


The Repair and Protection of Reinforced Concrete with Sika®
In Accordance with European Standard EN 1504

Innovation & Consistency | since 1910

Concrete Repair, Protection and Corrosion Management in Reinforced Concrete Structures

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The European Standard EN 1504 Series

The European Standard EN 1504 consists of 10 parts.
With these documents products for the protection and repair of concrete structures are defined. Quality control of the repair materials production and the execution of the works on site are also all part of these standards.

EN 1504 – 1	Describes terms and definitions within the standard
EN 1504 – 2	Provides specifications for surface protection products / systems for concrete
EN 1504 – 3	Provides specifications for the structural and non-structural repair
EN 1504 – 4	Provides specifications for structural bonding
EN 1504 – 5	Provides specifications for concrete injection
EN 1504 – 6	Provides specifications for anchoring of reinforcing steel bars
EN 1504 – 7	Provides specifications for reinforcement corrosion protection
EN 1504 – 8	Describes the quality control and evaluation of conformity for the manufacturing companies
EN 1504 – 9	Defines the general principles for the use of products and systems, for the repair and protection of concrete
EN 1504 – 10	Provides information on site applications of products and quality control of the works

These standards will help owners, engineers and contractors successfully complete concrete repair and protection works to all types of concrete structures.

CE Marking

The European Standard EN 1504 will be fully implemented on January 1st, 2009. Existing National Standards which have not been harmonized with the new EN 1504 will be withdrawn at the end of 2008 and CE Marking will be mandatory.
All products used for concrete repair and protection will now have to be CE marked in accordance with the appropriate part of EN 1504. This CE conformity marking contains the following information – using the example of a concrete repair mortar suitable for structural use:

CE 01234	■ CE – Symbol ■ Identification number of the notified body
Sika Schweiz AG Murtenstrasse 13, CH-3186 Düdingen **08** 01234-CPD-00234	■ Name or identifying mark of the producer ■ Year in which the marking was affixed ■ Certificate number as on the attestation certificate
EN 1504-3 Concrete Repair product for structural repair CC mortar (based on hydraulic cement)	■ Number of the European standard ■ Description of the product
Compressive strength: class R3 Chloride ion content: ≤ 0,05% Adhesive Bond: ≥ 1,5 MPa Carbonation resistence: Passes Elastic modulus: 21 GPa Thermal compatibility part 1: ≥ 1,5 MPa Capillary absorption: ≤ 0,5 kg · m^{-2} · $h^{-0,5}$ Dangerous substances: comply with 5.4 Reaction to fire: Euroclass A1	■ Information on regulated characteristics

The Key Stages in the Repair and Protection Process
In Accordance with the European Standard EN 1504

The successful repair and protection of concrete structures which have been damaged or which have deteriorated, firstly require professional assessment in an appropriate condition survey. Secondly the design, execution and supervision of technically correct Principles and Methods for the use of products and systems in accordance with European Standard EN 1504-9.

This brochure is intended to give guidance on the correct approach and procedures for concrete repair and protection works, including the use of Sika products and systems for the selected repair Principles and Methods.

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1 Assessment of the Structure from the Condition Survey

The assessment of a damaged or deteriorated reinforced concrete structure from the condition survey should only be made by qualified and experienced people.

This process of assessment must always include the following aspects:

- The condition of the structure including visible, non-visible and potential defects.
- Review of the past, current and future exposure.

2 Identification and Diagnosis of the Root Causes of Deterioration

Following review of the original design, construction methods and programme, and the assessment from the condition survey, it is possible to identify the "root causes" of each different type and area of damage:

- Identify defects and mechanical, chemical or physical damage to the concrete.
- Identify concrete damage due to reinforcement corrosion.

3 Determine the Repair and Protection Options and Objectives

With most damaged or deteriorated structures, the owner has a number of options which will effectively decide the appropriate repair and protection strategy to meet the future requirements of the structure.

These options include:
- Do nothing (for a certain time).
- Downgrade the capacity of the structure or its function.
- Prevent or reduce further damage without repair or improvement.
- Improve, strengthen or refurbish all or part of the structure.
- Reconstruction of all or part of the structure.
- Demolition.

Important factors when considering these options:
- Intended design life following repair and protection.
- The required durability, performance and requirements.
- How will loads be carried before, during and after the repair works.
- The possibility for further repair works in the future including access and maintenance.
- The costs of the alternative options and possible solutions.
- The consequences and likelihood of structural failure.
- The consequences and likelihood of any partial failure (falling concrete, water ingress etc.).

And environmentally:
- The need for protection from sun, rain, frost, wind, salt and/or other pollutants during the works.
- The environmental impact of, or restrictions on the works in progress, particularly the noise and dust, plus the time needed to carry out the work.
- The likely environmental and aesthetic impact of the improved or reduced appearance of alternative repair options and solutions.

4 Selection of the Appropriate Repair Principles and Methods

To meet the owner's future requirements, the appropriate Repair and Protection Principles must be selected, and then the best method of achieving each principle must be decided.

These should be:
- Appropriate to the site conditions and requirements, i.e. Principle 3 Concrete restoration.
- Appropriate to the future requirements and the relevant principles, i.e. Method 3.1 Applying repair mortar by hand or 3.2 Recasting the concrete.

Definition and specification of the properties of suitable products and systems

Following selection of the Repair and Protection Principles and Methods, the required performance characteristics of suitable products are defined, in accordance with Parts 2 to 7 of EN 1504 and with Part 10 Site application of products and systems, plus quality control of the work.

It is important that all of this evaluation and specification work considers not only the products' long-term performance on the structure, but also that the proposed repair materials will have no adverse physical or chemical reactions with each other, or the structure.

The work should be carried out with products and systems that comply with the relevant Part of EN 1504, i.e. Table 3 of EN 1504-3, item 7: Thermal compatibility, Part 1 Freezethaw, etc.

The application conditions and limitations for each type of material are also to be specified as outlined in Part 10 of EN 1504. In some instances, innovative systems or technologies outside of those currently included in EN 1504 may be required to solve specific problems and requirements, to resolve conflicts with environmental restrictions, or to meet local fire regulations for example.

5 Future Maintenance

Any future inspection and maintenance work that will need to be undertaken during the defined service life of the structure should also be defined.

Complete records of all the materials used in the works undertaken should be provided for future reference at the end of each project, including:
- What is the anticipated life expectancy, and then what is the mode and result of the selected materials' eventual deterioration, i.e. chalking, embrittlement, discolouration or delamination?
- What is the structural integrity inspection period?
- What future surface preparation and access systems will be required to carry out the necessary works and when?
- Is corrosion monitoring required?
- Who is responsible for arranging and financing the maintenance work and when?

The Root Cause(s) of Deterioration

Assessment from the Condition Survey and the Results of Laboratory Diagnosis

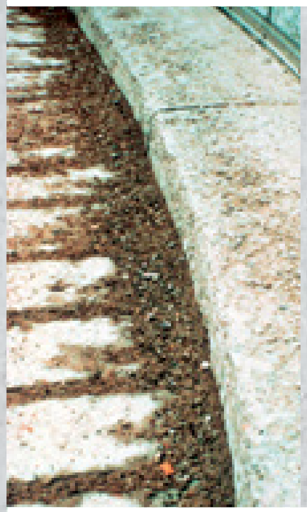
Concrete Defects and Deterioration

Mechanical attack

Cause	Relevant principles for repair and protection
Abrasion	Principles 3,5
Fatigue	Principle 4
Impact	Principles 3,4,5
Overload	Principles 3,4
Movement (settlement)	Principles 3,4
Explosion Vibration	Principles 3,4

Chemical attack

Cause	Relevant principles for repair and protection
AAR Alkali aggregate reactions	Principles 1,2,3
Aggressive agents	Principles 1,2,3,6
Biological action	Principles 1,2,3,6



Physical attack

Cause	Relevant principles for repair and protection
Freeze/thaw	Principles 1,2,3,5
Thermal effects	Principles 1,4
Salt crystallisation	Principles 1,2,3
Shrinkage	Principles 1,4
Erosion	Principles 3,5
Abrasion/wear	Principles 3,5

Reinforcement Corrosion

Cause	Relevant principles for repair and protection
Carbon dioxide (CO_2) in the atmosphere reacting with calcium hydroxide in the concrete pore liquid. $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$ Soluble and strongly alkaline pH 12–13 → almost insoluble and much less alkaline pH 9 Steel protected (passivation) → steel unprotected	Principles 1,2,3,7,8,11

Corrosive contaminants

Cause	Relevant principles for repair and protection
Chlorides accelerate the corrosion process and can also cause dangerous “pitting” corrosion At above 0.2 – 0.4% concentration in the concrete chlorides can break down the passive oxide protective layer on the steel surface Chlorides are typically from marine/salt water exposure and/or the use of de-icing salts	Principles 1,2,3,7,8,9,11

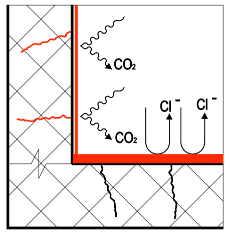
Stray currents

Cause	Relevant principles for repair and protection
Metals of different electropotential are connected to each other in the concrete and corrosion occurs Corrosion can also be due to stray electrical currents from power supply and transmission networks	No specific Repair Principles defined at this time. For repair of the concrete use Principles 2,3,10

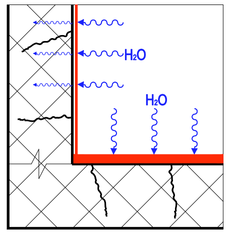
An Overview of the Principles of Concrete Repair and Protection according to EN 1504-9

The repair and protection of concrete structures requires relatively complex assessment and design. By introducing and defining the key principles of repair and protection, EN 1504-9 helps owners and construction professionals to fully understand the problems and solutions throughout the different stages of the repair and protection process.

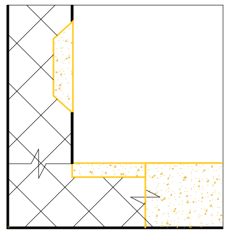
The Principles Relating to Defects in Concrete



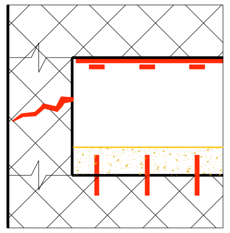
Principle 1 (PI)
Protection against ingress



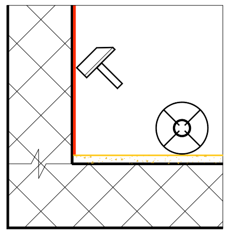
Principle 2 (MC)
Moisture control



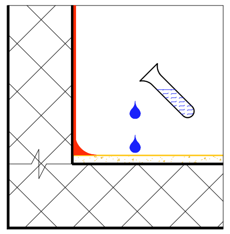
Principle 3 (CR)
Concrete restoration



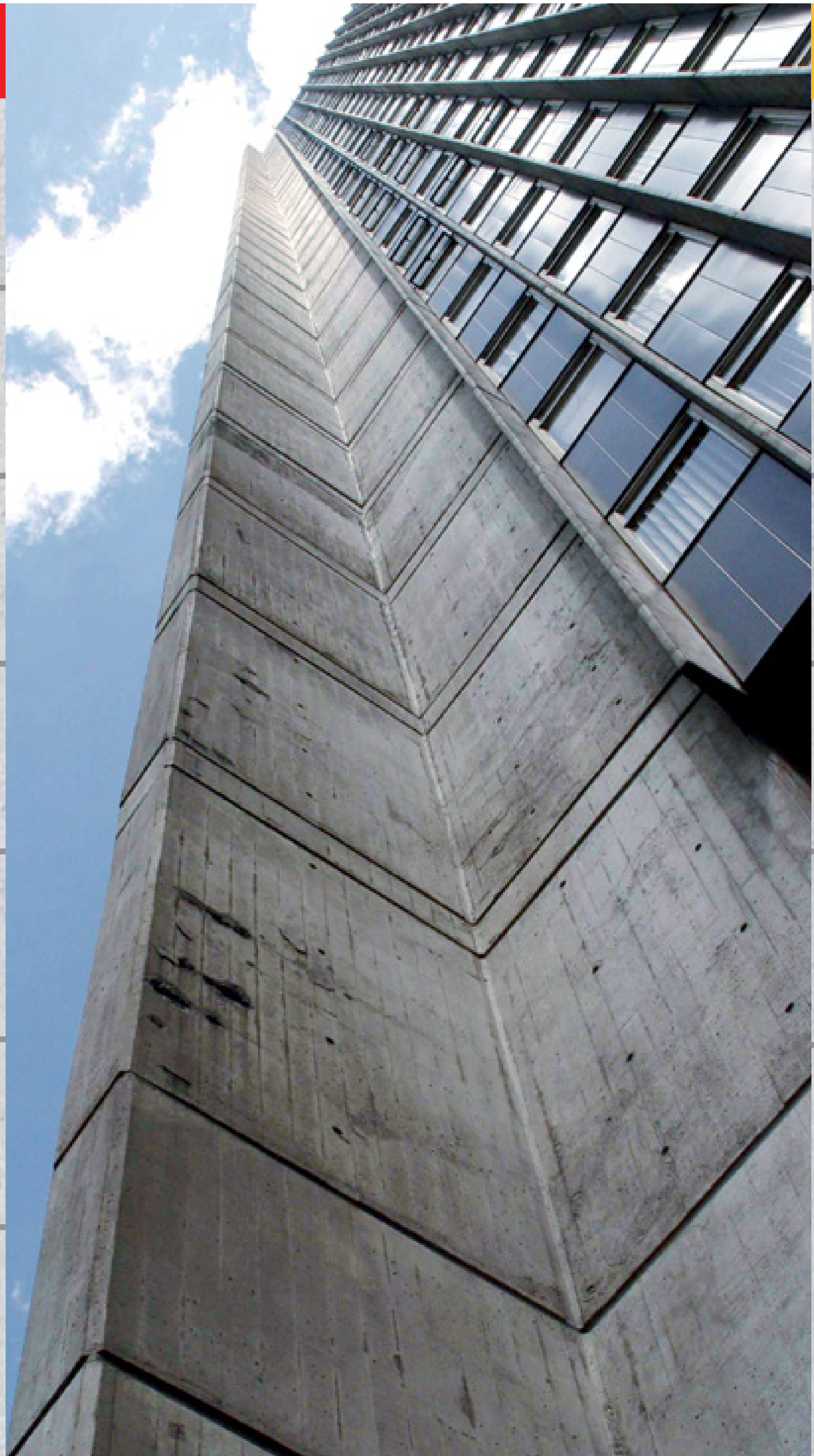
Principle 4 (SS)
Structural strengthening



Principle 5 (PR)
Increasing physical resistance

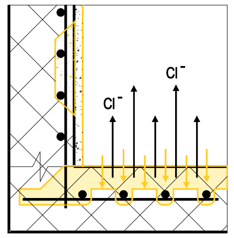


Principle 6 (RC)
Resistance to chemicals

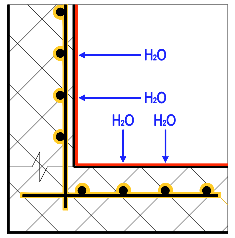


The Principles Relating to Steel Reinforcement Corrosion

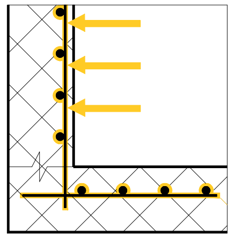
Principle 7 (RP)
Preserving or restoring passivity



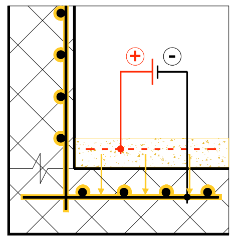
Principle 8 (IR)
Increasing resistivity



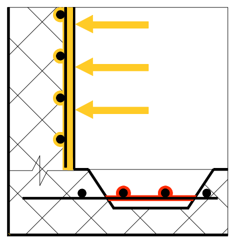
Principle 9 (CC)
Cathodic control



Principle 10 (CP)
Cathodic protection



Principle 11 (CA)
Control of anodic areas



The Principles of Concrete Repair and Protection

Know-How from Sika

Why Principles?

For many years the different types of damage and the root causes of this damage have been well known and equally the correct repair and protection methods have also been established. All of this knowledge and expertise is now summarized and clearly set out as 11 Principles in EN 1504, Part 9. These allow the engineer to correctly repair and protect all of the potential damage that can occur in reinforced concrete structures. Principles 1 to 6 relate to defects in the concrete itself, Principles 7 to 11 relate to damage due to reinforcement corrosion.

The European Union fully introduced all of the European Standards 1504 on 1st January 2009. These Standards define the assessment and diagnostic work required, the necessary products and systems including their performance, the alternative procedures and application methods, together with the quality control of the materials and the works on site.

The Use of the EN 1504 Principles

To assist owners, engineers and contractors with the correct selection of repair Principles, Methods and then the appropriate products, together with their specifica-tion and use, Sika has developed a useful schematic system of approach. This is designed to meet the individual requirements of a structure, its exposure and use and is illustrated on pages 42 to 45 of this brochure.

The Sika Solutions in Accordance with EN 1504

Sika is a global market and technology leader in the development and production of specialist products and systems for construction and industry. Repair and Protection of concrete structures is one of Sika's core competencies. The complete Sika product range includes concrete admixtures, resin flooring and coating systems, all types of waterproofing solutions, sealing, bonding and strengthening systems as well as other materials developed specifically for use in the repair and protection of reinforced concrete structures. These have numerous national and international approvals and Sika products are available worldwide through the local Sika companies and our specialist contracting and distribution partners.

For the past 100 years, Sika has gained extensive experience and expertise in concrete repair and protection with documented references dating back to the 1920's.
Sika provides ALL of the necessary products for the technically correct repair and protection of concrete, ALL fully in accordance with the Principles and Methods defined in European Standards EN 1504. These include systems to repair damage and defects in the concrete and also to repair damage caused by steel reinforcement corrosion.
Sika products and systems are available for use on specific types of structures and general concrete repairs in all different climatic and exposure conditions.

An Overview of the Principles and Methods of Repair and Protection from EN 1504-9

Tables 1 and 2 include all of the repair Principles and Methods in accordance with Part 9 of EN 1504. Following assessment from the condition survey and diagnosis of the root causes of damage, together with the owners repair objectives and requirements, the appropriate EN1504 repair Principles and Methods can be selected.

Products conforming to CE marking will have CE identification on product data sheet and packaging. These are supported with EC certification and Factory Control and Declaration of Conformity.

Table 1: Principles and Methods Related to Defects in Concrete

Principle	Description	Method	Sika Solution
Principle 1 (PI)	**Protection against ingress.** Reducing or preventing the ingress of adverse agents, e.g. water, other liquids, vapour, gas, chemicals and biological agents.	1.1 Hydrophobic Impregnation	**Sikagard**® range of hydrophobic impregnation
		1.2 Impregnation	**Sikafloor® CureHard-24**
		1.3 Coating	**Sikagard**® range of elastic and rigid coatings **Sikafloor**® range for flooring applications
		1.4 Surface bandaging of cracks	**Sikadur® Combiflex® SG System**
		1.5 Filling of cracks	**Sika® Injection** systems, **Sikadur**® range
		1.6 Transferring cracks into joints	**Sikaflex**® range, **Sikadur®-Combiflex® SG System**
		1.7 Erecting external panels	**SikaTack®-Panel System**
		1.8 Applying membranes	**Sikaplan**® sheet membranes, **Sikalastic**® liquid applied membranes and **Sikafloor**® car park decks
Principle 2 (MC)	**Moisture control.** Adjusting and maintaining the moisture content in the concrete within a specified range of values.	2.1 Hydrophobic impregnation	**Sikagard**® range of hydrophobic impregnation
		2.2 Impregnation	**Sikafloor® CureHard-24**
		2.3 Coating	**Sikagard**®-range of elastic and rigid coatings **Sikafloor**® range for flooring applications
		2.4 Erecting external panels	**SikaTack®-Panel System**
		2.5 Electrochemical treatment	A process
Principle 3 (CR)	**Concrete restoration.** Restoring the original concrete to the originally specified profile and function.	3.1 Hand applied mortar	**Sika® MonoTop**® and **SikaTop**® ranges
		3.2 Recasting with concrete or mortar	**Sika® MonoTop®, Sikacrete® SCC** (self-compacting concrete)
		3.3 Spraying concrete or mortar	**SikaCem® -Gunite**® range and **Sika® MonoTop**® systems
	Restoring the concrete structure by replacing part of it.	3.4 Replacing elements	**Sika**® bonding primers and **Sika**® concrete technology
Principle 4 (SS)	**Structural strengthening.** Increasing or restoring the structural load bearing capacity of an element of the concrete structure.	4.1 Adding or replacing embedded or external reinforcing bars	**Sikadur**® range
		4.2 Adding reinforcement anchored in pre-formed or drilled holes	**Sika® AnchorFix**® and **Sikadur**® range
		4.3 Bonding plate reinforcement	**Sikadur**® adhesive systems combine with **Sika® CarboDur**® and **SikaWrap**®
		4.4 Adding mortar or concrete	**Sika**® bonding primers, repair mortars and concrete technology
		4.5 Injecting cracks, voids or interstices	**Sika® Injection** systems
		4.6 Filling cracks, voids or interstices	**Sika® Injection** systems
		4.7 Prestressing (post-tensioning)	**Sika® CarboStress**® systems
Principle 5 (PR)	**Physical resistance.** Increasing resistance to physical or mechanical attack.	5.1 Coating	**Sikagard**® reactive coating range, **Sikafloor**® systems
		5.2 Impregnation	**Sikafloor® CureHard-24**
		5.3 Adding mortar or concrete	As for Methods 3.1, 3.2 and 3.3
Principle 6 (RC)	**Resistance to chemicals.** Increasing resistance of the concrete surface to deteriorations from chemical attack.	6.1 Coating	**Sikagard**® and **Sikafloor**® reactive coating range
		6.2 Impregnation	**Sikafloor® CureHard-24**
		6.3 Adding mortar or concrete	As for Methods 3.1, 3.2 and 3.3

Table 2: Principles and Methods Related to Reinforcement Corrosion

Principle	Description	Method	Sika Solution
Principle 7 (RP)	**Preserving or restoring passivity.** Creating chemical conditions in which the surface of the reinforcement is maintained in or is returned to a passive condition.	7.1 Increasing cover with additional mortar or concrete	**Sika® MonoTop®, SikaTop®, SikaCem**® ranges, plus **Sika® EpoCem**®
		7.2 Replacing contaminated or carbonated concrete	As for Methods 3.2, 3.3, 3.4
		7.3 Electrochemical realkalisation of carbonated concrete	**Sikagard**® range for post-treatment
		7.4 Realkalisation of carbonated concrete by diffusion	**Sikagard**® range for post-treatment
		7.5 Electrochemical chloride extraction	**Sikagard**® range for post-treatment
Principle 8 (IR)	**Increasing resistivity.** Increasing the electrical resistivity of the concrete.	8.1 Hydrophobic impregnation	**Sikagard**® range of hydrophobic impregnation
		8.2 Impregnation	**Sikafloor® CureHard-24**
		8.3 Coating	As for Method 1.3
Principle 9 (CC)	**Cathodic control.** Creating conditions in which potentially cathodic areas of reinforcement are unable to drive an anodic reaction.	9.1 Limiting oxygen content (at the cathode) by saturation or surface coating	**Sika® FerroGard**® admixture and surface applied corrosion inhibitors **Sikagard**® and **Sikafloor**® reactive coating range
Principle 10 (CP)	**Cathodic protection.**	10.1 Applying an electrical potential	**Sika**® overlay mortars **Sika® Galvashield**® range
Principle 11 (CA)	**Control of anodic areas.** Creating conditions in which potentially anodic areas of reinforcement are unable to take part in the corrosion reaction.	11.1 Active coating of the reinforcement	**SikaTop® Armatec®-110 EpoCem®, Sika® MonoTop®-610**
		11.2 Barrier coating of the reinforcement	**Sikadur®-32**
		11.3 Applying corrosion inhibitors in or to the concrete	**Sika® FerroGard**® admixture and surface applied corrosion inhibitors

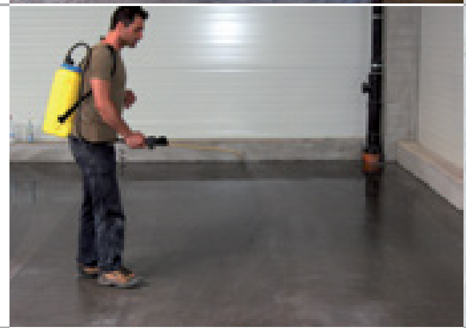
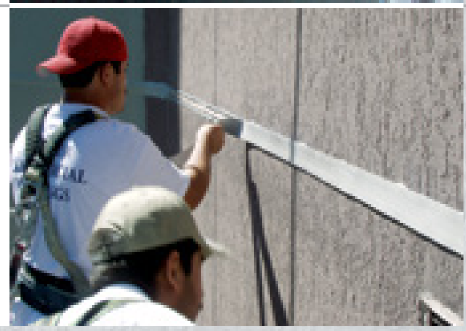
EN 1504-9 Principle 1: Protection against Ingress (PI)

Protecting the Concrete Surface against Liquid and Gaseous Ingress

A large amount of concrete damage is the result of the penetration of deleterious materials into the concrete, including both liquid and gaseous materials. The Principle 1 (PI) deals with preventing this ingress and includes Methods to reduce the concrete permeability and porosity of the concrete surfaces to these different materials.

The selection of the most appropriate method is dependent on different parameters, including the type of deleterious material, the quality of the existing concrete and its surface, the objectives of the repair or protection works and the maintenance strategy.

Sika produces a full range of impreg-nations, hydrophobic impregnations and specialized coatings for use in protecting concrete according to the Principles and Methods of EN 1504.

Methods	Pictures	Description	Main Criteria	Sika® Products (example
Method 1.1 Hydrophobic Impregnation		A hydrophobic impregnation is defined as the treatment of concrete to produce a water-repellent surface. The pores and capillary network are not filled, but only lined with the hydrophobic material. This functions by reducing the surface tension of liquid water, preventing its passage through the pores, but still allowing each way water vapour diffusion, which is in accordance with standard good practice in building physics.	Penetration: Class I: <10 mm Class II: ≥10 mm Capillary absorption: w <0.1 kg/m² × √h Drying rate coefficient	**Sikagard®-700 range** ■ Based on silane or siloxane hydrophobic impregnations ■ penetrate deeply and provide a liquid water repellent surface **Sikagard®-700 S** (Class I)
Method 1.2 Impregnation		An impregnation is defined as the treatment of concrete to reduce the surface porosity and to strengthen the surface. The pores and capillaries are then partly or totally filled. This type of treatment usually also results in a discontinuous thin film of 10 to 100 microns thickness on the surface. This serves to block the pore system to aggressive agents.	Penetration depth: ≥5 mm Capillary absorption: w <0.1 kg/m² × √h	**Sikafloor® CureHard-24** ■ Sodium silicate based ■ Colourless and odourless ■ Good penetration
Method 1.3 Coating		Surface coatings are defined as materials designed to provide an improved concrete surface, for increased resistance or performance against specific external influences. Fine surface cracks with a total movement of up to 0.3 mm can be safely repaired, then sealed and their movement accommodated by the use of elastic, crack bridging coatings, which are also waterproof and carbonation resistant. This will accommodate thermal and dynamic movement in structures subject to wide temperature fluctuation, vibration, or that have been constructed with inadequate or insufficient jointing details.	Carbonation resistance: S_d >50 m Capillary absorption: w <0.1 kg/m² × √h Water vapour ability: Class I: S_d <5 m Adhesion strength: Elastic: ≥0.8 N/mm² or ≥1.5 N/mm² (trafficking) Rigid: ≥1.0 N/mm² or ≥2.0 N/mm² (trafficking)	Rigid systems: **Sikagard®-680 S** ■ Acrylic resin, solvent based ■ Waterproof Elastic systems: **Sikagard®-550 W Elastic** ■ Acrylic resin, water based ■ Waterproofing and crack-bridging **Sikagard® ElastoColor-675 W** ■ Acrylic resin, water based ■ Waterproof **FLOOR SYSTEMS:** **Sikafloor® Range Resins** ■ Epoxy ■ Polyurethane ■ PMMA
Method 1.4 Surface banding of cracks		Locally applying a suitable material to prevent the ingress of aggressive media into the concrete.	No specific criteria	**Sikadur®-Combiflex® SG System** ■ Extremely flexible ■ Weather and water resistant ■ Excellent adhesion

*** This table is continued on pages 16 and 17**

EN 1504-9 Principle 1: Protection against Ingress (PI)
Protecting the Concrete Surface against Liquid and Gaseous Ingress (continued)

All concrete protection works must take account of the position and size of any cracks and joints in the concrete. This means investigating their nature and cause, understanding the extent of any movement in the substrate and its effect on the stability, durability and function of the structure, as well as evaluating the risk of creating new cracks as a result of any remedial joint or crack treatment and repair.

If the crack has implications for the integrity and safety of a structure, refer to Principle 4 Structural strengthening, Methods 4.5 and 4.6 on Page 24/25. This decision must always be taken by the structural engineer. Any selected surface treatments can then be applied successfully.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 1.5 Filling of Cracks		Cracks to be treated to prevent the passage of aggressive agents should be filled and sealed. Non-moving cracks – These are cracks that have been formed by initial shrinkage for example, they need only to be fully exposed and repaired / filled with a suitable repair material.	Classification of injection material: F: transmitting force D: ductile S: swelling	Structural Cracks and Void Repairs: Class F: **Sikadur® -52 Injection** **Sika® InjectoCem®-190** Waterproof Sealing of Joints/Cracks/Voids: Class D: **Sika® Injection-201/-203** Class S: **Sika® Injection-29/-304/-305**
Method 1.6 Transferring cracks into joints		Cracks to be treated to accommodate movement should be repaired so that a joint is formed to extend through the full depth of the repair and positioned to accommodate that movement. The cracks (joints) must then be filled, sealed or covered with a suitably elastic or flexible material. The decision to transfer a crack to the function of a movement joint must be made by a structural engineer.	No specific criteria	**Sikaflex® PU** range ■ One-component polyurethanes ■ iCure ■ High movement capability ■ Excellent durability **Sikadur®-Combiflex® SG System** ■ Extremely flexible ■ Weather and water resistant ■ Excellent adhesion
Method 1.7 Erection of external panels		Protecting the concrete surface with external Panels. A curtain wall or similar external façade cladding system, protects the concrete surface from external weathering and aggressive materials attack or ingress.	No specific criteria	**SikaTack®-Panel System** ■ for the secret fixing of rain-screen panel systems ■ One-component polyurethane
Method 1.8 Applying membranes		Applying a preformed sheet or liquid applied membrane over the concrete surface will fully protect the surface against the attack or ingress of deleterious materials.	No specific criteria	**Sikafloor®** liquid deck membrane for car parks. **Sikafloor®-375 System** or **Sikafloor®-350N System** or **Sikafloor®-15 Pronto System** ■ Waterproof ■ Crack bridging **Sikafloor®-264 System** or **Sikafloor®-14 Pronto System** ■ Waterproof ■ Rigid protection **Sikalastic®** liquid membrane ■ Waterproofing ■ Particularly useful for complex details

EN 1504-9 Principle 2: Moisture Control (MC)
Adjusting and Maintaining the Moisture Content in the Concrete

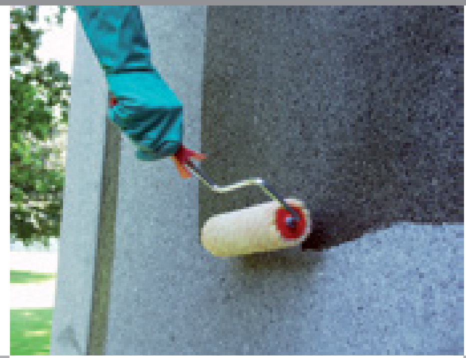
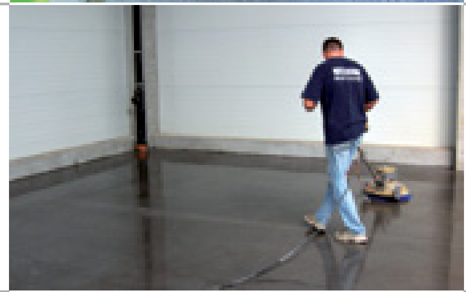
In some situations, such as where there is a risk of further alkali aggregate reaction, the concrete structure has to be protected against water penetration.

This can be achieved by the use of different types of products including hydrophobic impregnations, surface coatings and electrochemical treatments.

For many years, Sika has been one of the pioneers in concrete protection through the use of deeply penetrating silane and siloxane hydrophobic impregnations, plus durable acrylic and other resin based protective coatings.

Several of these are also tested and approved for use in conjunction with the latest electrochemical treatment techniques.

All of these Sika systems for the Method "Moisture Control" are fully in accordance with the requirements of EN 1504.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 2.1 Hydrophobic Impregnation		A hydrophobic impregnation is defined as the treatment of concrete to produce a water-repellent surface. The pores and capillary network are not filled, but only lined with the hydrophobic material. This function by reducing the surface tension of liquid water, is preventing its passage through the pores, but still allowing each way water vapour diffusion, which is in accordance with standard good practice in building physics.	Penetration: Class I: <10 mm Class II: ≥10 mm Capillary absorption: w <0.1 kg/m² × √h Drying rate coefficient	**Sikagard®-700 range** ■ Based on silane or siloxane hydrophobic impregnations ■ Preventing penetrate deeply and provide a liquid water repellent surface **Sikagard®-700 S** (Class I)
Method 2.2 Impregnation		An impregnation is defined as the treatment of concrete to reduce the surface porosity and to strengthen the surface. The pores and capillaries are then partly or totally filled. This type of treatment usually also results in a discontinuous thin film of 10 to 100 microns thickness on the surface. This serves to block the pore system to aggressive agents.	Penetration depth: ≥5 mm Capillary absorption: w <0.1 kg/m² × √h	**Sikafloor®-CureHard-24** ■ Sodium silicate based ■ Colourless and odourless ■ Good penetration
Method 2.3 Coating		Surface coatings are defined as materials designed to provide an improved concrete surface, for increased resistance or performance against specific external influences. Fine surface cracks with a total movement of up to 0.3 mm can be safely repaired, then sealed and their movement accommodated by crack bridging coatings which are also for waterproof and carbonation resistant. This will accommodate thermal and dynamic movement in structures subject to wide temperature fluctuation, vibration, or that have been constructed with inadequate or insufficient jointing details.	Capillary absorption: w <0.1 kg/m² × √h Water vapour ability: Class I: S_d <5 m Adhesion strength: Elastic: ≥0.8 N/mm² or ≥1.5 N/mm² (trafficking) Rigid: ≥1.0 N/mm² or ≥2.0 N/mm² (trafficking)	Rigid systems: **Sikagard®-680 S** ■ Acrylic resin, solvent based ■ Waterproof Elastic systems: **Sikagard®-550 W Elastic** ■ Acrylic resin, water based ■ Waterproofing and crack-bridging **Sikagard®-545 W Elastofill** ■ One component acrylic resin ■ Elastic **Sikagard® ElastoColor-675 W** ■ Acrylic resin, water based ■ Waterproof
Method 2.4 Erecting external panels		As long as the concrete surface is not exposed, no water can penetrate and the reinforcement can not corrode.	No specific criteria	**SikaTack®-Panel System** ■ For the discrete or 'secret fixing' of curtain wall façade systems ■ One-component polyurethane
Method 2.5 Electrochemical treatment		By applying an electric potential in the structure, moisture can be moved towards the negatively by charged cathode area.	No specific criteria	This is a process

EN 1504-9 Principle 3: Concrete Restoration (CR)
Replacing and Restoring Damaged Concrete

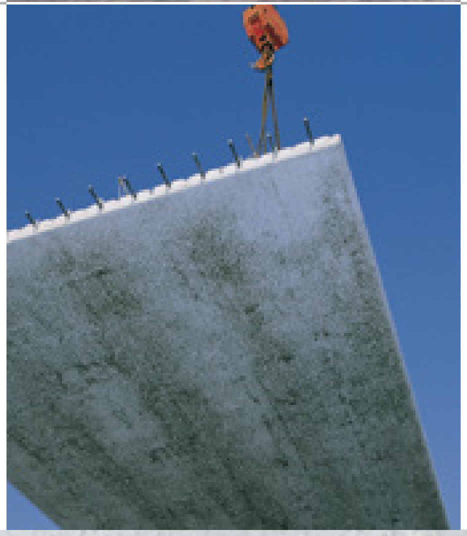
The selection of the appropriate method of replacing and restoring concrete depends on a number of parameters including:

- **The extent of damage (e.g. Method 3.1 Hand applied mortar, is more economic for limited damage)**
- **Congestion of rebar (e.g. Method 3.2 Recasting with concrete or mortar is usually to be preferred in the presence of heavily congested bars).**
- **Site access (e.g. Method 3.3 Spraying concrete or mortar by the “dry” spray process will be more suitable for long distances between the repair area and the point of preparation).**
- **Quality control issues (e.g. Method 3.3 Sprayed concrete or mortar by- the “wet” spray process, results in easier quality control of the mix).**
- **Health issues (e.g. Method 3.3 Sprayed concrete or mortar: wet spray application is to be preferred with reduced dust).**

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 3.1 Hand-applied mortar		Traditionally the localised repair of concrete damage and defects has been undertaken using hand-placed repair mortars. Sika provides an extensive range of pre-batched, hand-applied repair mortars for general repair purposes and also for very specific repair purposes. These include lightweight mortars for overhead application and chemically resistant materials to protect against aggressive gases and chemicals.	Structural repair: Class R4 Class R3 Non structural repair: Class R2 Class R1	Class R4: **Sika® MonoTop®-612, Sika® Rapid Repair Mortar** ■ High performance repair mortar ■ Extremely low shrinkage behavior Class R3: **Sika® MonoTop®-615** ■ Extremely low shrinkage behavior ■ Lightweight repair mortar
Method 3.2 Recasting with concrete or mortar		Typical recasting repairs, which are also frequently described as pourable or grouting repairs, are employed when whole sections or larger areas of concrete replacement are required. These include the replacement of all, or substantial sections of, concrete bridge parapets and balcony walls etc. This method is also very useful for complex structural supporting sections, such as cross head beams, piers and column sections, which often present problems with restricted access and congested reinforcement. The most important criteria for the successful application of this type of product is its flowability and the ability to move around obstructions and heavy reinforcements. Additionally they often have to be poured in relatively thick sections without thermal shrinkage cracking. This is to ensure that they can fill the desired volume and areas completely, despite the restricted access and application points. Finally they must also harden to provide a suitably finished surface, which is tightly closed and not cracked.	Structural repair: Class R4 Class R3	Class R4: **Sika® Armorex Armorcrete** ■ One component ■ Pourable ■ Rapid hardening **SikaGrout®-212** and **Sika L2 High Flow** ■ High final strengths ■ Expands during the plastic state of curing ■ Excellent flow characteristics Class R3: **Sikacrete® SCC** range ■ Self-Compacting Concretes

* This table is continued on pages 22 and 23.

EN 1504-9 Principle 3: Concrete Restoration (CR)
Replacing and Restoring Damaged Concrete (continued)

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 3.3 Spraying concrete or mortar		Spray applied materials have also been used traditionally for concrete repair works. They are particularly useful for large volume concrete replacement, for providing additional concrete cover, or in areas with difficult access for concrete pouring or the hand placement of repairs. Today in addition to traditional dry spray machines, there are also "wet spray" machines. These have a lower volume outputs, but also much lower rebound and produce less dust than the dry spray machines. Therefore they can also be used economically for smaller or more sensitive repair areas, where there is restricted access, or in confined environments. The most important application criteria for sprayed repair materials are minimal rebound plus high-build properties to achieve their required non-sag layer thickness. Application under dynamic load and minimal or easy finishing and curing, is also important due to their areas of use and therefore difficulties in access.	Structural repair: Class R4 Class R3	Class R4: **SikaCem®-133 Gunite** ■ High performance repair mortar ■ Very dense, high carbonation resistance ■ "Dry" spray mortar **Sika® MonoTop®-612** ■ High performance repair mortar ■ Extremely low shrinkage behaviour ■ Applied by hand or "wet" spray process **Sika®-Armorex® Armorcrete** ■ Micro-concrete repair system ■ Extremely low shrinkage behaviour ■ Applied by hand or machine
Method 3.4 Replacing concrete elements		In some situations it can be more economical to replace either the full structure or part of it rather than to carry out extensive repair works. In this case, care needs to be taken to provide appropriate structural support and load distribution by using suitable bonding systems or agents to ensure this is maintained.	No specific criteria	System consisting of Sika® bonding primer and Sika® concrete technology Sika® bonding primer: **SikaTop® Armatec®-110** ■ Epoxy modified high performance ■ Long open time **Sikadur®-32** ■ Two part epoxy based ■ High strength behavior Sika® concrete technology: **Sika® ViscoCrete®** range **Sikament®** range

EN 1504-9 Principle 4: Structural Strengthening (SS)
Increasing or Restoring the Structural Load Capacity

Whenever there is a need for structural strengthening due to a change of the structures designation, or to an increase in the structural load bearing capacity, for example, the appropriate analysis must be performed by a qualified structural engineer. Various methods are available to achieve the necessary strengthening and these include: adding external support or embedded reinforcing, by bonding external plates, or by increasing the dimensions of the structures.

The selection of the appropriate method is dependant on the different project parameters such as the cost, site environment and conditions, plus access and maintenance possibilities etc.

Sika has pioneered the development of many new materials and techniques in the field of structural strengthening. Since the early 1960's this has included the development of steel plate bonding and epoxy structural adhesives. In the 1990's Sika began working on the adaptation of these techniques using modern composite materials, particularly pultruded carbon fibre plates (Sika® CarboDur®).

Since then, Sika has further developed this technology by using multidirectional fabrics (SikaWrap®) based on several different polymer types (carbon, glass, aramid, etc.).

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 4.1 Adding or replacing embedded or external reinforcing bars		The selection of the appropriate size and configuration of such reinforcement, plus the locations where it is to be fixed, must always be determined by the structural engineer.	Shear strength: ≥12 N/mm²	For embedded bars: **Sikadur®-30** ■ Structural adhesive ■ High mechanical strength ■ Excellent bonding behavior
Method 4.2 Adding reinforcement anchored in pre-formed or drilled holes		The points for anchorages into the concrete should be designed, produced and installed in accordance with EN 1504 Part 6 and the relevant European Technical Approval Guideline (ETAG-001). The surface cleanliness of the grooves or anchor holes cut in the concrete should be prepared to be in accordance with EN 1504 Part 10 Sections 7.2.2 and 7.2.3.	Pull-out: Displacement ≤0.6 mm at load of 75 kN Creep under tensile load: Displacement ≤0.6 mm after continuous loading of 50 kN after 3 month Chloride ion content: ≤0.05%	**Sika®AnchorFix®-1** ■ Fast setting methacrylate based anchoring adhesive ■ Can be used at low temperatures (-10 °C) **Sikadur®-33+** ■ High performance epoxy adhesive ■ Shrinkage-free hardening
Method 4.3 Bonding plate reinforcement		Structural strengthening by the bonding of external plates is carried out in accordance with the relevant national design codes and EN 1504-4. The exposed surfaces of the concrete that are to receive the externally bonded reinforcement should be thoroughly cleaned and prepared. Any weak, damaged or deteriorated concrete must be removed and repaired, to comply with EN 1504 Part 10 Section 7.2.4 and Section 8 this must be completed prior to the overall surface preparation and plate-bonding application work being undertaken.	Shear strength: ≥12 N/mm² E-Modulus in compression: ≥2000 N/mm² Coefficient of thermal expansion: $\leq 100 \times 10^{-6}$ per K	**Sikadur®-30** ■ Epoxy based adhesive for use with the carbon fibre reinforced laminate **Sika® CarboDur®** system and as well with the traditional steel plate reinforcement. **Sikadur®-330** ■ Epoxy based adhesive used with **SikaWrap®** systems.
Method 4.4 Adding mortar or concrete		The methods and systems are well documented in Principle 3 Concrete restoration. To ensure the necessary performance, these products also have to fulfill the requirements of the EN 1504-3, class 3 or 4.	Mortar/Concrete: Class R4 Class R3 Adhesives: Shear strength ≥6 N/mm²	System consisting of Sika® bonding primer and Sika® concrete technology Repair materials: **Sika® MonoTop®-612/-615** **Sikacrete®-08 SCC** **SikaCem®-133 Gunite** Bonding primers: **Sikadur®-32** **SikaTop® Armatec®-110 EpoCem®**

*** This table is continued on pages 26 and 27.**

EN 1504-9 Principle 4: Structural Strengthening (SS)
Increasing or Restoring the Structural Load Capacity (continued)

Injecting and sealing cracks generally does not structurally strengthen a structure. However, for remedial work or when temporary overloading has occurred, the injection of low viscous epoxy resin based materials can restore the concrete to its original structural condition. The introduction of prestressed composite reinforcement for strengthening has now brought this technology to another level. This uses high strength, lightweight carbon fibre reinforced plates, plus the curing time is reduced and the application conditions are extended through innovative electrical heating of the adhesive.

These innovations serve to further demonstrate that Sika is the clear global leader in this field.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 4.5 Injecting cracks, voids or interstices		The cracks should be cleaned and prepared in accordance with the guidelines of EN 1504 Part 10 Section 7.2.2. Then the most suitable Sika system of resealing and bonding can be selected, to fully reinstate the structural integrity of the concrete.	Classification of injection material: F: transmitting force / load transfer	**Sikadur®-52** and **Sikadur®-32** Injection ■ Two-component epoxy resin ■ Low viscosity **Sika® InjectoCem®-190** ■ Two part micro cement injection ■ Corrosion protection of embedded reinforcement
Method 4.6 Filling cracks, voids or interstices		When inert cracks, voids or interstices are wide enough, they can filled by gravity or by using epoxy patching mortar.	Classification of injection material: F: transmitting force / load transfer	**Sikadur®-52** Injection ■ Two-component epoxy resin ■ Low viscosity **Sika® InjectoCem®-190** ■ Two part micro-cement injection ■ Corrosion protection of embedded reinforcement **Sikadur®-31** ■ Two part epoxy adhesive ■ High strengths ■ Thixotropic: non sag-flow in vertical or overhead applications
Method 4.7 Prestressing – (post tensioning)		Pre-stressing: with this method the system involves applying forces to a structure to deform it in such a way that it will withstand its working loads more effectively, or with less total deflection. (Note: post-tensioning is a method of pre-stressing a poured in place concrete structure after the concrete has hardened.)	No specific criteria	Carbon fiber prestressing systems: **Sika® CarboStress®** system

EN 1504-9 Principle 5: Physical Resistance (PR)
Increasing the Concrete's Resistance to Physical and / or Mechanical Attack

Concrete structures are damaged by different types of physical or mechanical attack:

- **Increased mechanical load**
- **Wear and tear from abrasion, such as on a floor (e.g. in a warehouse)**
- **Hydraulic abrasion from water and water borne solids (e.g. on a dam or in drainage / sewage channels)**
- **Surface breakdown from the effects of freeze – thaw cycles (e.g. on a bridge)**

Sika provides all of the right products to repair all of these different types of mechanical and physical damage on all different types of concrete structure and in all different climatic and environ-mental conditions.

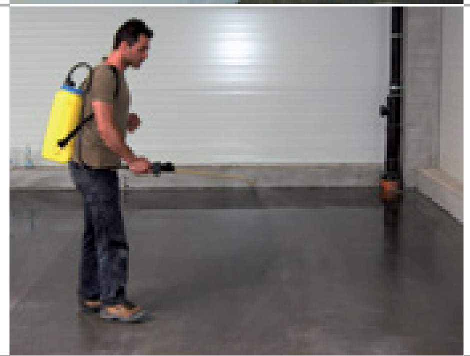
Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 5.1 Coating		Only reactive coatings are able to provide sufficient additional protection to the concrete to improve its resistance against physical or mechanical attack.	Abrasion (Taber-Test): mass-lost <3000 mg Capillary absorption: w <0.1 kg/m² × √h Impact resistance: Class I to Class III Adhesion strength: Elastic: ≥0.8 N/mm² or ≥1.5 N/mm² (trafficking) Rigid: ≥1.0 N/mm² or ≥2.0 N/mm² (trafficking)	Class II: **Sikafloor®-263 SL** ■ Good chemical and mechanical resistance ■ Excellent abrasion resistance ■ Solvent free Class I: **Sikafloor®-2530 W** ■ Two part, water dispersed epoxy resin ■ Good mechanical and chemical resistance **Sikafloor®-390** ■ High chemical resistance ■ Moderate crack-bridging behaviour
Method 5.2 Impregnation		An impregnation is defined as the treatment of concrete to reduce the surface porosity and to strengthen the surface. The pores and capillaries are partly or totally filled. This type of treatment also usually results in a discontinuous thin film of 10 to 100 microns thickness on the surface. Certain impregnations can react with some of the concrete constituents to result in higher resistance to abrasion and mechanical attack.	Abrasion (Taber-Test): 30% improvement in comparison to none impregnated sample Penetration depth: >5 mm Capillary absorption: w <0.1 kg/m² × √h Impact resistance: Class I to Class III	Class I: **Sikafloor® CureHard-24** ■ Sodium silicate based ■ Colourless and odourless ■ Good penetration
Method 5.3 Adding mortar or concrete		The Methods to be used and suitable systems for this are defined in Principle 3 Concrete restoration and the products have to fulfill the requirements of EN 1504-3, Class R4 or R3. In some specific instances products may also need to fulfill additional requirements such as resistance to hydraulic abrasion. The engineer must therefore determine these additional requirements on each specific structure.	Mortar/Concrete: Class R4 Class R3	Class R4: **Sika® MonoTop®-612** ■ Very low shrinkage ■ One component repair mortar **Sikafloor®-81/-82 EpoCem** ■ Epoxy modified cement mortar ■ High frost and deicing salt resistance Class R3: **Sikacrete® SSC** range ■ Self compacting concrete **Sika® MonoTop®-615** ■ Very low shrinkage ■ One component repair mortar

EN 1504-9 Principle 6: Chemical Resistance (RC)
Increasing the Concrete's Resistance to Chemical Attack

The chemical resistance requirements of a concrete structure and its surfaces are dependent on many parameters including the type and concentration of the chemicals, the temperatures and the likely duration of exposure, etc. Appropriate assessment of the risks is a prerequisite to allowing the correct protection strategy to be developed for any specific structure.

Different types of protective coatings are available from Sika to provide full or short term chemical resistance, according to their type and degree of exposure.

Sika therefore provides a full range of protective coatings to protect concrete in all different chemical environments. These are based on many different resins and materials including: acrylic, epoxy, polyurethane silicate, epoxy-cement combinations, polymer modified cement etc.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 6.1 Coating		Only high performance reactive coatings are able to provide sufficient protection to concrete and improve its resistance to chemical attack.	Resistance to strong chemical attack: Class I to Class III Adhesion strength: Elastic: ≥0.8 N/mm² or ≥1.5 N/mm² (trafficking) Rigid: ≥1.0 N/mm² or ≥2.0 N/mm² (trafficking)	Class II: **Sikagard®-63 N** ■ Two part epoxy resin with good chemical and mechanical resistance ■ Tightly cross-linked surface **Sikafloor®-390** ■ High chemical resistance ■ Moderate crack-bridging behaviour Class I: **Sikafloor®-264/-263 SL** ■ Good chemical and mechanical resistance ■ Excellent abrasion resistance ■ Solvent free
Method 6.2 Impregnation		An impregnation is defined as the treatment of concrete to reduce the porosity and to strengthen the surface. The pores and capillaries are then partly or totally filled. This type of treatment usually also results in a discontinuous thin film of 10 to 100 microns thickness on the surface. This therefore serves to block the pore system to aggressive agents.	Resistance to chemical attack after 30 d exposure	**Sikafloor® CureHard-24** ■ Sodium silicate based ■ Colourless and odourless ■ Good penetration
Method 6.3 Adding mortar or concrete		The Methods and systems required are defined in Principle 3, Concrete restoration. To be able to resist a certain level of chemical attack, cement based products need to be formulated with special cements and/or combined with epoxy resins. The engineer has to define these specific requirements on each structure.	Mortar/Concrete: Class R4	Class R4: **Sikagard®-720 EpoCem®/ Sikafloor®-81/-82 EpoCem®** ■ Epoxy modified cement mortars ■ Good chemical resistance ■ Very dense and watertight

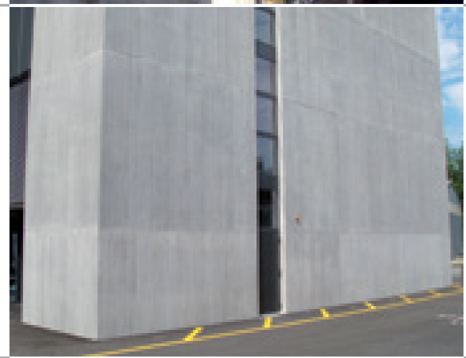
EN 1504-9 Principle 7: Preserving or Restoring Passivity (RP)
Levelling and Restoring the Concrete Surface and Profile

Corrosion of the reinforcing steel in a concrete structure only happens when various conditions are met: loss of passivity, the presence of oxygen and the presence of sufficient moisture in the surrounding concrete.

If one of these conditions is not met, then corrosion cannot occur. In normal conditions, the reinforcement steel is protected from the alkalinity surrounding the concrete cover. This alkalinity creates a passive film of oxide on the steel surface which protects the steel from corrosion.

However, this passive film can be damaged due to the reduction of the alkalinity by carbonation and when the carbonation front has reached the reinforcement steel. A break-down also occurs due to chloride attack. In both these instances, the protecting passivation is then lost. Different methods to reinstate (or to preserve) the passivity of the reinforcement are available.

The selection of the appropriate method will depend on various parameters such as: the reasons for the passivity loss e.g. due to carbonation or chloride attack), the extent of the damage, the specific site conditions, the repair and protection strategy, maintenance possibilities, costs, etc.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 7.1 Increasing cover with additional mortar or concrete.		If the reinforcement does not have adequate concrete cover, then by adding cementitious mortar or concrete the chemical attack (e.g. from carbonation or chlorides) on the reinforcement will be reduced.	Carbonation resistance: Class R4 or R3 Compressive strength: Class R4 or R3 Adhesive bond: Class R4 or R3	Class R4: **Sika® MonoTop®-612** **SikaCem®-133 Gunite** **Sika® Rapid Repair Mortar** **Sika®-Armorex® Armorcrete** Class R3: **Sika® MonoTop®-615**
Method 7.2 Replacing contaminated or carbonated concrete.		Through removing damaged concrete and rebuilding the concrete cover over the reinforcement, the steel is again protected by the alkalinity of its surroundings.	Carbonation resistance: Class R4 or R3 Compressive strength: Class R4 or R3 Adhesive bond: Class R4 or R3	Class R4: **Sika® MonoTop®-612** **SikaCem®-133 Gunite** Class R3: **Sika® MonoTop®-615** Sika concrete technology for quality concrete replacement: **Sika® ViscoCrete®** **Sikament®**
Method 7.3 Electrochemical realkalisation of carbonated concrete		Realkalisation of concrete structures by electrochemical treatment is a process performed by applying an electric current between the embedded reinforcement to an external system consisting of an anode mesh which is embedded in an electrolytic reservoir, placed temporarily on the concrete surface. This treatment does not prevent the future ingress of carbon dioxide. So to be effective in the long term, it needs to be combined with appropriate protective coatings that prevent future carbonation and chloride ingress.	No specific criteria	For post-treatment: **Sikagard®-720 EpoCem®** For post-treatment: **Sikagard®-680 S**
Method 7.4 Realkalisation of carbonated concrete by diffusion		There is limited experience with this method. It requires the application of a very alkaline coating over the carbonated concrete surface and the realkalisation is achieved by the slow diffusion of the alkali through the carbonated zone. This process takes a very long time and it is very difficult to control the right distribution of the material. After treatment, it is also always recommended to prevent further carbonation by applying a suitable protective coating.	No specific criteria	For post-treatment: **Sikagard®-720 EpoCem®** For post-treatment: **Sikagard®-680 S**
Method 7.5 Electrochemical chloride extraction		The electrochemical chloride extraction process is very similar in nature to cathodic protection. The process involves the application of an electrical current between the embedded reinforcement and an anode mesh placed at the outer surface of the concrete structure. As a result, the chlorides are driven out toward the surface. Once the treatment is completed, the concrete structure has to be protected with a suitable treatment to prevent the further ingress of chlorides (post treatment).	No specific criteria	For post-treatment: penetrating hydrophobic impregnation with **Sikagard®-700S** plus protective coating **Sikagard®-680 S**

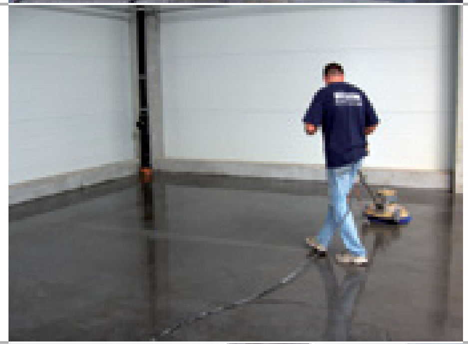
EN 1504-9 Principle 8: Increasing Resistivity (IR)

Increasing the Electrical Resistivity of the Concrete to reduce the Risk of Corrosion

Principle 8 deals with increasing the resistivity of the concrete, which is directly connected to the level of moisture available in the concrete pores. The higher the resistivity, the lower is the amount of free moisture available in the pores.

This means that reinforced concrete with high resistivity will have a low corrosion risk.

Principle 8 deals with the increase of the concrete's electrical resistivity, therefore then covers almost the same Methods of repair as Principle 2 (MC) Moisture Control.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 8.1 Hydrophobic Impregnation		A hydrophobic impregnation is defined as the treatment of concrete to produce a water-repellent surface. The pores and capillary network are not filled, but only lined with the hydrophobic material. This functions by reducing the surface tension of liquid water, preventing its passage through the pores, but still allowing each way water vapour diffusion, which is in accordance with standard good practice in building physics.	Penetration: Class II: ≥10 mm Drying rate coefficient: Class I: >30% Class II: >10% Water absorption and resistance to alkali: absorption rate: <7.5% alkali solution: <10%	**Sikagard®-700** range ■ Based on silane hydrophobic ■ Penetrate deeply and provide a liquid water-repellent surface **Sikagard®-700 S** (Class I)
Method 8.2 Impregnation		An impregnation is defined as the treatment of concrete to reduce the surface porosity and to strengthen the surface. The pores and capillaries are then partly or totally filled. This type of treatment usually also results in a discontinuous thin film of 10 to 100 microns thickness on the surface. This serves to block the pore system to aggressive agents.	Penetration depth: ≥5 mm Capillary absorption: w <0.1 kg/m² × √h	**Sikafloor® CureHard-24** ■ Sodium silicate based ■ Colourless and odourless ■ Good penetration
Method 8.3 Coating		Surface coatings are defined as materials designed to provide an improved concrete surface, for increased resistance or performance against specific external influences. Fine surface cracks with a total movement of up to 0.3 mm can be safely repaired, then sealed and their movement accommodated by elastic, crack bridging coatings, which are also waterproof and carbonation resistant. This is to accommodate thermal and dynamic movement in structures subject to wide temperature fluctuation, vibration, or that have been constructed with inadequate or insufficient jointing details.	Capillary absorption: w <0.1 kg/m² × √h Water vapour ability: Class I: S_d <5 m Adhesion strength: Elastic: ≥0.8 N/mm² or ≥1.5 N/mm² (trafficking) Rigid: ≥1.0 N/mm² or ≥2.0 N/mm² (trafficking)	Elastic systems: **Sikagard®-550 W Elastic** ■ Acrylic resin ■ Waterproofing and Elastic (crack-bridging) Rigid systems: **Sikagard®-680 S** ■ Acrylic resin ■ Waterproof **Sikagard® Wallcoat** ■ Two part epoxy resin ■ Water barrier **Sikagard® Elastic 675W** ■ Acrylic resin water based ■ Waterproof

EN 1504-9 Principle 9: Cathodic Control (CC)
Preventing Corrosion of the Steel Reinforcement

Principle 9 relies upon restricting the access of oxygen to all potentially cathodic areas, to the point when corrosion is prevented.

An example of this is to limit the available oxygen content by the use of coatings on the steel surface

Another is the application of a film forming inhibitor that will block the access of oxygen at the steel surface. This can be effective when the inhibitor migrates in sufficient quantities and forms a film to provide a barrier to the oxygen.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 9.1 Method 9.1 Limiting oxygen content (at the cathode) by surface saturation, surface coating or film forming inhibitors on the steel.		Creating conditions in which any potentially cathodic areas of the reinforcement are unable to drive an anodic reaction. Inhibitors (added to the concrete as admixtures or surface applied as an impregnation on the hardened surface) form a film on the surface of the reinforcement and prevent access to oxygen.	Penetration depth of surface applied inhibitors: >100 ppm (parts per million) at rebar level	Corrosion inhibitor **Sika® FerroGard®-903+** (surface applied) ■ Amino alcohol based inhibitors ■ Long term protection and durability ■ Economic extension of the service life of reinforced concrete structures

EN 1504-9 Principle 10: Cathodic Protection (CP)
Preventing Corrosion of the Steel Reinforcement

Principle 10 refers to cathodic protection systems. These are electrochemical systems which decrease the corrosion potential to a level where the rate of the reinforcing steel dissolution is significantly reduced. This can be achieved by creating a direct electric current flow from the surrounding concrete to the reinforcing steel, in order to eliminate the anodic parts of the corrosion reaction. This current is provided by an external source (Induced Current Cathodic Protection), or by creating a galvanic current through connecting the steel to a less noble metal (galvanic anodes e.g. zinc).

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 10.1 Applying an electrical potential.		In Induced Current Cathodic Protection, the current is supplied by an external electrical source and is distributed in the electrolyte via auxiliary anodes (e.g. mesh placed on top of and connected to the reinforcing steel). These auxiliary anodes are generally embedded in a mortar in order to protect them from degradation. To work efficiently the system requires the surrounding mortar to have a resistivity low enough to allow sufficient current transfer.	Resistivity of the mortar: according to local require-ments	Mortars for embedded cathodic protection mesh: Spray applied mortar: **Sika® MonoTop®-612** and **SikaCem®-133 Gunite** ■ Low shrinkage ■ Sufficient resistivity Levelling mortar: **Sikafloor® Level-30** ■ Self levelling ■ Sufficient resistivity Embedding mortar: **Sika® Ebonex Grout** and **Sika® Galvashield® Embedding Mortar** ■ Controlled resistivity mortar

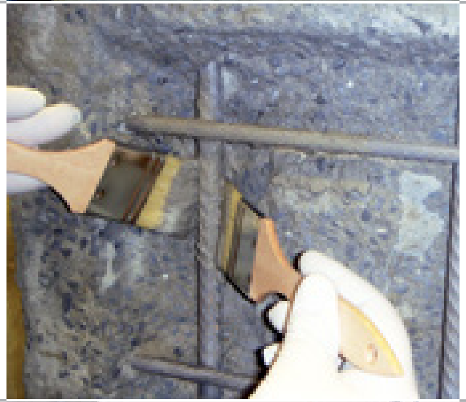
EN 1504-9 Principle 11: Control of Anodic Areas (CA)
Preventing Corrosion of the Steel Reinforcement

In considering the control of anodic areas to prevent corrosion with Principle 11, it is important to understand that particularly in heavily chloride contami-nated structures, spalling due to rein-forcement corrosion happens first in areas of low concrete cover. Additionally it is also important to protect repaired areas from the future ingress of aggres-sive agents (carbonation, chlorides).

A protective cement slurry can be applied directly on the reinforcement after appropriate cleaning, to prevent further steel dissolution at the anodic areas.

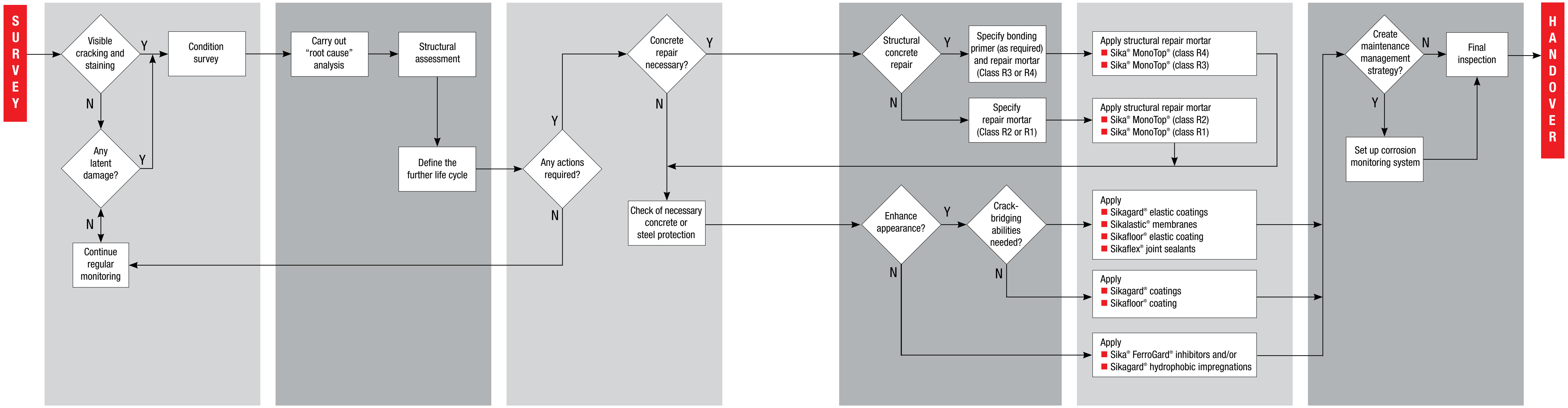
Additionally, to protect against the formation of incipient anodes in the areas surrounding the patch repairs, a corrosion inhibitor can be applied to migrate through the concrete and reach the reinforcement, where it forms a barrier, also protecting the anodic zones.

Note: Dual function inhibitors such as Sika® FerroGard® also protect the cathodic area simultaneously.

Methods	Pictures	Description	Main Criteria	Sika® Products (examples)
Method 11.1 Active coating of the reinforcement		These coatings contain active pigments that can function as an inhibitor or provide a passive environment due to its alkalinity. Although care must be taken to apply them properly, they are less sensitive to application defects than barrier coatings.	Compliance with EN 1504-7	Cement based: **Sika® MonoTop®-610** ■ 1-component corrosion protection ■ Good resistance to water and chloride penetration Epoxy modified cement based: **SikaTop® Armatec®-110 EpoCem®** ■ High density, suitable for demanding environment ■ Excellent adhesion to steel and concrete
Method 11.2 Barrier coating of the reinforcement		These coatings work by completely isolating the reinforce-ment from oxygen or water. Therefore they require higher levels of surface preparation and application control. This is because they can only be effective if the steel is completely free from corrosion and fully coated without any defects – this can be very difficult to achieve in site conditions. Any effective reduction in the bonding of the repair material to the treated reinforcement should also be considered.	Compliance with EN 1504-7	Epoxy based: **Sikadur®-32** ■ Low sensitivity to moisture ■ Very dense, no chloride penetration
Method 11.3 Applying corrosion inhibitors in or to the concrete.		Applying corrosion inhibitors to the concrete surface, they diffuse to the reinforcement and form a protective layer on the rebars. These corrosion inhibitors can also be added as admixtures to the repair mortars or concrete that is used for the concrete reinstatement works.	Penetration depth of surface applied corrosion inhibitors to achieve: >100 ppm (parts per million) at rebar level	Corrosion inhibitor: **Sika® FerroGard®-903+** (surface applied) ■ Amino alcohol based inhibitors ■ Long term protection and durability ■ Economic extension of the service live of reinforced concrete structures

Summary Flow Chart and Phases of the Correct Concrete Repair and Protection Procedure
In Accordance with European Standards EN 1504

Flow Chart of the EN 1504 Concrete Repair and Protection Procedure with the Sika® Systems



The Phases of Concrete Repair and Protection Projects in Accordance with EN 1504 Part 9

Information about the Structure
- History of structure
- Review documentation
- Condition survey

EN 1504-9, Clause 4, Annex A

Process of Assessment
- Defect diagnosis
- Analysis results
- Root cause identification
- Structural assessment

EN 1504-9, Clause 4, Annex A

Management Strategy
- Repair options
- Select Principles
- Select Methods
- Health and safety issues

EN 1504-9, Clauses 5 and 6, Annex A

Design of Repair Work
- Definition of performance
- Substrate preparation
- Products
- Application
- Specifications
- Drawings

EN 1504 Parts 2–7 and EN 1504-9, Clauses 6, 7 and 9

Repair Work
- Final product selection
- Equipment selection
- Health and safety assessment
- QA/QC definition

EN 1504-9, Clause 9 and 10 and EN 1504-10

Acceptance of Repair Work
- Acceptance of testing
- Acceptance of finishing
- Final documentation
- Maintenance strategy

EN 1504-9, Clause 8 and EN 1504-10

Related Pages in this Brochure

See more details on page 4
See more details on page 6/7
See more details on page 42 – 45
See more details on page 12 – 39
See more details on page 46 – 47
See more details on page 5

Selection of the Methods to be Used for Concrete Repair

In the matrix tables below the most common causes of deterioration of reinforced concrete structures and their possible repair methods are listed. This list is intended to be indicative instead of exhaustive. The repair proposals must be customised according to the specific conditions on each project. Deviations from this matrix are therefore possible and these must be determined individually for each situation. The numbers indicated in the tables are reference to the relevant Principles and Methods defined in EN 1504-9.

Concrete Deterioration

Deterioration Type	Low Damage	Medium Damage	Heavy Damage
Mechanical/Physical ■ Cracks	1.5 Filling of cracks	1.5 Filling of cracks 1.6 Transferring cracks into joints	4.5 Injecting cracks, voids or interstices 4.6 Filling cracks, voids or interstices
Mechanical ■ Impact	3.1 Hand applied mortar	3.1 Hand applied mortar 3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar	3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar 3.4 Replacing elements
Mechanical ■ Fatigue ■ Overload ■ Vibration	3.1 Hand applied mortar **and** 4.4 Adding mortar or concrete	3.1 Hand applied mortar **and** 4.1 Adding or replacing embedded or external reinforcing bars 3.1 Hand applied mortar **and** 4.2 Adding reinforcement anchored in pre-formed or drilled holes	3.3 Spraying concrete or mortar **and** 4.3 Bonding plate reinforcement 3.2 Recasting with concrete or mortar **and** 4.7 Prestressing (post-tensioning) 3.4 Replacing elements
Physical ■ Freeze/thaw	3.1 Hand applied mortar 5.1 Coating (cement based)	5.1 Coating (cement based) 5.3 Adding mortar or concrete	5.3 Adding mortar or concrete
Chemical ■ Aggressive agents ■ Biological action	6.1 Coating (cement based) 6.2 Impregnation	6.1 Coating (cement based) 6.3 Adding mortar or concrete	6.3 Adding mortar or concrete 3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar

Low damage: local damage, no influence on load capacity
Medium damage: local to extensive damage, slight influence on load capacity
Heavy damage: extensive to large-scale damage, strong influence on load capacity

Reinforcement Corrosion Deterioration

Deterioration Type	Low Damage	Medium Damage	Heavy Damage
Concrete spalling due to carbonation	3.1 Hand applied mortar	3.1 Hand applied mortar 3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar	3.2 Recasting with concrete or mortar **and** 4.1 Adding or replacing embedded or external reinforcing bars 3.3 Spraying concrete or mortar **and** 4.2 Adding reinforcement anchored in pre-formed or drilled holes 7.2 Replacing contaminated or carbonated concrete
Reinforcement corrosion due to chlorides	3.1 Hand applied mortar	3.1 Hand applied mortar 3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar	3.4 Replacing elements 7.2 Replacing contaminated or carbonated concrete **and** 4.1 Adding or replacing embedded or external reinforcing bars 7.2 Replacing contaminated or carbonated concrete **and** 4.3 Bonding plate reinforcement
Stray electrical currents	3.1 Hand applied mortar 3.2 Recasting with concrete or mortar	3.2 Recasting with concrete or mortar 3.3 Spraying concrete or mortar	3.2 Recasting with concrete or mortar **and** 4.2 Adding reinforcement anchored in pre-formed or drilled holes 3.3 Spraying concrete or mortar **and** 4.1 Adding or replacing embedded or external reinforcing bars

Selection of the Methods to be Used for Concrete and Re inforcement Protection

The protection required for concrete structures as well as for embedded steel reinforcement is dependent on the type of structure, its environmental location, its use and the maintenance strategy.
The protection proposals are therefore adapted to the local conditions.
Deviations from these are therefore possible and should always be determined on each individual project.
The numbers indicated in the tables below are the references to the relevant Principles and Methods of EN 1504-9.

Protection to Concrete

Protection Requirements	Low Level	Medium Level	Heavy Level
Cracks	1.1 Hydrophobic impregnation 1.3 Coating	1.1 Hydrophobic impregnation 1.3 Coating (elastic)	1.3 Coating (elastic) 1.8 Applying membranes (sheet or liquid)
Mechanical ■ Impact	5.2 Impregnation	5.1 Coating	5.3 Adding mortar or concrete
Physical ■ Freeze/thaw	5.1 Coating 5.2 Impregnation	5.1 Coating 5.2 Impregnation	5.1 Coating 5.3 Adding mortar or concrete
Chemical ■ Alkali aggregate reactions (AAR)	6.1 Coating 6.2 Impregnation	6.1 Coating (elastic) 6.2 Impregnation	6.1 Coating (elastic) 1.8 Applying membranes (sheet or liquid)
Chemical	6.2 Impregnation	6.3 Adding mortar or concrete	6.1 Coating (reactive)

Low level: slight concrete defects **and/or** short-term protection
Medium level: moderate concrete defects **and/or** mid-term protection
Heavy level: extensive concrete defects **and/or** long-term protection

Protection to Reinforcement

Protection Requirements	Low Level	Medium Level	Heavy Level
Carbonation	11.3 Applying corrosion inhibitors in or to the concrete	8.3 Coating **and** 11.3 Applying corrosion inhibitors in or to the concrete	8.3 Coating **and** 11.3 Applying corrosion inhibitors in or to the concrete 7.3 Electrochemical realkalization of carbonated concrete 7.4 Realkalisation of carbonated concrete by diffusion **and** 8.3 Coating
Corrosive contaminants ■ Chlorides	8.1 Hydrophobic impregnation 8.2 Impregnation 8.3 Coating 11.3 Applying corrosion inhibitors in or to the concrete	11.3 Applying corrosion inhibitors in or to the concrete **and** 8.1 Hydrophobic impregnation 11.3 Applying corrosion inhibitors in or to the concrete **and** 8.3 Coating	7.5 Electrochemical chloride extraction **and** 8.3 Coating 7.5 Electrochemical chloride extraction **and** 11.2 Barrier coating of the reinforcement 10.1 Applying an electrical potential
Stray currents	If disconnection of the electrical current is not possible: 10.1 Applying an electrical potential	If disconnection of the electrical current is not possible: 10.1 Applying an electrical potential	If disconnection of the electrical current is not possible: 10.1 Applying an electrical potential

The Independent Assessment and Approvals of Sika® Products and Systems, Plus Testing and Proof Statements in Accordance with the Requirements of EN 1504

Sika uses specific in-house and independent testing and assessment criteria to evaluate all of its products and systems for concrete repair and protection, which are fully in accordance with the requirements of the appropriate parts and sections of European Standard EN 1504 (Parts 2 – 7). The Sika Product and System Testing and Assessment criteria for these concrete repair and protection materials are as follows:

Protecting exposed reinforcement
- Bond strength to steel and concrete
- Corrosion protection
- Permeability to water
- Permeability to water vapour
- Permeability to carbon dioxide

Levelling the profile and filling surface pores
- Bond strength
- Permeability to carbon dioxide
- Permeability and absorption of water

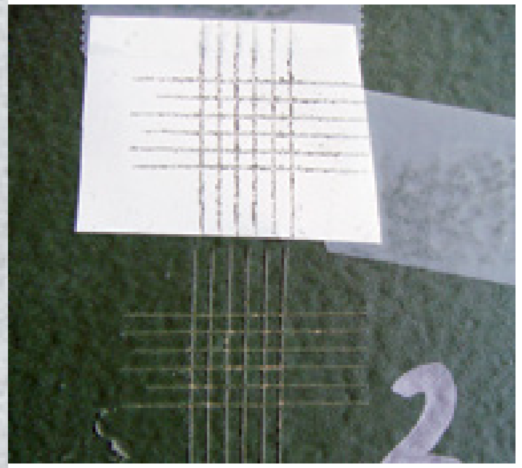
Replacing damaged concrete
- Bond strength
- Compressive and flexural strengths
- Permeability to water
- Elastic modulus (stiffness)
- Restrained shrinkage
- Thermal compatibility

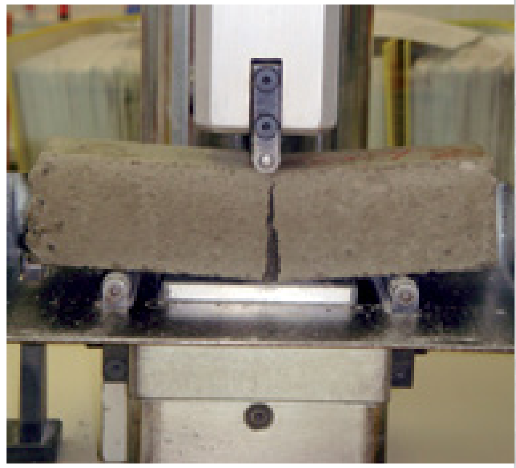
Sealing and coating – preventing the ingress of aggressive elements

Waterproofing with hydrophobic impregnations
- Penetration ability
- Water-repelling ability
- Water vapour permeability
- Freeze / thaw resistance

Anti-carbonation coatings
- Bond strength
- Cross-cut performance
- Permeability to carbon dioxide
- Permeability to water vapour
- UV light resistance
- Alkaline substrate resistance
- Freeze/thaw resistance
- Fire resistance
- Ease of cleaning

Crack-bridging anti-carbonation coatings
As above for anti-carbonation coatings, plus:
- Crack-bridging ability
  - – Statically
  - – Dynamically
  - – At low temperatures (–20 °C/–4 °F)





The Performance Criteria

Product and System Performance

There are functional and performance requirements which must be met by both the individual products as components of a system and the system functioning together as a whole.

Practical Application Criteria of the Performance

In addition to their performance in place on the structure, it is also essential to define and then test the application characteristics and properties of the products. At Sika we ensure that these are in accordance with the guidelines of EN 1504 Part 10, but additionally we also ensure that Sika products can all be applied practically on site and in all of the differing climatic conditions that will be encountered around the world.

For example:

Sika repair mortars must be suitable for use in differing thicknesses, areas and volumes of repair, which need to be applied in as few layers as possible. They must then rapidly become weather resistant.

Equally **Sikagard**® coatings must have adequate viscosity and the right thixotropic properties at different temperatures, in order to obtain the desired wet and dry film thicknesses. This should be achieved in the minimum number of coats, plus they must also achieve adequate opacity and become weather resistant quickly.

Production Quality Assurance / Quality Control

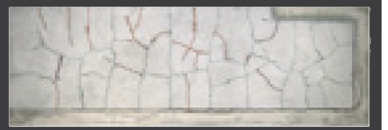
It is also necessary for any product or system to meet well defined Quality Assurance and Quality Control standards in production. This is why Sika produces to ISO 9001 Standards in all of our production facilities throughout the world. Sika also publishes product and system specification details together with Method Statements for the products application on site. Quality Control Procedures and checklists are available to support the site supervision in the overall management of concrete repair and protection projects.

Additional Performance Testing and the Extensive Independent Durability Assessments of Sika® Products and Systems

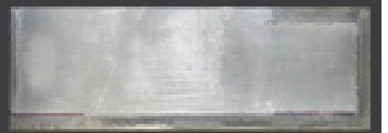
Concrete Repair

The "Baenziger Block" for Mortar Testing

The unfilled "Baenziger Block".



Filled "Baenziger Block" with crack sensitive Mortar.



Mortar with good crack behavior.

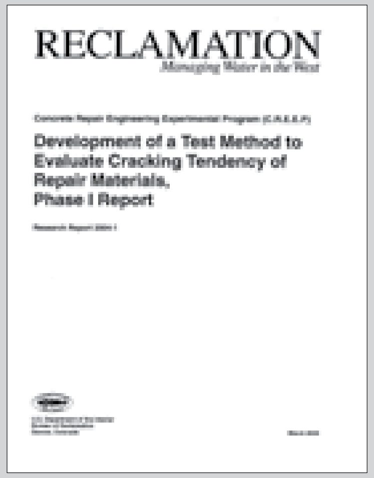
Sika advanced repair mortar product performance testing

The "Baenziger Block" for concrete repair mortars testing allows direct comparisons and measurements of performance between products, production methods, production facilities and application conditions anywhere in the world.

The "Baenziger Block" has now been assessed as the optimal specification and configuration for evaluating the sensitivity of repair materials by the USA Department of the Interior CREE Programme

This Sika innovation allows:

- Direct comparison worldwide
- Application horizontal, vertical and overhead
- Realistic site dimensions
- Additional lab testing by coring
- Shrinkage and performance crack testing



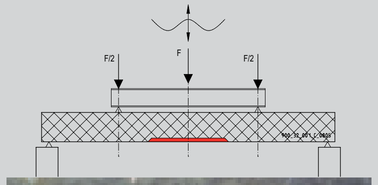
RECLAMATION
Managing Water in the West

Concrete Repair Engineering Experimental Program (C.R.E.E.P.)

Development of a Test Method to Evaluate Cracking Tendency of Repair Materials, Phase I Report

Testing Product Application under Dynamic Load

Application for installation and performance testing of repair mortars under live dynamic loading.



The Real Proof on Real Structures – Independent Evaluation of Completed Projects

A major international study of completed repair projects by inspection, testing and review was undertaken in 1997 by leading independent consultants and testing institutes.

This involved more than twenty major buildings and civil engineering structures in Norway, Denmark, Germany, Switzerland and the United Kingdom which were repaired and protected with Sika systems between 1977 and 1986. These were re-inspected and their condition and the repair systems' performance assessed after periods from 10 to 20 years by leading consultants specializing in this field.

The excellent condition of the structures and the materials performance reports that were the conclusions of these engineers, provide a clear and unequivocal testimony for Sika's concrete repair and protection products. They also confirm Sika's pioneering work in the early development of the modern, systematic approach to concrete repair and protection.

These reports are available in a printed Sika reference document "Quality and Durability in Concrete Repair and Protection".

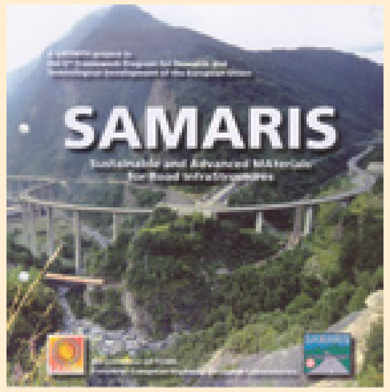
Concrete Protection

Testing the Performance of Corrosion Inhibitors

Sika introduced Surface Applied Corrosion Inhibitors in 1997.

Since then, millions of square metres of reinforced concrete have been protected from corrosion all over the world. **Sika® FerroGard®-903** covers the Principle 9 (Cathodic control) and Principle 11 (Anodic control). Since this introduction many studies have confirmed the efficiency of the corrosion protection afforded by this technology.

The latest international reports, amongst many available from leading institutions worldwide, are from the University of Cape Town South Africa, showing its efficiency in carbonated structures. From the Building Research Establishment (BRE) showing the effectiveness of **Sika® FerroGard®-903** applied as a preventative measure in a heavily chloride contaminated environment and this was carefully evaluated over a 2 to 5 year programme (BRE 224-346A)

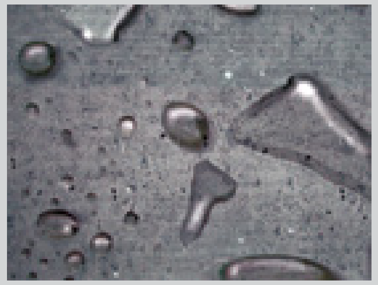


Additionally there is the European SAMARIS project begun in 2002 which forms part of the major European Community research project: **S**ustainable and **A**dvanced **Ma**terials for **R**oad **I**nfra-**S**tructure). This was set up to investigate innovative techniques for the maintenance of RC structures.

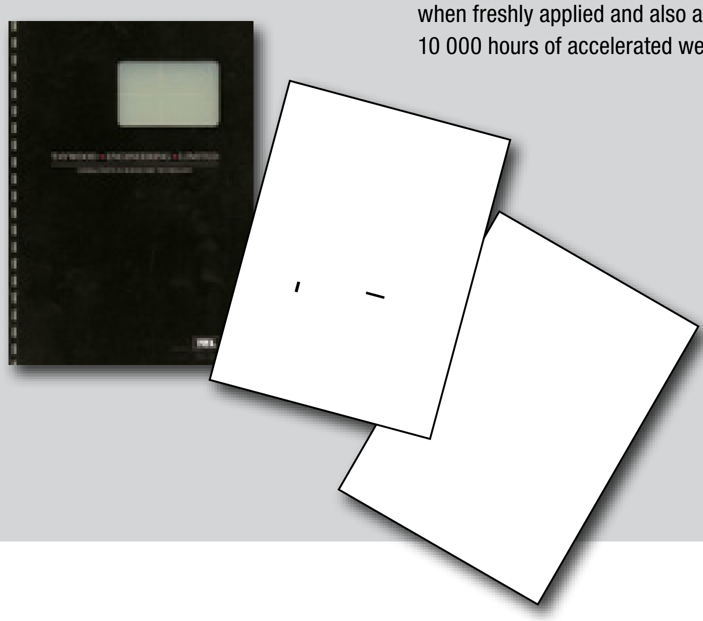
These reports all concluded that when the appropriate conditions are met, **Sika® FerroGard®-903** is a cost-effective method of corrosion mitigation.

Additional Test Procedure for Hydrophobic Impregnations

In addition to the European Standard EN 1504-2, the penetration performance of hydrophobic impregnations in concrete is tested by measuring the water absorption in the depth profile of concrete (e.g. on concrete cores from the top surface till 10 mm depth). Therefore the maximum penetration depth and effectiveness could be determined. On that penetration limit, the exact quantity of the active ingredient in the concrete is measured in the laboratory by FT-IR analysis. This value reflects the minimum content of hydrophobic particles and can therefore also be used for quality control on site.



Accelerated Weathering testing



- **Sikagard®** products are tested for their performance as anti-carbonation and water vapour diffusible coatings, both when freshly applied and also after up to 10 000 hours of accelerated weathering (equivalent to in excess of 15 years atmospheric exposure). Only this type of practically applied laboratory testing can give a true and complete picture of a product and its long-term performance.
- **Sikagard®** crack-bridging coating products and systems are tested to confirm their dynamic performance at low temperatures down to -20 °C.
- **Sikagard®** coatings will therefore continue to perform long after many other so-called "protective" coatings have ceased to provide any effective protection.

Examples of Typical Concrete Damage and its Repair and Protection with Sika® Systems

Commercial/Residential Buildings

Defects:	Sika Solutions:*
Concrete Spalling	Applying concrete or repair mortar by Hand or Spraying **Sika® MonoTop®-615** Admixtures for concrete with **Sikament®**
Exposed Steel	Protect the rebars from corrosion **Sika® MonoTop®-610**
Embedded Steel	Protection of the reinforcement by applying the corrosion inhibitors **Sika® FerroGard®-903**
Cracks	For non-moving cracks **Sika® MonoTop®-620** For fine surface cracks **Sikagard®-550 W Elastic**
Concrete Protection	Coatings to protect the concrete **Sikagard® ElastoColor 675 W** **Sikagard®-700 S**
Joints	**Sikaflex®-AT Façade**

Bridges

Defects:	Sika Solutions:*
Concrete Spalling	Applying concrete or repair mortar by Hand or Spraying **Sika® MonoTop®-612** or **SikaCem®-133 Gunite** Admixtures for concrete with **Sika® ViscoCrete®**
Exposed Steel	Protect the rebars from corrosion **SikaTop® Armatec®-110 EpoCem®, Sikadur®-32** for highly corrosive environment
Embedded Steel	Protection of the reinforcement by applying the corrosion inhibitors **Sika® FerroGard®-903**
Cracks	For non-moving cracks **Sika® MonoTop®-620** For fine surface cracks **Sikagard®-550 W Elastic** Cracks more than 0.3 mm wide **Sikadur®-52 Injection**
Concrete Protection	Coating to protect the concrete **Sikagard®-680 S** **Sikagard®-706 Thixo**
Joints	**Sikadur® Combiflex® System**

Multi-Storey Car Parks

Defects:	Sika Solutions:*
Concrete Spalling	Applying concrete or repair mortar by Hand, Pouring or Spraying **Sika® MonoTop®-612, Sika® MonoTop® 615, Sika® Rapid Repair Mortar, Sika® Armorex Armorcrete**
Exposed Steel	Protect the rebars from corrosion **SikaTop® Armatec®-110 EpoCem®** for highly corrosive environment or **Sika® MonoTop®-610**
Embedded Steel	Protection of the reinforcement by applying the corrosion inhibitors **Sika® FerroGard®-903** **Sika® Galvashield®-XP2**
Cracks	For non-moving cracks **Sika® MonoTop®-620** For fine surface cracks **Sikagard®-550 W Elastic** Cracks more than 0.3 mm wide **Sikadur®-52 Injection**
Applying Membranes	Protection of the concrete from water, ingress and mechanical damage by applying wearing coatngs Flexible membranes: **Sikafloor®-350N/375 OS11A System** or **Sikafloor® Pronto 15 System** Rigid membranes: **Sikafloor®-264** or **Sikafloor® Pronto 14 System**
Concrete Protection	Coatings to protect the concrete **Sikagard®-675 W Elastocolor** **Sikagard® 700 S**

Sewage Treatment Plants

Defects:	Sika Solutions:*
Concrete Spalling	Applying concrete or repair mortar by Hand or Spraying **Sika® MonoTop®-612** Admixtures for concrete with **Sika® ViscoCrete®**
Exposed Steel	Protect the rebars from corrosion **SikaTop® Armatec®-110 EpoCem®, Sikadur®-32** for highly corrosive environments
Cracks	For non-moving cracks **Sikagard®-720 EpoCem** For fine surface cracks **Sikafloor®-390** Cracks more than 0.3 mm wide **Sika® Injection-201**
Concrete Protection	Coatings to protect the concrete **Sikagard®-720 EpoCem®** **SikaCor® Poxitar F**
Joints	**Sikadur® Combiflex® System**

* Additional Sika solutions are also possible, please refer to specific documentation or contact our Technical Service Departments for advice.

Sika Worldwide

Sika - Your Local Partner with a Global Presence

The information, and, in particular, the recommendations relating to the application and end use of Sika® products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users should always refer to the most recent issue of the Product Data Sheet for the product concerned, copies of which will be supplied on request.

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