RUREGOLD
INNOVATION & SAFETY FOR BUILDING

FRCM SYSTEM FOR MASONRY

PBO-MESH 22/22

FRCM system for masonry consisting of 22+22 g/m² bidirectional PBO mesh and inorganic matrix

FIELDS OF APPLICATION

- Adapting and upgrading the static and anti-seismic behaviour of masonry buildings.
- Structural strengthening of loadbearing walls (piers) and perimeter strips (spandrels) of masonry buildings.
- Structural strengthening of masonry corners and horizontal bandaging at floor levels.
- Structural strengthening of eaves ring beams in masonry walls.
- Structural strengthening of masonry arches, vaults, and domes.
- Structural strengthening of masonry infrastructure.

ADVANTAGES AND PROPERTIES OF THE SYSTEM

- Increased strength capacity of structural elements that are subject to shear and combined axial and flexural forces, for in-plane and out-of-plane actions.
- Increased ductility of masonry buildings.
- High system reliability in relation to post-cracking behaviour in detachment conditions.
- High system ductility and energy dissipation capacity.
- The system is also resistant to high temperatures and freeze-thaw cycles.
- The inorganic matrix has very good ability to adhere to the support and very good chemical and physical compatibility with masonry.
- The inorganic matrix is easy and reliable to apply, in the same way as a traditional bagged premixed cementitious mortar.
- The system can also be applied to damp supports without any need for special protection.
- The mesh is easy to apply and manipulate.

METHOD OF USE

SUPPORT PREPARATION

The support must be reinstated and appropriately prepared in accordance with the following instructions, subject to prior approval by the Director of Works:

- The substrate must be clean, firm, and free of loose parts, dust, or mould.
- If necessary, clean the surfaces by sandblasting or low-pressure water jetting.
- Ensure the substrate is sufficiently moist and has been correctly prepared to take the first layer of **MX-PBO MASONRY** mortar, followed by the subsequent phases for applying the FRCM system.

If the support is deteriorated, irregular, and/or damaged, proceed as follows with prior approval by the Director of Works:

- Remove any incoherent residues of bedding mortar between different stone elements, and all previous work that could compromise the effectiveness of adhesion to the substrate - such as previous structural reinstatement work to the masonry element, e.g. unstitching-restitching work and/or deep repointing to the mortar joints.
- Remove all existing mortar residues, either mechanically or simply by raking out manually.
- Regularise the support and/or the mortar joints as necessary using structural repair mortars such as **MX-RW High Performance, MX-CP Lime, MX-15 Plaster**, or **MX-PVA Fibre Reinforced** (refer to the technical data sheet for the technical data sheets downloadable from **www.ruregold.com**).
- Ensure the substrate is sufficiently moist and has been correctly prepared to take the first layer of **MX-PBO MASONRY** mortar, followed by the subsequent phases for applying the FRCM system.

PREPARATION OF THE MX-PBO MASONRY MATRIX

- A planetary mixer can be used but should not be loaded to more than 60% of its nominal capacity for the indicated mixing times.
- A rotary mixer can be used but should not be loaded to more than 60% of its nominal capacity for the indicated mixing times.
- If mixing manually, pour part of the bag contents into a bucket and use a drill fitted with a paddle mixer, adding water as required.
- Once a bag of pre-mixed **MX-PBO MASONRY** has been opened, all of its contents must be used.

➢ Preparation using a **planetary** mixer (or a **rotary mixer**, or a **drill fitted with a mixer**):

1. Open the 25 kg bag of mortar.
2. Pour the premixed **MX-PBO MASONRY** into the mixer and add about 90% of the prescribed amount (6.0-7.0 litres) of clean water.
3. Mix continuously (without stopping, to prevent clumping) for 2-3 minutes (3-4 minutes if using a rotary mixer). Then add the remaining 10% of clean water and finish by mixing continuously for about one more minute.
4. Leave the mix to stand for about 1-2 minutes before use.
5. Before applying the material give it a final mix if necessary.

APPLICATION OF THE FRCM SYSTEM

Structural strengthening using **PBO-MESH 22/22** mesh in combination with the special **MX-PBO MASONRY** matrix is carried out in the following phases:

- Apply a first layer of **MX-PBO MASONRY** matrix to a minimum thickness of 3 mm and a maximum thickness of 5 mm.
- Apply the **PBO-MESH 22/22** mesh, manually incorporating it into the first still-fresh matrix layer using a **smooth metal trowel and/or metal spatula** until the PBO-MESH takes on a →"semi-see through" appearance.
- Apply the second layer of **MX-PBO MASONRY** matrix, again to a minimum thickness of 3 mm and a maximum thickness of 5 mm, on top of the first still-fresh matrix layer, applying sufficient pressure to push it through the openings of the mesh, to ensure optimal adhesion between the first and second matrix layers.
- Continue in the same way for any further layers of matrix, being sure to apply them whilst the previous layers are still fresh.
- Where mesh strips meet end to end, or if a strip needs to be extended in length, form an overlap of about 300 mm that follows the direction of the stress.
- To cut the **PBO-MESH 22/22** mesh use an **angle grinder** or the special **Ruregold scissors**.
- For rubblecore masonry and/or unconnected walls, use the appropriate **PBO-JOINT** face-to-face connectors in combination with **MX-JOINT** inorganic matrix (refer to the technical data sheet for the **PBO-JOINT + MX-JOINT** connection system, downloadable from **www.ruregold.com**).
- If the strengthening system is to be applied to one face only of the wall panel, use the appropriate **PBO-JOINT** connectors in combination with **MX-JOINT** inorganic matrix. The connectors should be long enough to penetrate into the outermost layer of the unstrengthened wall (refer to the technical data sheet for the **PBO-JOINT + MX-JOINT** connection system, downloadable from **www.ruregold.com**).

TECHNICAL CHARACTERISTICS

PROPERTIES OF PBO FIBRE (polyparaphenylene benzobisoxazole)	
Tenacity	5.80 GPa
Young's modulus of elasticity	270 GPa
Ultimate elongation	2.5 %
Density	1.56 g/cm^3
Decomposition temperature	+ 650 °C
Regulatory reference for the fibres	ISO 16120 – 1/4

PROPERTIES OF PBO-MESH 22/22	
Weight of the PBO fibres only	44 g/m^2
Total weight of the mesh	approx. 72 g/m^2
Equivalent thickness of the balanced mesh 0/90 ° (warp)	0.014 mm
Equivalent thickness of the balanced mesh 0/90 ° (weft)	0.014 mm
Young's modulus of elasticity E_f of the dry mesh	282 GPa
Coil width	100 cm
Coil length	15 metres
Storage	In a dry place away from heat sources
Packaging	15-metre coils, h 100 cm

PROPERTIES OF MX-PBO MASONRY INORGANIC MATRIX	
Density	approx. 1650 kg/m^3
Application time	After 10-15 minutes densification begins. Mix again and use within a maximum of approx. 45 minutes
Application temperature	from +5°C to +35°C
Compressive strength at 28 days	≥ 20 MPa
Flexural strength at 28 days	≥ 3.5 MPa
Young's modulus of elasticity at 28 days	≥ 7500 MPa
Consumption	1.3 kg/m^2 per mm of application thickness 5.2 kg/m^2 per 4 mm of application thickness
Reaction to fire (EN 13501-1)	Euroclass A2
Packaging	Disposable wooden pallets each with 40 no. 25 Kg bags, equivalent to 1000 kg of the loose product
Storage conditions	In original packaging, under cover, in a cool, dry, unventi-lated place
Shelf life (European Directive 2003/53/EC)	Not more than twenty-four (24) months from packing date
Safety data sheet	Available from **www.ruregold.com**
CE marking	EN 998 – 2

PROPERTIES OF THE FRCM MASONRY STRENGTHENING SYSTEM (PBO-MESH 22/22 + MX-PBO MASONRY)		
$\varepsilon_{lim,conv}$ (conventional limit stress according to CNR-DT 215/2018*)	Brick/clay support	1662 MPa
	Tuff support	2467 MPa
$\varepsilon_{lim,conv}$ (conventional limit strain according to CNR-DT 215/2018*)	Brick/clay support	0.59 %
	Tuff support	0.88 %
Matrix compressive strength	20 MPa	
Ultimate tensile strength of FRCM system (CNR-DT 215/2018*)	2400 MPa	
System-critical mechanism (CNR-DT 215/2018*)	Type F	
Operating temperature range (CNR-DT 215/2018*)	Max 100°C	
Application thickness of **MX-PBO MASONRY** matrix	3-5 mm per layer	

* CNR-DT 215/2018 - Guide for the Design and Construction of Externally Bonded Fibre Reinforced Inorganic Matrix Systems for Strengthening Existing Structures, issued by Italian national research council CNR - Advisory committee on technical recommendations for construction.

GENERAL NOTES/GUIDANCE

Implement **FRCM masonry strengthening system** following the methods indicated by the Designer, to consist of **PBO-MESH 22/22 + MX-PBO MASONRY** taking account of the mesh width and overlaps, and the positioning of any **PBO-JOINT + MX-JOINT** fibre connectors. Any support preparation work, if required, should be carried out with particular care.
Store the material under cover in a dry place well away from substances that could compromise the integrity and adhesion of the matrix. Appropriate site PPE must be worn when installing the FRCM system.
For further technical information, contact Ruregold Technical Support on +39 02.48011962 – info@ruregold.it.

SPECIFICATION ITEM

Supply and implement FRCM structural strengthening system consisting of Ruregold **PBO-MESH 22/22** balanced PBO fibre bidirectional mesh. The PBO fibre has a density of 1.56 g/cm^3, traction/tenacity strength of approx. 5.8 GPa, maximum Young's modulus of elasticity of 270 GPa, and ultimate elongation 2.5%. The system is coupled with Ruregold **MX-PBO MASONRY** inorganic matrix, specific for use on masonry supports, of compressive strength ≥ 20 MPa, flexural strength ≥ 3.5 MPa, and Young's modulus of elasticity ≥ 7,5 GPa. The dry mesh has a grammage (0/90 °) of 44 g/m^2 and an equivalent thickness (0/90 °) of 0.028 mm. The PBO fibre FRCM system increases the resistance to pressure bending and shear of loadbearing masonry walls and perimeter strips for in-plane and out-of-plane actions. It can also be used to strengthen masonry corners and ring beams at intermediate floors and eaves; to strengthen the extrados and intrados of arched and vaulted structures; to confine masonry columns; and increase ductility. The FRCM system is suitable for load conditions caused by seismic action. The system meets the requirements of CNR-DT 215/2018 (Guide for the Design and Construction of Externally Bonded Fibre Reinforced Inorganic Matrix Systems for Strengthening Existing Structures, issued by Italian national research council CNR - Advisory committee on technical recommendations for construction). The reaction to fire classification of the system meets the requirements of EN 13501-1: A2-s1, d0. Preparation of the surfaces and installation of the system must follow the manufacturer's instructions.

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