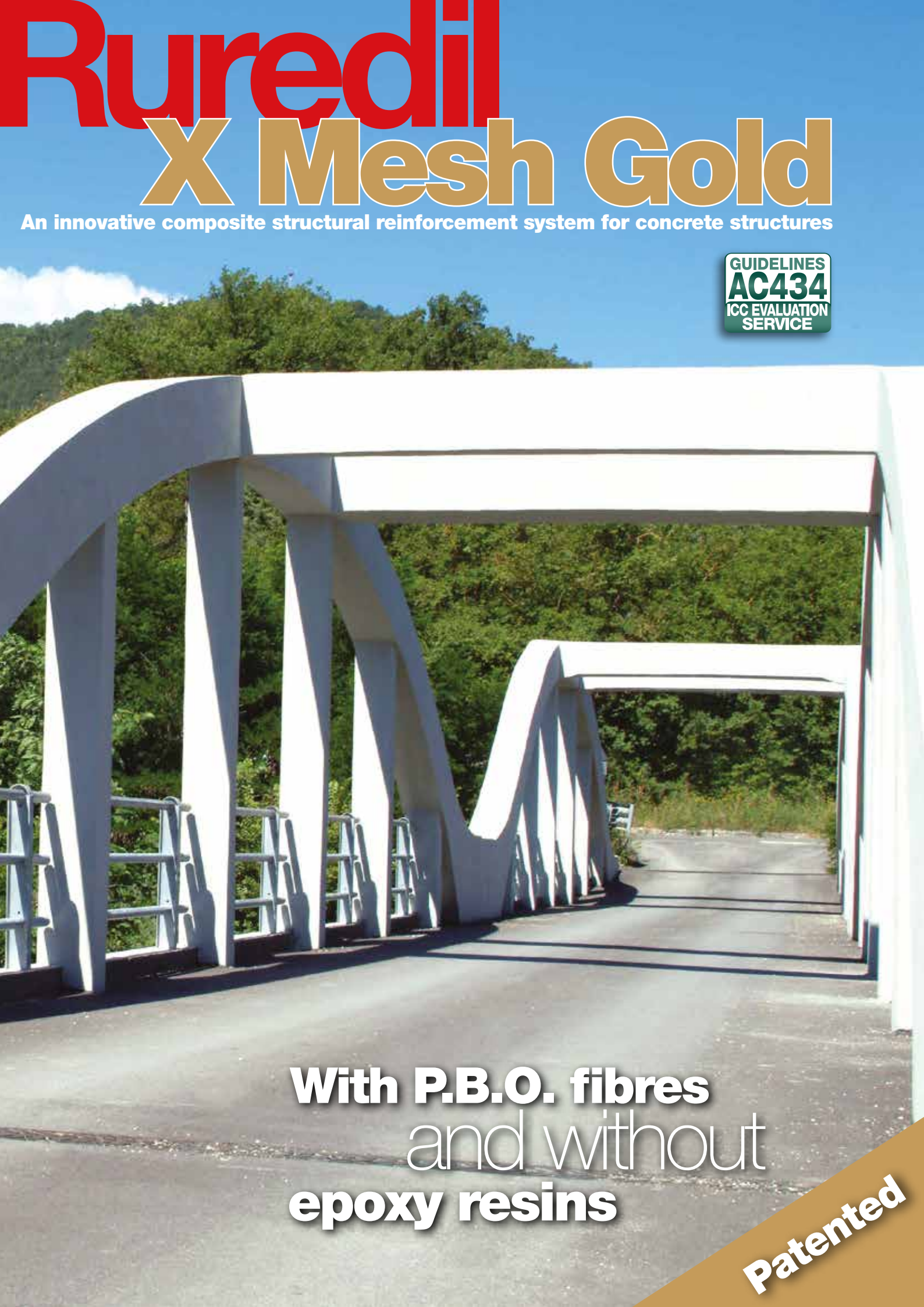
Ruredil X Mesh Gold

An innovative composite structural reinforcement system for concrete structures

GUIDELINES AC434 ICC EVALUATION SERVICE



With P.B.O. fibres
and without
epoxy resins

Patented

Ruredil X Mesh

Using innovative structural reinforcements designed specifically for concrete structures, fireproof, applicable to damp substrates quick and easy to apply.

Increasing concrete structures final shearing and flexural strengths, recovering reinforcements loss of efficiency, without using steel or epoxy resins.

Gold

All this is now possible thanks to **Ruredil X Mesh Gold**, a composite reinforcement system **designed specifically for concrete structures** without epoxy resins and without carbon fibres. Certified performance, easy application, assured results.

Ruredil X Mesh Gold

An innovative composite structural reinforcement system for concrete structures

Composite reinforcements

Composite reinforcement systems are the result of the combination of a long high performance fibre with a matrix (traditionally an epoxy resin), which acts as an adhesive, conveying stress from the structure to the fibre.

The mechanical properties of the fibres used to produce the composite (such as carbon, aramidic fibres, glass, etc.) allow this method to be used to reduce stress, due to bending and flexing and to increase the load on beams, floor slabs, pillars, etc.

Ruredil X Mesh Gold was used to restore the Montedison former plant in Assisi (PG).

effective • resistant • versatile

General limits of epoxy resins

Conventional F.R.P. systems make use of a specific kit of epoxy resins to glue a continuous fibre to the structure, so that they form a single unit and the fibre absorbs stresses. But epoxy resins, due to their chemical nature, which have a negative effect both on application and on heat and fire resistance, have well known limitations.

Use of FRP systems must therefore be carefully considered, taking into account the intrinsic limitations of the epoxy matrix, the application of which requires knowledge of the relative humidity of the substrate and an adequate **fire protection**, as advised by the Italian National Research Council (CNR) belonging to the Ministry of Industry – in the technical document DT 200/2013, paragraph 3.6.

Epoxy resins disadvantages

- They cannot be applied on damp substrates;
- they cannot be applied at temperatures of less than 10°C or more than 30°C, because the hardening phase is strongly affected by environmental temperature conditions, making their application difficult or risky;
- they are not fire or heat resistant, because once they have hardened, they return to a viscous/rubbery state at about 80°C / 110°C, making structural reinforcement ineffective.

Ruredil composite reinforcement systems: the only ones without epoxy resins

Ruredil is the first company in the world to have developed, innovative composite reinforcement systems **that do not rely on epoxy resins**: Ruredil X Mesh C10 since 2001, when it was launched on the Italian market, more than 300.000 m^2 have been applied on all kinds of structures and now it is the preferred market solution to reinforce masonry structures.

This experience has now generated **Ruredil X Mesh Gold**, a new **certified system** offering the exclusive benefits of **P.B.O. fibres**, instead of carbon fibres and the ease of application of a ready-to-use mortar.

The many advantages of this solution make Ruredil X Mesh Gold the perfect system for concrete structural reinforcement of public facilities (schools, hospitals, community facilities), infrastructures (bridges, viaducts, railway and motorway piers) and wherever heat and/or fire resistance is required along with an easy and economical application.

This system is **internationally patented** and is one of the **Ruredil's exclusive structural engineering solutions**.

• innovative • safe • certified •

Ruredi X Mesh Gold Advantages

- reliable performance, certified by university institutes;
- designed on the basis of experience with hundreds of important applications of Ruredil FRCM systems;
- easy to apply without the need of specially skilled workers;
- clean, as all tools can be cleaned just with water;
- applicable to damp substrates;
- as resistant to fire as the original substrate;
- no delamination under shearing stress.

Ruredil X Mesh Gold: the F.R.C.M. system specific for structural reinforcement of concrete constructions

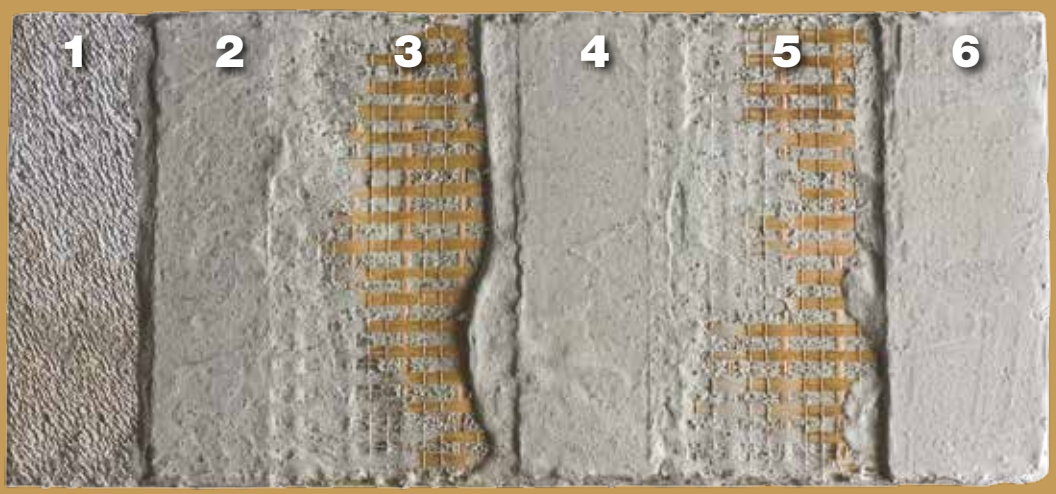
Ruredil X Mesh Gold is a composite system consisting of:
- a bidirectional (0°/90°) mesh woven with special high performance P.B.O. fibre;
- a special ready-to-use mono component cementitious mortar.

The mechanical properties of the fibre allow the bidirectional P.B.O. mesh to absorb forces generated by overloads and exceptional circumstances (such as earthquakes).

The special mortar acts as the matrix of the system, joining the high performance P.B.O. fibres to the substrate of the concrete structure.

Its particular formula creates a kind of chemical adhesion to the P.B.O. fibre without requiring any inter-phase (primer, resin, etc.) with the surfaces (fibre and substrate), thereby considerably improving the system's mechanical behaviour and final performance.

1. **Concrete substrate**
2. **First layer of Ruredil X Mortar 750**
3. **Ruredil X Mesh Gold**
4. **Second layer of Ruredil X Mortar 750**
5. **Ruredil X Mesh Gold (if specified)**
6. **Third layer of Ruredil X Mortar 750**



Typical application sequence

clean • advantageous

What are P.B.O. fibres?

P.B.O. (Polyparaphenylene benzobisoxazole) fibres are a new generation of ultra high performance fibres.

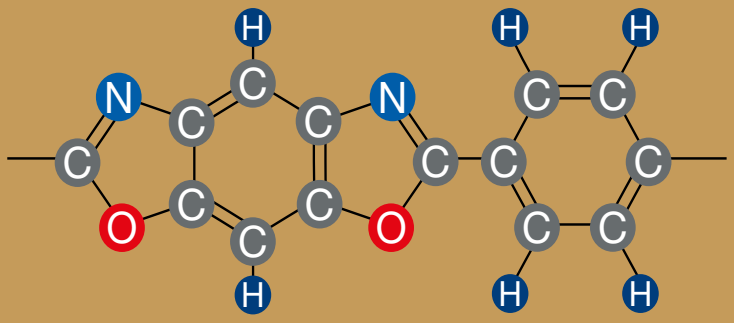
Compared with fibres normally used in composite reinforcement systems, P.B.O. fibres have 40% greater tensile strength (5.8 GPa vs. 4.1 GPa) and 15% greater modulus of elasticity (270 GPa vs. 240 GPa) than carbon fibres, while comparison with high modulus aramidic fibres reveals an advantage of 210% (tensile strength) and 250% (modulus of elasticity).

But the fibre's true innovation lies in its special chemical formula capable of establishing chemical bonds with the special Ruredil cementitous matrix in which it is immersed, to form the composite reinforcement.

These chemical bonds create a perfect adhesion between fibres and matrix without an interface (known as inter phase) as in ordinary FRPs, assuring excellent performance.

The new P.B.O. fibre: more effective link with inorganic matrix

The new Ruredil X Mesh Gold mesh has been realised weaving a Polyparaphenylene benzobisoxazole (PBO) fibre.



This synthesis polymer has a molecular structure able to establish strong chemical bonds with the special Ruredil X Mortar 750, and this plays a crucial role on the final performances of the new FRCM composite, P.B.O. + Ruredil X Mortar 750.

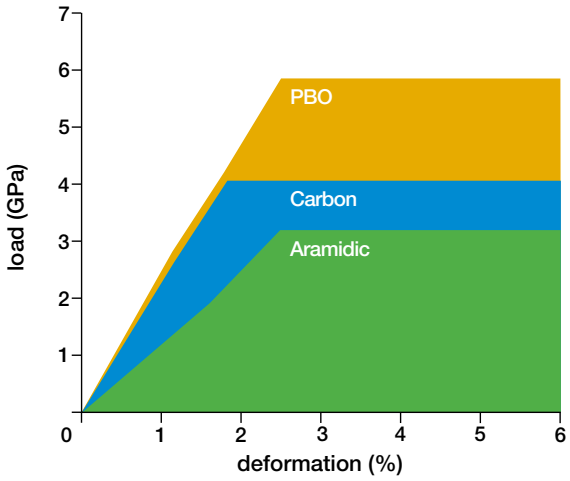
Ruredil X Mesh Gold

With P.B.O. fibres and without epoxy resins

Testing and certification

The Ruredil X Mesh Gold system has been deeply tested by authoritative universities and approved research laboratories, which have certified its effectiveness following strict testing procedures.

Comparison with the performance of ordinary FRP structural reinforcements (containing epoxy resins) clearly reveals that ultimate tensile strength is similar, but behaviour upon breakage reveals greater flexibility, so that forces continue to be absorbed for a longer time.



Structural fibres comparison: behaviour to monoaxial tensile strength

According to European norm **UNI EN 13501-1**, structural reinforcement **Ruredil X Mesh Gold** has been classified by Giordano Institute, who carried out tests, as follows:

Classification fire reaction

B: "no smoking"
s1: "limited smoke emission"
d0: "absence of burning drops and/or red-hot particles"

RUREDIL X MESH GOLD according to the Guidelines AC434 issued by ICC - ES

In 2013 Ruredil has achieved product certification for the FRCM composite called **Ruredil X Mesh Gold**, that consists of a polyparaphenylene benzobisoxazole (PBO) fiber mesh, (in accordance with AC 434): "Acceptance Criteria For Masonry and Concrete Strengthening Using Fiber-Reinforced Cementitious Matrix (FRCM) Composite Systems".

Tests required for product certification were performed at the accredited laboratory of the University of Miami and relative certification was issued by the American ICC-ES.

The International Code Council Evaluation Service (ICC-ES) is an American company that does technical evaluation of products and issues relative certifications (www.icc-es.org).

Having been performed by an accredited laboratory, this certification provides further technical evidence that the product is code-compliant, that means that product performance described may be used in any structural reinforcement project utilizing the Ruredil FRCM systems.

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Ruredil
Construction chemicals and building technologies

Via B. Buozzi, 1
20097 San Donato Milanese (MI)
Tel. +39 02 5276.041 - Fax +39 02 5272.185
export@ruredil.it - www.ruredil.it

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makelab.it