

C-MATRIX SYSTEM C-MATRIX C225N15-M

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



C-MATRIX C225N15-M is an FRCM (Fiber Reinforced Cementitious Matrix) reinforcement system that combines the effectiveness of a bidirectional dry high-tenacity carbon fiber mesh and an inorganic matrix based on natural hydraulic lime (NHL), bonded together by a water-based adhesion promoter. The system offers excellent chemical-physical and elasto-mechanical properties and ensures optimal compatibility with the supporting materials, even on architectural assets subject to preservation/protection.

System components:

- **FB-RC225-TH12-R16:** A bidirectional dry high-tenacity carbon fiber mesh with a dry weight of 206 g/m², which provides good 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 a compressive strength of ≥ 15 MPa, which ensures the correct transfer of stresses through good adhesion between the system and the substrate.
- **FB-IPN01:** A two-component, water-based product consisting of resins supported by a microcrystalline inorganic matrix, used for impregnating reinforcements made of glass or carbon fibers as an adhesion promoter.

The bidirectional dry high-tenacity carbon fiber mesh, characterized by flexibility and adaptability to irregular surfaces as well as good mechanical strength, works in synergy with the inorganic matrix, enhanced by the adhesion promoter, to create a homogeneous and low-thickness reinforcement that does not alter the mass distribution or structural rigidity. The system integrates perfectly with the existing masonry, thus improving the resistance and ductility of the structure, even in areas with potential seismic risk.

C-MATRIX C225N15-M ensures excellent chemical and mechanical compatibility with traditional building materials, making the system suitable for the consolidation of buildings with high historical and artistic value. The interventions carried out with this reinforcement system are structurally effective while being minimally invasive, allowing the architectural value of the existing structures to be preserved.

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 C225N15-M** is CE marked for structural reinforcement interventions. The system's constituent elements are EPD certified for CAM contribution purposes.

C-MATRIX SYSTEM

C-MATRIX C225N15-M

FIELDS OF APPLICATION

- 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, including those with reduced thickness.
- Confined and reinforced masonry columns.
- Anti-toppling protection and reinforcement of non-structural elements (NSEs) (e.g., infill walls on framed structures).
- Reinforced masonry coping beams.

MAIN ADVANTAGES

1. **High performance:** The system improves the tensile strength of the 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, resulting in the durability of the intervention.
3. **Ease of application:** The bidirectional dry high-tenacity carbon fiber mesh is lightweight, flexible, easy to handle, and simple to install. The "fresh on fresh" application method, combined with the characteristics of the mesh, helps reduce reinforcement installation time.
4. **Environmental sustainability and living comfort:** With the use of a matrix based on natural hydraulic lime, 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 C225N15-M** is a thin, non-invasive reinforcement solution, suitable for applications on various types of supports, including non-flat surfaces such as vaults and arches, columns, etc.
6. **Reversibility of the intervention:** The **C-MATRIX C225N15-M** system meets the reversibility criteria required for protected architectural heritage, ensuring non-invasive interventions that are easily removable.

TECHNICAL DATA OF THE SYSTEM

	Description of the system
Commercial Name	C-MATRIX C225N15-M
Manufacturer	Fibre Net SpA
Type of reinforcement	FB-RC225-TH12-R16+IPN Bidirectional mesh made of high tensile carbon fiber Water-based adhesion promoter
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	Average value	Value characteristic	U.M.	Ref.
	Support: brick masonry			
Conventional limit tension $\sigma_{lim,conv}$	1473	1197	MPa	EAD 340275-00- 0104
Conventional limit strain $\varepsilon_{lim,conv}$	0,75	-	%	
Tensile tests	Value average	Value characteristic	U.M.	
Ultimate tension σ_u of the composite	2142	1939	MPa	
Ultimate strain ε_u of the composite	1,10	-	%	
Stiffness modulus E_1 , in stage A	433,90	-	GPa	

GEOMETRIC, MECHANICAL AND PHYSICAL DATA OF THE REINFORCEMENT

Properties	Description	Ref.
Commercial name	FB-RC225-TH12-R16	
Weight of the mesh (dry) in warp	103 g/m ²	ISO 11667:1997
Weight 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 tensile strength σ_{uf} of the mesh	1964	1793	MPa	EAD 340275-00- 0104
Elastic modulus E_f of the mesh	195,31	173,90	GPa	
Ultimate strain in tension ϵ_{uf} of the mesh	1,01	-	%	

MECHANICAL CHARACTERISTICS OF THE ADHESION PROMOTER

Properties	Description	Ref.
Commercial name	FB-IPN01	
Catalysis ratio components A / B	0.5 : 1	-
Compressive strength at 28 days	> 15 MPa	EN 1542
Flexural strength at 28 days	> 5 MPa	EN 1015-11

MECHANICAL PROPERTIES OF 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 support	≥ 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** with assessment and verification of performance consistency **AVCP 2+**

APPLICATION INSTRUCTIONS FOR THE SYSTEM

The application of the **C-MATRIX C225N15-M** system follows a process designed to ensure maximum performance in every application context, whether historical or modern, and operates on masonry with an adequate quality index. Proper execution of all operational phases is crucial to achieving 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 exposure to direct sunlight or excessive humidity to ensure optimal mortar curing and proper mesh adhesion.

PREPARATION OF THE SUBSTRATE

The preparation of the substrate is crucial to ensure the full effectiveness of the **C-MATRIX C225N15-M** system. It is necessary to work 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 support: 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 using mechanical tools. All inconsistent or detached parts must be eliminated, continuing until the healthy masonry is reached.

Where possible, **scarification** should also be carried out on the mortar joints to a depth of ≥ 5 mm. If there are particularly strong and cohesive surface coatings or plasters that, if removed, would compromise the integrity of the substrate for the subsequent reinforcement application, it is advisable 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. If reinforcement is to be applied to the extrados, verify the consistency of the backing before removal and follow the steps outlined in the project.

In the presence of large voids or significant cracks, the substrate should be restored using materials compatible with the original ones, such as stones, bricks, or tuff, in order 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 the removal and the above-mentioned works, clean the surface thoroughly to remove dust, grease, efflorescence, and other substances using low-pressure water washing. Allow excess water to evaporate, ensuring the substrate is saturated but the surface remains dry (**s.s.a.**) before applying the mortar.

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

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

PREPARATION OF THE MORTAR

The **EPOCA CALCE CNHL115** mortar should be prepared by adding clean water in the amounts specified in the relevant technical data sheet. The mixing and preparation of the mortar must be carried out using appropriate tools and methods, in accordance with the guidelines provided 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.s.a.**), proceed with the following 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, float, or spray application. Allow this first layer to harden for 18-24 hours.

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

APPLICATION OF THE FIRST LAYER OF ADHESION PROMOTER

On still damp mortar, approximately 15–20 minutes after application, proceed with the application of the first layer of FB-IPN01 adhesion promoter using a brush or roller, at a coverage rate of approximately 600g/m² of the surface to be treated.

It is essential to apply the adhesion promoter on the surface of the mortar while it is still damp, but not in the water sheen stage.

INSTALLATION OF REINFORCEMENT MESH

While the adhesion promoter is still fresh, proceed with the application of the dry bidirectional high-tenacity carbon fiber mesh **FB-RC225-TH12-R16**. The mesh must be carefully positioned and gently pressed with a flat trowel to ensure it is fully embedded in the layer of mortar and adhesion promoter. At the junctions between the mesh sheets, both longitudinally and transversely, adequate overlap must be ensured as per the guidelines of **CNR-DT 215/2018**, thus maintaining the continuity and effectiveness of the structural reinforcement. In the absence of laboratory tests, a minimum overlap of **300 mm** is required.

APPLICATION OF SECOND LAYER OF ADHESION PROMOTER

Once the mesh is in place, apply the second layer of FB-IPN01 adhesion promoter to the still damp reinforcement using a brush or roller, at a coverage rate of 400g/m² of the surface to be treated. Be sure to use the special grooved steel roller to press the air out of the fabric, ensuring proper impregnation of the fibers.

APPLICATION OF THE SECOND LAYER OF MORTAR

Apply a second layer of mortar onto the last layer of adhesion promoter, fresh onto 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.

APPLICATION OF CONNECTORS (OPTIONAL)

In specific situations where a mechanical connection of the reinforcement to the load-bearing structure is required, high-tenacity carbon fiber connectors such as **FB-TUP10-CHT** or **FB-TUF_CHT** can be used. These connectors are inserted into pre-drilled holes in the masonry and embedded in 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 Manufacturer. Specifically, for the external reinforcement of arches or vaults, it is recommended to adopt connection systems on the reinforcement near the spring points, extending for approximately **200 mm**.

CURING AND PROTECTION

Once the reinforcement system application is completed, 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 tarpaulins or use wet curing techniques, such as misting water, to prevent rapid drying that could compromise the quality of the reinforcement. In aggressive environments or areas exposed to humidity or water, an additional protective layer should be applied using an appropriate product to ensure greater durability of the system. In these 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 phases: the matrix (monocomponent hydraulic lime-based mortar NHL) and the reinforcement (dry bidirectional high-tenacity carbon fiber mesh).

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

- 100 - 125 cm (H) x 50 - 100 (L) m

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

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

- 25 kg bag

The mortar must be stored in its original, tightly 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, operators must use the appropriate Personal Protective Equipment (PPE) for the specific handling of meshes and mortars (work clothing, protective goggles, gloves, and dust mask). For detailed instructions, refer to the relevant 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 attention.

In case of application in enclosed spaces, ensure proper ventilation to guarantee adequate air exchange.

ENVIRONMENTAL DECLARATIONS

The **FB-RC225-TH12-R16** mesh is provided with an Environmental Product Declaration (EPD) for compliance with CAM criteria.

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

CERTIFICATIONS

The C-MATRIX C225N15-M 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-M system by Fibre Net SpA, in compliance with EAD 340275-00-0104, CE marked with AVCP2+ control system, and meeting CAM criteria. 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. While the mortar is still damp, the first layer of the water-based FB-IPN01 adhesion promoter, made of interpenetrating resins, is applied. This is followed by the positioning of the dry bidirectional high-tenacity carbon fiber mesh FB-RC225-TH12-R16 by Fibre Net, with mesh size 16x16 mm, grammage 206 g/m², equivalent mesh thickness 0.058 mm, characteristic composite ultimate tensile strength 1197 MPa, and average elastic modulus of the mesh 195.31 GPa. A second layer of FB-IPN01 adhesion promoter is then applied, followed by a second layer of EPOCA CALCE CNHL115 mortar, bringing the total thickness of the intervention to 8 mm.

The following are excluded from the scope of work: removal of existing plaster, remediation of degraded areas, surface preparation by washing and water saturation of the application surfaces, connectors (if required), any finishing products, and material acceptance tests. All materials must conform to the technical specifications and be certified in accordance with applicable regulations.

The information provided in this data sheet, along with any technical advice given verbally or in writing regarding the usage methods and performance of our products, reflects the current state of scientific and practical knowledge. However, it does not imply any responsibility or guarantee regarding the final result of operations involving the use of our products. It is the responsibility of the customer to determine whether Fibre Net products are suitable for the intended use and objectives, and to ensure compliance with workplace conditions and disposal procedures in accordance with applicable laws and regulations. Fibre Net reserves the right to modify the technical characteristics, descriptions, and illustrations of the product covered by this data sheet at any time. The customer is required to verify that this data sheet has not been superseded by later editions and/or new products. For further information, the customer is advised to contact the Fibre Net technical office in advance. This edition cancels and replaces any previous versions.