TECHNICAL DESCRIPTION OF A MULLION/TRANSOM WALL OF MB-SR50 EI SYSTEM

1. DESCRIPTION OF CONSTRUCTION

The mullion-transom system MB-SR50N EI is intended for the construction and execution of light fire resistant curtain and filling walls of the fire resistance class EI15, EI30, EI45, EI60 according to the standards PN-EN 1364-3 and PN-EN 1364-1 as well as glazed roof coverings of the fire resistance class RE30 as per the standard PN-EN 1365-2. The system has been classified as non-fire-propagating (NFP).

The construction of the system is based on the load-bearing grid structure composed of vertical members (mullions) and horizontal members (transoms) of box-shape section and characteristic width 50 mm. The profiles of mullions and transoms are suitably connected with each other and form an aluminium grid structure, which is mounted to the building construction with suitable brackets.
In order to obtain fireproof aluminium profiles, mullions and transoms have been equipped with special fireproof inserts. A fireproof insert consists of a special-shape aluminium profile, fulfilling the function of reinforcement, shielded with panels made from fireproof materials.
This design of the construction made it possible to admit to the system standard profiles of mullions and transoms applied in the MB-SR50N system, which significantly enhanced cost efficiency of the whole construction and ensured identical appearance to the profiles of the MB-SR50N system.
The MB SR50 EI construction utilizes mullions ranging from 85÷225mm in depth and transoms whose depth is between 69,5÷189,5mm.
The system provides for a possibility of overlapping connection between transom and mullion, which enables efficient water deflection and proper ventilation of inter-pane space.
In order to achieve optimal thermal and acoustic insulation performance there has been applied a continuous thermal break (insulator) made of material called ”HPVC” and profiled EPDM glazing gaskets.
Glass panels or other infills are fitted in glazing grooves, shaped from mullion and transom profiles and a clamping strip. Additionally, a special expanding tape has been applied in glazing grooves of mullions and transoms. A clamping strip is fixed to the load-bearing sections with a metric screw and a stainless steel washer.
Such system of glazing protects a fireproof glass panel or other infills from falling off from the frame during fire. In the case of an angular wall special gaskets have been applied.
The wall of the MB SR50N EI system should be executed in accordance with working design, prepared individually for each object. Subject to the system documentation and structural analysis, the design should specify aluminium profiles for mullions and transoms, accessories to fasten mullions to the structure of the building and transoms to mullions, a lay-out of points where the construction of the wall is to be fixed to the building construction.
The design should also take into account all other materials and elements of the wall, details of connections and sealing between wall elements and the building construction, ventilating method and drainage of the wall. While taking into account requirements connected with the function and location and geometry of the building, the wall should be designed in accordance with applicable standards.
Allowable height of a curtain wall is a derivative of resistance-related parameters, ensuing from the structural analysis. However, at every floor the structure should be divided with vertical thermal expansion joints. Allowable spacing and span of load-bearing profiles, based on assumed structural analysis diagram result from structural analysis of construction and dimensions of infills. The curtain wall is in no way restricted as to its length, providing the horizontal expansion joint has been applied.

2. TECHNICAL DESCRIPTION OF RAW MATERIALS AND MATERIALS

2.1 Aluminium profiles

Aluminium profiles are produced in the process of mechanical working of the aluminium alloy: **EN AW-6060 T66** in conformance with the following standards:

- chemical composition of alloy: EN 573-3, EN 515
- tolerances on dimensions and form of extruded precision profiles EN 12020-2
- mechanical properties: EN 755-2
- conformant to EN 755-1

Surfaces of profiles are finished with anodic oxide coatings meeting the requirements set forth for Qualanod quality label or with Qualicaot-approved polyester powder coatings. The said coatings are applied as protection against corrosion.

2.2 Thermal break (insulator)

The insulators through which clamping (pressing) strips (used to mount facade claddings) are connected to mullions and transoms are made of HPVC.

2.3 FIRE PROTECTION ELEMENTS

Fire protection elements are made of GKF plasterboards, silicate-cement panels manufactured by PROMATEC -H and panels made from CI material. There are also applied fireproof expanding tapes cut off from the panels or supplied in rolls, as well as fireproof sealants.

2.4 GLAZING GASKETS

Glazing gaskets are made from EPDM - synthetic rubber, according to DIN 7863 and working standard as per DIN 7715 E2 or ISO 3302-1. Gaskets are joined either by gluing or vulcanizing.

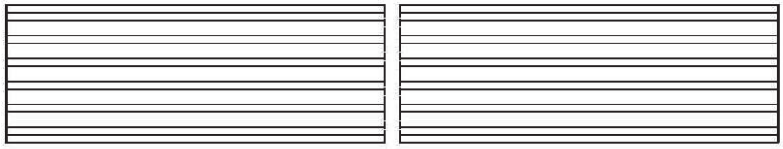
2.5 GLASS PANELS

Transparent fields of a curtain wall MB-SR50 EI are glazed with fireproof panels of type-1 and type-2, selected in such a manner as to meet the requirements in view of fire resistance specified for a relevant class EI15, EI30, EI45, EI60. Glass panels conform to the standard PN-EN 1279-1:2006 and PN-EN 1279-5:2006.

SPECIFICATION OF FIREPROOF GLASS **Type-1**

Maximum dimensions of glass panels in a vertical arrangement h x b = 2400 x 1400 [mm].
Maximum dimensions of glass panels in a horizontal arrangement h x b = 1200 x 1800 [mm].

Poz	Typ szyby	Min. grubość szyby, [mm]		Producent
		EI30	EI60	
1	*2*	*3*		*4*
1	Swissflam	13 16	25	VETROTECH (Saint-Gobain)
2	Pyrostop	15 18	23	PILKINGTON
3	Pyrobel	8 16 17	17 25	AGC
4	Promaglas	17	21	Promat
5	Pyranowa	16	21	Schott

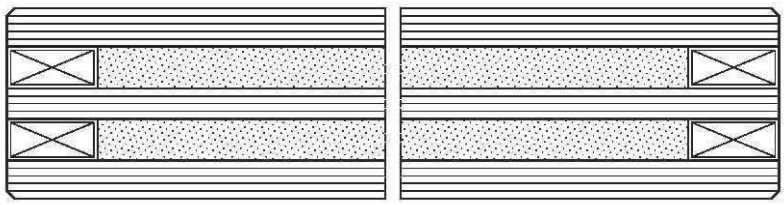


Example of glass panels Type-1

SPECIFICATION OF FIREPROOF GLASS **Type-2**

Maximum dimensions of glass panels in a vertical arrangement h x b = 3000 x 1500 [mm].
Maximum dimensions of glass panels in a horizontal arrangement h x b = 1200 x 1700 [mm].

Poz	Typ szyby	Min. grubość szyby [mm]		Producent
		EI30	EI60	
1	*2*	*3*		*4*
1	Contraflam	16	25	VETROTECH (Saint-Gobain)
2	Polflam	25	32	GLASS -TEAM

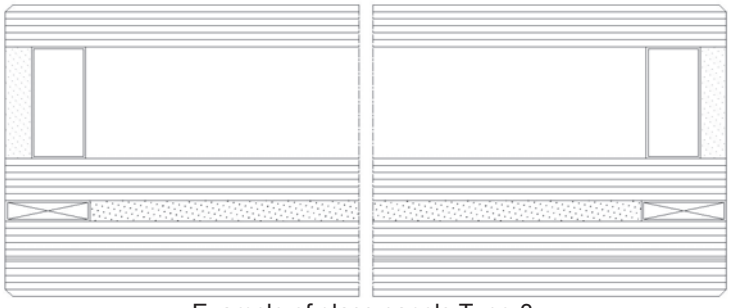


Example of glass panels Type-2

SPECIFICATION OF FIREPROOF GLASS **Type-3**

Maximum dimensions of glass panels in a vertical arrangement h x b = 2100 x 1100 [mm].
Maximum dimensions of glass panels in a horizontal arrangement h x b = 1100 x 2100 [mm].

Poz	Typ szyby	Grubość szyby [mm]	Producent
1	*2*	*3*	*4*
1	Contraflam Lite Climat Horizontal	-	VETROTECH (Saint-Gobain)



Example of glass panels Type-3

2.6 INFILLS OF NON-TRANSPARENT SECTIONS

Fillings of opaque sections (lintel and sill belts) are built as sandwiched elements in accordance with the constructional documentation of the system and are arranged as follows:

- single glass, air void, plasterboard GKF of thickness 12.5 mm, mineral wool of minimum thickness 110 mm and minimum density 60 kg/m^3, steel sheet of thickness 0.5 ÷ 1.25 mm and plasterboard GKF of thickness 12.5 mm;
- glazing unit, mineral wool of minimum thickness 110 mm and minimum density 60 kg/m^3, steel sheet of thickness 0.5 ÷ 1.25 mm and plasterboard GKF of thickness 12.5 mm;
- steel sheet of thickness 0.5÷1.25 mm (zinc-coated or powder-coated), mineral wool of minimum thickness 110 mm and minimum density 80 kg/m^3, steel sheet of thickness 0.5÷1.25 mm and plasterboard GKF of thickness 12,5 mm;
- aluminium sheet (anodised or powder-coated) of thickness 1÷3 mm; mineral wool of minimum thickness 110 mm and minimum density 80 kg/m^3, steel sheet of thickness 0.5 ÷ 1.25 mm and plasterboard GKF of thickness 12.5 mm.

2.7 FIXATION ELEMENTS

Fixation elements (screws, self-drilling screws, self-tapping screws for sheets, bolts, nuts, washers) applied to make connections are made of stainless steel according to standards referred to in the system documentation.

2.8 ALUMINIUM SUPPORTS AND CONNECTING MEMBERS

Aluminium supports and connecting members are made from aluminium alloy AlMgSi0,5 F22 and protected against corrosion with oxide coatings.

2.9 STEEL SUPPORTS

Steel supports are made from steel sheet and protected against corrosion; points of contact between steel and aluminium elements are isolated.

2.10 AUXILIARY ELEMENTS

Auxiliary elements (shims, adhesives and silicones) used to seal connections according with the system documentation.

3.0 SUPPLEMENTARY INFORMATION

3.1 WORKING

Decorative surfaces of profiles should be covered with protective foil for protection from any working-related damage.
Linear and angular dimensional tolerance, disregarding individual designation of tolerance, as per EN 22768-1, Class of tolerance – m (medium accuracy level).
Any splinters which occur in the process of working should be deburred.

3.2 ASSEMBLY GUIDELINES AT THE BUILDING SITE

The assembly of a mullion/transom wall of the MB-SR50N EI should be carried out in the minimum temperature of 5ºC. During the assembly the construction should be protected against external conditions, such as water, snow, any types of mortar or building dust. Aluminium profiles with fire resistance inserts and expanding mats adhered onto them should be prepared for transport and storage in such a way as to protect them against the above mentioned external conditions. Where mechanical working of fire resistance materials CI is required, after working, the surfaces should be protected with a double layer of polyurethane varnish.
In the case of fitting an expanding mat, the process should be carried out in the temperature not lower than 5°C. Before application of an expanding mat the surface should be prepared – it must be clean, smooth and degreased (e.g. wiped with acetone or extraction naphtha). Protective strip should be removed from adhesive tape and now the tape should be applied. The upper layer of sealing may be cleaned with a damp cloth soaked

in non-aggressive detergents. Sharp tools which may damage sealing material must never be used. After fitting an expanding sealant, filling elements should be installed, such as glass panels or other infills, clamping and masking strips.
The mullion/transom wall of the MB-SR50N EI system is fastened to the structure of the building by means of special steel or aluminium support brackets. Elements of brackets are screwed on to the floor/ceiling slab of the building with steel expansion bolts (or other bolts suitable for a particular type of the slab).
Vertical profiles (mullions) are fastened to the bracket with mounting screws.
Transoms are fastened between mullions. The whole forms a load-bearing truss-type construction.
Glass panels or other infills are mounted in the fields between mullions and transoms

WARNING:
Lime, cement, alkaline and cleaning substances (e.g. bleaches, abrasive pastes) have particularly harmful effect on aluminium profiles, especially on decorative protective surfaces. Thus any "wet" works must be limited to the minimum.
Should mortar be brought into contact with the surface of aluminium, it must be immediately washed (its hardening must not be allowed). Failure to wash mortar will result in permanent discolouring and will damage the surface.

3.3 STORAGE AND TRANSPORTATION

- Aluminium profiles

Aluminium profiles, details, infills, glass panels, windows and doors should be stored in dry rooms to protect elements against mechanical damage and against damage of anodised or painted coatings.
Aluminium profiles, details, infills, glass panels, windows and doors may be transported by any means of transport provided they are protected against soiling, dust and exposure to any damage during transportation.

- Fireproof materials CI

They should be stored in original packaging in horizontal position. If re-packing of inserts is required the following rules should be observed:
- inserts should be placed in a horizontal position on a flat surface (e.g. on a chipboard),
- subsequent layers should be interleaved with PE foil (e.g. thin painter's foil),
- maximum number of layers in one packaging: 25, but the stack must not be higher than 600 mm.
They should be stored in storerooms in normal weather conditions, i.e. in the temperature from 5ºC to 25 ºC and humidity between 50% and 80%.

After opening the packaging and taking the required number of inserts, the packaging must be covered with protective foil. The content should be protected against getting wet or drying up. The inserts should be carried carefully to avoid any damage – cracks.

3.4 MAINTENANCE

Anodised or coated aluminium profiles should be washed with a soft cloth and mild cleaning agents. No alkaline-based liquids are allowable as they may damage the oxide coating.

3.5 CATALOGUE UPDATES

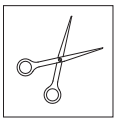
The catalogue should be updated by downloading PDF files at (http://www.aluprof.eu) in the authorized section "Catalogues".

3.6 AVAILABILITY OF CATALOGUE PRODUCTS

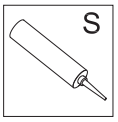
Rules and availability dates of the elements presented in the catalogue have been specified in Aluprof S.A. Price List, included in the authorised section of the website http://www.aluprof.eu in the section "Price Lists".

3.7 GRAPHIC SYMBOLS USED IN THE CATALOGUE

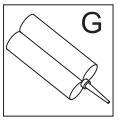
№	Number	N	Standard
!	Remarks		Working
	Total area [dm^2/m]		Compatible elements
	Decorative area [dm^2/m]		
	Angle of cut [º]		
	Dimensions [mm]		
1..	Number of items		
	Material		



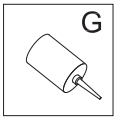
- Cut



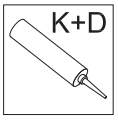
- Seal with silicone



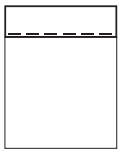
- Glue with two-component adhesive



- Glue



- Glue and seal



- Perform, using: _ _ _ _ _ _

STATYKA
STRUCTURAL ANALYSIS
СТАТИКА
STATIK

STRUCTURAL ANALYSIS

1. INTRODUCTION

Constructions made of aluminium profiles applied in the MB-SR50N system require structural analysis and selection of the required cross-sections of profiles on the basis of its results. Knowledge of principles and methods of calculation for such types of structures is necessary in order to properly account for static requirements.
Diagrams and data presented in this section will help select proper aluminium profiles.
Computations included in the catalogue are simplified, i.e. they do not take into account such phenomena as:

- vibrations of a structure caused by the dynamic force of the wind,
- existence of internal pressure in buildings exposed to an open area,
- wind loads.

There is a risk of making a mistake at the stage of:

- collecting information about the structure (its location, dimensions, surrounding),
- assessment of probability of occurrence of the phenomena described above.

ALUPROF S.A. shall bear no responsibility for faulty selection of aluminium profiles for mullions and transoms applied while assembling a curtain wall.

2. DIMENSIONING METHODS

The standard EN 1990 “Basis of Structural Design” recommends dimensioning by means of limit state design method.
There are two basic limit states:

- ultimate limit state (ULS)
- serviceability limit state (SLS)

In the process of designing it should be demonstrated that neither of the limit states have been exceeded. All relevant calculation situations and load exposure types should be checked. Checking one of the limit states may be omitted providing that there is sufficient amount of information confirming that if one of the limit states is met, the criteria for the other limit state are also fulfilled.

In the case of aluminium structures of curtain walls, while dimensioning, it is recommended that serviceability limit state (SLS) be used. Relatively low rigidity of aluminium cross-section in relation to its strength causes that in most cases the value of SLS, retaining at the same time loading capacity of the cross section (SGN conditions are met). It is always the designer of the facade who makes the decision which of the two limit states is more reliable.

3. MATERIAL PROPERTIES OF ALLOY EN AW-6060 T66

Tensile modulus	$E = 70\ 000\ [N/mm^2]$
Shear modulus	$G = 27\ 000\ [N/mm^2]$
Poisson’s ratio	$v = 0.3$
Coefficient of thermal expansion	$\alpha = 23 \times 10^{-6}\ [1/K]$
Density	$\rho = 2700\ [kg/m^3]$

4. STRENGTH PROPERTIES OF ALLOY AW-6060 T66

Wall thickness t [mm]	Elasticity limit f_o [N/mm^2]	Tensile strength f_u [N/mm^2]
$t \leq 3$	160	215
$3 < t \leq 25$	150	195

5. ALLOWABLE VALUES OF DEFLECTIONS

With regard to maintaining rigidity of aluminium profiles (standard: EN 13830)

In respect of wind load, the maximum front deflection of framework elements of a curtain wall should not exceed:

- L/200 or 15 mm, depending on which value is smaller.

Maximum deflection of each horizontal framework element caused by vertical loads should not exceed:

- L/500 or 3 mm depending on which value is smaller.

Due to limitations of deflection of glazing edge caused by wind load or snow load, deflection of elements of the structure of a curtain wall at the height H and glazing width B should not exceed (according to standard EN 1279-5)

- B/200 or H/200 or 12 mm, depending on which value is smaller.

6. LOADS EXERTED ON STRUCTURES

Curtain walls transmit external loads onto the load bearing structure of the building in points of its support. The structure may be exposed to the following loads:

- wind load (pressure or suction)
- load caused by the weight of infills (glazing, windows, panels)
- dead load
- horizontal load caused by the crowd pressure (from the inside of the building)
- snow load (for roofs, skylights and other spatial structures)

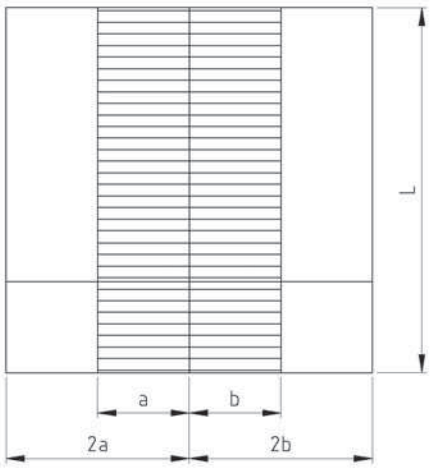
In the case of profile dimensioning by SLS method, while determining values of loads, characteristic values of loads should be applied.

Tabulating of loads exerted on structures of the facade and arranging combinations of loads is the task of the facade design engineer, who should take into account building functions and the regulations applicable in the country in which a particular structure will be used.

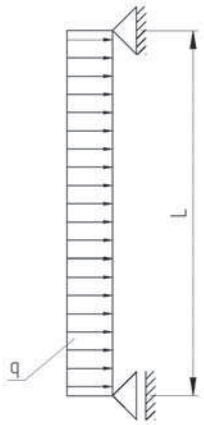
7. DIMENSIONING OF CURTAIN WALL MULLION

7.1 Determination of the moment of inertia I_x of a mullion in respect of the wind load – uniform load

Load diagram



Static diagram



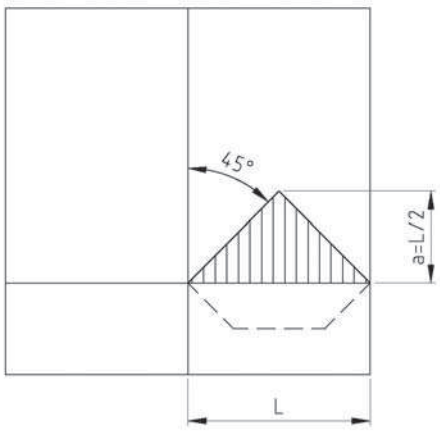
$$I_x = \frac{5 \cdot q \cdot L^4}{384 \cdot E \cdot f_{\max}} \cdot 10^5 = 18{,}601 \cdot \frac{(a+b) \cdot p_k \cdot L^4}{f_{\max}}$$

Where:
$q = p_k \times (a + b)$ – maximum load per profile unit length [kN/m]
p_k – characteristic wind load [kN/m^2]
$(a + b)$ – width of loaded area [m]
L – distance between points of support [m]
E – Young's modulus [GPa]
f_{max} – maximum allowable deflection of a profile [mm]
I_x – moment of inertia of a mullion [cm^4]

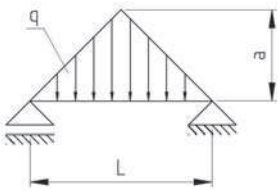
8. DIMENSIONING OF CURTAIN WALL TRANSOM

8.1 Determination of the moment of inertia I_{z1} of a transom in respect of the wind load – triangular load

Load diagram



Static diagram

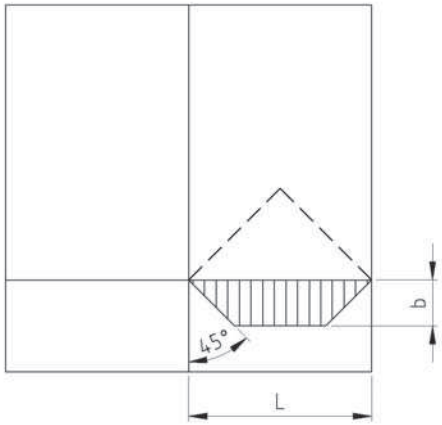


$$I_{z1} = \frac{q \cdot L^4}{120 \cdot E \cdot f_{\max}} \cdot 10^5 = 11{,}905 \cdot \frac{p_k \cdot a \cdot L^4}{f_{\max}}$$

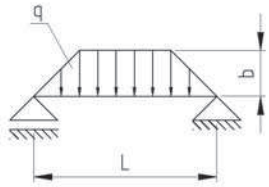
Where:
$q = p_k \times a$ – maximum load per profile unit length [kN/m]
p_k – characteristic wind load [kN/m^2]
a – height of loaded area [m]
L – distance between points of support [m]
E – Young's modulus [GPa]
f_{max} – maximum allowable deflection of a profile [mm]
I_{z1} – moment of inertia rygla [cm^4]

8.2 Determination of the moment of inertia I_{z2} of a transom in respect of the wind load – trapezoidal load

Load diagram



Static diagram



$$I_{z2} = \frac{q \cdot L^4}{1920 \cdot E \cdot f_{\max}} \cdot (25 - 40 \cdot \frac{b^2}{L^2} + 16 \cdot \frac{b^4}{L^4}) \cdot 10^5 = 0{,}744 \cdot \frac{p_k \cdot b}{f_{\max}} \cdot \left(5 \cdot L^2 - 4 \cdot b^2\right)^2$$

Where:
$q = p_k \times b$ – maximum load per profile unit length [kN/m],
b – height of loaded area [m]
p_k – characteristic wind load [kN/m^2]
L – distance between points of support [m]
E – Young's modulus [GPa]
f_{max} – maximum allowable deflection of a profile [mm]
I_{z2} – moment of inertia of a transom [cm^4]

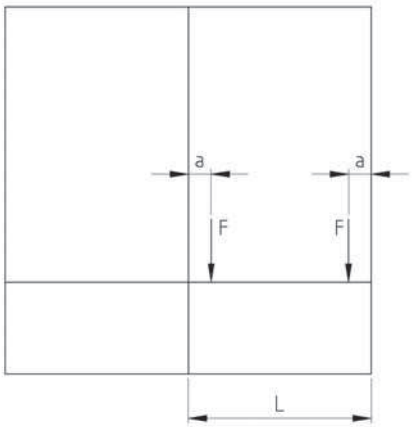
8.3 Determination of the moment of inertia in a transom I_z

In order to determine the moment of inertia in a transom I_z, exposed simultaneously to the triangular load (item 8.1) and trapezoidal load (item 8.2), the results obtained according to the formulas as above should be added.

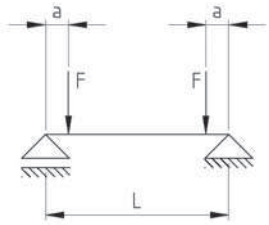
$$I_z = I_{z1} + I_{z2}$$

8.4 Determination of the moment of inertia I_y of a transom in respect of the load cause by the weight of glazing or infills.

Load diagram



Static diagram



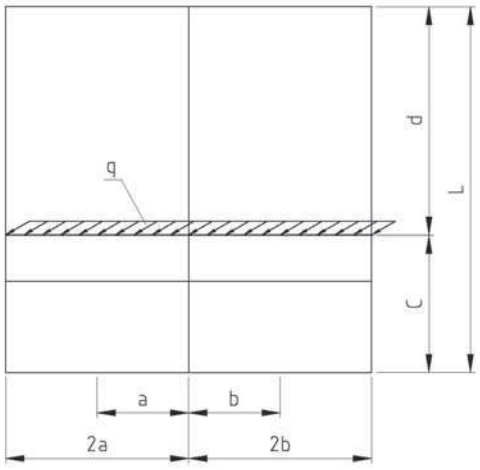
$$I_y = \frac{F \cdot a}{24 \cdot E \cdot f_{\max}} \cdot (3 \cdot L^2 - 4 \cdot a^2) \cdot 10^5 = 29{,}762 \cdot \frac{G \cdot a}{f_{\max}} \cdot (3 \cdot L^2 - 4 \cdot a^2)$$

Where:
$F = G/2$ – concentrated force resulting from the glazing weight [kN]
G – glazing weight [kN]
L – distance between points of support [m]
a – distance between the point of support of glazing and the profile end [m]
E – Young's modulus [GPa]
f_{max} – maximum allowable deflection of a profile [mm]
I_y – moment of inertia [cm^4]

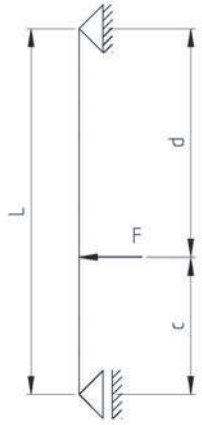
9. ADDITIONAL LOADS

9.1 Determination of moment of inertia I_x of a mullion in respect of the load caused by crowd pressure

Load diagram



Static diagram



$$I_x = \frac{F \cdot d}{3 \cdot E \cdot L \cdot f_{\max}} \cdot \left[\frac{c}{3} \cdot (L + d)\right]^{\frac{3}{2}} \cdot 10^5 = 476{,}19 \cdot \frac{q \cdot (a + b) \cdot d}{L \cdot f_{\max}} \cdot \left(\sqrt{\frac{c}{3} \cdot (L + d)}\right)^3$$

Where:
$F = q \times (a + b)$ – value of the concentrated load [kN]
q – value of the linear load [kN/m]
$(a + b)$ – width of the loaded area [m]
c – distance between the bottom fixing point and the point of force application [m]
d – distance between the upper fixing point and the point of force application [m]
L – distance between points of support [m]
E – Young's modulus [GPa]
f_{max} – maximum allowable deflection of a profile [mm]
I_x – moment of inertia [cm^4]

10. ADDITIONAL INFORMATION

Another method of making initial selection of aluminium profiles for mullions and transoms of the curtain wall is application of the computer software MB-CAD or logiKal. Those are calculating programmes, facilitating and speeding works connected with designing, cost-estimating and preparing the production of aluminium structures.

Should there arise any doubts with regard to the appropriateness of the adopted calculation assumptions, please contact the Technical Department of ALUPROF S.A. or a specialized design office.