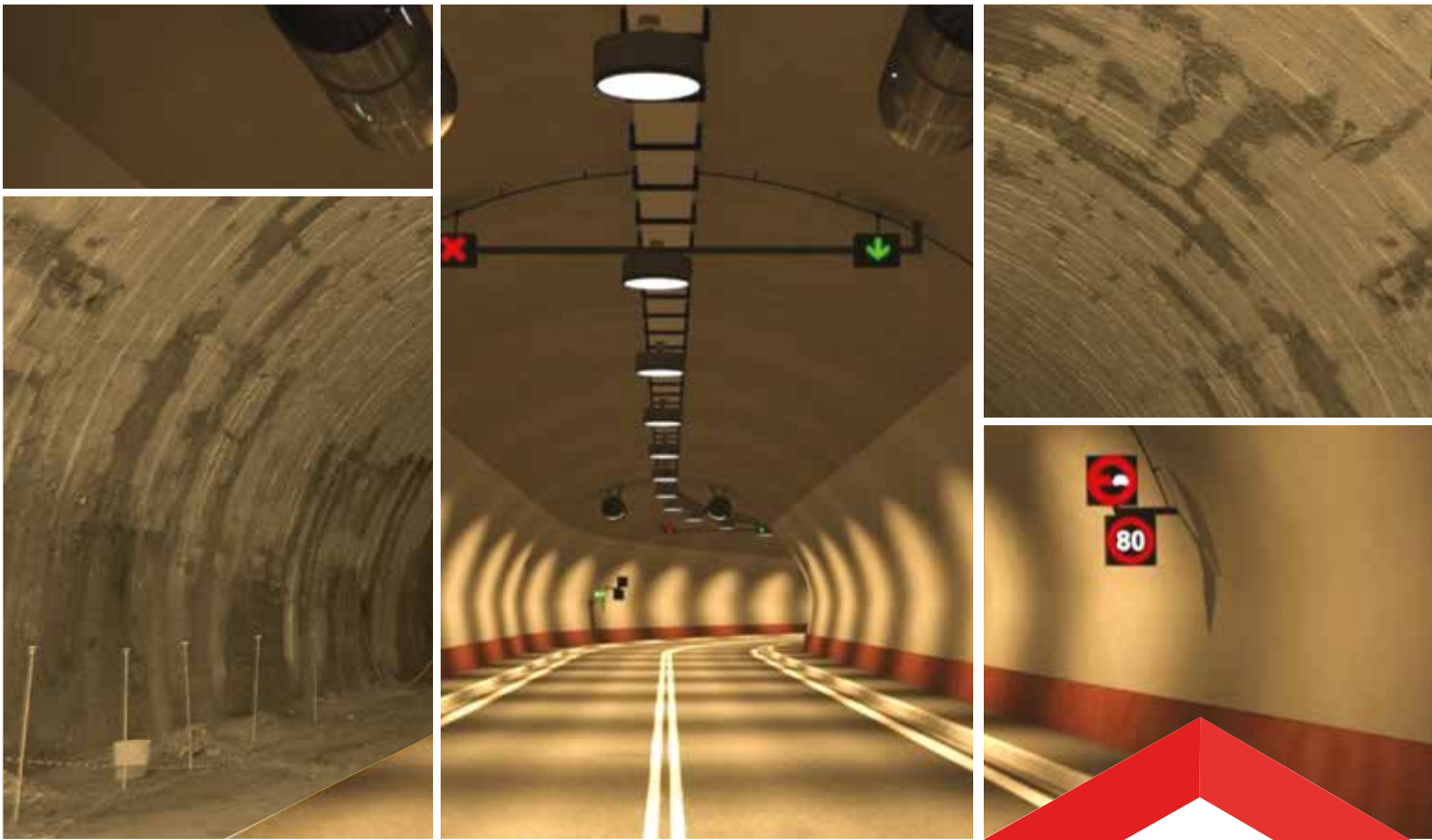




TECHNOLOGIES AND SOLUTIONS
FOR MAJOR WORKS.



SYSTEMS AND PRODUCTS
FOR THE MAINTENANCE
TUNNELS



IN PARTNERSHIP
CON



BE SURE. BUILD SURE.



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Who we are

Our company

In the first months of 2018 Licata S.p.A. began the process of acquiring FIP chemicals, a company specialized in the maintenance of infrastructure and present since 1970 in the chemistry sector of construction.

FIP chemicals has developed a considerable knowledge of innovative construction chemistry technologies, ensures effective solutions for the specific problems of underground infrastructures, offers technical training and support to the product application phases.

Tunnel maintenance is certainly a priority for public contractors (ANAS RFI, etc.), concessionaires for road, rail networks and water management companies.

Licata S.p.A.
MC-Bauchemie

In 2019 Licata SpA started to implement its solutions for the problems of tunnel maintenance, thanks to the partnership with MC-Bauchemie, a world leader in construction chemistry.

MC-Bauchemie has also developed, based on its extensive experience in the world market of maintenance and new tunnel construction, a specific range of products for the injection technology of polymeric resins for soil consolidation and the management of water infiltration.

The products

Licata S.p.A. and MC Bauchemie provide a range of services to assist:



in order to match the products to the design and construction needs



Technologies

The proposals for the restoration, consolidation and waterproofing of tunnels provide our customers with specific solutions for any degraded condition.

- Restoration, protection and reinforcement of concrete.
- Injections for sealing water infiltration.
- Waterproofing with cement or polymeric materials.
- Reinforcement of concrete or masonry structures with FRP (Fibre Reinforced Polymer) composite materials consisting of fibre fabrics of various natures and consistencies, immersed in a polymer matrix.
- Consolidation and waterproofing of soils.

Families produced

The four product families BetonFIP, ResinFIP, MC-Injekt and FiberFIP are divided into several lines to provide a wide range of solutions.

BetonFIP cement-based products:

- **Repair** for the repair and/or reinforcement of concrete and masonry structures;
- **WP** for waterproofing with cement-based products.

ResinFIP resin-based products:

- **Coat** for the protection of concrete structures;
- **WP** for waterproofing with synthetic-based products.

MC-Injekt polymer based products:

- For the consolidation and sealing of cracks and joints.

FiberFIP polymer matrix and carbon fibre products:

- **FiberFIP Adhesives**
- **FiberFIP Fabrics**



Certificazioni

- ISO 9001
- ISO 14001
- ISO 18001

Marcatura CE

- Per tutti i prodotti soggetti alla marcatura CE

Marcatura ETAG

- Per ancoranti chimici per i fissaggi strutturali

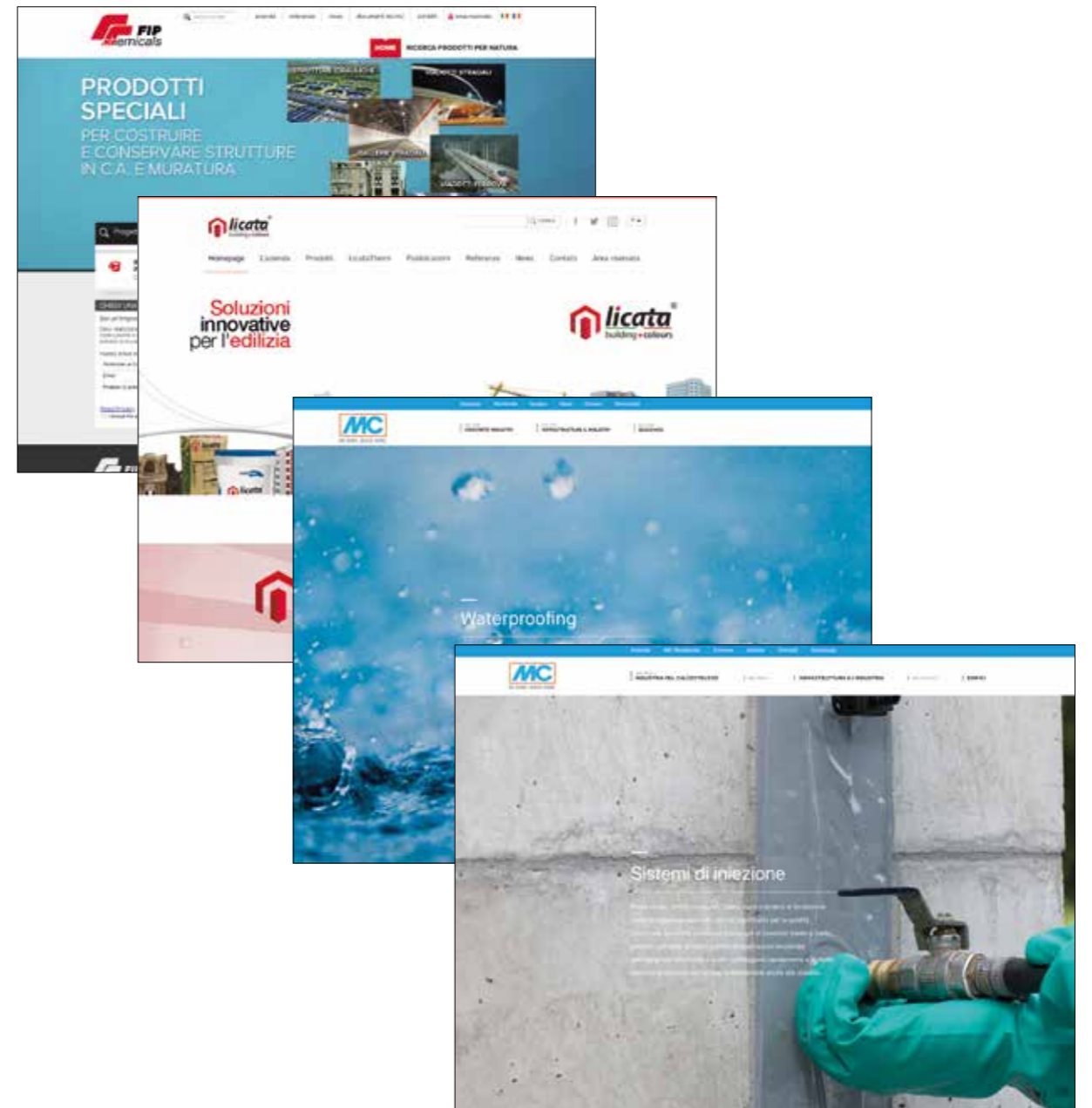
AVCP 2+

Sistema di controllo della produzione obbligatorio per i materiali strutturali



Technical data sheets, catalogues, specifications and other useful information are available on the web.

- <https://www.fipchemicals.it>
- <https://www.licataspaspa.it>
- <https://www.mc-bauchemie.com>





02



BetonFIP

Cement-based products for the restoration, reinforcement, and waterproofing of reinforced concrete and masonry structures.

The BetonFIP *family* is divided into two lines of products:

BetonFIP Repair
BetonFIP WP

Concrete Repair

Restoration and reinforcement of concrete structures

The concept of durability is fundamental in restoring and reinforcing structures in concrete

Too often in the past, the problems underlying the restoration of degraded structures have been faced with a simplistic approach that has sometimes led to astounding failures. In fact, it often became necessary to repair the repairs. Today, the UNI EN 1504 standard is available to all specialists and constitutes a guideline for maintenance interventions in concrete structures. Part 3 of the legislation is the reference for obtaining the CE marking of products used to reconstitute the section of concrete structures or to increase it.

Objectives of the intervention

The main objectives to be achieved in a restoration or reinforcement intervention are to:

- Identify and eliminate the cause of degradation;
- Define the areas and thickness of the intervention;
- Achieve a monolithic state between the introduced materials and the original structure;
- Ensure compatibility between materials;
- Ensure that the durability of the material used for the repair is greater than that of the original concrete;
- Prevent the formation of cracks that would become new preferential entry routes for aggressive environmental agents.

Steps in the recovery process

Having defined the main objectives, it is possible to identify the phases of the entire recovery process that can be summarised as follows:

- Carrying out surveys to determine the cause of degradation and to define the areas and the thickness of concrete to be removed, in order to ensure that the degradation process does not start again in the future;
- Choice of execution techniques;
- Choice of material performance;
- Definition of the execution phases;
- Technical standard that covers all the previous points;
- Price analysis consistent with the areas and the thickness to be reconstructed, the materials and intervention techniques required;
- Our technical service will carry out a preliminary check on the execution phases at the setting of the construction site, during the course of the works and a final check on the results of the interventions carried out.



Degradation phenomena and their acknowledgement

The degradation phenomena of concrete and reinforced concrete tunnels can be multiple and different. Among the most frequent causes we point out:

- cycles of freezing and thawing;
- washout;
- sulphate-based attack;
- corrosion of the reinforcements;

Degradation phenomena are manifested by:

- disintegration of the cement paste;
- cracking of concrete.

The surveys to be carried out are simple and regulated, allowing us to evaluate on which and how many areas to intervene and which is the concrete thickness to be removed and reconstructed.

Areas and thickness of intervention

A correct definition of the areas and thickness on which to intervene allows on one hand to block the deterioration phenomena and ensure that they do not recur in the future, on the other hand to draw up an accurate contractor report with a realistic quantification of costs.

Intervention techniques

Once the cause of the degradation and its extent has been identified (areas and thickness), it is a simple task to define the intervention techniques, which can be summarized as follows:

- Passivation of the reinforcement bars: intervention aimed at blocking oxidation processes.
- Skim coating: used to eliminate defects on exposed concrete surfaces, such as segregation, pitting, lack of concrete cover or to reconstruct the millimetric thickness of the original sections due to very superficial degradation;
- Mechanical spray or manual undercoating: allows you to restore vertical or overhead areas using thixotropic mortars with thickness ranging from 10 to 50 mm.
In a few cases it is possible to carry out operations with fluid products for casting in order to restore the profile of the tunnel, with mortar (thickness 10-50 mm), cement (thickness 50-100mm), concrete (thickness > 100mm).

Choice of material performance

Products must be selected in consideration of the required performance characteristics in order to satisfy the design and durability objectives of the specific project.

The main requirements and performance demanded for all products are:

- High adhesion to the substrate;
- Absence of shrinking;
- High durability to aggressive environmental agents.



Others on the other hand are specific to individual operating techniques, for example:

- Mechanical characteristics;
- Ductility;
- Curing speed;
- Use at low temperatures etc..

The materials most commonly used are expansive cement-based air curing products that guarantee a monolithic result with the substrate, mitigating long-term shrinkage typical of all cement-based mixes. Alternatively, modified polymer cement materials are used that ensure high adherence to the support thanks to the quality of the adhesive polymer used.

Application measures

All stages of the process must be scrupulously carried out in order to guarantee long-lasting solutions that significantly increase the useful life of the structure. The entire development process can be summarised as follows:

- Removal of concrete and preparation of the substrate by sandblasting, scarification or hydro-demolition;
- Possible application of reinforcement mesh and/or nails;
- Treatment of any cracks;
- Cleaning and saturation of the substrate before application
- Use of modified polymer or resin-based cement products;
- Compliance with mixing procedures and application methods;
- Correct finishing of surfaces;
- Curing.

The development stages too often underestimated are the preparation of the substrate, the finish (especially the trowelling of the thixotropic materials) and the curing of surfaces exposed to air.

Preparation of the substrate

The preparation of the substrate is very often an underestimated operation. It varies according to the intervention technique to be carried out, the concrete thickness to be reconstructed and the nature of the filler materials. In the case of operations involving the application of a material thickness in the order of a few millimetres (skim coating), the substrate must be sandblasted or water-sanded. If, on the other hand, work involving the application of a centimetre thickness is to be carried out, expansive mortar, cement or concrete shall be used, and the substrate shall be rendered macroscopically rough by hydro-demolition or milling.

The summary table indicates the specific technique to be used, the application method and recommended category of material for different levels of degradation.

SURFACE DEGRADATION



TECHNIQUE	PREPARATION OF SUBSTRATE	THICKNESS	DESCRIPTION OF PRODUCT	PRODUCT NAME
Skim coating with manual or mechanical application	Sandblasting or water jet at 400 bar	1-5 mm	Cement mortar, premixed, thixotropic, modified polymer, single-component, resistant to aggressive environmental agents. Designed to skim coat cement plaster and slightly degraded concrete structures.	BetonFIP MONO F SKIM COAT
Skim coating with manual or mechanical application	Sandblasting or water jet at 400 bar	4-18 mm	Cement mortar, premixed, thixotropic, modified polymer, single-component, medium particle size, white, water-repellent, resistant to aggressive environmental agents, particularly suitable for the internal arch of tunnels.	BetonFIP MONO G SKIM COAT

MEDIUM DEGRADATION



TECHNIQUE	PREPARATION OF SUBSTRATE	THICKNESS	DESCRIPTION OF PRODUCT	PRODUCT NAME
Application with spraying machines or manual	Hydro-demolition	10-50 mm	Cement mortar, premixed, thixotropic, class R4, expansive in air, resistant to aggressive environmental agents. Designed to restore and reinforce degraded reinforced concrete structures. Requires the application of an arc-welded mesh in cases where thickness is greater than 30 mm.	BetonFIP TIXO
	Milling Mechanical hammers		Cement mortars, premixed, thixotropic, class R4, containing inorganic fibres, expansive in air, resistant to aggressive agents of the environment. Designed to restore, repair, reinforce degraded structures in reinforced concrete. It does not require application of electro-welded mesh .	BetonFIP TIXO F
	Hydro-demolition		Cement mortar, premixed, thixotropic, class R4, modified polymer, two-component, resistant to aggressive environmental agents. Designed to restore, repair, reinforce degraded structures in reinforced concrete.	BetonFIP TIXO POLYMER 2K BetonFIP TIXO POLYMER MONO R4
Application by casting carried out by means of pumps or manually	Sandblasting or bush hammering	10-50 mm	Cement mortar, premixed, fluid, class R4, expansive in air, resistant to aggressive environmental agents. Designed to restore, repair, reinforce degraded structures in reinforced concrete. Requires the application of an arc-welded mesh in cases where thickness is greater than 30 mm.	BetonFIP FLUID
	Hydro-demolition		Pre-mixed cement mortar, fluid, class R4, containing inorganic fibres, expansive in air, resistant to aggressive environmental agents. Designed to restore, repair, reinforce degraded structures in reinforced concrete. Does not require the application of an arc-welded mesh.	BetonFIP FLUID F

DEEP DEGRADATION



TECHNIQUE	PREPARATION OF SUBSTRATE	THICKNESS	DESCRIPTION OF PRODUCT	PRODUCT NAME
Application by casting also inside the formwork, carried out by means of pumps or manually	Hydro-demolition	60-100 mm	Cement mortar, premixed, fluid, class R4, expansive in air, resistant to aggressive environmental agents. Designed to restore and reinforce degraded concrete structures. Requires the application of counteracting reinforcement.	BetonFIP FLUID AS
	Hydro-demolition		Cement mortar obtained by adding to the BetonFIP FLUID inert aggregates of size 5/10 mm free of impurities and perfectly washed, in the quantity indicated by the preliminary tests. Requires the application of counteracting reinforcement.	BetonFIP FLUID + grit
	Hydro-demolition		Cement mortar obtained by adding to the BetonFIP FLUID F inert aggregates of size 5/10 mm free of impurities and perfectly washed, in the quantity indicated by the preliminary tests. It does not require the application of contrasting reinforcements.	BetonFIP FLUID F + grit

Waterproofing with cement and resin-based systems

Choice of material performance

Waterproofing

The correct effectiveness of waterproofing in tunnels is the necessary condition for a high degree of functionality, usability and safety of the infrastructure.

One of the most common problems in the maintenance of tunnels is that of waterproofing the wall face against percolation water, dripping, dampness of the surfaces and water infiltration. It should be pointed out that a non-exhaustive approach to the study of the solution is the cause of defects that emerge in a very short time and manifest themselves in the form of a return to the same problems. The technologies available today allow you to perform:

- Continuous epoxy-cement waterproof coatings;
- Waterproof coatings based on cement and acrylic resin;
- Concrete waterproof coatings;
- Waterproof draining sheets in **TPO**.

The main requirements provided by the waterproof coatings of the **BetonFIP**, **ResinFIP** and **MC-Montan lines**, depending on the nature of the material, are:

- Good resistance to direct and indirect hydrostatic thrust;
- High adherence to the substrate;
- High water vapour permeability;
- Excellent resistance to freeze-thaw cycles;
- Excellent resistance to aggressive environmental agents;
- Good ability to act as bridge in the event of cracking.

Preparation of the substrate

For the success of the waterproofing intervention, it is necessary to use a series of complementary products that allow the hydraulic sealing of connection joints, expansion joints, any cracking states, re-coating, water infiltration sealing.

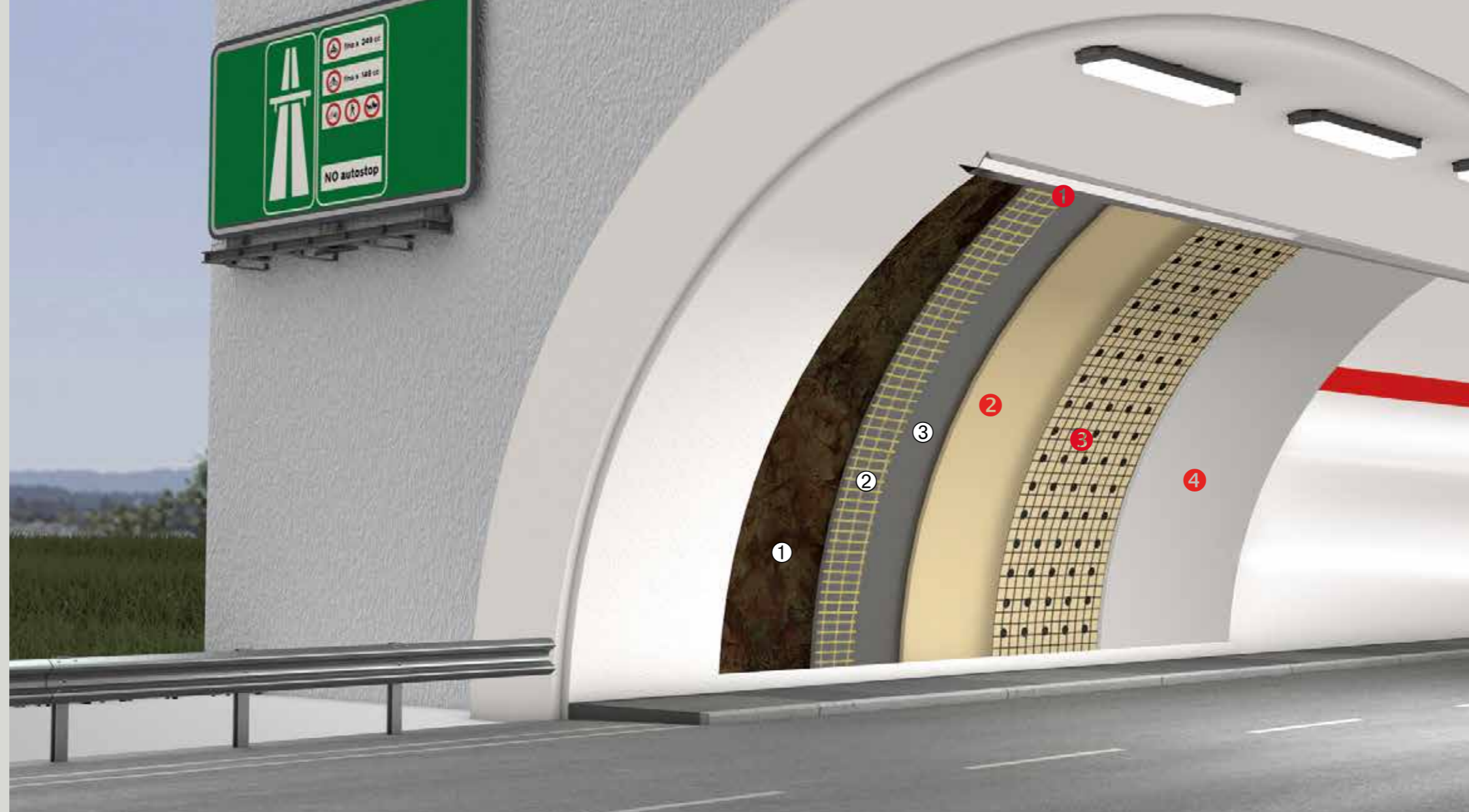
All application phases must also be executed with maximum precision.

Particular attention must be paid to the preparation of the surfaces to be waterproofed. They must be mechanically firm, free of dust, oil, grease, grout residue and any other element that may promote detachment.



FIELDS OF APPLICATION	MODALITY OF APPLICATION	DESCRIPTION OF PRODUCT	PRODUCT NAME
Construction of continuous rigid coating of hydraulic works and structures supported on the ground.	Application by spraying machines or manually.	Cement coating, premixed, thixotropic, single-component, rigid, with osmotic action, with high abrasion resistance. Designed for waterproofing concrete and masonry structures.	BetonFIP WP 600
Creation of flexible continuous coating of hydraulic works and infrastructures of different types, where a good ability to act as a bridge in the event of cracking is required.	Application by spraying machines or manually.	Cement coating, premixed, thixotropic, modified polymer, two-component, flexible for waterproofing and the protection of concrete structures and surfaces.	BetonFIP WP 610 FLEX
System for intercepting and conveying water infiltration in tunnels. Composed of: • synthetic membrane BetonFIP PM SL ; • water-repellent cement skim coat BetonFIP MONO G SKIM COAT .	Application of the synthetic membrane as indicated in the data sheet. Application of skim coat by way of spraying machines or manually.	Multi-layer synthetic membrane in TPO BetonFIP PM SL for underground works, coated with the BetonFIP MONO G SKIM COAT .	BetonFIP PM SL BetonFIP MONO G SKIM COAT
Blocking of concentrated water infiltration, also under pressure.	Application by manual pressure.	Cement mortar, premixed, with ultra-fast hardening to block water infiltration, also pressurised.	BetonFIP WP WATER BLOCK
Connection element to achieve continuity in corners and connections between walls.	Apply a slight pressure to the strip on the "bottom" layer of the waterproofing coating used, when it is still fresh. Cover the strip with another layer of the waterproof coating.	Special waterproofing strip made of thermoplastic elastomer, resistant to ageing, covered by a non-woven polypropylene fabric on both sides.	BetonFIP WP BANDELLA ELASTICA
Continuous waterproof coating for tunnels	Spray application between the projected concrete and the coating concrete or between two layers of mortar of the BetonFIP line.	Elastic waterproofing polymer membrane with IMB technology	MC-Montan Shot Seal
Ideal promoter for applications on wet substrates, it creates a vapour barrier. Counter-pressure waterproofing for concrete.	Application by spraying machines or manually.	Epoxy-cement primer, three-component, indicated to promote the adherence of systems of the ResinFIP line in the presence of humid substrates. In addition, thanks to its resistance and negative hydraulic pressure, it can be used as waterproofing of wall faces.	ResinFIP Primer WP 700

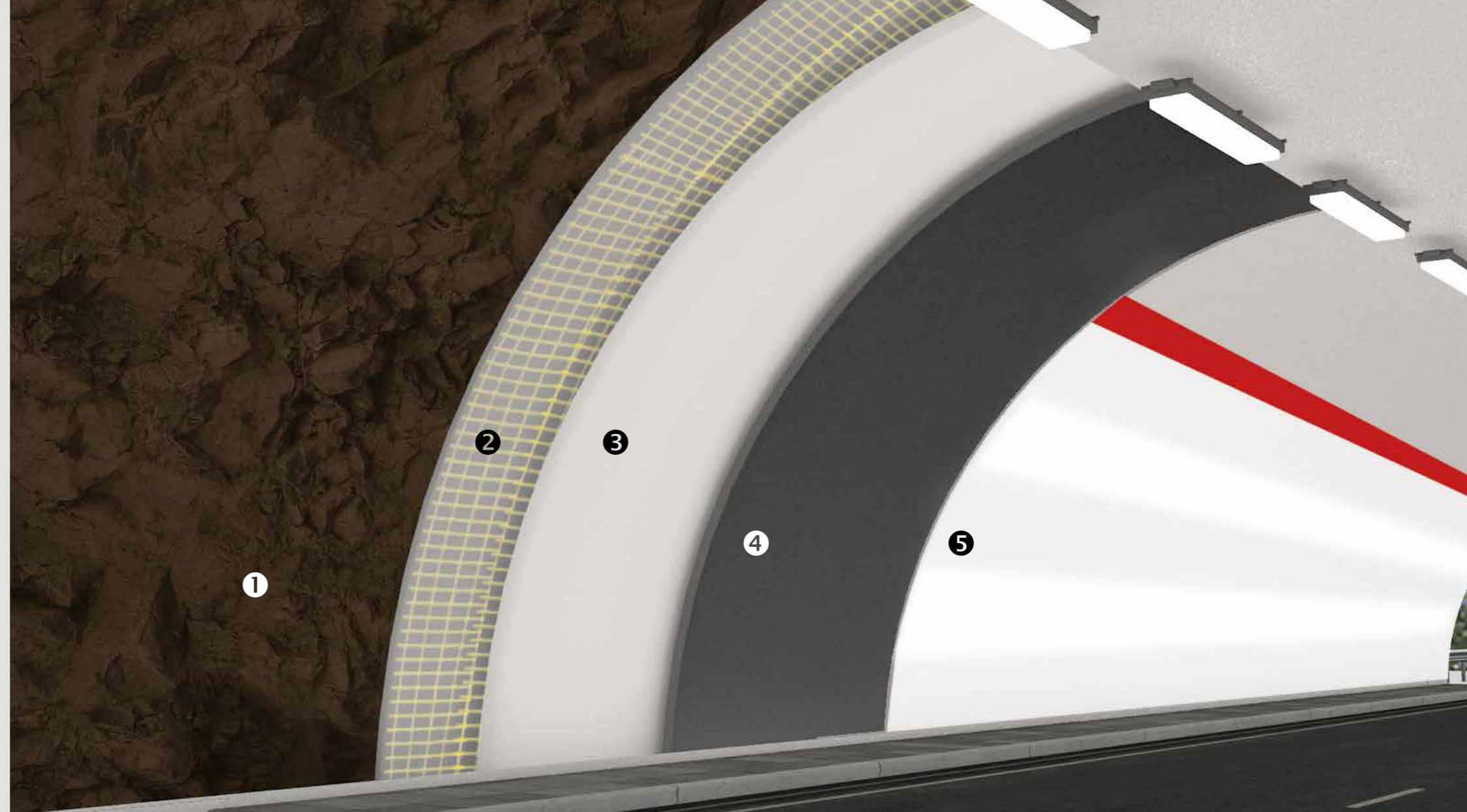




RESTORATION AND WATERPROOFING WITH DRAINING SHEET IN SYNTHETIC MEMBRANE

- Eventuale ripristino del calcestruzzo degradato**
- ① Eventuale preparazione del supporto, per eventuale ripristino del calcestruzzo degradato, mediante idrodemolizione, fresatura o bocciardatura.
 - ② Eventuale applicazione di armatura da incorporare nella malta da ripristino o di rete in fibra di vetro e resina vinilestere, ancorata al supporto con connettori a "L" presagomati in fibra di vetro.
FiberFIP GLASS WIRE NET
FiberFIP GLASS WIRE NET CONNECT
 - ③ Eventuale ricostruzione della sezione asportata del calcestruzzo.
BetonFIP TIXO
BetonFIP TIXO F
BetonFIP TIXO POLIMER 2K
BetonFIP TIXO POLIMER MONO R4

- ① **Impermeabilizzazione**
Profilo di ancoraggio del telo
- ② Membrana impermeabilizzante sintetica in **TPO BetonFIP PMISL**
- ③ Connettori, rondelle e rete in fibra di vetro **FiberFIP GLASS WIRE NET** o rete in acciaio
- ④ Malta cementizia e rasatura per galleria
BetonFIP TIXO POLIMER 2K
BetonFIP TIXO POLIMER MONO R4
BetonFIP RASANTE MONO G



SYSTEM OF EPOXY-CEMENT WATERPROOFING

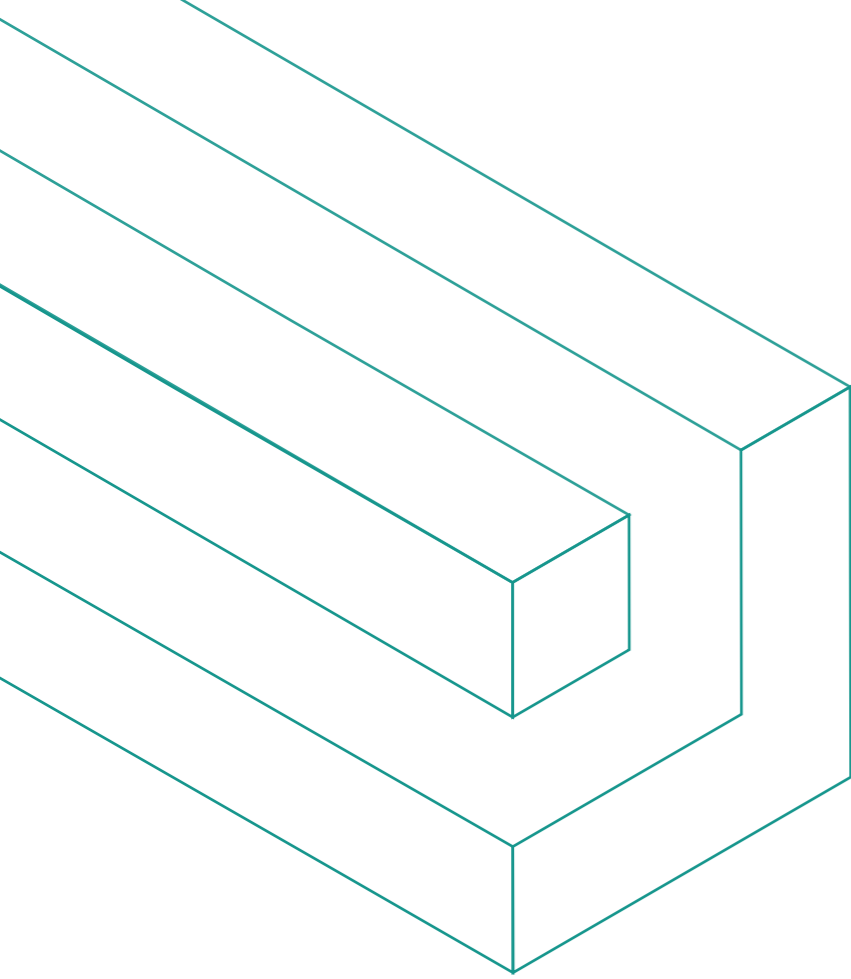
- ① **Eventuale ripristino del calcestruzzo degradato**
Eventuale preparazione del supporto, per eventuale ripristino del calcestruzzo degradato, mediante idrodemolizione, fresatura o bocciardatura.
- ② **Eventuale applicazione di armatura da incorporare nella malta da ripristino o di rete in fibra di vetro e resina vinilestere, ancorata al supporto con connettori a "L" presagomati in fibra di vetro.**
FiberFIP GLASS WIRE NET
FiberFIP GLASS WIRE NET CONNECT
- ③ **Eventuale ricostruzione della sezione asportata del calcestruzzo.**
BetonFIP TIXO
BetonFIP TIXO F
BetonFIP TIXO POLIMER 2K
BetonFIP TIXO POLIMER MONO R4
- ④ **Impermeabilizzante epossi-cementizio**
ResinFIP Primer WP 700
- ⑤ **Protezione del calcestruzzo**
ResinFIP COAT AC 351
ResinFIP COAT 351 HT
ResinFIP COAT ES 385
ResinFIP COAT E-AC 386



RESTORATION AND WATERPROOFING WITH SPRAY MEMBRANE SYSTEM IMB TECHNOLOGY

- ① **Ripristino del calcestruzzo degradato**
 Preparazione del supporto, per eventuale ripristino del calcestruzzo degradato, mediante asportazione con idrodemolizione, fresatura o bocciardatura.
- ② Eventuale applicazione rete elettrosaldata, da incorporare nella malta da ripristino o di rete di fibra di vetro e resina vinilestere, ancorata al supporto con connettori a "L" presagomati in fibra di vetro.
FiberFIP GLASS WIRE NET
FiberFIP GLASS WIRE NET CONNECT
- ③ Ricostruzione della sezione asportata del calcestruzzo.
BetonFIP TIXO
BetonFIP TIXO F
BetonFIP TIXO POLIMER 2K
BetonFIP TIXO POLIMER MONO R4

- Impermeabilizzazione**
- ① Impermeabilizzante elastomerico
MC - Montan Shot Seal
 - ② Malta o rasatura per galleria
BetonFIP RASANTE AS 2K
BetonFIP TIXO POLIMER MONO R4
 - ③ Protezione del calcestruzzo
ResinFIP COAT AC 351
ResinFIP COAT 351 HT
ResinFIP COAT ES 385
ResinFIP COAT E-AC 386



03 *BetonFIP*
ResinFIP
FiberFIP



Coating

Protective and waterproofing coatings, polymer-based, for reinforced concrete and masonry structures.

ResinFIP COAT

Coating

Protection of structures in concrete and

Many tunnels in concrete or reinforced concrete have shown a durability over time lower than estimated, due to degradation mainly represented by:

- Cycles of frost and thaw;
- Washout;
- Sulphate-based attack;
- Corrosion of the reinforcements.

Choice of the material performance

To increase the service life of the structures and improve their functionality in operation, the use of film-forming protective systems with the main function of creating a protection against the contact and penetration of aggressive agents, has become increasingly widespread. According to the specific formulation, protective systems for tunnels can perform these functions:

- Increase the durability of the concrete;
- Prevent corrosion of the reinforcements;
- Improve internal visibility thanks to light refraction;
- Improve road safety;
- Improve the aesthetic appearance;
- Prevent the onset of micro-organisms.

The protective systems, in relation to the degree of aggression of the environment and the specific use, are chosen according to the chemical composition that can generally be acrylic, epoxy-acrylic, epoxy-siloxane.

The choice of the most suitable protective product will be the result of a careful analysis of the specific situation, which takes into account the conditions of the substrate and the foreseeable exposure conditions. It is desirable that the design prescription of the coating, in addition to identifying the chemical nature of the formulation, is also accompanied by indications on the final performance to be obtained and, very importantly, also on the thickness of the dry film to be applied, a fundamental element for the durability of the intervention and the degree of protection of the coating regarding the structure.



Choice of material performance

Often the choice of the most appropriate protective system for tunnels depends on the humidity conditions of the substrate.

The main requirements of a tunnel protection system are:

- Adhesion to concrete;
- Waterproofing;
- Impermeability to CO₂;
- Permeability to water vapour;
- Chemical resistance to aggressive substances;
- Resistance to freeze-thaw cycles;
- Abrasion resistance for the cleaning cycles of the wall face;
- Permanent contact with water;
- Refraction to light.

Application measures

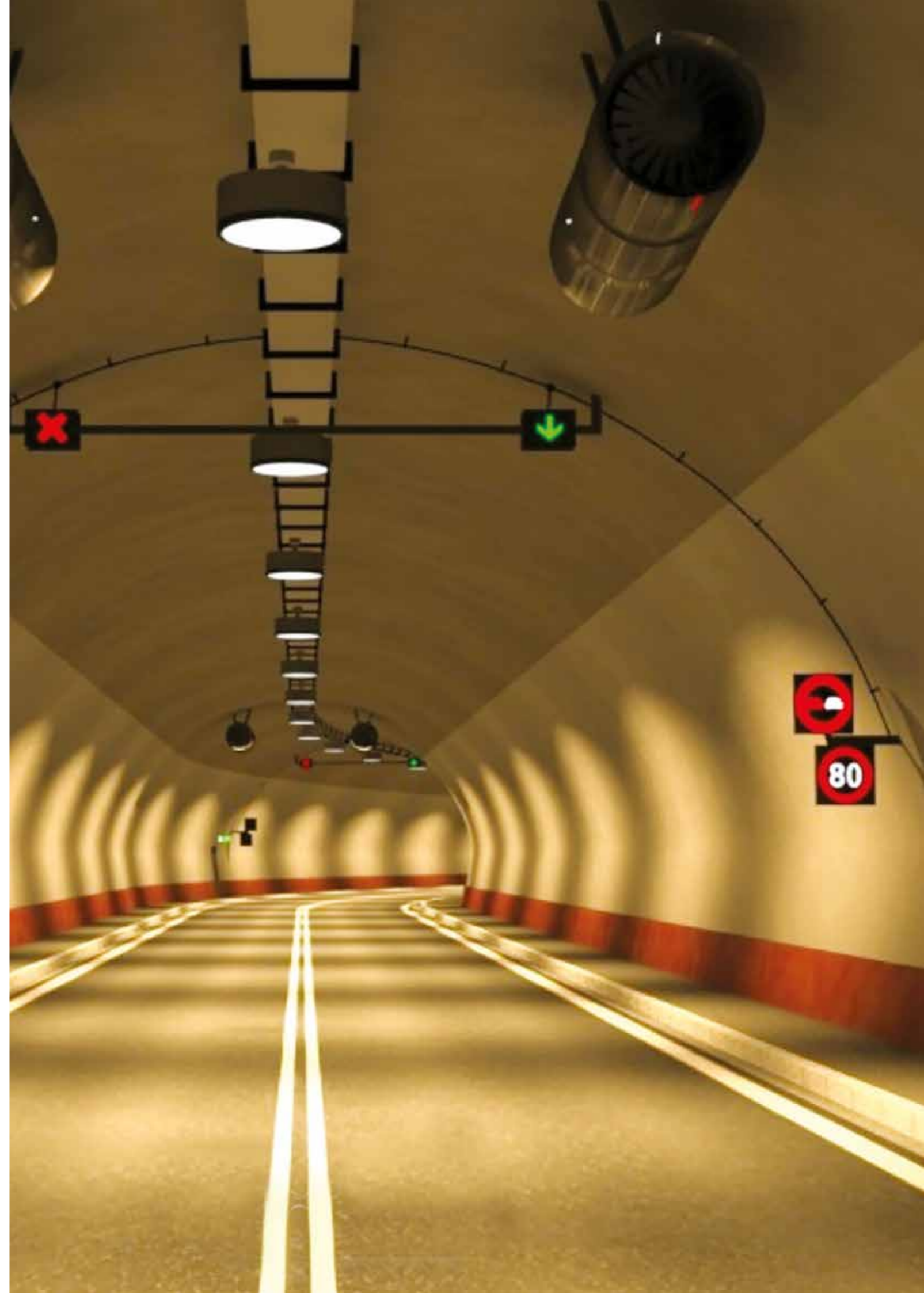
In order to achieve maximum effectiveness in protection, it is recommended to observe the following good application rules:

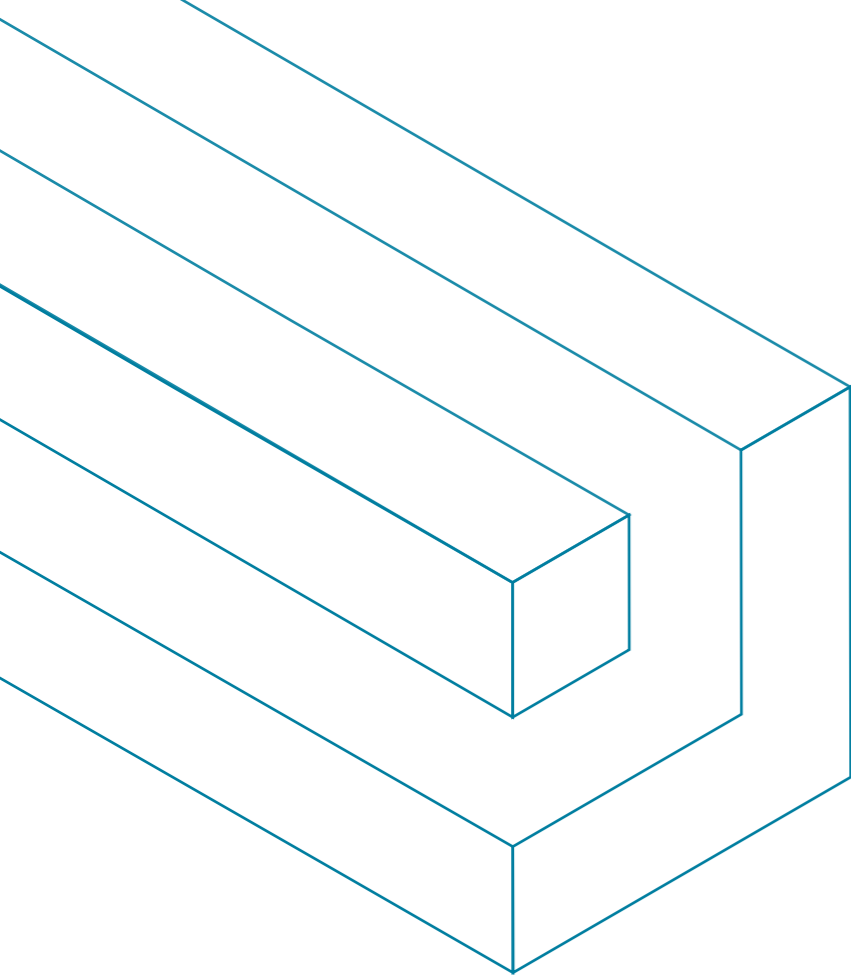
- The surfaces to be coated must be cohesive, if there are degraded areas it is necessary to restore them using the products of the **BetonFIP** line;
- The surfaces to be coated must be prepared by sandblasting and/or washing with pressurized water;
- The humidity of the substrate at the time of application of the protective system must be compatible with the specific formulation;
- The application must guarantee the dry film thickness foreseen in the project, it is essential not to make the mistake of confusing the thickness of the dry film with that of the wet film;
- The application of any primer and the two coats of the protective layer must be carried out in compliance with the re-coating times indicated on the product data sheet.



The following table aims to be a summarised support to guide the choice of the protective system.

FIELD OF APPLICATION	DESCRIPTION OF PRODUCT	PRODUCT NAME
PRIMER FOR WET SUBSTRATES		
Adhesion promoter for the application of ResinFIP coatings on wet substrates. It also acts as a vapour barrier.	Epoxy-cement primer, three-component, indicated to promote the adherence of the systems of the ResinFIP line in the presence of damp substrates and/or when it is necessary to create a vapour barrier, or guarantee high resistance to negative hydraulic pressure.	ResinFIP PRIMER WP 700
ACRYLIC FILM-FORMING COATING SYSTEMS		
Film-forming, rigid, single-component protective system based on acrylic resin in aqueous emulsion, for the protection of concrete structures not in permanent contact with water.	Suitable for moderately aggressive environments. Provides maximum water vapour permeability, maximum resistance to ultraviolet rays, maximum resistance to CO ₂ .	ResinFIP COAT AC 351
Film-forming, rigid, single-component protective system based on acrylic resin in aqueous emulsion, with a high content of titanium dioxide, for the protection of concrete structures not in permanent contact with water.	Specific in the protection cycles of tunnels, underpasses and for all situations in which it is necessary to have a coating that best reflects natural or artificial light.	ResinFIP COAT AC 351 HT
MIXED FILM-FORMING COATING SYSTEMS		
Film-forming, rigid, two-component protective system based on epoxy-acrylic resin in aqueous emulsion, for the protection of concrete structures, in particular tunnels and road underpasses.	Provides high resistance to exhaust gases from motor vehicles, improves visibility in tunnels and underpasses, ensures a reduced dirt retention and a consequent easy and less frequent cleaning of the treated surfaces.	ResinFIP COAT E-AC 386
Two-component white solvent-free epoxy-siloxane protective coating specifically for road tunnels, optimally improves visibility and consequently safety.	Specifically for maximum protection of tunnels. Significantly improves visibility in tunnels, guarantees excellent resistance to vehicle exhaust gases, ensures a reduced dirt build-up and the consequent easy and less frequent cleaning of the treated surfaces.	ResinFIP COAT ES 385





04



MC-Injektion

Polymer-based injection systems for the sealing of cracks and joints, the closure of water infiltration under pressure, the consolidation and waterproofing of soils.

MC-Injekt

Injections

Resin-based injections

For the solution of numerous problems in the interaction between the underground structure and the soil matrix; even in the event of water infiltration in the tunnel the use of resin-based injection systems is effective.

Examples of repairs or waterproofing performed with the injection of acrylic, polyurethane, epoxy or organic-mineral resins:

- Sealing of water infiltration under pressure;
- Sealing of joints;
- Sealing of dynamic or static cracks;
- Consolidation and waterproofing of soils;
- Filling of cavities on the back of the coating.

Tunnel construction is one of the most challenging engineering disciplines in the construction industry. Tunnels need extremely high standards in terms of strength, waterproofing and durability. The interaction between the artificial construction and natural rock and water often requires injection activities that become an integral part of the waterproofing process.

Choice of the material performance

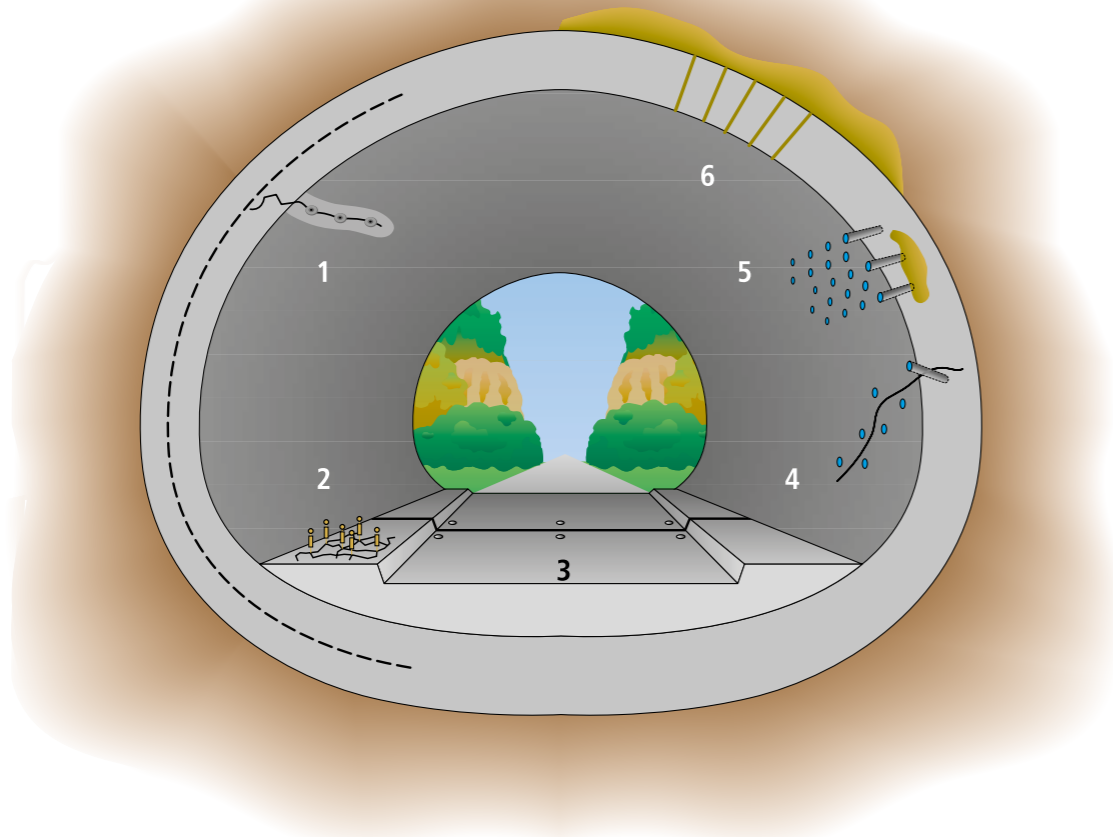
Injection resins have the following characteristics:

- Flexibility
- Composition of cells, open or closed
- Compatibility with groundwater or drinking water
- High mechanical strength
- Very low viscosity
- High expansion capacity
- Modulated reaction times

The design of injection interventions for the maintenance of tunnels must take into account the previous inquiry campaign about the structure and then the correct selection of the materials to be used. Our technicians are available to assist designers and clients in the design phase, in order to identify the most suitable intervention methods for the specific case. Once the activities have started on site, our technical assistance service will provide support to the operators in the use of the most suitable products and injection tools.



FIELDS OF APPLICATION	DESCRIPTION OF PRODUCT	PRODUCT NAME
Injection for the repair of joints or cracks with damp substrate, with dripping or with water under pressure.	Low viscosity acrylic resin, highly elastic, waterproof and expansive. Freeze-thaw resistance, excellent adhesion on dry and/or wet surfaces and suitable for direct contact with drinking water.	MC-Injekt 3000 HPS
Permanent sealing of large water infiltrations and filling of cavities.	Closed cell elastic foam, two-component polyurethane foam with low viscosity, high volume increase and rapid reaction. Conforms to UNI EN 1504-5.	MC-Injekt 2133 Flex
Permanent flexible sealing of cracks and voids.	Two-component elastomer, closed-cell polyurethane resin, very low viscosity and highly elastic. Suitable for direct contact with drinking water. Conforms to UNI EN 1504-5.	MC-Injekt 2300 Top

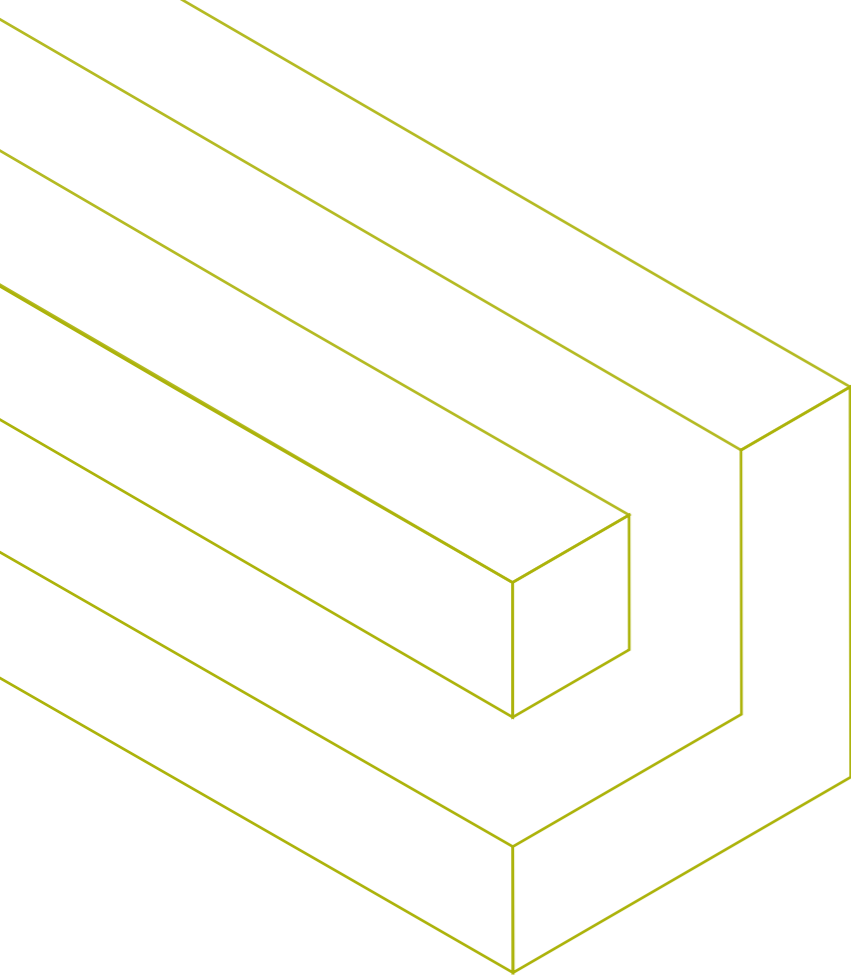


TIPOLOGIE DI INIEZIONE:

1. Iniezioni per la sigillatura di fessure su zone asciutte
2. iniezione a bassa pressione
3. iniezioni per la sigillatura di giunti di costruzione
4. Iniezioni di fessure su zone umide
5. iniezioni di cavità (macro-fessure) e vuoti strutturali
6. iniezioni per l'impermeabilizzazione di vaste superfici (manto impermeabile)

Tabella base per le resine di iniezione
PRODOTTI PRINCIPALI

Aspetti strutturali	Condizione della struttura				
	Asciutto	Umido	Bagnato	Sotto pressione d'acqua	Note principali
Iniezione di fessure statiche non strutturali	ResinFIP EPOBOND F 140 Resina epossidica iperfluida	ResinFIP EPOBOND F 140 Resina epossidica iperfluida MC-Injekt 2700/2700 L Resina poliuretanica rigida	MC-Injekt 1264 compact Resina epossidica compatibile con supporto bagnato MC-Injekt 2700/2700 L Resine poliuretaniche rigide con additivo MC-Additive ST	MC-Injekt 2700/2700 Resine poliuretaniche rigide con additivo MC-Additive ST	Tempo di reazione: MC-Injekt 2700 30 sec. MC-Injekt 2700 L 45 min.
Sigillatura di fessure dinamiche > 0.3 mm	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche MC - Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche MC - Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche	MC-Injekt 2133 flex è una schiuma a cellule aperte da utilizzare per la chiusura temporanea delle venute d'acqua. MC-KAT 20 è usato quale accelerante MC-Injekt 2133 flex.
Sigillatura di fessure dinamiche > 0.2 mm	MC-Injekt 2300 top Resina poliuretanica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche	MC-Injekt 2133 flex è una schiuma a cellule aperte da utilizzare per la chiusura temporanea delle venute d'acqua.
Sigillatura di fessure dinamiche > 0.1 mm	MC-Injekt 2300 top Resina poliuretanica elastica	MC-Injekt 2300 top Resina poliuretanica elastica MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top Resina poliuretanica elastica MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 2300 top MC-Injekt 2133 flex Resine poliuretaniche elastiche	MC-Injekt 2133 flex è una schiuma a cellule aperte da utilizzare per la chiusura temporanea delle venute d'acqua.
Espansione e giunti in movimento		MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 3000 HPS Resina acrilica elastica. L'applicazione avverrà dopo l'iniezione di MC-Injekt 2133 flex che bloccherà la fuoriuscita d'acqua.	MC-Injekt 2133 flex è una schiuma a cellule aperte da utilizzare per la chiusura temporanea delle venute d'acqua. MC-Injekt 3000 HPS Il tempo di reazione del gel acrilico è variabile secondo le diverse condizioni in sito.
Iniezioni diffuse		MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 3000 HPS Resina acrilica elastica	MC-Injekt 3000 HPS Resina acrilica elastica	Il tempo di reazione del gel acrilico è variabile secondo le diverse condizioni in sito

05


FiberFIP

Reinforcement of concrete or masonry structures with FRP (Fibre Reinforced Polymer) composite materials consisting of fibre fabrics of various natures and consistencies, immersed in a polymer matrix.

FiberFIP Tecnologia

FiberFIP Adhesives

FiberFIP Fabrics



FiberFIP

Consolidation and reinforcement of structures with composite materials

The fibrous composite materials with FRP polymer matrix have been increasingly used to apply reinforcements in reinforced concrete and masonry structures.

They allow the creation of bending, cutting and compression reinforcements in reinforced concrete and masonry structures without changing the masses, stiffness and dimensions of the elements on which the work is carried out

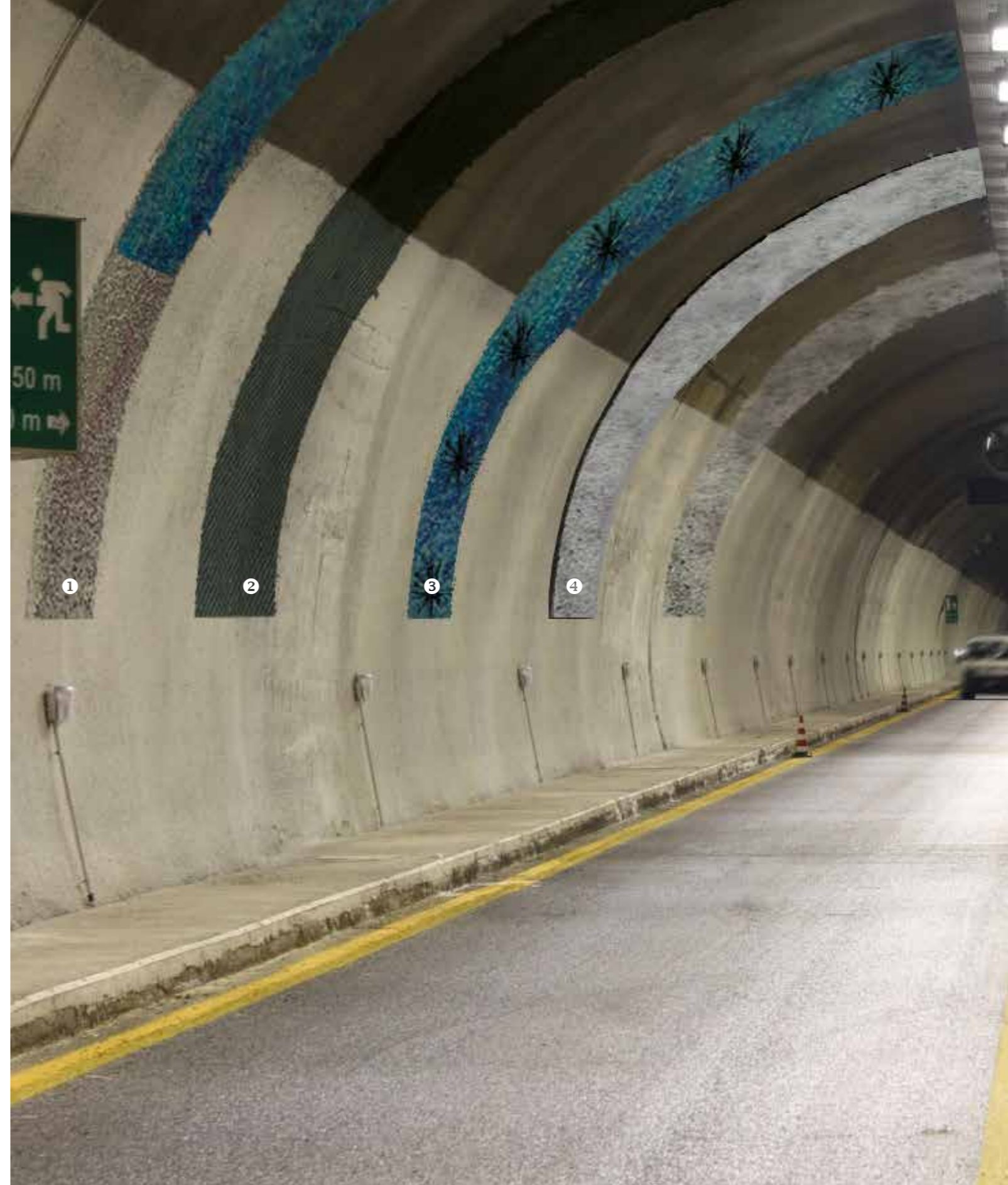
Advantages

The main advantages of fibre reinforced polymer materials are:

- Very high mechanical performance;
- Very limited intervention thickness
- Lightness;
- Speed and simplicity of interventions;

The most common fields of application for tunnel reinforcements are:

- Increase in tensile and flexural strength;
- Integration of the existing reinforcement or recovery of sections lost due to corrosion.



1. ResinFIP Primer 800 and overcoat of FiberFIP ADHESIVE 800.
2. FiberFIP CARBON T-UNI 230
3. FiberFIP Adhesive 800_FiberFIP CONNECT
4. Intumescent premixed plaster



FiberFIP Adhesives

Adhesives

Composite materials provide their structural contribution thanks to the development of a high adhesion between the application substrate and the composite.

Adherence must be guaranteed by the application to the interface between the substrate and the composite of specific adhesives bearing the CE marking, the standards of reference **UNI EN 1504** part 4. For the certification of the system composed by adhesives and fabric, it is necessary to issue a specific CVT (Technical Assessment Certificate) according to the Italian Ministerial Decree. 17.1.2018 issued by the Central Technical Service.

Choice of the material performance

An adhesive suitable for reinforcing with composite materials must provide high performance in relation to the following main requirements:

- Glass transition temperatures;
- Application temperature;
- Workability time;
- Adherence to steel;
- Resistance to compression;
- Resistance to traction by bending;
- Resistance to thermal cycles and wet dry cycles;
- Chemical Resistance;
- Dielectric performance.

Preparation of the substrate

In order to achieve an effective reinforcement it is necessary to pay particular attention to the preparation of the substrate that must be:

- Cohesive and resistant;
- Planar, i.e. free of roughness and depressions, as for example gravel nests or pitting;
- Perfectly clean and free of dust, oils, grease and any substances that may affect adherence;
- Dry;
- Slightly rough for easy adherence.



Execution measures

It is essential that the adhesive is applied in compliance with the the following measures:

- Suitable temperature and humidity of the environment and the substrate;
- Correct mixing ratio between component A and component B;
- Application process consistent with the processing time of the adhesive used.
- Consumption per square meter in line with the **CVT certification**.

In view of the glass transition point of the fabric impregnation adhesives (about 65°C), it is advisable to protect FRP applications from high temperatures, such as fire. The most traditional protections can be calculated and performed with **pre-mixed fire protection plasters that must comply with the test according to the RWS fire curve**.

The synoptic table shows the type of adhesive to be used with the specific material for the reinforcement intervention. Always consult the individual data sheets.

DESCRIPTION OF PRODUCT	MODALITY OF APPLICATION	PRODUCT NAME
Epoxy primer used as adhesion promoter for concrete and masonry substrates.	Roll-on application	FiberFIP PRIMER 800
Epoxy adhesive and impregnating agent for application of fabrics.	Manual application and impregnation of fabric with special bubble breaker roller	FiberFIP ADHESIVE 800

FiberFIP Fabrics

Carbon fibre fabrics or glass

Carbon fabrics are the most widespread form of use of FRP materials in the field of structural reinforcement.

FiberFIP fabrics **give** rise to fibrous reinforcement systems that are impregnated on site. Such systems are composed of a carbon fibre fabric and a polymeric adhesive consisting of a **FiberFIP PRIMER 800** primer and a **FiberFIP ADHESIVE 800** adhesive, with which the reinforcing fabric is bonded to the substrate through impregnation.

FiberFIP **fabrics** obtained through an industrial weaving process have different characteristics depending on the nature of the carbon filament, the mechanical characteristics of the filament or the tensile strength, the elastic modulus and the ultimate deformation.

FiberFIP **fabrics** are unidirectional, with the warp consisting of all fibres arranged in parallel and held together by a weft of wires that perform no static function.

In order to obtain the requested reinforcement, it may be necessary to apply additional layers of fabric, which will subsequently be impregnated layer by layer.

It is always recommended to protect the final layer with a protective system, resistant to the action of ultraviolet rays.

For a correct installation it is advisable to consult the specific preparation and installation manual and the technical data sheets of each specific product.

FIELD OF APPLICATION	DESCRIPTION OF PRODUCT	GRAMMAGE/ DIAMETER	MODULUS OF ELASTICITY	RESISTANCE TO TRACTION	PRODUCT NAME
	Unidirectional high-strength carbon fibre fabric for reinforcing concrete and masonry structures, of the composite system FiberFIP (FRP) composite system.	300 g/m ²	≥ 250 GPa	≥ 3,000 MPa	FiberFIP CARBON T-UNI 230
To reinforce structures to bending, shearing or by confinement as a result of: <ul style="list-style-type: none"> • increased loads; • variation of design codes; • deterioration of the reinforcements; • seismic adaptation; • exceptional events such as: impact, fire, etc.; • design errors; • execution errors. 	Unidirectional high modulus carbon-fibre fabric for the reinforcement of reinforced concrete and masonry structures of the FiberFIP composite system (FRP).	300 g/m ²	≥ 390 GPa	≥ 2800 MPa	FiberFIP CARBON T-UNI 390
	Connectors consisting of carbon filaments confined by a gauze, used for anchoring to the reinforcement structure made with fabrics or nets of the FRP FiberFIP system.	10-12 Ø	≥ 230 GPa	≥ 2,500 MPa	FiberFIP CONNECT

