

# Repairs

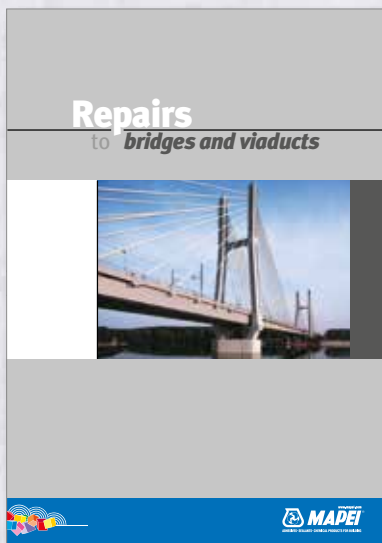
to *bridges and viaducts*



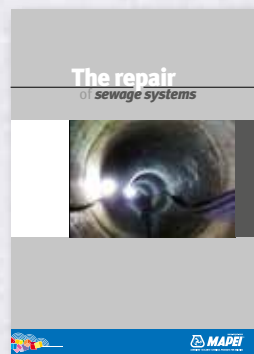
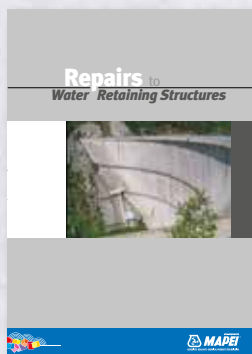
MAPEI produces a series of technical manuals so that the subject of the deterioration of concrete may be analysed in depth, and to offer a professional approach to the problems regarding repair work.

The subject of this manual is:

## **Repairs to bridges and viaducts**



The other manuals available in the series are:



The manuals are available upon request.

# Repairs

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## to *bridges and viaducts*

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## ► 1 | Introduction

When the subject of large-scale maintenance of infrastructure is discussed, we are inclined to think about the new, important projects which are being installed all over the country. Not everybody realises that there is another important aspect, which relates to maintenance on existing on infrastructure. In fact, each year the authority which manages the road networks has to invest a considerable amount of money into maintenance and repair work for the existing network which is currently in use, and a large number of these operations are carried out on structures such as bridges and viaducts.

The durability of such structures are severely tested by the enormous load cycles from the traffic in circulation, flooding conditions, aggressive atmospheric agents and the gases which are present in the air. This means that their state of conservation, and in the worst cases their static safety, are put in serious danger. For example, structures built using what are now considered out-of-date design criteria, such as road and railway bridges built in the 19<sup>th</sup> Century, and the first structures built using reinforced concrete and pre-stressed reinforced concrete in the 20<sup>th</sup> Century, are highly subject to problems caused by heavy deterioration. We must also consider the fact that the type and volume of traffic has changed enormously from when the structure was built up to today, and that they were built using materials which are inadequate for today's standards, or were built by keeping the costs as low as possible. Therefore, it is quite clear that special attention must be paid to the reliability of these infrastructures, and to intervene where necessary. In many cases, these structures are part of a network which carries heavy volumes of traffic. Apart from the safety issues, when repair work is carried out, there is also the problem of potential traffic congestion when traffic needs to be interrupted to replace or repair the structures.

All the structures in the road system must be well conserved to avoid compromising design responsibility, safety when the structures are in use and the implementation of maintenance operations. If the condition of a structure is not well monitored, it will be subject to such a degree of deterioration that normal maintenance operations will no longer be sufficient, and it will be necessary to carry out a more complex and heavier intervention, at a much higher cost. One way of preventing such problems is to have a detailed inspection programme which periodically singles out maintenance operations required on the structures, thus guaranteeing, apart from the safety of road-users, lower overall maintenance costs.

One of the most important parts of assessing the state of deterioration is a visual inspection, which also singles out the causes of the deterioration:

- intensity of circulating traffic;
- aggressive environment;
- climatic factors;

- excessive loads;
- occasional impacts;
- insufficient drainage system for rainwater.

Amongst all the possible causes of deterioration, road decks suffer most from the effects of atmospheric agents and the presence of water in general. Water due to atmospheric phenomena, with a certain level of pollution and, very often, the presence of de-icing salts, are extremely aggressive for concrete, as are thermal cycles both during the day and night, and during the different seasons of the year. The deterioration of concrete shows up in a number of ways, with the progressive erosion and crumbling of the surface, corrosion of the metal reinforcement and the formation of rust, swelling of the cortex area of the concrete, etc. Apart from the different causes of deterioration, the problem often shows up at different times, which is why all the structures must be carefully checked on a regular basis in order to identify both routine maintenance and extra maintenance requirements.

Below is a list of methods for the repair of bridges and viaducts:

- Preparation of the substrate;
- Protection of reinforcement rods;
- Positioning new reinforcement;
- Repairing concrete using thixotropic mortar;
- Repairing concrete using castable mortar;
- Repairing concrete using cementitious binders;
- Smoothing off concrete surfaces;
- Protecting and decorating concrete structures.

Each of these methods require different types of products, which are all suitable for achieving the required result, and the choice of which one of these to use depends on the location, the thicknesses to be repaired, on-site organisation, etc.

To make sure that repair work is efficient and long-lasting, having the most suitable products available is not always sufficient. Deterioration to a structure may be due to a multitude of causes, and only if these causes are well known, may we be sure that repair work will be resistant and long-lasting. Regarding this issue, the diagnosis of deterioration is a fundamental phase in the list of operations to be carried out.

Through a detailed analysis of a structure it is possible, and also absolutely essential, to define the type of aggression, the penetration depth of polluting agents and the characteristics of the concrete used for the structure. After these operations, it is then possible to carry out the repair work.



**photo 1**

Hydro-scarifying operations  
on a viaduct pile

## ► 2 | **Preparing the substrate**

Preparation of concrete surfaces on the external vertical faces of piles and abutments to make them suitable for repair or cladding, with a hydro-scarifying unit with jets of water at a variable pressure of from 1400 a 2500 bar. The unit is mounted on an automatic system for raising and lowering the unit using a system of pulleys and/or telescopic arms, which removes the swollen and loose parts of the deteriorated concrete and the surface oxide from the exposed metallic reinforcement, without compromising the stability of the structure.

Generally, every concrete surface which needs to be repaired requires preparation of the substrate. Which type of demolition technique to use will be evaluated according to the area and type of intervention. Manually, if the repair work is small; mechanically, such as with a pneumatic hammer or grinder; hydro-scarifying, if the area to be repaired is large and the substrate must be in perfect condition.

**photo 2**  
Hydro-scarifying operations  
on a viaduct pile



### ► 3 | Protecting reinforcement rods

#### ► 3.1 | Protection using MAPEFER

**Description:** *two-component, anti-corrosion cementitious mortar for protecting reinforcement rods.*

Apply MAPEFER on perfectly clean, rust-free reinforcement rods to bring the pH level back to more than 12, the minimum level required to guarantee passivation of the reinforcement rods. The mortar creates an impermeable, protective barrier against water and the aggressive agents present in the atmosphere. Apply MAPEFER by brush in two coats. The second coat may be applied approximately 2 hours after the first coat, and preferably within 24 hours. The total thickness of the two coats must be at least 2 mm. During this operation, it is inevitable that some of the concrete around the reinforcement rods will also be coated with MAPEFER. This will not create any kind of problem, since MAPEFER does not modify the adhesion of the repair mortar which, in normal environmental conditions, may be laid 6-24 hours after applying MAPEFER or even later, according to organisation of the site.

The product meets the minimum requirements for EN 1504-7 regarding the protection against corrosion of reinforcement.



**MAPEFER has the following performance characteristics:**

table 1

Characteristics	Test method	Requirements according to EN 1504-7	Performance of product
Density of mix (kg/m <sup>3</sup> ):	/	/	1,850
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 h (at +20°C)
Waiting time before applying repair mortar:	/	/	6-24 h (at +23°C)
Adhesion to concrete according to EN 1766 (MPa):	EN 1542	/	≥ 2
Slip-resistance of steel reinforcing bars – load for a movement of 0.1 mm:	EN 15184	Load equal to at least 80% of load on reinforcement with no protection	meets specifications
Resistance to corrosion: – 10 condensation cycles in water; – 10 cycles in sulphur dioxide according to EN ISO 6988; – 5 days in saline mist according to EN 60068-2-11	EN 15183	After the series of cycles, the protected rods must be corrosion-free. Penetration of rust at the ends of the steel plates with no protection must be < 1 mm	meets specifications
Consumption (g/m):	/	/	120 (approx. 2 mm layer of product applied on an 8 mm diameter bar)

### ► 3.2| Protection using MAPEFER 1K

**Description:** *one-component, anti-corrosion cementitious mortar for protecting reinforcement rods.*

Apply MAPEFER 1K single component, anti-corrosion cementitious mortar on perfectly clean, rust-free reinforcement rods to bring the pH level back to more than 12, the minimum level required to guarantee passivation of the reinforcement rods. MAPEFER 1K creates a protective, waterproof barrier and protection against aggressive agents present in the atmosphere.

After preparation, apply MAPEFER 1K by brush in two coats. We recommend completely covering the surface of the reinforcement with an even layer. The total thickness of the two coats must be at least 2 mm. During this operation, it is inevitable that some of the concrete around the reinforcement rods will also be coated with MAPEFER 1K. This will not create any kind of problem, since MAPEFER 1K does not modify the adhesion of the repair mortar which, in normal environmental conditions, may be laid 6-24 hours after applying MAPEFER 1K or even later, according to organisation of the site.

The product meets the minimum requirements for EN 1504-7 regarding the protection against corrosion of reinforcement.

**photo 3**

Application of anti-corrosion mortar on reinforcement rods



**MAPEFER 1K has the following performance characteristics:**

**table 2**

Characteristics	Test method	Requirements according to EN 1504-7	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	1,800
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Waiting time before applying repair mortar:	/	/	6-24 hours (at +20°C)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	/	≥ 2.0
Slip-resistance of reinforcement rods: – load with reference to a movement of 0.1 mm:	EN 15184	load equal to at least 80% of load on reinforcement with no protection	meets specifications
Resistance to corrosion: – 10 condensation cycles in water; – 10 cycles in sulphur dioxide according to EN ISO 6988; – 5 days in saline mist according to EN 60068-2-11	EN 15183	after the series of cycles, the protected rods must be corrosion-free. Penetration of rust at the ends of the steel rods with no protection must be < 1 mm	meets specifications
Consumption (g/m):	/	/	100 (approx. 2 mm of product applied on a ø 8 mm improved-adherence rebar)



**photo 4**  
Positioning  
new reinforcement

## ► 4 | Positioning new reinforcement

Diagnosis of the structure also includes the reinforcement rods, since they are a fundamental part of the concrete. According to the results of the analysis, we can then decide which type of intervention must be carried out. A simple cleaning operation and application of a protective layer of a passivating product could be required. If the reinforcement is seriously compromised, on the other hand, with corrosion which has reduced its section by more than 30%, it will be necessary to place new reinforcement to strengthen the structure.

Where necessary, new reinforcement will be placed for the cast concrete to integrate the structure, and will become an integral part of the substrate by inserting a series of connectors. The dimensions and amount of reinforcement will result from the calculation of the reinforcement required for the piles.

# Mapei mortars for repairing concrete

		BRIDGES AND VIADUCTS								
		Repairs to piles	Repairs to beams	Repairs to the internal face of floor slabs	Repairs to the external face of floor slabs	Repairs to pulvinoes	Repairs to reinforced concrete bearing elements	Repairs to kerbs	Repairs to joints in motorways	Fixing inspection shafts and manholes in place
Normal-setting thixotropic mortars	Mapegrout T60	•	•	•	•	•	•	•		
	Mapegrout Easy Flow	•	•	•	•	•	•	•		
	Mapegrout Easy Flow GF	•	•	•	•	•	•	•		
	Mapegrout BM	•	•	•	•	•	•	•	•	
	Mapegrout BMT3	•	•	•	•	•	•	•	•	
	Mapegrout LM2K	•	•	•		•				
Rapid-setting thixotropic mortars	Mapegrout SV T									•
Normal-setting castable mortars	Mapegrout Hi-Flow					•	•	•	•	•
	Mapegrout Hi-Flow GF					•	•	•	•	
	Mapegrout GF Betoncino B1					•	•	•	•	
	Mapegrout Hi-Flow B2					•	•	•	•	
	Mapegrout Hi-Flow TI 20					•	•	•	•	•
Rapid-setting castable mortars	Mapegrout SV									•
	Mapegrout SV Fiber					•	•		•	•
Cementitious binders	Stabilcem	•	•		•	•	•			
	Stabilcem SCC	•	•		•	•	•			
	Stabilcem SP	•	•		•	•	•			

## ► 5| Repairing concrete using thixotropic mortars

### ► 5.1| Repairs using MAPEGROUT EASY FLOW

**Description:** *one-component, fibre-reinforced, compensated-shrinkage, sulphate-resistant thixotropic mortar, particularly suitable for repairing concrete structures with a rendering machine.*

**Particularly suitable for:** *repairing concrete structures by application with a rendering machine; particularly suitable when easy pumping over long distances and to elevated positions is required.*

Rebuilding of demolished parts by applying MAPEGROUT EASY FLOW on substrates saturated with water, but with a dry surface.

Thanks to its special composition, MAPEGROUT EASY FLOW is particularly suitable for repairing concrete structures when repair mortar is applied by spray, where the characteristics of the work (considerable height of the structure under repair, such as viaduct piles), the morphology of the site area (little space available to position mixing and pumping units in the vicinity of the structure under repair) and for site organisation requirements, mortar which is easy to pump over long distances and up to considerable heights is required.

To improve expansion in the open air during the first few days of the curing cycle,



**photo 5**  
MAPEGROUT EASY FLOW  
applied by spray

MAPEGROUT EASY FLOW must include 0.25% of MAPECURE SRA special liquid admix, which has the property of reducing hydraulic shrinkage and the formation of micro cracks. Layers of MAPEGROUT EASY FLOW thicker than 3 cm must only be applied after installing electro-welded metallic mesh of at least 10x10 cm and 5 mm diameter and after roughening the surface of the concrete, making sure that the concrete around the reinforcement is at least 2 cm thick. Thinner layers may be applied if there is no reinforcement, but the surface of the substrate must be well roughened before application to contrast expansion. The mortar may be applied by spray with a suitable worm-screw or piston-type rendering machine, such as a Turbosol or a Putzmeister. The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

**MAPEGROUT EASY FLOW has the following performance characteristics:**

table 3

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,200
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 17% of water:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 60 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	> 8 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Crack resistance:	“O Ring Test”	/	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.25
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Reaction to fire:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	18.5 (per cm of thickness)

### ► 5.2| Repairs using MAPEGROUT EASY FLOW GF

**Description:** one-component, shrinkage-compensated, sulphate-resistant, thixotropic, inorganic fibre-reinforced mortar for repairing concrete structures where higher ductility is required.

**Particularly suitable for:** repairing and/or enlarging sections of concrete structures using a rendering machine, applied at thicknesses of up to 5 cm without supporting reinforcement mesh. This product is particularly suitable when easy pumping over long distances and to elevated positions is required.

Repairing deteriorated concrete structures and/or enlarging sections in concrete structures using MAPEGROUT EASY FLOW GF applied with a rendering machine. Thanks to its special composition, MAPEGROUT EASY FLOW GF is particularly suitable for repairing concrete

#### MAPEGROUT EASY FLOW GF has the following performance characteristics:

table 4

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,200
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 16% of water:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 60 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	11 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	≥ 2 (after 28 days)
Crack resistance:	"O Ring Test"	/	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.25
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Reaction to fire:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	18.5 (per cm of thickness)

structures when repair mortar is applied by spray, where the characteristics of the work (considerable height of the structure under repair, such as viaduct piles), the morphology of the site area (little space available to position mixing and pumping units in the vicinity of the structure under repair) and for site organisation requirements, mortar which is easy to pump over long distances and up to considerable heights is required.

In fact, after mixing MAPEGROUT EASY FLOW GF with water, it forms a mortar with a thixotropic consistency which is very easy to apply, even on vertical surfaces, at thicknesses of between 1 and 5 cm without the need for dolly rods and formwork. To improve expansion in the open air during the first few days of the curing cycle, MAPEGROUT EASY FLOW GF must include 0.25% of MAPECURE SRA special liquid admix, which has the property of reducing hydraulic shrinkage and the formation of micro cracks.

The mortar is usually applied using either a piston or worm-screw spray rendering machine, such as a Turbosol or a Putzmeister.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

### ► 5.3| Repairs using MAPEGROUT T60

**Description:** *fibre-reinforced, sulphate-resistant thixotropic mortar for repairing concrete.*

**Particularly suitable for:** *repairing deteriorated, normal concrete structures and reinforced cement structures subject to attack by sulphur. Hydraulic structures, repairs to concrete around reinforcement rods and applications on ceilings, such as the inside face of floor slabs.*

**photo 6**  
Structure repaired  
using MAPEGROUT T60





Repairing deteriorated, normal concrete structures and reinforced cement structures subject to attack by sulphur using MAPEGROUT T60. Apply on substrates saturated with water, but with a dry surface. When this product is mixed with water, it forms a thixotropic mortar which is easy to apply on vertical surfaces, even in thick layers, without formwork. To improve expansion in the open air during the first few days of the curing cycle, MAPEGROUT T60 may include 0.25% of MAPECURE SRA special admix, which has the property of reducing plastic and hydraulic shrinkage and the formation of micro cracks. If there is insufficient boundary support, filling layers of more than 20 mm must only be applied after inserting dolly rods and roughing the surface of the concrete. A layer of at least 20 mm thick must be applied over the rods.

### MAPEGROUT T60 has the following performance characteristics:

table 5

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,200
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 17% of water:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	60 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	8 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Crack resistance:	"O Ring Test"	/	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.25
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Fire resistance:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	18.5 (per cm of thickness)

MAPEGROUT T60 may be applied by spray with a suitable worm-screw or piston-type spray rendering machine, such as a Turbosol or a Putzmeister.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

#### ► 5.4| Repairs using MAPEGROUT BM

**Description:** *two-component cementitious mortar with a low modulus of elasticity for the restoration of concrete.*

**Particularly suitable for:** *repairing deteriorated parts in concrete, the corners of beams and pillars and the front edges of balconies. Filling rigid joints, for example between footings and pillars.*

**photo 7**  
MAPEGROUT BM  
applied by spray



Repairing deteriorated cortices of concrete structures which are subject to small deformations under load, thermal cycles or which are exposed to particularly harsh climatic conditions using MAPEGROUT BM. Apply on substrates saturated with water, but with a dry surface.

The maximum thickness to be applied for each layer is approximately 35 mm. For thicknesses of more than 30 mm, we recommend using electro-welded mesh embedded in the mortar.

The product is applied by trowel or by spray without formwork, even on vertical surfaces or

ceilings. The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

### MAPEGROUT BM has the following performance characteristics:

table 6

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,100
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 47 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	> 10 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	22 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 10
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Fire resistance:	EN 13501-1	Euroclass	E
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 21 (per cm of thickness)

## ► 5.5| Repairs using MAPEGROUT BMT3

**Description:** two-component, thixotropic, fibre-reinforced cementitious mortar with added organic-based corrosion inhibitor for repairing concrete.

**Particularly suitable for:** repairs to damaged or deteriorated concrete structures subject to small deformations when loaded and structures exposed to thermal cycles or harsh climatic conditions. Filling rigid joints and repairs to prefabricated structures and hydraulic works.

After hardening, MAPEGROUT BMT3 has the following properties:

- excellent adhesion to old concrete (> 2 MPa);
- high dimensional stability;

- resistance to aggressive atmospheric agents (e.g. CO<sub>2</sub>);
- waterproof.

Apply the mortar by trowel without formwork in layers from 1 to 5 cm thick. MAPEGROUT BMT3 may also be applied by spray with a suitable worm-screw type concrete pump such as a Turbosol, Putzmeister, Continental or Bunker. Depending on surrounding weather conditions, tamp the surface with a sponge float as soon as the mortar starts to set.

To improve the excellent inherent performance characteristics of MAPEGROUT BMT3, MAPECURE SRA special internal curing agent may also be added to the mix to reduce surface tension in the capillary pores and, as a result, improve the mortar's dimensional stability.

The product meets the minimum requirements of EN 1504-3 for R4-class structural mortar.

**MAPEGROUT BMT3 has the following performance characteristics:**

*table 7*

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of mix (kg/m <sup>3</sup> ):	/	/	2,100
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	55 (after 28 days)
Flexural strength (MPa):	EN 196-1	not required	10 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	25 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Crack resistance:	"O Ring Test"	not required	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	Depth of carbonation ≤ reference concrete (MC 0.45 w/c ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water – penetration depth - (mm):	EN 12390-8	not required	< 15
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.5
Thermal compatibility measured as adhesion according to EN 1542 (MPa): – freeze-thaw cycles with de-icing salts:	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Pull-out strength of steel reinforcement rods – adhesion stress (MPa):	RILEM-CEB-FIP RC6-78	not required	> 20
Reaction to fire:	EN 13501-1	Euroclass	E
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 21 (per cm of thickness)

## ► 5.6| Repairs using MAPEGROUT SV T

**Description:** *quick-setting and hardening, compensated-shrinkage thixotropic mortar for repairing concrete and fixing drains, manholes and urban fittings in place.*

**Particularly suitable for:** *repairing concrete elements, including those with a slope. Fixing inspection shafts and manholes in place, repairing pavements and fixing lamp-posts and fences in place. Anchoring protective barriers and crash barriers in place. Fixing grated covers for run-off channels in place.*



**photo 8**

An example of the application of MAPEGROUT SV T

MAPEGROUT SV T is a single component, pre-blended, compensated-shrinkage thixotropic mortar in powder form, made from special hydraulic binders, high-strength cement, graded aggregates and special additives. MAPEGROUT SV T is suitable where large thicknesses need to be applied (up to 5 cm), in specially-prepared areas without the use of formwork.

Thanks to its rapid hardening properties, it may be stepped on and opened to rubber-wheeled traffic after only 2 hours from application at a temperature of +20°C. Thanks to its special composition and the additives contained in the product, the mortar has high mechanical qualities even after a long period of time, is waterproof and is highly resistant to abrasion. Apply the product using a trowel in the pre-prepared area.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

**MAPEGROUT SV T has the following performance characteristics:**

table 8

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,250
pH of mix:	/	/	> 12
Pot life of mix:	/	/	approx. 10 min. (at +20°C)
Mechanical characteristics using 13% of water at 20°C:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	45 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	6 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	25 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.5
Thermal compatibility to freeze/thaw cycles with de-icing salts, measured as adhesion according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Fire resistance:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	20 (per cm of thickness)

► **5.7| Repairs using MAPEGROUT LM2K**

**Description:** *two-component, thixotropic, fibre-reinforced, cementitious mortar with a low modulus of elasticity and added organic corrosion inhibitor for repairing concrete, applied in a single layer at a thickness of from 3 to 20 mm.*

**Particularly suitable for:** *smoothing over surface defects in cast concrete, such as gravel clusters, spacer holes, construction joints, etc. Repairing deteriorated elements, such as beams, piles and pulvinoes.*

MAPEGROUT LM2K is a pre-blended thixotropic cementitious mortar with corrosion inhibitor made from two pre-dosed components to be mixed together.

Component A (powder) is made from cement, selected, mixed aggregates, synthetic fibres and special admixtures which reduce both plastic shrinkage and final hygrometric shrinkage.

Component B (liquid) is a solution of synthetic resin in water.



**photo 9**  
Application of  
MAPEGROUT LM2K

**MAPEGROUT LM2K has the following performance characteristics:**

**table 9**

Characteristics	Test method	Requirements according to EN 1504-3 for R3 class mortar	Performance of product
Density of mix (kg/m <sup>3</sup> ):	/	/	2,080
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Compressive strength (MPa):	EN 12190	≥ 25 (after 28 days)	≥ 38 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	≥ 7 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 15 (after 28 days)	17 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 1.5 (after 28 days)	≥ 2 (after 28 days)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ the reference concrete (MC 0.45 type water/cement ratio ≤ 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 15
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.5
Thermal compatibility to freeze/thaw cycles with de-icing salts measured as bond strength EN 1542 (MPa):	EN 13687-1	≥ 1.5 (after 50 cycles)	≥ 2
Reaction to fire:	EN 13501-1	Euroclass	E
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 21 (per cm of thickness)

After hardening, MAPEGROUT LM2K has the following properties:

- low modulus of elasticity (17 GPa);
- excellent bond strength to old concrete (> 2 MPa) if dampened with water before application, and to reinforcement rods, especially if treated beforehand with MAPEFER or MAPEFER 1K;

- high dimensional stability and, therefore, low risk of cracking during the plastic phase and when hardened;
- resistance to aggressive agents in the atmosphere (e.g. CO<sub>2</sub>).

The product meets the minimum requirements of EN 1504-3 for R3-class structural mortar.

## ► 5.8| Summary of the main characteristics of thixotropic repair mortars

THIXOTROPIC MORTARS							
Characteristics	MAPEGROUT EASY FLOW	MAPEGROUT EASY FLOW GF	MAPEGROUT T60	MAPEGROUT BM	MAPEGROUT BMT3	MAPEGROUT LM2K	MAPEGROUT SV T
Standards class according to EN 1504-3	R4	R4	R4	R4	R4	R3	R4
Maximum size of aggregate	2.5 mm	2.5 mm	2.5 mm	2.5 mm	2.5 mm	1.6 mm	2.5 mm
Mixing ratio	16.5% - 17.5% of water	15.5% - 16.5% of water	16.5% - 17.5% of water	Comp. A : Comp. B 5.3 : 1	Comp. A : Comp. B 5.3 : 1	Comp. A : Comp. B 10 : 2.1	12.5% - 13.5% of water
Density of mix	2,200 kg/m <sup>3</sup>	2,200 kg/m <sup>3</sup>	2,200 kg/m <sup>3</sup>	2,100 kg/m <sup>3</sup>	2,100 kg/m <sup>3</sup>	2,080 kg/m <sup>3</sup>	2,250 kg/m <sup>3</sup>
Application temperature range	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +35°C
Pot life of mix at +20°C	approx. 1h	approx. 1h	approx. 1h	approx. 1h	approx. 1h	approx. 1h	approx. 10'
Compressive strength	> 60 MPa after 28 days	> 60 MPa after 28 days	60 MPa after 28 days	> 47 MPa after 28 days	55 MPa after 28 days	≥ 38 MPa after 28 days	45 MPa after 28 days
Flexural strength	> 8 MPa after 28 days	11 MPa after 28 days	8 MPa after 28 days	> 10 MPa after 28 days	10 MPa after 28 days	≥ 7 MPa after 28 days	6 MPa after 28 days
Compressive modulus of elasticity	27 GPa after 28 days	27 GPa after 28 days	27 GPa after 28 days	22 GPa after 28 days	25 GPa after 28 days	17 GPa after 28 days	25 GPa after 28 days
Bond strength on concrete according to EN 1766	> 2 MPa after 28 days	≥ 2 MPa after 28 days	> 2 MPa after 28 days	> 2 MPa after 28 days	> 2 MPa after 28 days	≥ 2 MPa after 28 days	> 2 MPa after 28 days
Thermal compatibility to freeze-thaw cycles with de-icing salts, measured as bond strength according to EN 1542	> 2 MPa	> 2 MPa	> 2 MPa	> 2 MPa	> 2 MPa	≥ 2 MPa	> 2 MPa
Maximum thickness applied by hand	35 mm	50 mm	40 mm	35 mm	50 mm	20 mm	50 mm
Consumption	18.5 kg/m <sup>2</sup> per cm of thickness	18.5 kg/m <sup>2</sup> per cm of thickness	18.5 kg/m <sup>2</sup> per cm of thickness	approx 21 kg/m <sup>2</sup> per cm of thickness	21 kg/m <sup>2</sup> per cm of thickness	approx 21 kg/m <sup>2</sup> per cm of thickness	20 kg/m <sup>2</sup> per cm of thickness



## ► 6 | Repairing concrete using castable mortar

### ► 6.1 | Repairs using MAPEGROUT HI-FLOW

**Description:** fibre-reinforced, shrinkage-controlled mortar for repairing concrete.

**Particularly suitable for:** repairs in thick layers to concrete structures. Structural reintegration of concrete beams and pillars by casting into formwork, floor slabs and floors.

MAPEGROUT HI-FLOW is used to repair concrete structures where high thicknesses and special conformations of deterioration require the use of a castable mortar. Apply on substrates saturated with water, but with a dry surface. When mixed with water, MAPEGROUT HI-FLOW



**photo 10**

Structure repaired using  
MAPEGROUT HI-FLOW

forms a highly-fluid mortar, suitable for application by casting into formwork with no risk of segregation, including when applied at high thicknesses. To improve expansion in the open air during the first few days of the curing cycle, MAPEGROUT HI-FLOW must include 0.25% of MAPECURE SRA special liquid admix, which has the property of reducing hydraulic shrinkage and the formation of micro cracks. Pour the mortar into the formwork in a continuous flow from one side only, in order to help all air to be expelled.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

**MAPEGROUT HI-FLOW has the following performance characteristics:**

table 10

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,350
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 13% of water:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 75 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	12 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Crack resistance:	“O Ring Test”	/	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.08
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Fire resistance:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 21 (per cm of thickness)

► **6.2| Repairs using MAPEGROUT HI-FLOW GF**

**Description:** castable, compensated-shrinkage cementitious mortar reinforced with inorganic fibres, for repairing concrete structures where higher ductility is required.

**Particularly suitable for:** repairing motorway, road and railway viaduct piles. Repairing the lower spigots on pre-compressed beams for viaducts. Reintegrating floor slabs after removing deteriorated areas by scarifying. Repairs to concrete floors.

MAPEGROUT HI-FLOW GF is a one-component pre-blended mortar made from high-strength cement, selected graded aggregates, special admixture and synthetic and inorganic fibres. When MAPEGROUT HI-FLOW GF is mixed with water, it forms a fluid mortar which is suitable for casting into formwork without segregating at a thickness of between 1 and 5 cm. No electro-welded mesh is required as a support. MAPEGROUT HI-FLOW GF may also include 0.25%

of MAPECURE SRA, a special admix with the property of reducing plastic and hydraulic shrinkage and the formation of micro cracks.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.



**photo 11**  
Application of  
MAPEGROUT HI-FLOW GF

### MAPEGROUT HI-FLOW GF has the following performance characteristics:

**table 11**

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of mix (kg/m <sup>3</sup> ):	/	/	2,350
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
pH of mix:	/	/	> 12.5
Compressive strength (Mpa):	EN 12190	≥ 45 (after 28 days)	> 65 (after 28 days)
Flexural strength (Mpa):	EN 196-1	/	10 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete according to EN 1766 (Mpa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Resistance to accelerated carbonation:	EN 13295	Depth of carbonation ≤ the reference concrete (MC 0.45 type water/cement ratio ≤ 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.25
Slip-resistance of steel reinforcing rods – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze/thaw cycles with de-icing salts measured as bond strength EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Reaction to fire:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 21 (per cm of thickness)

### ► 6.3| Repairs using MAPEGROUT GF BETONCINO B1

**Description:** *ready-mixed, free-flowing, compensated-shrinkage cementitious mortar reinforced with inorganic fibres for repairing concrete structures where higher ductility is required.*

**Particularly suitable for:** *repairs to damaged or deteriorated concrete structures and/or increasing the section of concrete structures where certain thicknesses and special conformations require the use of hi-flow mortar. Reintegrating reinforced cement pillars and beams, reintegrating floor slabs after scarifying damaged or deteriorated areas and repairs to hydraulic works.*

The inorganic fibres have the following characteristics:

- length: 12 mm;
- diameter: 14 µm;
- tensile strength: 1,700 MPa;
- modulus of elasticity: 72 GPa

**photo 12**  
Application of  
MAPEGROUT GF BETONCINO B1



When mixed with water, MAPEGROUT GF BETONCINO B1 forms a fluid mortar which does not segregate with the capacity to flow into tight and complex spaces. To allow the mortar to expand fully and correctly in the open air, the product may be admixed with MAPECURE SRA, a special curing agent with the capacity to reduce plastic and hydraulic shrinkage. The product is suitable for pouring into formwork placed around the areas to be filled and does not require vibro-compacting.

The product meets the minimum requirements of EN 1504-3 for R4-class structural mortar.

**MAPEGROUT GF BETONCINO B1 has the following performance characteristics:**

table 12

Characteristics	Method Test	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,300
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 10.5% of water and 0.16% of MAPECURE SRA:			
Compressive strength – 100 mm cube (MPa):	EN 12390-3	≥ 45 (after 28 days)	> 70 (after 28 days)
Flexural strength – 100 x 100 x 400 mm rod (MPa):	EN 12390-5	not required	7 (after 28 days)
Flexural strength – 40 x 40 x 160 mm rod (MPa):	EN 196-1	not required	10 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	30 (after 28 days)
Adhesion to concrete (substrate in MC 0.40 - water/cement ratio = 0.40) according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Contrasted expansion (µm/m):	UNI 8147 method A	not required	> 400 after 1 day (*)
Warp test:	//	not required	convex (*)
Crack resistance:	“O Ring Test”	not required	no cracks after 180 days (*)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water – penetration depth - (mm):	EN 12390-8	not required	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.1
Slip-resistance of steel reinforcing bars – adhesion strength (MPa):	RILEM-CEB-FIP RC6-78	not required	> 25
Thermal compatibility measured as adhesion according to EN 1542 (MPa):			
– freeze-thaw cycles with de-icing salts:	EN 13687-1	≥ 2 (after 50 cycles)	> 2
– storm cycles:	EN 13687-2	≥ 2 (after 30 cycles)	> 2
– dry heat cycles:	EN 13687-4	≥ 2 (after 30 cycles)	> 2
Reaction to fire:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>3</sup> ):	/	/	approx. 2,100

(\*) Performance obtainable by adding 0.16% of MAPECURE SRA

## ► 6.4| Repairs using MAPEGROUT HI-FLOW B2

**Description:** *shrinkage-compensated, free-flowing, fibre-reinforced cementitious mortar for concrete structures.*

**Particularly suitable for:** *repairs to damaged or deteriorated concrete structures and/or increasing the section of concrete structures where certain thicknesses and special conformations require the use of hi-flow mortar. Reintegrating reinforced cement pillars and beams, reintegrating the lower ribs of pre-stressed beams on viaducts and repairs to concrete floors and hydraulic works.*

When mixed with water, MAPEGROUT HI-FLOW B2 forms a fluid mortar which does not segregate with the capacity to flow into tight and complex spaces. To allow the mortar to expand fully and correctly in the open air, the product may be admixed with MAPECURE SRA, a special curing agent with the capacity to reduce plastic and hydraulic shrinkage. The product is suitable for pouring into formwork placed around the areas to be filled and does not require vibro-compacting.

The product meets the minimum requirements of EN 1504-3 for R4-class structural mortar.

**MAPEGROUT HI-FLOW B2 has the following performance characteristics:**

table 13

Performance characteristic	Test method	Requirements according to EN 1504-3 for R4-class mortar	Performance of product
Density of mix (kg/m <sup>3</sup> ):	/	/	2,300
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 10% of water and 0.16% of MAPECURE SRA:			
Compressive strength – 100 mm cube (MPa):	EN 12390-3	not required	70 (after 28 days)
Compressive strength – 40 x 40 x 160 mm prism (MPa):	EN 12190	≥ 45 (after 28 days)	70 (after 28 days)
Flexural strength – 100 x 100 x 400 mm beam (MPa):	EN 12390-5	not required	7 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	28 (after 28 days)
Adhesion to concrete (substrate in MC 0.40 - water/cement ratio = 0.40) according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Contrasted expansion (µm/m):	UNI 8147 method A	not required	> 400 after 1 day (*)
Warp test:	//	not required	convex (*)
Crack resistance:	“O Ring Test”	not required	no cracks after 180 days (*)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water – penetration depth - (mm):	EN 12390-8	not required	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.08
Slip-resistance of steel reinforcing bars – adhesion stress (MPa):	RILEM-CEB-FIP RC6-78	not required	> 25
Thermal compatibility measured as adhesion according to EN 1542 (MPa):			
– freeze-thaw cycles with de-icing salts:	EN 13687-1	≥ 2 (after 50 cycles)	> 2
– storm cycles:	EN 13687-2	≥ 2 (after 30 cycles)	> 2
– dry heat cycles:	EN 13687-4	≥ 2 (after 30 cycles)	> 2
Reaction to fire:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>3</sup> ):	/	/	approx. 2,100

(\*) Performance obtainable by adding 0.16% of MAPECURE SRA

## ► 6.5| Repairs using MAPEGROUT HI-FLOW TI 20

**Description:** *castable, shrinkage-compensated, fibre-reinforced, with stiff steel fibres, high-ductility cementitious mortar for repairing concrete.*

**Particularly suitable for:** *repairing concrete structures where high thicknesses are required, by casting into formwork at a thickness of up to 5 cm without the need for reinforcement mesh. Structural reintegration of pillars, beams, pulvinoes and reinforced concrete bearing elements, reintegration of floor slabs and repairs to concrete floors.*



**photo 13**

Application of  
MAPEGROUT HI-FLOW TI 20

Repairs where high thicknesses are required, or when repairs to complicated shapes require the use of a free-flowing mortar, using MAPEGROUT HI-FLOW TI 20. Apply on substrates saturated with water but with a dry surface. When MAPEGROUT HI-FLOW TI 20 is mixed with water, it forms a highly fluid mortar which is suitable for casting into formwork, without segregation, at a thickness of between 1 and 5 cm, and does not require electro-welded mesh as a support. To improve expansion in the open air during the first few days of the curing cycle, MAPEGROUT HI-FLOW TI 20 must include 0.25% of MAPECURE SRA special liquid admix, which has the property of reducing hydraulic shrinkage and the formation of micro cracks. Pour MAPEGROUT HI-FLOW TI 20 into the formwork in a continuous flow from one side only, in order to help all air to be expelled. The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

**MAPEGROUT HI-FLOW TI 20 has the following performance characteristics:**

table 14

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,300
pH of mix:	/	/	> 12.5
Pot life of mix:	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 14% of water:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 70 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	> 16 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to the concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	≥ 2 (after 28 days)
Impeded contraction in open air (µm/m):	UNI 8147 mod.	/	> 400 (after 1 day) (*)
Crack resistance:	“O Ring Test”	/	no cracks after 180 days (*)
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.3
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa):	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Toughness: – load at first cracking: – toughness index:	ASTM C1018	/	> 20 kN I <sub>20</sub> > 20
Fire resistance:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 20 (per cm of thickness)
<b>CHARACTERISTICS OF THE FIBRES</b>			
Length (mm):	/	/	30
Diameter (mm):	/	/	0.6
Tensile strength (MPa):	/	/	> 1200
Modulus of elasticity (GPa):	/	/	210

(\*) Performance obtainable by adding 0.16% of MAPECURE SRA



## ► 6.6| Repairs using MAPEGROUT SV FIBER

**Description:** *castable, shrinkage-compensated, quick-setting/hardening, fibre-reinforced, with stiff steel fibres, high-ductility cementitious mortar applied at temperatures as low as -5°C, for repairing concrete.*

**Particularly suitable for:** *repairing concrete structures where high thicknesses and special conformations of deterioration require the use of a free-flowing mortar, including at low temperatures. Repairs to concrete floors. Repairing hydraulic structures (breather channels, canals and forced run-off channels).*



**photo 14**

Repairing a floor using  
MAPEGROUT SV FIBER

When MAPEGROUT SV FIBER is mixed with water, it forms a fluid mortar which is suitable for casting into formwork, without segregation, at a thickness of between 10 and 50 mm.

If the thickness to be repaired is higher than 50 mm, suitably-sized gravel according to the thickness to be rebuilt must be added at a rate of 30% to 50% in weight of the mortar. The cast mortar must be reinforced as required with metallic reinforcement inserted at approximately half the thickness of the mortar, and must be connected to the old reinforcement rods. Also, the surfaces of the element under repair must be saturated with water.

The product meets the minimum requirements of EN 1504-3 Standards for R4-class structural mortar.

**MAPEGROUT SV FIBER has the following performance characteristics:**

table 15

Characteristics	Test method	Requirements according to EN 1504-3 for R4 class mortar	Performance of product
Density of the mix (kg/m <sup>3</sup> ):	/	/	2,350
pH of mix:	/	/	> 12
Pot life of mix:	/	/	approx. 20 min. (at +20°C)
Mechanical characteristics using 13.5% of water at +20°C:			
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	70 (after 28 days)
Flexural strength (MPa):	EN 196-1	/	20 (after 28 days)
Compressive modulus of elasticity (GPa):	EN 13412	≥ 20 (after 28 days)	29 (after 28 days)
Bond strength to the concrete according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Crack resistance:	“O Ring Test”	/	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation ≤ than the reference concrete (MC 0.45 type water/cement ratio = 0.45) according to UNI 1766	meets specifications
Impermeability to water: – penetration depth - (mm):	EN 12390-8	/	< 5
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	≤ 0.5	< 0.35
Slip-resistance of reinforcement rods: – bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	/	> 25
Thermal compatibility to freeze-thaw cycles with deicing salts, measured as bonding according to EN 1542 (MPa)	EN 13687-1	≥ 2 (after 50 cycles)	> 2
Toughness: – load at first cracking: – toughness index:	ASTM C1018	/	> 20 kN I <sub>20</sub> > 20
Fire resistance:	EN 13501-1	Euroclass	A1
Consumption (kg/m <sup>2</sup> ):	/	/	approx. 20 (per cm of thickness)
<b>CHARACTERISTICS OF THE FIBRES</b>			
Length (mm):	/	/	30
Diameter (mm):	/	/	0.38
Tensile strength (MPa):	/	/	> 2.600

## ► 6.7 | Summary of the main characteristics of castable repair mortars

Characteristics	CASTABLE MORTARS					
	MAPEGROUT HI-FLOW	MAPEGROUT HI-FLOW GF	MAPEGROUT GF BETONCINO B1	MAPEGROUT HI-FLOW B2	MAPEGROUT HI-FLOW TI 20	MAPEGROUT SV FIBER
Standards class according to EN 1504-3	R4	R4	R4	R4	R4	R4
Maximum size of aggregate	2.5 mm	2.5 mm	10 mm	10 mm	2.5 mm	2.5 mm
Mixing ratio	13% - 14% of water	14% - 16% of water	10.5% - 12% of water	10% - 11% of water	14% - 16% of water	13.5% - 14.5% of water
Density of mix	2,350 kg/m <sup>3</sup>	2,350 kg/m <sup>3</sup>	2,300 kg/m <sup>3</sup>	2,300 kg/m <sup>3</sup>	2,300 kg/m <sup>3</sup>	2,350 kg/m <sup>3</sup>
Application temperature range	from +5°C to +35°C	from +5°C to +35°C	from +5°C to +40°C	from +5°C to +35°C	from +5°C to +35°C	from -5°C to +35°C
Pot life of mix at +20°C	approx 1h	approx 1h	approx 1h	approx 1h	approx 1h	approx 20'
Compressive strength	> 75 MPa after 28 days	> 65 MPa after 28 days	> 70 MPa after 28 days	70 MPa after 28 days	> 70 MPa after 28 days	70 MPa after 28 days
Flexural strength	12 MPa after 28 days	10 MPa after 28 days	10 MPa after 28 days	7 MPa after 28 days	> 16 MPa after 28 days	20 MPa after 28 days
Compressive modulus of elasticity	27 GPa after 28 days	27 GPa after 28 days	30 MPa after 28 days	28 MPa after 28 days	27 GPa after 28 days	29 GPa after 28 days
Bond strength on concrete according to EN 1766	> 2 MPa after 28 days	> 2 MPa after 28 days	> 2 after 28 days	> 2 after 28 days	> 2 MPa after 28 days	> 2 MPa after 28 days
Thermal compatibility to freeze-thaw cycles with de-icing salts, measured as bond strength according to EN 1542	> 2 MPa	> 2 MPa	> 2 MPa	> 2 MPa	> 2 MPa	> 2 MPa
Maximum thickness applied by hand	40 mm	50 mm	10 cm	10 cm	50 mm	50 mm
Consumption	approx. 21 kg/m <sup>2</sup> per cm of thickness	approx. 21 kg/m <sup>2</sup> per cm of thickness	approx. 2.100 kg/m <sup>3</sup>	approx. 2.100 kg/m <sup>3</sup>	approx. 20 kg/m <sup>2</sup> per cm of thickness	approx. 20 kg/m <sup>2</sup> per cm of thickness

## ► 7| Repairing concrete using cementitious binders

### ► 7.1| Repairs using STABILCEM

**Description:** *expansive, super-fluid cementitious binder for mixing injection slurry, mortar and concrete.*

**Particularly suitable for:** *preparing compensated-shrinkage fluid concrete and beton for casing into formwork. Injection applications, below foundations and filling rigid joints.*

Repairs using controlled-shrinkage, high-strength consolidating slurry, mortar and pumped concrete using STABILCEM super-fluid cementitious binder to prepare injected slurry, mortar, beton and concrete.

#### **STABILCEM has the following performance characteristics:**

table 16

Mechanical characteristics of mortar mixed with Stabilcem (EN 196/1)	Performance of product
Composition of mix:	water 225 g Stabilcem 450 g standardised sand 1,350 g
Specific gravity (kg/l):	2.23
Slump flow (UNI 7044-72) (%):	160-180
Bleeding:	none
Compressive strength (MPa):	> 62 (after 28 days)
Flexural strength (MPa):	> 9 (after 28 days)
Consumption: – injection slurry (kg/dm <sup>3</sup> ) – mortar and beton (kg/m <sup>3</sup> ): – concrete (kg/m <sup>3</sup> ):	1.6 350-550 300-400

### ► 7.2| Repairs using STABILCEM SCC

**Description:** *cementitious binder for mixing self-compacting, volumetrically-stable beton and concrete, used for repairing concrete structures.*

**Particularly suitable for:** *preparing self-compacting, shrinkage-compensated, high-strength concrete and beton, applied by pumping or casting, without the need to vibrate the cast concrete.*

Increasing the section of piles using self-compacting, high-strength, pozzolanic-reaction volumetrically-stable concrete without segregation.

Concrete applied using a concrete pump or by casting into formwork, without the need of vibrating the cast concrete.



**photo 15**

An example of concrete prepared using STABILCEM SCC

**Beton and concrete prepared using STABILCEM SCC have the following characteristics:**

**table 17**

Characteristics	Performance of product			
Dosage of Stabilcem SCC (kg/m <sup>3</sup> ):	515	550	600	655
Dosage of aggregates (kg/m <sup>3</sup> ):	1,615	1,530	1,470	1,435
Dosage of water (kg/m <sup>3</sup> ):	240	215	230	230
Specific gravity (kg/m <sup>3</sup> ):	2,367	2,298	2,303	2,318
Water/binder ratio:	0.47	0.39	0.38	0.35
Slump flow (cm):	71	74	72	76
Compressive strength (N/mm <sup>2</sup> ):				
– after 24 h:	14	17	20	21
– after 7 days:	36	40	44	45
– after 28 days:	49	53	55	57
Shrinkage according to UNI 6555 (mm):	435	445	440	468
Waterproof according to EN 206:	no	yes	yes	yes
Durability: environmental exposure class to which concretes manufactured with Stabilcem SCC resist according to EN 206-1:	XS1 XD1-XD2 XF1-XF3 XA1, XA2 X0 XC1-XC4 XS1-XS3 XD1-XD3 XF1-XF4 XA1-XA3			
<b>N.B.:</b> For environmental exposure classes XF2-XF3 a minimum air content of 4% is required				

STABILCEM SCC special binder must be used to prepare the concrete, a specially formulated product to guarantee no shrinkage during the first few weeks of the curing cycle, including in open air.

According to the type of aggregate available and performance characteristics required, the dose of binder must be between 550 and 600 kg/m<sup>3</sup>. The concrete is prepared on site or in a cement-mixing plant, and must include from 25 to 35 kg/m<sup>3</sup> of calcium oxide-based expanding agent, and 5 kg/m<sup>3</sup> of MAPECURE SRA glycol-based curing admix, which has the property of containing shrinkage by reducing the surface tension of the capillary pores in the cementitious paste, and DYNAMON SP3 super-plasticiser or similar admix, according to the surrounding temperature, so that the formwork may be removed approximately 14 hours after casting.

The mix must contain inert materials with a good grain-size distribution with a maximum diameter of 15 mm, and a water/binder ratio of  $\leq 0.35$ .

### ► 7.3| Repairs using STABILCEM SP

**Description:** *lightly expansive, cementitious binder for mixing mortar and beton, for the repair of concrete structures.*

**Particularly suitable for:** *preparing low-shrinkage, high-strength pumpable mortar and beton. For example, repairing bridge structures and joints, beams and kerbs on viaducts by applying pumped material.*

STABILCEM SP is a cementitious-based binder in powder form with special additives, used instead of normal cement to prepare high quality mortar. The use of STABILCEM SP allows for the preparation of mortar which does not segregate, which has a low water/cement ratio and high compressive strength. According to the type of work to be carried out and the consistency chosen, the mortar may be applied using traditional techniques or with a concrete pump.

**450 g of STABILCEM SP with 1,350 g of standardised sand and 225 g of water have the following performance characteristics:**

table 18

Characteristics	Performance of product
Density of mix (kg/m <sup>3</sup> ):	2,250
Slump flow (UNI 1015/3) (mm):	180
Compressive strength (MPa) (after 28 days):	> 43
Flexural strength (MPa) (after 28 days):	> 8

► **7.4 | Summary of main characteristics of mortars made with cementitious binders**

Characteristics	CEMENTITIOUS BINDERS			
	STABILCEM			
Mortar made from Stabilcem:	Mixing water: 225 g Stabilcem: 450 g Normalised sand: 1,350 g			
Slump flow (UNI 7044-72) (%):	160-180			
Weight (kg/l):	2.23			
Bleeding:	absent			
Compressive strength (MPa):	> 62 after 28 days			
Flexural strength (MPa):	> 9 after 28 days			
Bonding slurry made from Stabilcem:	Stabilcem: 2,000 g water: 620 g			
Flow-cone (EN 445):	20-30 seconds			
Weight (kg/l):	2-2.1			
Compressive strength (MPa):	> 80 after 28 days			
Flexural strength (MPa):	> 8 after 28 days			
Expansion in plastic phase according to Standard UNI 8996/89 (%):	≥ 0.3			

Characteristics	CEMENTITIOUS BINDERS			
	STABILCEM SCC			
Dosage of Stabilcem (kg/m <sup>3</sup> ):	515	550	600	655
Dosage of aggregates (kg/m <sup>3</sup> ):	1,615	1,530	1,470	1,435
Dosage of water (kg/m <sup>3</sup> ):	240	215	230	230
Density (kg/m <sup>3</sup> ):	2,367	2,298	2,303	2,318
Water/binder ratio:	0.47	0.39	0.38	0.35
Slump flow (cm):	71	74	72	76
Compressive strength after 28 days (MPa):	49	53	55	57
Shrinkage according to UNI 6555 (mm):	435	445	440	468
Impermeability to water according to EN 206:	no	yes	yes	yes

	CEMENTITIOUS BINDERS
Characteristics	STABILCEM SP
Composition of mix:	Stabilcem SP: 450 g water: 225 g normalised sand: 1,350 g
Slump flow (EN 1015/3) (mm):	180
Density of mix (kg/m <sup>3</sup> ):	2,250
Bleeding:	absent
Compressive strength after 28 days (MPa):	> 43
Flexural strength after 28 days (MPa):	> 8

## Mapei mortars for smoothing, levelling, protecting and waterproofing concrete

Product		MONOFINISH	MAPEFINISH	MAPELASTIC	MAPELASTIC SMART	MAPELASTIC GUARD
Type	Normal setting	•	•	•	•	•
	Rapid setting					
Application	Trowel/Flat trowel	•	•	•		•
	Roller/Brush				•	
Where to use	Natural finish smoothing layer	•	•			
	Flexible finishing and smoothing layer			•	•	•
	Smoothing out surface defects	•	•			
	Abrasion resistance		•			
	Protection against aggressive agents	•	•	•	•	•



## ► 8 | Smoothing, protecting and waterproofing concrete surfaces

### ► 8.1 | Protecting and waterproofing with MAPELASTIC

**Description:** *two-component, flexible cementitious mortar for waterproofing, balconies, baths and swimming pools, up to -20°C.*

**Particularly suitable for:** *waterproofing and protecting concrete structures, including those subject to small deformations, render and cementitious screeds.*

*Water tanks, bathrooms, showers, balconies and retaining walls.*

*Protecting against the penetration of water and aggressive atmospheric agents, seawater, de-icing salts and sulphate salts.*

Waterproofing and protecting structures using MAPELASTIC. After mixing together the two components which make up MAPELASTIC to form a homogenous, lump-free product, apply according to the type of intervention to be carried out. The product may be applied manually using a smooth trowel or, in the case of large surface areas, as in this case, by spray using a rendering machine with a smoothing and levelling fitting.

One of the following machines may be used to apply the product by spray:

1. Turbosol T6 or similar;
2. Agres Jolly;
3. Putzmeister S5 EV/TM/2.



**photo 16**

An example of the application of MAPELASTIC on a bridge pile

Whatever type of the above equipment is used, a fitting for smoothing and levelling fitting must be used with a 10 mm diameter nozzle, with an air compressor with a capacity of 800 l/min. Dampen the surface, spray on a layer of at least 2 mm of MAPELASTIC within 60 minutes of mixing and finish off with a flat trowel.

Thanks to the high content and quality of the synthetic resins, the hardened layer of the product remains highly flexible under all environmental conditions.

The product meets the minimum requirements of EN 1504-2, coating (C) according to the PI, MC and IR required in the EN 14891, for the protection of concrete.

**MAPELASTIC has the following performance characteristics:**

table 19

Performance characteristic	Requirements according to EN 1504-2 coating (C) principles PI, MC and IR	Performance of product
Mixing ratio:	/	component A : component B = 3 : 1
Consistency of mix:	/	plastic, trowelable
Density of mix (kg/m <sup>3</sup> ):	/	1,700
Pot life of mix:	/	1 hour (at +20°C)
Adhesion to concrete - after 28 days at +20°C and 50% R.H. (N/mm <sup>2</sup> ):	For flexible systems with no traffic: ≥ 0.8 with traffic: ≥ 1.5	1.0
Thermal compatibility to freeze/thaw cycles with de-icing salts, measured as adhesion (N/mm <sup>2</sup> ):		0.8
Adhesion to concrete - after 7 days at +20°C and 50% R.H. + 21 days in water (N/mm <sup>2</sup> ):	not required	0.6
Elasticity expressed as elongation - after 28 days at +20°C and 50% R.H. (%):	not required	30
Static crack-bridging at -20°C expressed as maximum crack width (mm):	from class A1 (0.1 mm) to class A5 (2.5 mm)	cclass A3 (-20°C) (> 0.5 mm)
Dynamic crack-bridging at -20°C of a film of Mapelastik reinforced with Mapetex Sel, expressed as resistance to cracking cycles:	from class B1 to class B4.2	class B3.1 (-20°C) No failure of the test piece after 1,000 crack cycles with movement of crack from 0.10 to 0.30 mm
Permeability to water vapour - equivalent thickness of air S <sub>D</sub> (m):	class I: S <sub>D</sub> < 5 m (permeable to vapour)	S <sub>D</sub> = 2.4    μ = 1200
Impermeability to water, expressed as capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	< 0.1	< 0.05
Permeability to carbon dioxide (CO <sub>2</sub> ) - diffusion in equivalent air layer thickness S <sub>D,CO2</sub> (m):	> 50	> 50
Reaction to fire:	Euroclass	C, s1-d0
Consumption (kg/m <sup>2</sup> ): – manual application: – spray application using rendering machine:	/	approx. 1.7 (per mm of thickness) approx. 2.2 (per mm of thickness)

## ► 8.2| Protecting and waterproofing with MAPELASTIC SMART

**Description:** *two-component, high-flexibility cementitious mortar, (crack-bridging > 2 mm), applied by trowel or with a roller, for waterproofing balconies, terraces, bathrooms and swimming pools.*

**Particularly suitable for:** *waterproofing and protecting concrete structures, may be applied by trowel or roller which makes it particularly suitable for waterproofing irregular-shaped surfaces. Waterproofing hydraulic structures and retaining walls. Protecting against the infiltration of water and aggressive atmospheric agents, seawater, de-icing salts and sulphate salts.*



**photo 17**  
MAPELASTIC SMART  
applied with a roller

Protecting new concrete structures, and concrete structures repaired using special mortar from the MAPEGROUT or PLANITOP ranges using MAPELASTIC SMART. When the two components are mixed together, a blend with a plastic consistency is obtained. It may be applied by trowel or roller, or by spraying with a worm screw rendering machine with a smoothing and levelling fitting, on both horizontal and vertical surfaces at a thickness of approximately 2 mm per layer. Thanks to the high content and quality of the synthetic resins, the hardened layer of MAPELASTIC SMART remains constantly flexible under all environmental conditions.

The product meets the minimum requirements of EN 1504-2, coating (C) according to the PI, MC and IR, for the protection of concrete and the requirements EN 14891.

**MAPELASTIC SMART has the following performance characteristics:**

table 20

Characteristics	Requirements according to EN 1504-2 coating (C) principles PI, MC and IR	Performance of product
Mixing ratio:	/	component A : component B = 2 : 1
Consistency of mix:	/	fluid, may be applied by brush
Density of mix (kg/m <sup>3</sup> ):	/	1,600
Pot life of mix:	/	1 hour (at +20°C)
Adhesion to concrete - after 28 days at +20°C and 50% R.H. (N/mm <sup>2</sup> ):	for flexible systems with no traffic: ≥ 0.8 with traffic: ≥ 1.5	1,3
Thermal compatibility to freeze/thaw cycles with de-icing salts, measured as Adhesion (N/mm <sup>2</sup> ):		0,9
Adhesion to concrete - after 7 days at +20°C and 50% R.H. + 21 days in water (N/mm <sup>2</sup> ):	not required	0,9
Elasticity expressed as elongation - after 28 days at +20°C and 50% R.H. (%):	not required	120
Static crack-bridging at -20°C expressed as maximum crack width - after 28 days at +20°C and 50% R.H. (mm):	from class A1 (0.1 mm) to class A5 (2.5 mm)	class A5 (+20°C) (> 2.5 mm)
Dynamic crack-bridging at +20°C expressed as resistance to cracking cycles:	from class B1 to class B4.2	class B4.2 (+20°C) No failure of the test piece after 20,000 crack cycles with movement of crack from 0.20 to 0.50 mm
Permeability to water vapour - equivalent air thickness S <sub>D</sub> (m):	class I: S <sub>D</sub> < 5 m (permeable to vapour)	S <sub>D</sub> = 3.6    μ = 1800
Impermeability to water, expressed as capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	< 0.1	< 0.05
Permeability to carbon dioxide (CO <sub>2</sub> ) - diffusion in equivalent air layer thickness S <sub>DCO<sub>2</sub></sub> (m):	> 50	> 50
Reaction to fire:	Euroclass	C, s1-d0
Consumption (kg/m <sup>2</sup> ): – manual application: – spray application using rendering machine:	/	approx. 1.6 (per mm of thickness) approx. 2.2 (per mm of thickness)

► **8.3| Protecting with MAPELASTIC GUARD**

**Description:** *two-component elastic cementitious mortar for protecting large concrete structures subjected to high stresses.*

**Particularly suitable for:** *stopping carbon dioxide penetrating into concrete piles and joists on road and railway viaducts, protecting structures with insufficient concrete around the steel reinforcement and protecting concrete surfaces that come into contact with sea water, sodium chloride and calcium chloride de-icing salts or sulphate salts.*



**photo 18**

An example of MAPELASTIC GUARD applied on the piles of a viaduct

When the two components of MAPELASTIC GUARD are mixed together, they form a free-flowing mix that may also be applied on vertical surfaces in layers up to 2 mm thick with a smooth trowel or by spray with a concrete pump. Thanks to the high content of quality synthetic resins, the hardened layer of MAPELASTIC GUARD maintains its elasticity under all environmental conditions and is totally impermeable to water and the penetration of de-icing salts, sulphates, chlorides and carbon dioxide. MAPELASTIC GUARD also has excellent adhesion on all sound, clean concrete surfaces. These properties, together with its excellent resistance to UV rays, ensures that structures protected with MAPELASTIC GUARD are durable, including those located in areas with particularly rigid climatic conditions, in coastal areas with a saline-rich atmosphere or in industrial areas where the air is highly polluted.

The product complies with the minimum requirements of EN 1504-2 coating (C) according to principles PI, MC and IR.

**MAPELASTIC GUARD has the following performance characteristics:**

table 21

Characteristics	Test method	Requirements according to EN 1504-2 coating (C) principles PI, MC and IR	Performance of product
Mixing ratio:	/	/	comp. A : comp. B = 3 : 1
Consistency of mix:	/	/	plastic-trowellable
Density of mix (kg/m <sup>3</sup> ):	/	/	1,700
Pot life of mix:	/	/	1 hour (at +20°C)
Adhesion on concrete (substrate type MC 0.45) according to EN 1766 (N/mm <sup>2</sup> ):	EN 1542	flexible systems with no traffic: ≥ 0.8 with traffic: ≥ 1.5	1.0
Thermal compatibility measured as adhesion according to EN 1542 (N/mm <sup>2</sup> ): – freeze-thaw cycles with de-icing salts:	EN 13687-1		0.8
Adhesion on concrete (substrate type MC 0.45) according to EN 1766 after 7 days at +20°C and 50% R.H. + 21 days in water (N/mm <sup>2</sup> ):	EN 1542	not required	0.6
Elasticity expressed as elongation: – after 28 days at +20°C and 50% R.H. (%):	DIN 53504 mod.	not required	30
Static crack-bridging at -20°C expressed as maximum width of crack (mm):	EN 1062-7	from class A1 (0.1 mm) to class A5 (2.5 mm)	class A3 (-20°C) (> 0.5 mm)
Permeability to water vapour – equivalent air layer thickness S <sub>D</sub> (m):	EN ISO 7783-1	Class I S <sub>D</sub> < 5 m (permeable to vapour)	S <sub>D</sub> = 2.1    μ = 1,160
Impermeability expressed as coefficient of permeability to free water (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 1062-3	W < 0.1	W < 0.02 Class III (low permeability) according to EN 1062-1
Permeability to carbon dioxide (CO <sub>2</sub> ) – diffusion in equivalent air layer thickness S <sub>DCO2</sub> (m):	EN 1062-6 Method B	> 50	> 50
Reaction to fire:	EN 13501-1	Euroclass	E
Consumption (kg/m <sup>2</sup> ): – manual application: – spray application using rendering machine:	/	/	approx. 1.7 (per mm of thickness) approx. 2.2 (per mm of thickness)

## ► 8.4| Protecting with MAPEFINISH

**Description:** *two-component cementitious mortar for finishing off concrete.*

**Particularly suitable for:** *evening out surface defects in cast concrete before being painted over. Smoothing and levelling off concrete repaired using mortar from the MAPEGROUT range. Protecting concrete against weak aggressive agents from the surrounding environment.*



**photo 19**

Smoothing layer  
using MAPEFINISH

Protecting and evening out surfaces in MAPEFINISH two-component cementitious mortar for finishing off concrete. When the two components are mixed together, a free-flowing mix is obtained which may be easily applied, even on vertical surfaces, at a thickness of up to 2-3 mm in one single layer. Thanks to its high content of synthetic resin, MAPEFINISH has high bonding strength to all concrete surfaces and, once hardened, forms a tough, compact, layer which is impermeable to water and atmospheric agents.

The product meets the minimum requirements of EN 1504-3 Standards for R2-class non structural mortar and EN 1504-2, and the minimum requirements of EN 1504-2, coating (C) according to the principles MC and IR.

**MAPEFINISH has the following performance characteristics:**

table 22

Characteristics	Test method	Requirements according to EN 1504-2 coating (C) MC and IR principles	Requirements according to EN 1504-3 for mortar class R2	Performance of product
Mixing ratio:	/	/	/	4 parts of Mapefinish comp. A with 1 part of comp. B
Consistency of mix:	/	/	/	fluid - trowellable
Density of the mix (kg/m <sup>3</sup> ):	/	/	/	1,900
Pot life of mix:	/	/	/	approx. 1 hour (at +20°C)
Compressive strength (MPa):	EN 12190	not required	≥ 15 (after 28 days)	> 35 (after 28 days)
Flexural strength (MPa):	EN 196-1	not required	not required	> 10.0 (after 28 days)
Modulus of elasticity in compression (GPa):	EN 13412	not required	not required	14 (after 28 days)
Bond strength on concrete (substrate in MC 0.40) according to EN 1766 (MPa):	EN 1542	for rigid systems without traffic: ≥ 1.0 with traffic: ≥ 2.0	≥ 0.8 (after 28 days)	≥ 2 (after 28 days)
Thermal compatibility measured as bonding according to EN 1542 (MPa): – freeze-thaw cycles with deicing salts: – thunder-shower cycle: – dry thermal cycle:	EN 13687-1 EN 13687-2 EN 13687-4	For rigid systems without traffic: ≥ 1.0 with traffic: ≥ 2.0	≥ 0.8 (after 50 cycles) ≥ 0.8 (after 30 cycles) ≥ 0.8 (after 30 cycles)	≥ 2 ≥ 2 ≥ 2
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	not required	≤ 0.5	< 0.30
Impermeability expressed as coefficient of permeability to free water (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 1062-3	W < 0.1	not required	W < 0.05 - Class III (low permeability) according EN 1062-1
Permeability to water vapour - equivalent air thickness S <sub>D</sub> - (m):	EN ISO 7783-1	Class I S <sub>D</sub> < 5 m Class II 5 m ≤ S <sub>D</sub> ≤ 50 m Class III S <sub>D</sub> > 50 m	not required	S <sub>D</sub> < 0.5 Class I (permeable to water vapour)
Resistance to accelerated carbonation:	EN 13295	not required	not required	Depth of carbonation ≤ of reference concrete (MC 0.45 type with water/ concrete ratio = 0.45) according to UNI 1766
Reaction to fire:	EN 13501-1	Euroclass		E
Consumption (kg/m <sup>2</sup> ):	/	/		2 (per cm of thickness)



## ► 8.5| Protecting with MONOFINISH

**Description:** *one-component, normal-setting cementitious mortar for smoothing concrete and cementitious renders.*

**Particularly suitable for:** *protective and smoothing layers on concrete surfaces. Application on strong, concrete and rendered surfaces.*



**photo 20**  
Smoothing layer using  
MONOFINISH

Protecting and smoothing surfaces using MONOFINISH. Application by trowel and finishing with a sponge float. Smoothing layers with MONOFINISH must also be applied on the surfaces which are not under repair, to form a uniform, homogenous substrate ready for successive dressing layers, paint or resin-based anti-corrosion treatment.

The product meets the minimum requirements of EN 1504-3 Standards for R2-class non structural mortar and EN 1504-2, and the minimum requirements of EN 1504-2, coating (C) according to the principles MC and IR.

**MONOFINISH has the following performance characteristics:**

table 23

Characteristics	Test method	Requirements according to EN 1504-2 coating (C) MC and IR principles	Requirements according EN 1504-3 for mortar class R2	Performance of product
Mixing ratio:	/	/	/	100 parts of Monofinish with 18-19 parts of water (approx. 4.0-4.2 litres of water per 22 kg bag)
Consistency of mix:	/	/	/	fluid-trowellable
Density of the mix (kg/m <sup>3</sup> ):	/	/	/	1,700
Pot life of mix:	/	/	/	approx. 1 hour (at +20°C)
Mechanical characteristics using 18.5% of water:				
Compressive strength (MPa):	EN 12190	not required	≥ 15 (after 28 days)	> 25 (after 28 days)
Flexural strength (MPa):	EN 196-1	not required	not required	> 6.5 (after 28 days)
Modulus of elasticity in compression (GPa):	EN 13412	not required	not required	12 (after 28 days)
Bond strength on concrete (substrate in MC 0.40) according to EN 1766 (MPa):	EN 1542	for rigid systems without traffic: ≥ 1.0 with traffic: ≥ 2.0	≥ 0.8 (after 28 days)	≥ 2 (after 28 days)
Thermal compatibility measured as bonding according to EN 1542 (MPa): – freeze-thaw cycles with deicing salts: – thunder-shower cycle: – dry thermal cycle:	EN 13687-1 EN 13687-2 EN 13687-4	For rigid systems without traffic: ≥ 1.0 with traffic: ≥ 2.0	≥ 0.8 (after 50 cycles) ≥ 0.8 (after 30 cycles) ≥ 0.8 (after 30 cycles)	≥ 2 ≥ 2 ≥ 2
Capillary absorption (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 13057	not required	≤ 0.5	< 0.30
Impermeability expressed as coefficient of permeability to free water (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	EN 1062-3	W < 0.1	not required	W < 0.05 - Class III (low permeability) according EN 1062-1
Permeability to water vapour - equivalent air thickness S <sub>D</sub> - (m):	EN ISO 7783-1	Class I S <sub>D</sub> < 5 m Class II 5 m ≤ S <sub>D</sub> ≤ 50 m Class III S <sub>D</sub> > 50 m	not required	S <sub>D</sub> < 0.5 Class I (permeable to water vapour)
Resistance to accelerated carbonation:	EN 13295	not required	not required	Depth of carbonation ≤ of reference concrete (MC 0.45 type with water/ concrete ratio = 0.45) according to UNI 1766
Reaction to fire:	EN 13501-1	Euroclass		E
Consumption (kg/m <sup>2</sup> ):	/	/		1.4 (per cm of thickness)

► **8.6| Summary of the main characteristics of mortars for smoothing and levelling concrete**

Characteristics	MORTAR FOR FLEXIBLE SMOOTHING AND LEVELLING LAYERS ON CONCRETE		
	MAPELASTIC	MAPELASTIC SMART	MAPELASTIC GUARD
Certification principles according to EN 1504-2	PI, MC and IR	PI, MC and IR	PI, MC and IR
Mixing ratio	Comp. A : Comp.B 3 : 1	Comp. A : Comp.B 2 : 1	Comp. A : Comp.B 3 : 1
Density of mix	1,700 kg/m <sup>3</sup>	1,600 kg/m <sup>3</sup>	1,700 kg/m <sup>3</sup>
Density after application by spray	2,200 kg/m <sup>3</sup>	2,200 kg/m <sup>3</sup>	2,200 kg/m <sup>3</sup>
Application temperature range	from +5°C to +35°C	from +5°C to +40°C	from +5°C to +35°C
Pot life of mix (at +20°C)	1 h	1 h	1 h
Bond strength on concrete according to EN 1542	1 MPa	1.3 MPa	1 MPa
Thermal compatibility to freeze-thaw cycles with de-icing salts, measured as bond strength according to EN 1542	0.8 MPa	0.9 MPa	0.8 MPa
Static crack-bridging according to EN 1062-7 expressed as maximum width of crack	> 0.5 mm (-20°C)	> 2.5 mm (+20°C)	> 2.5 mm (-20°C)
Dynamic crack-bridging according to EN 1062-7	No failure of test piece after 1,000 crack cycles with movement of crack from 0.1 to 0.3 mm (mapelastic reinforced with Mapetex sel at -20°C)	No failure of test piece after 2,000 crack cycles with movement of crack from 0.2 to 0.5 mm (+20°C)	/
Permeability to water vapour according to EN ISO 7783-1	S <sub>D</sub> : 2.4 μ: 1,200	S <sub>D</sub> : 3.6 μ: 1,800	S <sub>D</sub> : 2.1 μ: 1,160
Impermeability to water expressed as capillary absorption according to EN 1062-3 (kg/m <sup>2</sup> ·h <sup>0.5</sup> )	< 0.05	< 0.05	< 0.02
Permeability to carbon dioxide (CO <sub>2</sub> ) according to EN 1062-6 - diffusion in equivalent air thickness S <sub>DCO<sub>2</sub></sub> (m)	> 50	> 50	> 50
Consumption	By hand: 1.7 kg/m <sup>2</sup> per mm of thickness By spray: 2.2 kg/m <sup>2</sup> per mm of thickness	By hand: 1.6 kg/m <sup>2</sup> per mm of thickness By spray: 2.2 kg/m <sup>2</sup> per mm of thickness	By hand: 1.7 kg/m <sup>2</sup> per mm of thickness By spray: 2.2 kg/m <sup>2</sup> per mm of thickness

Characteristics	MORTARS FOR SMOOTHING AND LEVELLING CONCRETE	
	MONOFINISH	MAPEFINISH
Certification principles according to EN 1504-2	MC and IR	MC and IR
Maximum size of aggregate	0.4 mm	0.4 mm
Mixing ratio	18% - 19% of water	Comp. A : Comp.B 4 : 1
Density of mix	1,700 kg/m <sup>3</sup>	1,900 kg/m <sup>3</sup>
Application temperature range	from +5°C to +35°C	from +5°C to +35°C
Pot life of mix (at +20°C)	approx 1 h	approx 1 h
Compressive strength	> 25 MPa after 28 days	> 35 MPa after 28 days
Flexural strength	> 6.5 MPa after 28 days	> 10 MPa after 28 days
Bond strength on concrete according to EN 1766	≥ 2 MPa after 28 days	≥ 2 MPa after 28 days
Thermal compatibility to freeze-thaw cycles with de-icing salts, measured as bond strength according to EN 1542	≥ 2 MPa	≥ 2 MPa
Thickness applied	from 1 to 3 mm	from 1 to 3 mm
Consumption	1.4 kg/m <sup>2</sup> per mm of thickness	2 kg/m <sup>2</sup> per mm of thickness

## ► 9| Protecting and decorating concrete surfaces

### ► 9.1| MALECH

**Description:** *acrylic water based layer.*

**Particularly suitable for:** *base preparation of surfaces before applying the final colouring coat, to regulate absorption of the substrate and improve bonding. May also be used in the permanent AQUAFLEX SYSTEM, as anchoring base for the following layers covered by AQUAFLEX capping cycle of asbestos cement. This product is also odourless, which makes it particularly suitable in closed or poorly ventilated environments.*

Once MALECH has been applied, it penetrates deeper down into the substrate than conventional water-based products, and thanks to its special formulation, guarantees consolidation of dust on the surface to be treated. MALECH's high penetration depth also slows down the formation of efflorescence.

Apply the product using traditional techniques; brush, roller or spray.

### ► 9.2| ELASTOCOLOR PRIMER

**Description:** *consolidating solvent-based primer.*

**Particularly suitable for:** *consolidating surface dust by impregnating absorbent surfaces. Suitable for promoting bonding before applying finishing products from the ELASTOCOLOR range of products.*

Fixing treatment for crumbly and dusty surfaces, such as cementitious render and concrete surfaces, using ELASTOCOLOR PRIMER. Thanks to its special properties, the product penetrates easily into absorbent substrates and guarantees excellent insulation and good bonding for successive coats of paint.

### ► 9.3| Protecting and decorating surfaces using ELASTOCOLOR PAINT

**Description:** *elastomeric paint for crack-bridging protection.*

**Particularly suitable for:** *application on cracked façades or concrete with deformation problems. Protects concrete structures against the phenomenon of carbonation.*

Painting surfaces by applying ELASTOCOLOR PAINT. Dilute ELASTOCOLOR PAINT with 10-15% of water and mix using a low-speed drill until it is completely blended. Once mixed as above, the product may be applied using traditional application techniques: by brush, roller or spray.

**photo 21**  
An example of the finish obtained using ELASTOCOLOR PAINT



**ELASTOCOLOR PAINT has the following performance characteristics:**

**table 24**

Characteristics	Performance of product
Dry solids content (EN ISO 3251) (%):	approx. 63
Adhesion to concrete according to EN 1542 (N/mm <sup>2</sup> ):	≥ 0.8
Permeability to carbon dioxide (CO <sub>2</sub> ) – diffusion in equivalent air layer thickness for 250 µm of dry coating S <sub>D</sub> CO <sub>2</sub> (m):	S <sub>D</sub> = 318 µ = 1,272,581
Permeability to water vapour (EN ISO 7783): – diffusion in equivalent air layer thickness for 250 µm of dry coating S <sub>D</sub> (m):	S <sub>D</sub> = 0.5 µ = 2,193
Impermeability expressed as coefficient of permeability to free water (EN 1062-3) (kg/m <sup>2</sup> ·h <sup>0.5</sup> ):	W = 0.01 - Class III (low permeability to water) according to EN 1062-1
Thermal compatibility measured as adhesion according to EN 1542 (MPa): – ageing: 7 days at + 70°C (EN 1062-11): – freeze-thaw cycles with immersion in de-icing salts (EN 13687-1): – storm cycles (EN 13687-2): – thermal cycles without immersion in de-icing salts (EN 13687-3):	≥ 0.8 ≥ 0.8 ≥ 0.8 ≥ 0.8
Static crack-bridging capacity according to EN 1062-7 expressed as maximum width of crack (mm):	class A4 (> 1.25 mm)
Dynamic crack-bridging capacity according to EN 1062-7 expressed as resistance to cracking cycles:	class B2
Resistance to accelerated aging (colour RAL 7032) after 1,000 hours exposure to a Weather-Ometer (ASTM G 155 cycle 1):	Δ E < 2.5
Reaction to fire (EN 13501-1) (Euroclass):	B, s1-d0
Consumption (kg/m <sup>2</sup> ):	0.2-0.4 (per coat)

For effective, complete covering of the surface, apply at least two coats. Under normal humidity and temperature conditions, wait 24 hours between each coat.

ELASTOCOLOR PAINT is available in a wide range of colours, created using the COLORMAP® automatic colouring system.

The product meets the minimum requirements of the norm EN 1504-2, coating (C) according to the principles PI, MC and IR, for the protection of concrete.

## ► 9.4| MAPECOAT E23

**Description:** *two-component epoxy primer for protecting concrete, before applying polyurethane finishing products.*

**Particularly suitable for:** *thanks to its high dry solids content, consolidation of concrete surfaces and mineral-based substrates. Recommended for the first coat in epoxy and polyurethane cycles.*

MAPECOAT E23 has a high residual dry solids content, and is recommended as consolidating primer for concrete surfaces and mineral-based substrates. MAPECOAT E23 is an epoxy resin-based paint containing selected pigments. It is used as a primer on steel-cement elements subject to high chemical, mechanical and atmospheric stress.

MAPECOAT E23 is applied in a single coat by brush, roller, spray or the airless spray system.

## ► 9.5| Protecting and decorating surfaces using MAPECOAT PU33

**Description:** *two-component, flexible, polyurethane resin-based coating.*

**Particularly suitable for:** *protecting concrete, and protecting and waterproofing civil and industrial flat and sloping roofs.*

Protecting and waterproofing concrete using MAPECOAT PU33 which, thanks to its special composition, is highly resistant to industrial environments and atmospheric agents in general, is highly flexible, highly resistant to tearing, resistant to micro cracks in the substrate, impermeable to water while remaining permeable to water vapour, keeps its colour very well and is easy to apply. Once completely hardened, MAPECOAT PU33 is resistant to the aggressive action of UV rays and impedes penetration of CO<sub>2</sub>. MAPECOAT PU33 is resistant to freezing weather conditions, and gives an attractive finish to the treated surface. It should be applied after the MAPECOAT E23 coat, and not directly on the substrate.

The product must be applied in two coats using a brush, roller or by spray to form a dry thickness layer of at least 400 µm.

**MAPECOAT PU33 has the following performance characteristics:**

*table 25*

Characteristics	Performance of product
Density of the mix (g/cm <sup>3</sup> ):	1.3 ± 0.05
Dry solids content in volume (%):	58 ± 2
Can be painted over:	min. 12 h - max. 72 h (at +20°C)
Pot life of mix:	3 h
Water vapour diffusion (μ DIN 52615):	10,300
Water vapour diffusion resistance of 0.3 mm coating layer thickness, S <sub>v</sub> (DIN 52615):	< 3.1 m
Bond strength to concrete (MPa):	> 3.5
Elongation at breakage (UNI 8202/8) (%):	420
Final hardening time:	7 days
Consumption (kg/m <sup>2</sup> ):	1.14 (two coats for a dry thickness of 400 μm)



# Repairs

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**Notes:** \_\_\_\_\_

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# Repairs

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to ***bridges and viaducts***

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