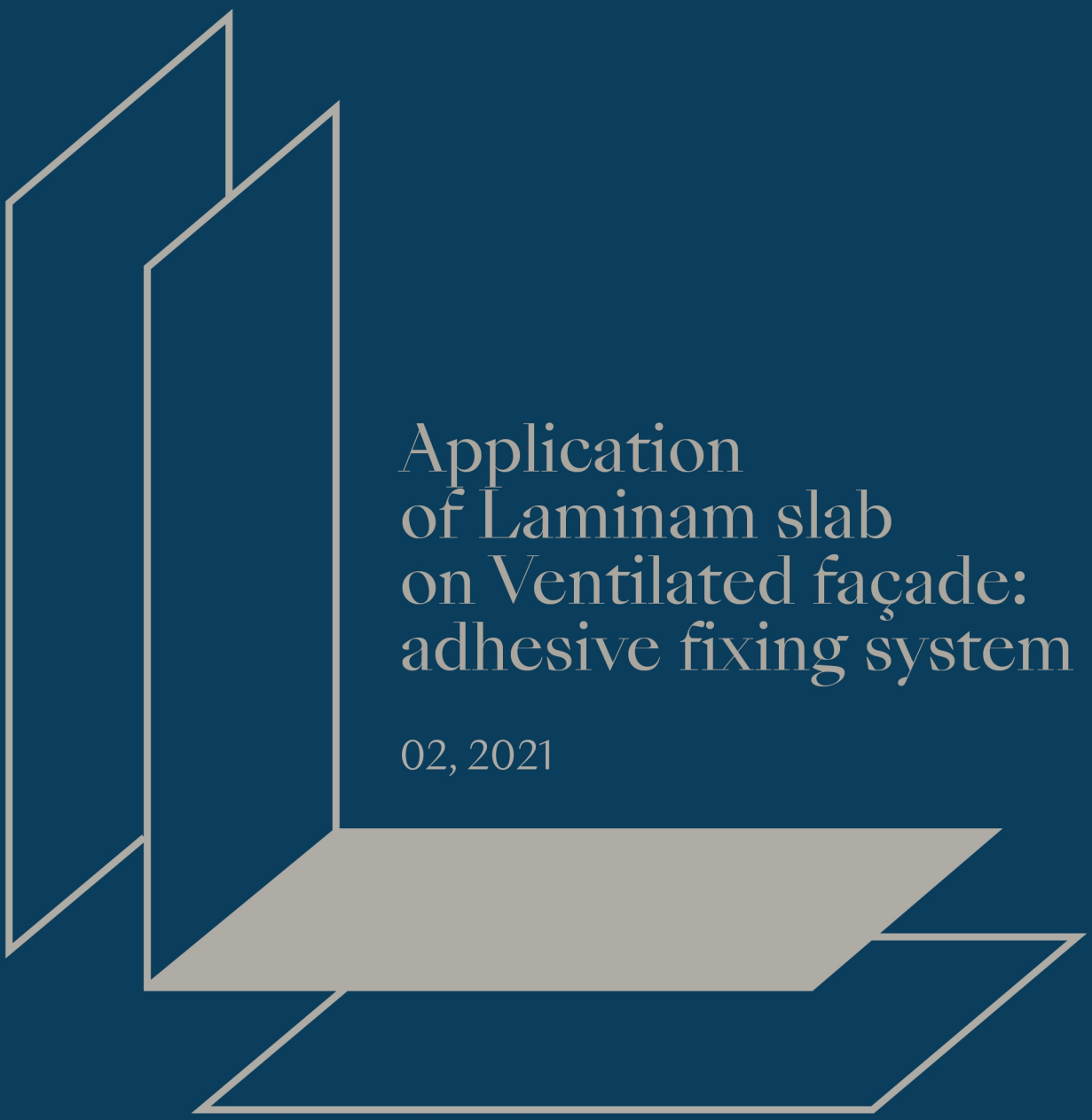

Application of Laminam slab on Ventilated façade: adhesive fixing system

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LAMINAM
SUPERIOR NATURAL SURFACES

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Laminam Spa produces and provides porcelain stoneware slabs for the construction of ventilated/ continuous façades. The execution shall be borne by specialized companies that deal with design and installation.
The Project Engineer of Laminam SpA provides technical assistance and resistance values of the slab to the wind for a correct sizing and installation.

1. The product

All the values and design indications provided in this handbook are only valid for porcelain stoneware slabs produced by Laminam SpA. The variables linked to the production of Laminam slabs, such as the choice of raw materials, time frames, systems and firing curves and the application of fibreglass, make this product unique, with technical features that are unrivalled by any other slab.
Laminam SpA cautions against the use of the values and information contained in this handbook for the sizing and designing of porcelain stoneware slabs not produced in its plant.

Laminam 3+

Features: Laminam 3+ consists of a base slab structurally reinforced with a fibreglass mat applied to the back of the slab with the appropriate adhesive.
Nominal thickness: 3,5 mm

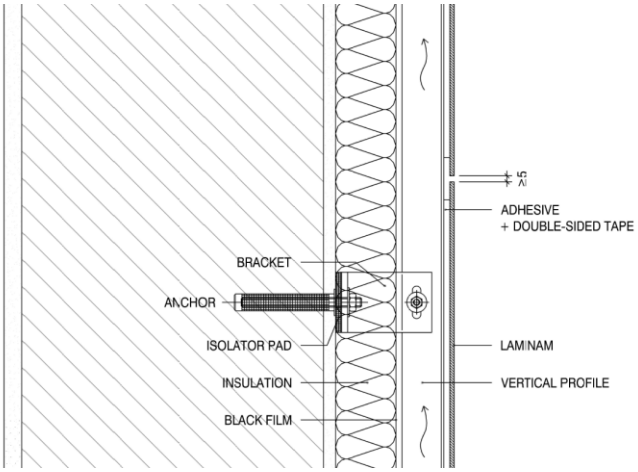
Laminam 5+

Features: Laminam 5+ consists of a base slab structurally reinforced with a fibreglass mat applied to the back of the slab with the appropriate adhesive.
Nominal thickness: 6,0 mm

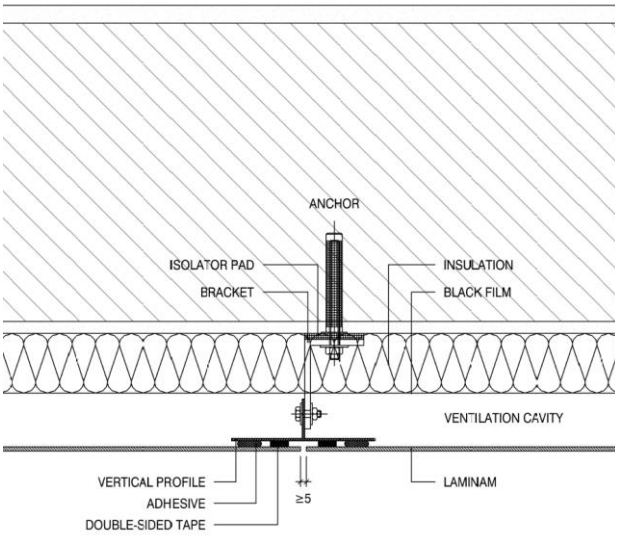
Reinforcement fibre adhesion properties

The presence of a fibreglass reinforcement on the back of Laminam 3+ and Laminam 5+ makes it possible to use these innovative products as ventilated façade cladding, as the reinforcement acts like a retainer, trapping any ceramic fragments in the event of breakages, an essential requirement for this intended use. Laminam SpA uses an automated industrial process to apply this reinforcement ensuring superior quality standards, which are checked via in-house controls on individual production batches, together with the repeatability and consistency of product performance (ISO 9001 conforming process).
The consistent adhesion performance of the ceramic slab to the reinforcement fibreglass has also been verified by means of a test protocol, the methodology of which was specifically devised for this purpose and was supervised by Istituto Giordano SpA, with the aim of evaluating the adhesion features between the component layers of the products. This follows multiple cycles of conditioning and ageing, in order to simulate the conditions under which the Laminam 3+ and Laminam 5+ slabs may find themselves during the life cycle of their final application.

2. Adhesive fixing system



Vertical section



Horizontal section

**The construction details specified above are for information purposes only and are not definitve details, whichh should be developd by the designer in accordance with the design requirements of each project.*

Laminam slabs can be fixed to the ventilated façade using adhesive applied directly onto the sub-structure profiles at the construction site. The bonding with the adhesive must counter the action of the wind and compensate for the different thermal expansions between the profile and the slab. Both Laminam 3+ slabs and Laminam 5+ slabs can be used, depending on the performance required and on the features of the building and of the site.

Adhesive

The slab is fixed using single-component adhesive applied vertically directly to the aluminium sub-structure at the construction site. The bonding may also be horizontal, taking care to avoid water stagnation along the silicone bead. Silicones, polyurethanes, and MS polymers can be used.
The adhesive bead must be designed by the product supplier and the latter will be responsible for providing proper advice on the most suitable product, the possible use of cleaner or primer and the application methods depending on the specific conditions of the design.
The adhesive must be supplemented by double-sided tape with the aim of determining the correct thickness of the silicone and guarantee the immediate bonding of the slab that has just been applied.
The metallic sub-structures can be simple T-shaped or L-shaped in aluminium or steel, or special profiles devised specifically for this type of fixing.
This type of fixing is used by all systems which envisage profiles bonded vertically to the back of the slab and which make use of other types of mechanical attachment between the profiles and the sub-structure.
In this case, the instructions herein concern the metallic profile-slab bonding; have a licensed technician refer to the design for fixed-point or continuous mechanical fixing. In this case, the bonding can also be done in the workshop using two-component structural adhesive.

Laminam slab sizes

Laminam 3+ and Laminam 5+ slabs can be applied in the maximum 1000x3000mm, 1200x3000mm, and 1620x3240mm sizes.
Any restrictions due to local regulations must be evaluated individually by the appointed designer.

Slab installation

Laminam slabs can be installed both vertically and horizontally, with care being taken when handling. The joint between the slabs, which is generally 5 mm or more, and perfect horizontal levelling must be guaranteed with the use of removable or fixed spacers. A fixed aluminium L-shaped or generic-section horizontal profile can also be used to act as a support for the slab at the time of application and guarantee correct horizontal levelling of the joint during installation or a Kerfix-type anti-fall mechanical hanger fixed to the sub-structure.
Adhesives guarantee perfect anchoring of the cladding slabs but, if necessary, a steel anti-fall hanger can be applied.

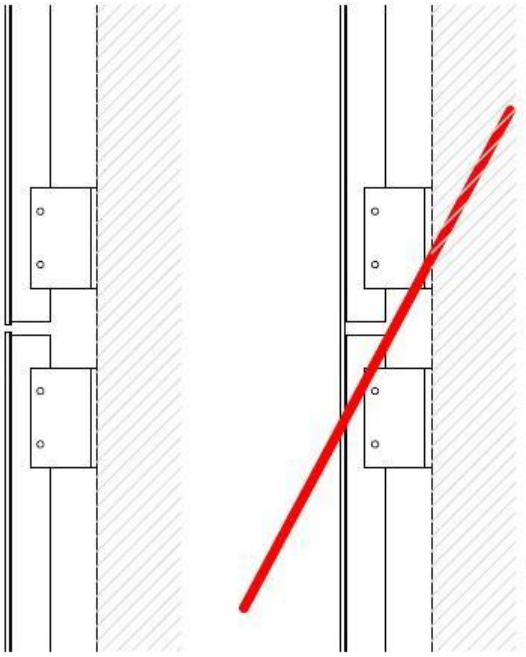
This hanger, which can be used in Laminam 5+ slabs, is seated in some milling performed on the back of the slab
and then fixed to the sub-structure by means of a mechanical anchor or self-threading screw.
The hanger prevents the slab from falling in the case of exceptional detachment, allowing it to be easily removed and repaired.
For proper slab handling, we recommend the use of suction cups or frames fitted with suction cups to facilitate handling operations. All the sub-structure profiles can have an L-shaped, T-shaped, box-section or a generic profile, with a width that will guarantee outstanding bonding. The profiles used for the sub-structure must be cleaned with a cleaner recommended by the silicone manufacturer in order to guarantee perfect adhesion of the adhesive to the metal. Any use of a primer on the slab must be recommended by the silicone manufacturer. In the event that coloured profiles are used, the paint must be applied with the anodising process or treatments that do not alter the surface features of the metal. The centre distance between the adhesive beads must be determined in accordance with the installation site, the height of the building and the wind pressure.

3. Thermal insulation layer

All types of thermal insulating material available on the market can be inserted since their application is entirely independent of the Laminam cladding. The thickness of the insulating material may, however, affect the choice of bracket size as the brackets must protrude from the insulating layer and facilitate the attaching of the sub-structure profiles to the same. Insulating materials with a black surface finish can be used to obtain a black or dark background, which is visible between the joints of the façade. As an alternative, arrange a waterproof but breathable black fabric between the insulating material and the slab. The thermo-hygrometric verification of the façade package will be charged to the technician in charge.

4. Sub-structure

Profiles



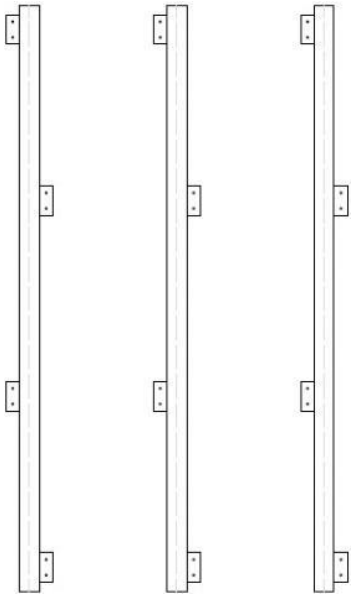
The design and sizing of the sub-structure based on the wind load and the weight are the responsibility of the sub-structure supplier or a licensed technician. The designer and the installer are therefore responsible for the design and assembly of all its component parts.
The Laminam slabs are fixed to a sub-structure in aluminium or steel profiles, which is in turn fixed to the bearing structure by means of adjustable brackets.
Wooden vertical profiles may be used in exceptional circumstances. There are a multitude of profile types which can be used to make up the sub-structure; summed up more easily as L-shaped, T-shaped, Ω-shaped or generic box-section profiles, which are sufficiently wide to enable the easy application of the fastenings considered and a minimum tolerance required.

The section, thickness and inertia of the profile must be sized by the technician in charge of the design, in accordance with national/local construction regulations and according to the calculation of loads, wind and weight to withstand.

The vertical profiles may be painted using techniques or processes that do not alter their features and allow the application of structural adhesives, where necessary. However, in the event that mechanical attachments are used, and no particular profile surface performance is required, coloured tape can be applied along the vertical profiles. It is preferable for the profiles to be placed vertically to avoid stagnating water. When designing the sub-structure, it is also important to ensure the movements of the profiles without transmitting tension to the slab: the joint between the profiles must coincide with the joint between the slabs.

The aluminium sub-structure must be suitably sized by the technician in charge of the design, in accordance with national/local construction regulations. The deflection value of the sub-structure must be below 1/200 of the span or 15 mm (in accordance with European regulations) or in any case below the value set by the local standard. If there is contact between the aluminium and the steel elements, galvanic corrosion phenomena must be prevented by inserting an insulating material element in between the parts.

Brackets



The support brackets in aluminium, steel or other material allow the vertical profiles to be fixed to the main structure. These brackets, which are height- and depth-adjustable, allow the optimal installation of the ventilated façade and the adjustment of the distance between the main structure and the slab, creating the necessary ventilation and leaving room for the application of the insulating material.
The centre distance between the brackets varies depending on the mechanical properties of the profiles, on the wind load and on the dead load, and the resistance to tearing of the support.
The fastening of the brackets to the main structure is guaranteed using elements that are suitable for the type of bearing structure, able to withstand the pull-out forces due to the wind load and the cutting forces due to the dead load.
The resistance to tearing of the anchor must be checked by the anchor supplier.
To eliminate any torsional effects on the aluminium profiles of the sub-structure, the brackets must be arranged in an alternated sequence to the left and right of the profile. Any thermal bridges can be eliminated by inserting insulating material between the bracket and the main structure.

Fastenings between aluminium profiles and brackets

When fastening the aluminium profiles to the brackets, the differential thermal expansion between ceramic and aluminium must be taken into account and both fixed and mobile fixing points envisaged. The quantity of anchors is determined according to the acting loads.

5. Main structure and infill

The ventilated façade with Laminam slabs can be applied to any suitable substrate designed to withstand its dead and accidental loads. The particularly light weight of the Laminam slab compared to traditional ceramic or natural stone slabs makes for much easier application.
The brackets are anchored using mechanical or chemical anchors depending on the tear resistance guaranteed by the substrate and checked by the anchor supplier.
In the case of non-bearing infills or curtain wall installations, in the absence of vertical structures, the metallic sub-structure is attached to the bearing structure of the building from one inter-storey to another: the vertical profile must be designed to support vertical and horizontal loads with a free inflection span equal to the inter-storey span. Any out of plumb of the bearing structure can be corrected using height- and depth-adjustable sub-structures.

6. Architectural design

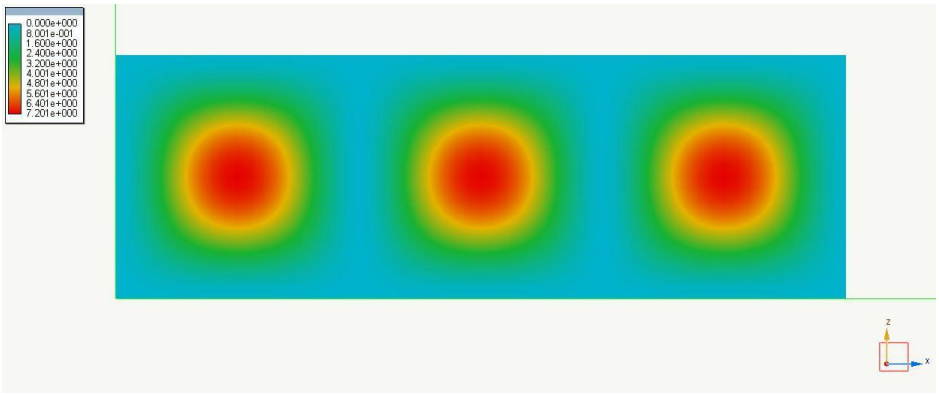
The ventilated wall is designed to accommodate the architectural and functional requirements of the building on which it is installed. When designing ventilated façades with Laminam slabs it is important that the slab size is managed correctly, enhancing its dimensions (1000x3000mm, 1200x3000mm, and 1620x3240mm), and limiting trimmings as much as possible.

The easy processing afforded by Laminam slabs means that any shape and size can be obtained by using the biggest size. The fixation method also needs to be considered based on the abacus of the façade. L-shaped cuts should be avoided with non-modular openings or elements (very frequent in building renovations).

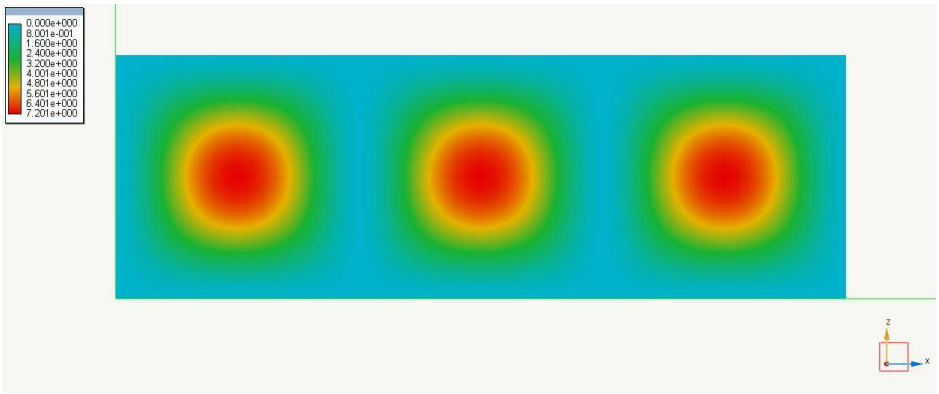
7. Structural design

Determing the tensile strenght values

The wind resistance values of Laminam slabs were calculated with FEM finite element software, using all the characteristic values indicated in the technical and product datasheets. The mechanical features of the slab were considered, and the restrictions were summarised as consistently as possible according to the true nature of the fixings.



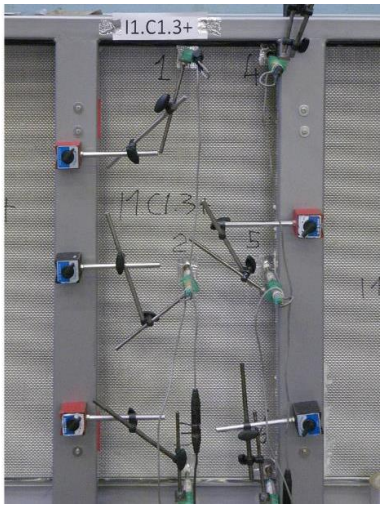
Deformative state - The values shown are purely illustrative



Tensional state – The values shown are purely illustrative

All values were validated by research and experimental inspections conducted at Istituto Giordano, during which slabs were tested in the various fixing and sub-structure pitch configurations. During the tests, the deformations of the slab in relation to the depression exerted were monitored and recorded in order to correctly calibrate the related calculation model.

The tests were performed with the wind in depression since this is the most severe condition, as it does not take into account the fibreglass bonded to the back of the slab. In effect, the fibreglass only ensures that the material is contained in the event of slab damage and breakage caused by an accidental knock.



The deformations of each slab when subjected to increasing pressure were detected using comparators. To request the wind resistance values, please contact the Laminam SpA Project Engineer at: infobim@laminam.com

8. Technical modelling data

Physical-chemical properties	Standard / method	Laminam 3+	Laminam 5+
Weight [kg/m^2]	Laminam	Average value 8,2	Average value 14
Density of stoneware [kg/m^3]	Laminam	2500	2500
Bending strenght [N/mm^2]	ISO 10545-4	Average value 50	Average value 50
Young's modulus E [N/mm^2]	UNI EN 843-2	Average value 50000	Average value 50000
Cutting modulus G [N/mm^2]	UNI EN 843-2	Average value 20660	Average value 20660
Poisson's ratio	UNI EN 843-2	Average value 0,21	Average value 0,21

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