PBO-MESH 70/18

FRCM strengthening system for concrete consisting of biaxial PBO fabric mesh weighing 70+18 g/m² (2.0+0.5 oz/yd²) and MX-PBO Concrete inorganic matrix.

FIELDS OF APPLICATION

- Retrofitting and upgrading the static and seismic behaviour of R.C. buildings.
- Retrofitting and upgrading the static and seismic behaviour of R.C. infrastructure.
- Flexural structural strengthening of beams.
- Structural strengthening for combined axial and flexural forces in columns.
- Shear structural strengthening of reinforced concrete beams, columns, beam-column joints and walls.
- Confinement of reinforced concrete columns.
- Improving the ductility of reinforced concrete elements.

METHOD OF USE

Preparing the substrate

Repair and prepare the substrate as necessary, in accordance with the following instructions, subject to prior approval of the Works Manager:

- Remove any deteriorated substrate by hydrodemolition of the concrete cover and stripping the reinforcement until reaching a concrete layer that is well-compacted and not carbonated.
- Eliminate any loose material, grease, or oil from the concrete rebars and remove the rust layers by brushing (manually or mechanically). We recommend also sand-blasting the concrete rebars.
- Coat the concrete rebars with a passivating layer, using a paintbrush to apply two coats of an anti-corrosive, cementitious mortar, e.g. **Ruregold Passivator** (consult the technical data sheet on the web site Ruregold.com) so that the exposed reinforcements are completely covered.
- Restore the volume of the substrate by repairing the concrete cover using **MX-R4 Repair** type mortar, applying the product in 20-25 mm (0.79-0.98 in) layers using a trowel while the preceding layer is still wet (consult the technical data sheet on the web site Ruregold.com).
- Before applying the FRCM system, round off the sharp edges of the section (radius ≥ 20mm (0.79 in) see CNR DT215/2018 and ACI 549.4R-20 – Chapter 11).
- Saturate the substrate before applying the FRCM strengthening system.

Preparing the inorganic matrix

MX-PBO Concrete does not require any additional material and may be prepared using:

- A planetary type mixer.
- A concrete mixer (do not exceed 60% of the nominal load limit and mix with the axis of rotation almost horizontal).
- A screw mixer (e.g. Gras Calce **Turbomalt** mixer).
- The product may also be mixed manually in a bucket using a paddle mixer, pouring in a part of the contents of the bag and adding the appropriate quantity of water.

Mix as follows:

1. Pour in the contents of the bag of **MX-PBO Concrete** and add approx. 5.5-6.0 litres (1.45-1.58 gal) of clean water, as specified on the bag.
2. Mix for about 3-4 minutes (4-5 minutes when using a concrete mixer) so as to obtain a smooth, homogeneous mix.
3. Leave the mix to stand for about 1-2 minutes before use.

APPLICATION

To realise the FRCM system, proceed as follows:

- Cut the **PBO-MESH 70/18** to the required dimensions using an **angle grinder** or **Ruregold SCISSORS**.
- Apply an initial layer of **MX-PBO Concrete** matrix, between 3 mm (0.12 in) and 5 mm (0.20 in) thick.
- Apply the **PBO-MESH 70/18**, embedding it manually in the initial layer of matrix while still fresh using a **smooth metal float and/or spatula with rounded edges** to create a see-through effect.
- Apply a second layer of **MX-PBO Concrete** matrix, between 3 mm (0.12 in) and 5 mm (0.20 in) thick, over the initial layer while it is still fresh, exerting sufficient pressure to guarantee optimal adhesion between the two layers.
- When applying two or more layers of PBO mesh, apply each layer on the previous one while still fresh as described above.
- Where they meet longitudinally, ensure the mesh strips overlap by approx. 300 mm (11.81 in) in the direction of the stress.
  (provide sufficient overlap when splicing fabrics as determined according to test methods specified in AC434 - see ACI 549.4R-20 chapter 11)
- When using the system for strengthening columns against combined axial and flexural forces and in all those cases where it is not possible to guarantee an anchoring depth of at least 300 mm (11.81 in) (see Section 6, CNR DT215/2018) and 152 mm (6.0 in) (see ACI 549.4R-20 – Chapter 11), install **PBO-JOINT** connectors as necessary, using **MX-JOINT** inorganic matrix (consult the technical data sheet on the web site www.ruregold.com).

FINISHING

Once the mortar is fully cured, apply the appropriate finishing, provided it does not contain chalk.

PROPERTIES OF PBO (polyparaphenylene benzobisoxazole) FIBRE

Toughness	5.8 GPa (841.2 ksi)
Modulus of elasticity	270 GPa (39160.2 ksi)
Maximum strain at rupture	2.5 %
Density	1.56 g/cm^3 (0.056 lb/in^3)
Decomposition temperature	+ 650 °C (1202 °F)
Compliant	ISO 16120 – 1/4

PROPERTIES OF PBO-MESH 70/18

PBO fabric mesh weight	70 g/m^2 (2.0 oz/yd^2) in warp and 18 g/m^2 (0.5 oz/yd^2) in weft
Mesh total weight	approx. 126 g/m^2 (3.7 oz/yd^2)
Equivalent thickness of the mesh in warp	0.045 mm^2/mm (0.002 in^2/in)
Equivalent thickness of the mesh in weft	0.012 mm^2/mm (0.0004 in^2/in)
Strand pitch distance (yarn)	approx. 9 mm (0.35 in)
Area single thread (yarn)	approx. 0.42 mm^2 (0.00065 in^2)
Dry mesh modulus of elasticity E_f	241 GPa (34954 ksi)
Width of mesh on the reel	100 cm (39.4 in)
Length of mesh on the reel	15 m (49.2 ft)
Storage conditions	In the original packaging, indoors, in a cool, dry, unventilated place away from sources of heat.
Packaging	15-metre (49.2 ft) rolls, h 100 cm (39.4 in)

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PROPERTIES OF MX-PBO CONCRETE INORGANIC MATRIX

Density of fresh mortar (EN 1015-6)	Approx. 1900 kg/m³ (118.6 lb/ft³)
Application time at 20°C	densification begins after approx. 10-15 minutes. Mix again and use within a maximum of about 45 minutes
Application temperature	From +5°C (41°F) up to +35°C (95°F)
Compressive strength after 28 days	≥ 40 MPa (5801.5 psi)
Modulus of elasticity in compression after 28 days	≥ 15 GPa (2175.6 ksi)
Coverage	approx.9.3 kg/m² (1.91 lb/ft²) per strengthening layer (3+3 mm) approx. 18.5 13.9 kg/m² (2.85 lb/ft²) per double strengthening layer (3+3+3 mm)
Packaging	Disposable wooden pallet laden with 60 x 25 kg (55 lb) bags - total weight 1500 kg (3300 lb)
Storage conditions (Regulation (CE) No. 1907/2006 – Annex XVII point 47)	In original packaging, indoors, in a cool, dry, unventilated place.
Durability (Regulation (CE) No. 1907/2006 – Annex XVII point 47)	Not more than 12 months from packing date.
Compliance	EN 1504-3 / FRCM Guidelines 03/22

PROPERTIES OF THE PBO-MESH 70/18 + MX-PBO CONCRETE STRENGTHENING SYSTEM

Designed in accordance with "CNR-DT215/2018" (National Research Council Technical Guidelines)

Conventional limit stress (characteristic value)	$\sigma_{lim,conv}$	Concrete	1914 MPa (277602 psi)
Conventional limit strain (characteristic value)	$\varepsilon_{lim,conv}$	Concrete	0.79 %
Ultimate tensile strength of the FRCM composite (Tensile failure) (characteristic value)	σ_u	2568 MPa (343594 psi)	
Ultimate tensile strength of the dry fabric (Tensile failure) (characteristic value)	$\sigma_{u,f}$	3388 MPa (494578 psi)	
Dry fabric modulus of elasticity (mean value)	E_f	241 GPa (34954 ksi)	
Matrix compressive strength (characteristic value)	$f_{c,mat}$	40 MPa (5801.5 psi)	
Equivalent thickness of the mesh in warp	t_f	0.045 mm (0.002 in)	
System failure mechanism	-	Type D	
Serviceability temperature range	T_{min} - T_{max}	From -18°C (-0.4 °F) to +100°C (212°F)	
Application thickness of MX-PBO Masonry matrix	-	3-5 mm (0.12-0.20 in) per layer	
Reaction to fire (EN 13501-1)		A2-s1, d0	
Certification	-	**CE Marked** according to **EAD 340275-00-0104** "Externally bonded composite systems with inorganic matrix for strengthening of concrete and masonry structures" **DoP n. R0042** **CVT no. 285 of 28/06/2023** according to the 'Guidelines for the identification, qualification, and acceptance control of fiber-reinforced composites with inorganic matrix (FRCM) to be used for the structural consolidation of existing buildings' in combination with the PBO-MESH 70/18 mesh.	

"ICC-ES" verification in accordance with "AC434" Acceptance Criteria

Designed in accordance with "ACI 549.4R-20" and "ACI 549.6R-20"

Ultimate tensile strength (characteristic value)	f_{fu}	1532 MPa (222.20 ksi)
Ultimate tensile strain (characteristic value)	ε_{fu}	1.63 % reduced to 1.2 % in accordance with ACI 549.4R-20 for confinement and flexural strengthening reduced to 0.4 % in accordance with ACI 549.4R-20 for shear strengthening
Composite (FRCM kit) modulus of elasticity in cracked phase (mean value)	E_f	128 GPa (18564.82 ksi)
Matrix compressive strength (characteristic value)	$f_{c,mat}$	40 MPa (5801.51 psi)
Equivalent thickness of the mesh in warp	t_f	0.045 mm (0.0018 in)
Application thickness of MX-PBO Masonry matrix	-	3-5 mm (0.12-0.20 in) per layer
Certification	-	ESR-3265

SPECIFICATION ITEM

Supply and application of a CE marked FRCM structural strengthening system, consisting of an unbalanced, bi-directional PBO fibre mesh, e.g. Ruregold **PBO-MESH 70/18** and **MX-PBO Concrete** inorganic matrix. The PBO fibre has a density of 1.56 g/cm^3 (0.056 lb/in^3), toughness/tensile strength of approx. 5.8 GPa (841.2 ksi), maximum modulus of elasticity of 270 GPa (39160.2 ksi), and fracture strain 2.5%. The grammage of the dry mesh is 70 g/m^2 (2.0 oz/yd^2) in warp and 18 g/m^2 (0.5 oz/yd^2) in weft, while the equivalent thickness is 0.045 mm (0.002 in^2/in) in warp and 0.012 mm (0.0004 in^2/in) in weft. The compressive strength of the inorganic matrix, which is specifically designed for concrete substrates, is ≥ 40 MPa (5801.5 psi), while the modulus of elasticity is ≥ 15 GPa (2175.6 ksi). The PBO fibre FRCM system may be used to increase the resistance to combined axial and flexural forces, and confinement in columns and shear in beams; in addition, it may also be used for localised strengthening at beam - column joints. The system is resistant to high temperatures and freeze/thaw cycles and may be applied directly to moist substrates. The system is consistent with the March 2022 FRCM Guidelines and is recognised by the International Code Council ICC-ES with Evaluation Service Report ESR-3265 according to AC434. The fire reaction classification of the system meets the requirements of EN 13501-1: A2–s1, d0. The substrate must be prepared and the system applied in accordance with the manufacturer's instructions

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