Ruredil X Mesh C10 M25

Carbon Mesh with stabilized cement matrix for Masonry Structural Reinforcement

Product description

RUREDIL X MESH C10 is a structural composite material consisting of a carbon mesh which acts as continuous reinforcement and a stabilized inorganic matrix which joins the mesh to the masonry support.
RUREDIL X MESH C10 is a patented system introducing world-wide innovation in the field of structural reinforcement systems based on high performance fibers such as carbon, Kevlar, glass, etc., generically referred to as FRP. The latter compounds have an organic binder (epoxy resin or polyester) to guarantee adhesion to the support.
RUREDIL X MESH C10 is a Fiber Reinforced Cementitious Matrix which, unlike FRPs with epoxy resin, uses an inorganic matrix consisting of a pozzolanic hydraulic binder that is perfectly chemically, physically, and mechanically compatible with the masonry support.

Typical applications

RUREDIL X MESH C10/M25 is the specific FRCM reinforcement system for all masonry structures:

- Structural reinforcement.
- Seismic improvement.
- Seismic compliance.
- Replacement of conventional reinforced concrete slab made with wire or glass mesh.

Packaging, storage, dosage and yield

- RUREDIL X MESH C10: roll of carbon mesh, 100 cm wide and 15 meters long.
- RUREDIL X MESH M25: inorganic stabilized matrix, 25 kg bags.
- 1 roll of 15 meters of RUREDIL X MESH C10 requires 5 bags of RUREDIL X MESH M25 mortar.
- As it is based on inorganic materials, RUREDIL X MESH M25 is sensitive to humidity, so it must be kept indoors in a dry place. Use up all the content once the container is opened.
- Store at a temperature between +5°C and +40°C.

Consistency (EN 1015-3)	165
Specific weight of fresh mortar (EN 1015-6)	1.50 ± 0.05
Liters of water per 100 kg Ruredil X Mesh M25	25 – 27
Yield Kg/m^2/mm (dry product)	1.160 – 1.220
Liters of fresh mortar per 100 kg Ruredil X Mesh M25	84 – 86

Benefits over conventional FRPs

RUREDIL X MESH C10 offers the following advantages over an epoxy resin or polyester based FRP system:

Fireproof to the same degree as the masonry base

The structural properties of FRP systems are dependent on the operation temperature. In fact, it should be considered that the vitreous transition temperature (Tg) of epoxy resins – which is usually between 40 and 80 °C – is the chemical-physical parameter influencing the performances of an FRP system, independently from the fiber (carbon, aramid, etc.).
When the external temperature is higher than the vitreous transition temperature, epoxy resin is no longer able to transfer strains from the structure to the high module fiber sunk in it, affecting the effectiveness as structural reinforcement. This behavior is due to total loss of the adhesive bound between resin and fiber and/or resin and support.
After hardening, RUREDIL X MESH M25 is not influenced by the external temperature and is fire-resistant as it is inorganic, like the masonry support.
FRP systems are not fire-resistant and they even feed the fire, producing toxic fume emissions.

Resistance to humidity

The adhesion to masonry of RUREDIL X MESH M25 is not influenced by relative room humidity, unlike FRPs. In fact, epoxy resin degrades due to extended exposure to environment humidity, losing its adhesive properties, hence the capacity to transfer strains to the structural fiber.

Applicability on wet bases, being a cement-based product

FRP systems can only be applied if the support is dry, as resins (polyester and epoxy resins) do not catalyze with water.

Easy application even on rough or irregular surfaces

The layer of inorganic mortar RUREDIL X MESH M25 smoothes over irregularities in the surface (considering the system thickness) without any need for smoothing over the surface as in the case of FRP applications.

Easy handling

The premixed material is simply mixed with the amount of water specified in the instruction sheet and applied like conventional cement mortar, drowning the structural carbon mesh in it.

Workability
There are no major differences in workability retention times between 5°C and 40°C. Resin pot life depends on temperature, limiting application of FRPs in unfavorable temperature and humidity conditions.

This is not a toxic product unlike the resins used in FRPs
When applying RUREDIL X MESH C10, it is sufficient to follow the normal operating instructions for cement mortars.

Tools used in application can be cleaned in water
FRPs require the use of special solvents, and in many cases tools cannot be used again.

Recommendations for use and applications

a) Preparing the base
Prepare the surface as follows:
- Remove the existing plaster through demolition with electric or compressed air hammers. If it is not possible to use mechanical equipment, proceed through simple chipping;
- Remove any protective surface treatments with "grip primers" or any other material that may affect proper adhesion on the support;
- Beat and remove any incoherent parts through water blasting or washing at low pressure with brushing;
- If any macroscopic defects are identified on surfaces, repair the surface on the original levels with RUREWALL mortars;
- Before proceeding with plating with RUREDIL X MESH C10/M25, apply the render mortar RUREWALL R/Z to smoothen the base.

b) Preparing the mortar RUREDIL X MESH M25
Pour about 90% of the recommended quantity of water into the mixer and start the mixer by continuously adding RUREDIL X MESH M25 to prevent clot formation.
Mix for 2-3 minutes; if necessary, add the remaining water until the desired consistency is reached and mix for another 3-4 minutes. In particularly hot climate conditions, small water content increases are acceptable as compared with the values indicated in the technical data sheet. The opposite is applicable in cold and damp weather conditions.
Mixing by hand is recommended.

c) The effect of temperature
It is recommendable to apply the product at a temperature between +5% and +35%°C; lower temperatures (4-10°C) considerably slow down the setting time, while at higher temperatures (35-50°C) the mortar will rapidly become unworkable.

d) Applying the mortar RUREDIL X MESH M25
Dampen the base by soaking it with water and removing any excess water, then apply RUREDIL X MESH M25 with a smooth metal trowel in a layer about 3 mm thick; bury RUREDIL X MESH C10 in it immediately.
Apply a second layer of RUREDIL X MESH M25 about 3 mm thick so as to cover the mesh completely.

e) Applying the mesh RUREDIL X MESH C10
RUREDIL X MESH C10 must be applied with an orientation of 0°/90° as compared with the ground level or the bedding level of bricks in the masonry. Overlap by at least 10 cm at the joints.
If several layers of RUREDIL X MESH C10 are required, repeat the operation described above - wet on wet - applying the next layer when the previous layer is not completely hardened. Also apply RUREDIL X MESH C10 preferably alternating the 0°/90° orientation with +45°/-45° orientation (diagonally with respect to the previous layer of mesh or as required by the architect).
Overlap by at least 10 cm at the joints.
Do not apply the RUREDIL X MESH C10 system under the sun, during the hot hours of summer days or when the wind is moderate to strong. If it is raining, protect the structure appropriately.

f) Curing
Protection systems may be required in locations subject to strong ventilation or exposure to the sun (such as wet nonwoven fabric, application of CURING S, etc.).

Properties:

- **Mechanical characteristics of carbon fibers RUREDIL X MESH C10 consists of:**

Flexural strength (MPa)	4,800
Elastic modulus (GPa)	240
Fiber density (g/cm^3)	1.78
Ultimate elongation (%)	1.8

- **Characteristics of mesh RUREDIL X MESH C10**

Weight of carbon fibers in the mesh (g/m^2)	168
Thickness for calculation of carbon section at 0° or 90°(mm)	0.047

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Engineering criteria of reinforcements with RUREDIL X MESH C10 for masonry

Masonry reinforced with RUREDIL X MESH C10 reinforcement system allows the existence of a tension status, which could not exist if there is no reinforcement.

In fact, plating made with RUREDIL X MESH C10/M25 prevents the formation of joints between two adjacent bricks through the formation of tangential tensions on the interface surface between reinforcement and support.

Therefore, any *crisis mode* of the *masonry-composite* structural element occurs due to:

1. Break from wall compression;
2. Break from traction of reinforcement material (in rare cases);
3. Delamination of reinforcement created by detachment of reinforcement from the support and removal of a wall layer (in 99% of cases).

In the spirit of the Technical Manual CNR-DT200/2004, the dimensioning of reinforcement must be calculated considering the following ratio:

$$\varepsilon_{fd} = \min \{\varepsilon_{fRd}, \varepsilon_{fdd}\}$$

where:

ε_{fRd} = break expansion of reinforcement
ε_{fdd} = maximum expansion for intermediate delamination.

Therefore, for engineering purposes it is important to quantify the ε_{fd} value, which usually coincides with the ε_{fdd} value of the previous ratio, whose value refers to the crisis mode No. 3.

In the case of the RUREDIL X MESH C10/M25 system, this term has been deducted through a significant experiment campaign developed at the Laboratory of Ruredil spa's Material Structural Engineering Department.

For the analysis of mechanical characteristics of the adherence bound between the wall and RUREDIL X MESH C10/M25 system, a test was used, called, *double-shear push test* in technical literature (Yao et Al 2004).

These tests allowed associating each anchoring length adopted with the corresponding delamination strength and the corresponding delamination expansion, considered as end delamination expansion.

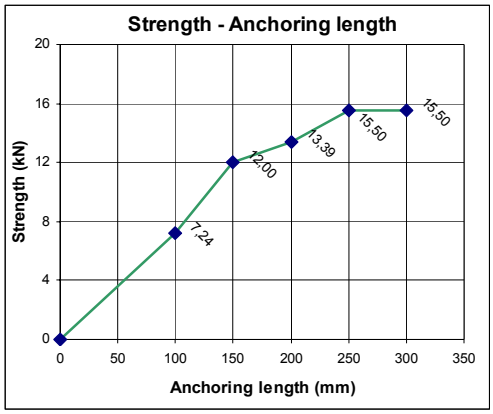

Fig. 1 Diagram showing *Delamination strength-anchoring length* for clay brick walls.

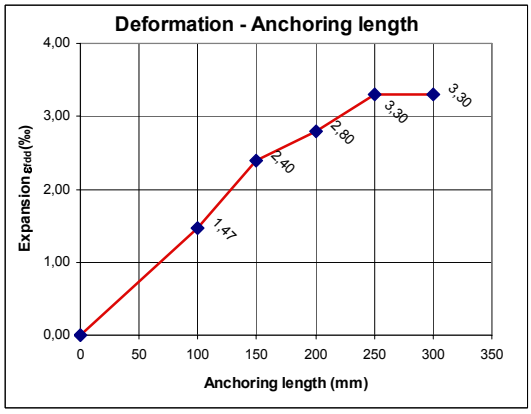

Fig. 2. Diagram showing ε_{fdd}- *anchoring length* for clay brick walls.

The following table shows the calculation values of end delamination expansion ε_{fdd2}, intermediate delamination ε_{fdd}, mechanical tensile strength up to delamination **F**, and effective length L_{eff} obtained for test samples consisting of walls made with different materials:

WALL TYPE	ε_{fdd2} ‰	ε_{fdd} ‰	F (Mpa	L_{eff} (mm)
Clay bricks (in good conditions)	3.3	6.6	1650	250
Hollow brick	1.4	2.8	700	250
Calcareous tufa stone blocks	4.1	8.1	2060	250
Clay bricks (in bad conditions)	2.8	5.6	1415	250

The value ε_{fdd} is also a required input data set of Ruredil X-Mesh Masonry Design program, requested as a characteristic of the composite material.

It is remarked that calculation strengths indicated in the table can only be obtained if masonry has appropriate mechanical characteristics. Otherwise, early masonry cracks may appear and, hence, the crisis with fiber sliding in the cement matrix may not be reached.

Therefore, careful assessment of support mechanical characteristics and checks that this is appropriate for plating of the reinforcement system are recommended.

NOTE:
The project of a reinforcement action shall anyhow be based, as for any kind of composite material, on careful evaluation of the characteristics of the structure to be strengthened. In particular, the qualities of materials used shall be investigated.
The crisis mode of the structure before and after reinforcement shall also be assessed.

*The **engineers** must know the mechanical properties and durability of structural reinforcement in the various temperature and hygrometry conditions.*
Before delivery of the executive project, the engineer shall estimate the masonry mechanical characterization and local damage (cracks and detachments) to be repaired, based on required tests in situ.

*The **clerk of works** shall perform an accurate acceptance test of composite material as concerns the following: its mechanical and stability characteristics in the various environmental conditions for its application; the compliance with conditions set by the engineer as concerns gluing surfaces; performance of a preventive test; and usual monitoring activities on application, including the application of composite material.*

Revision 09/2009. The present edition cancels and replaces all the previous ones. The information contained in the present technical data sheet is based on our knowledge and experience and should therefore not be taken as our guarantee. Neither shall we be responsible for the utilisation of the product since the conditions under which it is used are beyond our control

Ruredil S.p.A.
Headquarters and plant: Via B. Buozzi, 1 - I-20097 San Donato Milanese – Milan (ITALY)
Phone: +39.02.5276041 Export dept.: ext. 1255 – Fax: +39.02.5272185 e-mail: info@rurcem.it website: www.ruredil.it
Abroad: Algeria, Austria, Canada, Costa Rica, Chile, Cuba, Cyprus, Dominican Republic, Ecuador, Egypt, France, Greece, Iran, Morocco, Panama, Poland, Portugal, Qatar, Romania, Russia, Spain, Switzerland, Tunisia, Ukraine, U.S.A.