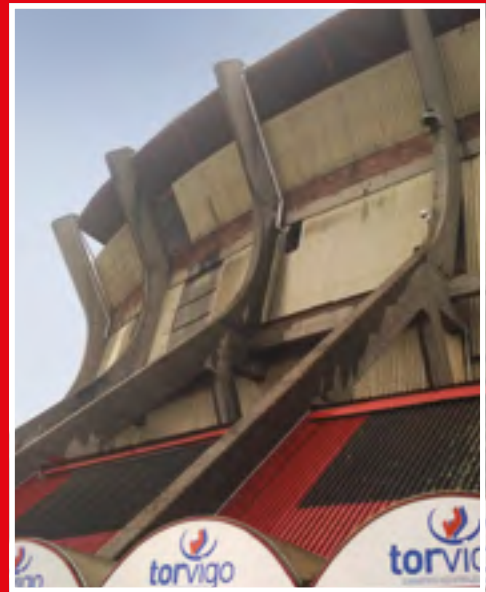


Restoration and Repair of Concrete Structures



**Systems for Protection and Repair of Concrete Structures
according to EN 1504**

DRIZORO S.A.U.



COMPANY PROFILE

DRIZORO S.A.U. is a Spanish company established in **1977**, beginning its activity as a manufacturer of chemical products for construction. Nowadays, the company is a leader on supplying speciality products and systems designed for waterproofing, concrete repair, flooring and decorative finishes.

Our **Headquarters** and Production Plant is based in **Madrid** (Torrejon de Ardoz) - Spain. This is also the base for all operations of the different departments; Production, Research & Development, Laboratory, Technical, Sales, Marketing and Administration.

COMMITMENT TO QUALITY AND ENVIRONMENT

Our strong commitment to Quality Control and the Environment has led us to establish an Integrated Quality and Environmental Management System. This is based on the ISO 9001:2008 and ISO 14001:2004 standards. This system was certified by *Bureau Veritas Quality International*.

COMMITMENT TO RESEARCH, DEVELOPMENT AND INNOVATION

Our strong commitment to Research and Development of both our product range and of human resources enables us to offer the market innovative systems with a high standard of quality whilst being mindful of environmental concerns. These developments are transferred into improvements to our products range. This is based on substantial market research, including on-site experience under the most adverse worldwide conditions, combined with laboratory studies.

TECHNICAL ASSISTANCE

Our Technical Department and Sales Network comprises of highly qualified professionals with wide experience and trained in the construction industry. They provide personalized advice to our clients during all phases of construction in order to specify the most suitable system of products.



DRIZORO TECHNICAL SOLUTIONS



WATERPROOFING



STRENGTHENING



DECORATION



REPAIR



PROTECTION



OTHER USES

Introduction to Repair and Protective Systems for Concrete Structures

Non-structural and Structural repair mortars, levelling fluid mortars and screeds, thixotropic mortars for mechanical or manual application with sulphate-resisting features, synthetic fibres and / or corrosion inhibitors are provide to the professional. Also products for the treatment of steel reinforcements through oxide passivating material and corrosion protectors are provided.

Pathologies in Concrete Structures

Nowadays, the 25% of the total investment in construction is dedicated to the rehabilitation and maintenance of existing structures. percentage which rise up every year and is predicted to be equal to the new construction budget.

The rehabilitation of reinforced concrete and pre-stressed structures is a complex activity which requires of an intensive knowledge of the materials performance and the constructive procedures. The accumulated experience in the last 30 years in pathologies of concrete has overcome the initial idea of structural concrete as a lifelong material, nevertheless it is a material subject to intensive aggressive attacks. coming from weathering and chemical and

mechanical exposure, requiring of maintenance operations to preserve and increase its durability.

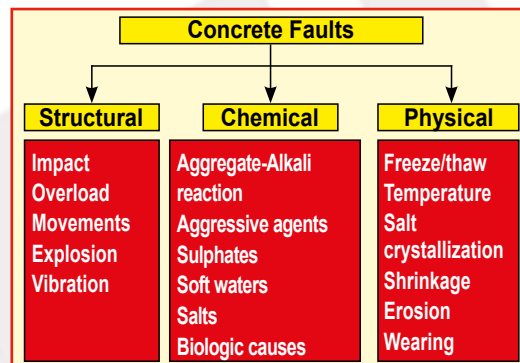
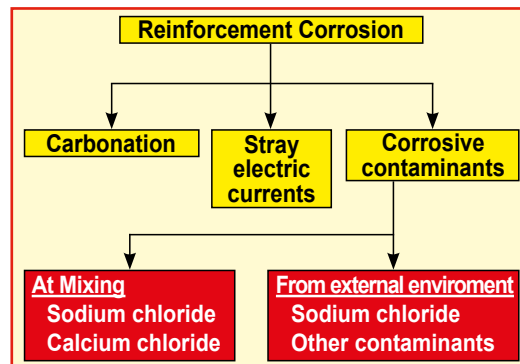
The right identification of the symptoms and causes and the aggressive agents which get involved into the pathologies of the reinforced concrete allows performing a correct diagnosis of the trouble. Once diagnosis has been carried out, is possible to focus on the best and most suitable method to repair and restorate. The knowledge on materials for repairing and protection, its advantages and disadvantages, and the different application methods available and its alternatives, allow a right design of the restoration method.



REINFORCEMENT CORROSION

The most common cause of concrete deterioration is the steel re-bars corrosion. It is showed as spots in dark red-brown colour on the surface of the concrete element affected, corresponding with the location of the main steel re-bars. The oxide increase the volume of the steel rebar inside the concrete generating fissures due to the tensional stress. The process continues and later on appears other signals and fissures coinciding with the transverse tie reinforcement. Oxidation progression generates detachment of the concrete covering.

Corrosion of steel re-bars takes place as consequence of the carbonation process in the concrete covering. The corrosion process speeds up if there are chlorides ingress up to the steel reinforcement depth. The corrosion can also appear because the reduction of alkalinity due to the lixiviation of alkali presents in the water streams. To start the electrolytic corrosion is necessary to form a galvanic cell, thus, a cathode, an anode, an electrolyte and oxygen. The process consumes oxygen and it is necessary to account with water to start it. Therefore, a dry atmosphere or with low humidity (below 40%), the corrosion is very slow. The optimum moisture to speed up the corrosion process is about 70% to 80%, because with higher values, the diffusion of oxygen ions is considerably reduced. The presence of chlorides considerably accelerates the oxidation of the reinforcements.



AGGRESSIVE AGENTS

Another very common pathology is the sulphates attack, caused by reaction between the aggressive solution and the main cement components forming by-products. These by-products are expansive when crystallizing, causing the detachment of the concrete covering, and might destroy completely the concrete element. Concrete change colour on surface, when attacked by sulphates, following by some cross fissures which width increases gradually and simultaneously appears delamination with a curve deformation in the most external layers of the concrete element followed by irregular fissures, all of them caused by the expansive by-products.

CRACKING

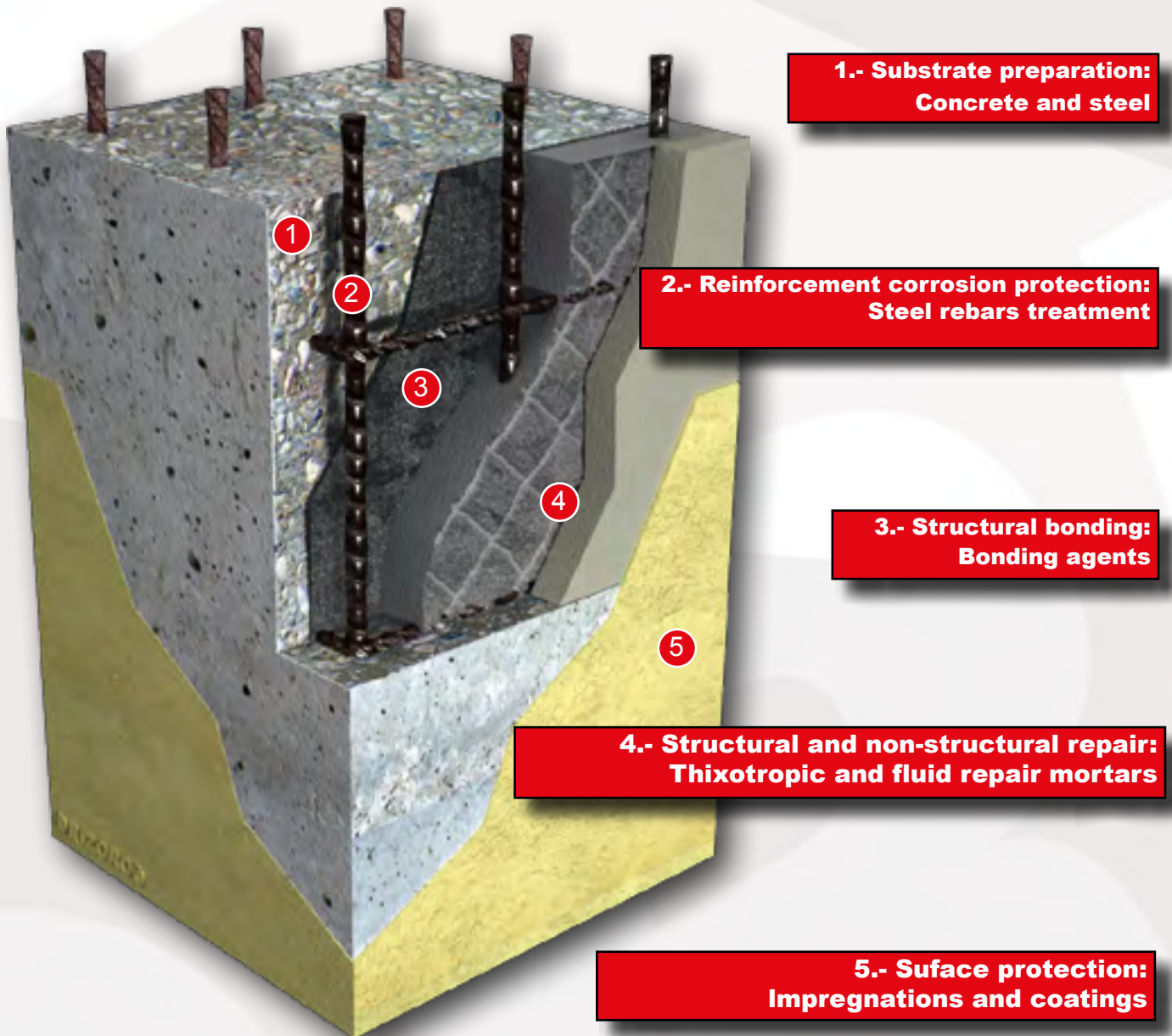
Additionally to the action of aggressive chemical compounds, the concrete element may be cracked or need a strengthening. Cracking might appear because concrete volumetric shrinkage or during the lifespan of the structure due to an increase of load. This cracking pathology must be properly treated.



DRIZORO Systems

EN 1504 Standard

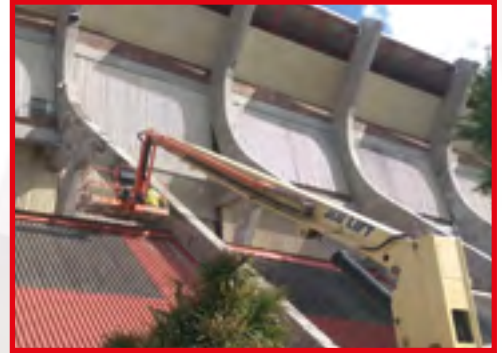
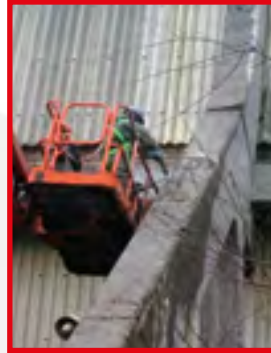
The standard *EN 1504*, from the Technical Committee CEN/TC 104 Concrete: Performance, production, commissioning work and conformity criteria, has 10 documents which include the procedures for Repairing and Protection of Structural Concrete. The aim of this standards is to define the products and systems used for repairing, maintaining and protection, restoration and strengthening of concrete structures, as well as the requirements for identification, performance, safety and evaluation of the conformity and the procedures of application and control of quality of themselves.



EN 1504:1	Definitions
EN 1504:2	Surface protection systems for concrete
EN 1504:3	Structural and non-structural repair
EN 1504:4	Structural bonding
EN 1504:5	Concrete injection
EN 1504:6	Anchoring of reinforcing steel bar
EN 1504:7	Reinforcement corrosion protection
EN 1504:8	Quality control and evaluation of conformity
EN 1504:9	General principles for the use of products and systems
EN 1504:10	Site application of products and systems and quality control of the works

Reinforcement Corrosion Protection: Reinforcement Treatment. EN 1504-7

Existing steel reinforcing should be treated. Thus the oxide must be eliminated and the steel rebars protected by coatings formulated with inhibitors agents of corrosion.



Product	Product type	Appearance	Steel reinforcement preparation	Consumption (Kg/m ²)
MAXREST[®] PASSIVE (CE)	Water-based protective primer / oxide converter	Water based, one component liquid	St-2: Oxide elimination by steel brush	0,30 kg/m ²
MAXRITE[®] PASSIVE (CE)	Cement - based corrosion inhibitor primer	Cement based. Fluid coating mortar	St-3: Oxide elimination up to metallic shining	2,60 kg/m ²
MAXRITE[®] INHIBITOR (CE)	Corrosion inhibitor liquid by migrating effect	Water-based transparent liquid	Concrete surface: free of dirt and dust	0,50 kg/m ²

The **MAXREST[®]**, **MAXRITE[®]-F**, **MAXRITE[®] 500** and **MAXRITE[®] 700** structural repair mortars are certified for use as products for reinforcement corrosion protection.

Structural Bonding: Bonding Agents. EN 1504-4

Before applying the repair mortars, it is necessary to apply a bonding agent to improve the adherence between the old concrete and the new material for repairing in order to achieve the best stress transmission.

One of the major advantages of the **DRIZORO** thixotropic mortars is that the usual bonding agent is made up with the same material by adding a 10% more water to obtain a fluid grout, due to the admixtures included in the formulation of the mortar which improves substantially the adherence.

Just in case of concretes with a severe pathology of chloride ingress, it is recommended to apply an epoxy bonding agent such as **MAXEPOX[®] BOND** to isolate the structural repairing mortar and the steel reinforcing from the chlorides inside the concrete.



Product	Application	Pot Life at 20 °C (min)	Open Time at 20 °C (min)
MAXEPOX[®] BOND (CE)	Epoxy bonding agent for dry surfaces	75	120
MAXEPOX[®] BOND -W	Epoxy bonding agent for wet surfaces	90	120
MAXEPOX[®] BOND -S	Epoxy bonding agent for dry surfaces and suitable for spraying methods	25	120

Structural Repair: Repair Mortars. EN 1504 : 3

Introduction

The European standard EN 1504:3 covers the repair mortars, to return and / or replace the unsound concrete and to protect the steel reinforcement, increasing the lifespan of the concrete structure which is affected or deteriorated. Repair mortars are classified in four classes: R4 and R3 for structural repairing, and R2 and R1 for non-structural repairing, according to the following table criteria.

Performance characteristics	Structural		Non-structural	
	CLASS R4	CLASS R3	CLASS R2	CLASS R1
EN 12190 Compressive strength	> 45 MPa	> 25 MPa	> 15 MPa	> 10 MPa
EN 1015-7 Chloride content	< 0,05%		< 0,05%	
EN 1542 Adhesion	> 2,0 MPa	> 1,5 MPa	> 0,8 MPa	> 0,8 MPa
EN 12617-4 Controlled shrinkage / expansion	> 2,0 MPa	> 1,5 MPa	> 0,8 MPa	no requirements
EN 13295 Carbonation resistance	$d_k < \text{concrete control}$		no requirements	
EN 13412 Elasticity modulus	> 20 GPa	> 15 GPa	no requirements	
EN 13687-1 Thermal compatibility Freeze -Thaw cycles	> 2,0 MPa	> 1,5 MPa	> 0,8 MPa	visual inspection
EN 13687-2 Thermal compatibility rain. Thunder showers	> 2,0 MPa	> 1,5 MPa	> 0,8 MPa	visual inspection
EN 13687-4 Thermal compatibility. Dry cycling	> 2,0 MPa	> 1,5 MPa	> 0,8 MPa	visual inspection
EN 13057 Capillary absorption	< 0,5 kg/m ² .h ^{0,5}		< 0,5 kg/m ² .h ^{0,5}	

APPLICATION FIELDS

R3 & R4 CLASSES

- Concrete restoration by hand applied mortar and spraying mortar.
- Preserving or restoring passivity by increasing cover to reinforcement with mortar, or replacing contaminated concrete.
- Structural strengthening by adding mortar.

Composition							Principles EN 1504-9								
Polymers	Fibbers	Corrosion Inhibitors	Silica fume	Thickness (mm)	Initial setting time	Class EN 1504	Products	3. Concrete restoration		4. Structural strengthening	7. Preserving / restoring passivity		11. Control of anodic areas		
								3.1 Hand applied mortar	3.2 Recasting with mortar	3.3 Spraying mortar	4.4 Adding mortar	7.1 Increasing cover	7.2 Replacing concrete	11.1 Coating with active pigments	11.2 Barrier coating
				10 - 30	Quick (20')	R4	MAXREST®	●			●				●
●	●	●	●	5 - 50	Quick (10')	R4	MAXRITE® 500	●			●				●
●	●	●	●	5 - 50	Middle (75')	R4	MAXRITE® 700	●		●					●
●				5 - 50	Normal (3-4 h)	R4	MAXRITE® -S	●		●					●
●	●		●	5 - 40	Normal (3-4 h)	R4	MAXRITE® -F	●		●				●	●
●	●	●	●	5 - 100	Normal (5 h)	R3	MAXRITE® -HT	●		●					●
●				5 - 40	Normal (3-4 h)	R3	MAXRITE® -R	●		●					●
				10 - 50	Normal (5 h)	R4	MAXGROUT®	●	●						
				10 - 50	Quick (30-45 h)	R4	MAXGROUT® -HR	●	●						
●			●	10 - 50	Normal (5 h)	R4	MAXRITE® INJECTION	●	●						
●				0 - 3	Normal (1-2 h)	R2	CONCRESEAL® -3	●							
●				1 - 5	Normal (2-3 h)	R3	CONCRESEAL® -5	●							
●				3 - 5	Normal (1-2 h)	R2	MAXEPOX® CEM	●							

Structural Repair: Thixotropic Repair Mortars

Description

The thixotropic mortars are composed by special cements, selected aggregates of controlled granulometry, polymers, silica fume, and other admixtures which allow to the structural concrete repairing, to return its original geometry in a very short time without using formworks. Due to its excellent thixotrophy there is no mortar slump. Mechanical properties are equal or higher than concrete ones. The structural mortars can be applied by hand or by wet spraying methods in thickness up to 10 cm, and once applied they can be remodeled, texturized or coated for cosmetic appearance.

NECESSARY PERFORMANCE

- Adequate mechanical strength for the use.
- High thixotrophy.
- Adequate open time.
- Compensated shrinkage and cracking control.



Setting up

Concrete restoration by hand applied mortar



Cleaning of surface and application of the oxide converter / protective coating.



Application of bonding slurry composed of the same repair product and water.



Application of structural repair mortar while bonding slurry still fresh.



For successive layers, scratching the surface to improve adhesion thereof.



Providing of an esthetic finishing of the repaired area.

Concrete restoration by spraying mortar

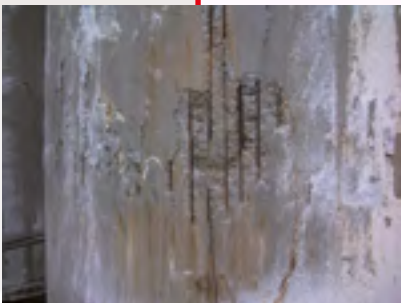
For the repair of large areas by wet spraying methods in vertical and horizontal elements without using formworks, **MAXRITE® -S**, **MAXRITE® -F**, **MAXRITE® -HT**, **MAXRITE® -R**, and **MAXRITE® 700**. One component structural repair mortar with normal setting time, and composed by special cements, aggregates of selected granulometry and modified with polymers, which give them excellent workability and high adherence on the more usual construction substrates.



Structural Repair: Thixotropic Repair Mortars



Structural repair using special mortars applied by hand and with quick setting time: **MAXREST®**, **MAXRITE® 500**, and **MAXRITE® -R**.



Structural repair using mortars by spraying methods: **MAXRITE® -S**, **MAXRITE® -F**, **MAXRITE® HT**, **MAXRITE® -R**.

Structural Repair: Fluids Repair Mortars

Description



Fluids mortars improves the setting up due to its high fluidity, facilitating the filling of formworks and the filling of the space between the steel rebars of the reinforcement, minimizing the vibrating operations. They have very good adherence with concrete and the steel rebars, with high initial and final mechanical strengths.

These mortars are characterized by being very resistant to repeated loads, without retraction and slightly expansive. They have self levelling capabilities (self compacting), waterproof and high resistant to water, oil, fats and derivatives. They may be applied by pouring and by injection .



Setting up

Concrete restoration by pouring



Cleaning the surface before repairing the concrete element.



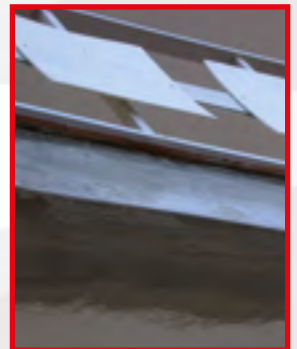
Placing the formworks and the new steel reinforcement.



Mixing the mortar only with clean water.



Pouring the mixed mortar inside the formwork.



General overview of the repaired element.

Concrete restoration by injection



For the adequate filling of recesses or in structural elements with a too tight steel reinforcing mesh, it is recommended the use of structural mortars of high fluidity, i.e. applied by injection.

Structural Repair: Fluids Repair Mortars

Repair and strengthening of concrete structures in different sport facilities



Placement of formworks for the pouring of the mortar.



Pouring of the mortar by gravity.



Sealing of the drilled holes for the air vent while the mortar is poured.



Overview of formwork after pouring.

Overview of the metallic structure

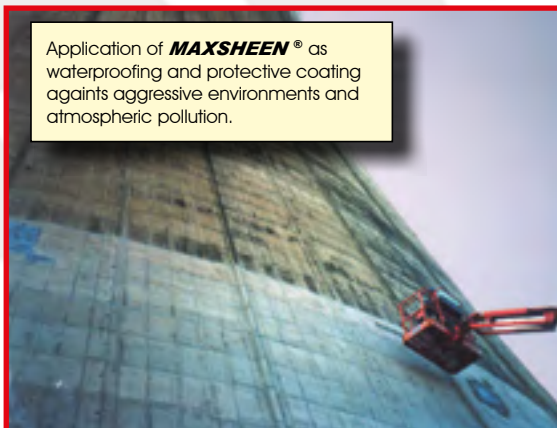
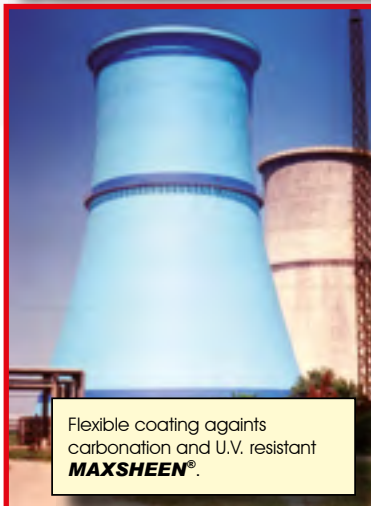
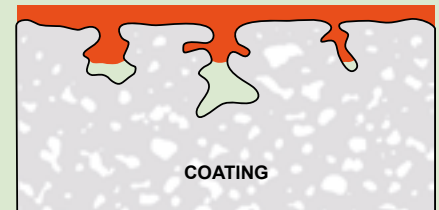
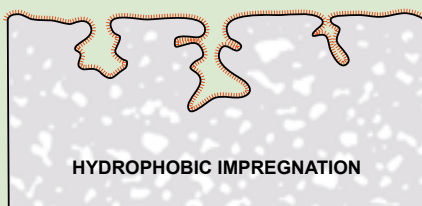


General overview of the strengthened pillar.

Concrete Surface Protection: Coatings and Impregnations. EN 1504-2

The **DRIZORO** protection systems accomplish with the protection principles against penetration, moisture control and improve the physical and chemical resistance established by the European standard EN 1504:2. Also increase the resistivity by limiting the moisture content. So, we can distinguish between:

- 1.- **HYDROPHOBIC IMPREGNATION:** Surface treatment as water repellent, without forming a skin which do not change the element colour and aspect.
- 2.- **IMPREGNATION:** Surface treatment which reduces the porosity, reinforcing the surface by filling totally or partially the pores and surface capillars.
- 3.- **COATING:** Treatment of the surface to produce a continuous film with a thickness between 0,1 and 5,0 mm.



Product	Hydrophobic Impregnation	Impregnation	Coating			Ingress protection		Moisture control		Physical resistance		Chemical resistance		Increase of resistivity	
			1.1*	1.2*	1.3*	2.1*	2.2*	5.1*	5.2*	6.1*	8.1*	8.2*			
MAXSEAL® -M			●			●	●	●						●	●
MAXSEAL® FLEX -M			●			●	●	●					●		●
MAXSEAL® SUPER			●			●	●	●							●
MAXSHEEN® ELASTIC -F			●			●	●	●							●
MAXURETHANE®			●			●	●	●					●		
MAXURETHANE® 2C / TOP			●			●	●	●					●		
MAXURETHANE® 2C -W			●			●	●	●					●		
MAXEPOX® FLEX			●			●	●	●					●		
MAXEPOX® TAR -K -F			●			●	●	●					●		
MAXGLAZE® -D		●				●									
MAXCLEAR® -D / TOP	●					●		●							●

* Methods to meet the principles according to European Standard EN-1504:9

