MAPEWRAP C UNI-AX SYSTEM

Structural strengthening system consisting of high-strength high-modulus unidirectional 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 UNI-AX 300 - MAPEWRAP C UNI-AX 300 W - MAPEWRAP C UNI-AX 600 - MAPEWRAP C UNI-AX 600 W - MAPEWRAP 31 - MAPEWRAP 11 - MAPEWRAP 12 - MAPEWRAP PRIMER 1

WHERE TO USE

This system is recommended for repairing and increasing the structural capacity of under-dimensioned or damaged elements and structures in reinforced concrete, masonry, steel and wood, to improve the flexural strength, shear strength, compressive confinement capacity and bending/compressive capacity of concrete and masonry elements and structures, to upgrade or improve the seismic capacity of structures in high-risk areas, to improve the characteristics of beam-pillar hinge points and to increase the ductility of confined elements.

Some application examples

- Repairs and static and seismic upgrading of unstable or weak structures where the shear and tensile strength need to be supplemented.
- Confining compressed and pre-stressed members (pillars, bridge piles, chimneys, etc.) to improve their load-bearing capacity or ductility.
- Restoration work and seismic upgrading of arched and vaulted structures without increasing their mass and without the risk of liquids percolating towards the inner face.
- Repairs to structures damaged by fire.
- Strengthening load-bearing members in buildings whose structural system has been modified due to new architectural requirements or change in use.
- Seismic upgrading of reinforced concrete industrial buildings.

The system is covered by Certificate of Technical Assessment (CVT) N° 376/2022 (which replace the previous certificate N° 206/2019) issued by the 2° Div. of the STC (Central Technical Service) of the CSLP (Ministry of Public Works).
MAPEWRAP C UNI-AX 300 + **MAPEWRAP 31** and **MAPEWRAP C UNI-AX 600** + **MAPEWRAP 31** systems are also covered by ESR-3499 certification issued by the American Institute ICC-ES (International Code Council - Evaluation Service) which assessed their mechanical performance properties and durability under various conditions and by performing tests on full-scale strengthened elements.

TECHNICAL CHARACTERISTICS

MAPEWRAP C UNI-AX SYSTEM is the combined application of **MAPEWRAP C UNI-AX 300** / **MAPEWRAP C UNI-AX 300 W** or **MAPEWRAP C UNI-AX 600** / **MAPEWRAP C UNI-AX 600 W** 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 ± 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/m²).
MAPEWRAP C UNI-AX 300 / **MAPEWRAP C UNI-AX 300 W** are unidirectional (0°) fabrics available in various widths weighing 300 g/m². They are made from high-strength carbon fibre woven with thermoplastic glass fibre thread (which has no structural function) and are characterised by their high tensile strength and high modulus of elasticity.
MAPEWRAP C UNI-AX 600 / MAPEWRAP C UNI-AX 600 W are unidirectional (0°) fabrics available in various widths weighing 600 g/m². They are made from high-strength carbon fibre woven with thermoplastic glass fibre thread (which has no structural function) and are characterised by their high tensile strength and high modulus of elasticity.
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** meet the requirements 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 UNI-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 plaquè), **MAPEWRAP C UNI-AX SYSTEM** may be modelled to suit any shape of element or structure requiring repair, it does not require temporary supports during application and 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

Substrate preparation

Surfaces on which **MAPEWRAP C UNI-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.
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 the **MAPEGROUT** range.
Wait at least three weeks before applying **MAPEWRAP C UNI-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** o **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 concrete or masonry elements and structures which are to be strengthened with **MAPEWRAP C UNI-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 MAPEWRAP C UNI-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 UNI-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 trowel then smooth over the surface using a flat trowel 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 0.5 mm thick coat of **MAPEWRAP 31** on the **MAPEWRAP 11** or **MAPEWRAP 12** while they are still wet with a brush or roller.

7. Application of MAPEWRAP C UNI-AX FABRIC

Immediately lay **MAPEWRAP C UNI-AX** fabric over **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 UNI-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 the **MAPEWRAP C UNI-AX SYSTEM** refer to the relative Technical Data Sheet).

Joints

The overlap of the ends of the strips of **MAPEWRAP C UNI-AX SYSTEM** fabric must by at least 30 cm. It is not necessary to overlap the strips width ways; in this case, make sure each strip is butted up to the adjalent strip.
After applying and pressing the fabric with the special roller, **MAPEWRAP C UNI-AX** fabric must not be moved or adjusted.
“Wet” application procedure (within 24 hours) for additional layers of **MAPEWRAP C UNI-AX** fabric
Application of the first coat of **MAPEWRAP 31**, application of the first layer of **MAPEWRAP C UNI-AX** and application of the second coat of MAPEWRAP 31. Application of the next layer of **MAPEWRAP C UNI-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 UNI-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

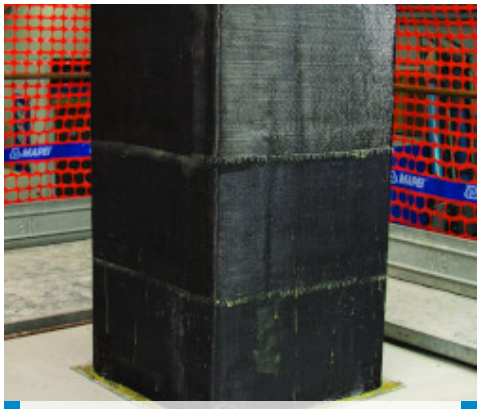
Once the resin products used in the system has hardened (approx. 1-2 days at +23°C), the surface may be finished off with a skim-coat of fine-textured cementitious compound such as **PLANITOP 200** or **PLANITOP 210** (refer to the relative Technical Data Sheet).
For external applications, protect the system once the resin products have completely hardened by applying a coat of **MAPELASTIC** two-component cementitious mortar. This product forms an efficient barrier against UV rays, which makes it particularly recommended for structures exposed to direct sunlight.
To protect the system from fire it may be dressed with panels, which are usually made from calcium-silicate, or with a layer of intumescent render, as specified in article 4.8.2.3 of CNR DT 200 R1/2013.

Application of MapeWrap Primer 1

Skim-coat of MapeWrap 11 or MapeWrap 12

First coat of MapeWrap 31

Application of MapeWrap C UNI-AX fibre impregnated with MapeWrap 31



Pillar confined with MapeWrap C UNI-AX System

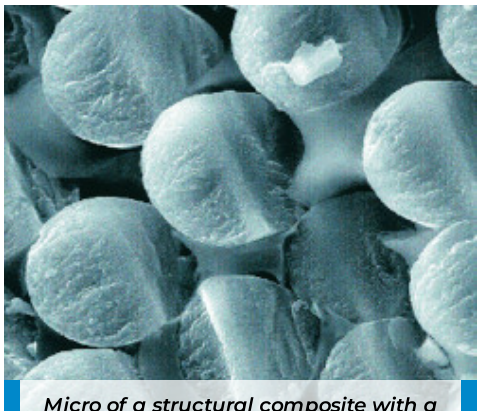
Beam-pillar joints confined with MapeWrap C UNI-AX System

Joints and pillars strengthened with MapeWrap C UNI-AX System

Flexural strengthening of joists of a brick-concrete floor slab with MapeWrap C UNI-AX System

Domed roof strengthened with MapeWrap C UNI-AX System

Brickwork chimney strengthened with MapeWrap C UNI-AX System



Micro of a structural composite with a polymer matrix taken in the MAPEI Research & Development Laboratory

PRECAUTIONS TO BE TAKEN DURING AND AFTER APPLICATION

- The temperature during application must be at least +5°C (or at least +10°C if **MAPEWRAP PRIMER 1** has been used) and the structure must 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 at least +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 it is recommended to clean all work tools with solvent (such as ethanol, toluene, etc.) before the products harden.

PACKAGING AND STORAGE

MAPEWRAP C UNI-AX is supplied in a cardboard box containing one 50 metre roll.
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.

TECHNICAL DATA

GEOMETRICAL AND PHYSICAL CHARACTERISTICS

Property	*Test method reference standard*	*MAPEWRAP C UNI-AX 300/300 W*	*MAPEWRAP C UNI-AX 600/600 W*
Type of fibre	–	high-strength carbon	
Appearance	–	unidirectional fabric	
Density of fibres ρ_{fib}	ASTM D 792	1.80-1.84 g/cm³	1.78-1.81 g/cm³
Weight of fibres per unit of area p_x	–	300 g/m²	600 g/m²
Density of resin ρ_m	ISO 2811-1	1.06 g/cm³	1.06 g/cm³
Equivalent area of dry fabric A_{rt}	–	164.3 mm²/m	337.08 mm²/m
Equivalent thickness of dry fabric t_{eq}	–	0.164 mm	0.337 mm
Amount of fibres in the composite by weight	ASTM D 3171	40-50%	
Amount of fibres in the composite by volume	ASTM D 3171	40-50%	
Glass transition temperature of resin used to impregnate the fibres $T_{g.im}$	ISO 11357-2 DSC	+58°C	
Glass transition temperature of levelling putty (optional) $T_{g.re}$	ISO 11357-2 DSC	+64°C	
Minimum and maximum service temperature (1)	ACI 440.2R-08	-20°C to +43°C (2)	
Reaction to fire	UNI EN 13501-1	F	
Resistance to fire	–	N/A	

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 UNI-AX 300/300 W*	*MAPEWRAP C UNI-AX 600/600 W*
Tensile strength:	≥ 4,900 N/mm²	≥ 4,900 N/mm²
Maximum load per unit of width:	> 800 kN/m	> 1,600 kN/m
Tensile modulus of elasticity:	252,000 N/mm² ± 2%	252,000 N/mm² ± 2%
Deformation at failure:	≥ 2%	≥ 2%

MECHANICAL PROPERTIES OF THE MAPEWRAP C UNI-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)	Chart value	210 GPa
Strength of laminate (for net area of fibres)	Chart value	2,700 MPa

Property	Test method reference standard	MAPEWRAP C UNI-AX 300/300 W		MAPEWRAP C UNI-AX 600/600 W	
		for 1 layer of fabric	*for 3 layers of fabric*	*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	225 GPa	250 GPa	230 GPa
Tensile strength of laminate refers to net area of fibres characteristic value $f_{fib,k}$		3,800 MPa	3,400 MPa	3,500 MPa	3,000 MPa
Elongation failure ε_{fib}		1.60%	1.50%	1.40%	1.30%
Adhesion to concrete	> 3 N/mm² (failure of substrate)				

MECHANICAL PROPERTIES OF MAPEWRAP C UNI-AX SYSTEM ACCORDING TO ESR-3499 ICC-ES					
	MAPEWRAP C UNI-AX 300		*MAPEWRAP C UNI-AX 600*		
PROPERTY	Average value	Design value[1]	Average value	Design value[1]	Test method
Tensile strength*	1,637 MPa	1,492 MPa	1,630 MPa	1,450 MPa	D-3039
Tensile modulus of elasticity*	83,848 MPa	83,848 MPa	81,876 MPa	81,876 MPa	D-3039
Elongation at failure*	2%	1,7%	2%	1,76%	D-3039
Nominal thickness of fabric*	0.500 mm	0.500 mm	1 mm	1 mm	–
Adhesion to concrete:	> 3 N/mm² (failure of substrate)				

** values obtained from tests carried out on 20 samples in compliance with American Standard ACI 440. Tests carried out in compliance with ASTM D3039.*

[1] average value less 3 x standard deviation in compliance with American Standard ACI 440.2R (par. 4.3.1).

PACKAGING - MapeWrap C UNI-AX fabric is available in 50 metre rolls in a cardboard box and in the following sizes:				
	Weight	*Width*	*Area*	*Area*
MapeWrap C UNI-AX 300/10 - 300/10 W	300 g/m²	10 cm	0.1 m²/m	5 m²/roll
MapeWrap C UNI-AX 300/20 - 300/20 W	300 g/m²	20 cm	0.2 m²/m	10 m²/roll
MapeWrap C UNI-AX 300/40 - 300/40 W	300 g/m²	40 cm	0.4 m²/m	20 m²/roll
MapeWrap C UNI-AX 600/10 - 600/10 W	600 g/m²	10 cm	0.1 m²/m	5 m²/roll
MapeWrap C UNI-AX 600/20 - 600/20 W	600 g/m²	20 cm	0.2 m²/m	10 m²/roll
MapeWrap C UNI-AX 600/40 - 600/40 W	600 g/m²	40 cm	0.4 m²/m	20 m²/roll

CONSUMPTION OF EPOXY SYSTEMS	
Priming, evening out and skimming surfaces	
	Consumption
MapeWrap Primer 1	250-300 g/m²
MapeWrap 11 or MapeWrap 12	1,500-1,600 g/m²

Impregnating MapeWrap C UNI-AX fabric				
	Weight	*Consumption*	*Width*	*Consumption*
MapeWrap 31	300 g/m²	1,000-1,100 g/m²	10 cm	100-110 g/m
			20 cm	200-220 g/m
			40 cm	400-440 g/m
	600 g/m²	1,500-1,550 g/m²	10 cm	150-155 g/m
			20 cm	300-310 g/m
			40 cm	600-620 g/m

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 UNI-AX 300, **MAPEWRAP C UNI-AX 300 W**, **MAPEWRAP C UNI-AX 600** and **MAPEWRAP C UNI-AX 600 W** are articles and referring to the current European regulations (Reg. 1906/2007/CE - REACH) do 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

SYSTEM SPECIFICATIONS

Repairing and increasing the structural capacity of under-dimensioned or damaged elements and structures in reinforced concrete, masonry, steel and wood, improving the flexural strength, shear strength, compressive confinement capacity and bending/compressive capacity of concrete and masonry elements and structures, upgrading or improving the seismic capacity of structures in high-risk areas, improving the characteristics of beam-pillar hinge points and increasing the ductility of confined elements by applying a strengthening system (such as **MAPEWRAP C UNI-AX SYSTEM** by MAPEI S.p.A.) comprising **MAPEWRAP C UNI-AX** high-strength, high-modulus carbon fibre fabric with high tensile strength 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.

There are various sizes of fabric available (10, 20 or 40 cm wide) with a weight of 300 or 600 g/m², depending on the type of work to be carried out.
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:	300 g/m²	600 g/m²
Equivalent thickness of dry fabric:	0.164 mm	0.337 mm
Resistant area per unit of width:	164.3 mm²/m	337.08 mm²/m
Tensile strength of impregnated fabric:	≥ 4,900 N/mm²	≥ 4,900 N/mm²
Maximum load per unit of width:	> 800 kN/m	> 1,600 kN/m
Tensile modulus of elasticity:	252,000 N/mm² ± 2%	252,000 N/mm² ± 2%
Elongation at failure:	≥ 2%	≥ 2%

Properties of the system:

Modulus of elasticity of laminate (refers to net area of fibres) average for 3 layers E_f:	≥ 225,000 MPa	≥ 230,000 MPa
Strength of laminate (refers to net area of fibres) typical value for 3 layers $f_{fib,k}$:	≥ 3,400 MPa	≥ 3,000 MPa
Deformation at failure ε_{fib}:	1.50%	1.30%
Adhesion to concrete:	> 3 N/mm² (failure of substrate)	

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