

Vertical structures

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Vertical structures

vertical structures

range

Vertical structures are all those, indoor or outdoor, linear or curved structures that serve only as dividers. These structures can be built at the site or prefabricated. Take the following parameters into account when deciding on the type of installation:

- dimensions of the surface to be built
- weight of the Vetrorredo structure
- whether it will be indoors or outdoors
- the number and sequence of Vetrorredo installations
- complexity of the shape/geometry

square

dimensions (cm)	glass design	colours	finishes*
19x19x8	O - T	blue – aquamarine – turquoise – green – yellow – siena – amethyst – pink – lilac – nordica - clear	transparent satin finished on 1 side satin finished metalized
	DP	clear	transparent satin finished
	DI		transparent
	DNP - DNI - DQ		
24x24x8	DO - DT	clear	transparent satin finished on 1 side satin finished
	DP	clear	transparent satin finished
	DI	clear	transparent
30x30x10	DO - DT	clear	transparent satin finished
19x19x5	DO - DT - DI	clear	transparent
19x19x10	T	clear	transparent sandblasted

rectangular

dimensions (cm)	glass design	colours	finishes*
19x9,4x8	O - T	blue – aquamarine – turquoise – green – yellow – siena – amethyst – pink – lilac – nordica - clear	transparent satin finished on 1 side satin finished metalized
24x11,5x8	DO - DT	clear	transparent satin finished on 1 side satin finished

Legend for glass designs

- O** = Wavy
- T** = Smooth
- P** = Parallel lines
- I** = Cross ribbed
- NP** = New parallel lines
- NI** = New cross ribbed
- Q** = Squared

The Vetroarredo range also includes end glass blocks that allow the installation of “wing” walls without using finishes of other materials.

End glass blocks feature a rounded glass profile that allows creative combinations.

End glass blocks are available in linear as well as in curved versions.

Corner glass blocks are used for the installation of full glass walls with 90° angles.

The Vetroarredo range also includes a series of accessories: from spacers to openable frames for self-ventilation walls, from expansion joints and stainless steel rods to vetromalta.

special pieces

dimensions (cm)	model	glass design	colours	finishes*
19x19x8	linear end block	O	blue – aquamarine – green – pink – clear	transparent satin finished metalized
		T	clear	
	curved end block	O	blue – aquamarine – green – pink – clear	
		T	clear	
9x9x19	corner square	O	blue – aquamarine – green – pink – clear	transparent satin finished metalized
		T	clear	
14,5x11x19	corner hexagon	O - T	clear	transparent satin finished
17,2x17,2x23,6x8	triangular	O - T	clear	

accessories for installation

spacers	for 2 mm Pegasus joints (for linear vertical surfaces)
	for 5 mm Pegasus joints (for linear vertical surfaces)
	for 10 mm Pegasus joints (for linear vertical surfaces)
	for 10 mm joints (for 30x30x10 glass blocks)
	for 16 mm Pegasus joints (for linear vertical surfaces)
	for curved walls with 10 mm internal joints
	spacer / caisson floor with 1 cm joints
openable frames	for 1 unit, dimensions: 21.5x22.5x9 cm (for 19x19x8 cm glass blocks)
	for 2 unit, dimensions: 21.5x22.5x9 cm (for 19x19x8 cm glass blocks)
	for 4 unit, dimensions: 21.5x22.5x9 cm (for 19x19x8 cm glass blocks)
	for 1 unit, dimensions: 26.5x27.5x9 cm (for 24x24x8 cm glass blocks)
	for 2 unit, dimensions: 26.5x27.5x9 cm (for 24x24x8 cm glass blocks)
	for 4 unit, dimensions: 26.5x27.5x9 cm (for 24x24x8 cm glass blocks)
expansion joint	dimensions 6x0.6 cm
stainless steel rod	diameter 6 mm
Vetromalta (mortar)	white and grey

Legend for glass designs

O = Wavy

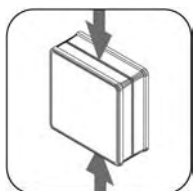
T = Smooth

Vertical structures

Features and performance

Compressive strength

Only excellent quality raw materials and a manufacturing process that dedicates special attention to sealing and annealing, such as those used for Vetroarredo products, can guarantee high compressive strength in glass blocks. This is a fundamental requirement when it comes to safety and security in designing complex, large and heavy projects.



Testing method

Compressive strength tests are performed by applying perpendicular loads with press plates to Vetroarredo glass blocks joined with cement mortar.

dimensions (cm)	glass designs	Breakage tension			
		Average value		Minimum value	
		Vetroarredo certified value (N)	Average value according to DIN 18175/77 (EN 1051-1) (N)	Vetroarredo certified value (N)	Minimum value according to DIN 18175/77 (EN 1051-1) (N)
19x19x8	O - T - P - I - NP - NI - Q	> 7,5	7.5	> 6.0	6.0
19x9,4x8	O - T		*		*
24x24x8	O - T - P - I		7.5		6.0
24x11.5x8	O - T				
30x30x10	O - T		*		*
19x19x5	O - T - I				

* item not specified in the standard

Notes:

Test performed and certified by SIGMA s.r.l. laboratory in Prato according to the following standard:

- DIN 18175, 1977 edition
- Tests performed on individual glass blocks, not assembled in structures or walls.

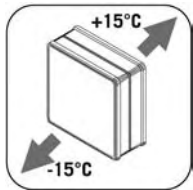
Legend for glass designs

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Thermal endurance

Thermal shock is one of the most stringent tests that Vetroarredo glass blocks must undergo to verify their strength and resistance. Only proper annealing eliminates residual stresses that can trigger accidental breakage. This requisite makes it possible to use Vetroarredo glass blocks in outdoor applications under the most varied climatic conditions.



Testing method

The thermal endurance test was performed by submerging Vetroarredo glass blocks in a container of heated water and then immediately placing them in another container filled with water at room temperature.

dimensions (cm)	glass designs	Sudden temperature change (ΔT)		
		Vetroarredo certified value °C	value according to UNI 7740/75 °C	value according to DIN 18175/77 (EN 1051-1) °C
19x19x8	O - T	30°C	18°C	25°C
19x9,4x8	O	30°C		*
24x24x8		20°C		20°C
30x30x10		30°C		*
19x19x5		25°C		

* item not specified in the standard

Notes:

- Test performed and certified by SIGMA s.r.l. laboratory in Prato according to the following standard
- Test performed according to the provisions of UNI 9303, edition 1988, according to the A method
- Tests performed on individual glass blocks, not assembled in structures or wall.

Legend for glass designs

- O = Wavy
- T = Smooth



Light transmission

Transparency, one of the most important features of glass blocks, creates different effects in relation to the many possible combinations that can be made using different patterns, shapes, finishes and colours.

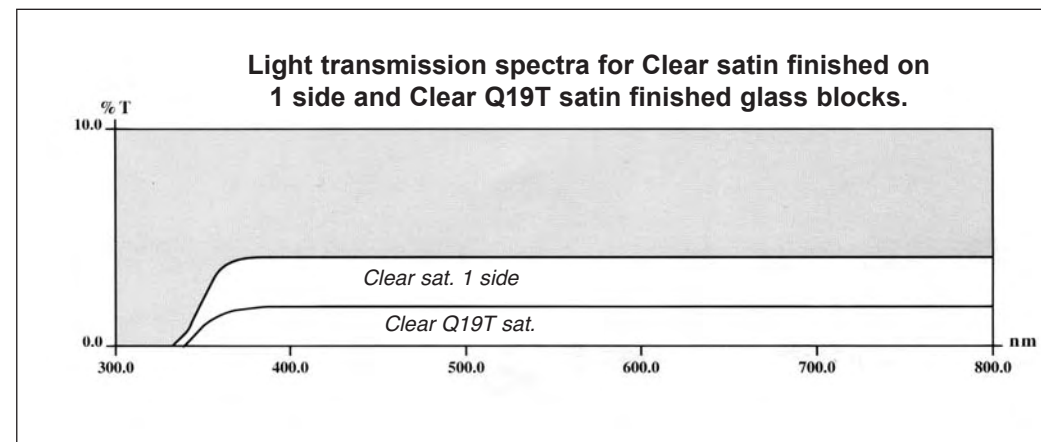
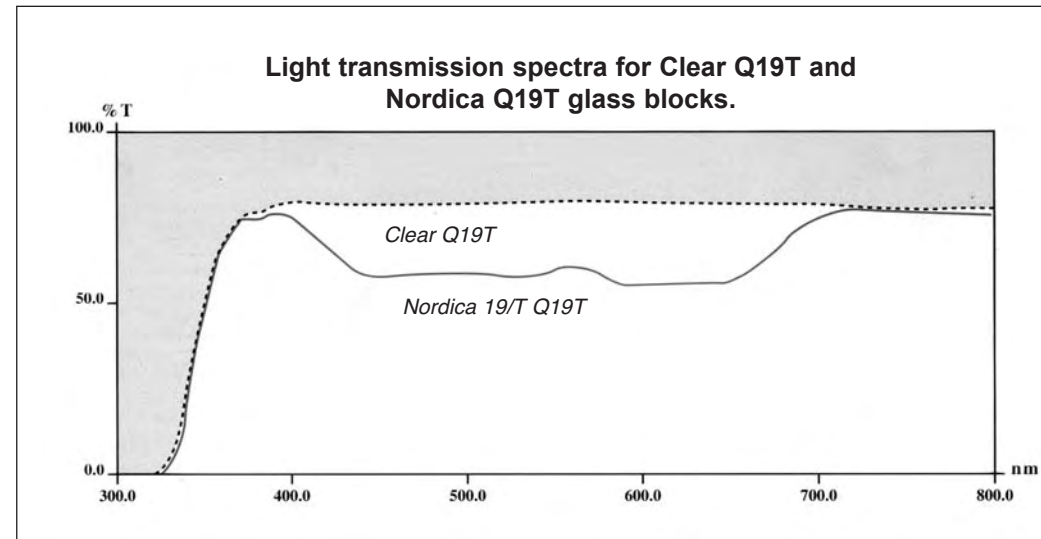
Using Vetroarredo glass blocks it is possible to obtain different light transmission values, and a less or more clear definition of images behind the wall, in order to satisfy aesthetic and functional design requirements in relation to environmental and climatic factors.

Vetroarredo glass blocks are made with high quality raw materials that make it possible to create a particularly "colourless" base product and to guarantee excellent light transmission values.



Testing method

The light transmission test was performed by subjecting Vetroarredo glass blocks to a perpendicularly light beam of a wavelength that can be perceived by the human eye (between 0.38 and $0.78 \mu\text{m}$). The light beam that passes through the two surfaces of the blocks is the light transmission; the spectral composition of which is translated into colour perception and light intensity.



Note:

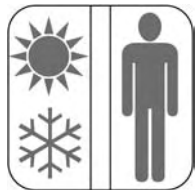
- Measurements and certifications were carried out at CO.RI.VE. of Parma, according to the provisions of ISO 9050 standard, 1990 edition. (Ref. 01/FV, 02/FV, 03/FV, 04/FV of June 10, 1996.
- Tests performed on individual glass blocks, not assembled in structures or walls.

Thermal insulation

The air space inside Vetroarredo glass blocks guarantees thermal insulation levels equal to those achieved using standard glazing. The parameter for measuring thermal insulation is the unit heat transmission coefficient “K” “μ”; the lower this value, the greater the thermal insulation.

The best thermal insulation (that is the lowest “K” value) is obtained with larger size models and when lightened mortar is used for installation.

In both cases, the “thermal bridges” created by gaps between Vetroarredo glass blocks are reduced.



Testing method

The test was performed by placing a panel made of Vetroarredo glass in order to create two chambers with different temperatures and to evaluate the “K” coefficient, that is the amount of heat that crosses the panel, per unit of time, per square meter per 1°C of temperature difference between the two faces.

The “K” coefficient takes into account conduction and convection heat exchange phenomena, but not irradiation phenomena.

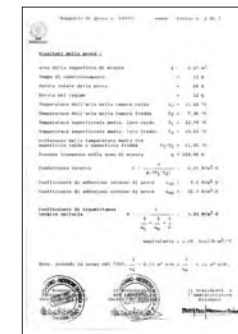
dimensions (cm)	Test specime	Mortar used for the test	“K”, coefficient of certified unit heat transmission	
			W/m ² °K	K cal/h m ² °C
19x19x8	single panel	traditional	3.02	2.60
		lightened*	2.81	2.42
19x19x8	single panel	Posavelox	2.72**	
24x24x8	single panel	traditional	2.95	2.54
	double panel		1.48	1.27
24x24x8 satin finished.	single panel		2.89	2.49

* panel made with mortar lightened with sand and expanded clay
 ** value obtained with the Vetroarredo calculation method

Notes:

Tests performed and certified by the Istituto Giordano s.p.a. of Bellaria (RN) according to the following standards:

- ASTM C236
- DIN 52619
- Tests performed on panels.



Vertical structures

Features and performance

Sound insulation

Features such as mass and the internal air space guarantee that Vetroarredo glass blocks offer a high level of sound insulation, even superior to that of brick walls of identical thickness.

This makes Vetroarredo glass blocks the preferred material even in very noisy environments (discos, manufacturing facilities, etc.) because they can combine optimum insulation with creativity and aesthetics.

The parameter that measures acoustic insulation is the sound insulating power.



Testing method

The test was performed by evaluating noise damping achieved by a vertical panel of Vetroarredo glass dividing the testing area into two chambers, the emitting chamber (that contains the noise sources) and the receiving chamber (containing the instrument for measuring the noise that crossed the wall).

dimensions (cm)	Test specimen	Certified sound insulation power dB at 500 Hz	
		According to the UNI standard	According to the ISO standard
19x19x8	single panel	40.5	40.0
	single panel*	40.0	40.0
24x24x8	single panel	40.5	40.0
	single panel	40.5	45.0

* panel made with mortar lightened with sand and expanded clay

Notes:

- Tests performed and certified by the Istituto Giordano s.p.a. of Bellaria (RN) according to the following standards:
- UNI 8270 - Part III "Acoustics - Measurement of acoustic insulation in buildings and elements of buildings - Laboratory measurement of the sound insulation power of elements of buildings".
- UNI 8270 - Part VII "Acoustics - Evaluation of acoustic performance levels of buildings and components of buildings".
- ISO 140/III - 1978 "Acoustics - Measurement of sound in building and of building elements - part III: laboratory measurements of airborne sound insulation of building elements".
- ISO 717/3 - 1982 "Acoustics - Rating of sound insulation in buildings and of building elements - Part 3: airborne sound insulation of facade elements and facades".
- Tests performed on panels.



Fire resistance and reaction

Reaction to fire is the degree to which a combustible material reacts to fire. Materials are divided into six classes from incombustible to highly flammable materials. Glass products are made of minerals and belong to class 0 that is, incombustible materials. The purpose of the tests is to verify the panel's stability, its tightness and its thermal insulation.* Considering that glass, by its nature, tends to break quickly when subjected to thermal shock, Vetroarredo structures offer a good level of safety. They constitute an effective fire barrier. Each Vetroarredo glass block undergoes strict quality controls that raise their average resistance standard.

* Defined by D.M. 30/11/1983, item 1.11.



Testing method

The test was performed on vertically mounted panels subjected to burner flames according to a specific heating curve.

dimensions (cm)	test specimen	certified fire resistance class (minutes)				
		REI*	RE*	coupe-feu de degré **	pare-flammes de degré**	G***
19x19x8	single panel	15	60	15	90	60
	double panel	30	120			
24x24x8	single panel	15	60	15	60	60
	double panel	30	120			
30x30x10	single panel			15	30	
19x19x10 (1910 C 60)	double panel	60	60			

* Italian regulations

- R: Stability = structure's mechanical resistance to flame.
- E: Integrity = structure's ability to seal off gas and vapours
- I: Thermal insulation = Structure's ability to limit heat transmission.

The data shown are the results of tests performed at the Istituto Giordano S.p.A. of Bellaria (RN) according to the provisions of Circular 91 of the Italian Ministry of the Interior, Directorate General of fire prevention services of 14/09/1961.

** French regulations

The data refer to the tests performed at the "Station d'Essais Centre Technique Industriel de la Construction Metallique" of Maizières lés Metz according to the provisions of the Ordinance of 21/04/1983 of the French Ministry of the Interior.

*** German regulations

- G: Mechanical resistance of the structure to flame and its ability to seal off gas and vapours. The data shown are the results of the tests carried out at the Istituto Giordano S.p.A. of Bellaria (RN) according to DIN standards.

• Also according to the European standard pr EN 1363-1 1999 and pr EN 1364-1 1999.

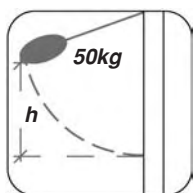
Notes:

- Tests performed on panels. For the right way of installation, see the test report or contact the Vetroarredo technical department.



Resistance to soft body impact

The stability and the resistance of the Vetroarredo panel are guaranteed by the thickness of its faces, by the annealing treatment and by the precision of the welding process. These features guarantee an impact strength value that assures a safety level higher than that provided for in the relevant regulations.



Testing method

The soft body impact test is carried out by subjecting a Vetroarredo glass panel to a series of three soft body impacts, with swinging movement and without initial speed, from the relevant specific heights. At the end of each impact the soft body was prevented to fall again on the panel and the possible damages caused by the impact have been taken into consideration.

Internal wall - Test results

h: falling height (mm)	impact (n.)	instantaneous camper (mm)	residual camper (mm)	notes
50	1	0.351	0.005	At the end of the test the following elements have been verified: - no clearances were present between the different elements of the test specimen; - no fragments or shivers were present; - no alterations were presents between the perimeter joints and the different elements of the test specimen; - the verticality of the test specimen was unchanged; - the aesthetics of the face opposed to the tested one was unchanged.
	2	0.096		
	3	0.035		
100	1	0.318	0.150	
	2	0.084		
	3	0.027		
150	1	0.302	0.149	
	2	0.005		
	3	0.102		
200	1	0.345	0.124	
	2	0.076		
	3	0.018		
250	1	0.361	0.157	
	2	0.077		
	3	0.092		
300	1	0.174	0.075	
	2	0.089		
	3	0.065		

External glass dividers - Test results

Resistance of the panel to an impact of 1000 J on the glass divider

The Vetroarredo wall has obtained better results than those required in the standards: no breakages and/or no damages to its functionality

Notes:

Tests performed and certified by the Istituto Giordano S.p.A. of Bellaria (RN) according to the following standards:

- Resistance to soft body impact of internal wall according to the UNI 8210 standard of June 1981.
- Provisions of the "Common Directives for the technical agreement on windows" of the UEAtc, paragraph 3.3.4.1 "Soft body impact".
- Tests performed on panels.



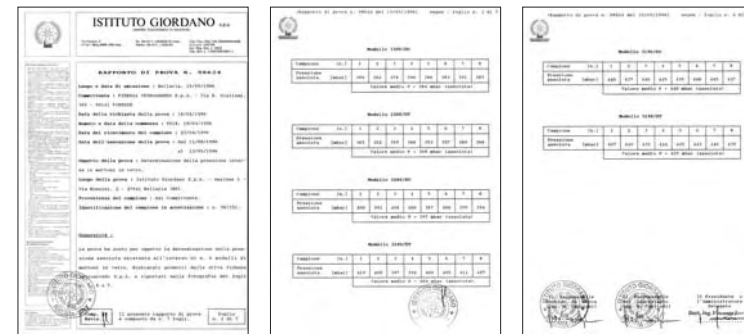
Internal pressure

The pressure inside Vetroarredo glass blocks is lower than the atmospheric pressure ($\approx 1020^{+10}$ mbar). Therefore, in the event of breakage, the glass fragments tend to converge towards the inside (implosion) of the glass blocks instead of being projected outwards (explosion). This is a very important feature when it comes to limiting damages and injuries.

dimensions (cm)	glass designs	certified average absolute pressure (mbar)
19x19x8	O	≈ 440
	T	≈ 437
24x24x8	O	≈ 397
	T	≈ 404
30x30x10	O	≈ 384
	T	≈ 359

Notes:
 Absolute pressure levels inside the air space of glass blocks have been measured and certified at the Istituto Giordano S.p.A. of Bellaria (RN):
 • Test performed on individual glass blocks, not on structures.

Legend for glass designs
 O = Wavy
 T = Smooth



This part of the guide is addressed to people designing or installing structures with Vetroarredo glass blocks. By following the instructions and the right sequence during the installation phase it will be possible to install glass block structures in a simple and rapid way and to obtain structures with nearly any dimensions.

The installation system is suitable for structures constructed on site as well as for prefabricated structures.

When designing with glass blocks it is important to bear in mind the features of the three materials composing them: steel, cement and glass, in order to prevent any problems arising from an incorrect use of these elements.

It is well known that glass passes from the elastic phase to breaking without the intermediate plastic phase typical of other construction materials.

Glass lacks therefore the characteristic that, in steel and reinforced concrete structures, makes it possible to distribute loads and stresses over elements less subject to fatigue. It is therefore important to avoid any load and external restraint conditions that would concentrate stresses on glass blocks structures.

For this reason it is advisable to design isostatic structures when working with Vetroarredo glass blocks.

A design with glass blocks that calls for hyperstatic connection with other (more rigid and solid) structures would subject the structure to critical stresses.

Moreover, when the dilatation due to temperature rises is prevented, this would generate a stress that could lead to breakage.

Experience acquired by specialised builders recommends structures that are free to deform and expand, so that the expansions and deformations of the various parts (glass block structures and bearing structures) are independent.

During design and construction it is also important to remember that glass blocks must never be in direct contact with the metal sections or reinforcement bars that are needed for assembly.

Basic elements for calculating and verifying glass block structures

Physical and mechanical properties of glass

Modulus of elasticity: $\approx 760.000 \text{ kg/cm}^2$

Poisson's coefficient: ≈ 0.20

Density / specific weight: $\approx 2.5 \text{ g/cm}^3$ (2500 kg/m³)

Hardness (Mohs scale): ≈ 6.0

Linear expansion (between -20 and +50°C): $\approx 0.000007 \text{ cm/cm}^\circ\text{C}$

Source: Enrico Brusa, Progettazione del Vetrocemento. Fidenza S.A. Vetraria Editrice, Milan, 1967. Average values in relation to glass for diffusers manufactured with reverberatory furnaces.

Vetroarredo glass blocks, manufactured with clear sodium lime glass or coloured in paste, are annealed and do not contain harmful substances.

Vetroarredo glass block structures cannot have load-bearing functions, but they should only be used as curtains or dividers. Indoors as well as outdoors there are two main fields of design applications:

- Vertical linear walls.
- Vertical curved walls.

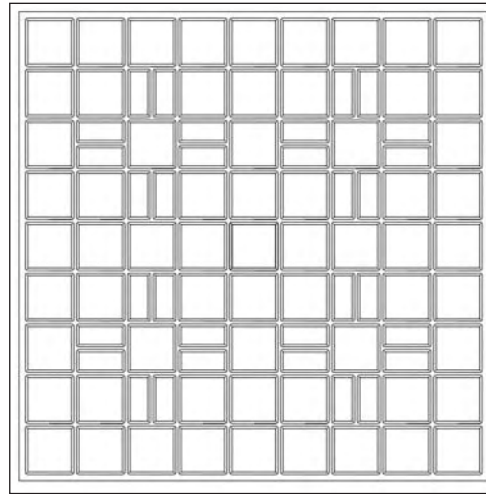
These structures are considered self-supporting and therefore do not play any structural role, since they are only capable of safely sustaining their own weight together with the horizontal load generated by the wind and any perpendicular impact.

Combination of different sizes

If the design requires glass blocks of different sizes and shapes, we recommend a composition (19x19x8 cm with 19x9.4x8 cm or 24x24x8 cm with 24x11.5x8 cm) that will permit the use of both vertical and/or horizontal steel reinforcement bars.

For combining different element a 10 mm joint is to be guaranteed when 24x24x8 and 24x11.5x8 cm Vetroarredo glass blocks are used.

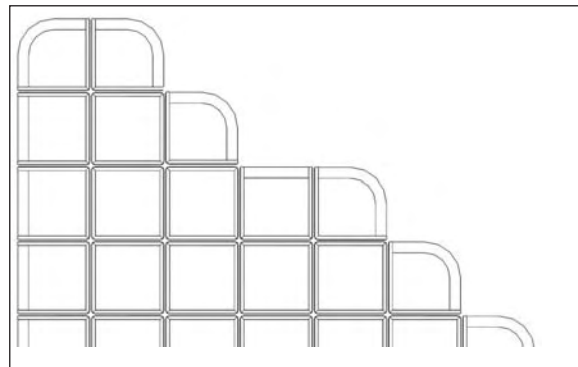
The triangular glass blocks create design options using the 45° angle to be combined with different glass elements.



Possible combination with 2 mm joints.

End glass blocks allow the construction of full glass flag walls. Linear end glass blocks can be used horizontally as well as vertically, the curved ones allow finishing the junction between the horizontal and the vertical end glass blocks.

The two models combine with 19x19x8 cm and 19x9.4x8 cm glass elements.



Possible combination with all joints (2 mm, 5 mm, 10 mm, 16 mm).

Linear walls

Calculating the dimensions and the required number of glass blocks

Vetroarredo supplies plastic spacers that facilitate installation and allow the creation of 2* mm, 5* mm, 10 mm and 16 mm joints between the glass blocks; 16 mm joints are suitable for the installation of openable frames and of larger size *Vetroarredo* glass blocks.

* Possible joints with pegasus

$$L = (n \times Lo) + [gv \times (n-1)] + 2fl$$

$$H = (m \times Lv) + [go \times (m-1)] + (fs + fi)$$

$$n = (gv + L - 2fi) / (Lo + gv)$$

$$m = (go + H - 2fi) / (Lv + go)$$

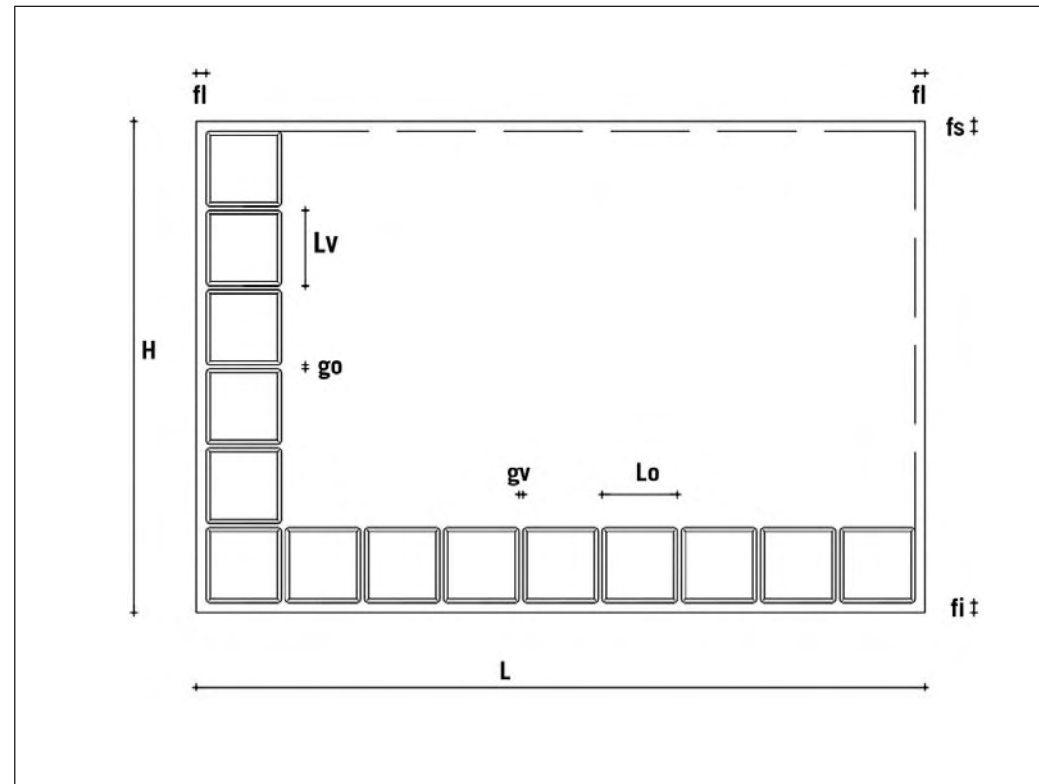
Where:

n = number of horizontal glass blocks
 m = number of vertical glass blocks
 Lo = length (cm) of the glass blocks
 Lv = height (cm) of the glass blocks
 fl = size of the lateral band (cm) - minimum value 1.5 cm
 fi = size of the lower band (cm) - minimum value 1.5 cm
 fs = size of the upper band (cm) - minimum value 1.5 cm
 go = horizontal internal joint (cm)
 gv = vertical internal joint (cm)

In the formula fl and fi values amount to 1.5 cm

As concerns the result of the formula it is necessary to take into consideration only the entire number.

The exceeding fraction will be counted as an integrating part of bands.



Dimensional limits

When constructing large walls, with 2 mm, 5 mm, 10 mm and 16 mm joints, it is recommended to divide the wall into sections not larger than 15 m².

For larger surfaces specific structural calculations are needed.

For this division the designer shall place between the panels an expansion and settling joint measuring about 1 cm and made of rot-proof material.

Curved walls

Calculating the dimensions and the required number of glass blocks

The following formulas allow determining the size of the external joint in relation to the curvature radius and to the specific Vetroarredo glass blocks, and the number of glass blocks to be used in relation to the circumference.

$$E = [(Lo + gv) \times (1 + s/r)] - Lo$$

$$Np = r \times \pi \times a / [180 / (Lo + go)]$$

Where:

E = size of the external vertical joint (cm)

Np = number of Vetroarredo pieces

Lo = length of the glass blocks (cm)

gv = size of the internal vertical joint (cm)

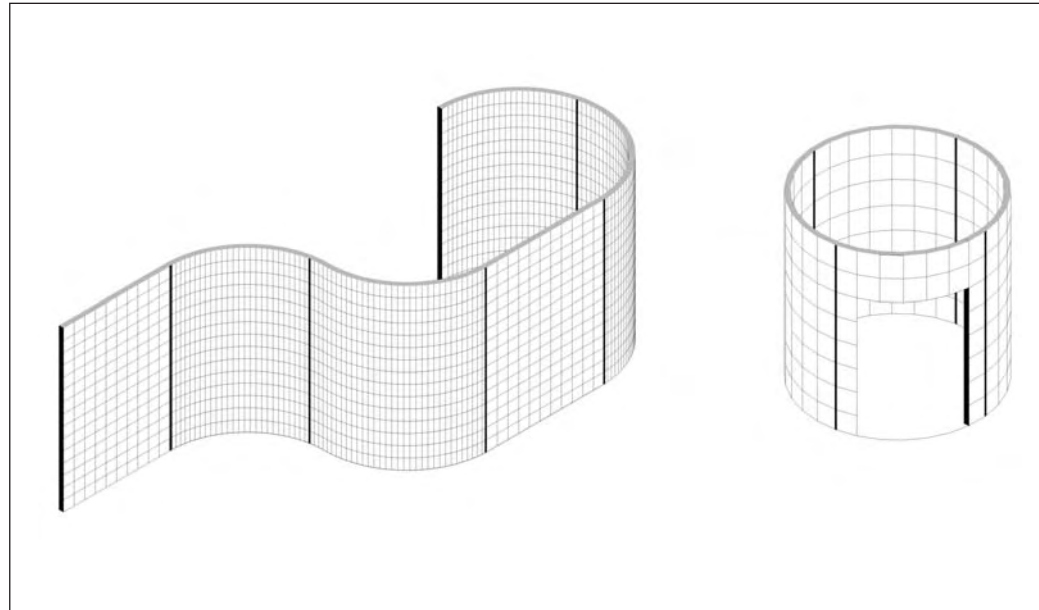
r = internal curvature radius (cm)

s = lateral thickness of glass blocks (cm)

a = angle between the development radius of the curve

$\pi = 3.14$

go = horizontal internal joint (cm)



Dimensional limits

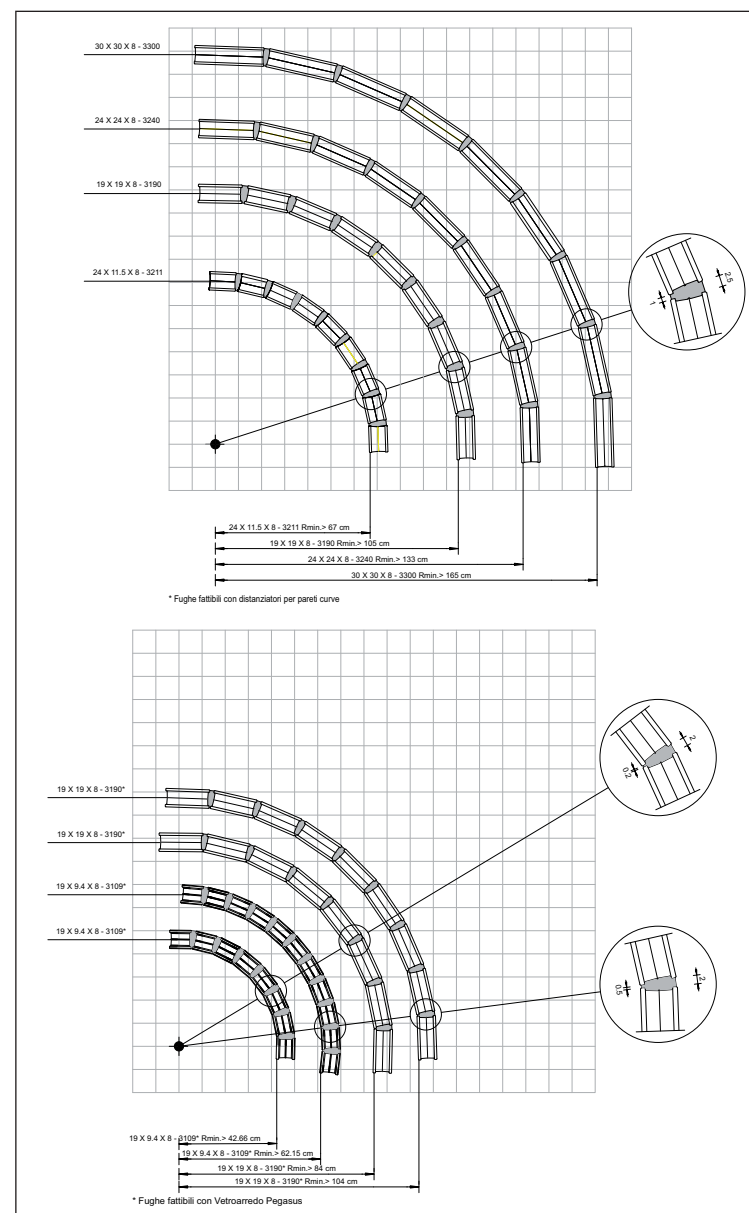
For curved walls, we recommend the size limits as indicated for linear vertical walls. The geometrical structure of these walls, in any case, gives them greater stability against horizontal loads. In curved walls, the internal vertical joint is different from the external one.

Curved walls

Dimensional relationships between internal radiuses of curvature

Dimensions of glass elements and vertical joints

gv - sizes of vertical and horizontal internal joints, and of horizontal external joints (cm)	E - size of vertical external joints (cm)	s - lateral thickness of glass blocks (cm)					
		8					
		Lo - length of glass elements (cm)					
		9,4	11,5	19	24	30	19
		R - internal radius of curvature (cm)					
0.2*	1.5			118			
	2			85			
0.5*	1.5			156			
	2			104			
1	1.5	160	200	320	400	496	200
	2	80	100	160	200	248	100
	2.5	53	67	105	133	165	67
1.6	2	212	262	412	512	632	257.5
	2.5	94	116.5	183.5	227.5	281	114.5
	3	60.5	75	117.5	146	180.5	73.5



* Only with Pegasus version

Calculating the weight per m² of a Vetroarredo structure

$$\begin{aligned} \text{Weight} &= /PV + PC + PA) (L \times H) \times 10000 \\ PV &= RV \times n \times m \\ PC &= RC \times s \times L \times H - (m \times L_o \times n \times L_v)] \\ PA &= RA \times [(m + 1) \times L (n - 1) \times H] \end{aligned}$$

Where:

PV = weight of glass elements (kg)
 PC = weight of cement mortar (kg)
 PA = weight of steel reinforcing bars (kg)
 RV = average unit weight of glass elements (kg)
 RC = Specific weight of mortar (kg/cm)
 RA = linear density of the steel /kg/cm
 s = lateral thickness of glass elements (cm)
 n = number of horizontal glass blocks
 m = number of vertical glass blocks

dimensions (cm)	Average unit weight (kg)	Approximate weight of the structure (kg/m ²)				Number of pieces per m ²			
		2 mm* joints	5 mm* joints	10 mm joints	16 mm joints	2 mm* joints	5 mm* joints	10 mm joints	16 mm joints
19x19x8	2.3	≈ 78	≈ 80	≈ 78	≈ 82	≈ 27	≈ 26	25	≈ 23
19x9,4x8	1.3	≈ 92	≈ 94	≈ 92	≈ 96	≈ 54	≈ 51	50	≈ 46
24x24x8	4.1			≈ 81	≈ 84			16	≈ 16
24x11.5x8	2.2			≈ 92	≈ 95			32	≈ 31
30x30x10	4.7			≈ 82	≈ 84			≈ 11	≈ 11
19x19x5	2.1			≈ 65				25	
19x19x5 (1910 c. 60)	4.0				≈ 121				≈ 23

* only with Pegasus version

Installation with the traditional system (cement mortar)

Anchor sections

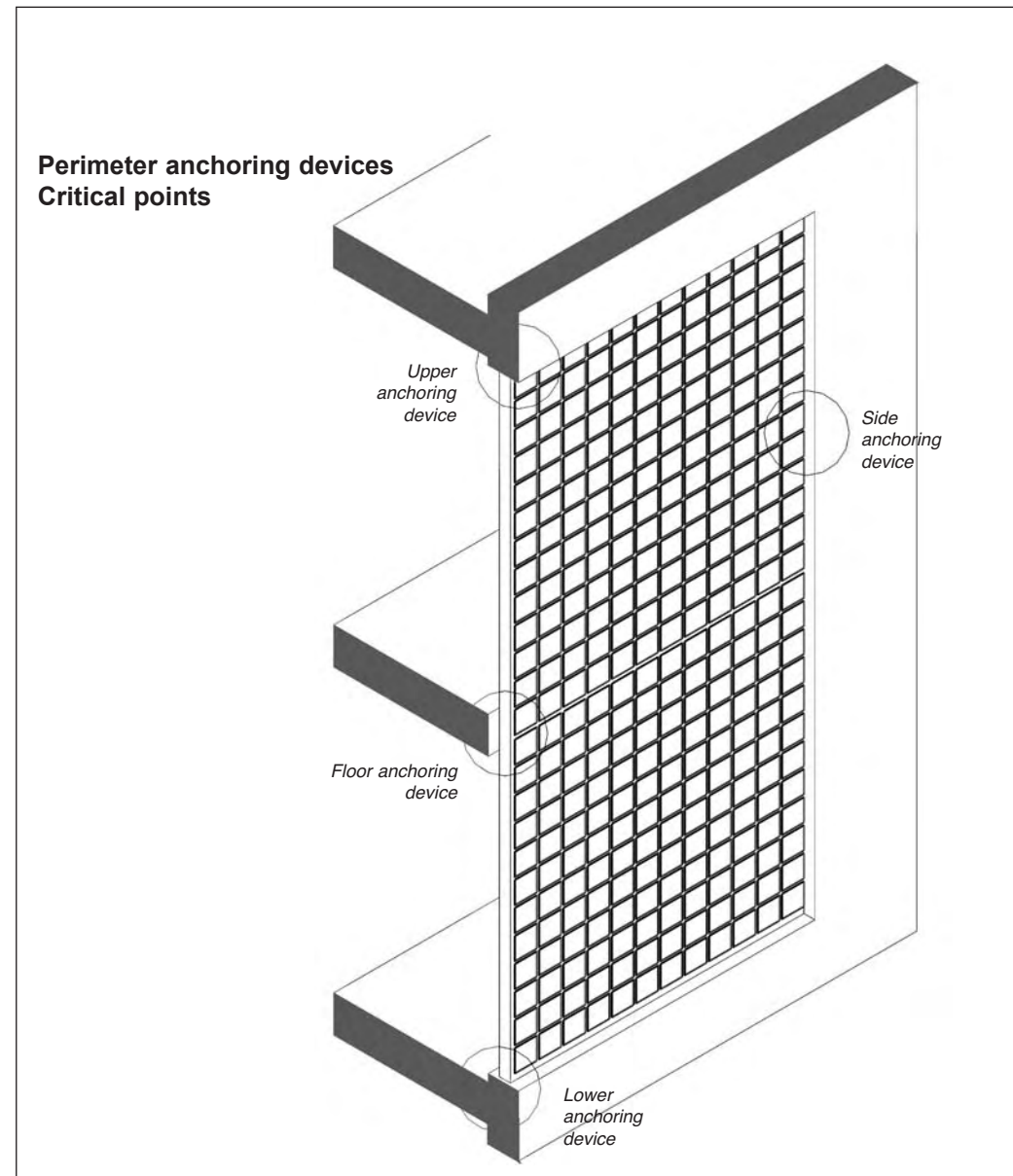
When designing Vetroarredo walls it is always important to provide adequate perimeter supports for the stability of the wall.

It is fundamental to allow for both settling and expansion, by providing a 6 mm expansion area with the Vetroarredo expansion joint.

Vertical and horizontal load-bearing structures that support Vetroarredo walls must feature the suitable dimensions.

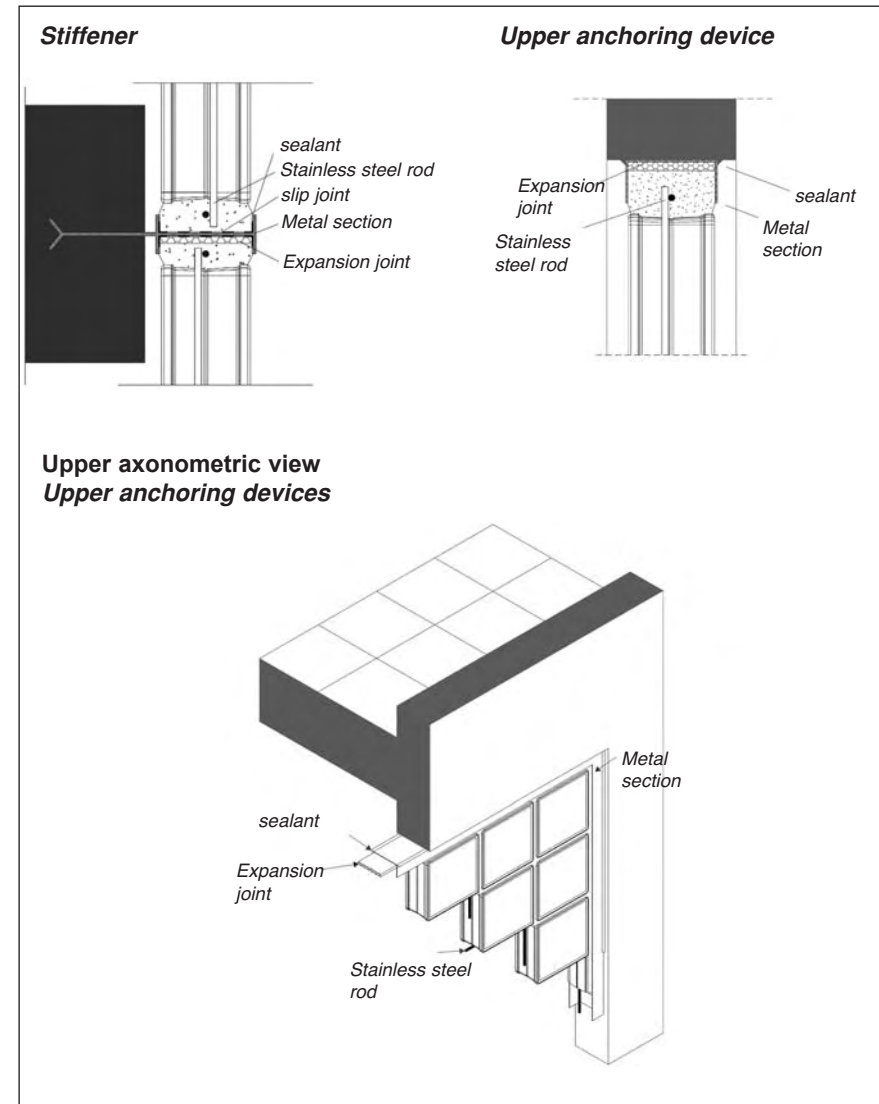
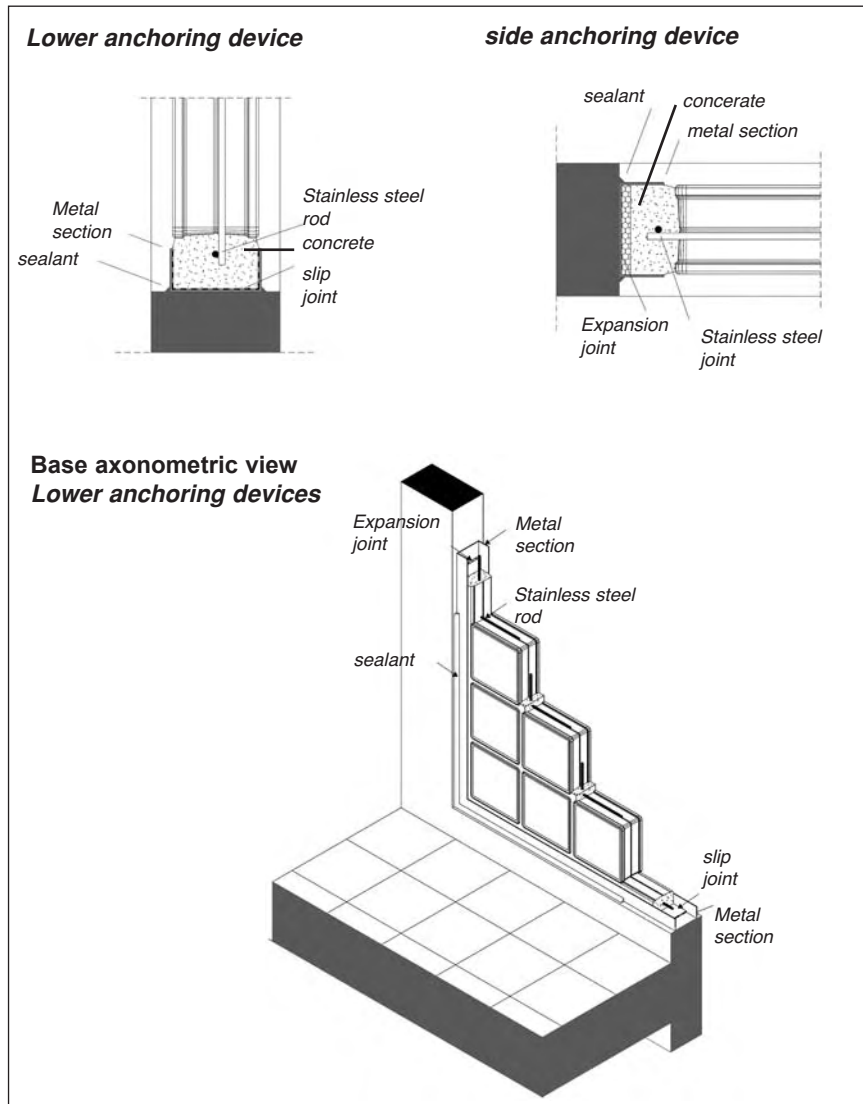
As shown in the examples below there are two types of anchoring methods:

- Continuous restraint (page 23) along the entire vertical edge of the Vetroarredo structure, obtained by using metal sections or “U” section channels. The internal size between the flanges of the profiles or of the channels must be even and higher than the thickness of Vetroarredo glass blocks, in order to facilitate sliding movements. In order to avoid friction with the surface, we recommend to provide for a slip joint at the base of the wall.
- Dowel restraint (page 24) obtained by extending the reinforcement bars, which are used in all horizontal joints, into holes in the adjacent load-bearing vertical structures. The diameter and the depth of these holes must lightly exceed the bars in order to allow a slip joint or sliding connection.



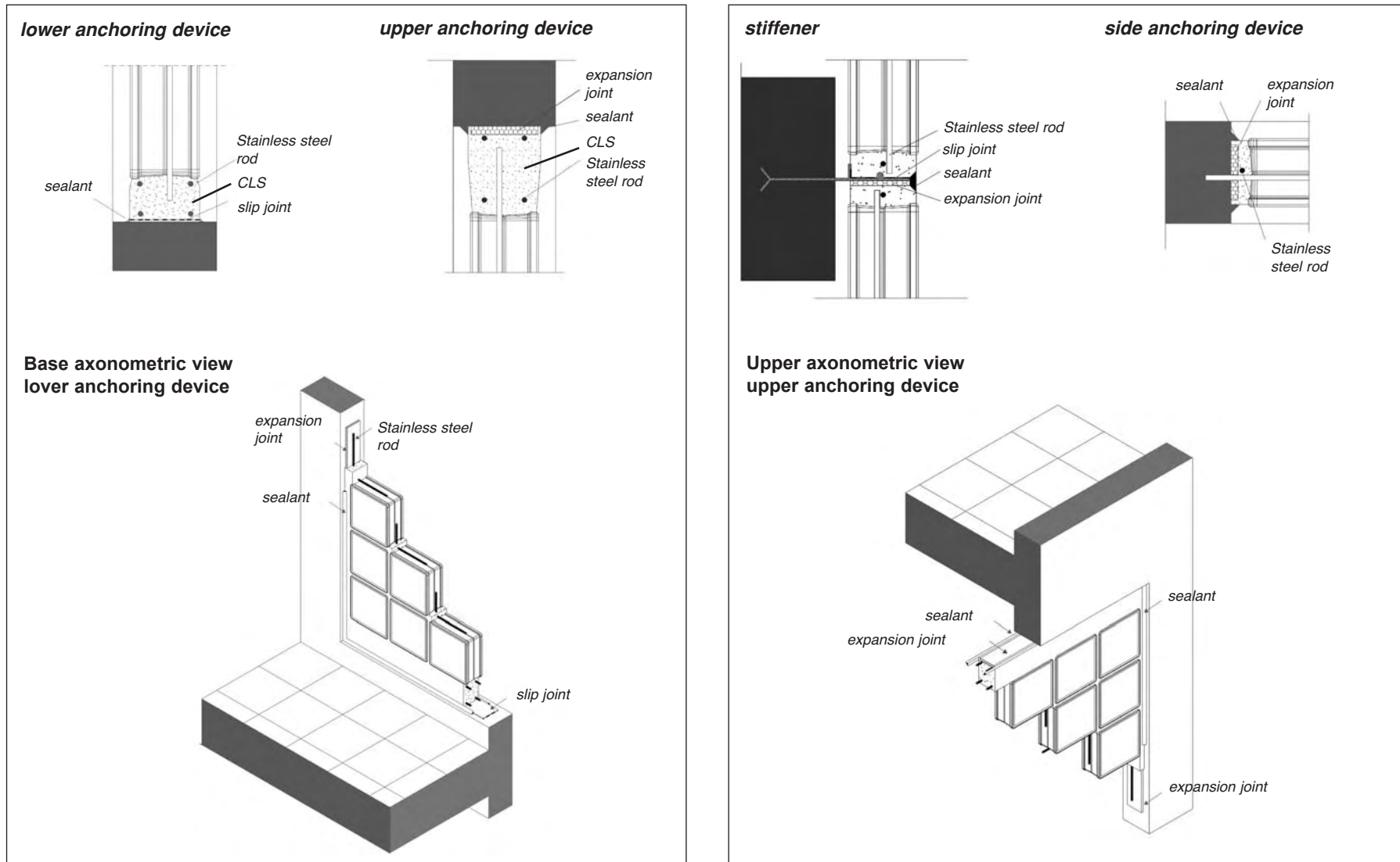
Installation with the traditional system (cement mortar)

Continuous restraint with metal section



Installation with the traditional system (cement mortar)

Dowel restraint with cement



Vetroarredo wall interruption

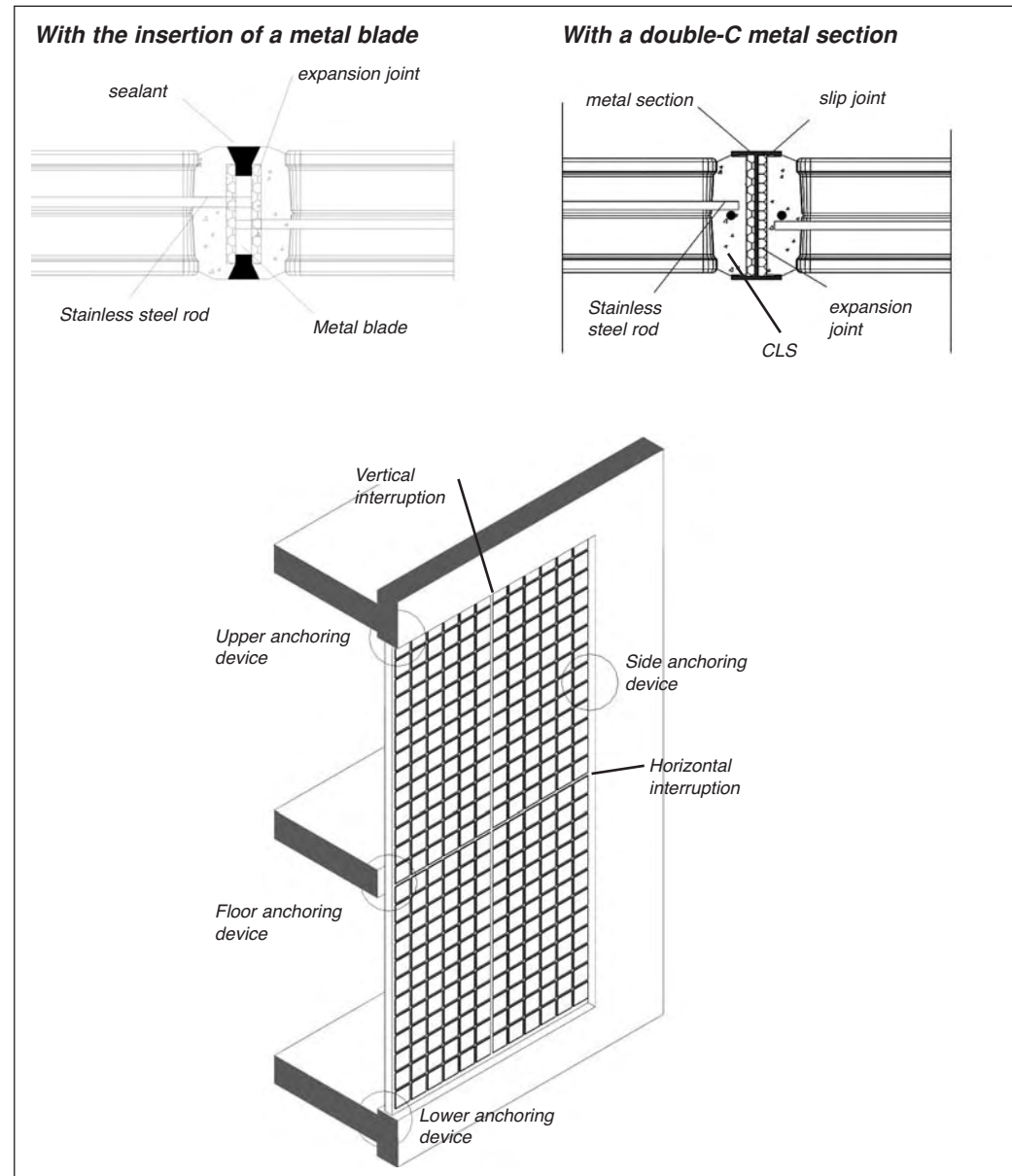
Where structural needs require the division of the wall into smaller panels, it is advisable to insert between the panels an expansion/slip joint where the structural continuity of the panel is interrupted.

Vertical interruption

The insertion of metal joints with blade or profile metal joints allows the interruption of a vertical wall and guarantees an optimum expansion and slip tolerance.

Horizontal interruption

When the panel is to be horizontally interrupted with a joint, an anchoring device to the bearing structure of the building shall be provided for.



Angles and intersecting walls

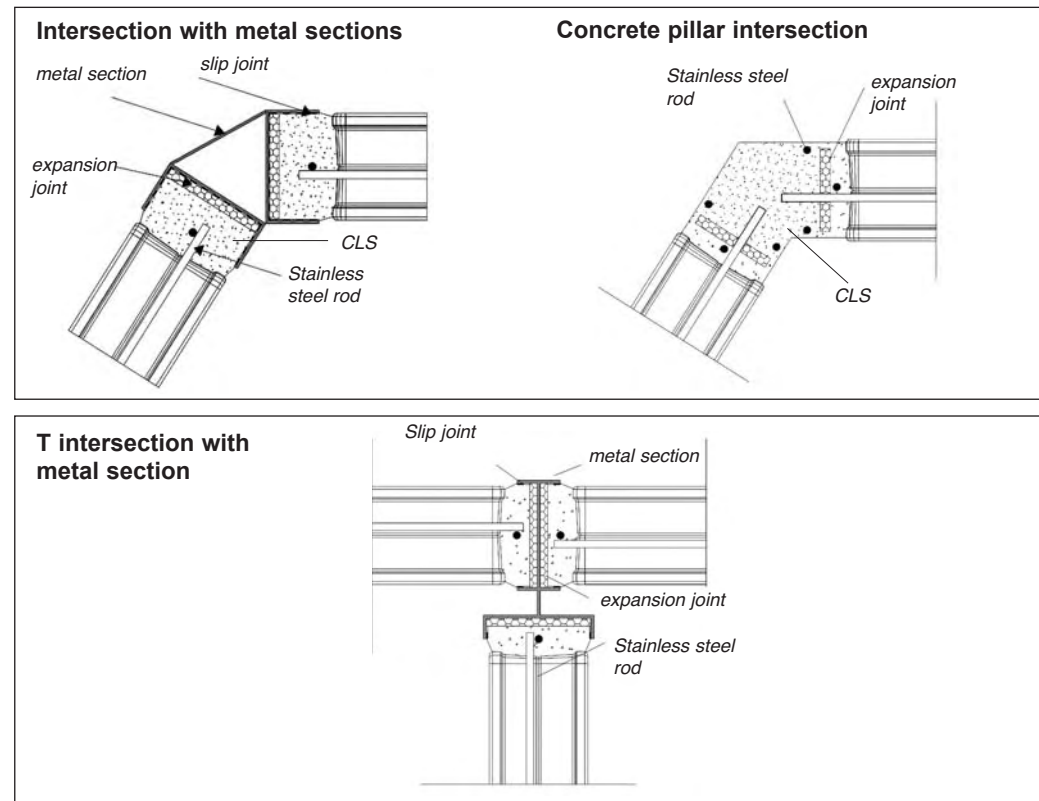
With glass blocks

Corner Vetroarredo glass blocks can be used to create 90° angles.

In concrete with metallic profiles

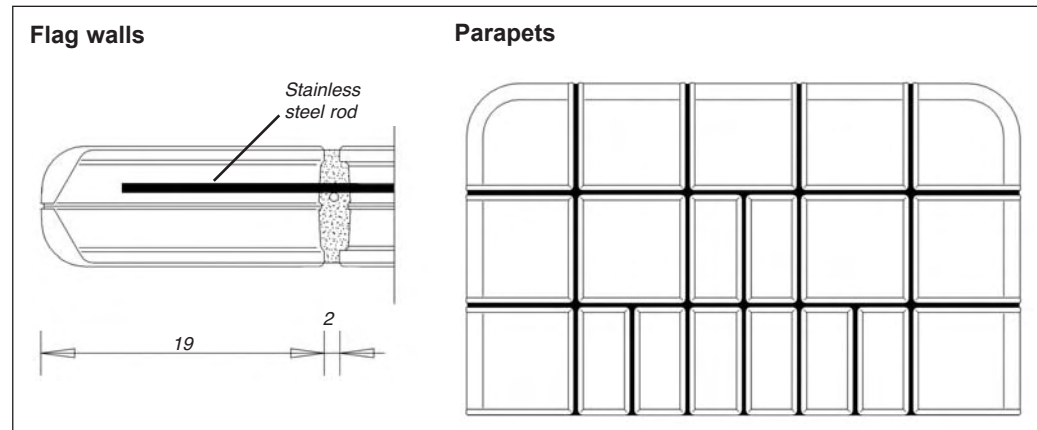
For angles different from 90°, Vetroarredo walls can intersect with the help of metal sections or with reinforced concrete or tile pillars where to anchor glass block walls.

The “T” intersection between Vetroarredo walls can be done with the suitable metal sections.



Flag walls and parapets

Thanks to the Vetroarredo end glass blocks it is possible to install wing walls with the end part in glass; in the same way they allow the installation of parapets.

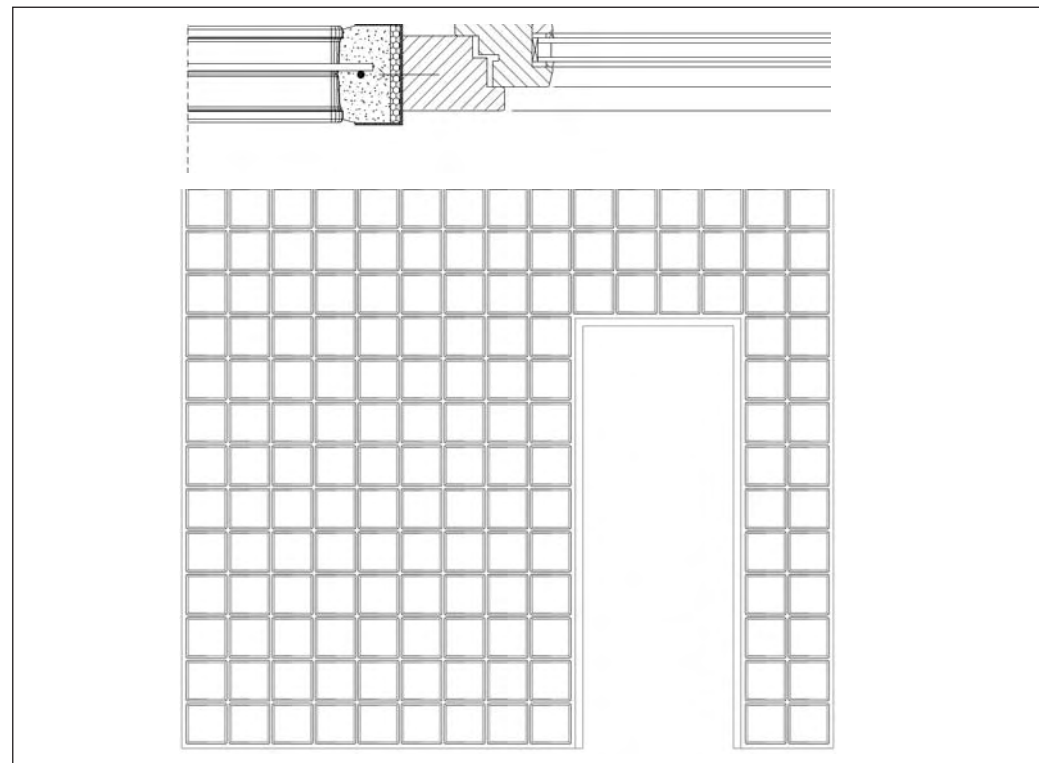


Fitting doors and windows – shower box doors

To fit doors and windows into a glass block wall you must create an opening with a frame made of metal U-sections. You must position the frame, using temporary supports, before the Vetroarredo structure. Install the glass blocks making sure to leave a minimum of 1 cm space between the frame and the blocks positioned along its perimeter.

In order to prevent damage to the glass blocks that may be caused by slamming the door or window, make sure to cover the inside of the metal sections with rubber or similar material. Heavy door leaves or windows should be equipped with appropriate “braking” systems and the weight of the door shall not bear on the glass wall.

The metal sections can serve as supports for the fixed door or window frame or for subframe.

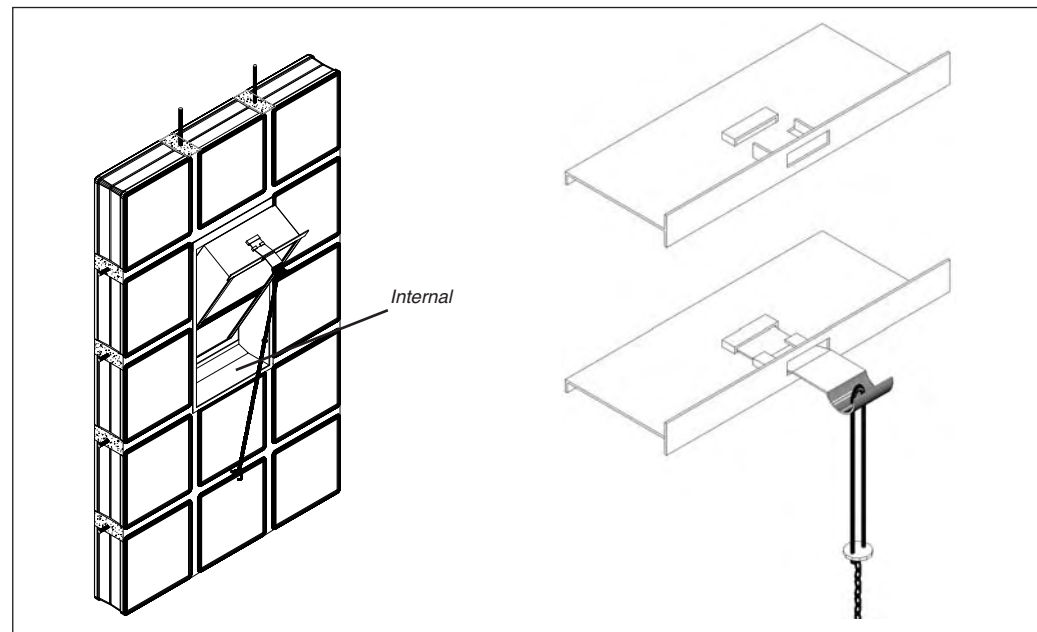
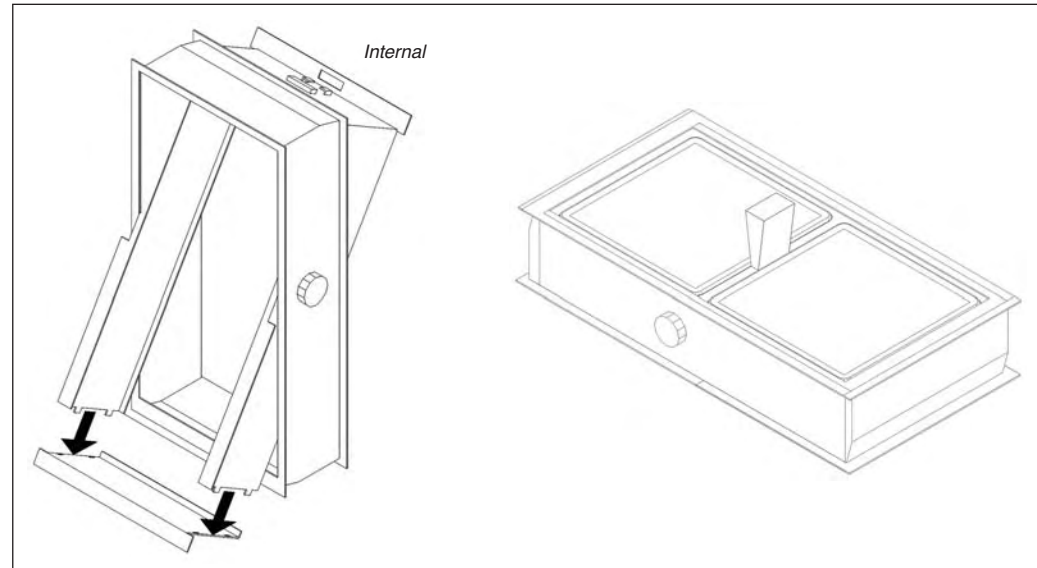


Fitting openable frames

Openable frames, designed for allowing ventilation, can hold one, two or four glass blocks (19x19x8 or 24x24x8 cm). They swing open horizontally and glass blocks are installed in *Vetroarredo* walls with joints not smaller than 16 mm.

- Place the glass blocks in the frame; for frames that hold only one or two blocks, remove the lower side of the openable part.
- Place the frame on a smooth surface and fill the joints with cement mortar; use wooden wedges as spacers.

- Attach the handle by raising the metal strips located on the side of the openable part of the frame.
- Insert the handle before the frame is installed in order to prevent it from shifting out of position and from opening.
- When the mortar has hardened, install the frames as you build up the wall.
- Insert the openable frame with the horizontal swing opening and the handle at the top in order to prevent water infiltrations.



Installation materials

Cement mortar

For vertical walls use preferably Vetromalta; this is a pre-mixed binder, in white or grey colours, with a yield of about 25kg/m² (including finishing).

This product is suitable for the installation as well as for the finishing of Vetroarredo structures.

As an alternative to Vetromalta, you can use cement mortar consisting of the traditional mixture of Portland type or similar cement, class 32.5.

Make the mortar with 350 kg of binder for each cubic meter of sand (washed, mineral sand, assorted granulometry, maximum size 3 mm), add clean water until a plastic-like consistency is obtained.

The mortar should have good mechanical strength and at the same time be easy to work in order to completely and properly fill narrow spaces.

Furthermore, it must be water-proof and shrink minimally during setting.

Excessive shrinkage creates stresses which are harmful to glass blocks and can cause cracks in the mortar itself to the detriment of water-proofing features.

The white paint on the sides of the blocks makes it possible to use any colour mortar without affecting the luminosity of the glass.

This paint coat also improves the mortar's adherence to the edges of the blocks.

Technical data of Vetromalta

Appearance: powder

Colour: white/grey

Specific weight: 1.55 kg/l

Water for mixture: 22-24%

Mixture pH: 12.8

Allowed application temperature: +5°C to +35°C

Working temperature: +30°C to +90°C

Lifespan of the mixture: 2 hours from the preparation

Allowed thickness: 2 mm to 25 mm

Harmfulness: EEC 88/379 NO

Flammability: NO

Compressive strength after 28 days: 19.5 N/mm²

Flexural strength after 28 days: 7.5 N/mm²

Yield: about 25 kg/m² for the installation and filling of the glass block

Data taken at 23°C, relative humidity 50%, without wind

For further information contact the Vetroarredo Technical Assistance Service

Steel reinforcements

We recommend using stainless steel bars (available from Vetroarredo) or hot-galvanized or specially treated oxidation-proof steel bars.

The size of the rods varies according to the designer's calculations and the need for endowing the structure with sufficient structural strength. Furthermore, the rods must not touch the glass. With regard to the joints, we recommend the following rod diameters:

- For 2 and 5 mm joints (only Pegasus version), or 10 mm joints: maximum diameter = 6 mm
- For 16 mm joints: maximum diameter = 8 mm.

Joint finishes

The most common methods for grouting include:

- White and grey Vetromalta that can be coloured with the normal oxides present on the market;
- Cement mortar with fine screened sand for grey joints;
- White cement mortar with marble powder for white joints;
- Cement mortar with fine sand and oxides for coloured joints.

The finishing mortar should not contain aggregates that could scratch the glass.

If you use pre-mixed mortar, make sure that they do not contain additives that could make it difficult to clean the Vetroarredo glass blocks, especially satin-finished surfaces.

To fill joints, you must use mortar with a compressive strength that does not exceed that of the mortars used for installing the glass blocks.

Protective treatments and sealants

After you have completed the installation, you can add protective treatments on the joints to prevent water infiltration.

This is indispensable for Vetroarredo structures exposed to rain and for shower stalls.

The treatment usually consists of one or more layers of transparent water-proofing protective material.

We recommend that you apply a sealant around the perimeter of the structure to prevent the joints from cracking where in contact with other structures.

Slip and expansion/settling joints

It is necessary to place suitable materials laterally and upper that can absorb any settling of the structure, such as the Vetroarredo expansion joint that is adhesive on one side in order to guarantee an easy application on the structure, this is 6 mm thick.

At the base a slip joint shall be placed in order that the wall does not belong to the same structure of the building.

Spacers

In order to make installation faster and easier, Vetroarredo offers a full range of plastic spacers for linear or curved walls.

These accessories make it possible to make even joints and reduce the risk of contact between the reinforcement bars and the sides of the Vetroarredo glass blocks.

Spacers are differentiated in relation to the size of the joints, the thickness of the glass blocks and the type of wall (linear or curved).

The range of spacers consists of:

- Spacer for 2 mm joints (only Pegasus version) and 8 cm thick glass blocks;
- Spacer for 5 mm joints (only Pegasus version) and 8 cm thick glass blocks;
- Spacer for 10 mm joints and 8 cm thick glass blocks;
- Spacer for 10 mm joints and 30x30x10 cm glass blocks;
- Spacer for 10 mm joints and 5 cm thick glass blocks;
- Spacer for 16 mm joints and 8 cm thick glass blocks and for openable frames;
- Spacer for curved walls and 8 cm thick glass blocks;
- Spacing tile / caisson floor for 1 cm joints.

Quick method for calculating the number of spacers

Use the following formula to calculate the number of spacers needed for your specific installation:

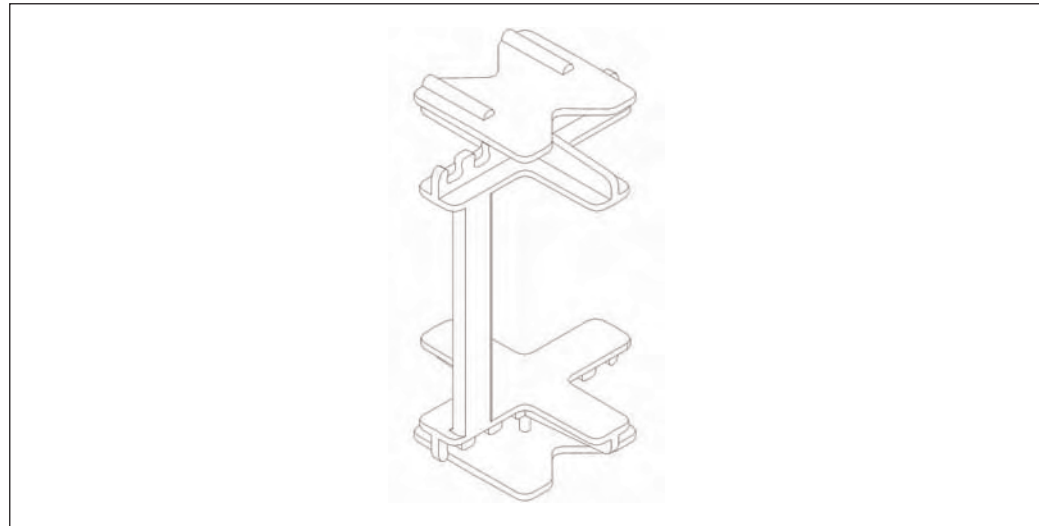
$$D = (n + 1) \times (m + 1)$$

Where:

D = number of spacers

n = number of horizontal glass elements

m = number of vertical glass elements



Installation

Installation consists of three phases:

- Preliminary phase
- Installation phase
- Finishing phase

The walls must lean against and be anchored to rigid, appropriately sized supporting structures, these must be rimmed with rot-proof material that is thick, dense and hard enough to absorb structural expansion, settling and slipping.

Preliminary phase

1.

Make sure that the supporting structures are vertical and horizontal.

Place two wooden strips horizontally on the surface where the wall will be built.

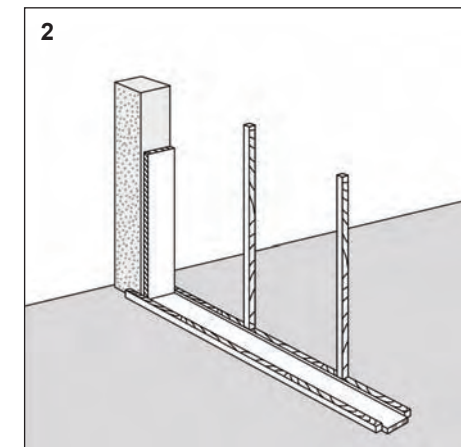
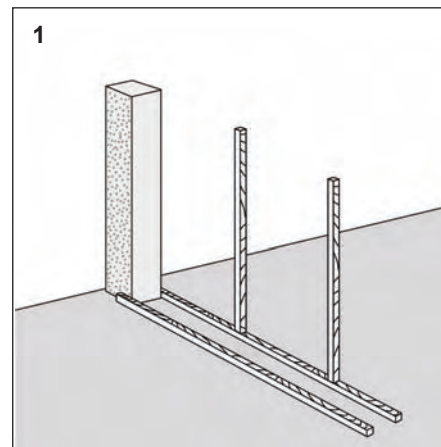
The strips must follow the wall, and the distance between them must be equal to the thickness of the glass blocks you will be using.

Arrange the vertical guides, they must be plumb, and 100/120 cm apart to assure that the wall itself will be perfectly plumb. The wall must be perfectly vertical both lengthwise and upwards in order to avoid eccentric loads.

2.

Place a slip joint into the horizontal strips to prevent expansion/friction between the base of the panel and the supporting surface.

Place the expansion/settling joints on the side and at the panel support points.



Installation (continues)

Installation phase

3.
Use a trowel long enough to allow you to work easily between the vertical reinforcement bars.

Apply cement mortar between the base strips, it must be at least 1,5 cm thick and proportionate to the height of the wall.

Position the first row of Vetroarredo glass blocks.

4.
Build the first course perfectly level.

Use the plastic spacers to make even joints.

Apply mortar to the vertical spaces between the glass blocks you have just laid, temporarily remove the spacers as you work and then replace them.

5.
Place the reinforcing rod on the central wing of the spacer to prevent it to touch the glass block side.

Apply the mortar without touching the spacer.

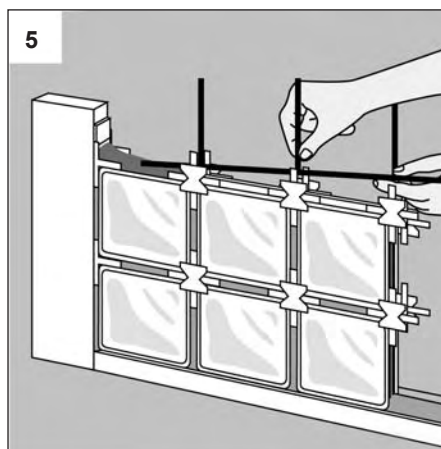
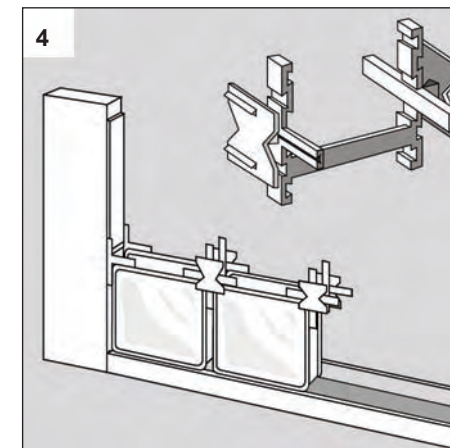
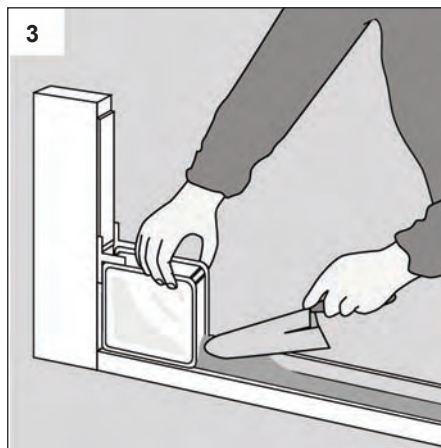
Make sure that each glass block is surrounded by well compacted and evenly distributed mortar on all sides and that the bearing structures do not touch them.

Insert the reinforcement bars, vertically and horizontally; the bars should not be more than 50 cm apart.

Use a piece of wood to remove excess mortar from the joints before it hardens; this is in preparation for the finishing phase.

Wipe the glass blocks with a wet sponge to remove any mortar residue.

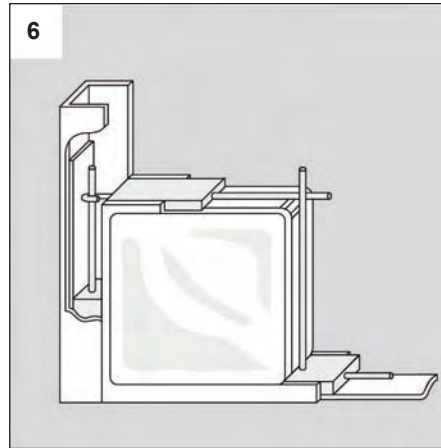
If the wall reaches to the ceiling, position the expansion/settling joint the same way you did on the sides.



Installation (continues)

6.

To guarantee stability for small and medium size walls, fix them to the adjacent supporting structures with the horizontal reinforcement bars inserted in the structures themselves. The diameter of the holes should be slightly bigger than that of the bars over a sufficient length so they also pass through the expansion/settling joint and they not tilt. For large walls it is better to use U-sections, which are plugged or cramped to the adjacent supporting structures. To prevent the metal from touching the glass, position the first row of glass blocks at least 10 mm from the wings of the section. When using U-sections, place the expansion/settling joint inside them.

**Finishing phase**

7.

Finish the joints only when the mortar is completely hardened.

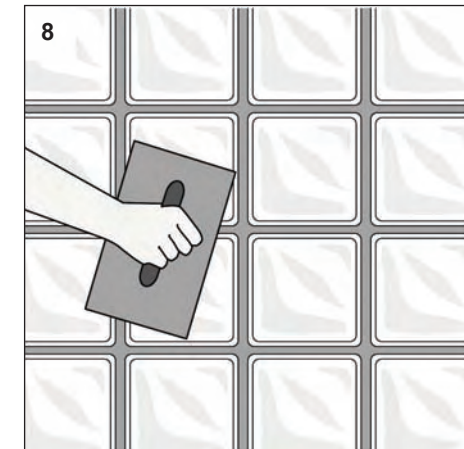
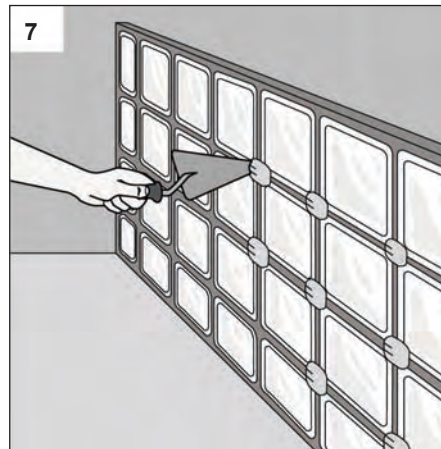
Remove the outer plates of the spacer using a tool that will not scratch the glass.

8.

Apply the finishing, fill the joints well; use soft brushes and plastering trowels.

Make a perimeter cordon, or part of the outside joint, using elastic sealant to prevent cracking along the expansion/settling joints.

If the walls are to be exposed to water, use a transparent protective paint along the joints to enhance their water-proof features.



Prefabrication

The methods, which are quite similar to those for horizontal installations, are fully described in the section entitled "Horizontal structures" Pages 58 and 59).

To position the vertical panels they must be equipped with suitable accessories (such as fasteners) which, when sunk into the glass block panel, make it possible to install and anchor it to the supporting structures.

It is important that all fastening systems allow for expansion and settling as well as the necessary stability.

Cleaning Vetroarredo structures

At the end of the installation activity follow these instructions for a suitable cleaning of the product:

- *Clean off the finishing mortar while it is still damp using wet soft sponges or white rags. Rinse them frequently in clean water.*
- *Remove mortar residue from the glass blocks when it is dry but not yet hardened.*

Work on one side at a time so that you do not wipe over still soft joints that you have just made.

Remove any rims or cement spots using diluted hydrochloric acid (such as muriatic acid, products that remove calcareous deposits or similar products) or acetic acid (such as white wine vinegar). Take care not to go over the joints and take the necessary safety precautions for using such substances. Do not use oily solvents, hydrofluoric acid or alkaline solutions (such as soda or similar substances).

If you use finishing mortar that contains additives, test it first on some spare glass blocks of the same type used to build the wall. Apply the product and clean the glass blocks according to the manufacturer's instructions.

Be particularly careful when you install satin-finished glass blocks. Remove the protective film from the blocks only when you are about to apply the filler. Remove any residue of the protective film adhesive with warm, slightly soapy water; for difficult residue use acetone or trichloroethylene and a non-abrasive sponge.

Horizontal structures

Horizontal structures are all those linear or curved structures, for indoor and outdoor applications. These structures can be built at the site or prefabricated. Take the following parameters into account when deciding on the type of installation:

- dimensions of the surface to be built
- weight of the Vetroarredo structure
- whether it will be indoors or outdoors
- the number and sequence of Vetroarredo installations
- complexity of the shape/geometry

Dimensions, designs, finishing types and accessories: also for horizontal structures Vetroarredo offer a wide range of different solutions for surfaces that are suitable for pedestrian traffic and at the same time guarantee the glass peculiar features, as well as safety and stability.

square

dimensions (cm)	glass design	colours	finishes
19x19x8	DS -DSC	clear	Transparent
	DA*		
19x19x7	MF		
20x20x2,2	PS		
14,5x14,5x5,5	F		
14,5x14,5x11	DSF		

* Upon request the 3190 DA model can also be satin-finished on 1 side

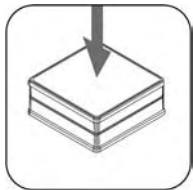
Accessories for installation

grids	20x20 cast iron
	15x15 cast iron
	19.5x19.5 plastic
	13.7x13.7 plastic

tiles	cast iron grid for 3013 F (dimensions 15x15)
	plastic grid for 3013 F (dimensions 15x15)
	plastic grid for 3019 MF (dimensions 19.5x19.5)
	spacing tile / caisson floor 3 cm joints for 3019 MF

Resistance to breakage

The study of glass blocks for use in horizontal structures that can withstand pedestrian traffic, has found that the thickness of the sides, annealing and accurate welding are the three main features that make the product resistant to breakage. Vetroarredo glass blocks reach the highest levels of these three features, thereby raising the safety standards well beyond the required limits.



Testing method

The test to determine breaking resistance was performed by subjecting to a load the surface of Vetroarredo glass blocks by applying, perpendicular to the centre of the glass block, a specially shaped punch attached to a press.

dimensions (cm)	glass designs	Ultimate strength (N)	
		Vetroarredo certified value (N)	Minimum value according to DIN 18175/77 (EN 1051-1) (N)
14,5x14,5x5,5	F	> 5900	5900
19x19x7	MF		*
14,5x14,5x11	DSF	> 2500	2500
19x19x8	DA - DS - DSC		
20x20x2,2	PS		

* item not specified in the standard

Notes:

Test performed and certified by SIGMA s.r.l. laboratory in Florence according to the UNI 7440 standard, edition 1975.

- Tests performed on individual glass blocks.
- Tests performed on glass blocks for horizontal structures.

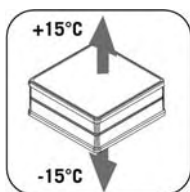


Horizontal structures

Features and performance

Thermal endurance

Thermal shock is one of the most stringent tests that Vetroarredo glass blocks must undergo to verify their strength and resistance. Only proper annealing eliminates residual stresses that can trigger accidental breakage also due to environmental causes. This requirement makes it possible to use Vetroarredo glass blocks in outdoor applications under the most varied climatic conditions.



Testing method

The thermal endurance test was performed by submerging Vetroarredo glass blocks in a container of heated water and then immediately placing them in another container filled with water at room temperature.

dimensions (cm)	glass designs	Sudden temperature change (C°)		
		Vetroarredo certified value	value according to UNI 7740/75	value according to DIN 18175/77 (EN 1051-1)
19x19x8	DA - DSC	25° C	18° C	25° C
	DS	30° C		
14,5x14,5x5,5	F		30° C	
14,5x14,5x11	SF		18° C	
19x19x7	MF		30° C	

* item not specified in the standard

Notes:

Test performed and certified by SIGMA s.r.l. laboratory in Florence:

- Test performed according to the provisions of UNI 9303 standard, edition 1988, according to the A method
- Tests performed on individual glass blocks.



Calculating the dimensions and the carrying capacity

Vetroarredo glass blocks for horizontal structures are used for panels which are just leaned on something.

The designer shall avoid glass blocks works that are fixed or restrained in supporting structures.

Glass blocks do not represent structural elements because they just have aesthetic and dividing functions and can support only their own weight and a perpendicular live load.

This load shall be mainly static, and these structures shall be considered suitable to pedestrian traffic.

Using small size glass works increases safety because in this way the foot also touches the joint and not only the glass surface, and slip resistance is higher.

We recommend a joint of at least 3 cm between the glass blocks. When designing skylights you should take into consideration a sloping structure for the downflow of rainwater.

Table A

This table shows the weight per m² of Vetroarredo structures made of cement mortar with a weight of 1800 kg/ m² and a reinforcement for each joint composed of two steel bars weighting 0.39 kg/ml (Ø 8 mm).

For 14.5x14.5x5.5 glass blocks we have taken into consideration, for each joint, only one 8 mm diameter rod.

For calculating the weight of glass blocks structures with joints larger than 3 mm, see the calculation method described on page 21.

Table B

The table shows the maximum dimensions for horizontal panels with 3 cm joints; the limits are calculated in relation to overload, reinforcing bars and Vetroarredo glass blocks type.

The values have been calculated at the following conditions:

- Grating panels where supported on all four sides;
- Evenly distributed overload;
- Permitted stresses:

Iron 1000 kg/ cm²,

Cement 50 kg/ cm²;

- 3 cm joint.

A. Calculating the weight and the number of glass blocks for each m²

Dimensions (cm)	Vetroarredo		Approximate weight of the structure (kg/ m ²)	Number of pieces per m ²
	model	Unit weight (kg)	3 cm joints	3 cm joints
19x19x8	DS	2,8	≅ 104	≅ 21
	DSC	3,8	≅ 123	≅ 21
	DA	2,7	≅ 102	≅ 21
20x20x2,2	PS	2,2	≅ 95	≅ 19
14,5x14,5x5,5	F	1,4	≅ 84	≅ 33
14,5x14,5x11	DSF	2,8	≅ 165	≅ 33
19x19x7	MF	2,5	≅ 93	≅ 21

B. Calculating the maximum surface of a floor

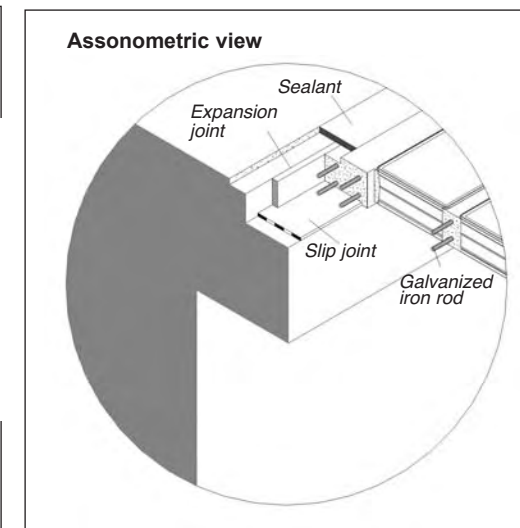
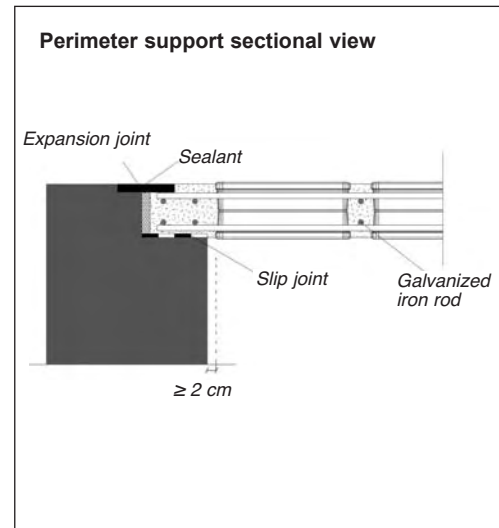
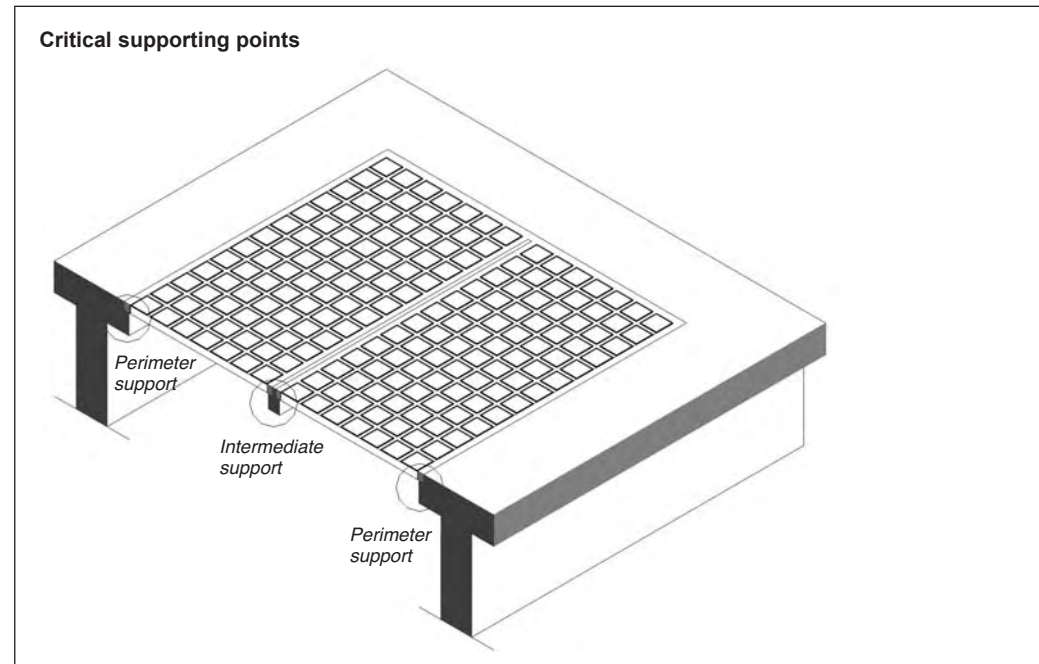
Overload	Structures which are not suitable for pedestrian traffic 200 kg/ m ²			Structures suitable for pedestrian traffic 400 kg/ m ²		
	Ø 6	Ø 8	Ø 10	Ø 6	Ø 8	Ø 10
Bar diameter (mm)	Ø 6	Ø 8	Ø 10	Ø 6	Ø 8	Ø 10
modello	m ²	m ²	m ²	m ²	m ²	m ²
3190/DS	4,5	8	9,5	2,7	4,8	6
3190/DA	4,5	8	9,5	2,7	4,8	6
3019/MF	4	6,5	8	2,3	4	4,5
3013/F	3,5	4,5	5,5	2	2,5	3
3013/DSF	6,7	11,5	13,5	4,4	7,5	9

Perimeter supports

The designer must allow for at least 2-3 centimetres between the load-bearing structure and the first row of glass blocks in the panel, in order to prevent the glass from coming into direct contact with the support.

The support should run along the entire perimeter of the panel thanks to the insertion of a slip joint. Both the panel and the supporting structure must be properly and adequately dimensioned.

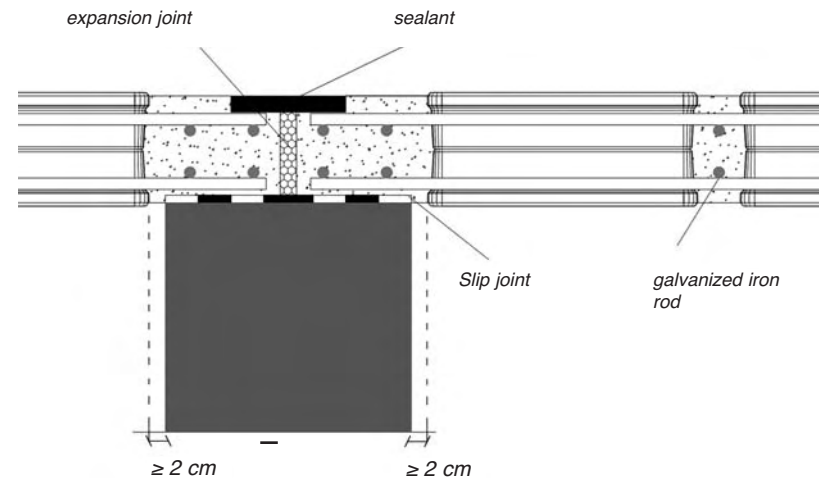
If the glass block structure is even with the roof or walls, the designer must provide for an elastic expansion joint finished with a suitable sealant to be placed on the upper part of the panel.



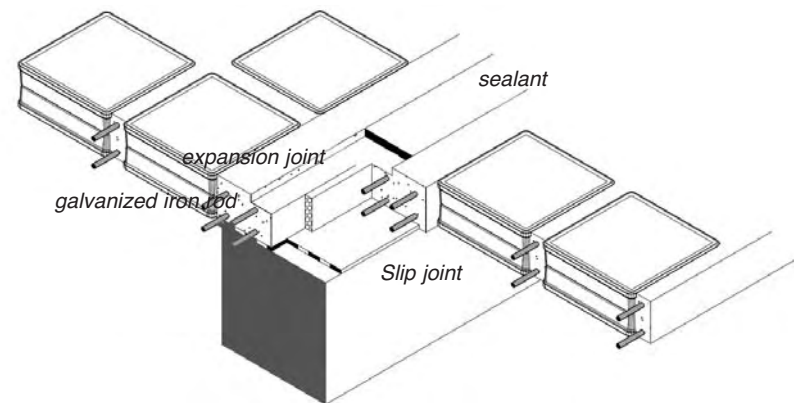
Intermediate supports

When intermediate supports are present, the designer must allow for at least 2-3 centimetres between the load-bearing structure and the first row of glass blocks in the panel, in order to prevent the glass from coming into direct contact with the support. Moreover steel reinforcements must not be continuous in order to avoid internal stresses to the same structure.

Intermediate support sectional view



Axonometric view of intermediate support



Installation materials

Concrete

For horizontal walls use preferably cement mortar consisting of the traditional mixture of Portland type or similar cement, class 42.5. Make the mortar with 350 kg of binder for each cubic meter of sand (washed, mineral sand, assorted granulometry, maximum size 3 mm), add clean water until a plastic-like consistency is obtained.

The mortar should have good mechanical strength and at the same time be easy to work in order to completely and properly fill narrow spaces.

Furthermore, it must be water-proof and shrink minimally during setting.

Excessive shrinkage creates stresses which are harmful to glass blocks and can cause cracks in the mortar itself to the detriment of water-proofing features.

Slip and expansion/settling joints

It is necessary to place an expansion joint along the whole perimeter in order to absorb any settling of the structure, such as the Vetroarredo expansion joint that is adhesive on one side in order to guarantee an easy application on the structure, this is 6 mm thick.

At the base a slip joint shall be placed in order that the wall does not belong to the same structure of the building.

Steel reinforcements

We recommend using improved adherence, hot-galvanized or specially treated oxidation-proof iron bars.

The size of the rods varies according to the designer's calculations and the need for endowing the structure with sufficient structural strength.

Joint finishes

The most common methods for grouting include:

- White and grey Vetromalta that can be coloured with the normal oxides present on the market;
- Cement mortar with fine screened sand for grey joints;
- White cement mortar with marble powder for white joints;
- Cement mortar with fine sand and oxides for coloured joints.

The finishing mortar should not contain aggregates that could scratch the glass.

If you use pre-mixed mortar, make sure that they do not contain additives that could make it difficult to clean the Vetroarredo glass blocks, especially satin-finished surfaces.

To fill joints, you must use mortar with a compressive strength that does not exceed that of the mortars used for installing the glass blocks.

Protective treatments and sealants

After you have completed the installation, you can add protective treatments on the joints to prevent water infiltration.

This is indispensable for Vetroarredo structures exposed to rain and for shower stalls.

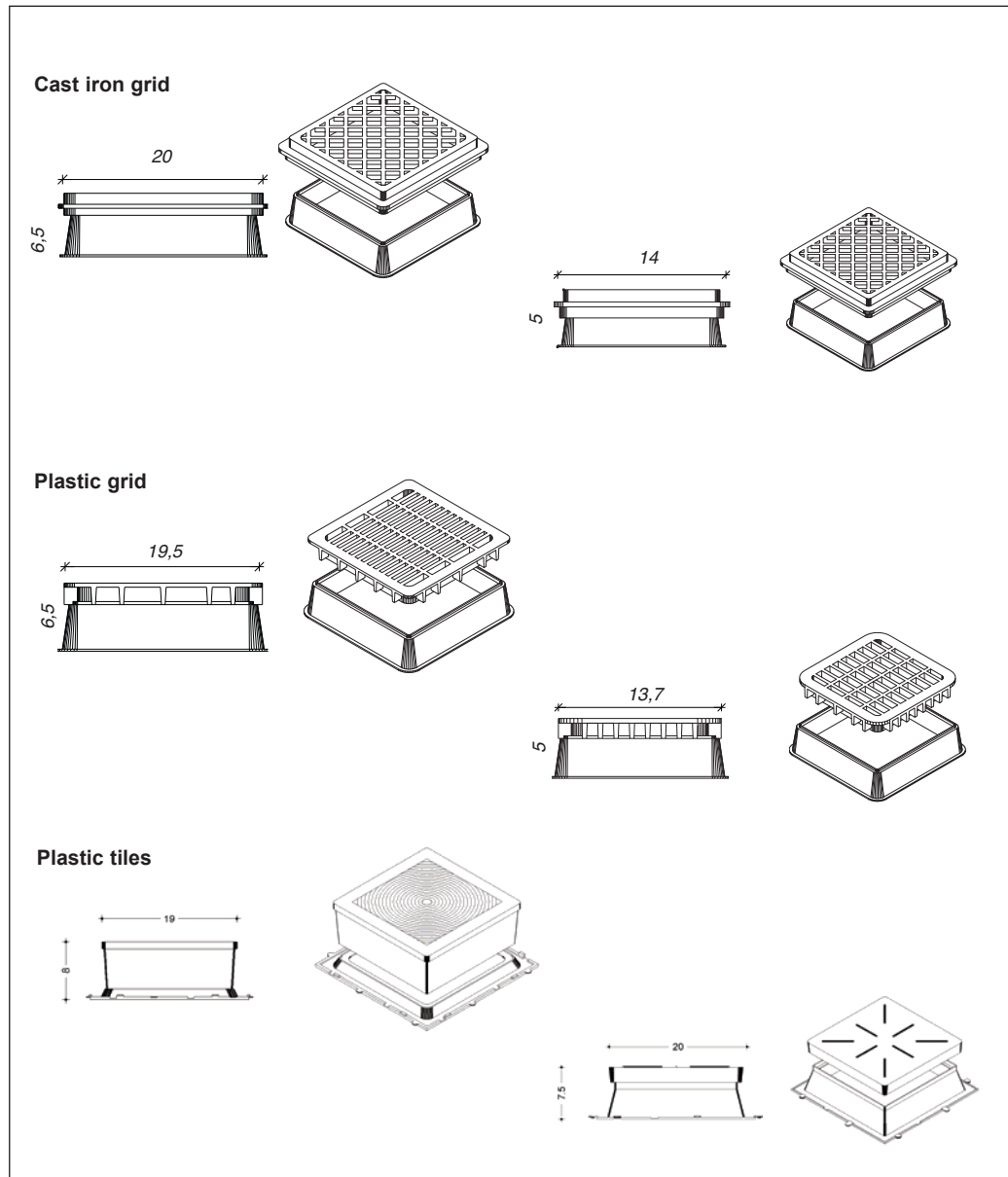
The treatment usually consists of one or more layers of transparent water-proofing protective material.

We recommend that you apply a sealant around the perimeter of the structure to prevent the joints from cracking where in contact with other structures.

Installation materials (continues)

Ventilation grids

In order to obtain a panel that allows air as well as light transmission you can replace one or more glass blocks (dim. 19x19x7 cm or 14.5x14.5x5.5 cm) with cast iron or plastic grids; they can be mounted with the suitable plastic tiles.



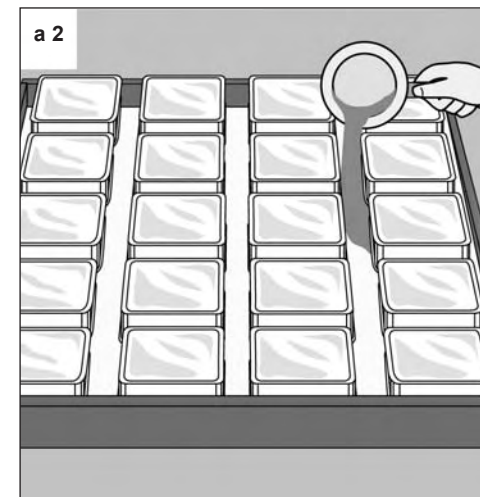
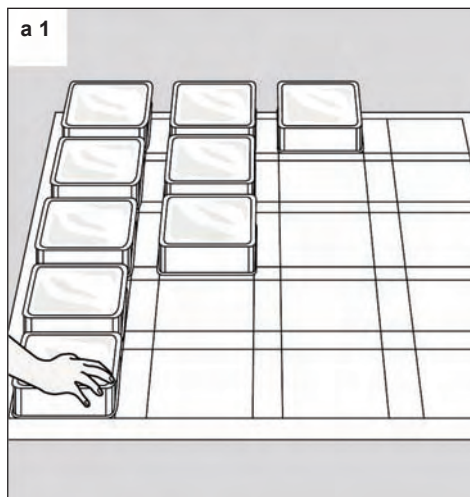
Installation of prefabricated panels

Generally, prefabricated Vetrorredo panels are installed as horizontal or sloping structures.

Prefabrication can be done at the work site or in the installer's shop, the are three main prefabrication phases:

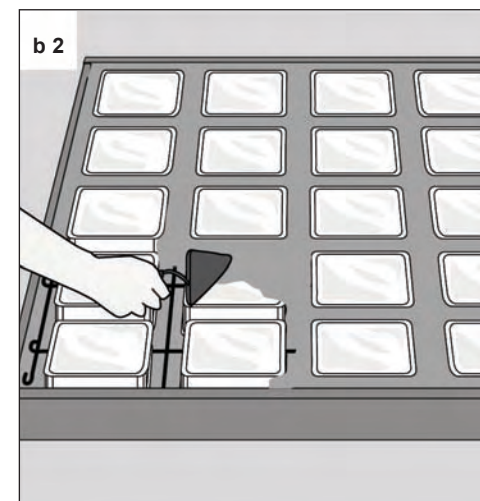
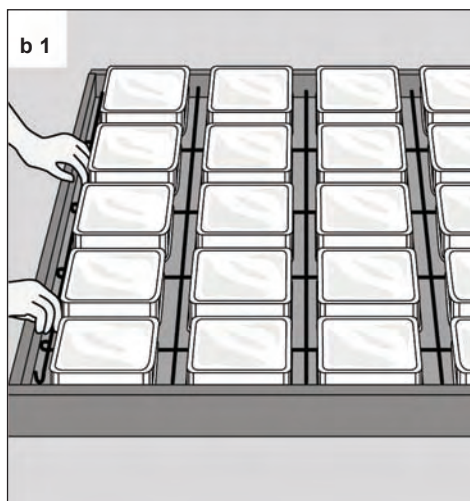
a. Preliminary phase

- Work on flat smooth surfaces or surfaces that have been ground.
- Trace the outline of the grid bearing in mind that the dimensions are derived from the length of the side of the Vetrorredo glass blocks you plan on using and the dimensions of the reinforced joints between the blocks.
- Spread release agent on the ground surface.
- Place the glass blocks on the traced grid and pour a few millimetres of very liquid plaster or cement into the spaces to prevent the glass blocks from shifting when you pour in the next mortar.



b. Installation phase

- Apply enough mortar to assure that the reinforcement rods you will be inserting will be at least 20 mm from the base.
- Reinforce the joints between the glass blocks and along the perimeter with steel bars that are shorter than the sides of the panel itself (in order to prevent them from coming out and oxidising). This will create an orthogonal frame.
- If the panel has to be laid on the supporting structure with two sides only, first insert the rods perpendicular to the support and then the others.
- Make sure that the bars are positioned in the middle of the space to prevent them from touching the glass blocks.
- Constipated the mortar well and fill all spaces to make it impermeable.

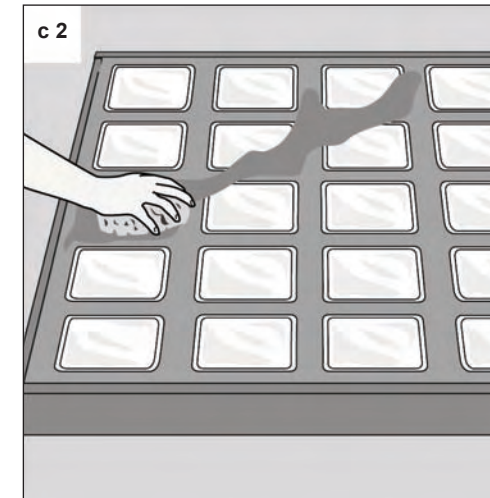
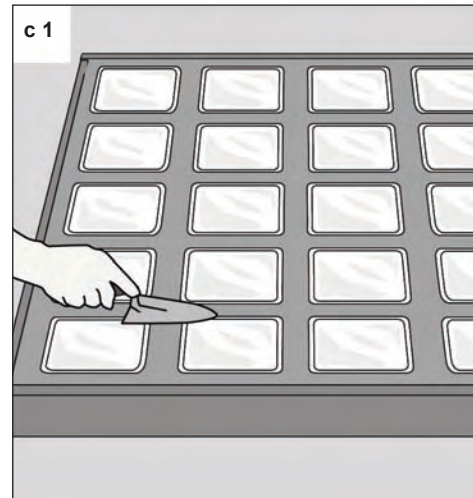


This process is similar to that for the installation of vertical panels (see page 34).

Installation of prefabricated panels *(continues)*

c. Finishing phase

- Smooth the joints between the glass blocks with the tip of the trowel. When the joints are semi-hardened, clean them with rags until they are completely even with the surface of the glass blocks.
- Mark the bottom and/or upper surface of the panel so that it can be installed in the right position, this will allow the materials (concrete and steel) to work properly.
- Cover the panel with approximately 3 cm of wet sand to limit cement shrinkage.
- Take environmental factors such as relative humidity, temperature and exposure to wind into consideration before striking the prefabricated panels (wait at least 5 days after pouring).
- Only move and install the panels after the concrete is completely hardened, and in any event, not less that 28 days after pouring.
- Insert suitable accessories such as hooks and cramps into the concrete to facilitate moving large panels.
- If the panel is going to be exposed to rain, spread silicon-based water repellent protective substances between the glass blocks.
- To create a panel that will allow both lighting and ventilation replace one or more 19x19x7 cm or 14.5x14.5x5.5 cm glass blocks with the respective plastic system (plastic frame + grid).



Installation

The construction methods described for prefabricated panels also apply to building panels at the site. The only difference is that temporary timbering and casing will be needed to support the panel; they will only be removed when the concrete has attained the required strength.

The bottom of the casing must be perfectly flat and level with the perimeter supporting structure. Place a horizontal slip sheath on the perimeter supporting structure and a vertical expansion/settling joint. If the structures are to be impermeabilized, avoid sealing the expansion joints with heat fixed or spread materials in order to prevent thermal shock and dilatation that can be hazardous for the glass blocks.



Roofing



Roofing

When designing roofs with plain roofing tiles, the designer must provide for sealant along the edges of the glass blocks in order to absorb vibrations and movement caused by weather and structural settlement.

The plain roofing tiles are complete with a support step to the supporting edge and also a hole to provide a connection using a nylon thread.

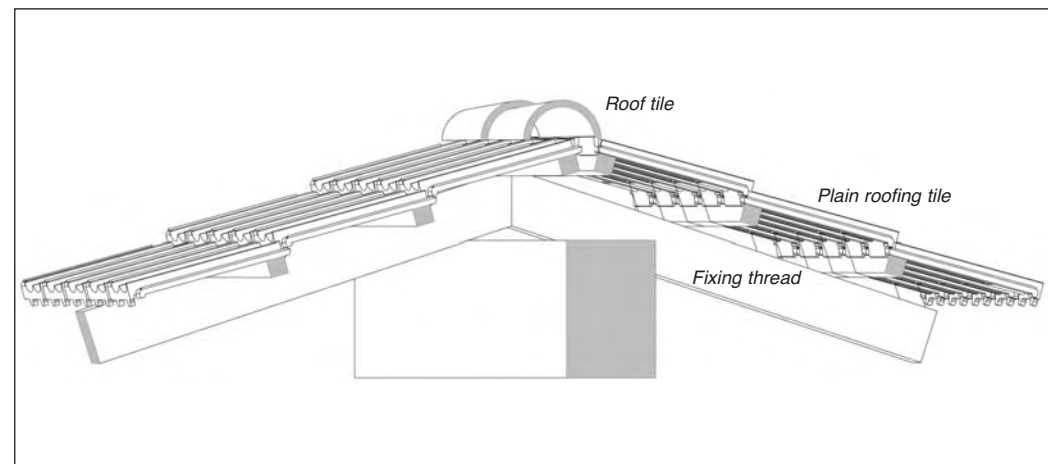
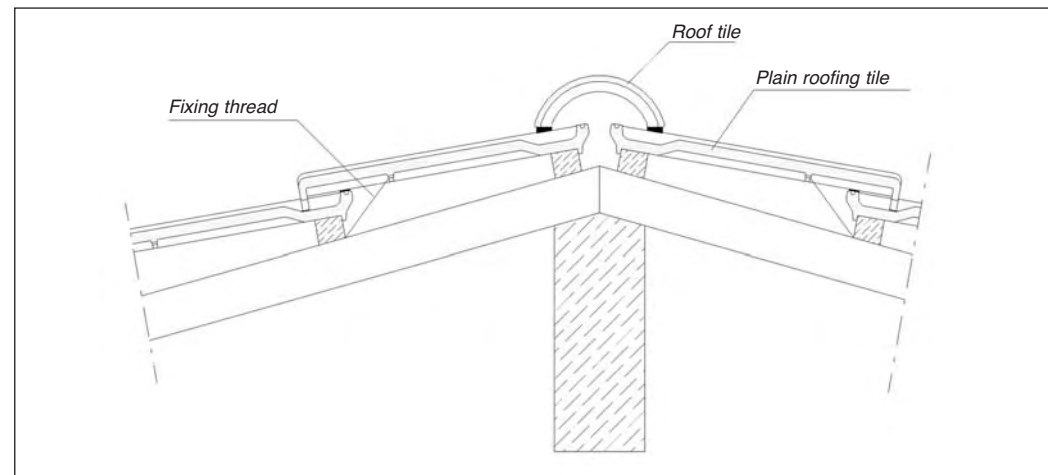
When creating skylights inside a traditional plain roofing tile brick roof, it is essential to control that the tiles can be used together with the glass blocks.

The roof should slope in such a manner as to ensure that the glass blocks will be held securely in position in relation to the restraint.

Plain roof tiles or Vetroarredo roof tiles of the following dimensions are suitable for integral roofing as well as for alternating with brick elements.

Weights and number of pieces per square meter

description	dimensions (cm)	unit average weight (kg)	indicative number of pieces per m ²	indicative weight of the roofing 8kg/m ²)
Plain roofing tile	39,5x23	3x3	= 15	= 49
Roof tile	17,5x14x44	2	= 33	= 66



Specifications

General conditions: for Vetroarredo Pegasus glass blocks

Supply and installation of vertical walls made of Vetroarredo Pegasus blocks being pressed, annealed and hot assembled by means of welding the faces; these blocks are 19x19x8 cm, with glass design, colours and finishing determined by the work management, and they are white or metallized painted on the lateral bands.

The products must comply with the UNI 7440/75 and DIN 18175/77 standards.

The producer must have a quality system UNI – EN – ISO 9001.

The internal pressure of the glass block must be lower than 450 mbar.

These glass blocks are installed by inserting suitable Vetroarredo plastic spacers with joints' dimensions according to the work management starting from a joint of 2 mm to 5 mm, including positioning with specific mortar, Vetromalta, which is elastic, water-and humidity-proof, in white or grey colours so that it can be used for the installation as well as for filling works.

Walls must be properly reinforced with stainless steel rods (Aisi 304) smooth drawn, diameter 6 mm, to be placed within the joints in the horizontal as well in the vertical positions.

Structures must be laterally and upper insulated with special Vetroarredo rot-proof expansion joints, that is adhesive on one side and can be repositioned, made of veolene (expanded polyethylene with closed cells) dimensions 65x6 mm, and on the lower side with a strip of non compressible insulation material.

The intersection of glass blocks walls with adjacent structures must be carried out with specific sealant for walls and joints must be coated with specific water-proofing material.

Frequently Asked Questions

- 1. How many installation methods are available for Vetroarredo and which are they?** Traditional installation with cement mortar;
- 2. Which type of structures can be constructed with Vetroarredo?** With Vetroarredo you can build:
Linear and curved vertical walls, for indoor as well as outdoor applications;
Floors and roofing structures.
- 3. Which are the dimensions of Vetroarredo glass blocks?** Squared (19x19x8) cm is the most commonly used dimension together with the relevant rectangular (19x9.4x8 cm), but Vetroarredo also produces 24x24 and 30x30 modules as well as other special dimensions with different thickness values.
There are then special pieces, that are linear, curved and angle end glass blocks.
- 4. Is it possible to build all glass blocks wall?** This is possible thanks to linear, curved and angle end blocks and corner blocks.
- 5. Which are the most common glass designs?** The Vetroarredo range includes smooth and wavy glass designs; however for some models other glass designs are available.
- 6. How can I calculate the number of the needed spacers for a Vetroarredo wall?** Use the following formula to calculate the number of spacers needed for your specific installation: $D = (n + 1) \times (m + 1)$
- Where:
D = number of spacers
n = number of horizontal glass elements
m = number of vertical glass elements
- 7. At which distance can I place the glass blocks when installing Vetroarredo?** The smaller joint amounts to 2 mm. There are also 5, 10 and 16 mm spacers.
- 8. Can I fit a door or a window in a Vetroarredo wall?** This is possible thanks to openable frames, in this case make sure a 16 mm joint is available. To fit doors into a glass block wall you must create an opening with a frame made of metal U-sections. Install the glass blocks making sure to leave a minimum of 1 cm space between the frame and the glass blocks.
In order to prevent damage to the glass blocks that may be caused by slamming the door or window, make sure to cover the inside of the metal sections with rubber or similar material. Heavy door leaves or windows should be equipped with appropriate “braking” systems.
- 9. Does Vetroarredo also supply the mortar for installation?** Vetroarredo has developed a specific mortar, called Vetromalta, for installing glass blocks; in vertical structures.

Frequently Asked Questions

- | | |
|---|--|
| 10. What the expansion joint is used for? | The expansion joint is necessary for correctly installing Vetroarredo and it must be placed on lateral and upper edges in order to prevent possible settlings of the structure from transmitting vibrations to Vetroarredo and damage it. |
| 11. Is it necessary to use stainless steel rods? Is it necessary to weld them? | The glass block wall must be reinforced in vertical and horizontal joints. This procedure guarantees higher stability and safety.
Rods shall not be welded because this would create a too rigid structure and damage the glass part. |
| 12. Is it possible to build wide walls with Vetroarredo? | Yes, of course. The annealing and welding processes as well as the strict compressive resistance tests guarantee a high safety level also for complex installations.
No dimensional limits exist, but only when you interrupt the wall with expansion joints featuring the suitable dimensions. |
| 13. Can Vetroarredo be used in particular climatic conditions? | The thermal endurance test as well as the annealing process guarantee the elimination of any residue internal stresses.
Vetroarredo can therefore be installed in the most extreme climatic conditions. |
| | |
| 15. Which glass block type shall be used for outdoor installations in order to guarantee a good light transmission level and at the same time "privacy"? | Transparent clear glass blocks guarantee a higher level of light transmission; satin-finished (on one or two sides) glass blocks guarantee more privacy and coloured glass blocks provide for a specific colour yield according to the nuance. |
| 16. Do you recommend the use of a Vetroarredo wall when an optimum thermal insulation is required? | Yes. The internal air space within glass blocks guarantees the same performance of glazing in terms of thermal insulation. |
| 17. Do you recommend the use of Vetroarredo in very noisy places such as discos and production activities? | In relation to a full brick walls, Vetroarredo glass blocks guarantee, thanks to the internal air space and their mass, an high value in terms of sound insulation. |
-

Frequently Asked Questions

- 18. Is it possible to use Vetroarredo glass blocks for shower stalls?**
Yes. After installation and the filling process it is necessary to protect cement-based joints with water-repellent products and to silicone the perimeter when it is in contact with the pre-existing wall.
- 19. Is it possible to build a curved wall with Vetroarredo glass blocks?**
With the help of spacers for curved walls with the traditional as well as with the Posavelox system, we can obtain curved walls even with minimum radiuses, while with the modular system the suitable wooden wedges are necessary.
- 20. Can I build a Vetroarredo wall inside a plasterboard wall?**
You have to accurately calculate the weight of the wall and to strengthen metal sections of the plasterboard in correspondence of supporting points.
- 21. Do Vetroarredo glass blocks walls for outdoor applications have safety and anti-intrusion features?**
Vetroarredo has been subjected to breakage resistance tests. The results have shown that non safety problems exist.
The necessary reinforcement with stainless steel rods guarantees stability and resistance and makes the installed Vetroarredo wall a real “reinforced wall”.
- 22. Is it a glass block wall safe for children?**
Yes, because the thickness of the glass faces, the annealing process and the accurate sealing process guarantee high stability to the panel.
Within the glass blocks the pressure is lower than the atmospheric one and for this reason, in the case of breakage, glass splinters will converge towards the internal part.
- 23. Is Vetroarredo fire-proof?**
Glass blocks panels represent a solid barrier against fire and guarantee a good safety level. They have been certified according to the Italian, French and German standards.
- 24. Is there a Vetroarredo glass block featuring fire resistance?**
Vetroarredo offer a specific product, called 1910 C/60 REI 60, in clear and sanded versions, with standard dimensions but with 10 cm thickness; this is to be installed according to specific technical instructions.
- 26. Are there glass blocks suitable for pedestrian traffic? Can I use glass blocks for vertical installations in horizontal installations?**
There are two Vetroarredo glass blocks models that are suitable for pedestrian traffic: the one with the upper face with dots and the one with concentric circles; they are available in different thickness and dimensions.
It is not recommended to use these glass blocks for horizontal installations because they are not certified for this specific application.

Frequently Asked Questions

- 27. Is it possible to build a loft with glass blocks?** It is possible to use Vetroarredo glass blocks suitable for pedestrian traffic also creating prefabricated panels to be laid afterwards. For this purpose an accurate design activity is required in order to guarantee that the structure can bear the weight of the element to be installed.
- 28. Is it possible to build a carriageable floor with glass blocks?** Glass blocks for horizontal structures are certified for pedestrian traffic only; however thanks to the carrying capacity of the elements – about 400 kg/m² - it is possible a different use. But the designer shall perform the necessary calculations on the underlying bearing structure.
- 29. Is it possible to ventilate a glass block floor with grids?** Vetroarredo offers a system in cast iron and plastic composed of grids and tiles to be used with a specific glass blocks. This system cannot be used with 8 mm thick glass.
- 30. What joint require glass block structures in order to be suitable for pedestrian traffic?** We recommend a minimum joint of 3 cm because the bigger cement-based surface allows for a better distribution of the weight.
- 31. Which model should I use for allowing light transmission, but having at the same time a covering effect?** The suggested model is the satin-finished and dotted on one side.
- 32. In order to install wide structures for pedestrian traffic, what should I take into consideration?** We recommend an evaluation of the total weight of the panel with armature, cement mortar and glass. According to the diameter of stainless steel rods different panel dimensions are available. It is possible to install wide horizontal surfaces if you interrupt the panels with fixing joints, extension joints and suitable intermediate supports.
-

Reference standards

Most important norms for glassblocks:

For products:

- UNI 7440/75
“Vetri per vetrocemento armato” (Glasses for glass – slabs in reinforced concrete)

- DIN 18175/77
“Glasbausteine: Anforderungen, Prüfung” (Glass blocks for building: tests; features)

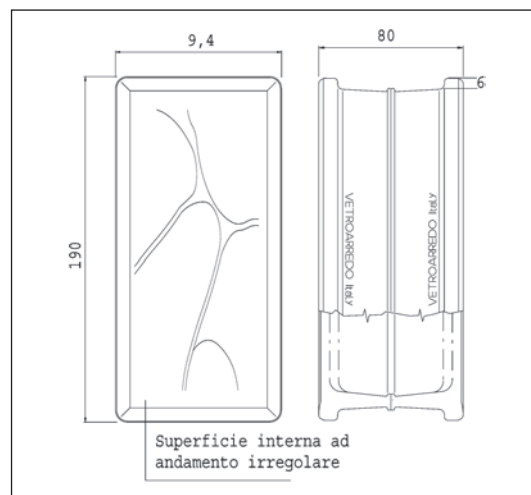
- DIN 4243/78
“Betonglaser: Anforderungen, Prüfung” (Glass blocks for floors: tests, features)

For the installation:

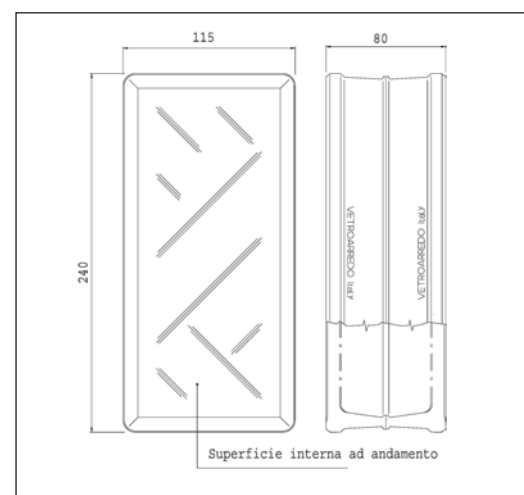
- DIN 4242/79
“Glasbaustein – Wände: Ausführung und Bemessung” (Glass block walls: construction and calculations)

The information contained in this technical document is accurate and reliable to the extent of our knowledge to date. Since Vitrablok s.r.o. has no way of controlling installation conditions and methods, the use of appropriately skilled labour, and the proper use of the accessory materials, no guarantee can cover materials that prove defective after installation and/or assembly.

Rectangular

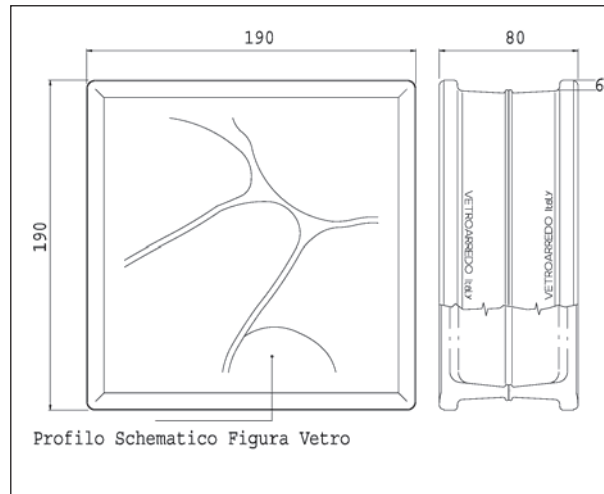
Pegasus 190x94x80 mm

240x115x80

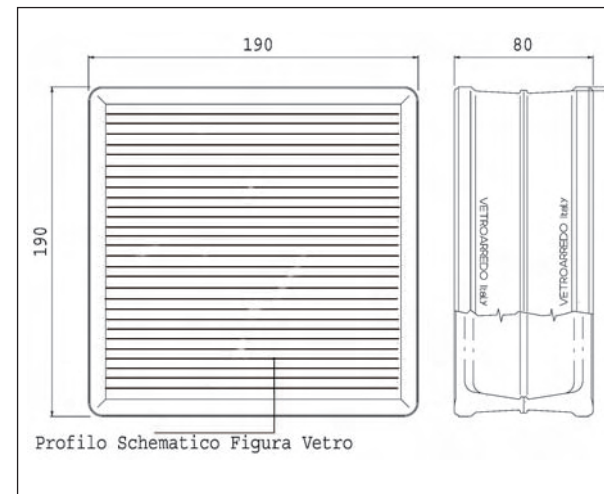


Square

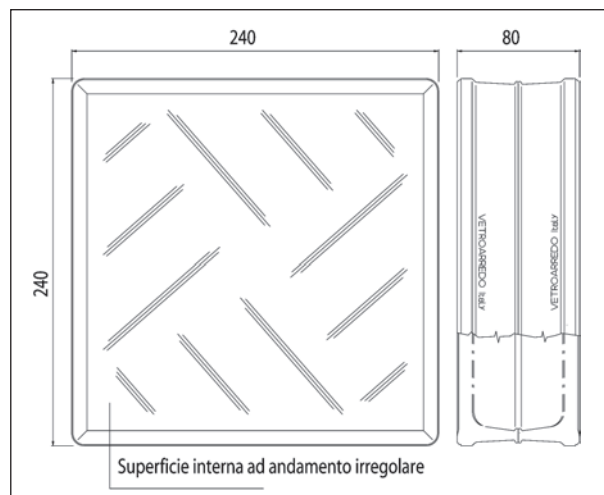
Pegasus 190x190x80 mm



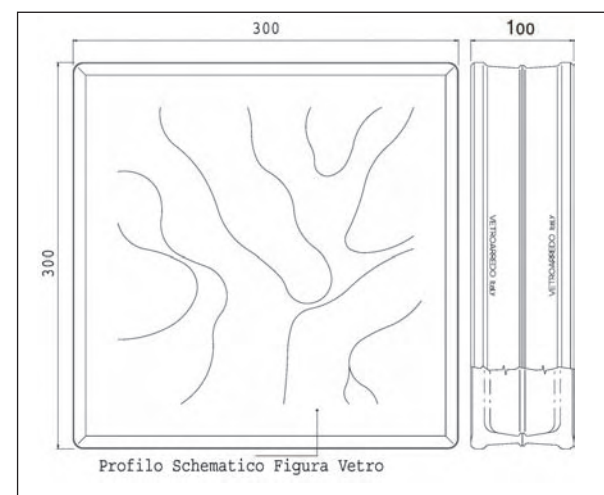
190x190x80 mm



240x240x80

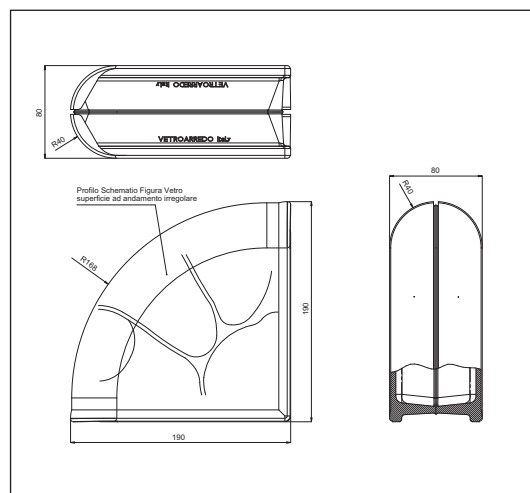


300x300x100 mm

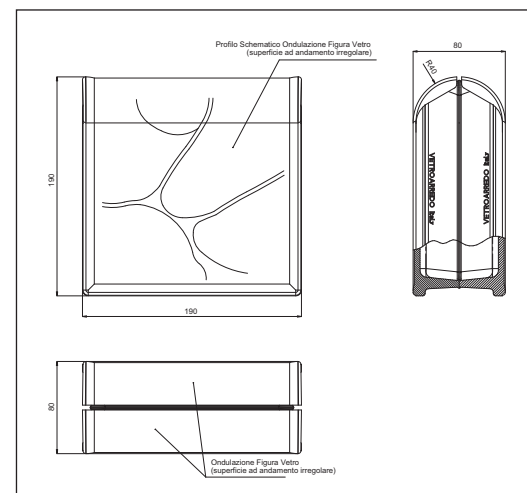


Special pieces

190x190x80 mm Pegasus curved end glass block



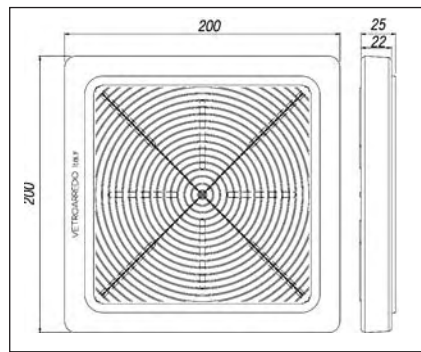
190x190x80 mm Pegasus linear end glass block



Squares

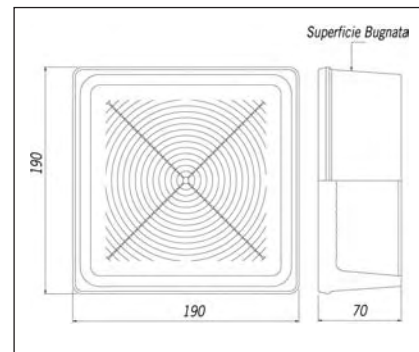
200x200x22 mm

3200 PS



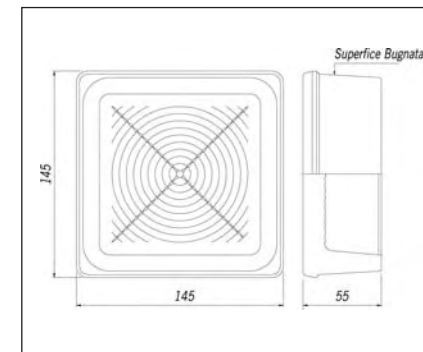
190x190x70 mm

3019 MF



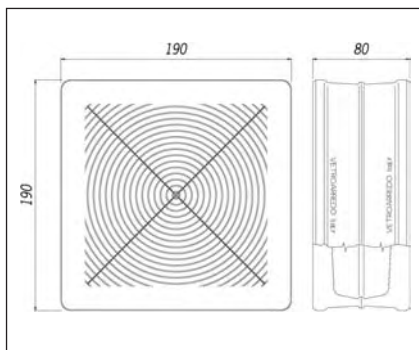
145x145x55 mm

3013 F



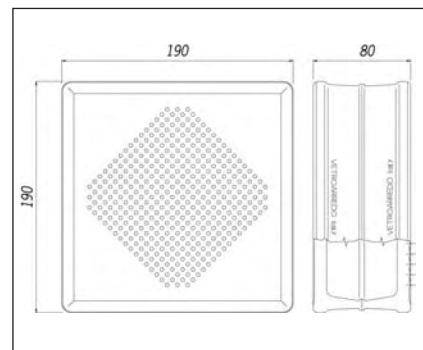
190x190x80 mm

3190 DSC



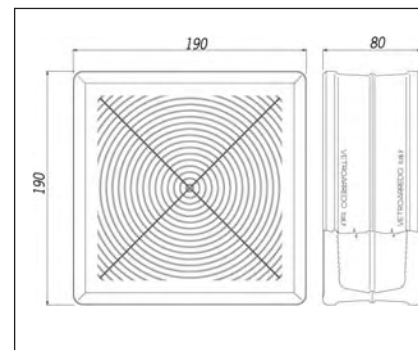
190x190x80 mm

3190 DA



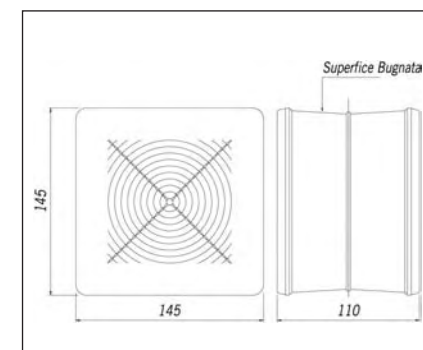
190x190x80 mm

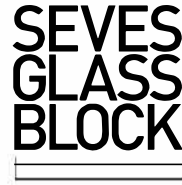
3190 DS



145x145x110 mm

3190 DSF





SEVES GLASSBLOCK

Vitrablok s.r.o.
Bílinská 782/42
419 01 Duchcov
Czech Republic
Tel: +420 417 818 111
Fax: +420 417 835 807
Email: info@sevesglassblock.com

Vitrablok s.r.o.
Via delle Robinie, 12
50019 Sesto F.no
Florence - Italy
Tel: +39 055 449 51
Fax: +39 055 455 295
Email: info@sevesglassblock.com

Seves Glassblock Inc
10576 Broadview Road,
Broadview Heights, Ohio
44147 - USA
Tel: +1 440 627 6257
Toll Free: +1 877 738 3711
Email: inquiry@sevesglassblock.com

www.sevesglassblock.com

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