



STRUCTURAL STRENGTHENING

Selection chart of composite materials



SELECTION CHART OF COMPOSITE MATERIALS FOR STRUCTURAL STRENGTHENING

Mapei: technological innovation in constant evolution

The use of **composite materials** is now one of the consolidated strengthening techniques employed for the **static and seismic retrofitting of existing reinforced concrete, steel, masonry and wooden structures**.

And also in this field, for more than 20 years, **Mapei** has played a key role in the development of new techniques, that are the result of highly productive collaboration between the company's internal R&D laboratories and numerous international universities.

The systems described in this Selection Chart can also be found in the Structural Strengthening Manual - available on the website www.mapei.com, with additional information and specifications.



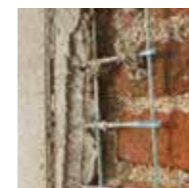
FRP SYSTEMS



HPC SYSTEMS



CRM SYSTEMS

MAPEWRAP
EQ SYSTEM

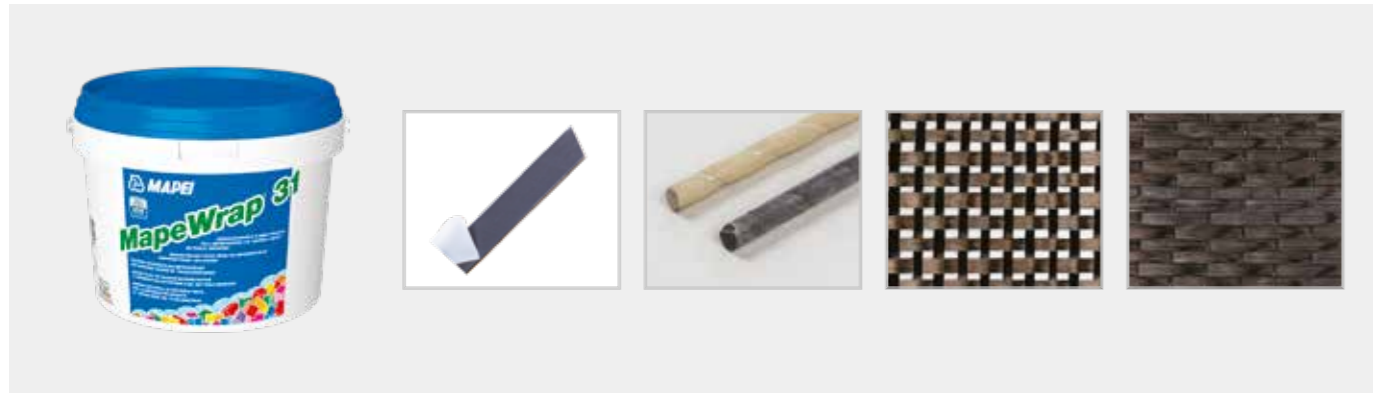
FRCM SYSTEMS

PLANITOP
INTONACO
ARMATO

SYSTEMS FOR STRUCTURAL STRENGTHENING

FRP Systems

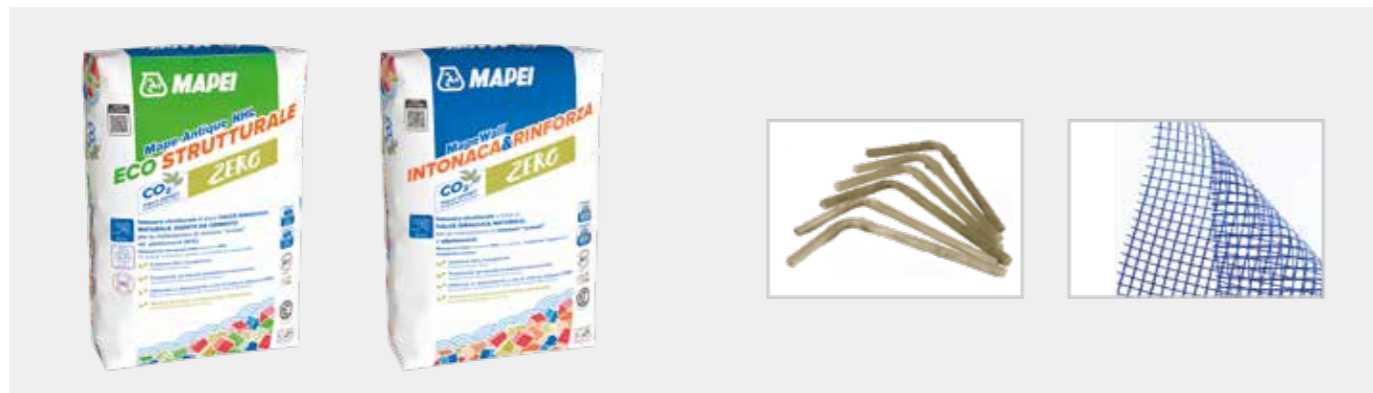
Fibre-Reinforced Polymers, more commonly known as **FRP**, or **fiber-reinforced polymer matrix composite materials** cover an extensive range of composite materials with an organic polymer matrix (epoxy resin) that is used to impregnate a long, continuous fibre with high mechanical properties, typically made of carbon or glass. They are used for the **strengthening, the static and seismic retrofitting** of structures made of normal, pre-stressed and reinforced concrete, steel, masonry or wood. These systems are typically composed of uni, bi, or quadridirectional **MapeWrap** fabric, which has to be impregnated on site, or **Carboblade** plates, **Maperod** rods and **Carbotube** preformed tubes.



CRM Systems

CRM Systems are made of **mortars** suitable for application in layers up to 3-4 cm thick, so they also cover the surface of uneven masonry, combined with **glass fibre mesh** with high chemical resistance **Mapenet EM** and **Mapenet EMR**. Due to its thickness, the system needs to be connected mechanically to the masonry with glass fibre **connectors**.

CRM Systems are used for **strengthening reinforced concrete and masonry structures**.



FRCM Systems

FRCM Systems are made of special **fiber-reinforced mortars** applied in low thickness layers (approx. 1-1.5 cm), in combination with **Mapegrid, strengthening meshes** made of glass, basalt or carbon fibre. These systems allow the mass and stiffness of the strengthening package to be reduced effectively while significantly increasing its mechanical properties. The mortar used in such systems adheres very strongly to the substrate so that there is no need for transversal connectors. If a mechanical connector is absolutely necessary, specific **MapeWrap Fiocco**, spike anchors made of glass fibre, basalt fibre or carbon fibre, can be used. **FRCM Systems** are used for **strengthening reinforced concrete and masonry structures**.



HPC Systems

HPC Systems are made of **high performance** microconcrete **HPFRCC** (High Performance Fiber Reinforced Cementitious Composites) from the **Planitop HPC** range. The main performance properties characterizing these types of cementitious composites are extremely high mechanical strength and high ductility. Due to the presence of metal fibres, the behaviour of the material is such that traditional reinforcement can be reduced or, in many cases, completely replaced. **HPC Systems** are used for **reinforcing existing floor slabs** when creating a slab overlay, and for strengthening **existing pillars, beams, and beam-pillar joints** using the jacketing technique.



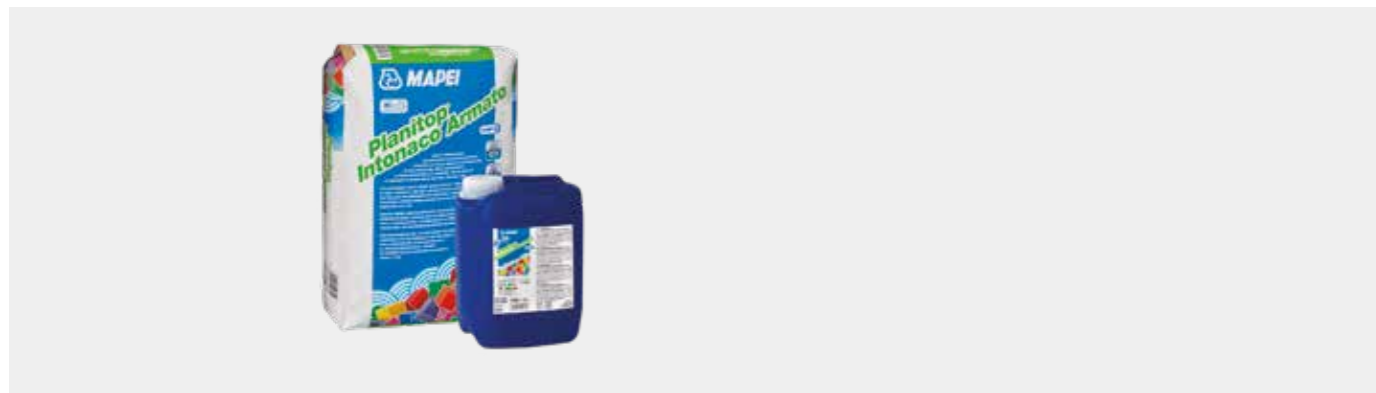
MapeWrap EQ System

Innovative **protection system of non-structural elements** in the form of "**seismic wallpaper**" to give people more time to evacuate a building if in the event of an earthquake. It improves the distribution of stresses induced by dynamic loads in structures and reduces the seismic vulnerability of **secondary partitions**, by making the strengthened elements more ductile. The system also improves the performance characteristics of **hollow bricks** and **concrete floor slabs** and reduces their risk of collapse.



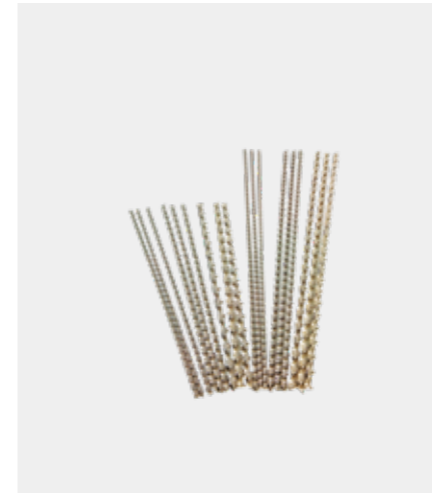
Planitop Intonaco Armato

Planitop Intonaco Armato is an innovative, cement-free, natural hydraulic lime (NHL) and Eco-Pozzolan based mortar, with diffused micro reinforcement, for levelling, repairing, and strengthening existing masonry. It is a **two-component, fibre-reinforced mortar**. Its fibre content replaces the application of additional mesh (both metal or fibre mesh) typically used in structural strengthening technologies (traditional reinforced render). **Planitop Intonaco Armato** is used for **improving shear and tensile strength of masonries**, and provides them high ductility, while there is no significant increase in the structure's stiffness or mass. Furthermore, it is produced using at least **30% of recycled raw materials**, which reduces its environmental impact.



COMPLEMENTARY SYSTEMS

Mapei offers a wide range of **connectors** that completes the strengthening package of FRP, CRM, FRCM and HPC technologies.



Mapei Steel Bar and Mapei Steel Dry

Mapei Steel Bar and **Mapei Steel Dry** are **helical shape bars made of stainless steel** (available in AISI 304 and AISI 316) characterized by extremely high mechanical resistance and chemical stability. The special shape of the bar ensures a solid anchor and guarantees a considerably high level of mechanical adherence. They are used for **strengthening masonries and wooden floor slabs**.



MapeWrap Fiocco

MapeWrap Fiocco are **uni-directional fibre cords** made of carbon, glass, basalt, or high strength steel, to be impregnated with two-component epoxy resin (such as **MapeWrap 21** or **MapeWrap 31**). The products from the **MapeWrap Fiocco** range can be used in combination with the **MapeWrap**, fabrics, the **Carboplate** plates and with the strengthening systems that include the **Mapegrid** meshes. The **MapeWrap Fiocco** products improve the anchorage, in particular in flexural and shear strengthening interventions. The products from the **MapeWrap Fiocco** range must be impregnated on site the day before their application. This enables the user to customise the length both of the dowel and of the fan depending on the specific needs.



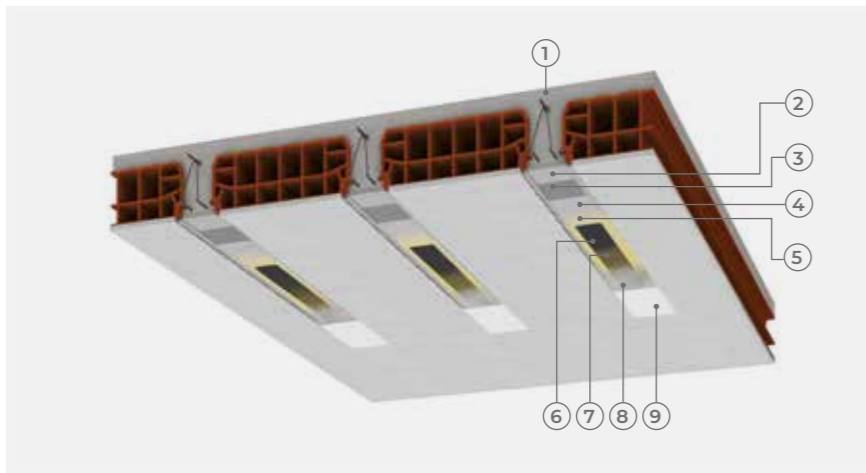
MapeWrap Connector

The **MapeWrap Connector** products are **preformed connectors** made of carbon fibres. They are composed of a rigid dowel and a non-impregnated free edge, which has to be splayed on the surface. The products from the **MapeWrap Connector** range can be used in combination with the **MapeWrap**, fabrics, the **Carboplate** plates and with the strengthening systems that include the **Mapegrid** meshes. The **MapeWrap Connector** products improve the anchorage, in particular in flexural and shear strengthening interventions. Compared to the **MapeWrap Fiocco** products, the rigid dowel of the **MapeWrap Connector** products is preformed and does not need to be impregnated the day before its application.

STRENGTHENING OF REINFORCED CONCRETE, MASONRY, AND TIMBER

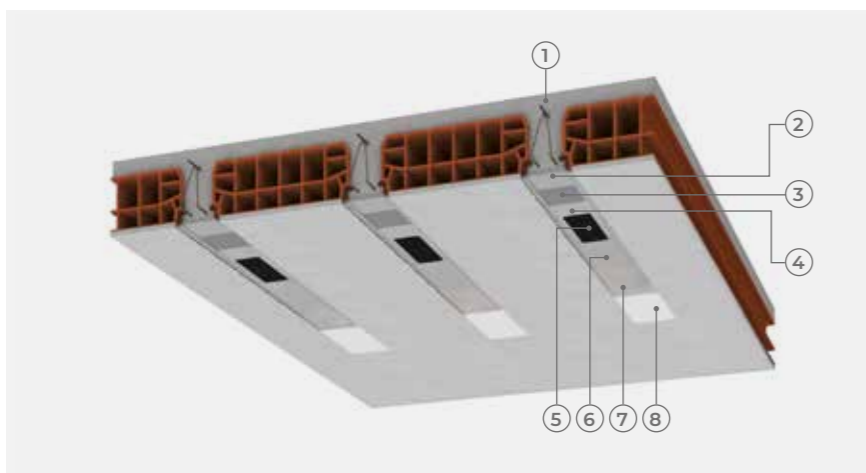
FLOOR SLABS STRENGTHENING FROM THE BOTTOM

MapeWrap System



- ① Existing joint
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Planitop 200

Carboplate System

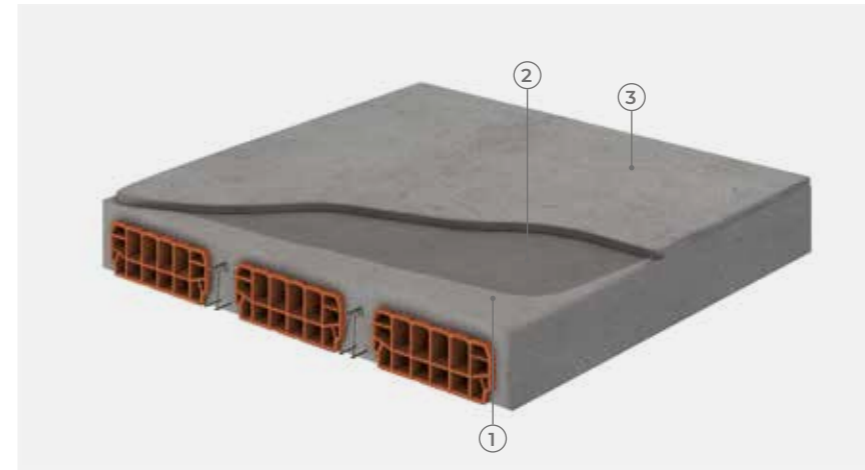


- ① Existing joint
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ Carboplate E 170 or Carboplate E 200 or Carboplate E 250
- ⑥ MapeWrap 11/12
- ⑦ Quartz 1.2
- ⑧ Planitop 200

FLOOR SLABS

STRENGTHENING FROM THE TOP WITH HIGH PERFORMANCE CONCRETE SLAB OVERLAY

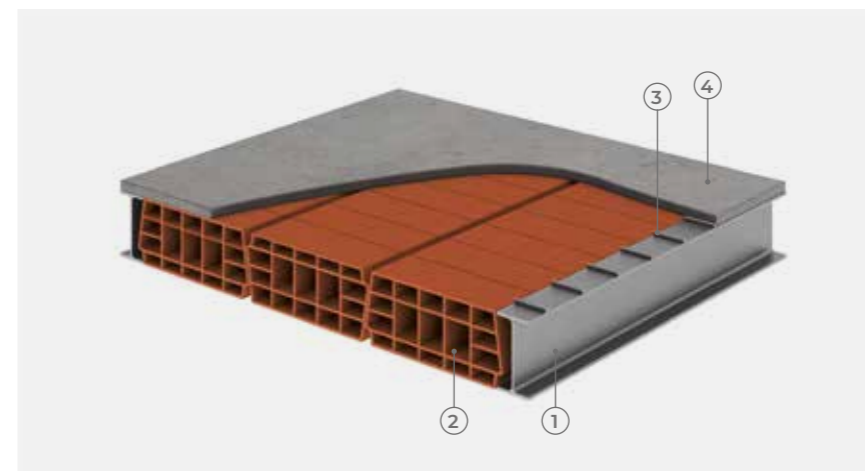
Planitop HPC Floor



- ① Hollow bricks and concrete floor slab
- ② Primer 3296
- ③ Planitop HPC Floor

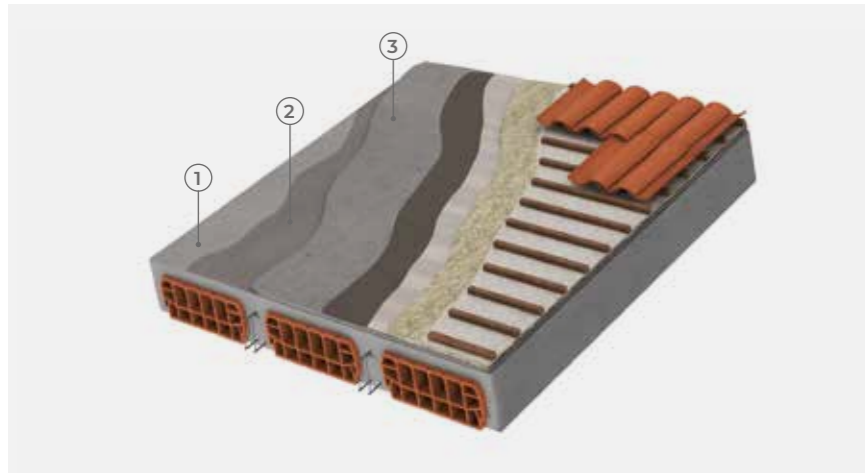


- ① Timber joist
- ② Timber planks
- ③ Polyethylene sheet or microporous sheet
- ④ Planitop HPC Floor or Planitop HPC Floor T
- ⑤ Mapei Steel Dry 304



- ① Steel H-beam
- ② Hollow bricks
- ③ Metal connectors
- ④ Planitop HPC Floor

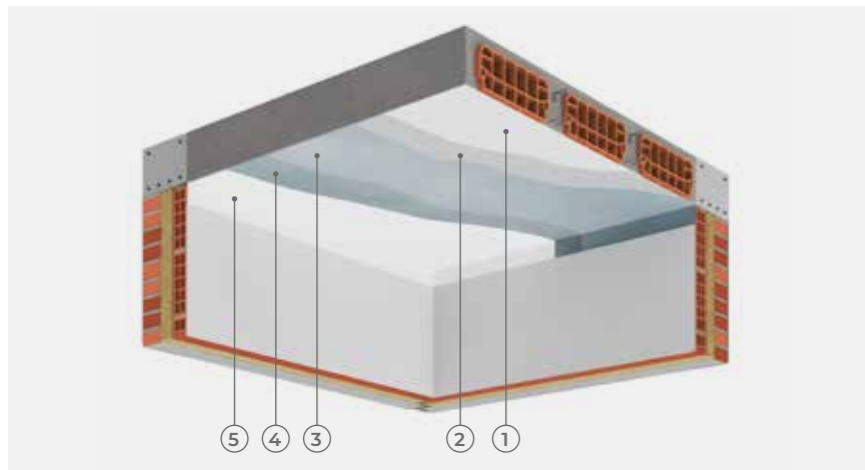
Planitop HPC Tixo



- ① Existing sloping hollow bricks and concrete floor slab
- ② Primer 3296
- ③ Planitop HPC Tixo + Fibre HPC

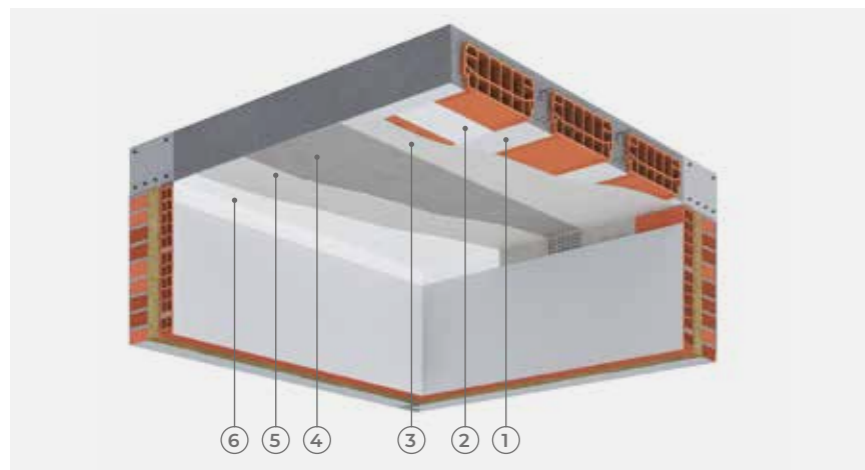
FLOOR SLABS ANTI-COLLAPSE SYSTEMS FOR CEILING

MapeWrap EQ System



- ① Existing render
- ② MapeWrap EQ Adhesive
- ③ MapeWrap EQ Net
- ④ MapeWrap EQ Adhesive
- ⑤ Planitop 200

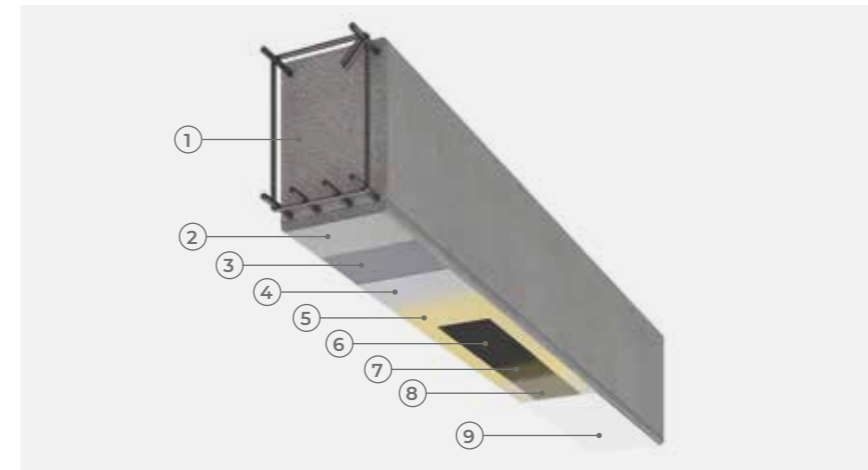
FRCM System



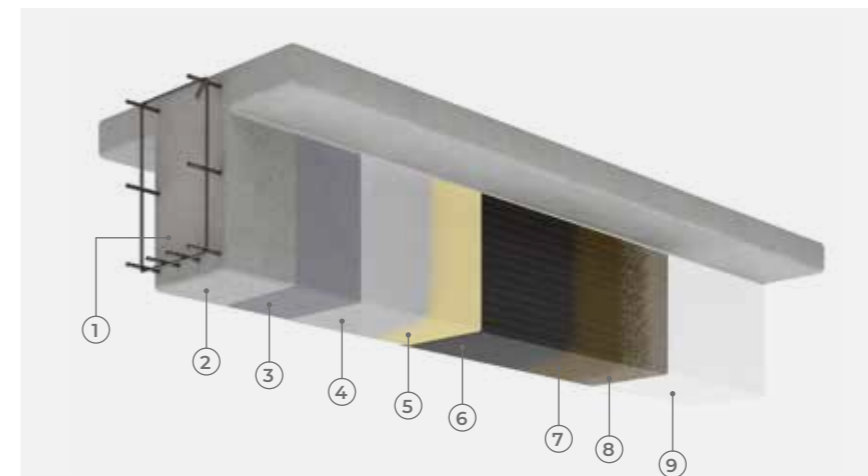
- ① Existing floor slab
- ② EPS panel bonded with Mapetherm ARI GG
- ③ Planitop HDM Maxi
- ④ Mapegrid G 120
- ⑤ Planitop HDM Maxi
- ⑥ Skim coat

BEAMS SHEAR AND FLEXURAL STRENGTHENING

MapeWrap System

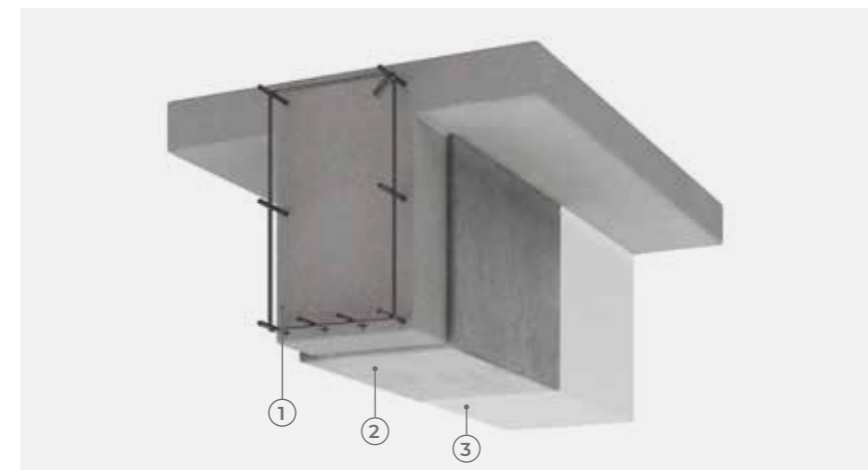


- ① Existing beam
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap C UNI-AX HM
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Planitop 200



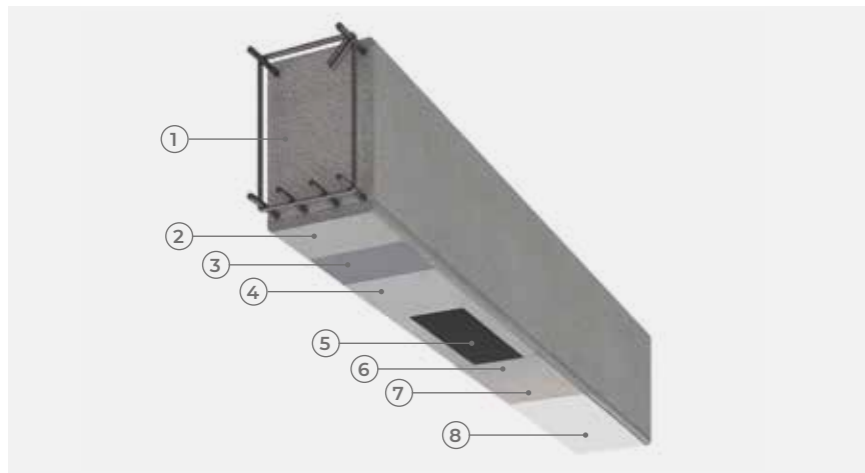
- ① Existing beam
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap C UNI-AX HM
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Planitop 200

Planitop HPC

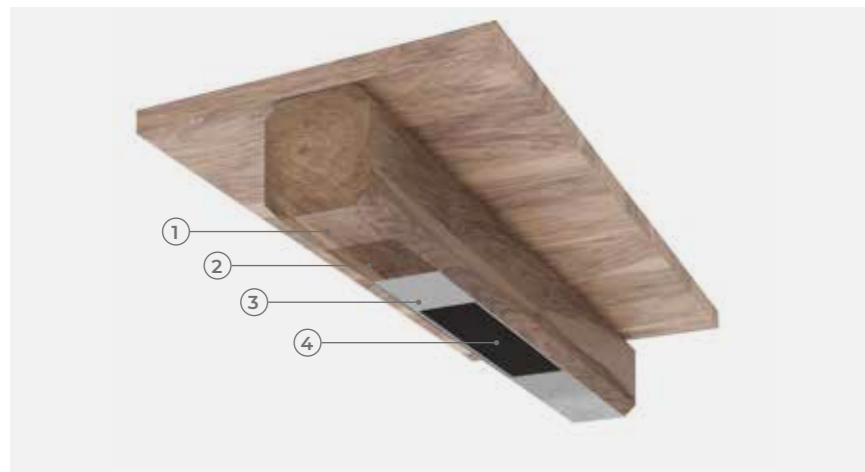


- ① Existing beam
- ② Planitop HPC + Fibre HPC
- ③ Planitop 200

Carboplate System



- ① Existing beam
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ Carboplate E 170 or Carboplate E 200 or Carboplate E 250
- ⑥ MapeWrap 11/12
- ⑦ Quartz 1.2
- ⑧ Planitop 200



- ① Existing timber beam/joist
- ② MapeWrap Primer 1
- ③ MapeWrap 11/12
- ④ Carboplate E 170 or Carboplate E 200 or Carboplate E 250

Maperod

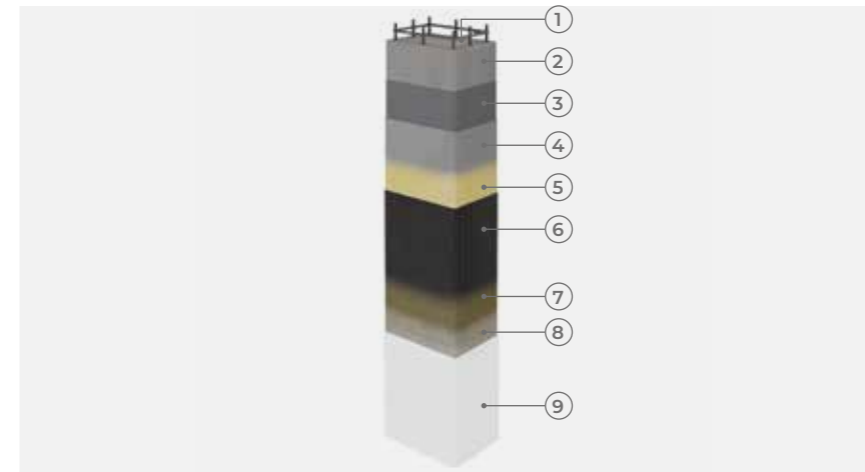


- ① Existing timber beam/joist
- ② Mapewood Primer 100
- ③ Mapewood Paste 140
- ④ Maperod C or Maperod G
- ⑤ Mapewood Paste 140

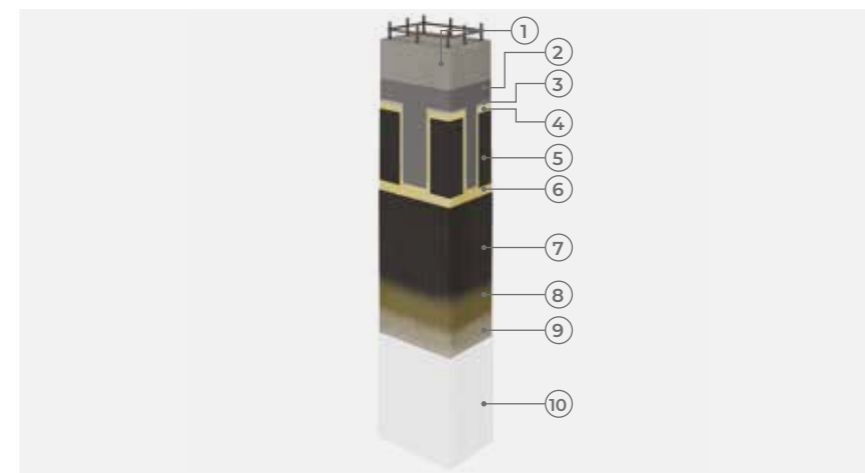
PILLARS

SHEAR AND COMPRESSING-BENDING STRENGTHENING AND CONFINEMENT

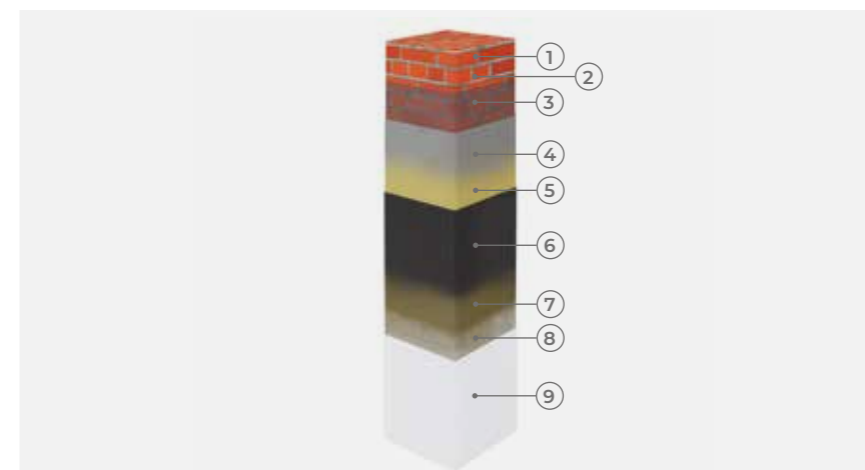
MapeWrap System



- ① Existing pillar
- ② Repaired section
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap C UNI-AX HM
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Planitop 200



- ① Existing pillar
- ② MapeWrap Primer 1
- ③ MapeWrap 11/12
- ④ MapeWrap 31
- ⑤ MapeWrap C UNI-AX or MapeWrap C UNI-AX HM
- ⑥ MapeWrap 31
- ⑦ MapeWrap C UNI-AX or MapeWrap C UNI-AX HM
- ⑧ MapeWrap 31
- ⑨ Quartz 1.2
- ⑩ Planitop 200



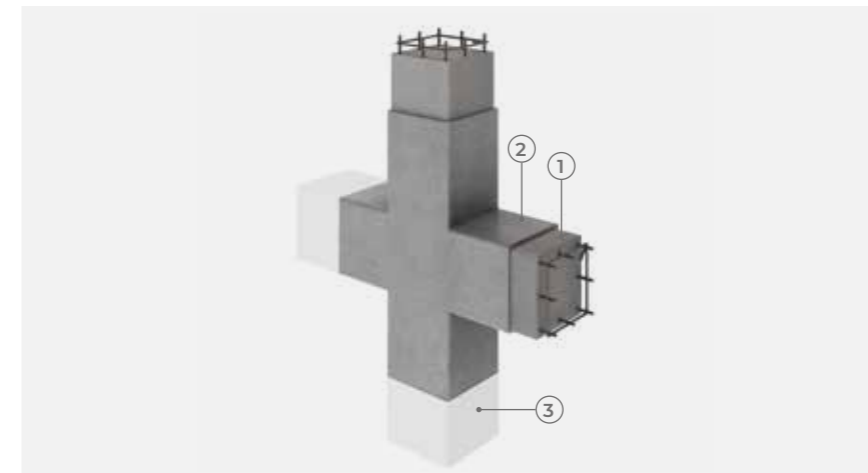
- ① Existing column
- ② Planitop HDM Maxi (optional)
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap G UNI-AX
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Finishing

Planitop HPC



- ① Existing pillar
- ② Planitop HPC + Fibre HPC
- ③ Connection bars
- ④ Planitop 200

Planitop HPC

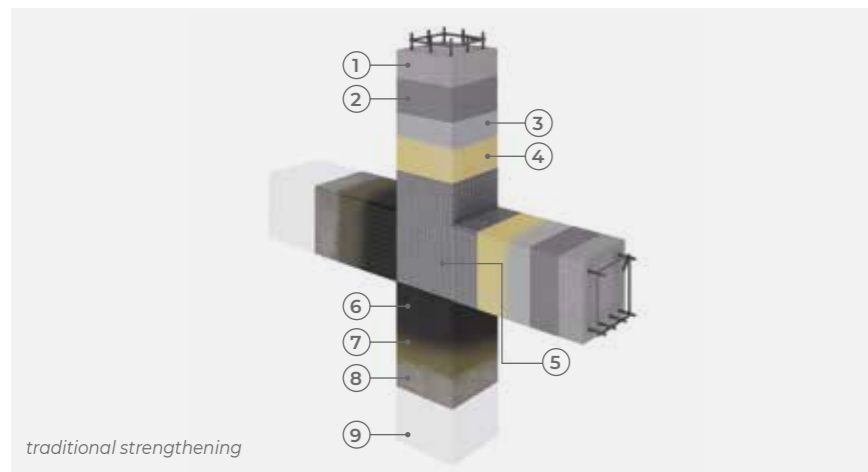


- ① Existing beam-column joint
- ② Planitop HPC + Fibre HPC
- ③ Planitop 200

BEAM-COLUMN JOINTS

STRENGTHENING OF UNCONFINED BEAM-COLUMN JOINTS

MapeWrap System

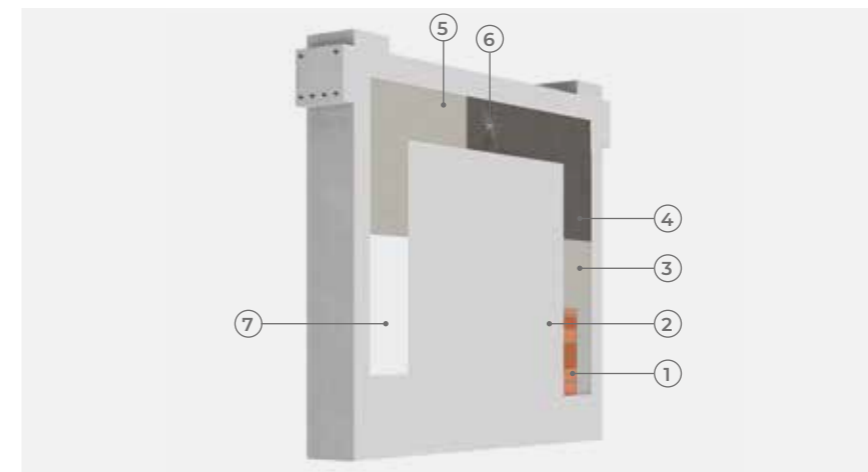


- ① Existing reinforced concrete structure
- ② MapeWrap Primer 1
- ③ MapeWrap 11/12
- ④ MapeWrap 31
- ⑤ MapeWrap C QUADRI-AX
- ⑥ MapeWrap C UNI-AX
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Planitop 200

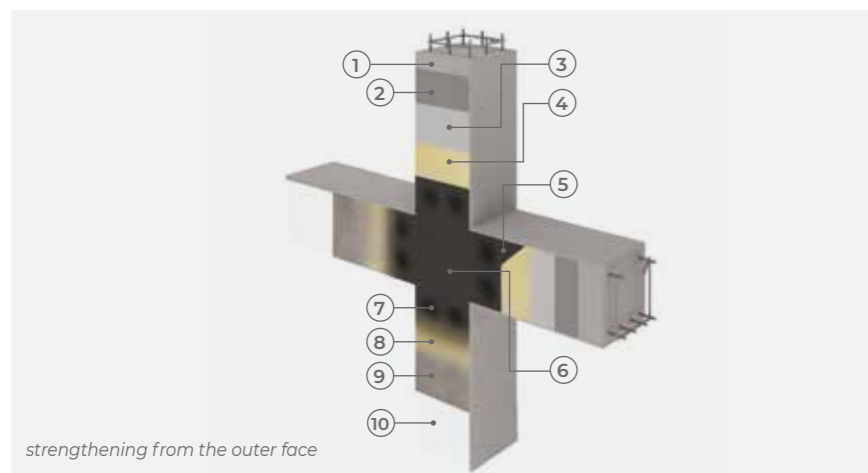
INFILL AND PARTITION WALLS

ANTI-OVERTURNING SYSTEMS AND REPARATION OF CRACKS

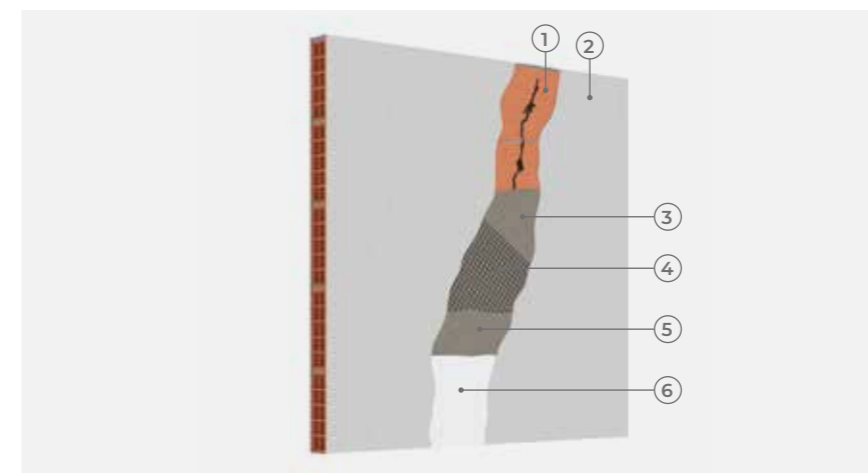
FRCM System



- ① Existing partition/infill wall
- ② Existing render
- ③ Planitop HDM Maxi
- ④ Mapegrid G 120
- ⑤ Planitop HDM Maxi
- ⑥ MapeWrap SG Fiocco or MapeWrap G Fiocco
- ⑦ Planitop 200

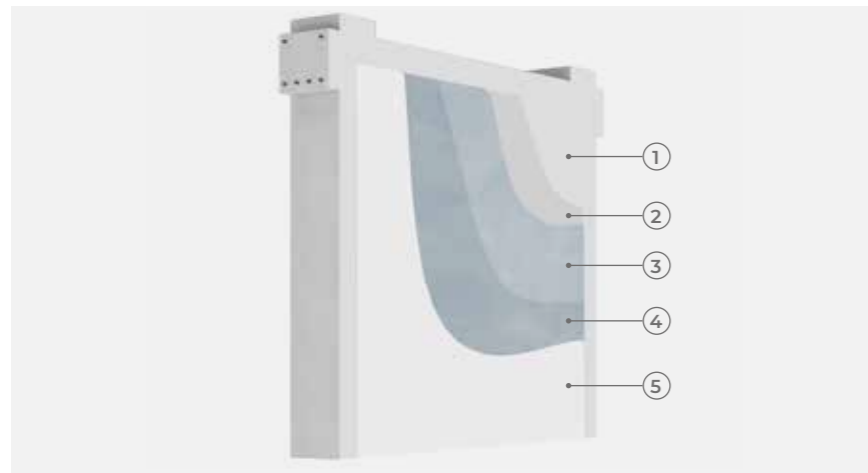


- ① Existing reinforced concrete structure
- ② MapeWrap Primer 1
- ③ MapeWrap 11/12
- ④ MapeWrap 31
- ⑤ MapeWrap C UNI-AX
- ⑥ MapeWrap C QUADRI-AX
- ⑦ MapeWrap C Fiocco or MapeWrap C Connector
- ⑧ MapeWrap 31
- ⑨ Quartz 1.2
- ⑩ Planitop 200



- ① Existing partition/infill wall
- ② Existing render
- ③ Planitop HDM Maxi
- ④ Mapegrid G 120
- ⑤ Planitop HDM Maxi
- ⑥ Planitop 200

MapeWrap EQ System



- ① Existing render
- ② MapeWrap EQ Adhesive
- ③ MapeWrap EQ Net
- ④ MapeWrap EQ Adhesive
- ⑤ Planitop 200

Mapei Steel Dry



- ① Existing masonry
- ② Mapei Steel Dry
- ③ Planitop HDM Restauro for grouting the hole

ANTI-OVERTURNING TIE

STRENGTHENING WITH FRP COMPOSITE TIE

MapeWrap System



- ① Existing masonry
- ② Planitop HDM Maxi (optional)
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap G UNI-AX
- ⑦ MapeWrap 31
- ⑧ Mapefix VE SF
- ⑨ MapeWrap C Fiocco or MapeWrap G Fiocco
- ⑩ Quartz 1.2

Maperod

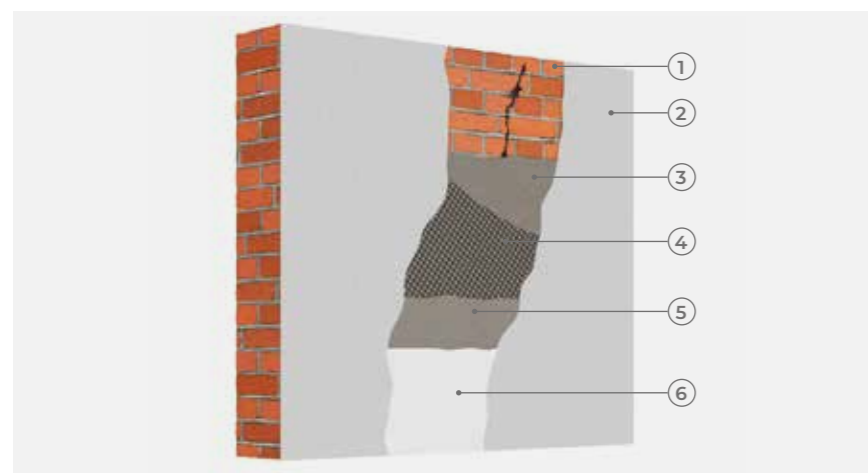


- ① Existing masonry
- ② Maperod C or Maperod G
- ③ Mape-Antique I-15 or MapeWall Inject & Consolidate
- ④ Mape-Antique Allettamento or MapeWall Muratura Fine for grouting the hole

MASONRY

REPAIRING CRACKS IN LOAD-BEARING MASONRY

FRCM System



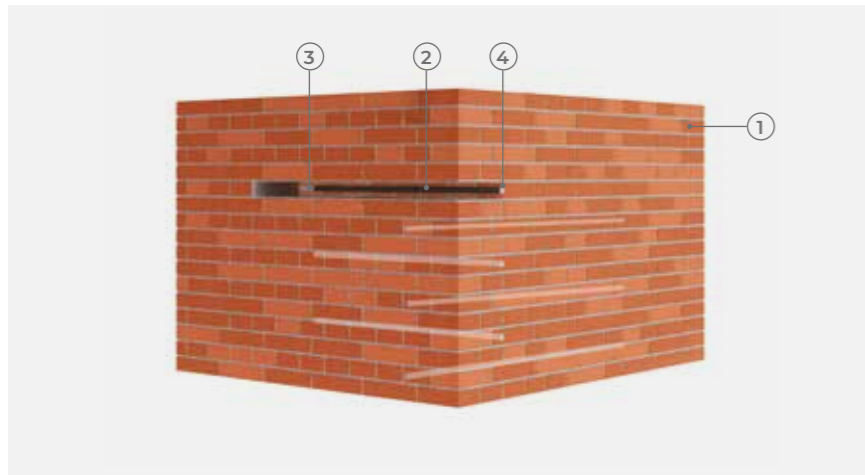
- ① Existing masonry
- ② Existing render
- ③ Planitop HDM Maxi or Planitop HDM Restauro
- ④ Mapegrid G 220 or Mapegrid B 250
- ⑤ Planitop HDM Maxi or Planitop HDM Restauro
- ⑥ Skim coat



- ① Existing masonry
- ② MapeWrap Primer 1
- ③ Maperod C or Maperod G
- ④ Mapefix VE SF or Mapefix EP 100 or MapeWrap 11 or MapeWrap 12
- ⑤ Mape-Antique Allettamento or MapeWall Muratura Fine for grouting the hole

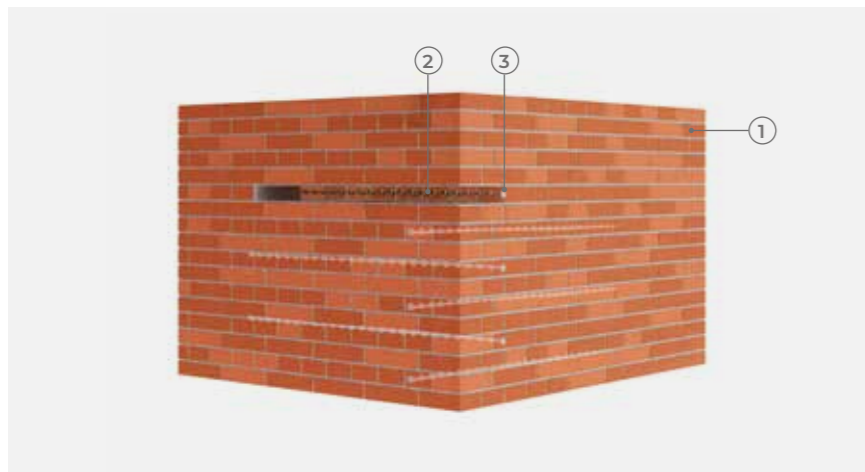
MASONRY CONNECTIONS BETWEEN NON-CONNECTED WALLS

Carbotube



- ① Existing masonry
- ② Carbotube
- ③ Mape-Antique I-15 or MapeWall Inject & Consolidate
- ④ Mape-Antique Allettamento or MapeWall Muratura Fine for grouting the hole

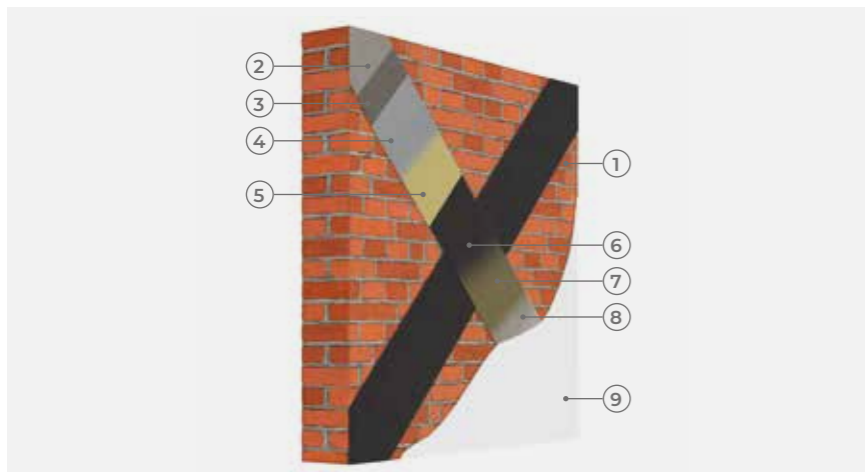
Mapei Steel Dry



- ① Existing masonry
- ② Mapei Steel Dry
- ③ Mape-Antique Allettamento or MapeWall Muratura Fine for grouting the hole

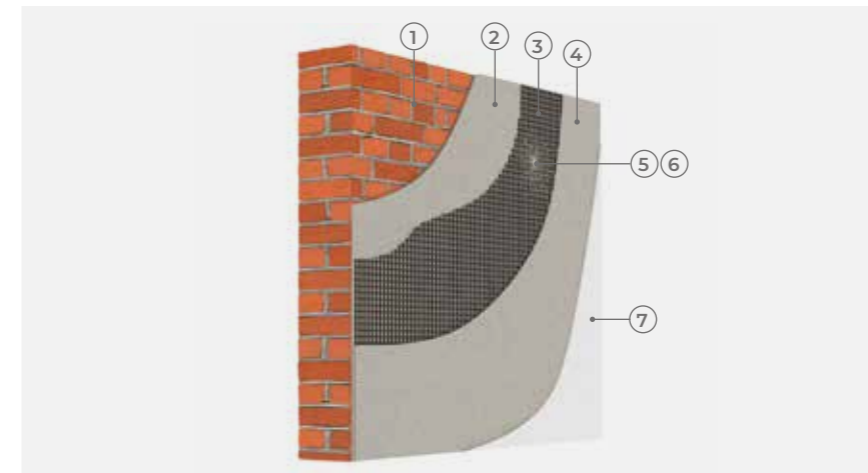
MASONRY STRENGTHENING OF LOAD-BEARING MASONRY

MapeWrap System



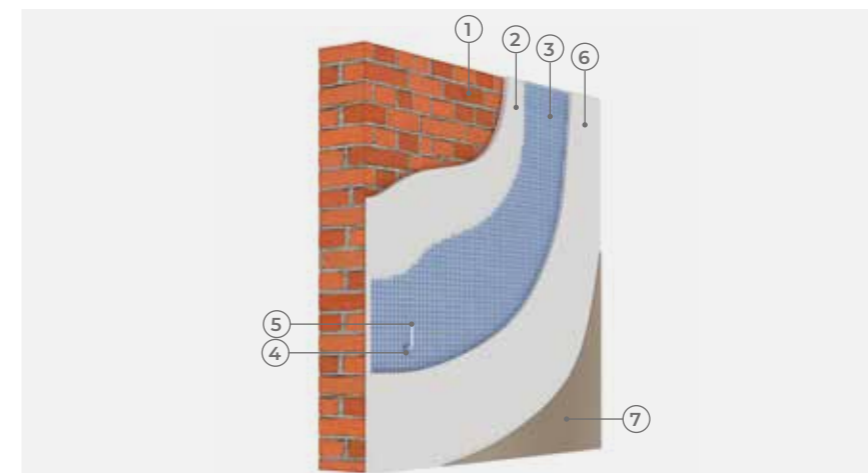
- ① Existing masonry
- ② Planitop HDM Maxi (optional)
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap G UNI-AX
- ⑦ MapeWrap 31
- ⑧ Quartz 1.2
- ⑨ Finishing

FRCM System



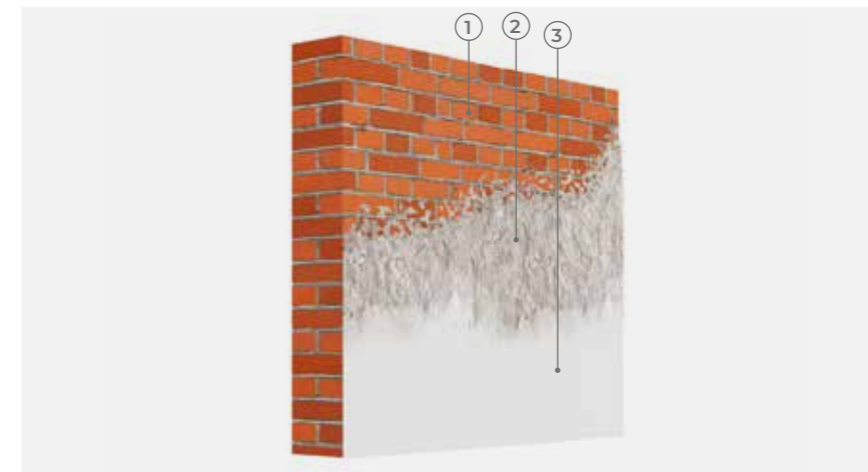
- ① Existing masonry
- ② Planitop HDM Maxi or Planitop HDM Restauro
- ③ Mapegrid G 220 or Mapegrid B 250
- ④ Planitop HDM Maxi or Planitop HDM Restauro
- ⑤ Mapefix VE SF
- ⑥ MapeWrap G Fiocco or MapeWrap B Fiocco
- ⑦ Finishing

CRM System



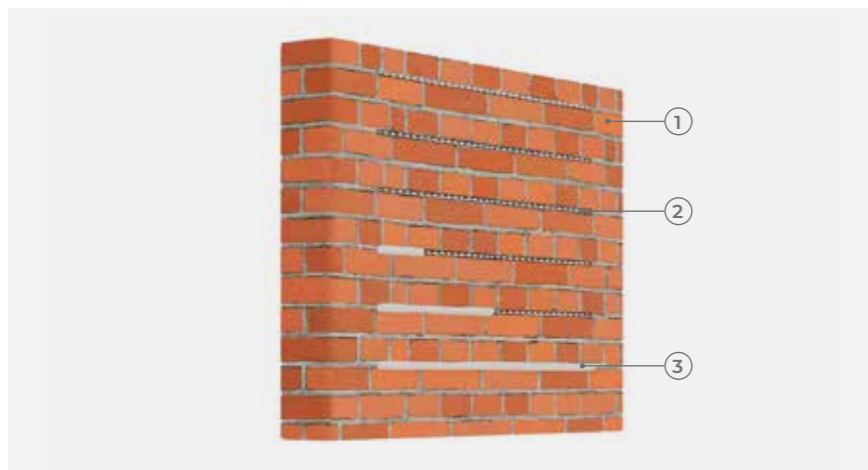
- ① Existing masonry
- ② MapeWall Render & Strengthen or Mape-Antique NHL Eco Strutturale
- ③ Mapenet EM 30/40 or Mapenet EMR 33/66/99
- ④ Mapefix VE SF
- ⑤ Mapenet EM Connector or Mapenet EMR Connector
- ⑥ MapeWall Render & Strengthen or Mape-Antique NHL Eco Strutturale
- ⑦ Finishing

Planitop Intonaco Armato



- ① Existing masonry
- ② Planitop Intonaco Armato
- ③ Finishing

Mapei Steel Bar

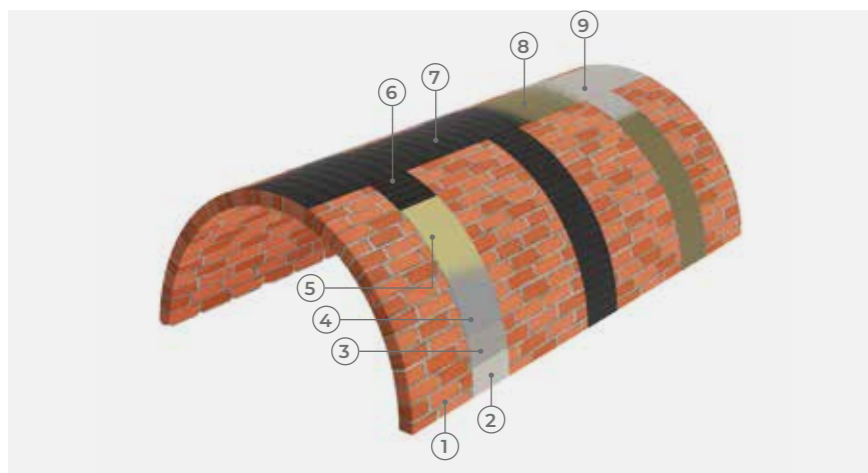


- ① Existing masonry
- ② Mapei Steel Bar
- ③ Planitop HDM Restauro or Mape-Antique Allettamento for pointing brick masonry

ARCHES AND VAULTS

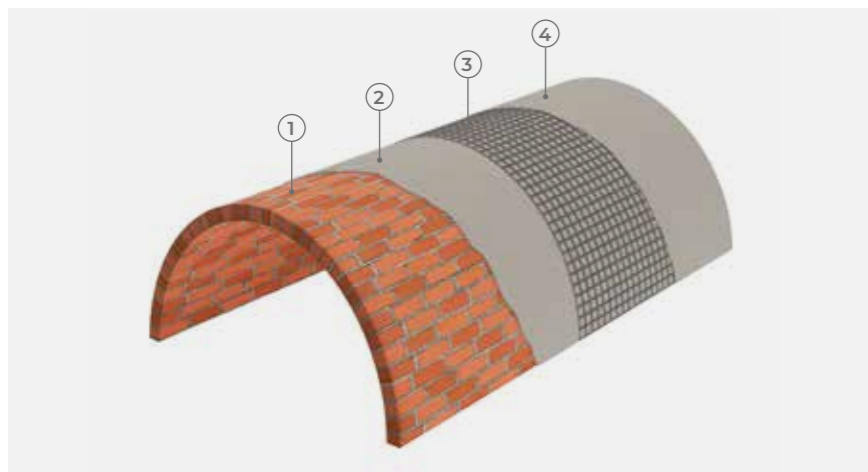
STRENGTHENING FROM THE TOP OR FROM THE BOTTOM

MapeWrap System



- ① Existing vault
- ② Planitop HDM Maxi (optional)
- ③ MapeWrap Primer 1
- ④ MapeWrap 11/12
- ⑤ MapeWrap 31
- ⑥ MapeWrap C UNI-AX or MapeWrap G UNI-AX
- ⑦ MapeWrap C Quadri-AX
- ⑧ MapeWrap 31
- ⑨ Quartz 1.2

FRCM System



- ① Existing vault
- ② Planitop HDM Maxi or Planitop HDM Restauro
- ③ Mapegrid G 220 or Mapegrid B 250
- ④ Planitop HDM Maxi or Planitop HDM Restauro

MAPEI STRUCTURAL DESIGN CALCULATION TOOL FOR MAPEI STRUCTURAL STRENGTHENING SYSTEMS

Mapei Structural Design is a new **calculation software** conceived by **Mapei** and developed in collaboration with Eucentre, an international research and informatics centre focused on seismic and structural engineering. Using **Mapei Structural Design** it is possible to obtain precise and reliable calculations in structural strengthening projects. Freely accessible on the **Mapei** website, this software is designed to cater to professionals and operators. It can be used seamlessly on PCs, tablets, or smartphones without the need for installation. **Mapei Structural Design** calculations are based on the latest international reference standards and can be performed on a computer in your office, with the option to save them within your personal account. Your project can be reviewed or modified at any moment, even on the building site, using a smartphone or tablet. To access the tool, you only need the login credentials for the **Mapei** website, where you will always find the most updated version, available in Italian, English, and Spanish.

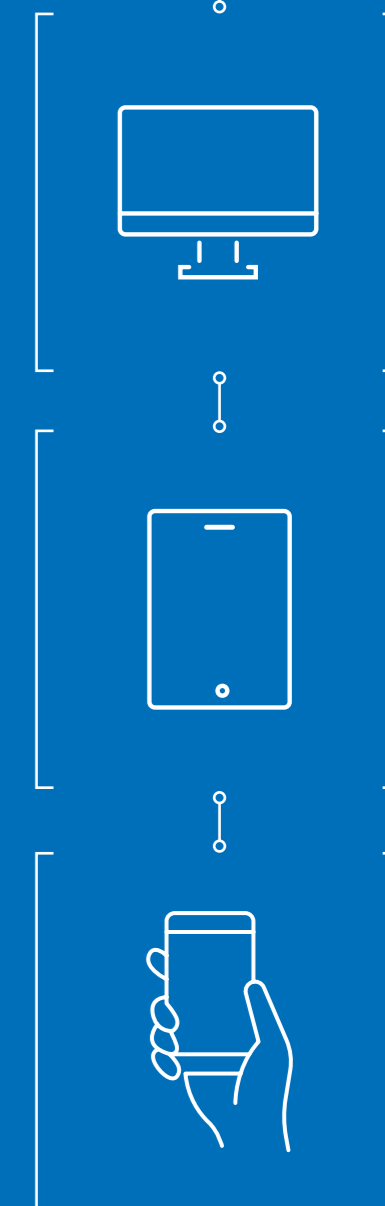
Mapei Structural Design supports the design of strengthening interventions for existing structures made of:

- reinforced concrete
- masonry
- timber
- non-bearing elements

Access the tool and start using it now:

<https://structuraldesign.mapei.com/home.html#!>

USE MAPEI
STRUCTURAL DESIGN
on mapei.com



Carboplate	MapeWrap C UNI-AX	MapeWrap C UNI-AX HM	MapeWrap C BI-AX	MapeWrap C QUADRI-AX	MapeWrap G UNI-AX	Mapegrid G 120 + Planitop HDM Maxi	Mapegrid G 220 + Planitop HDM Maxi	Mapegrid B 250 + Planitop HDM Restauro	Mapenet EM/EMR + MapeWall Render & Strengthen	Mapenet EM/EMR + Mape-Antique NHL Eco Strutturale
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Planitop Intonaco Armato	Mapei Steel Dry	Mapei Steel Bar	Carbotube	Maperod C	Maperod G	MapeWrap C Connector	MapeWrap C/G/B/SC FIOCCO	MapeWrap EQ Net + MapeWrap EQ Adhesive	Planitop HPC + Fibre HPC	Planitop HPC Floor	Planitop HPC Floor T	Planitop HPC Floor 46	Planitop HPC Floor 46 T	Planitop HPC Tixo + Fibre HPC
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STRENGTHENING INTERVENTIONS

FLOOR SLABS	Flexural strengthening														
	Strengthening with High Performance Concrete slab overlay														
	Anti-collapse systems for ceiling														
BEAMS	Shear strengthening														
	Flexural strengthening														
PILLARS	Shear and compressing-bending strengthening and confinement														
BEAM-COLUMN JOINTS	Strengthening of beam-pillar joints														
INFILL AND PARTITION WALLS	Anti-overturning systems														
	Repair of cracks														
ANTI-OVERTURNING TIE	Strengthening with FRP composite tie														
MASONRY	Repairing cracks in load-bearing masonry														
	Connections between non-connected walls														
	Strengthening of load-bearing masonry (walls and pillars)														
ARCHES AND VAULTS	Strengthening of masonry arches and vaults														

STRENGTHENING INTERVENTIONS

EVERYTHING'S OK,
WITH MAPEI



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