

C-MATRIX SYSTEM

C-MATRIX G220N15-H

FRCM (FIBER REINFORCED CEMENTITIOUS MATRIX) REINFORCEMENT SYSTEM FOR THE REHABILITATION AND STRUCTURAL CONSOLIDATION OF HISTORIC AND MODERN MASONRY BUILDINGS



C-MATRIX G220N15-H is an FRCM reinforcement system that combines the effectiveness of an AR (Alkali-Resistant) fiberglass bidirectional mesh impregnated with resin and an inorganic matrix based on natural hydraulic lime (NHL). The system offers excellent chemical-physical and elastomechanical properties and ensures optimal compatibility with support materials, even on architectural assets subject to preservation or protection.

System components:

- **FB-VAR220R12S**: Bidirectional AR fiberglass mesh (Alkali Resistant) impregnated with thermosetting resin, with a dry weight of 200 g/m², which provides good tensile strength for the entire system and ensures the correct distribution of static and seismic stresses
- **EPOCA CALCE CNHL115**: Structural mortar based on natural hydraulic lime (NHL), with a compressive strength ≥ 15 MPa, which ensures proper transfer of stresses through good adhesion between the system and the support.

The impregnated AR fiberglass bidirectional mesh, characterized by flexibility and adaptability to even irregular surfaces, as well as good mechanical strength, works in synergy with the inorganic matrix to create a homogeneous and low-thickness reinforcement that does not alter the mass distribution or structural stiffness. The system integrates seamlessly with the existing masonry, thereby improving the resistance and ductility of the structure, even in contexts with potential seismic hazard.

C-MATRIX G220N15-H ensures excellent chemical and mechanical compatibility with traditional building materials, making the system suitable for strengthening buildings of high historical and artistic value. Interventions carried out with this reinforcement system are structurally effective while being minimally invasive, preserving the architectural value of existing structures.

Compliant with the provisions of EAD 340275-00-0104 "Externally bonded Composite systems with inorganic matrix for strengthening of concrete and masonry structures," **C-MATRIX G220N15-H** is CE marked for structural strengthening interventions.

APPLICATION FIELDS

- Structural reinforcement and seismic improvement of existing masonry with high masonry quality index
- Increase in structural strength and ductility
- Prevention of local and/or global collapses
- Reinforcement of masonry arches and vaults, even of reduced thickness
- Confinement and reinforcement of masonry columns
- Anti-overturning protection and reinforcement of non-structural elements (NSEs) (e.g., infill walls on framed structures)
- Reinforced masonry top courses

MAIN ADVANTAGES

1. **High performance:** The system enhances the tensile strength of masonry, ensuring structural safety even in seismic contexts and under high stress conditions, without increasing the rigidity or mass of the structure.
2. **Durability and Compatibility:** The matrix-reinforcement system ensures optimal chemical-physical compatibility with the materials of historic masonry, guaranteeing the durability of the intervention.
3. **Ease of application:** The bidirectional AR fiberglass mesh is lightweight, flexible, easy to handle, and simple to install. The "wet-on-wet" application method, combined with the mesh's characteristics, helps reduce reinforcement installation time.
4. **Environmental sustainability and living comfort:** With a matrix based on natural hydraulic lime, the system is breathable, eco-friendly, and has a low environmental impact.
5. **Versatile solution:** Suitable for both historic buildings and modern masonry structures, **C-MATRIX G220N15-H** offers a thin, non-invasive reinforcement solution ideal for use on various surfaces, including non-flat ones such as vaults, arches, and columns.
6. **Reversibility of the intervention:** The **C-MATRIX G220N15-H** system meets the reversibility criteria required for protected architectural heritage, ensuring non-invasive and easily removable interventions.

TECHNICAL DATA OF THE SYSTEM

	<i>System description</i>
Commercial Name	C-MATRIX G220N15-H
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-VAR220R12S Bidirectional AR fiberglass mesh impregnated
Type of matrix	EPOCA CALCE CNHL115 Lime-based NHL mortar
Nominal thickness of the reinforcement system	8 mm

MECHANICAL CHARACTERISTICS OF THE SYSTEM

Peel tests	Support: brick masonry		U.M.	Ref.
	Value average	Value characteristic		
Conventional limit tension $\sigma_{lim,conv}$	1290	1176	MPa	EAD 340275-00- 0104
Conventional limit deformation $\varepsilon_{lim,conv}$	1,48	-	%	
	Support: stone masonry			
Conventional limit tension $\sigma_{lim,conv}$	1183	1025	MPa	
Conventional limit deformation $\varepsilon_{lim,conv}$	1,35	-	%	
	Support: tuff masonry			
Conventional limit tension $\sigma_{lim,conv}$	1258	1018	MPa	
Conventional limit deformation $\varepsilon_{lim,conv}$	1,44	-	%	
Tensile tests	Value average	Value characteristic	U.M.	
Ultimate tension σ_u of the composite	1353	1131	MPa	
Ultimate deformation ε_u of the composite	1,78	-	%	
Stiffness modulus E_1 , in stage A	2360	-	GPa	
Effective lap tension (l=200mm) σ_{lap}	-	> 90% $\sigma_{u,k}$	-	LG 2022 FRCM quali- fication
Effective lap shear stress (l=250mm) σ_{lap}	-	> 90% $\sigma_{u,k}$	-	

GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	Description	Ref.
Commercial name	FB-VAR220R12S	
Grammage of the mesh (dry) in warp	100 g/m ²	ISO 11667:1997
Grammage of the mesh (dry) in weft	100 g/m ²	
Equivalent thickness of the reinforcement mesh in both directions	0.038 mm	EAD 340275-00-0104
Density of the material constituting the reinforcement mesh	2.65 g/cm ³	
Mesh size	12x12 mm	Internal method

Tensile tests	Value average	Value characteristic	U.M.	Ref.
Ultimate tension σ_{uf} of the mesh	1412	1232	MPa	EAD 340275-00-0104
Elastic modulus E_f of the mesh	87,4	81,6	GPa	
Ultimate tensile strain ϵ_{uf} of the mesh	1,62	-	%	

Properties	Description	Ref.
Commercial name	EPOCA CALCE CNHL115	
Class	M15	EN 998-2
Compressive strength at 28 days	≥ 15 MPa	EAD 340275-00-0104
Elastic modulus at 28 days	≥ 10 GPa	
Adhesion to the brick substrate	≥ 0.5 MPa (FP: A)	EN 1015-12
Percentage by weight of organic components	< 10 %	-
Vapor permeability	15 / 35	EN 998-2

System qualified with **CE Marking** and **AVCP 2+** performance evaluation and verification.

APPLICATION GUIDELINES FOR THE SYSTEM

The **C-MATRIX G220N15-H** system is applied through a process designed to ensure optimal performance in both historical and modern contexts, on masonry with an adequate quality index. Correct execution of all operational phases is essential to achieve effective and durable reinforcement.

ENVIRONMENTAL CONDITIONS

Application temperature: The system should be applied under environmental conditions ranging from +5°C to +35°C. Direct sunlight exposure and excessive humidity should be avoided to ensure optimal curing of the mortar and proper adhesion of the mesh.

PREPARATION OF THE SUBSTRATE

Surface preparation is crucial to ensure the full effectiveness of the **C-MATRIX G220N15-H** system. Work must be conducted on a healthy, compact, and mechanically resistant surface to ensure perfect adhesion of the mortar and reinforcement.

Removal of surface layers and preparation of the substrate: For interventions on load-bearing masonry, arches, or vaults, it is recommended to completely remove the existing plaster and/or surface coatings, either manually or with mechanical tools. All inconsistent or delaminating parts should be removed until sound masonry is reached.

Where possible, surface grinding should also be performed on mortar joints to a depth of ≥ 5 mm.

In the presence of stubborn surface coatings or plasters that are strongly bonded to the masonry, the removal of which would compromise the integrity of the support for subsequent reinforcement application, it is recommended to consult Fibre Net technicians for a specific evaluation.

For interventions on vaults, mechanically remove the existing plaster until the masonry is reached. In the case of reinforcement applied to the exterior, verify the consistency of the infill before removal and adhere to the steps outlined in the project.

In the presence of large voids or cracks, the support must be restored using materials compatible with the original ones, such as stones, bricks, or tuff, to maintain structural coherence and compatibility with existing materials.

Any edges where the system will be applied should be rounded with a curvature radius of at least 20 mm. After removal and the above preparatory work, carefully clean the surface of dust, grease, efflorescence, and other substances using low-pressure water washing. Allow excess water to evaporate, ensuring that the substrate is saturated but the surface is dry (surface dry to the touch) before applying the mortar.

The prepared surface should be level, not smooth but rough, with a roughness index ≥ 1 mm, sufficient to ensure proper adhesion of the subsequent mortar layer.

For highly absorbent or mechanically weak masonry, it is recommended to apply a consolidating primer to improve mortar adhesion. This step is particularly recommended for gypsum-based supports or substrates with low cohesion. For details on the most suitable consolidation materials, please contact the company.

MORTAR PREPARATION

The **EPOCA CALCE CNHL115** mortar should be prepared by adding clean water according to the specifications outlined in the respective technical data sheet. The mixing and preparation of the mixture must be done with appropriate tools and methods, as specified in the same technical data sheet.

APPLICATION OF THE FIRST MORTAR LAYER

On the properly roughened surface, thoroughly washed using low-pressure water washing and with the support saturated but the surface dry to the touch (surface dry), proceed with the following steps. Before applying the reinforcement system, and in the presence of irregular surfaces, it is possible to level the masonry by applying a layer of **EPOCA CALCE CNHL115** mortar using a trowel, spatula, or spray application. Allow this first layer to cure for 18-24 hours.

Then, apply a uniform first layer of **EPOCA CALCE CNHL115** mortar with a thickness of 3 to 5 mm, ensuring the material is evenly distributed across the entire surface to be treated.

INSTALLATION OF THE REINFORCEMENT MESH

While the mortar is still fresh, proceed with the application of the bidirectional AR fiberglass mesh impregnated with **FB-VAR220R12S**. The mesh should be carefully positioned and gently pressed using a flat trowel to ensure it is fully embedded in the mortar layer. At the junction points between mesh sheets, both longitudinally and transversely, ensure the adequate overlap as specified by **CNR-DT 215/2018**, guaranteeing the continuity and effectiveness of the structural reinforcement. In the absence of laboratory tests, a minimum overlap of **300 mm** is required.

In this specific case, the system is qualified for overlap lengths of **200 mm** and **250 mm**.

APPLICATION OF THE SECOND MORTAR LAYER

Once the mesh is in place, apply a second layer of mortar, fresh on fresh, with a uniform thickness of approximately 3 to 5 mm, ensuring the total thickness reaches **8 mm**. This layer must completely cover the mesh and provide adequate protection for the reinforcement.

APPLICATION OF CONNECTORS (OPTIONAL)

In special cases where a mechanical connection of the reinforcement to the load-bearing structure is required, high-strength fiberglass connectors such as **FB-TUP10-VAR** or **FB-TUF_VAR** can be used. These connectors are inserted into the masonry thickness through pre-drilled holes and embedded in the mortar, ensuring an effective connection between the reinforcement system and the existing structure. The installation of the connectors must follow the project's technical specifications and the guidelines provided by the company. In particular, for exterior reinforcement of arches or vaults, it is recommended to use connection systems on the reinforcement at the supports for approximately **200 mm**.

CURING AND PROTECTION

Once the reinforcement system has been applied, the surfaces must be adequately protected during the curing phase for at least **24 hours**. In particularly dry, hot, or windy conditions, it is recommended to cover the surfaces with tarps or use wet curing techniques, such as misting with water, to prevent the mortar from drying too quickly, which could compromise the quality of the reinforcement. In particularly aggressive environments or areas exposed to moisture or water, it is advisable to apply an additional protective layer with an appropriate product to ensure greater durability of the system. In such cases, it is recommended to consult the Technical Department to determine the most suitable protective treatment for the specific conditions.

HANDLING AND STORAGE CONDITIONS

The system is supplied in two distinct phases: the matrix (single-component hydraulic lime-based mortar) and the reinforcement (bidirectional AR fiberglass mesh impregnated).

The FB-VAR220R12S mesh is available in rolls with the following dimensions:

- 100 – 150 – 200 cm (H) x 50 – 100 (L) m

The mesh must be stored in a dry, dust-free place. Direct exposure to light and heat sources should be avoided.

The mortar **EPOCA CALCE CNHL115** is supplied in the following format:

- 25 kg bag

The mortar must be stored in its original, well-sealed packaging, in a dry place, and protected from freezing, high temperatures, excessive sunlight, and wind during the curing period.

SAFETY INSTRUCTIONS

During all stages of preparation and application of the products, the operator must use the Personal Protective Equipment (PPE) required for the specific use of meshes and mortars (work clothing, protective goggles, gloves, and dust mask). For specific instructions, refer to the respective technical and safety data sheets. Avoid contact with skin and eyes; in case of skin contact, wash thoroughly with water and soap; in case of eye contact, rinse with water and consult a doctor.

When applying in enclosed spaces, ensure adequate ventilation of the area to guarantee proper air exchange.

ENVIRONMENTAL DECLARATIONS

The **EPOCA CALCE CNHL115** mortar is certified for its minimum recycled content, issued by ICMQ.

CERTIFICATIONS

The C-MATRIX G220N15-H system is CE marked in accordance with ETA No. 22/0865.

SPECIFICATION VOICE

BRICK SUPPORT

Structural reinforcement of existing brickwork walls using the **FRCM C-MATRIX G220N15-H** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE marked with an AVCP2+ control system, and adhering to CAM requirements. The intervention involves the application of an initial layer of **EPOCA CALCE CNHL115** mortar by Fibre Net, based on natural hydraulic lime (NHL) with a compressive strength ≥ 15 MPa. This is followed by the application of a bidirectional glass fiber mesh AR impregnation FB-VAR220R12S by Fibre Net, with mesh size 12x12 mm, grammage 200 g/m², equivalent mesh thickness 0.038 mm, characteristic tensile strength of the composite 1176 MPa, and an average elastic modulus of the mesh of 87.40 GPa. A second layer of **EPOCA CALCE CNHL115** mortar will then be applied until a total intervention thickness of 8 mm is achieved. This specification excludes the following: removal of existing plaster, remediation of degraded areas, preparation of the support through surface washing and water saturation, connectors (if required), finishing products, and material acceptance tests.

All materials must comply with the technical specifications and be certified according to current regulations.

STONE SUPPORT

Structural reinforcement of existing stone masonry using the **FRCM C-MATRIX G220N15-H** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE marked with an AVCP2+ control system, and adhering to CAM requirements. The intervention involves the application of an initial layer of **EPOCA CALCE CNHL115** mortar by Fibre Net, based on natural hydraulic lime (NHL) with a compressive strength ≥ 15 MPa. This is followed by the application of a bidirectional glass fiber mesh AR impregnation FB-VAR220R12S by Fibre Net, with mesh size 12x12 mm, grammage 200 g/m², equivalent mesh thickness 0.038 mm, characteristic tensile strength of the composite 1025 MPa, and an average elastic modulus of the mesh of 87.40 GPa. A second layer of **EPOCA CALCE CNHL115** mortar will then be applied until a total intervention thickness of 8 mm is achieved. This specification excludes the following: removal of existing plaster, remediation of degraded areas, preparation of the support through surface washing and water saturation, connectors (if required), finishing products, and material acceptance tests. All materials must comply with the technical specifications and be certified according to current regulations.

TUFF SUPPORT

Structural reinforcement of existing tuff masonry using the **FRCM C-MATRIX G220N15-H** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE marked with an AVCP2+ control system, and adhering to CAM requirements. The intervention involves the application of an initial layer of **EPOCA CALCE CNHL115** mortar by Fibre Net, based on natural hydraulic lime (NHL) with a compressive strength ≥ 15 MPa. This is followed by the application of a bidirectional glass fiber mesh AR impregnation FB-VAR220R12S by Fibre Net, with mesh size 12x12 mm, grammage 200 g/m², equivalent mesh thickness 0.038 mm, characteristic tensile strength of the composite 1018 MPa, and an average elastic modulus of the mesh of 87.40 GPa. A second layer of **EPOCA CALCE CNHL115** mortar will then be applied until a total intervention thickness of 8 mm is achieved. This specification excludes the following: removal of existing plaster, remediation of degraded areas, preparation of the support through surface washing and water saturation, connectors (if required), finishing products, and material acceptance tests. All materials must comply with the technical specifications and be certified according to current regulations.

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