

C-MATRIX SYSTEM

C-MATRIX G220N15-S

FRCM (FIBER REINFORCED CEMENTITIOUS MATRIX) REINFORCEMENT SYSTEM FOR THE RESTORATION AND STRUCTURAL STRENGTHENING OF HISTORIC AND MODERN MASONRY BUILDINGS.



C-MATRIX G220N15-S is an FRCM (Fiber Reinforced Cementitious Matrix) reinforcement system that combines the efficiency of a bidirectional dry AR (Alkali-Resistant) glass fiber mesh with an inorganic matrix based on natural hydraulic lime (NHL). The system offers excellent chemical-physical and elasto-mechanical properties, ensuring optimal compatibility with support materials, including architecturally protected structures.

System components:

- **FB-VAR220R12:** A bidirectional dry AR (Alkali-Resistant) glass fiber mesh with a dry weight of 200 g/m². This component provides high tensile strength for the entire system and ensures the proper distribution of static and seismic stresses.
- **EPOCA CALCE CNHL115:** A structural mortar based on natural hydraulic lime (NHL) with a compressive strength ≥ 15 MPa. It ensures effective stress transfer through excellent adhesion between the system and the substrate.

The AR glass fiber mesh, characterized by its flexibility, adaptability to irregular surfaces, and robust mechanical resistance, synergizes with the inorganic matrix to create a homogeneous, thin, and lightweight reinforcement layer. This design minimizes mass distribution alterations and structural stiffness changes. The system integrates seamlessly with existing masonry, enhancing structural strength and ductility, even in seismic risk contexts.

C-MATRIX G220N15-S ensures excellent chemical and mechanical compatibility with traditional construction materials, making it ideal for the consolidation of historically and artistically valuable buildings. Reinforcement applications with this system are structurally effective yet 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," the C-MATRIX G220N15-S system is CE-marked for structural reinforcement interventions. Its components are also EPD-certified, contributing to compliance with CAM (Minimum Environmental Criteria).

APPLICATION FIELDS

- Structural reinforcement and seismic upgrading of existing masonry with a high-quality index.
- Increase in structural strength and ductility.
- Prevention of local and/or global collapses.
- Reinforcement of masonry arches and vaults, even those with reduced thickness.
- Confinement and reinforcement of masonry columns
- Anti-overturning measures and reinforcement of non-structural elements (NSEs), e.g., infill walls in framed structures.
- Reinforcement of masonry bond beams at the top of structures.

MAIN ADVANTAGES

1. **High performance:** The system enhances the tensile strength of masonry, ensuring structural safety even in seismic contexts and under high stress, without increasing the stiffness or mass of the structure.
2. **Durability and compatibility:** The matrix-reinforcement system ensures optimal chemical-physical compatibility with the materials of historic masonry, contributing to the long-term durability of the intervention.
3. **Ease of application:** The lightweight, flexible, and easy-to-handle bidirectional AR glass fiber mesh simplifies installation. The "wet-on-wet" application method, combined with the mesh's properties, reduces reinforcement execution time.
4. **Environmental sustainability and living comfort:** Thanks to the use of a natural hydraulic lime (NHL) matrix, the system is breathable, eco-friendly, and has a low environmental impact (EPD certification available).
5. **Versatile solution:** Suitable for both historic buildings and modern masonry structures, C-MATRIX G220N15-S is a thin, non-invasive reinforcement solution adaptable to a variety of substrates, including non-flat surfaces such as vaults, arches, and columns.
6. **Reversibility of the intervention:** The **C-MATRIX G220N15-S** system meets the reversibility criteria required for protected architectural heritage, enabling non-invasive and easily removable interventions.

TECHNICAL DATA OF THE SYSTEM

	Description of the system
Commercial Name	C-MATRIX G220N15-S
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-VAR220R12 Bidirectional dry mesh made of AR glass fiber
Type of matrix	EPOCA CALCE CNHL115 Lime-based NHL mortar
Nominal thickness of the reinforcement system	8 mm

MECHANICAL CHARACTERISTICS OF THE SYSTEM

Pull-off tests	Average value	Value characteristic	U.M.	Ref.
	Support: brick masonry			
Conventional limit stress $\sigma_{lim,conv}$	516	382	MPa	EAD 340275-00- 0104
Conventional limit strain $\varepsilon_{lim,conv}$	0,65	-	%	
Tensile tests	Value average	Value characteristic	U.M.	
Ultimate stress σ_u of the composite	594	490	MPa	
Ultimate strain ε_u of the composite	0,93	-	%	
Stiffness modulus E_1 , in stage A	95,4	-	GPa	

GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	Description	Ref.
Commercial name	FB-VAR220R12	
Weight of the mesh (dry) in warp	100 g/m ²	ISO 11667:1997
Weight 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 tensile strength σ_{uf} of the mesh	687	612	MPa	EAD 340275-00- 0104
Elastic modulus E_r of the mesh	79	69,5	GPa	
Ultimate strain in tension ε_{uf} of the mesh	0,87	-	%	

MECHANICAL PROPERTIES OF THE MORTAR

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
Weight percentage of organic components	< 10 %	-
Vapor permeability	15 / 35	EN 998-2

The system is CE-marked and certified under the **Assessment and Verification of Constancy of Performance (AVCP) System 2+**, ensuring compliance with rigorous European standards for quality and performance consistency.

APPLICATION GUIDELINES FOR THE SYSTEM

The application of the **C-MATRIX G220N15-S** system follows a structured process designed to ensure optimal performance across all application contexts, whether historic or modern, and on masonry with an adequate quality index. Proper execution of all operational phases is critical to achieving effective and durable reinforcement.

ENVIRONMENTAL CONDITIONS

Application temperature: The system must be applied in ambient conditions between +5°C and +35°C. Avoid direct solar exposure or excessive humidity during application to ensure optimal mortar curing and proper adhesion of the mesh.

PREPARATION OF THE SUBSTRATE

Substrate preparation is essential to ensure the full effectiveness of the C-MATRIX G220N15-S system. It is crucial to work on a **sound, compact, and mechanically resistant surface** to guarantee perfect adhesion of the mortar and reinforcement

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

Where possible, the removal process should also include mortar joints to a depth of ≥5 mm. In the presence of surface coatings or particularly cohesive plasters whose removal could compromise the integrity of the substrate for subsequent reinforcement applications, it is advisable to consult Fibre Net technicians for a specific assessment.

For interventions on vaults, mechanically remove the existing plaster until the masonry is exposed. If reinforcement is planned for the extrados, verify the consistency of the backfill before removing it and follow the project's specified phases.

In the case of large voids or cracks, restore the substrate using materials compatible with the originals, such as stones, bricks, or tuff, to maintain structural coherence and compatibility with existing materials.

Any edges where the system will be applied must be rounded with a minimum curvature radius of 20 mm. After removal and the above-mentioned procedures, thoroughly clean the surface of dust, grease, efflorescence, and other substances using low-pressure water washing. Allow excess water to evaporate, ensuring the substrate is saturated but the surface is dry to the touch (s.s.d.) before applying the mortar.

The prepared surface should be planar, not smooth but rough, with a roughness index of ≥1 mm to ensure adequate bonding of the subsequent mortar layer.

For highly absorbent or mechanically weak masonry, the application of a consolidating primer is recommended to improve mortar adhesion. This operation is especially advised for gypsum-based substrates or those with low cohesion. For details on the most suitable consolidation materials, contact the company.

MORTAR PREPARATION

The mortar **EPOCA CALCE CNHL115** must be prepared by adding clean water as specified in the corresponding technical data sheet. Mixing and preparation of the compound must be carried out using appropriate tools and following the procedures detailed in the technical data sheet.

APPLICATION OF THE FIRST LAYER OF MORTAR

On the properly roughened surface, thoroughly cleaned using low-pressure water washing and with a substrate that is saturated but surface-dry (s.s.d.), proceed with the following steps.

Before applying the reinforcement system, and in the presence of irregular surfaces, it is possible to regularize the masonry by applying a layer of **EPOCA CALCE CNHL115** mortar using a trowel, spatula, or spray. Allow this initial layer to cure for 18–24 hours.

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

APPLICATION OF THE REINFORCEMENT MESH

While the mortar is still fresh, proceed with the application of the dry bidirectional fiberglass mesh **AR FB-VAR220R12**. Carefully position the mesh and gently press it into the mortar layer using a flat spatula to ensure it is completely embedded.

At the junctions between mesh sheets, both longitudinally and transversely, ensure adequate overlap as specified in CNR-DT 215/2018, thereby maintaining the continuity and effectiveness of the structural reinforcement. In the absence of laboratory testing, a minimum overlap of **300 mm** is required.

APPLICATION OF THE SECOND LAYER OF MORTAR

Once the mesh has been positioned, apply a second layer of mortar *wet-on-wet* with a uniform thickness of approximately **3–5 mm**, ensuring a total thickness of **8 mm** is achieved. This layer must fully cover the mesh and provide adequate protection for the reinforcement system.

APPLICATION OF CONNECTORS (OPTIONAL)

In specific situations where a mechanical connection between the reinforcement system and 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 pre-drilled holes in the masonry and embedded within the mortar layer, ensuring an effective connection between the reinforcement system and the existing structure. The installation of connectors must follow the technical specifications of the project and the guidelines provided by the company. For extrados reinforcement of arches or vaults, it is recommended to include connectors in the reinforcement system turned over at the springing points, extending approximately **200 mm**.

CURING AND PROTECTION

After completing the application of the reinforcement system, the surfaces must be adequately protected during the curing phase for at least **24 hours**. In particularly dry, hot, or windy climates, cover the surfaces with sheets or employ wet-curing techniques, such as water misting, to prevent overly rapid drying, which could compromise the reinforcement quality.

In highly aggressive environments or areas exposed to moisture or water, applying an additional protective layer with an appropriate product is advisable to ensure the system's long-term durability. In such cases, it is recommended to consult the Technical Office to determine the most suitable protective treatment for the specific conditions.

HANDLING AND STORAGE CONDITIONS

The system is supplied in two distinct components: the **matrix** (single-component mortar based on hydraulic lime NHL) and the **reinforcement** (dry bidirectional fiberglass mesh AR).

The **FB-VAR220R12** meshes are available in rolls with the following dimensions:

- 100 cm (H) x 50 – 100 (L) m

The meshes must be stored in a dry, dust-free environment, avoiding direct exposure to light and heat sources.

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

- 25 kg bag

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

SAFETY GUIDELINESS

During all phases of preparation and application of the products, the operator must use the Personal Protective Equipment (PPE) specified for the specific use of nets and mortars (workwear, protective goggles, gloves, and dust mask). For detailed instructions, refer to the respective technical and safety data sheets. Avoid contact with skin and eyes; in case of skin contact, wash with water and soap; in case of eye contact, rinse with water and seek medical advice.

When working in enclosed spaces, ensure adequate ventilation to maintain proper air exchange.

ENVIRONMENTAL DECLARATIONS

The **FB-VAR220R12** mesh has an EPD (Environmental Product Declaration) to meet the CAM criteria. Similarly, the **EPOCA CALCE CNHL115** mortar is certified for a minimum recycled content, issued by ICMQ.

CERTIFICATIONS

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

SPECIFICATION VOICE

Structural reinforcement intervention on existing masonry walls using the FRCM system **C-MATRIX G220N15-S** by Fibre Net SpA, compliant with EAD 340275-00-0104, CE marked with AVCP2+ control system certification, and meeting CAM standards.

The intervention includes 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, followed by the installation of a bidirectional dry AR glass fiber mesh (FB-VAR220R12 by Fibre Net) with a mesh size of 12x12 mm, a weight of 200 g/m², an equivalent thickness of 0.038 mm, a characteristic ultimate tensile strength of 382 MPa, and a mean elastic modulus of 79 GPa.

The system is EPD-certified and meets CAM standards.

The intervention will conclude with the application of a second layer of **EPOCA CALCE CNHL115** mortar, achieving a total intervention thickness of 8 mm.

Excluded from this scope of work are the removal of existing plaster, rehabilitation of degraded areas, substrate preparation through cleaning and water saturation, installation of connectors (if required), application of finishing products, and acceptance testing of materials.

All materials must comply with technical specifications and certifications in accordance with current regulations.

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