C-MATRIX SYSTEM

C-MATRIX C225N15-S

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

C-MATRIX C225N15-S is an **FRCM reinforcement system** that combines the performance of a bidirectional dry carbon fiber mesh with high tenacity and an inorganic matrix based on natural hydraulic lime (NHL). The system offers **excellent chemical-physical and elastic-mechanical properties**, ensuring optimal compatibility with substrate materials, including those in architecturally protected or heritage structures.

System components:

- **FB-RC225-TH12-R16:** A bidirectional dry mesh made of high-tenacity carbon fiber, with a dry weight of 206 g/m². This component provides the system with high tensile strength 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. This ensures effective stress transfer through strong adhesion between the system and the substrate.

The bidirectional high-tenacity carbon fiber dry mesh, characterized by flexibility and adaptability to irregular surfaces as well as high mechanical strength, synergizes with the inorganic matrix to create a homogeneous, thin reinforcement layer. This layer does not alter mass distribution or structural stiffness. The system integrates seamlessly with existing masonry, enhancing both the strength and ductility of the structure, particularly in seismic risk areas.

C-MATRIX C225N15-S exhibits excellent chemical and mechanical compatibility with traditional construction materials, making it ideal for the consolidation of buildings of high historical and artistic value. Reinforcement interventions using this system are structurally effective yet minimally invasive, preserving the architectural integrity of existing structures.
The system complies with the provisions of EAD 340275-00-0104 ("Externally Bonded Composite Systems with Inorganic Matrix for Strengthening of Concrete and Masonry Structures") and bears CE marking for structural consolidation applications. Furthermore, the components of the system are EPD-certified, contributing to CAM (Minimum Environmental Criteria) compliance. **C-MATRIX C225N15-S** provides a reliable and durable reinforcement solution for masonry and concrete structures, ensuring structural efficiency and the preservation of historical and architectural value.

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

C-MATRIX C225N15-S

APPLICATION FIELDS

- Structural reinforcement and seismic improvement of existing masonry with a high-quality index.
- Enhancement of strength and structural ductility.
- Prevention of local and/or global collapses.
- Reinforcement of masonry arches and vaults, even those with minimal thickness.
- Confinement and reinforcement of masonry columns.
- Anti-overturning measures and strengthening of non-structural elements (NSEs), such as infill panels in framed structures.
- Construction of reinforced masonry tie beams.

MAIN ADVANTAGES

1. **High performance**: Enhances tensile strength in masonry, ensuring structural safety even under high stress or seismic conditions, without increasing stiffness or mass.
2. **Durability and compatibility**: Provides optimal chemical and physical compatibility with historic masonry materials, ensuring long-lasting interventions.
3. **Ease of application**: Lightweight, flexible, and easy-to-handle bidirectional high-tenacity carbon fiber mesh enables quick and efficient installation. The "wet-on-wet" application method further reduces execution time.
4. **Environmental sustainability and living comfort**: The natural hydraulic lime-based matrix ensures breathability, eco-compatibility, and low environmental impact, supported by EPD certification.
5. **Versatile solution**: Suitable for both historic and modern masonry structures, offering a thin, non-invasive reinforcement layer adaptable to various substrates, including irregular surfaces like arches, vaults, and columns.
6. **Reversibility of the intervention**: Complies with criteria for reversible interventions on protected architectural heritage, enabling non-invasive and easily removable reinforcement.

Fibre Net SpA - Via Jacopo Stellini, 3 - 33050 - Z.I.U. Pavia di Udine (UD)- Italy
C.F. e P.IVA 02212620302 - Capitale Sociale € 1.000.000,00 i.v. - N. REA UD - 243635
T. +39.0432.600918 - info@fibrenet.it - www.fibrenet.it

C-MATRIX C225N15-S

TECHNICAL DATA OF THE SYSTEM

	System Description
Commercial Name	**C-MATRIX C225N15-S**
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-RC225-TH12-R16 High-tensile bidirectional carbon fiber mesh
Type of matrix	EPOCA CALCE CNHL115 Lime-based mortar NHL
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 tension $\sigma_{lim,conv}$	1320	1137	MPa	EAD 340275-00-0104
Conventional limit strain $\varepsilon_{lim,conv}$	0,70	-	%	
Tensile tests	**Value average**	**Value characteristic**	**U.M.**	
Ultimate tension σ_u of the composite	1965	1762	MPa	
Ultimate strain ε_u of the composite	1,15	-	%	
Stiffness modulus E_1, in stage A	366,20	-	GPa	

GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	**Description**	**Ref.**
Trade name	**FB-RC225-TH12-R16**	
Grammage of the mesh (dry) in warp	103 g/m^2	ISO 11667:1997
Grammage of the mesh (dry) in weft	103 g/m^2	
Equivalent thickness of the reinforcement mesh in both directions	0.058 mm	EAD 340275-00-0104
Density of the material constituting the reinforcement mesh	1.78 g/cm^3	
Mesh size	16 x16 mm	Internal method

Tensile tests	**Value average**	**Value characteristic**	**U.M.**	**Ref.**
Ultimate tension σ_{uf} of the mesh	1324	1137	MPa	EAD 340275-00-0104
Elastic modulus E_f of the mesh	189,10	151,80	GPa	
Ultimate tensile strain ε_{uf} of the mesh	0,70	-	%	

Fibre Net SpA - Via Jacopo Stellini, 3 - 33050 - Z.I.U. Pavia di Udine (UD)- Italy
C.F. e P.IVA 02212620302 - Capitale Sociale € 1.000.000,00 i.v. - N. REA UD - 243635
T. +39.0432.600918 - info@fibrenet.it - www.fibrenet.it

C-MATRIX C225N15-S

MECHANICAL CHARACTERISTICS OF THE MORTAR

Properties	Description	Ref.
Trade 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

Qualified system with **CE marking** under **Assessment and Verification of Constancy of Performance (AVCP) System 2+**.

APPLICATION GUIDELINES FOR THE SYSTEM

The application of the **C-MATRIX C225N15-S** system follows a process designed to ensure maximum performance in any application context, whether historical or modern, by working on masonry with an appropriate quality index. Proper execution of all operational phases is crucial to achieving effective and durable reinforcement.

ENVIRONMENTAL CONDITIONS

Application temperatures: The system must be applied under environmental conditions between +5°C and +35°C. Avoid exposure to direct sunlight or excessive humidity to ensure optimal mortar curing and proper adhesion of the mesh.

PREPARATION OF THE SUBSTRATE

Proper substrate preparation is essential to ensure the full effectiveness of the C-MATRIX C225N15-S system. The surface must be sound, compact, and mechanically resistant to ensure perfect adhesion of the mortar and reinforcement.

Removal of surface layers and preparation of the support: For interventions on load-bearing masonry, arches, or vaults, it is recommended to completely remove the existing plaster and/or surface covering layers, either manually or using mechanical tools. All inconsistent or detached parts should be eliminated, proceeding until reaching sound masonry.
Scarification, where possible, should also include mortar joints to a depth of ≥5 mm. For surfaces with particularly cohesive plaster or coatings whose removal might compromise the integrity of the support for subsequent reinforcement, consult Fibre Net technicians for a specific evaluation.

For vault interventions, mechanically remove the existing plaster until reaching the masonry. In the case of extrados reinforcement, verify the consistency of the filling before removing it, and follow the project phases.
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 the existing materials.
Any edges where the system will be applied must be rounded with a curvature radius of at least 20 mm.
After removal and the aforementioned processes, thoroughly clean the surface of dust, grease, efflorescence, and other substances using low-pressure water cleaning. Allow excess water to evaporate, ensuring the support is saturated but the surface is dry to the touch (SSD condition) before applying the mortar.
The prepared surface must be planar, not smooth but rough, with a roughness index ≥1 mm, sufficient to ensure proper bonding of the subsequent mortar layer.
For highly absorbent or mechanically weak masonry, applying a consolidating primer to improve mortar adhesion is recommended. This operation is particularly advised for gypsum supports or substrates with low cohesion. For details on the most suitable consolidating materials, contact the company.

Fibre Net SpA - Via Jacopo Stellini, 3 - 33050 - Z.I.U. Pavia di Udine (UD)- Italy
C.F. e P.IVA 02212620302 - Capitale Sociale € 1.000.000,00 i.v. - N. REA UD - 243635
T. +39.0432.600918 - info@fibrenet.it - www.fibrenet.it

MORTAR PREPARATION

The **EPOCA CALCE CNHL115** mortar must be prepared by adding clean water as specified in its technical data sheet. Mixing and preparation should be conducted with the appropriate tools and methods outlined in the data sheet.

APPLICATION OF THE FIRST LAYER OF MORTAR

On the properly roughened surface, thoroughly cleaned through low-pressure water washing and in a condition where the support is saturated but the surface is dry to the touch (SSD), proceed with the subsequent phases. For irregular surfaces, it is possible to level the masonry by applying a layer of **EPOCA CALCE CNHL115** mortar with a trowel, spatula, or spray. This first layer must be allowed to harden for 18–24 hours. Afterward, a uniform first layer of **EPOCA CALCE CNHL115** mortar should be applied 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, the high-strength bidirectional carbon fiber mesh **FB-RC225-TH12-R16** must be applied in its dry state. The mesh should be positioned carefully and gently pressed with a flat spatula to ensure it is completely embedded within the mortar layer. At the junctions between mesh sheets, both longitudinally and transversely, adequate overlap must be ensured as specified by CNR-DT 215/2018 to guarantee the continuity and effectiveness of the structural reinforcement. In the absence of laboratory tests, 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, wet-on-wet, 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.

APPLICATION OF CONNECTIONS (OPTIONAL)

In specific situations where a mechanical connection of the reinforcement to the load-bearing structure is required, high-strength carbon fiber connectors such as **FB-TUP10-CHT** or **FB-TUF_CHT** can be used. These connectors are inserted into the masonry through pre-drilled holes and embedded within the mortar layer, ensuring an effective connection between the reinforcement system and the existing structure. Connector installation must be carried out in accordance with the project specifications and the guidelines provided by the company. In particular, for extrados reinforcement of arches or vaults, it is recommended to use connection systems on the reinforcement system turned back at the springing points, covering 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 conditions, it is advisable to cover the surfaces with sheets or use wet curing techniques, such as water misting, to prevent overly rapid drying, which could compromise the quality of the reinforcement.
In particularly aggressive environments or areas exposed to humidity or water, applying an additional protective layer with a suitable product is recommended to ensure greater durability of the system. In such cases, consulting the Technical Office to determine the most appropriate protective treatment for the specific conditions is strongly advised.

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 dry bidirectional high-strength carbon fiber mesh).

The **FB-RC225-TH12-R16** meshes are available in rolls with the following dimensions:

- 100 – 125 cm (H) x 50 – 100 (L) m

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

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

- 25 kg bag

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

Fibre Net SpA - Via Jacopo Stellini, 3 - 33050 - Z.I.U. Pavia di Udine (UD)- Italy
C.F. e P.IVA 02212620302 - Capitale Sociale € 1.000.000,00 i.v. - N. REA UD - 243635
T. +39.0432.600918 - info@fibrenet.it - www.fibrenet.it

C-MATRIX C225N15-S

SAFETY INSTRUCTIONS

During all phases of product preparation and application, operators must use the Personal Protective Equipment (PPE) required for the specific handling of meshes and mortars, including work clothing, protective goggles, gloves, and a dust mask. For detailed guidance, refer to the relevant technical and safety data sheets. Avoid contact with skin and eyes; in case of skin contact, wash thoroughly with soap and water. In case of eye contact, rinse with water and seek medical attention.

For indoor applications, ensure adequate ventilation to maintain proper air exchange.

ENVIRONMENTAL DECLARATIONS

The **FB-RC225-TH12-R16** mesh has an Environmental Product Declaration (EPD), contributing to the CAM (Minimum Environmental Criteria) requirements. Similarly, the **EPOCA CALCE CNHL115** mortar is certified for minimum recycled content by ICMQ.

CERTIFICATIONS

The C-MATRIX C225N15-S system is CE-marked in accordance with ETA No. 22/0865.

SPECIFICATION VOICE

Structural reinforcement intervention on existing brick masonry using the **FRCM C-MATRIX C225N15-S** system by Fibre Net SpA, compliant with **EAD 340275-00-0104**, CE-marked under AVCP2+ system, and meeting CAM requirements.
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 of ≥ 15 MPa. This is followed by the installation of a dry bidirectional high-strength carbon fiber mesh FB-RC225-TH12-R16 by Fibre Net, with the following specifications: 16x16 mm mesh size, 206 g/m² weight, equivalent mesh thickness of 0.058 mm, characteristic conventional composite tensile strength of 1137 MPa, and average elastic modulus of 189.10 GPa.
Subsequently, a second layer of **EPOCA CALCE CNHL115** mortar is applied to achieve a total intervention thickness of 8 mm.
The scope excludes the following: removal of existing plaster, remediation of deteriorated areas, preparation of the substrate through washing and water saturation, connectors (if required), finishing products, and material acceptance testing.
All materials must comply with the technical specifications and be certified in accordance with current regulations.

Fibre Net SpA - Via Jacopo Stellini, 3 - 33050 - Z.I.U. Pavia di Udine (UD)- Italy
C.F. e P.IVA 02212620302 - Capitale Sociale € 1.000.000,00 i.v. - N. REA UD - 243635
T. +39.0432.600918 - info@fibrenet.it - www.fibrenet.it