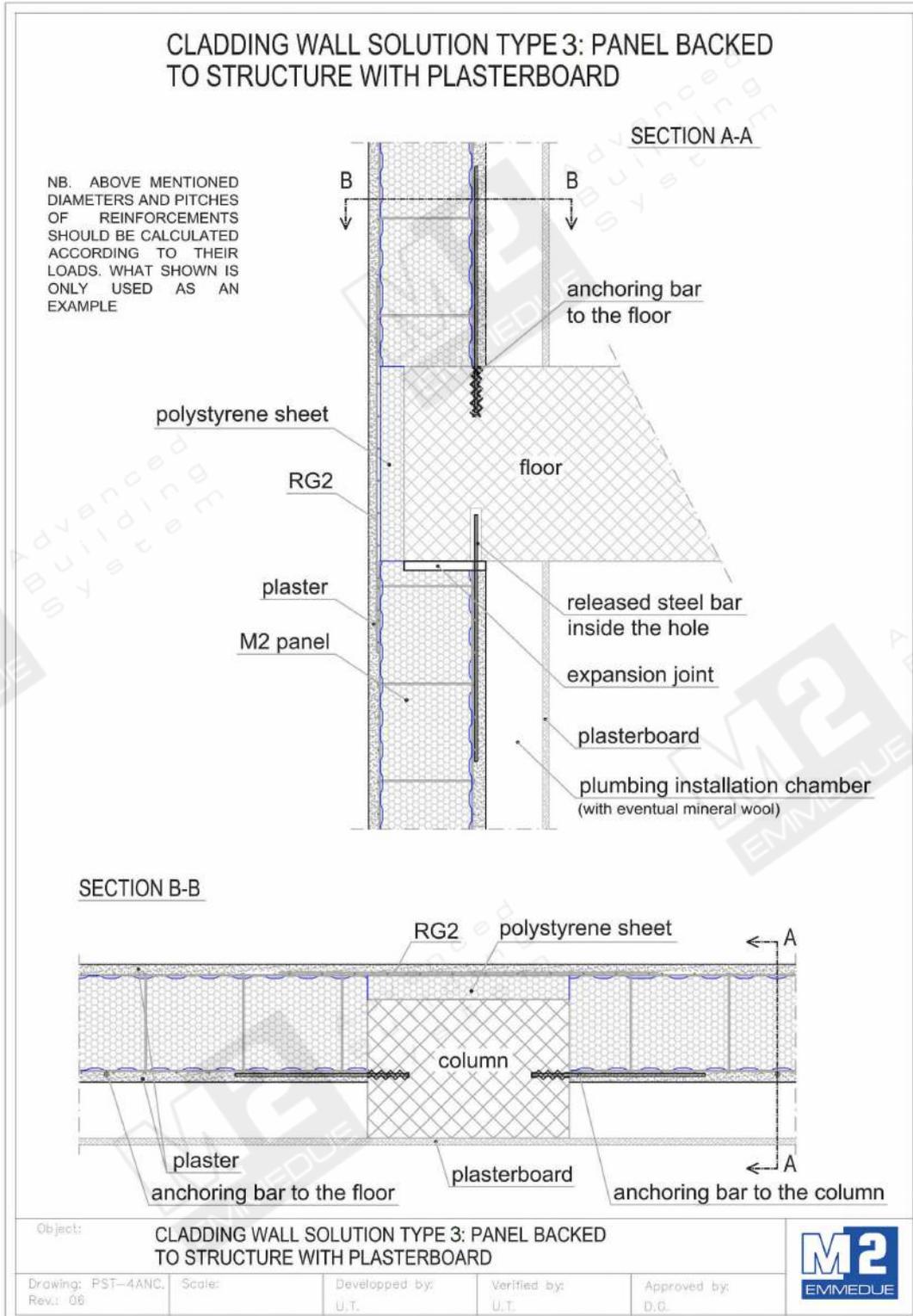
➤ 3.9.1 SOLUTION 1: PANEL BACKED TO STRUCTURE WITH PROTRUDING PILLAR



➔ 3.9.2 SOLUTION 2: CONTINUOUS EXTERNAL PANEL



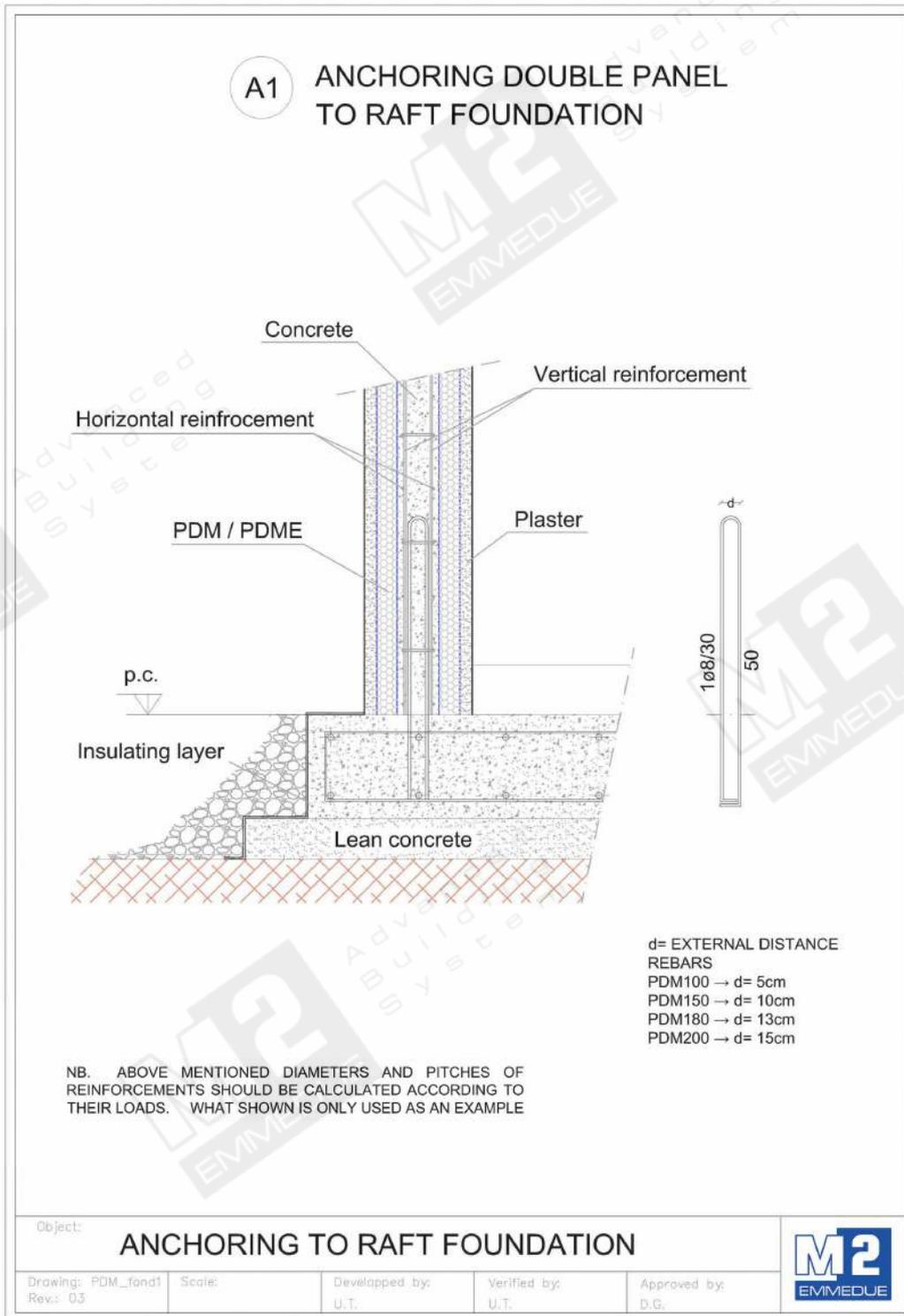
➔ 3.9.3 SOLUTION 3: PANEL BACKED TO STRUCTURE WITH PLASTERBOARD



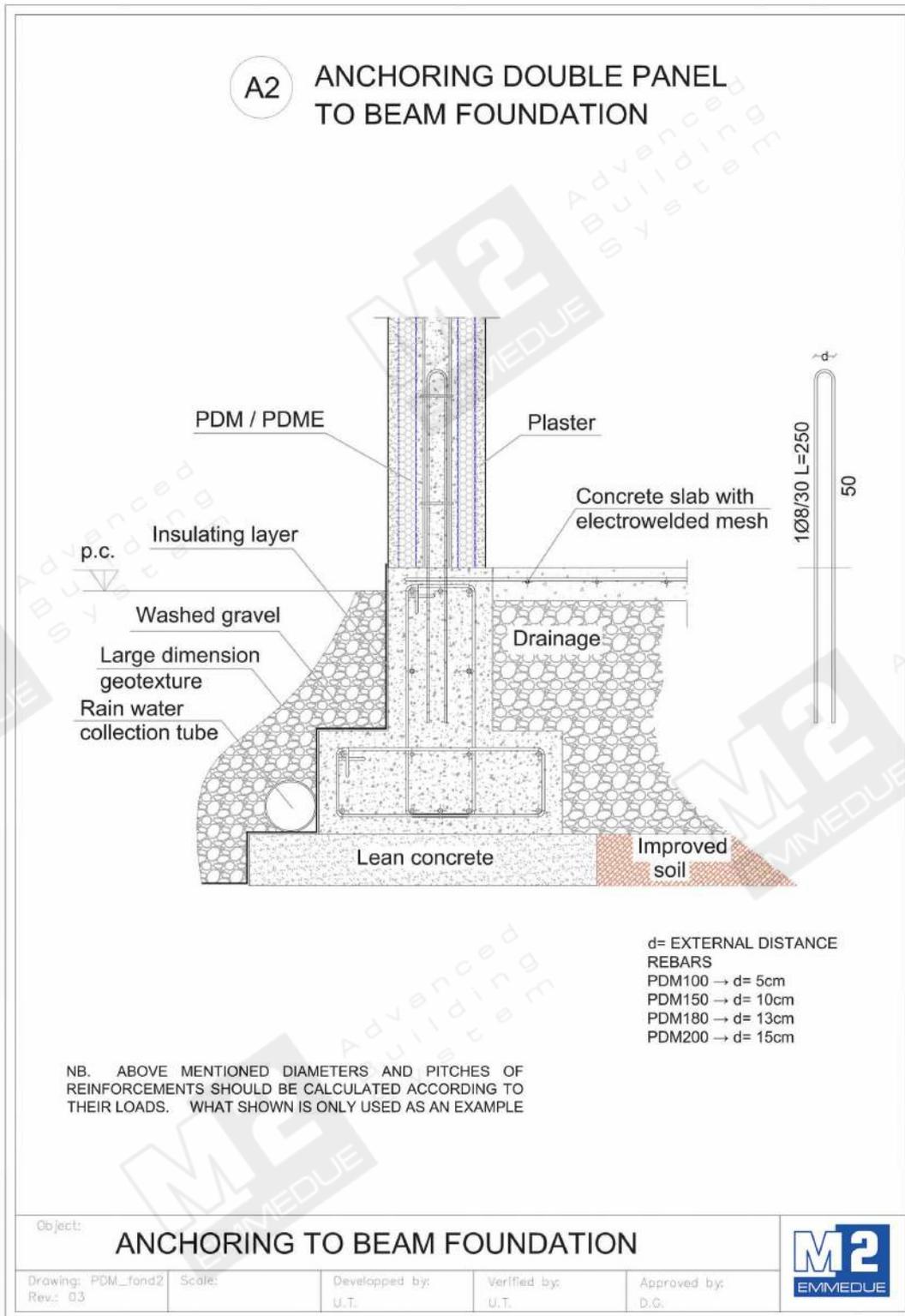
3.10 DOUBLE PANEL ANCHORAGE

➔ 3.10.1 ANCHORING DOUBLE PANEL TO RAFT FOUNDATION

OPERATOR'S HANDBOOK

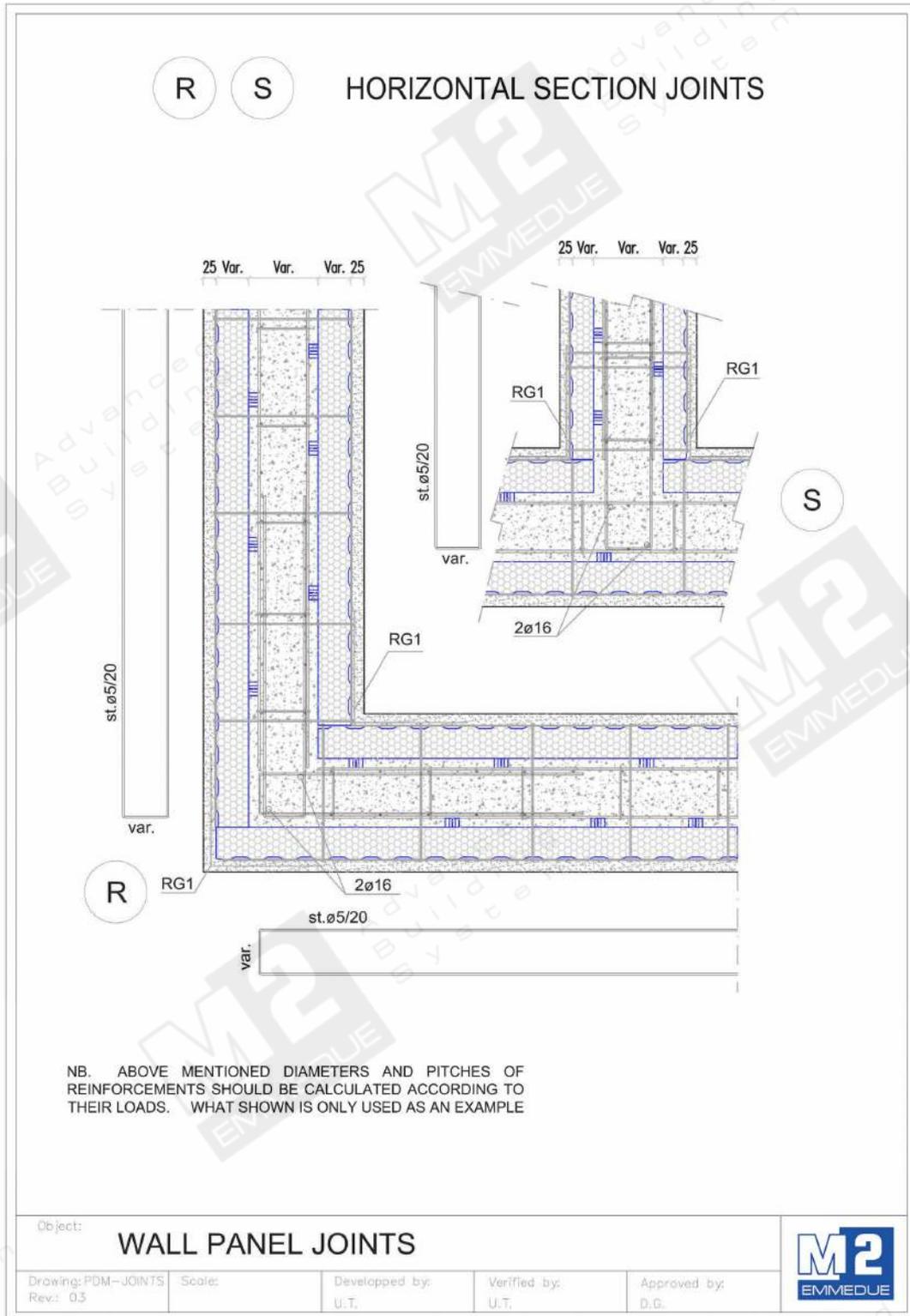


➔ 3.10.2 ANCHORING DOUBLE PANEL TO BEAM FOUNDATION



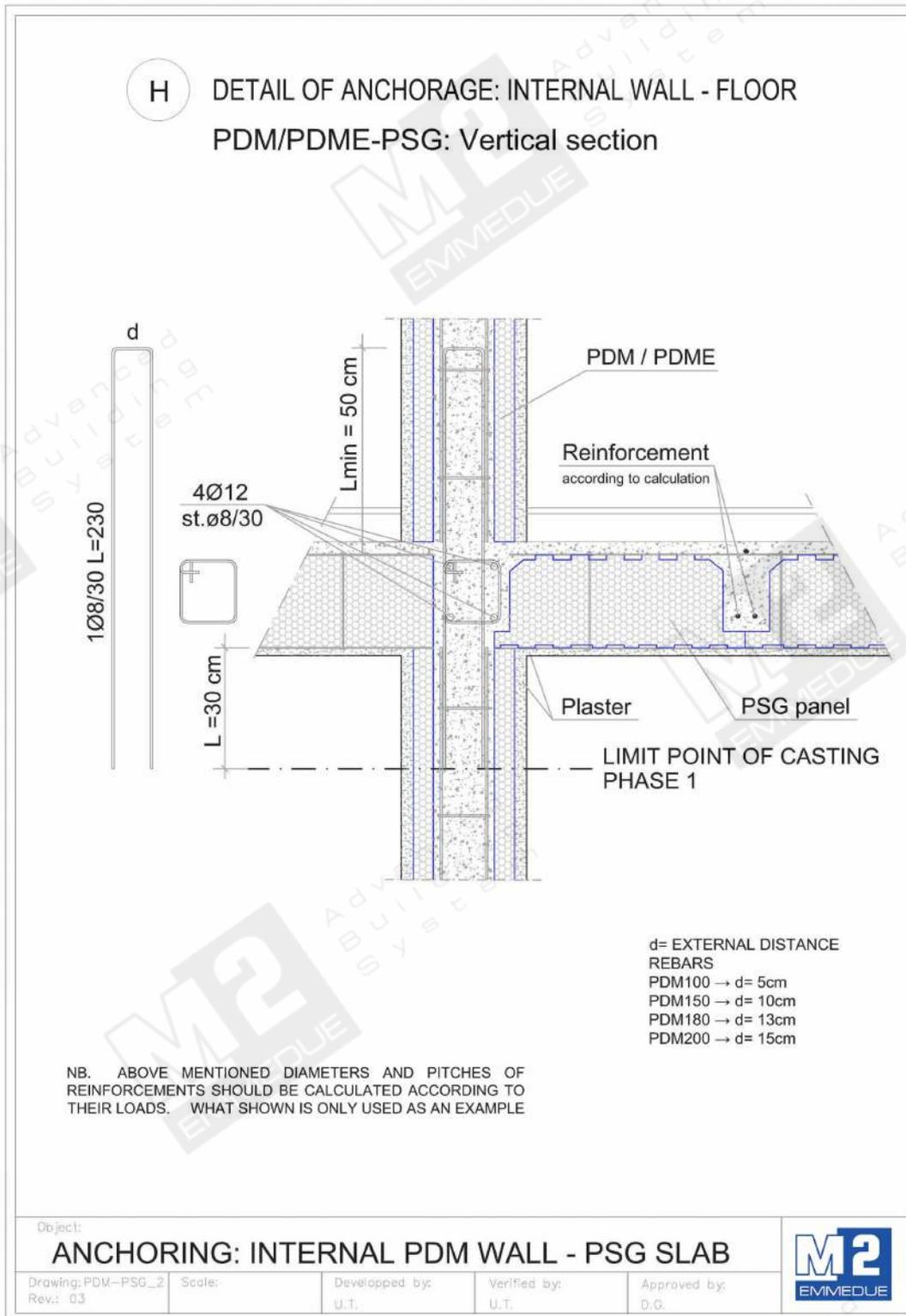
3.11 WALL PANEL JOINTS (PDM PANEL)

➤ 3.11.1 HORIZONTAL SECTION OF WALL PANEL JOINTS (PDM PANEL)



3.12 DETAIL OF ANCHORAGE OF WALL/FLOOR (PDM/PDME PANEL - PSG PANEL)

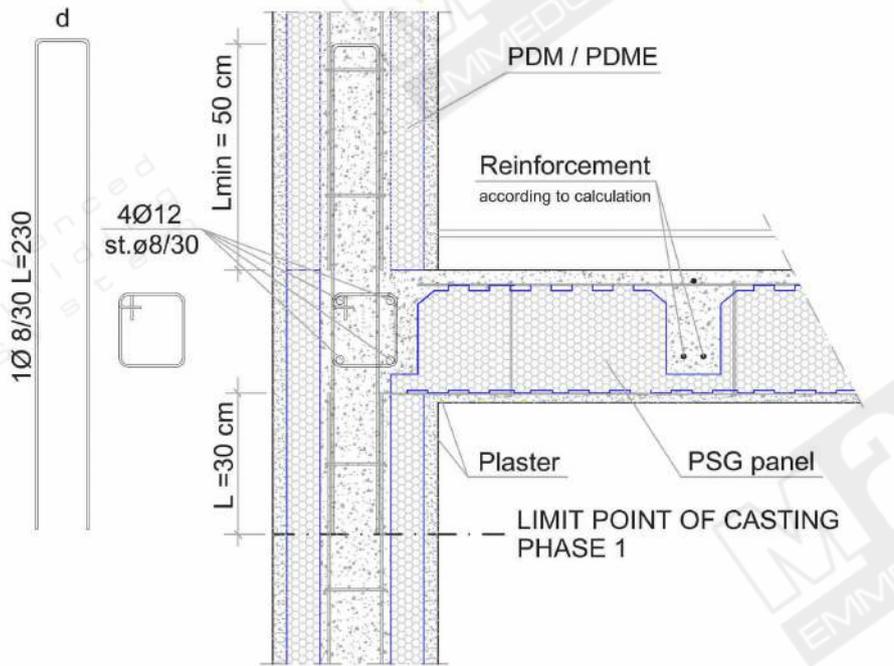
➔ 3.12.1 DETAIL OF ANCHORAGE: INTERNAL WALL/FLOOR (PDM/PDME PANEL - PSG PANEL)





3.12.2 DETAIL OF ANCHORAGE: EXTERNAL WALL/FLOOR (PDM/PDME PANEL - PSG PANEL)

E DETAIL OF ANCHORAGE: EXTERNAL WALL - FLOOR
PDM/PDME-PSG: Vertical section



d= EXTERNAL DISTANCE
REBARS
PDM100 → d= 5cm
PDM150 → d= 10cm
PDM180 → d= 13cm
PDM200 → d= 15cm

NB. ABOVE MENTIONED DIAMETERS AND PITCHES OF REINFORCEMENTS SHOULD BE CALCULATED ACCORDING TO THEIR LOADS. WHAT SHOWN IS ONLY USED AS AN EXAMPLE

Object:

ANCHORING: EXTERNAL PDM WALL - PSG SLAB

Drawing: PDM-PSG_1
Rev.: 03

Scale:

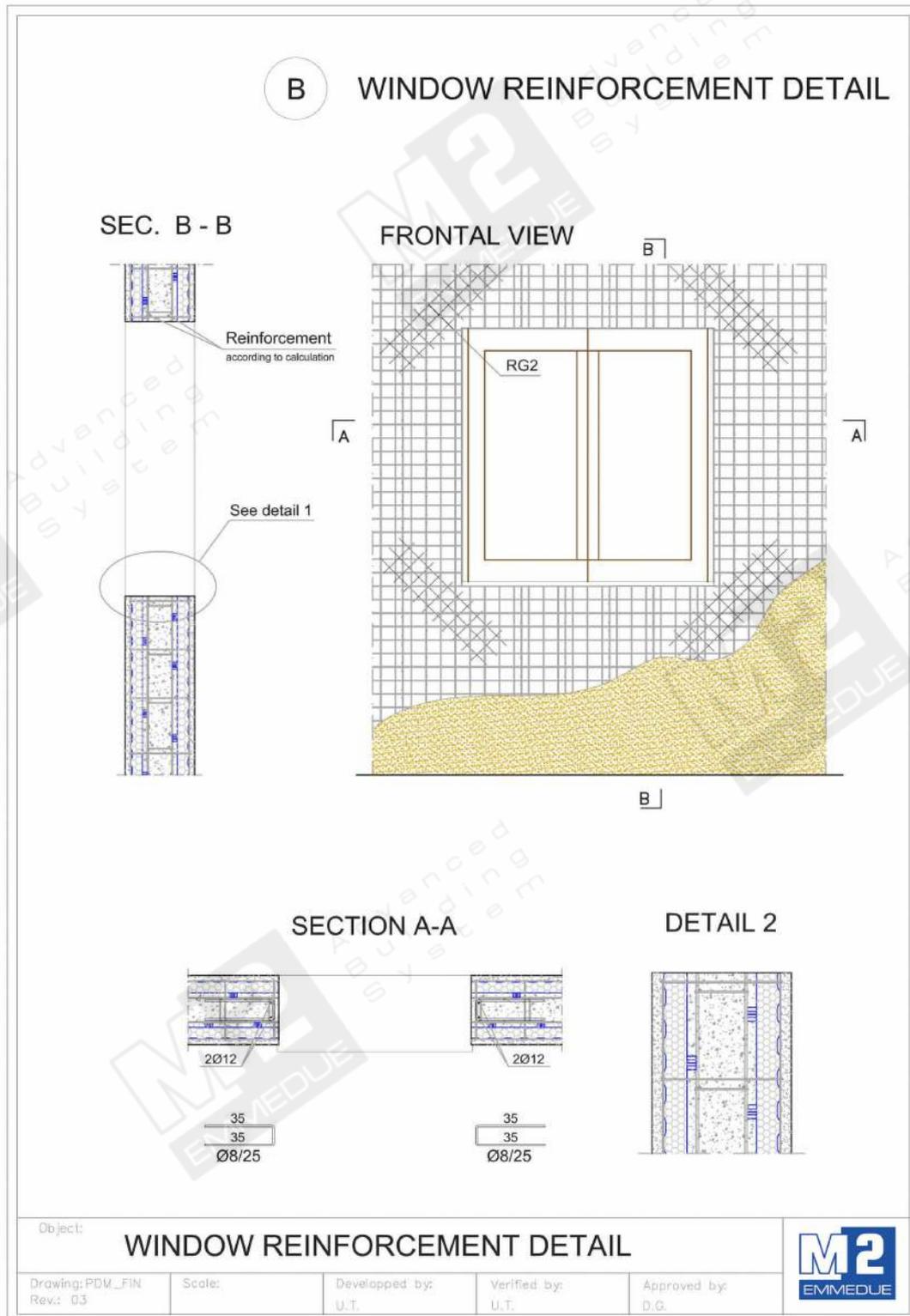
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U.T.

Verified by:
U.T.

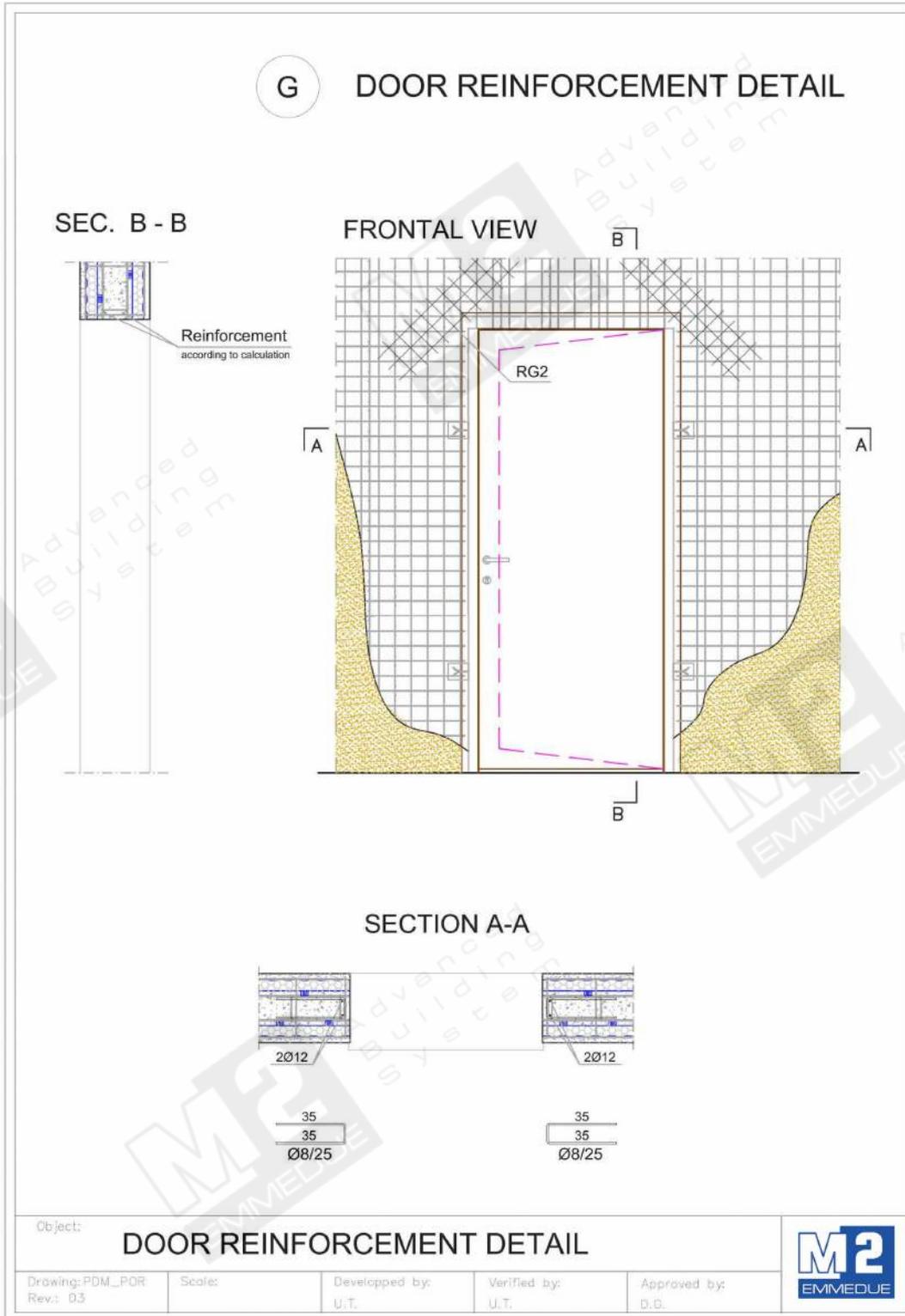
Approved by:
D.G.

3.13 OPENING REINFORCEMENT (PDM)

3.13.1 WINDOW REINFORCEMENT DETAIL

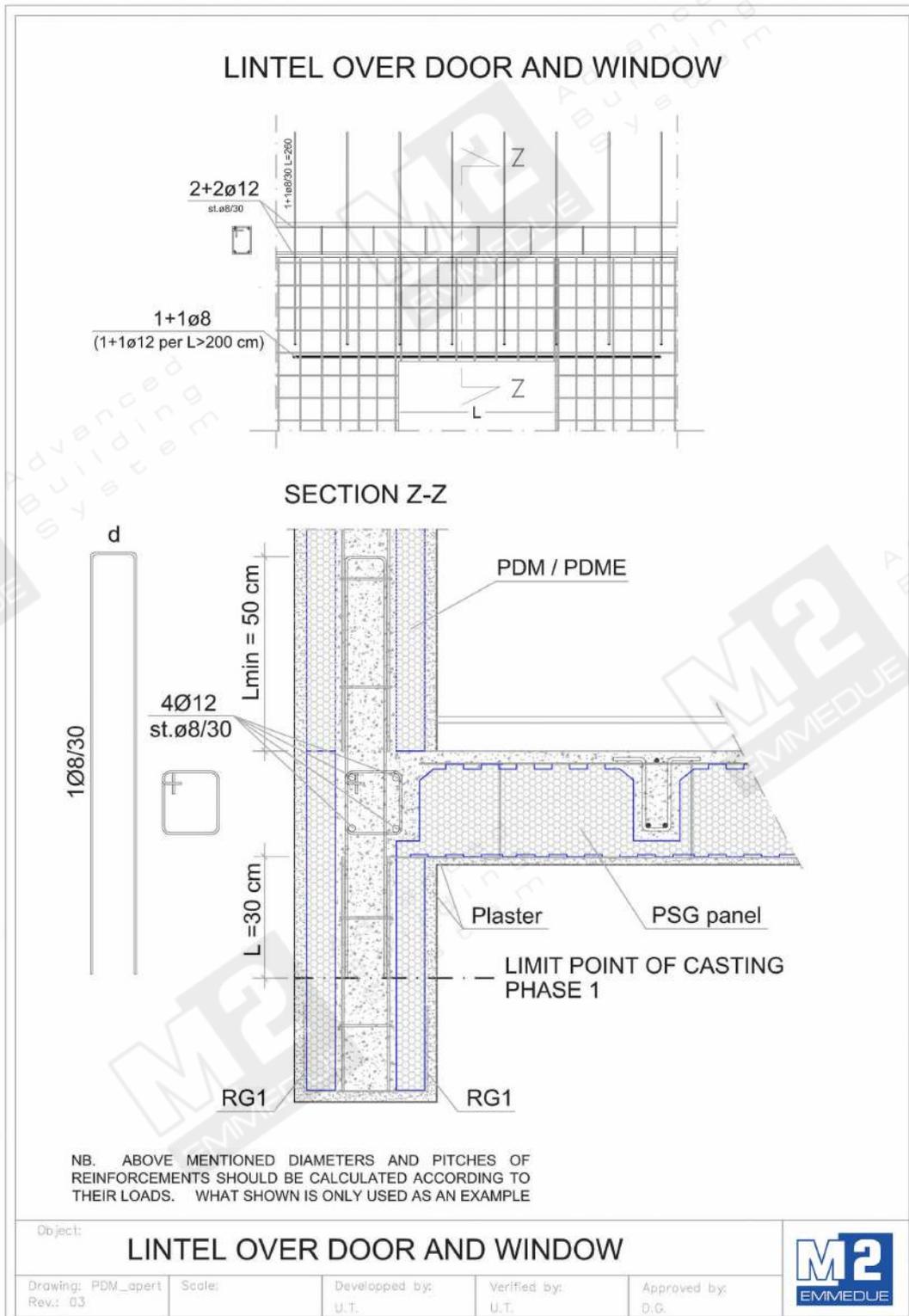


➔ 3.13.2 DOOR REINFORCEMENT DETAIL

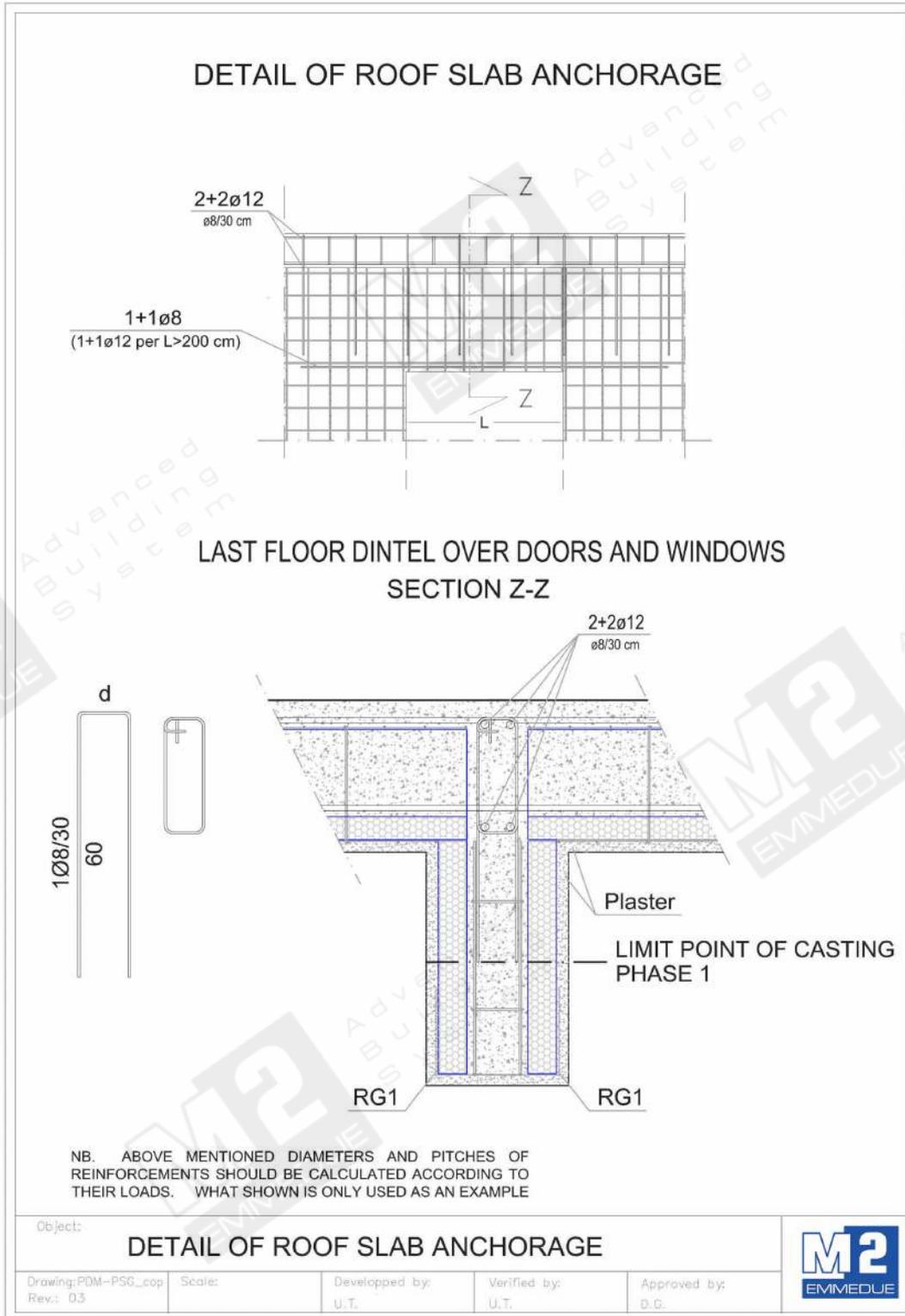


3.14 LINTEL OVER DOOR AND WINDOW (DOUBLE PANEL)

➔ 3.14.1 LINTEL OVER DOOR AND WINDOW

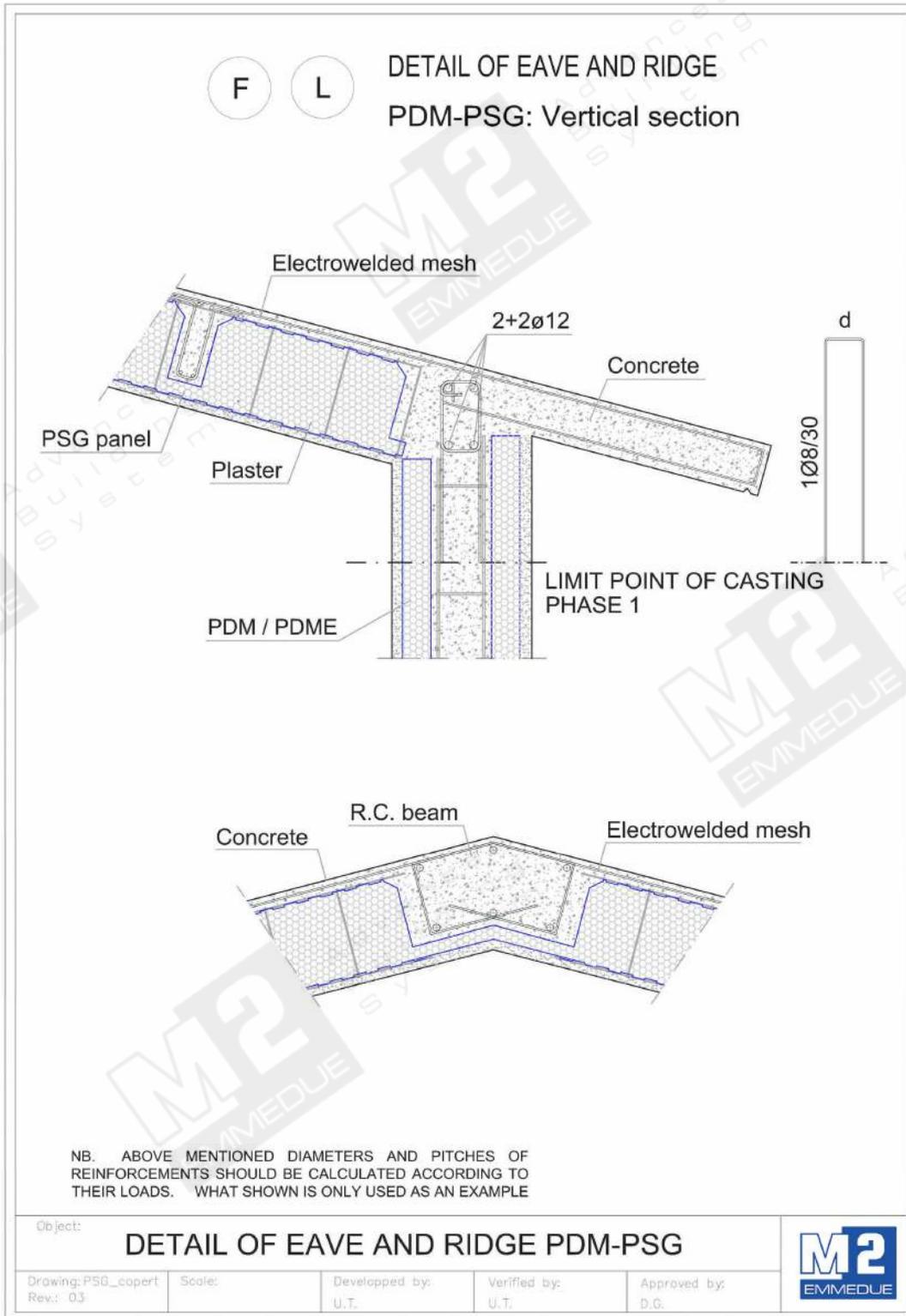


➔ 3.14.2 DETAIL OF ROOF SLAB ANCHORAGE



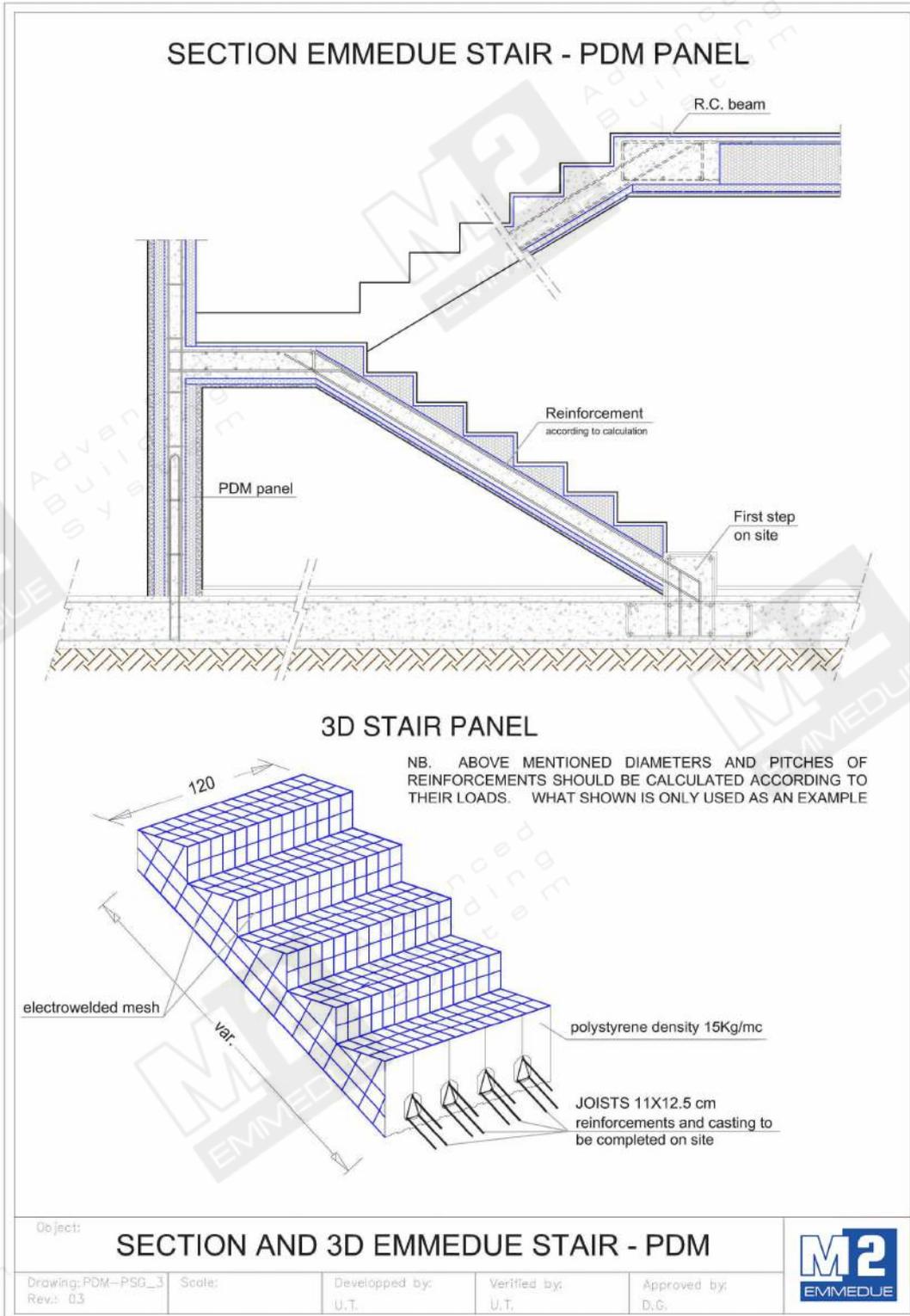
3.15 EAVE AND RIDGE DETAIL (PDM-PSG PANEL)

➔ 3.15.1 DETAIL OF EAVE AND RIDGE WITH PDM-PSG PANEL



3.16 STAIRCASE ANCHORAGE

3.16.1 SECTION AND 3D EMMEDUE STAIRS-PDM PANEL





A d v a n c e d
B u i l d i n g
S y s t e m

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