

# MapeWrap C QUADRI-AX System

**STRUCTURAL STRENGTHENING SYSTEM CONSISTING OF HIGH-STRENGTH  
HIGH-MODULUS QUADRIDIRECTIONAL CARBON FIBRE FABRIC AND EPOXY  
RESINS TO IMPREGNATE AND BOND THE FABRIC (FRP)**

**COVERED BY CERTIFICATE OF TECHNICAL ASSESSMENT (CVT)  
N° 376/2022 CLASS 210C**



## **PRODUCTS USED IN THE SYSTEM:**

**MapeWrap C QUADRI-AX 380**

**MapeWrap 31**

**MapeWrap 11 - MapeWrap 12**

**MapeWrap Primer 1**

## **WHERE TO USE**

The system is recommended for cladding beam-pillar hinge-point panels to improve and upgrade their resistance to seismic, dynamic and impulse loads, to repair and upgrade reinforced concrete and masonry structures when it is difficult to identify the exact trend of tensile equilibrium in two-dimensional structures such as plates and sheets, storage tanks, domed covers and ceilings, and for strengthening load-bearing elements in general in buildings in which the structural system has been modified due to a change in use.

## **Some application examples**

- Restoring two-dimensional structures such as plates and sheets, domed covers and storage tanks without having to consider the exact trend of tensile strains.
- Seismic upgrading and restoration of domed structures without increasing their seismic mass and without the risk of liquids percolating towards their inner surfaces.
- Cladding beam-pillar hinge points to upgrade the seismic capacity of buildings and structures.
- Strengthening load-bearing members in buildings whose structural system has been modified due to new architectural requirements or change in use.

The system is covered by Certificate of Technical Assessment (CVT) N° 376/2022 issued by the 2° Div. of the STC (Central Technical Service) of the CSLP (Ministry of Public Works).

## **TECHNICAL CHARACTERISTICS**

### **MAPEWRAP C QUADRI-AX SYSTEM**

is the combined application of **MAPEWRAP C QUADRI-AX 380** carbon fibre fabric,

a system of epoxy binders which includes **MAPEWRAP 31** epoxy resin to impregnate and bond the fabric, **MAPEWRAP 11** or **MAPEWRAP 12** epoxy grout to level off surfaces and bond the fabric and **MAPEWRAP PRIMER 1** epoxy primer recommended to consolidate the substrate.

The use of epoxy grout **MAPEWRAP 11** or **MAPEWRAP 12** is recommended in particular to level surfaces with roughness equal to or greater than  $\pm 2$  mm. The application of epoxy grout is furthermore suggested to increase the adhesion and to facilitate the application of fabric with high weight (equal to or greater than 600 g/m<sup>2</sup>).

**MAPEWRAP C QUADRI-AX 380** is a quadridirectional, balanced carbon fibre fabric characterised by its high modulus of elasticity (comparable to that of steel) and very high tensile strength.

**MAPEWRAP 31** is a medium-viscosity epoxy adhesive used to impregnate **MAPEWRAP** fabrics and is made from:  
– component A (resin);  
– component B (catalyser).

**MAPEWRAP 11 / MAPEWRAP 12** are epoxy grouts with a thixotropic consistency used to level off surfaces and to form structural bonds and are made from:

- component A (resin);
- component B (catalyser).

**MAPEWRAP PRIMER 1** is an epoxy primer used to prepare the surface of concrete, reinforced concrete and masonry elements and structures before bonding **MAPEWRAP** fabrics and is made from:

- component A;
- component B.

**MAPEWRAP 31**, **MAPEWRAP 11** and **MAPEWRAP 12** respond to the principles defined in EN 1504-9 (*“Products and systems for the*

*protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity. General principles for the use of products and systems”*), and the minimum requirements for EN 1504-4 (*“Structural bonding”*).

## **ADVANTAGES**

Unlike work carried out using conventional techniques, thanks to its extremely low weight, **MAPEWRAP C QUADRI-AX SYSTEM** may be installed by a smaller team of workers. The system may be applied extremely quickly and often without interrupting the use of the structure. Compared with the cladding technique with metal plates (beton plaqué), **MAPEWRAP C QUADRI-AX SYSTEM** may be modelled to suit any shape of element or structure requiring repair, it does not require temporary supports during application and any there is no risk of corrosion to the strengthening system.

## **RECOMMENDATIONS**

All workers must use protective gloves and goggles and anti-solvent safety masks.

## **APPLICATION PROCEDURE**

### **Preparation of the substrate**

Surfaces on which **MAPEWRAP C QUADRI-AX SYSTEM** is to be applied must be perfectly clean, dry and strong. Masonry structures: before applying the fabric, remove all loose or crumbling areas or areas at risk of becoming detached and level off the surfaces with a layer of **PLANITOP HDM MAXI**. Wooden structures: repair wooden elements and structures, where required, by applying adhesives from the **MAPEWOOD** range.



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Concrete structures in good condition: sandblast the surface to remove all traces of stripping compound, paint and cement laitance.

Damaged concrete structures: remove all damaged areas with a hammer, a jack-hammer or by hydro-scarifying. Remove all traces of rust from the steel reinforcement and protect the reinforcement by applying **MAPEFER** two-component anti-corrosion cementitious mortar or **MAPEFER 1K** one-component anti-corrosion cementitious mortar. Repair the surface of concrete with products from **MAPEGROUT** range. Wait at least three weeks before applying **MAPEWRAP C QUADRI-AX SYSTEM**. If structural strengthening work needs to be carried out immediately, use **ADESILEX PG1** or **ADESILEX PG2** to carry out repairs. Seal any cracks in the structure by injecting them with **EPOJET** or **EPOJET LV** (suitable only for dry or slightly damp cracks) or with **FOAMJET T** or **FOAMJET F** (suitable for damp cracks or if water is seeping in).

Refer to the relative Technical Data Sheet for details on how to apply the aforementioned products. Round off all sharp edges and corners on elements which are to be strengthened with **MAPEWRAP C QUADRI-AX SYSTEM** (such as beams and pillars) with a jack-hammer or other suitable tools. It is recommended to round them off to a radius of at least 2 cm (in compliance with CNR-DT 200 R1/2013 guidelines).

## Application procedure for the MAPEWRAP C QUADRI-AX SYSTEM

Application phases

1. Preparation of **MAPEWRAP PRIMER 1**.
2. Application of **MAPEWRAP PRIMER 1**.
3. Preparation of **MAPEWRAP 11** or **MAPEWRAP 12**.
4. Application of **MAPEWRAP 11** or **MAPEWRAP 12**.
5. Preparation of **MAPEWRAP 31**.
6. Application of the first coat of **MAPEWRAP 31**.
7. Application of **MAPEWRAP C QUADRI-AX** fabric.

### 1. Preparation of MAPEWRAP PRIMER 1

The two components which make up **MAPEWRAP PRIMER 1** must be mixed together. Pour component B into component A and mix with a drill at low-speed with a mixing attachment until the resin is completely blended. Mixing

ratio: 3 parts in weight of component A with 1 part in weight of component B. To avoid dosage errors, use the entire contents of the two components. If only partial quantities are required, use high-precision electronic scales to weigh out the components (this procedure must also be adopted for the other products). Once prepared, the workability time of **MAPEWRAP PRIMER 1** is around 90 minutes at +23°C.

### 2. Application of MAPEWRAP PRIMER 1

Apply an even coat of **MAPEWRAP PRIMER 1** with a brush or roller on the clean, dry surface of the concrete or masonry. If the surface is particularly absorbent, apply a second coat of **MAPEWRAP PRIMER 1** once the first coat has been completely absorbed.

### 3. Preparation of MAPEWRAP 11 or MAPEWRAP 12

Choose whether to use **MAPEWRAP 11** or **MAPEWRAP 12** according to the surrounding temperature and their workability times (the workability time of **MAPEWRAP 12** is higher than **MAPEWRAP 11**). Pour component B into component A and mix with a drill at low-speed with a mixing attachment to form an even grey paste. Mixing ratio for both products: 3 parts in weight of component A with 1 part in weight of component B. At +23°C **MAPEWRAP 11** remains workable for approximately 35 minutes after mixing, while **MAPEWRAP 12** remains workable for approximately 50 minutes. **MAPEWRAP 11** is particularly recommended if the surrounding temperature is between +5°C and +23°C, while **MAPEWRAP 12** is recommended for higher temperatures.

### 4. Application of MAPEWRAP 11 or MAPEWRAP 12

On concrete or masonry surfaces previously treated with **MAPEWRAP PRIMER 1**, and while it is still wet, apply a layer around 1 mm thick of **MAPEWRAP 11** or **MAPEWRAP 12** with a notched spreader then smooth over the surface using a flat spreader to remove any imperfections on the surface.

Using the same product, fill and round off the corners to form an edge with a radius of at least 2 cm.

### 5. Preparation of MAPEWRAP 31

Pour component B into component A and mix with a drill at low-speed with a mixing attachment to form an even yellow paste. Mixing ratio: 4 parts in weight of component A with 1 part in weight of component B. After mixing, the product remains workable for approximately 40 minutes at +23°C.

### 6. Application of the first coat of MAPEWRAP 31

Apply a first, even coat around 0.5 mm

thick of **MAPEWRAP 31** on the **MAPEWRAP 11** or **MAPEWRAP 12** while they are still wet with a brush or a roller.

### 7. Application of MAPEWRAP C QUADRI-AX fabric

Immediately lay **MAPEWRAP C QUADRI-AX** fabric on **MAPEWRAP 31** while it is still "wet", making sure it is applied by hand (wear protective rubber gloves), without any creases or folds and pass over the surface several times with a **MAPEWRAP ROLLER** so that the adhesive completely penetrates into the fibres of the fabric. Apply a second coat of **MAPEWRAP 31** over **MAPEWRAP C QUADRI-AX** fabric. Go over the surface of the impregnated fabric with a **MAPEWRAP ROLLER** to remove any air bubbles trapped in the layers during the previous phases. While the resin is still wet, broadcast the surface with 1.2 mm to 1.9 mm quartz sand.

(For further information on the technical characteristics of each resin product used for **MAPEWRAP C QUADRI-AX SYSTEM** refer to the relative Technical Data Sheet).

### Joints

When binding pillars, the ends of the strips of **MAPEWRAP C QUADRI-AX** fabric must overlap each other by at least 20 cm.

The same procedure must be followed when strips applied in a longitudinal direction have to be joined. After applying and pressing the fabric with the special roller, **MAPEWRAP C QUADRI-AX** fabric must not be moved or adjusted.

### "Wet" application procedure (within 24 hours) for additional layers of MAPEWRAP C QUADRI-AX fabric

Application of the first coat of **MAPEWRAP 31**, application of the first layer of **MAPEWRAP C QUADRI-AX** and application of the second coat of **MAPEWRAP 31**. Application of the next layer of **MAPEWRAP C QUADRI-AX** and the next coat of **MAPEWRAP 31**, and so on for any other additional layers required. To exploit the mechanical characteristics of **MAPEWRAP C QUADRI-AX** as much as possible, it is recommended to apply no more than three layers.

**Note:** if additional layers of fabric need to be applied after more than 24 hours, the surface of the hardened resin must be roughened up by sanding.

### FINISHING AND PROTECTING THE SYSTEM

Once the resin products used in the system have hardened (approx. 1-2 days at +23°C), the surface may be finished off with **MAPELASTIC** two-



component, elastic cementitious mortar or **ELASTOCOLOR** elastic acrylic paint (please refer to the Technical Data Sheet for each product for application instructions).

The products mentioned above form an efficient barrier against UV rays, which makes them particularly recommended for structures exposed to direct sunlight.

### PRECAUTIONS TO BE TAKEN DURING AND AFTER APPLICATION

- The temperature during application operations must be at least +5°C (or at least +10°C if **MAPEWRAP PRIMER 1** has been used) and the structure must also be dry and protected from rain and dust carried by the wind.
- After completing the application operations, make sure the treated surfaces are kept at a temperature of at least +5°C (or +10°C if **MAPEWRAP PRIMER 1** has been used).
- Protect surfaces from rain for at least 24 hours if the temperature does not drop below +15°C and for at least 3 days if the temperature is lower.

### Cleaning

Epoxy systems form an extremely strong bond and we recommend cleaning all work tools with solvent (such as ethanol, toluene, etc.) before they harden.

### PACKAGING AND STORAGE

**MAPEWRAP C QUADRI-AX** is supplied in a cardboard box containing 1 roll x 50 metres long.

**MAPEWRAP 31** is supplied in 5 kg kits comprising one 4 kg drum (component A) and one 1 kg drum (component B).

**MAPEWRAP 11** and **MAPEWRAP 12** are supplied in 6 kg kits comprising one 4.5 kg drum (component A) and one 1.5 kg drum (component B).

All the products from the system must be stored in a dry, covered area.

### NOTES

Procedures regarding the safe handling of the products are contained in the Material Safety Data Sheet for each single product in the system. However, the use of protective gloves and goggles is recommended when mixing and applying the products.

### WARNING

*Although the technical details and recommendations contained in this data sheet correspond to the best of our knowledge and experience, all the above information must, in all cases, be taken as merely indicative and subject to confirmation after long-term, practical applications. For this reason, anyone who intends using this product must ensure beforehand that it is suitable for the envisaged application. In all cases, the user alone is fully responsible for any*

*consequences deriving from the use of this product.*

### SAFETY INSTRUCTIONS FOR PREPARATION AND APPLICATION

**MAPEWRAP C QUADRI-AX 380** is an article and referring to the current European regulations (Reg. 1906/2007/CE - REACH) does not require the preparation of the Safety Data Sheet. During use it is recommended to wear gloves and goggles and follow the safety requirements of the workplace in which work is carried out.

PRODUCT FOR PROFESSIONAL USE.

Regarding **MAPEWRAP 31**, **MAPEWRAP 11**, **MAPEWRAP 12** and **MAPEWRAP PRIMER 1**, always refer to the latest, updated version of the Technical Data Sheet available on the company website [www.mapei.com](http://www.mapei.com)



Application of MapeWrap Primer 1



Skim-coat of MapeWrap 11 or MapeWrap 12



First coat of MapeWrap 31



Application of MapeWrap C QUADRI-AX fabric



Second coat of MapeWrap 31

**SYSTEM SPECIFICATIONS**

Cladding of beam-pillar hinge-point panels to improve and upgrade their resistance to seismic, dynamic and impulse loads, to repair and upgrade reinforced concrete and masonry structures when it is difficult to identify the exact trend of tensile equilibrium in two-dimensional structures such as plates and sheets, storage tanks, domed covers and ceilings, and for strengthening load-bearing elements in general in buildings in which the structural system has been modified due to a change in use by applying a strengthening system (such as **MAPEWRAP C QUADRI-AX SYSTEM** by MAPEI S.p.A.) comprising **MAPEWRAP C QUADRI-AX** high-strength, high-modulus (comparable to that of steel), quadridirectional, balanced carbon fibre fabric using the following procedure:

- application of **MAPEWRAP PRIMER 1**;
- levelling off the substrate with **MAPEWRAP 11** or **MAPEWRAP 12**;
- impregnating the fabric with **MAPEWRAP 31**.

Depending on the type of work to be carried out, the fabric, which weighs 380 g/m², is available in two standard widths (30 cm and 48 cm); other widths are available on request.

The system is applied according to Certificate of Technical Assessment (CVT) N° 376/2022 issued by the 2° Div. of the STC (Central Technical Service) of the CSLP (Ministry of Public Works) and must have the following characteristics:

Class according to Legislation DPCS (Prime Ministerial Decree) LL.PP. No. 293 of 29/05/2019: 210C

Properties of dry fabric:

Weight:	380 g/m²
Equivalent thickness of dry fabric:	0.053 mm
Resistant area per unit of width:	53.1 mm²/m
Tensile strength of dry fabric:	> 4,800 N/mm²
Maximum load per unit of width:	> 254 kN/m
Tensile modulus of elasticity:	230,000 N/mm²
Elongation at failure:	2.1%

Properties of the system:

Modulus of elasticity of laminate (refers to net area of fibres) average for 3 layers $E_l$ :	$\geq 250,000$ MPa
Strength of laminate (refers to net area of fibres) average for 3 layers $f_{fib,k}$ :	$\geq 3,400$ MPa
Deformation at failure $\epsilon_{fib}$ :	$\geq 1.16\%$
Adhesion to concrete:	$> 3$ N/mm² (failure of substrate)



*Broadcasting of quartz sand*





## GEOMETRICAL AND PHYSICAL CHARACTERISTICS

Property	Test method reference standard	MAPEWRAP C QUADRI-AX 380
Type of fibre	–	high-strength carbon
Appearance	–	balanced quadridirectional fabric
Density of fibres $\rho_{fib}$	ASTM D 792	1.80-1.84 g/cm <sup>3</sup>
Weight of fibres per unit of area $p_x$	–	380 g/m <sup>2</sup>
Density of resin $\rho_m$	ISO 2811-1	1.06 g/cm <sup>3</sup>
Equivalent area of dry fabric for single direction $A_{rt}$	–	53.1 mm <sup>2</sup> /m
Equivalent thickness of dry fabric for single direction $t_{eq}$	–	0.053 mm
Amount of fibres in the composite by weight	ASTM D 3171	38-48%
Amount of fibres in the composite by volume	ASTM D 3171	25-35%
Glass transition temperature of resin used to impregnate the fibres $T_{g,im}$	ISO 11357-2 DSC	+58°C
TGlass transition temperature of levelling putty (optional) $T_{g,re}$	ISO 11357-2 DSC	+64°C
Minimum and maximum service temperature <sup>(1)</sup>	ACI 440.2R-08	-20°C to +43°C <sup>(2)</sup>
Reaction to fire	UNI EN 13501-1	F
Resistance to fire	–	NPD

### Notes:

(1) Refers to the temperature of the resin, not the environmental temperature.

(2) Maximum service temperature is considered to be 15°C lower than the glass transition temperature of the adhesive, as specified in CNR-DT 200 R1/2013 ref. ACI 440.2R-08.

Note: this assumption is highly precautionary; the ACI mentioned refers to Tg values measured by DMA (Dynamic Mechanical Analysis), a method that gives reading around 15-20°C higher than the DSC (Differential Scansion Calorimeter) method used in this case as specified by European standards.

## MECHANICAL PROPERTIES OF DRY FABRIC

Property	MAPEWRAP C QUADRI-AX 380
Tensile strength	> 4,800 N/mm <sup>2</sup>
Maximum load per unit of width	> 254 kN/m
Tensile modulus of elasticity	230,000 N/mm <sup>2</sup>
Deformation at failure	2.1%

## MECHANICAL PROPERTIES OF THE MAPEWRAP C QUADRI-AX SYSTEM ACCORDING TO CVT N° 376/2022

Class according to Legislation DPCS (Prime Ministerial Decree) LL.PP. No. 293 of 29/05/2019			210C
Modulus of elasticity of laminate (for net area of fibres)			210 GPa
Strength of laminate (for net area of fibres)			2,700 MPa
Property	Test method reference standard	MAPEWRAP C QUADRI-AX 380	
		for 1 layer of fabric	for 3 layers of fabric
Modulus of elasticity of laminate (for net area of fibres) average value $E_f$	EN 2561	≥ 230 GPa	≥ 250 GPa
Tensile strength of laminate refers to net area of fibres characteristic value $f_{fib,k}$		≥ 2,900 MPa	≥ 3,400 MPa
Elongation failure $\epsilon_{fib}$		≥ 1.29%	≥ 1.16%
Adhesion to concrete	> 3 N/mm <sup>2</sup> (failure of substrate)		

**PACKAGING** - MapeWrap C QUADRI-AX fabric is available in 50 metre rolls in a cardboard box with the following codes:

	<i>Weight</i>	<i>Width</i>	<i>Area</i>	<i>Area</i>
MapeWrap C QUADRI-AX 380/30	380 g/m <sup>2</sup>	30 cm	0.3 m <sup>2</sup> /m	15 m <sup>2</sup> /roll
MapeWrap C QUADRI-AX 380/48	380 g/m <sup>2</sup>	48.5 cm	0.485 m <sup>2</sup> /m	24.25 m <sup>2</sup> /roll

#### CONSUMPTION OF EPOXY SYSTEMS

*Priming, evening out and skimming surfaces*

	<i>Consumption</i>
MapeWrap Primer 1	250-300 g/m <sup>2</sup>
MapeWrap 11 or MapeWrap 12	1,500-1,600 g/m <sup>2</sup>

#### Impregnating MapeWrap C QUADRI-AX fabric

	<i>Weight</i>	<i>Consumption</i>	<i>Width</i>	<i>Consumption</i>
MapeWrap 31	380 g/m <sup>2</sup>	2,000-2,100 g/m <sup>2</sup>	30 cm	600-700 g/m
			48.5 cm	970-1020 g/m