**HFE-tec® masonries**

**High Fracture Energy Technologies**

**High Deformation Energy**

**INNOVATION**

**ECC – Engineered Cementitious Composites**

- Rational Systems for Repair, Structural Reinforcement and Seismic Retrofitting of Masonries
- Fire resistance
- Anti-corrosion

January 2013

**Innovative systems with very high performance**

**SYSTEMS**

**REINFORCED RENDERING**

**WITH HIGH FRACTURE ENERGY AND DEFORMATION CAPACITY FOR STRUCTURAL STRENGTHENING AND SEISMIC RETROFITTING OF BEARING MASONRIES, PLUGGING, PARTITIONS**

- **DUCTILITY**
- **ENERGY DISSIPATION**
- **RIGIDITY**
- **DIAGONAL COMPRESSION TEST**
- **TANGENTIAL TENSILE**
- **SHEAR LIMIT DEFORMATION**
REINFORCED RENDERING SYSTEMS WITH HIGH DUCTILITY FOR THE STRUCTURAL REINFORCEMENT AND SEISMIC ADJUSTMENT OF MASONRY WALLS

The technique of consolidation using reinforced renders is to achieve, in adherence to the wall to be strengthened, a layer of mortar, reinforced with mesh, fixed to the wall through bulkhead connectors.

The technique allows to improve the characteristics of resistance of the wall, thanks to the increase in section resistance made from the mortar layer and the effect of confinement exercised on the degraded masonry, and, at the same time, to increase the ductility. This technique may be suitable to those walls in a particular advanced state of degradation and not able to withstand excessive handling (in the presence of complex and extended cracking patterns, other techniques, such as injections or the construction of walls, may in fact be difficult to apply).

The technique is also applicable to reinforce a limited section of a damaged wall, or vertical intersections of walls which are not sufficiently connected.

The consolidation with reinforced renders is a simple method and rather rapid, suitable also for seriously poor masonry walls, when adequately and extensively treated, requiring appropriate dimensioning and structural load distribution.

The application of the reinforced render does not change the state of stress of the structure during the execution, but can change the stiffness of the walls and thus their seismic response.

The application of system **HFE-tec® masonries** ensures maximum reliability of this technique through the following fundamental features: the intrinsic Ductility and Energy of Deformation of used Render, the Adhesive Capacity of the mortar to the wall, some peculiarities in the Mechanical Characteristics of Mortar, the choice Reinforcement net and transversal Connectors, Correct Application.

The Structural reinforcement system **HFE-tec® masonries** ensures the transfer and stress distribution from the wall to the reinforced render slab with the highest ductility and fracture energy of the SYSTEM, particularly in the case of Seismic Stress.
In the System all the materials which compose the Design of Structural Reinforcement play a fundamental role and synergy in the transfer of the Forces in the Masonry Reinforcement system.

Systems allow the durable functional recovery in many different grades of degradation and different purposes of structural reinforcement, including seismic adaptation of constructions.

Fundamental role is played by the quality of the binders and reinforcement used, that must allow:
- Increase of ductility without stiffness or shear differences in the structure.
- Dissipation of the energy without collapsing in case of seismic event.
Two experimental examples of the System HFE-tec® masonries
by measuring the diagonal compressive strength
on wall with dimension 100x100x40 cm
thickness render 3 cm

Determination and measuring the diagonal compression strength on masonry walls rendered with a fibre-reinforced mortar with very high Deformation Energy, reinforced with a steel or glass fibre net: Systems HFE-tec® Masonries

The crack of unreinforced masonry: the wall “bursts”

The crack of reinforced masonry HFE-tec®: not damaged
APPLICATION TYPOLGY

SYSTEMS of reinforced renders with the technology of the "structural sandwich"

1. Realisation of drillholes, inserting steel connectors Tecnofib FIOCCO STEEL 162
   Or in glassfibre Tecnofib FIOCCO GLASS 73
   And fixation with in alternative with TECNOFIB CORVINIL 380
   or Tecnoepo 701

2. Application of first layer of high deformation energy mortar
   BS 38/39-2.5 Mucis sra
   or BS 37 FPL-LIGHT

3. Realization of drillholes, inserting steel connectors Tecnofib FIOCCO STEEL 162
   Or in glassfibre Tecnofib FIOCCO GLASS 73
   And fixation with in alternative with TECNOFIB CORVINIL 380
   or Tecnoepo 701

4. Application of second layer of mortar with high deformation energy
   BS 38/39-2.5 Mucis sra
   or BS 37 FPL-LIGHT

5. Tapping the drillholes to insert the connectors Tecnofib FIOCCO STEEL 162
   Or glassfibre Tecnofib FIOCCO GLASS 73

6. Fixation with in alternative with TECNOFIB CORVINIL 380
   or Tecnoepo 701

7. Installation of steel net Tecnofib SALT-4/90
   or glass fibre net Tecnofib GLASS net 340
   And fix to the connectors

8. Anti-tilt system for walls and partitions (in this case by reducing the thickness to no more than 10 ÷ 20 mm)

9. Structural cooperating cover in fibre reinforced bi component mortar with high deformation energy
   BS 38/39-2.5 Mucis sra
   No shrinkage, anti-corrosion

10. Anchoring with cement based material BS 91 ANCORA or epoxy based product TECNOEPO 400

11. Application of first layer of high deformation energy mortar
   BS 38/39-2.5 Mucis sra
   or BS 37 FPL-LIGHT

12. Application of second layer of mortar with high deformation energy
   BS 38/39-2.5 Mucis sra
   or BS 37 FPL-LIGHT

13. Realisation of drillholes, inserting steel connectors Tecnofib FIOCCO STEEL 162
   Or in glassfibre Tecnofib FIOCCO GLASS 73
   And fixation with in alternative with TECNOFIB CORVINIL 380
   or Tecnoepo 701

   or glass fibre net Tecnofib GLASS net 340
   And fix to the connectors

15. Fixing the steel or glassfibre net Tecnofib ST-ELT

16. Installation of steel net Tecnofib SALT-4/90
   or glass fibre net Tecnofib GLASS net 340
   And fix to the connectors
**PRODUCT**

**DESCRIPTION**

**PARTICULAR CHARACTERISTICS**

**USE**

**MuCis® mia 200**

Multiple function repair and tertiary corrosion inhibitor for reinforcement of existing concrete structures, with anodic protection.

EN 1504-4 principle 17 (CA) +1.3

Anodic and cathodic protection, reaches to the structure, reaches and protects the steel inside.

Nanostructured surface coating, pre-stressed particularly when subject to extremely aggressive conditions.

**MuCis® PROTEZONE® FEDRO bi-component**

Polyurethane coating, with self-curing ability, for concrete reinforcement.

EN 1504-4 type 2A

Compressive strength : 45 MPa

Modulus of elasticity : 6500 MPa

Adhesion to concrete : 2 MPa

- Anti-corrosion treatment for the ideal reinforcement after preparation, and before the application of the repair mortar.

**BS 38/39-2,5 MuCap® (bi-component)**

Fibre-reinforced structural mortar, anti-corrosion, super-high deformation energy.

Compressive strength : 31 MPa

Flexural strength : 8,2 MPa

Modulus of elasticity : 10500 MPa

Adhesion to concrete : 1,5 MPa

High Flexural Energy

For structural anti-corrosion repairs on reinforced concrete. Reinforced tendrils, deep sealing of joints and cracks, repairs, leveling, regularization, smoothing of the support, fixation. For structural reinforcement of masonry.

Applied with a trowel or spray.

**BF 37 FL-LIGHT HFE-tec®**

Polysiloxane, fiber-reinforced lightweight mortar, high capacity of deformation and fracture energy. Suitable for systems HFE-tec® masonry.

Modulus of elasticity : 10000 MPa

Adhesion to concrete : 2,3 MPa

Very High Deformation Energy

System of external HFE-tec® - High Flexure Energy Technologies - high-energy fracture of masonry new or old or by carrying reinforcements with reinforced masonry, mesh and connectors in metal or glass fiber.

In the case of seismic events, the energy dissipation capacity and increase of the ductility without variations of shear strength of the structure.

**HEF-tec® HERO 200**

Component fiber-reinforced mortar with FIBTECH® - MC polymer fibers with high elastic modulus, with exceptional fracture energy. It is suitable for structures where more than 500 times higher than the last structural mortars.

Approved Certificate N. 1305-CPD-8888

Compressive strength : 31 MPa

Flexural strength : 8,2 MPa

Modulus of elasticity : 10500 MPa

Adhesion to concrete : 1,5 MPa

High Flexural Energy

Remodelling of structures in reinforced concrete or masonry in harsh environmental conditions, particularly subject to high loads and dynamic loads and in areas with industrial floor areas, tal areas, rail bases, repairs of concrete in highly stressed environmental conditions.

**HEF-tec® PA 380**

Combined two-component fiber-reinforced cement paste specially studied for high strength with exceptional values of deformation and fracture energy and DUCTILITY. HFE-tec®-PAV is used for horizontal applications by casting.

Compressive strength : 25 MPa

Flexural strength : 19 MPa

Modulus of elasticity : 10500 MPa

Adhesion to concrete : 3 MPa

High Flexural Energy

For repairs by horizontal application or in formwork, subject to high loads and dynamic loads and in areas with industrial floor areas, tal areas, rail bases, repairs of concrete in highly stressed environmental conditions.

**HEF-tec®® ECC 1280 THIKO**

High-Flexure-Energy Technologies ECE - Engineered Cementitious Composites Special fibre-reinforced polymer cement composition containing FIBTECH® - MC polymer fibers with high elastic modulus. Its deformability is about a 500 times higher compared to standard cement compositions. Once mixed with water, it is highly thixotropic.

Compressive strength : 20-22 MPa

Flexural strength (tensile modulus): 16-22 MPa

Modulus of elasticity : 9,5-10,5 GPa

Adhesion to concrete : 20000 N/m

High Flexural Energy

For applications that need to absorb large deformations without failure:

- Structural elements in seismic areas (e.g. parking lots or other structural elements, seismic-resistant walls in combination with ideal reinforcement)

- Joints (durable slabs of Bridges and viaducts, durable walls)

- Repair of structures to absorb heavy loads without failure or fracture

- Items suitable for the measurement of static or dynamic loads through the monitoring of deformations or continuous coatings without joints.

**HEF-tec®® BB 80**

Ultra-high deformation mortar, for the protection against fire of structures in concrete.

Compressive strength : 42 MPa

Flexural strength : 9,3 MPa

Modulus of elasticity : 10430 MPa

Adhesion to concrete : 1,1 MPa

High Flexural Energy

For the fire protection of the deformable concrete structure or as a protective restoration layer over scarified / deconcrete concrete. The product is applied in a single layer with a thickness from 3 to 6 cm without the need for ideal reinforcement

HFE-tec®® BB 80 protects the existing structure from aggressive substances such as gas and de-icing salts as well as thermal stress resulting from fire. The formation of oxides of iron that is typical of cement-based coatings is prevented through the use of a sophisticated coolant of high performance polymeric fibers. The same fibers guarantee high resistance to the fire of HFE-tec®® BB 80.

**BS 5+**

Structural fibre-reinforced mortar, thermoplastic, with compensated shrinkage.

RIMA: 1,85 Kg/m³/mm thickness

Compressive strength : 41 MPa

Flexural strength : 6,5 MPa

Dynamic modulus of elasticity : 26500 MPa

Static modulus of elasticity : 21500 MPa

Structural repairs in class R5 of concrete and masonry. Reinforcement of masonry. Applied with a trowel or spray.

**LBE INJECTION**

Colloidal injection for consolidation and re-strengthening of masonry structures.

Consumption : 1192 Kg/m³

Compressive strength : 70-120 MPa

Flexural strength : 1,5 MPa

Modulus of elasticity : 5000-7500 MPa

Adhesive to brick : +1MPa

Consolidating injection in walls of brick, stone or masonry with high penetration and low heat of hydration. Great adhesion to stone surfaces, bricks and the reinforcing bars / connectors in steel or glass.

**LBE INJECTION 9000**

Colloidal injection for consolidation and re-strengthening of masonry structures.

Consumption : 1400 Kg/m³

Compressive strength : 13 MPa

Flexural strength : 3-5 MPa

Modulus of elasticity : 5000 MPa

Adhesive to brick : +1MPa

Consolidating injection in walls of brick, stone or masonry with high penetration and low heat of hydration. Great adhesion to stone surfaces, bricks and the reinforcing bars / connectors in steel or glass.

**BS 37 MCACRA mono and bi-component**

Structural pourable mortar, high fluidity, anti-corrosion, for anchoring, reinforcement casting, consolidation.

Consumption : 1,9 Kg/m³/mm thickness

Compressive strength : 32 MPa

Flexural strength : 5 MPa

Modulus of elasticity : 3300 MPa

Adhesive to concrete : 2,5 MPa

Sliding : displacement + 0,15 mm with load of 75 KN

**Steel, Glass Fibre Net**

<table>
<thead>
<tr>
<th>Material/Code</th>
<th>Description</th>
<th>Dimensions</th>
<th>Modulus of Elasticity</th>
<th>Tensile Strength</th>
<th>Weight</th>
<th>Calculation Thickness</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tecnofib C240</td>
<td>Carbon fibre, uni-directional. Tensile modulus of elasticity 240 GPa. Weight 300 g/m².</td>
<td>Tensile strength: 4.800 MPa</td>
<td>600 g/m²</td>
<td>≥0,9 GPa</td>
<td>&gt; 4.800 MPa</td>
<td>0,166 mm</td>
<td>Reinforcement of structures in the reinforced concrete, walls, arches, and vaults.</td>
</tr>
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<td>0,166 mm</td>
<td>Reinforcement of structures in the reinforced concrete, walls, arches, and vaults.</td>
</tr>
<tr>
<td>Tecnofib CROSS 230 (300 g/m²)</td>
<td>Carbon-fibre fabric, bi-directional. Tensile modulus of elasticity 240 GPa. Weight 300 g/m².</td>
<td>Tensile strength: 4.800 MPa</td>
<td>600 g/m²</td>
<td>≥0,9 GPa</td>
<td>&gt; 4.800 MPa</td>
<td>0,166 mm</td>
<td>Reinforcement of structures in the reinforced concrete, walls, arches, and vaults.</td>
</tr>
<tr>
<td>Tecnofib TETRA CARB (380 g/m²)</td>
<td>Quadri-axial carbon fibre fabric with high tenacity.</td>
<td>Tensile strength: 4.800 MPa</td>
<td>600 g/m²</td>
<td>≥0,9 GPa</td>
<td>&gt; 4.800 MPa</td>
<td>0,167 mm</td>
<td>Reinforcement of structures in the reinforced concrete, walls, arches, and vaults.</td>
</tr>
<tr>
<td>Tecnofib GLASS 73</td>
<td>Uni-directional glass fibre textile. Tensile modulus 73 GPa. Low rigidity. Guidelines CNR - DT 2004.</td>
<td>Tensile strength: 4.800 MPa</td>
<td>600 g/m²</td>
<td>≥0,9 GPa</td>
<td>&gt; 4.800 MPa</td>
<td>0,167 mm</td>
<td>Reinforcement of structures in the reinforced concrete, walls, arches, and vaults.</td>
</tr>
<tr>
<td>Tecnofib TETRA GLASS</td>
<td>Reinforcement system with quadri-directional glass fibre mat, balanced type. Guidelines CNR - DT 2004.</td>
<td>Tensile strength: 4.800 MPa</td>
<td>600 g/m²</td>
<td>≥0,9 GPa</td>
<td>&gt; 4.800 MPa</td>
<td>0,167 mm</td>
<td>Reinforcement of walls, backfilling, floors, and concrete structures.</td>
</tr>
</tbody>
</table>

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**Glass, Glass Fibre, Carbon Fibre, and Reinforcement Bars**

<table>
<thead>
<tr>
<th>Material/Code</th>
<th>Description</th>
<th>Dimensions</th>
<th>Modulus of Elasticity</th>
<th>Tensile Strength</th>
<th>Weight</th>
<th>Calculation Thickness</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tecnofib R</td>
<td>Epoxy-amine based product, modified with reactive diluents, formulated as adhesive-paste putty, high thixotropy, two-component, room temperature curing</td>
<td>Tensile strength: 160 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>For the sealing of cracks, discontinuities in general in concrete, installation of insulation nipples, sealing interventions, concrete bonding of steel, bricks, stones, wood.</td>
</tr>
<tr>
<td>Tecnofib T00</td>
<td>Epoxy-amine based product, formulated as adhesive primer, bi-component, hardening at room temperature</td>
<td>Tensile strength: 160 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>Priming of the surface that to be reinforced in composite materials, prior regularization of the same.</td>
</tr>
<tr>
<td>Tecnofib T01</td>
<td>Epoxy-amine based product, formulated as adhesive matrix, bi-component, hardening at room temperature</td>
<td>Tensile strength: 160 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>Adhesive for the gluing of composite matrices to the substrate. N.B.: the adhesive must well impregnate the composite fibres.</td>
</tr>
<tr>
<td>Tecnofib T001/IL</td>
<td>Epoxy-amine based product, formulated as adhesive matrix, bi-component, hardening at room temperature</td>
<td>Tensile strength: 160 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>Adhesive for the gluing of prefabricated composite laminates to the substrate.</td>
</tr>
<tr>
<td>Tecnofib 400</td>
<td>Adhesive for structural bonding</td>
<td>Tensile strength: 160 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>As adhesive for: castings (thin concrete on fresh resin) - assembly of elements of structural concrete made of prefabricated elements (segments) - coating of anchor bolts and stud-electrode reinforcement bars or unit plates.</td>
</tr>
<tr>
<td>Tecnofib IN3</td>
<td>Epoxy resin at very low viscosity for the structural injection in reinforced concrete with transmission of stresses</td>
<td>Tensile load at break: 480 MPa</td>
<td>300 g/m²</td>
<td>&gt;30 MPa</td>
<td>60 MPa</td>
<td>0,167 mm</td>
<td>Sealing joints in mortars and masonry for the reinforcement of structures.</td>
</tr>
</tbody>
</table>
Two Prestigious Examples of Restoration and Consolidation of masonry through injections LIME INJECTION, Grouting joints and partial reconstructions with mortars High Deformation Energy, without rendering
Some applications of Systems

HFE-tec® masonries

BS 38/39–2,5 MuCis® sra

+ Tecnofib TETRAGLASS

+ Tecnofib TETRAGLASS

+ Tecnofib FIOCCO glass 73

+ Tecnoepo 701

+ Tecnoepo 700 primer

+ Tecnofib CW 240

+ Tecnoepo 701

+ Tecnofib FIOCCO C240

+ Tecnofib C240

+ Tecnobolt®

+ Tecnoepo 701
Request for Information and/or Assistance:

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