

D7.11 Envelope components for on-field demonstration - II

January 2020

Project title	Holistic Energy and Architectural Retrofit Toolkit
Project acronym	HEART
Grant Agreement No.	768921
Project call	EEB-05-2017 Development of near zero energy building renovation
Work Package	WP7
Lead Partner	GAR- García Rama
Contributing Partner(s)	GAR
Security classification	Public
Contractual delivery date	31/01/2020
Actual delivery date	31/01/2020
Version	1.0
Reviewers	ZH, ACER, POLIMI

HISTORY OF CHANGES

Version	Date	Comments	Main Authors
0.1	11/12/2019	First draft, establishing document structure	A. Llamas (GAR)
0.2	08/01/2020	First version, incorporating input from all participants.	A. Llamas, J. García (GAR)
0.3	09/01/2020	Revision of first version	S. García, F. Gabaldón (GAR)
0.4	14/01/2020	Quality review	M. Buzzetti (ZH), C. Del Pero (POLIMI) and ACER
1.0	28/01/2019	Final version addressing all further comments	A. Llamas (GAR)



TABLE OF CONTENTS

EXECUTIVE SUMMARY	5
1 THERMAL-INSULATION SYSTEM	6
1.1 System components	7
1.2 Fire reaction	18
2 PANEL DISTRIBUTION	20
2.1 Panel quantities	21



DISCLAIMER

This document contains confidential information in the form of the HEART project findings, work and products and its use is strictly regulated by the HEART Consortium Agreement and by Contract no. 768921.

Neither the HEART Consortium nor any of its officers, employees or agents shall be responsible or liable in negligence or otherwise howsoever in respect of any inaccuracy or omission herein.

The contents of this document are the sole responsibility of the HEART consortium and can in no way be taken to reflect the views of the European Union.



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 768921.



EXECUTIVE SUMMARY

The present deliverable is intended to update the description and features of the envelope components for on-field demonstration, upgrading the content of D7.10. Such components were prototyped, manufactured and machined, or are already manufactured pending of minor adjustments to be defined during installation, and are being dispatched for the installation in the first case-study building (Italy).

After a deep analysis for the integration of the thermal façade system with the rest of the building elements, several prototypes and tests for the progressive readjusting of the insulation panel system were made in order to meet HEART requirements. Consequently, the manufacturing process took place to finally shape and machine all the necessary elements. The system was adapted for the integration of the wiring, pipes, vents and sensors. Moreover, improvements on the structure have been carried out to allow an easy installation and to avoid the needs of scaffolding.



1 THERMAL-INSULATION SYSTEM

The system has been adapted for the integration of the different ducts and sensors. The improvements made on the fixing substructure allow an installation without the needs of scaffolding.

Throughout this adaptation analysis, several prototypes and tests of the new and modified solutions were made. These tests were decisive to complete product technical assessment and compliance analysis. After some minor adjustments and further tests, the new elements were manufactured and machined.

The multifunctional thermal-insulation system for the case-study building in Bagnolo in Piano (IT) is defined and composed by different elements, as follows.

Substructure	Cover	Insulation	Auxiliary
<ul style="list-style-type: none">• Brackets• Fixings• Profiles• Clamps• Stop piece	<ul style="list-style-type: none">• Metallic insulation panel• Aluminium Composite Panel• Finishing metallic sheet<ul style="list-style-type: none">• Corners• Windows (jambs, lintel, windowsill)• Doors (jambs, lintel)	<ul style="list-style-type: none">• PIR boards• Balconies• Jambs• Lintels• Windowsill• PIR foam projected	<ul style="list-style-type: none">• Sealing• Rubber strip• Coupling ducts system• Fire foam projected



1.1 System components

More in detail, the components of the system of the modular façade thermal insulation are reported and described in this section.

Components > Substructure

Different supporting elements comprise the substructure, necessary to install the panels, namely: brackets, profiles, splices and fixings. The substructure elements for the building demo case at Bagnolo in Piano were manufactured and machined and are ready to dispatch.

Components > Substructure > Brackets



Figure 1: Preparation of new brackets

There are different shaped brackets, depending on the connection type and span length. All the new aluminium and steel brackets were prototyped, tested, adjusted and manufactured. The new connection between panels includes: a bracket, an adjustable profile for clipped junction and an upright profile.





"L" shape aluminium bracket
(balconies)



"L" shape steel bracket
(ground to 3rd floor)



"U" shape aluminium bracket for panel connection

Figure 2: Types of brackets



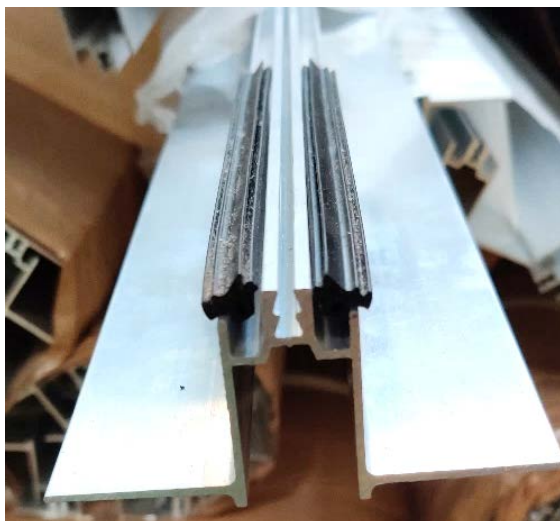
Components > Substructure > Profiles



Figure 3: Preparation of new profiles

The vertical steel profiles for the new substructure of floors 1st to 3rd were prototyped for a 100mm panel width and subsequently were tested, adjusted and manufactured.

In the case of the new vertical aluminium profiles for the panel connection, a matrix was developed following the testing and adjustment of the profiles. Finally, it was manufactured through the extrusion process and machined.



Aluminium vertical profile for panel connection



Steel upright profile





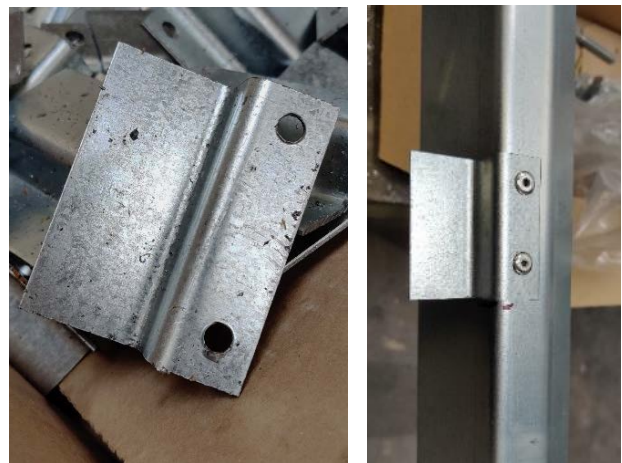
Connection piece for upright profiles



Horizontal profile starting of the system



Vertical upright profile balconies



Stop piece for panels

Figure 4: Types of profiles

Components > Substructure > Fixing elements

The fixings elements are different types of screws, interior and exterior spacer and pop rivets.



Fastening screw HILTI HRD or similar with insulated plastic anchor



Self-tapping sheet metal screw





Interior spacer



Exterior spacer

Figure 5: Types of fixing elements

Components > Cover



Figure 6: Metallic insulation panels of 100mm and 50mm width

After the manufacturing of the cover insulation panels, the adaptation and machining of the panels for the façades of the Bagnolo in Piano building was carried out with the subsequent quality control; panels are currently ready for dispatch. The metallic sheet for the finishing elements (corners, windows and doors) was manufactured and machined, pending a small number of points to define during installation.



The cover panels of aluminium composite for the balconies were adapted and machined and are ready to be dispatched with the rest of the components, pending a small number of points to define during the installation process.



Metallic insulation panel: Smooth finishing

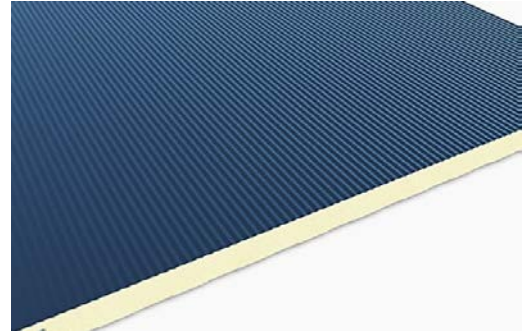
Technical characteristics:

Colours: "Titanium" (ground floor), "Sahara" (1st - 3rd floor)

Length: variable customized

Width: 50mm (ground floor), 100mm (1st - 3rd floor)

Height: 1150mm



Metallic insulation panel: Microline finishing

Technical characteristics:

Colours: "Titanium"

Length: variable customized

Width: 100mm

Height: 1150mm



Aluminium Composite Panel

Colours: "Light grey"

Length: 1250 - 1500mm

Width: 4mm

Height: 4000 - 5000 mm



Jamb metallic sheet finishing





Windowsill metallic sheet finishing



Lintel metallic sheet finishing

Figure 7: Types of cover components

Components > Insulation

The metallic insulation panel has a twofold role, it's a thermal insulation element whilst covering and protecting the façade being the last layer in contact with the exterior.

However, in the balconies areas, where a different solution was adopted, it is necessary to use thermal insulation boards. Polyisocyanurate (PIR) was the insulation chosen due to its low lambda coefficient.

Insulation boards (50 mm) for the balconies will be installed, as well as in, corners, windows and doors (jambs, lintels and windowsills). Projected PIR foam will be used in certain areas to seal small cavities to create the watertight and airtight system.

The building in Bagnolo in Piano (IT) is not subject to fire testing according to the actual regulation (only buildings higher than 24 m). However, the metallic insulation panel is certified Bs3d0. Moreover, as additional support, a projected fire stop foam will be applied in critical areas such as windows and balcony doors that connect the exterior with the living space. This adds fire resistance to the current system.



PIR boards (balconies, jambs, lintels, windowsill)





PIR foam projected

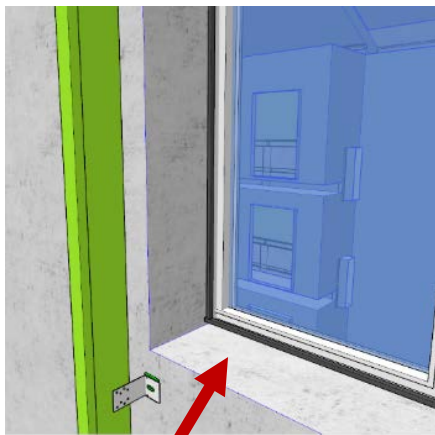


Fire foam projected

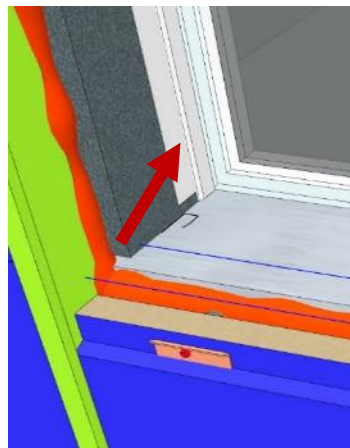
Figure 8: Types of insulation sealing

Components > Supplementary elements

Other supplementary elements are necessary for the installation of the system such as: silicone sealing and rubber strip for the windows, and the coupling ducts piece designed to adapt the wires and pipes into the system.

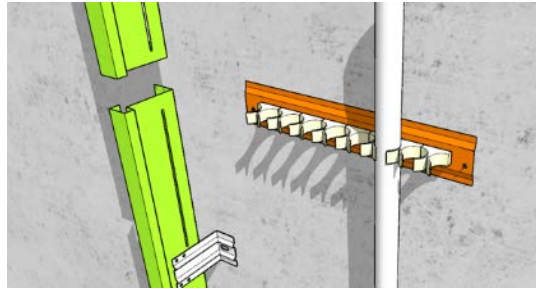


Rubber strip on window perimeter



Clamp profiles for jambs





Coupling ducts system (pending real picture)

Figure 9: Various supplementary elements

In the following table, a complete inventory of all the components for the thermal insulation system of the Italian demo building and their technical characteristics are reported.

Table 1: Inventory of components of the thermal insulation façade

1	Panel	
item	Name	Description
1.1	Layer-1	Three-layer steel, magnesium, zinc, aluminium with bilayer primer and 35-micron organic colour protection.
1.2	Layer-2	Insulation 100 mm PIR. Lambda 0.022 W/mK .
1.3	Layer-3	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and organic colour protection.
1.4	Spacers	Tongue and groove spacers. Galvanized steel Z275 of 1mm, shaped.

2	Substructure	
item	Name	Description
2.1	Upright profile for plumb	Galvanized steel Z275 of 1.5mm. shaped, length on demand.
2.2	Upright profile for junction	Galvanized steel Z275 of 1.5mm. shaped, length on demand.
2.3	Upright profile for clipped junction	Aluminium 6063 2mm, length on demand.
2.4	Stop piece for panels	Galvanized steel Z275 of 1.5mm. shaped.
2.5	Starting profiles	Galvanized steel Z275 of 1.5mm. shaped, length on demand.
2.6	Fixings	Galvanized steel screws, M8 and length on demand up to 230 mm.
2.7	Adjustable washer for fixings	Polypropylene



2.8	Underlay of fixing brackets	Polyamide or polyethylene
2.9	Structural pop rivets	Ø4.8mm. Aluminium or Steel on demand
2.10	Supporting brackets	Galvanized steel Z275 of 1.5 mm. shaped, length on demand up to 230 mm.
2.11	Auxiliary brackets	Galvanized steel Z275 of 1.5 mm. shaped, length on demand up to 230 mm.
2.12	"U" shape brackets	Aluminium 6063 2mm, length on demand up to 120 mm.
2.13	Draining tray	Galvanized steel Z275 of 1.5 mm. shaped, length on demand up to 230 mm.
2.14	Draining barrier	Mineral wool
2.15	Snap-caps, plugs and washers	Steel, aluminium, polypropylene, polyamide
2.16	Joints	EPDM, polyamide
2.17	Auxiliary material	Steel, aluminium, polypropylene, polyamide

3	Finishing trims covers and sealings	
item	Name	Description
3.1	Jambs	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.2	Windowsill	Natural anodized aluminium 20-30 microns
3.3	Lintels	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.4	Cover for vertical grooves, panel connection.	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.5	Clamp receiver-regulator	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.6	Finishing trim at start	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.7	Finishing trim at sides	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.8	Finishing trim at corners	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.9	Finishing trim at top	Three-layer steel, magnesium, zinc, aluminium with primer bilayer and 35-micron organic colour protection
3.10	Auxiliary supports	Aluminium 6063 2mm, length on demand up to 120 mm.
3.11	Fixings	Screws with striking system. Galvanized steel, M (Metric) Ø5.5mm x 65mm and polyamide anchor
3.12	Structural pop rivets	Ø4.8mm. Aluminium or Steel on demand
3.13	Sealing foam	High performance foam CF-I 65 ECO



3.14	Barrier foam	Intumescent foam barrier against fire and smoke
3.15	Neutral silicone	Silicone sealing, neutral type, high range.
3.16	Structural silicone	Silicone of structural joints, high range.

4	Auxiliary	
item	Name	Description
4.1	Supporting ducts strip	Supporting strip with clips for ducts of various installations. Z275 galvanized steel
4.2	Holder	Supports for auxiliary installations and probes. Galvanized steel or aluminium.
4.3	Ventilation extensions	Aluminium, polypropylene, polyethylene.

As stated before, all the components were prototyped, manufactured and machined or are already manufactured pending some minor adjustments to be defined during installation phase. The system components are shown also in the demo video tutorial prepared to support the installation phase (see below some captures).

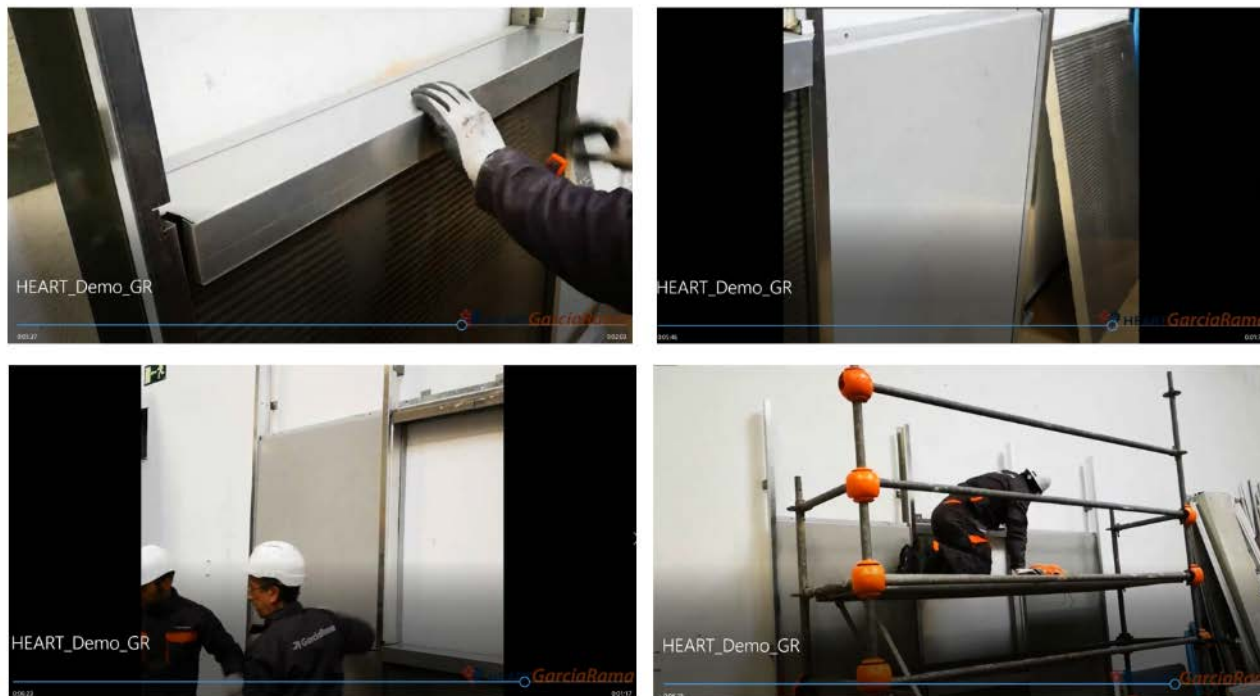


Figure 10: Demo video tutorial



1.2 Fire reaction

The system is composed by the different elements previously described, which are mainly insulation panels and substructure.

As already introduced, the panel insulation is certified to reaction to fire with classification Bs3d0 (EN 13501-1).

Most of the rest of the components for the substructure (profiles and brackets) are made of steel or aluminium. Steel and aluminium are classified to fire reaction as A1 (EN 13501-1), which means they are non-flammable materials and do not contribute to fire.

As explained in previous deliverable “D7.10: Manufacturing design of the modular façade thermal-insulation” some of the constructive solutions and connections have been improved to speed up the installation and adapt to HEART requirements. However, the composition of the material of the elements does not vary in any case, being steel or aluminium the only material composing the element.

When an element is changed for another of the same material composition (in this case steel or aluminium accordingly) and the shape of the element is almost identical, the Spanish regulation does not consider that the certification to reaction to fire changes. Substituting one element for another that changes slightly in shape does not invalid the test to fire reaction of the element.

For example, in the case of the following profile (Figure 11), there is a slight variation in the shape to enable a quicker installation with less brackets and to allow a gap of 5 cm. Being very similar in morphology and steel is its main and only component, the contribution of the element to fire is the same.



Figure 11: Vertical profile



The same occurs with the elements of the new connection between panels (Figure 12), as it is composed of aluminium elements that have been modified slightly in shape.

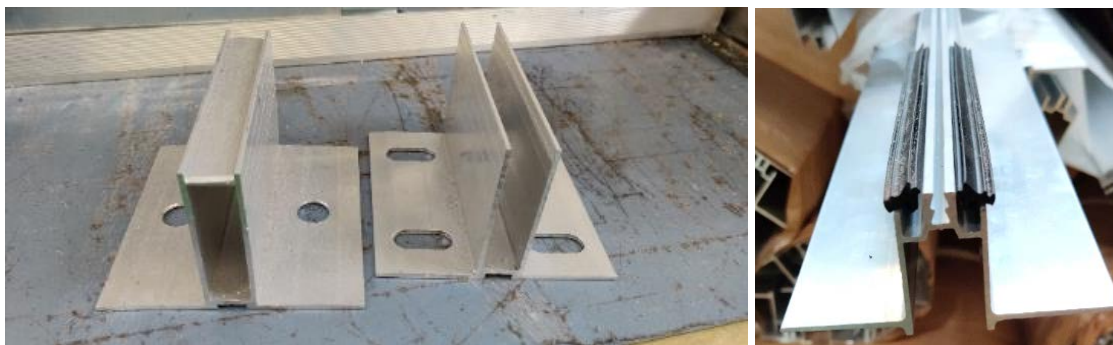


Figure 12: Panels connection elements



2 PANEL DISTRIBUTION

The following images show the different panels distribution to be installed in the façades.



Figure 13: Panel distribution on back view (north façade)




Figure 14: Panel distribution on frontal and side view (south and west façade)



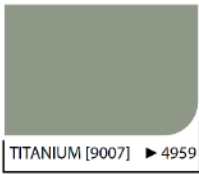
2.1 Panel quantities

The distribution of panels shown in the previous point results in the following quantities of panel according to their typology.

Floors 1st-3rd: Metallic insulation Panel 100mm: "Sahara (4156)"

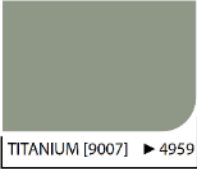
	<i>units</i>	<i>length (mm)</i>
 SAHARA [1015] ▶ 4156	8	460
	8	505
	8	760
	8	790
	8	870
	8	950
	1	1178
	16	1700
	1	1865
	1	1945
	1	2015
	18	2110
	18	2155
	8	2260
	8	2280
	8	2410
	18	2425
	18	2445
	8	2790
	8	2810

Floors 1st-3rd: Metallic insulation Panel 100mm with Microline finish: "TITANIUM (4959)"

	<i>units</i>	<i>length (mm)</i>
 TITANIUM [9007] ▶ 4959	6	638
	2	728
	6	1177
	6	1186
	6	1189
	6	1190
	6	1193
	6	1189
	6	642
	14	638



Ground Floor: Metallic insulation Panel 50mm: "TITANIUM (4959)"

	<i>units</i>	<i>length (mm)</i>
	2	450
	2	805
	4	1340
	2	1410
	2	1555
	2	1690
	2	1750
	2	1870
	2	2210
	2	2305
	2	2335
	2	2740
	4	2850
	2	2937
	2	3145
	2	3245
	2	3320
	2	3655
	2	3675
	2	3725
	2	4055

Thorough plans of all the façades have been made in order to serve as an installation guide. The plans contain the distribution of panels, comprehensive details of the connection points as well as other key points, solutions to tackle the most challenging areas, and other useful information for the installers.

The installation will be performed in different stages as indicated in the installation plans. Furthermore, the numbering of stages is indicated in the panels to identify quickly the panels by different zones and therefore, ease the installation process.



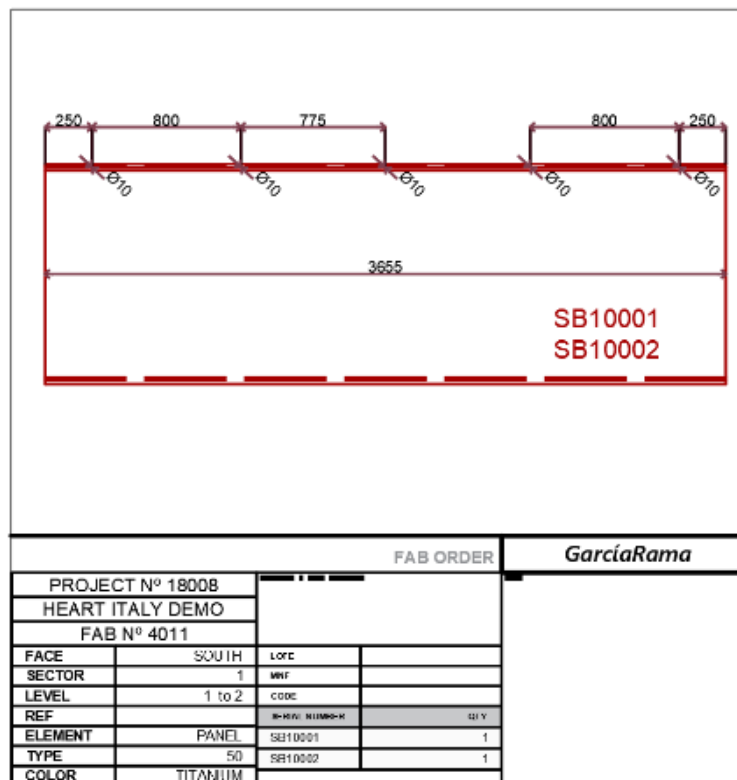


Figure 15: Example of panel numbering code

