FIBRE NET
composite engineering

C-MATRIX SYSTEM

C-MATRIX G320N15-H

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

C-MATRIX G320N15-H is an FRCM (Fiber Reinforced Cementitious Matrix) strengthening system that combines the effectiveness of an impregnated bidirectional AR (Alkali Resistant) glass fiber mesh and an inorganic matrix based on natural hydraulic lime (NHL). The system offers excellent chemical-physical and elastomechanical properties and ensures optimal compatibility with supporting materials, even on architectural heritage subject to protection or preservation regulations.

System components:
- **FB-VAR320R16S:** Bidirectional AR glass fiber mesh (Alkali Resistant) impregnated with an organic matrix, with a dry weight of 300 g/m², providing good tensile strength for the entire system and ensuring the proper distribution of static and seismic stresses
- **EPOCA CALCE CNHL115:** Structural mortar based on natural hydraulic lime (NHL), with compressive strength ≥ 15 MPa, ensuring correct stress transfer through good adhesion between the system and the substrate.

The impregnated bidirectional AR glass fiber mesh, characterized by flexibility and adaptability to irregular surfaces, as well as good mechanical resistance, works in synergy with the inorganic matrix to create a homogeneous and low-thickness reinforcement that does not alter mass distribution or structural rigidity. The system integrates perfectly with the existing masonry, thus enhancing the resistance and ductility of the structure, even in potentially seismic-prone contexts.

C-MATRIX G320N15-H ensures excellent chemical and mechanical compatibility with traditional building materials, making it suitable for the consolidation of buildings with high historical and artistic value. Interventions performed with this strengthening system are structurally effective while being minimally invasive, preserving the architectural value of existing structures.
In compliance with the provisions of EAD 340275-00-0104 "Externally bonded Composite systems with inorganic matrix for strengthening of concrete and masonry structures," **C-MATRIX G320N15-H** is CE marked for structural consolidation interventions.

CE EAD 340275-00-0104 ETA - 22/0865 | CONFORMITÀ CAM | AVCP 2+

C-MATRIX G320N15-H

APPLICATION FIELDS

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

MAIN ADVANTAGES

1. **High performance**: the system enhances the tensile strength of the masonry, ensuring structural safety even in seismic contexts and under high stress, without increasing the structure's rigidity or mass.
2. **Durability and compatibility**: the matrix-reinforcement system ensures optimal chemical-physical compatibility with masonry, resulting in long-lasting intervention durability.
3. **Ease of application**: the impregnated bidirectional AR glass fiber mesh is lightweight, flexible, easy to handle, and simple to install. The "fresh on fresh" application technique, combined with the mesh characteristics, helps reduce reinforcement installation times.
4. **Environmental sustainability and living comfort**: the use of a natural hydraulic lime-based matrix makes the system breathable, eco-friendly, and low environmental impact.
5. **Versatile solution**: suitable for both historic buildings and modern masonry structures, C-MATRIX G320N15-H is a thin, non-invasive reinforcement solution, ideal for applications on various types of substrates, including non-flat surfaces such as vaults, arches, and columns.
6. **Reversibility of the intervention**: the **C-MATRIX G320N15-**H system meets the reversibility criteria required for protected architectural heritage, ensuring non-invasive and easily removable interventions.

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C-MATRIX SYSTEM

C-MATRIX G320N15-H

TECHNICAL DATA OF THE SYSTEM

	Description of the system
Commercial Name	**C-MATRIX G320N15-H**
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-VAR320R16S Impregnated bidirectional fiberglass mesh AR
Matrix type	EPOCA CALCE CNHL115 Lime-based NHL mortar
Nominal thickness of the reinforcement system	8 mm

MECHANICAL CHARACTERISTICS OF THE SYSTEM

Pull-off tests	**Support: brick masonry**		**U.M.**	**Ref.**
	Value average	**Value characteristic**		
Conventional limit tensile strength $\sigma_{lim,conv}$	911	708	MPa	EAD 340275-00-0104
Conventional limit strain $\varepsilon_{lim,conv}$	1,09	-	%	
	Support: stone masonry			
Conventional limit tensile strength $\sigma_{lim,conv}$	1007	740	MPa	
Conventional limit strain $\varepsilon_{lim,conv}$	1,21	-	%	
	Support: tuff masonry			
Conventional limit tensile strength $\sigma_{lim,conv}$	929	790	MPa	
Conventional limit strain $\varepsilon_{lim,conv}$	1,11	-	%	
Tensile tests	**Value average**	**Value characteristic**	**U.M.**	
Ultimate tensile strength σ_u of the composite	854	633	MPa	
Ultimate strain ε_u of the composite	0,74	-	%	
Stiffness modulus E_1, in stage A	1872	-	GPa	
Effective lap shear strength (l=250mm) σ_{lap}	-	> 90% $\sigma_{u,k}$	-	LG 2022 FRCM qualification

GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	**Description**	**Ref.**
Commercial name	**FB-VAR320R16S**	
Weight of the mesh (dry) in warp	150 g/m^2	ISO 11667:1997
Weight of the mesh (dry) in weft	150 g/m^2	
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^3	
Mesh size	16x16 mm	Internal method

Tensile tests	**Value average**	**Value characteristic**	**U.M.**	**Ref.**
Ultimate tensile strength σ_{uf} of the mesh	899	454	MPa	EAD 340275-00-0104
Elastic modulus E_f of the mesh	83,50	71,40	GPa	
Ultimate tensile strain ε_{uf} of the mesh	1,08	-	%	

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C-MATRIX G320N15-H

MECHANICAL CHARACTERISTICS 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
Percentage by weight of organic components	< 10 %	-
Vapor permeability	15 / 35	EN 998-2

System qualified with CE marking and performance consistency evaluation and verification AVCP 2+.

APPLICATION GUIDELINES FOR THE SYSTEM

The application of the **C-MATRIX G320N15-H** system follows a process designed to ensure maximum performance in all application contexts, whether historical or modern, on masonry with an adequate quality index. Proper execution of all operational phases is crucial for achieving an effective and long-lasting reinforcement.

ENVIRONMENTAL CONDITIONS

Application temperature: The system should be applied in environmental conditions between +5°C and +35°C. Direct exposure to sunlight or excessive humidity should be avoided 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 G320N15-H system. Work must be performed on a sound, compact, and mechanically resistant surface to ensure perfect adhesion of the mortar and reinforcement

Removal of surface layers and preparation of the substrate: interventions on load-bearing masonry, arches, or vaults, it is recommended to completely remove the existing plaster and/or surface coating layers, either manually or using mechanical tools. Any inconsistent or detached parts must be eliminated, continuing until sound masonry is reached.
If possible, scarification should also be performed on the mortar joints to a depth of ≥5 mm. In the presence of tenacious surface coatings or plasters that are strongly bonded to the masonry, the removal of which could compromise the integrity of the substrate for subsequent reinforcement application, it is advised to consult Fibre Net technicians for a specific evaluation.

In the case of interventions on vaults, mechanically remove the existing plaster until the masonry is reached. For external reinforcement, verify the consistency of the filling material before removal and follow the steps outlined in the project.
In the presence of voids or large cracks, the substrate must be restored using materials compatible with the original ones, such as stones, bricks, or tuff, to maintain structural consistency and compatibility with the existing materials.
Any edges where the system will be applied must be rounded with a radius of curvature of at least 20 mm.
After the removal and processing described above, thoroughly clean the surface from 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 (s.d.a.) before applying the mortar. The prepared surface should be flat, not smooth but rough, with a roughness index ≥ 1 mm sufficient to ensure proper bonding of the subsequent mortar.
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 plaster substrates or those with low cohesion. For details on the most suitable consolidation materials, please contact the Company.

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MORTAR PREPARATION

The **EPOCA CALCE CNHL115** mortar should be prepared by adding clean water according to the specifications in the relevant technical data sheet. The mixing and preparation of the paste must be carried out using appropriate tools and methods as specified in the same technical data sheet.

APPLICATION OF THE FIRST LAYER OF MORTAR

On the properly roughened surface, thoroughly cleaned using low-pressure water washing, and with the substrate saturated but the surface dry (s.d.a.), proceed with the next steps.
Before applying the reinforcement system, and in the case 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. Allow this first layer to harden for 18-24 hours.
Next, apply a first uniform layer of **EPOCA CALCE CNHL115** mortar, with a thickness of 3 ÷ 5 mm, ensuring that 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 impregnated bidirectional AR glass fiber mesh **FB-VAR320R16**. The mesh should be carefully positioned and gently pressed with a flat trowel to ensure it is fully embedded in the mortar layer.
At the junctions between the mesh sheets, both longitudinally and transversely, proper overlap must be ensured according to CNR-DT 215/2018, guaranteeing continuity and the effectiveness of the structural reinforcement. In the absence of laboratory tests, a minimum overlap of **300 mm** is required. For this specific system, the overlap length is qualified to be **250 mm**.

APPLICATION OF THE SECOND LAYER OF MORTAR

Once the mesh is positioned, apply a second layer of mortar, fresh on fresh, with an even thickness of approximately 3 ÷ 5 mm, ensuring the total thickness reaches 8 mm. This layer must completely cover the mesh and provide adequate protection to the reinforcement.

APPLICATION OF CONNECTORS (OPTIONAL)

In specific situations where a mechanical connection between the reinforcement 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 the thickness of the masonry through pre-drilled holes and embedded in the mortar layer, ensuring an effective connection between the reinforcement system and the existing structure. The installation of the connectors must follow the technical specifications of the project and the guidelines provided by the Company. Specifically, for external reinforcement of arches or vaults, it is recommended to use connection systems on the reinforcement at the points of support 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 weather conditions, it is advised to cover the surfaces with tarps or use wet curing techniques, such as misting water, to prevent rapid drying that could compromise the quality of the reinforcement. In highly aggressive environments or areas exposed to humidity or water, it is recommended to apply an additional protective layer using an appropriate product to ensure greater durability of the system. In these cases, it is advised to consult the Technical Department to determine the most suitable protective treatment for the specific conditions.

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HANDLING AND STORAGE CONDITIONS

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

The **FB-VAR320R16S** meshes are available in rolls with the following dimensions:

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

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

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

- 25 kg bag

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

SAFETY GUIDELINES

During all stages of preparation and application of the products, the operator must use the appropriate Personal Protective Equipment (PPE) specified for the use of the mesh 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 contact with skin, wash with water and soap; in case of eye contact, rinse with water and consult a doctor.

In the case of application in closed environments, ensure sufficient ventilation of the area to guarantee proper air exchange.

ENVIRONMENTAL DECLARATIONS

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

CERTIFICATIONS

The **C-MATRIX G320N15-H** system is CE marked in accordance with ETA No. 22/0865.

SPECIFICATIONS

BRICK SUPPORT

Structural reinforcement intervention on existing brick masonry using the **FRCM C-MATRIX G320N15-H** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE marked with an AVCP2+ control system and in line with CAM systems. The intervention involves applying 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 application of bidirectional AR glass fiber mesh **FB-VAR320R16S** by Fibre Net, with a mesh size of 16x16 mm, a weight of 300 g/m², an equivalent mesh thickness of 0.057 mm, a characteristic conventional limit tensile strength of 708 MPa, and an average elastic modulus of 83.50 GPa. The process is completed by applying a second layer of **EPOCA CALCE CNHL115** mortar, achieving an overall intervention thickness of 8 mm.

Excluded from this scope are: removal of existing plaster, remediation of degraded areas, surface preparation through washing and saturation with water of the application surfaces, connectors (if required), any finishing products, and acceptance tests for materials.

All materials must comply with the technical specifications and be certified in accordance with current regulations.

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STONE SUPPORT

Structural reinforcement intervention on existing stone masonry using the **FRCM C-MATRIX G320N15-H** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE marked with an AVCP2+ control system and in accordance with CAM systems. 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, followed by the application of bidirectional AR glass fiber mesh FB-VAR320R16S by Fibre Net, with a mesh size of 16x16 mm, a weight of 300 g/m², an equivalent mesh thickness of 0.057 mm, a characteristic conventional limit tensile strength of 740 MPa, and an average elastic modulus of 83.50 GPa. The process is completed by applying a second layer of **EPOCA CALCE CNHL115** mortar to achieve an overall intervention thickness of 8 mm.
Excluded from this scope are: removal of existing plaster, remediation of degraded areas, surface preparation through washing and saturation with water of the application surfaces, connectors (if required), any finishing products, and acceptance tests for materials.
All materials must comply with the technical specifications and be certified in accordance with current regulations.

TUFF SUPPORT

Structural reinforcement intervention on existing tufo masonry using the **FRCM C-MATRIX G320N15-H** system by Fibre Net SpA, compliant with EAD 340275-00-0104, CE marked with an AVCP2+ control system and in accordance with CAM systems. 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, followed by the application of bidirectional AR glass fiber mesh FB-VAR320R16S by Fibre Net, with a mesh size of 16x16 mm, a weight of 300 g/m², an equivalent mesh thickness of 0.057 mm, a characteristic conventional limit tensile strength of 790 MPa, and an average elastic modulus of 83.50 GPa. The process is completed by applying a second layer of **EPOCA CALCE CNHL115** mortar to achieve an overall intervention thickness of 8 mm.
Excluded from this scope are: removal of existing plaster, remediation of degraded areas, surface preparation through washing and saturation with water of the application surfaces, connectors (if required), any finishing products, and acceptance tests for materials.
All materials must comply with the technical specifications and be certified in accordance with current regulations.

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