

Guide to the façade coating

3. Type of padding panel

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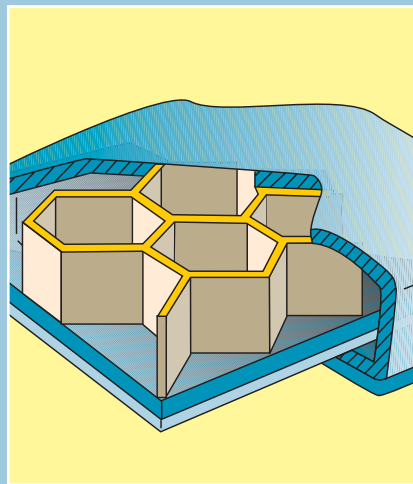
The aluminium coating panels can be distinguished in four categories:

1. Stiffened panels
2. Sandwich panels
3. Multilayer panels
4. Panels in massive Mirawall® sheet

Of each category, we will take into consideration the technological, aesthetical and economical features.

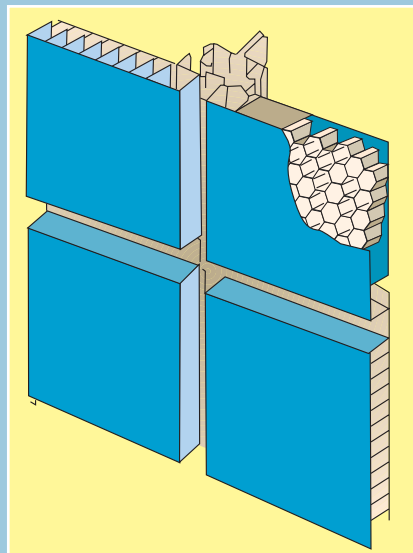
Stiffened panels

They are made up of a “honeycomb” core glued between two pre-painted aluminium sheets. The honeycomb panels are among the best technological products which are available nowadays to close a façade. Their technology comes from aeronautics, and offers the maximum level of mechanical characteristics with a minimum weight (about 9 Kg/sq m). For aesthetical purposes, a favourable point is represented by the



1- HONEYCOMB STIFFENED PANEL-CONSTRUCTIVE DIAGRAM.

2- FAÇADE SECTION WITH STIFFENED PANEL COATING.

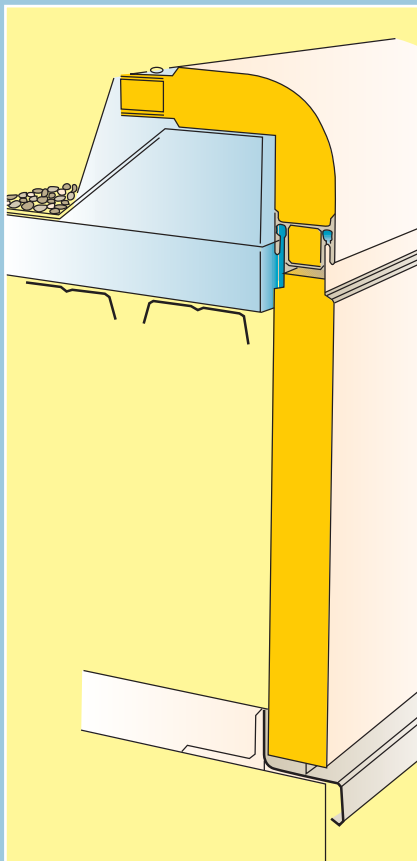


exceptional planarity of these panels, even on resting on-centres of 2 metres and long up to 6 metres. However, an unfavourable point is represented by the shape and adaptability limits, which make it a system rigidly pre-set in its type of application, thereby highly reducing its use. Another drawback is their high cost compared to the replacement products (about 60 euro for sq m). Therefore, their use is limited to those cases where the operating conditions require particularly high static performances. To solve this drawback, some manufacturers have performed more economical versions of these panels replacing the honeycomb rigid heart with an aluminium Greek fret having a thickness between 4 and 28 mm; which, in its more economical versions, can have a cost of 40 euros per sq.m., though it has narrower size limits (max 1,5 m x 3,5 m).

Sandwich panels

They are made up of two metal half-section gutters which are kept together by an insulating foam thickness,

usually polyurethane, inserted by injection. These types of panels have been mainly used in the industrial building sector but, in the most precious versions with planarity and finishing, are also used in the



3- DETAIL OF CONSTRUCTION THROUGH INSULATED SANDWICH PANELS AND MALE AND FEMALE JOINT.

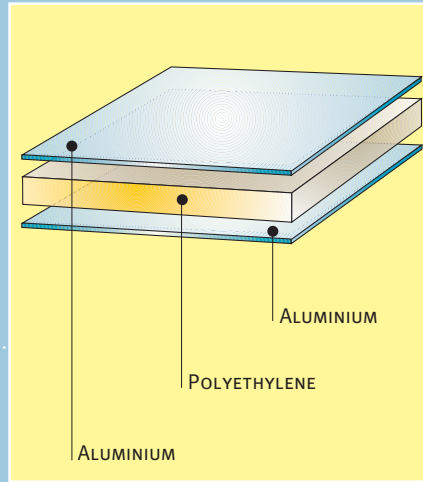
commercial building sector. There are aluminium and steel versions in this panel. From a technological point of view, steel prevails since aluminium has a higher coefficient of thermal dilation, which after some years causes the detachment of the insulator from the metal as a consequence of the thermal gradient. The polyurethane, in fact, is joined with the sheet at a temperature of 40° C, so that for each lower or higher temperature there will be a tension between insulator and sheet depending on the sheet dilation coefficient. To increase the adherence between sheet and insulator, the sandwich panel parameters are usually Greek fretted. The Greek fret also helps to improve the mechanical features and to minimize the planarity defects. From the described foam panels some exceptions stand out. An example is given by foamed panels having flat and smooth fittings, and very good esthetical and mechanical features. To obtain this result, the production is performed through a discontinuous-type system where the foaming occurs vertically. This process, though slow, can increase the foam-metal adhesion

and increase the whole mechanical resistance. A further example, for special purposes, is provided by flat fitting panels whose insulator includes a thermo-hardening poliutherane cell mix which is put through the concept of jet in formwork, allowing the insertion of any type of insert (having the function of channelling, sector, stiffening, support or else) and a very personalized production. Moreover, this type of manufacturing allows much better mechanical characteristics than the foam panel. Since the sandwich panel has both the coating function and insulating ones, it represents in the current commercial versions an economical competitive solution (20/25 euros per sq m). The price can sharply increase (over 50 euros) in the versions with high esthetical and mechanical performances.

Multi-layer panels

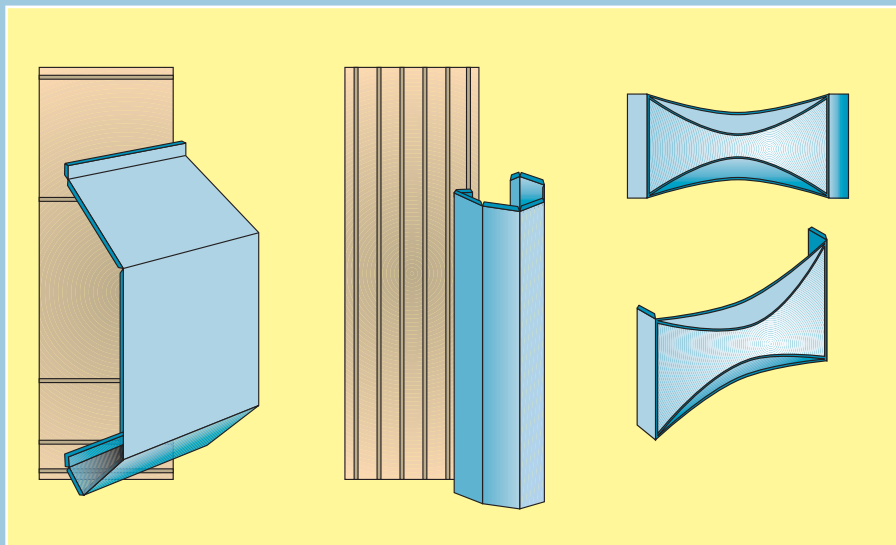
Every panel other than single layer (that is made up of a single material), may be within the category of the multilayer panel classification. To distinguish them by type, we have to say that in the multi-layer or "composite" panel the core is a homogenous thermoplastic material obtained by extrusion or lamination, to perform cold shaping on the panel. The most known type is the two aluminium alloy sheets (each having a thickness of 0,4 mm) coupled with an extruded polyethylene core having a thickness between 2 to 7 mm with a continuous manufacturing process which allows the cut up to a measure of 8 metres.

The strong points of the product essentially consist in the surface planarity (even on large format sample) which is guaranteed by the same concept of multi-layer manufacturing which allows a balancing, free from internal tensions, and in a rigidity/weight ratio which is better than the single-layer materials, as shown in the comparison table:



4- MULTI-LAYER PANELS: PANEL COMPOSITION.

5- EXAMPLE OF SHAPING THROUGH MILLING.



(table below). However, this type of structure does not allow the panel to have a high resistance to external agents, such as hail or accidental shocks which may occur during the assembling.

RIGIDITY IN CONNECTION WITH THICKNESS AND WEIGHTS

RIGIDITY E.J.	MULTILAYER		ALUMINIUM		STEEL	
	thickness	weigth	thickness	weigth	thickness	weigth
0,125 kNm/m	3 mm	4,5 kg/m ²	2,7 mm	7,3 kg/m ²	1,9 mm	14,8 kg/m ²
0,240 kNm/m	4 mm	5,5 kg/m ²	3,3 mm	8,9 kg/m ²	2,4 mm	18,7 kg/m ²
0,590 kNm/m	6 mm	7,3 kg/m ²	4,5 mm	12,2 kg/m ²	3,2 mm	25 kg/m ²
1,110 kNm/m	8 mm	9,1 kg/m ²	5,5 mm	14,9 kg/m ²	4 mm	31,2 kg/m ²

Moreover, the combination between a natural material like aluminium and a synthetic one like polyethylene does not allow the panel recycling: once its function is over, it must be disposed with supplementary costs.

The product can be easily cold shaped through standard tools. For the folding, a V milling must be performed on the panel back, leaving on the groove bottom a polyethylene film to protect aluminium. Then, skilled assembly teams will be able to manually perform the folding operations in the

yard, with high benefits in terms of packages, transport and connected risks. The product is provided on the market fitted with a high range of joint systems which make it versatile in the types of application, allowing flexibility of manufacturing schemes and innovative solutions. Its price on the market (about 30 euros per sq. m) is much higher than the single-layer panel.

Mirawal® massive panels

They are panels made up of a single

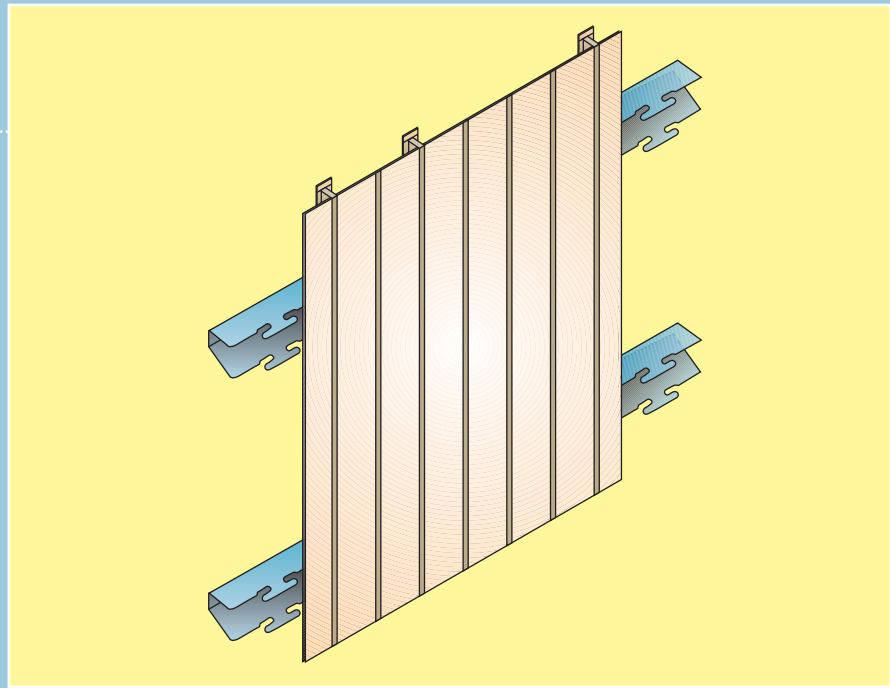
homogeneous material. They are used especially as linear panels (staves) and modular panels (boxed elements). Due to the high availability of colours and shapes, these systems can satisfy any need of coating on the façade, for both new constructions and restoration interventions. The fixings for both linear panel systems and modular panels are always invisible from the outside because the panels are applied to the relevant sub-structures through special hidden hooks.



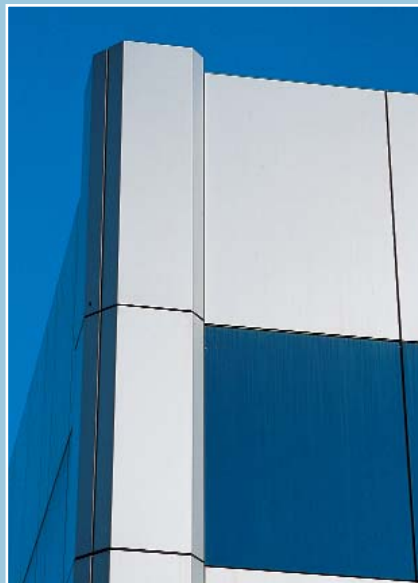
Linear panel systems

The stave systems can be open ("screen" coating) or closed (ventilated coating). They are made up of two fundamental elements: coating staves and supporting crossbars.

The staves are baked pre-painted aluminium elements which are shaped through roller profiling. In closed systems, they are shaped with male and female edges to fit the water tight joint. In its turn, the cloth, can be flat or open V shaped to increase the stiffening. The stave thickness can vary from 0,6 and 1 mm in accordance with the pitch, which is usually 150 or 300mm. In open systems, staves have a symmetrical shaping on both sides, and a pitch between 80 and 120 mm. The crossbars are drawn by profiling from pre-painted aluminium tape. Due to its structural features, the panel assembly can be performed either vertically or horizontally, at single or combined modularity. The staves are hooked by release on the crossbars with no fixing elements. The crossbars can be directly applied to the wall or fixed to a sub-structure.



6- DIAGRAM OF VERTICAL STAVE COATING, INSERTED BY RELEASE ON HORIZONTAL CROSSBARS.



Modular panel systems

All the four sides are flapped in the modular panel by folding the material on press folder or after back millings with the technique used for the multi-layer panels. The folding without back millings is obviously the simplest and most economical process. The only limitation is due to the fact that the curve radius shall not be higher than the aluminium thickness. The folding with back milling, on the contrary, allows to have sharp corner angles, which is the most common choice in the architectural field. The typical modular panel is boxed and hooked.

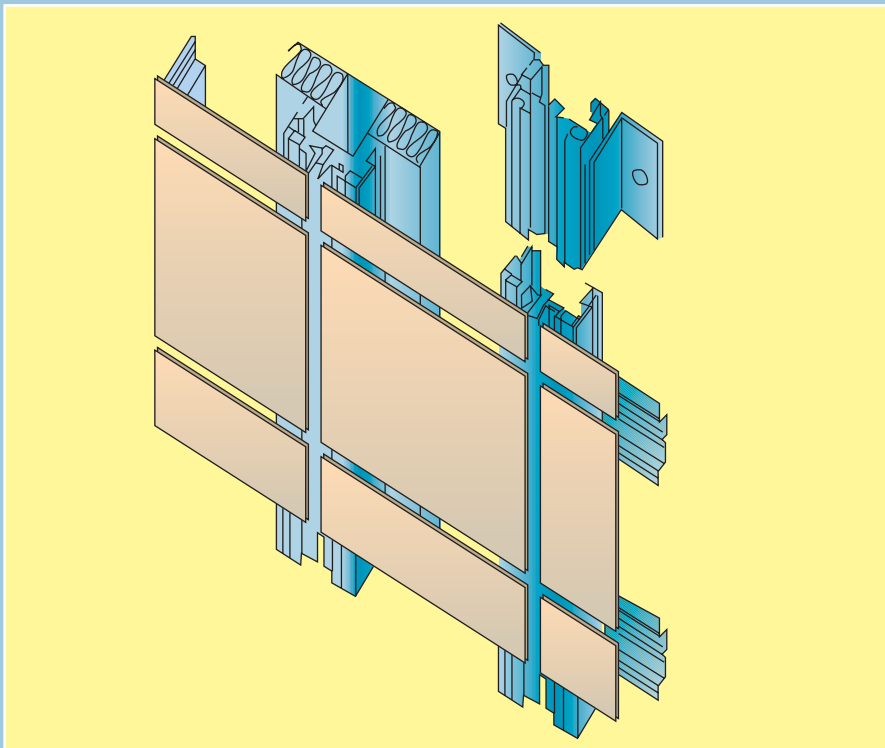


Within the boxed and hooked panels, there are two versions:

- The boxed panel welded at the vertices and subsequently anodised or painted.
- The boxed panel and left free at the vertices or blocked through a riveting, like the multi-layer panels.

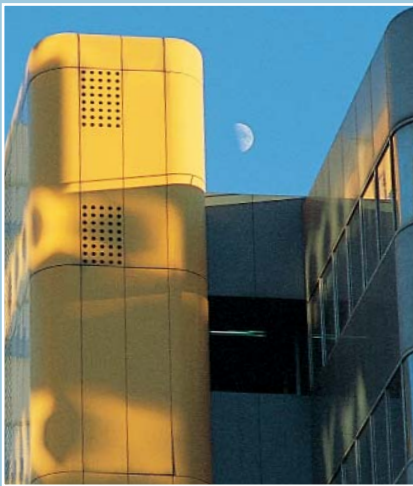
The first panel, more rigid and structural, can have higher sizes, but cannot be pre-anodised or pre-painted

7- MODULAR PANEL SYSTEM FITTED WITH SUB-STRUCTURE AND FITTING GASKETS.



(which does not allow to have constant thickness and paint colour), like the second type. A façade modular system is also available on the market; it is provided by the manufacturer in assembly kit fitted with press-folded panels in 1,4 mm or 2 mm sheet, crossed type aluminium sub-structure made up of vertical posts and horizontal rafters, Dutral and silicon gaskets, which have the function of panel containment and water tightness. It is an integrated system where anything is provided and calculated and where the technician has no project and dimensioning charge. From the economical point of view, the single-layer panels, especially in the pre-painted version, certainly represent an advantageous solution. The validity, even from the static and esthetical point of view, depends upon the appropriate projecting of the modules, whose thickness and dimensioning must be appropriately linked to the loading conditions.

For this purpose it is always recommended to refer to the supplier indications. This will avoid, as it often occurs, that an approximate projecting



may degrade a good basic product. In fact, you can very often understand that, to get a good result, you can act on the module sizes or on the sheet thickness, or that it is not possible to use a certain type of coating specific project characteristics.

- discontinuous bake painting;
- continuous pre-anodisation;
- discontinuous anodic oxidation.
- Each system has advantages and disadvantages in terms of performances and economy.

Obviously the continuous application processes, “coil-coating” for the painting and “coil-anodising” for the anode

oxidation, represent a more economical solution with respect to the discontinuous processes and offer better guarantee in quality steadiness due to the control of all the cycle phases. The “coilcoating” pre-painting processing includes the following phases, on which most of the pre-painted sheet duration depends.

COATING SUPERFICIAL FINISHING

Aluminium resists to corrosion because when in contact with air it self-protects through an inert and continuous layer. Each attack stops at the depth of a few hundredth of millimetre. If we make a superficial finishing process, it is only for esthetical reasons and not to guarantee a protection. In Rome there are two church covers made in natural aluminium sheet, unprotected, carried out respectively 94 and 87 years ago. They are the dome of San Gioacchino church performed in 1897 and the dome of the Israeli Temple performed in 1904, on which the recent surveys have pointed out the optimum metal conservation with insignificant thickness reduction, though in the urban atmosphere of Rome. Therefore,

speaking about exposure in conditions not particular, all the processings which we will make on aluminium tend to guarantee the esthetical validity over time.

The aluminium sheet can be processed with the following procedures:

- liquid or dust continuous pre-painting;
- discontinuous baked painting;
- continuous pre-anodisation;
- discontinuous anodic oxidation.

Each system has advantages and disadvantages in terms of performance and economy. It is clear that the continuous application processes, “coil-coating” for the painting and “coil-anodizing” for the anode oxidation, represent a more economical solution in comparison with the respective discontinuous processes and offer better guarantees of steadiness of the quality due to the control of all the cycle phases. The pre-painting processing “coilcoating” includes the following phases, on which most of the pre- painted duration sheet depends.

- Cleaning (it eliminates the lamination oil traces).

A VERY GOOD EXAMPLE OF THE ALUMINIUM RESISTANCE IN THE TIME IS REPRESENTED BY THE DOME OF THE ISRAELI TEMPLE IN ROME, MANUFACTURED IN 1904.

- Brushing (it coarsens the surface by preparing it to a good adherence with the paint layers).
- Pre-processing (in case of aluminium it is the chroming or phosphochroming, and it is used to improve the resistance to climatic aggressions to which the pre-processed product must be subject during the external exposure).
- Passivation (it confirms what has been done and exposed for the pre-processing).
- Application of priming, with the relevant baked cooking and cooling (it is the traditional PRIMER which guarantees optimum adhesion between pre-processed aluminium and finishing paint).
- Application of finishing paint (with the relevant baked cooking at the metal temperature which can vary from 240 ° C and 260° C in accordance with the paint used).

The types of liquid paint generally used for the façade coating are:

- Polyester (PE)
- Silicon-polyester (SMP)
- Poliammidic (PMD)
- Polietheranic (PUR)



- Polyvinylidene Fluoride (PVDF)
Among them, the fluoropolymer based PVDF represents the best of the liquid paints for the exceptional resistance to the discolouring and industrial pollution. As far as the dust painting is concerned, the system is similar to the one for the liquid painting with the difference that the painting is applied through electrostatic guns instead of roll ones.
At present the only type of experimented paint is polyester resin based which reticulate by oven to form a complex

polymer characterized by a very good behaviour in external applications. As far as the anodisation process is concerned, the “coil-anodizing” system whose technology has been recently used, has solved most of the problems of the difference in the colour tone and the unsteadiness of the oxide thickness which represent the weak points for the use of the anodised finishing through discontinuous process, in façade coatings.