

## C-MATRIX SYSTEM C-MATRIX G320N15-S

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



**C-MATRIX G320N15-S** is an FRCM (Fiber Reinforced Cementitious Matrix) reinforcement system that combines the effectiveness of an alkali-resistant (AR) glass fiber bidirectional dry 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 the substrate materials, even when applied to architecturally protected or heritage structures.

### System components:

- **FB-VAR320R12:** A bidirectional AR glass fiber dry mesh weighing 300 g/m<sup>2</sup>, which provides high tensile strength to the entire system and ensures proper distribution of static and seismic stresses.
- **EPOCA CALCE CNHL115:** A structural mortar based on natural hydraulic lime (NHL) with compressive strength  $\geq 15$  MPa, ensuring effective stress transfer through strong adhesion between the system and the substrate.

The AR glass fiber dry mesh, characterized by its flexibility, adaptability to irregular surfaces, and good mechanical strength, works in synergy with the inorganic matrix to create a homogeneous, low-thickness reinforcement. This configuration does not alter the mass distribution or structural stiffness. The system seamlessly integrates with existing masonry, improving the structure's strength and ductility, even in seismically vulnerable contexts.

**C-MATRIX G320N15-S** offers excellent chemical and mechanical compatibility with traditional construction materials, making it ideal for consolidating structures of high historical and artistic value. Reinforcement interventions with this system are structurally effective and minimally invasive, preserving the architectural significance of existing structures.

The system complies with EAD 340275-00-0104 ("Externally bonded composite systems with inorganic matrix for strengthening of concrete and masonry structures") and is CE-marked for structural reinforcement applications. Additionally, the system components hold EPD (Environmental Product Declaration) certification, contributing to compliance with Minimum Environmental Criteria (CAM) requirements.

### APPLICATION FIELDS

- Structural reinforcement and seismic improvement of existing masonry with a high masonry quality index.
- Enhancement of structural strength and ductility.
- Prevention of local and/or global collapses.
- Reinforcement of masonry arches and vaults, including those with reduced thickness.
- Confinement and reinforcement of masonry columns.
- Anti-overturning measures and reinforcement of non-structural elements (NSEs), e.g., infill panels in frame structures.
- Masonry top beams with integrated reinforcement.

### MAIN ADVANTAGES

1. **High performance:** The system enhances the tensile strength of masonry, ensuring structural safety even in seismic contexts and under high stress levels, without increasing the structure's stiffness or mass.
2. **Durability and compatibility:** The matrix-reinforcement system ensures optimal chemical-physical compatibility with historical masonry materials, resulting in long-lasting interventions.
3. **Ease of application:** The lightweight, flexible, and easy-to-handle AR glass fiber bidirectional dry mesh, combined with "wet-on-wet" application, significantly reduces installation time.
4. **Environmental sustainability and living comfort:** Thanks to its natural hydraulic lime-based matrix, the system is breathable, eco-friendly, and has a low environmental impact (EPD certification available).
5. **Versatile solution:** Suitable for both historical buildings and modern masonry structures, **C-MATRIX G320N15-S** offers a thin, non-invasive reinforcement solution adaptable to various substrates, including irregular surfaces such as vaults, arches, and columns.
6. **Reversibility of the intervention:** The **C-MATRIX G320N15-S** system complies with the reversibility criteria required for protected architectural heritage, ensuring non-invasive and easily removable interventions.

## TECHNICAL DATA OF THE SYSTEM

	Description of the system
Commercial Name	<b>C-MATRIX G320N15-S</b>
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-VAR320R12 Bidirectional dry mesh made of AR fiberglass
Type of matrix	EPOCA CALCE CNHL 115 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 $\sigma_{lim,conv}$	460	388	MPa	EAD 340275-00- 0104
Conventional limit strain $\varepsilon_{lim,conv}$	0,69	-	%	
Tensile tests	Value average	Value characteristic	U.M.	
Ultimate stress $\sigma_u$ of the composite	531	398	MPa	
Ultimate strain $\varepsilon_u$ of the composite	0,78	-	%	
Stiffness modulus $E_1$ , in stage A	382,60	-	GPa	

## GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	Description	Ref.
Commercial name	<b>FB-VAR320R12</b>	
Weight of the mesh (dry) in warp	150 g/m <sup>2</sup>	ISO 11667:1997
Weight of the mesh (dry) in weft	150 g/m <sup>2</sup>	
Equivalent thickness of the reinforcement mesh in both directions	0.057 mm	EAD 340275-00-0104
Density of the material constituting the reinforcement mesh	2.65 g/cm <sup>3</sup>	
Mesh size	12x12 mm	Internal method

Tensile tests	Value average	Value characteristic	U.M.	Ref.
Ultimate tensile strength $\sigma_{uf}$ of the mesh	493	362	MPa	EAD 340275-00- 0104
Elastic modulus $E_r$ of the mesh	66,50	57,90	GPa	
Ultimate tensile strain $\varepsilon_{uf}$ of the mesh	0,74	-	%	

## MECHANICAL CHARACTERISTICS OF THE MORTAR

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

The system is **CE-certified**, with performance assessment and verification conducted under the **AVCP 2+ system** (Assessment and Verification of Constancy of Performance).

## SYSTEM APPLICATION GUIDELINES

The application of the **C-MATRIX G320N15-S** system follows a process designed to ensure maximum performance in any context, whether historical or modern, and is intended for masonry with an adequate quality index. Proper execution of all operational steps is essential to achieve an effective and durable reinforcement.

## ENVIRONMENTAL CONDITIONS

**Application temperature:** The system should be applied in environmental conditions ranging from +5°C to +35°C. Avoid direct exposure to solar radiation or excessive humidity during application to ensure optimal curing of the mortar and proper adhesion of the mesh.

## PREPARATION OF THE SUBSTRATE

The preparation of the substrate is essential to guarantee the full effectiveness of the **C-MATRIX G320N15-S** system. The substrate must be healthy and intact, free from any deteriorated material, dust, grease, or other contaminants. It must also be compact and mechanically resistant to ensure perfect adhesion between the mortar and the 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 layers of the coating, either manually or using mechanical tools. All loose or delaminating parts must be eliminated, proceeding until reaching sound masonry.

Where possible, raking out should also be carried out on the mortar joints to a depth of at least 5 mm. In cases where surface coatings or plasters are particularly cohesive and tightly bound to the masonry, and their removal might compromise the integrity of the substrate for the subsequent reinforcement application, it is advisable to consult Fibre Net technicians for specific assessments.

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

In the presence of large voids or cracks, repairs to the substrate must be carried out using materials compatible with the originals, such as stone, bricks, or tuff, to maintain structural coherence and compatibility with the existing materials.

Any edges where the system will be applied should be rounded with a curvature radius of at least 20 mm. Following the removal and preparation steps, thoroughly clean the surface of dust, grease, efflorescence, and other substances using low-pressure water jet cleaning. Allow excess water to evaporate, ensuring the substrate is saturated but the surface is dry (s.s.d.) before applying the mortar.

The prepared surface should be flat, not smooth but rough, with a roughness index of ≥ 1 mm to ensure proper adhesion 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 step is particularly advised for substrates made of gypsum or those with low cohesion. For details on the most suitable consolidation materials, contact the company.

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## **MORTAR PREPARATION**

The **EPOCA CALCE CNHL115** mortar must be prepared by adding clean water according to the specifications outlined in its technical data sheet. Mixing and preparation must be carried out using the appropriate tools and methods as specified in the technical data sheet.

## **APPLICATION OF THE FIRST MORTAR LAYER**

On the surface that has been properly roughened, thoroughly cleaned using low-pressure water jet cleaning, and saturated but with a dry surface (s.s.d.), proceed to the next steps.

Before applying the reinforcement system, and in the presence of irregular surfaces, the masonry can be leveled by applying a layer of **EPOCA CALCE CNHL115** mortar using a trowel, spatula, or spray application. Allow this initial layer to cure for 18-24 hours.

Subsequently, 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 to be treated.

## **REINFORCEMENT MESH INSTALLATION**

While the mortar is still fresh, proceed with the application of the **FB-VAR320R12** bidirectional AR glass fiber dry mesh. Carefully position the mesh and gently press it into the mortar using a flat trowel to ensure it is fully embedded within the layer.

At the junctions between mesh sheets, both longitudinally and transversely, adequate overlap must be ensured in compliance with **CNR-DT 215/2018**. This guarantees 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 MORTAR LAYER**

Once the mesh has been positioned, apply a second layer of mortar, fresh on fresh, with a uniform thickness of approximately 3–5 mm, ensuring a total thickness of 8 mm. This layer must completely cover the mesh and provide adequate protection for the reinforcement.

## **INSTALLATION OF CONNECTORS**

In specific cases where a mechanical connection between the reinforcement and the load-bearing structure is required, high-strength glass fiber connectors such as **FB-TUP10-VAR** or **FB-TUF\_VAR** can be used. These connectors are inserted into the thickness of the masonry through pre-drilled holes and embedded within the mortar layer, ensuring effective integration between the reinforcement system and the existing structure.

The installation of connectors must follow the project's technical specifications and the guidelines provided by the company. In particular, for extrados reinforcement of arches or vaults, the use of connection systems is recommended on the folded reinforcement system at the springings, extending approximately **200 mm**.

## **CURING AND PROTECTION**

After 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 advisable to cover the surfaces with sheets or use wet curing techniques, such as misting water, to prevent overly rapid drying that could compromise the reinforcement quality.

In aggressive environments or areas exposed to high humidity or water, an additional protective layer should be applied with a suitable product to ensure greater durability of the system. In such cases, it is recommended to consult the Technical Office to define the most appropriate protective treatment for the specific conditions.

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## HANDLING AND STORAGE CONDITIONS

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

**FB-VAR320R12 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 and dust-free place. Avoid direct exposure to sources of light and heat.

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

- 25 kg bag

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

## SAFETY INSTRUCTIONS

During all phases of preparation and application of the products, operators must use the Personal Protective Equipment (PPE) required for handling meshes and mortars. This includes work clothing, protective goggles, gloves, and a dust mask. For specific guidance, refer to the respective technical and safety data sheets.

Avoid contact with skin and eyes. In case of contact with skin, wash thoroughly with soap and water. If contact occurs with eyes, rinse immediately with water and consult a physician.

When working in enclosed environments, ensure adequate ventilation to provide proper air exchange.

## ENVIRONMENTAL DECLARATIONS

The **FB-VAR320R12 mesh** is equipped with an **EPD (Environmental Product Declaration)** for compliance with CAM criteria.

Similarly, the **EPOCA CNHL115 mortar** is certified with a minimum recycled content declaration issued by **ICMQ**

## CERTIFICATIONS

The **C-MATRIX G320N15-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 G320N15-S by Fibre Net SpA, compliant with EAD 340275-00-0104, CE marked under the AVCP2+ control system, and meeting CAM standards. The intervention includes the application of a first layer of EPOCA CALCE CNHL115 mortar by Fibre Net, based on natural hydraulic lime (NHL) with a compressive strength  $\geq 15$  MPa, followed by the placement of a bidirectional dry AR glass fiber mesh FB-VAR320R12 by Fibre Net, with a mesh size of 12x12 mm, a weight of 300 g/m<sup>2</sup>, an equivalent thickness of 0.057 mm, a characteristic tensile strength of 388 MPa, and an average elastic modulus of 66.50 GPa. A second layer of EPOCA CALCE CNHL115 mortar will then be applied to achieve a total intervention thickness of 8 mm.

The specification excludes the removal of existing plaster, the restoration of deteriorated areas, the preparation of the substrate through cleaning and water saturation of the application surfaces, the installation of connectors (if required), any finishing products, and the acceptance tests on materials. All materials must comply with the technical specifications and be certified in accordance with current regulations.

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