

CONSTRUCTION STRUCTURE PROCESS AND GLASSES MOUNTING IN THE CONTINUOUS FACADES

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ABSTRACT

The article summaries in a short way the process of construction and building of the curtain walls. The first paragraph includes brief the advantages of these constructions as compared with classical way. Profiles of ALUMIL S.A. Company have been taken for concretization, which have been used to construct three four buildings of this kind. The second and third paragraphs are focused on the most useful systems of these kinds of curtain walls and on their constructive and calumniating side. The defining of active loads and deformations. The last paragraph includes data on the components parts of the curtain walls their composition and way of selection.

Keywords: glasses mounting, construction, continuous facades

1. INTRODUCTION

This article should draw attention, to the designers and constructors, on advantages also importance of deep study and precise calculation for static and dynamic elements in continues facade as nowadays technology.

2. SYSTEMS AND FUNDAMENTALS

Constructing skyscrapers need to improve or replace the classic constructive materials (brick and stone) with new one, easier through mounting and lighter, like combination of glass and aluminum used for construction continues façade.

Such structures have the following advantages: Overall structure can be constructed in a shorter period accomplish in that way the economic objectives. It is easy to fit the surrounding environmental with the buildings view, it is fluxional and the constructive cost is relatively law. Materials used in such cases are long life and maintenance expenses are law. Continues façade imposed to the end-users the grandiosity. They allows the natural light entrance through buildings, make possible also an open view from inside, ensure very good isolation from noise and considerably reduce thermal exchange. All this benefits will assure only through a very good architectural project and precise calculation for construction. [9], [10]

The variety of ALUMIL S.A. series and profiles gave us the conformity to easily construct even the most difficult forms and further to create new forms for the different difficult issues we faced during the constructive process. Studies and projections, done during the preparation phase, make us possible to easily accomplish the mounting phase and save us considerable time during the montage period. Some of the construction we have realize are in figure 1 [1], [2], [3].

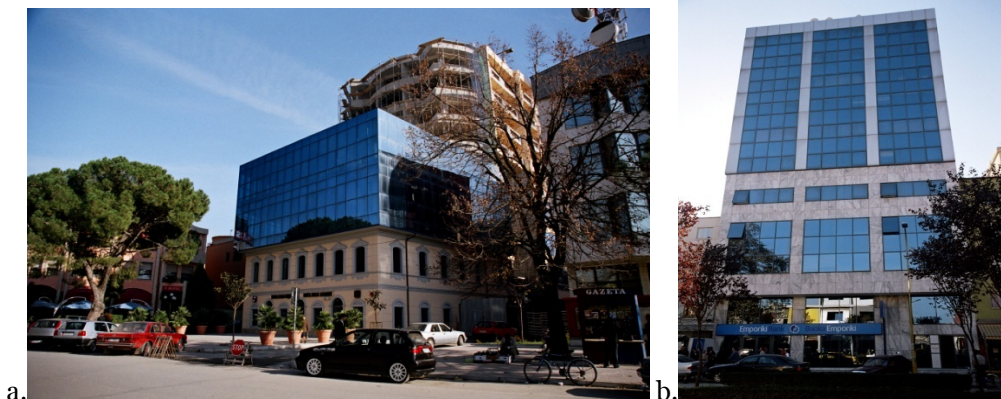




Figure 1. Some of the construction we have realize

The aluminum profiles of ALUMIL S.A. are projected in the way that give the durability during the functions and guarantee. In such comfort conditions we realized an esthetic view, as the models showed in the figure 1, also constructing in the best way the slope surfaces, spherical surfaces, different inside and outside angel etc.

3. FAÇADE SYSTEMS

Construction continues façade need in any case a special study and it is a very delicate job. Refer to this study we have decide on the view of the buildings, we have set the technical dimensions of construction; realize the proper engineering calculation which consist on careful static and dynamic calculation. [4], [5], [6], [7]. In order to accomplish in the right way the constructive calculation, in accordance with producer diagrams, we have to follow with the high precision each detail given and foreseen in the project for the building. We have to realize calculation in order to face full and exactly all tensions will occur in the structure sourced from the tendencies for deformation and bending arrows as per object construction. Aluminum Profile dimension are mainly depended from the mechanical parameters we have accepted such are glass weight, air depression, building architecture. Tolerances motivated from “economical” reasons are prohibited due to the undesirable high risks they can generate.

3.1. Standard Solar Façade Serial ALUMIL M1

The main vertical and horizontal columns are mounted in the inner side, than glasses one or two layer (common two layers) capture with proper elastic elements and in the end cover that accomplished structure. From the outside you can see one aluminum strip wide 55mm which can be different geometric forms and color in order to be fit with the architectonic selection (figure 2). Such construction type, successfully have been implemented, at the building in the Kavaja street figure 1a and in the many others cassas. [1], [2] .

It is very easy to mount such facades compare to the other types but they generate more problems during the maintenance period. Meantime we should be very careful during the isolation process.

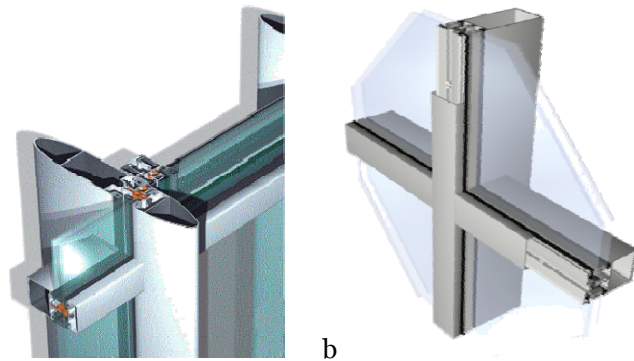


Figure 2. Standard Solar Façade Serial ALUMIL M1

3.2. Semi Structural Solar Façade Serial ALUMIL M3

The difference, with the above mentioned system, consist on the outside view in both direction vertical and horizontal, we can see just a small strip of aluminum, width enough to ensure the glass keeping figure 3.a Such construction type, successfully have been implemented, at the building in the figure 4 b .[1],[3]



Figure 3. Semi Structural Solar Façade Serial ALUMIL M3

3.3. Structural Solar Façade Serial ALUMIL M4

This is a well known type of continues facades «structural spacer glazing system » figure 5 it is very difficult to see the aluminum profile. We use special glue for their construction. [1], [3]

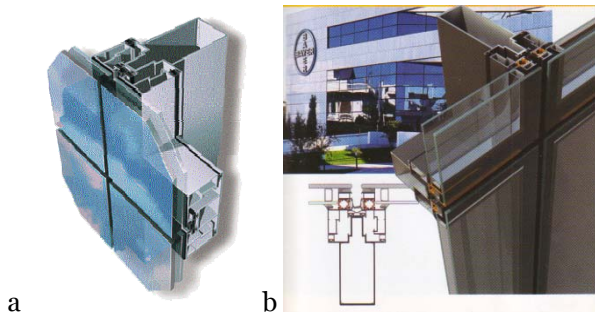


Figure 4. Structural Solar Façade Serial ALUMIL M4

In all above mentions structures we can use also thermo aluminum profile, they do not change any constructive elements or calculation, except the increasing the thermo-insulation ability of facades figure 4 b

4. ACTING LOADS AND DEFORMATION

- ❖ Loads, sourced from the air compression, are linked closely with building height, place, and orientation etc. [3], [4], [5]
- ❖ Loads, sourced from weights of the compound elements of the facades such are glasses, panels etc. These loads are categorized in two compounds, which have their respective acting points in 1/2 and 1/10 of the horizontal columns. It is clear that the materials transmit their weight forces to holding profile; practically it is not possible to calculate the exact influence of those materials. [3], [4], [5]
- ❖ There is minimum permit for bending arrow, showing the air pressing, which should be less than 1/300 of the columns length (figure 2) Potential deformation permitted should be in that size that, cannot act in the opening windows of facades and meantime to assure protection from water and air. [3], [4]

5. SELECTION OF THE APPROPRIATE PROFILE FOR THE MULLION

In the absence of a special agreement between designer and client, Euro code 9 sets specific limits in terms of deformation, which must not exceeded. Based on Euro code (ENV 1999-1-1, Design of aluminum structures), the European EN 13830 makes special reference on the serviceability limits of aluminum structures concerning resistance to wind load.

Specifically for curtain wall mullion and transoms, the following limits for the elastic deflection have been set: $L / 200$ or 15 mm, whichever is less, where L is the length between supports.

This selection of the proper profile was based on the condition for the maximum acceptable deflection of a beam supported at two $f \leq H / 200 \leq 15$ mm. The following formula for the necessary moment of inertia results from this condition:

$$J_{\min} = \frac{q_w * \alpha * H^3}{1920 * E * f_{\max}} * \left[25 - 40 * \frac{\alpha^2}{H^2} + 16 * \frac{\alpha^3}{H^4} \right]$$

- Jmax = Moment of inertia
- Qw = Wind load
- a = Width L/2
- H = Mullion height
- E = Elasticity moduls
- Fmax = Maximum reflection

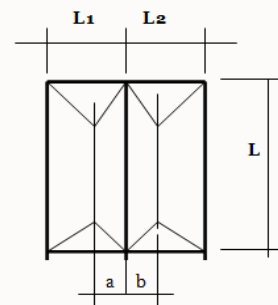


Table 1

Structure Height	Wind pressure w	Wind load we For c = 1.2	Wind load we For c = 1.6
0 - 8 m	0.50 KN/m ²	0.60 KN/m ²	0.80 KN/m ²
8 - 20 m	0.80 KN/m ²	0.96N/m ²	1.28 KN/m ²
20 - 100	1.1 KN/m ²	1.32 KN/m ²	1.76 KN/m ²

The first step of the selection of the proper mullion profile must be the selection of the appropriate wind load value, used for the calculation, depending on the construction height and exposure of the structure in wind pressure. Parameter c is an additional safety factor.

We = c * w

c = 1.2 for non wind exposed building; c = 1.6 for wind exposed building

In the table in the catalog we may to recurrent moment of inertia of a mullion, referring to a wind load of 1.0 KN/m², applied on one side of the structure. For any other wind load value, each cell of the table must be multiplied by this value. E.g. for a 0.6 KN/m² wind load value, each cell of the table must be multiplied by a 0.8 factor.

5.1 Calculation

The calculation for the curtain walls in the figure 5.

- ❖ Building height: 18 m

- ❖ Safely factor: 1.6 m
- ❖ Length between supports: 3.4 m
- ❖ Left side: 0.8 m
- ❖ Right side: 0.8 m



Figure 5. Semi Structural Solar Façade Serial ALUMIL M3 alutherm

For an 18 m building, with a safety factor of 1.6 (for a wind exposed building), the design value of wind load is 0.8 KN/m². Using the table 3, we get one value of the moment of inertia, that we have the same dimension for each side of the mullion. These values must be multiplied by 0.8. We then add these values. Finally, we select from table in the catalog the appropriate mullion profile, keeping in mind that the moment of inertia I_x of this mullion must be greater than the sum (I₁+ I₂):

In the table for H = 3.4 m and L₁ = 0.8 / 2 = 0.4, the moment of inertia is 85.7 cm⁴.

$$I_1 = 0.8 \times 85.7 = 68.56 \text{ cm}^4$$

In table 2 for H = 3.4 m and L₁ = 0.8 / 2 = 0.4, the moment of inertia is 85.7 cm⁴.

$$I_2 = 0.8 \times 85.7 = 68.56 \text{ cm}^4.$$

From table, we select the profile M9951, which has a moment of inertia I_x = 222.41 cm⁴, greater than the sum (I₁ + I₂).

6. CONTINUOUS FAÇADE ELEMENTS

6.1. Supports

Supporters are set in proper places, in horizontal and vertical lines, in accordance with constructions conditions and controlling the façade plan. The plane control for supporters is carried out simply, through the common methods in vertical and horizontal direction and cross the diagonals of façade.

Aluminum columns are mounted to the supporters in vertical way, in some cases we can mount even in horizontal line. They are mounting between two floors. Column length from 6-6.5 m has to have at least two anchorage points.

Project must assure some possibilities for small dislocation (up-down-front-behind) depended even from the defects born from construction façade level. This is the reason why they are produced with elliptical whole.

Materials are aluminum, thickness up to 8 mm, special content 6005 A F26 and high durability.

6.2. Vertical and Horizontal aluminium parts

The base construction is compound from aluminium profile, these are going upper with facade in vertical way (colons) and in horizontal. There are elements within columns and cross-linked in proper way with columns.

The architectural study and static also dynamic calculations on structure decide on forms and dimensions of those parts.

The columns high, in figure 2, are linked direct with calculation. The high should decide in the very beginning and then after depended on loads and architectural areal distances we can decide on horizontal lengths. The expansion coefficient, of the aluminum content parts used in profile production, accepted based on formula $\alpha = 23 \times 10^{-6}$ for each °C. Based on the expansion coefficient we should calculate a displacement of 1.4mm per meter in the condition of temperature diapason -10 °C up to 50 °C.

The width of columns is comfort to using rules. This dimension has direct effects on glass hold.

6.3. Axiliaries equipment for links.

Equipment, used for linking different aluminum parts, are made from aluminum mark 6005A F26, this prevent any damage of those part from corrosion and warranty the sustainable linkage.

All screws, in contact with aluminum, are made from stainless steel or galvanized.

6.4. Hermetic rubber

All water flows must be in the direction of the outside of façade. In order to accomplish such condition the hermetic rubber must be and set in the proper way.

All hermetic rubber, used for assuring hermetically and elasticity purposes within aluminum parts and accommodating glasses in the system, are with high quality and special. The rubbers, which are the most sensitive element and being one of the most important element in assurance of hermetic must have high durability as per thermal characteristic for temperature from -20°C up to $+80^{\circ}\text{C}$.

They should have durability, due to the fact of difficulties facing for changing, they should not change the characteristics during the time and maintain their elasticity in order to allow and follow the changes happenings in other elements affected from nature temperature changes.

6.5. Parts from nylon

Between the supporters and profiles, profiles their-selves, we put nylon elements which allow small displacement, caused from expansion, shrinkage, inevitable changes happening in concrete structure or in aluminum structure, as well as different small movements vice versa.

Thermo isolation material set between the main columns and pressing plate, offers us a benefit in the heat transmitting coefficient in the level of $2.5\text{ W/m}^2\text{ }^{\circ}\text{C}$.

6.7. Glasses

Glasses are the base element of façade. The main criteria, in (gross) glasses selection process, are: Glasses durability against damages, especially those caused from air pressing. For that reason calculate an element with maximal load (for example in the highest point) based on the maximum air pressing registered in the region we calculate the glass width.

Selecting, one, two or three, glasses layer depended on requirements. In this view point we should consider the atmospheric condition in region, thermal isolation as well as the acoustic noises in the surroundings area.

Within the two layers of glasses there is a light aluminum frame. We stick, with special glue, the glasses from the two sides of this frame. We should surround the inside and outside area with special rubber meantime it should set even between the glasses and aluminum. The common isolation glasses compound from two layers with thickness 6mm and 4 mm the distance between must be 12 mm and the total thickness is approximately 22mm. [2],[3]

7. CONCLUSIONS

- ❖ Continuous façade construction already is an imperative, especially for the high buildings or skyscrapers; meantime we replace the classical materials with a combination of glasses with aluminum.
- ❖ Continuous façade construction is a delicate entrepreneurship, it require to carried out a detail study which will guide the architectural solution and decide the constructive dimension in accordance with calculation of acting forces.
- ❖ Based on consumer requirements, economic restriction and detailed studies we have make possible constructing such facades even in our country.
- ❖ Realizing a careful selection process for construction as well all other compound elements will make possible to achieve the optimal results as per durability, hermetically and thermo isolation.

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