



Fosroc Solutions for Concrete Repairs in Accordance with EN1504

www.fosroc.com



constructive solutions

ABOUT FOSROC INTERNATIONAL

Since the company's beginnings over 80 years ago, Fosroc has developed into an International leader in delivering Constructive Solutions for projects across a broad range of market segments including transport, utilities, industrial and general buildings.

Fosroc's commitment to customer service and technical support is second to none. We work closely with architects, structural engineers, contractors and owners to best understand their requirements. Together we can develop a bespoke solution for a construction project, adding value and becoming more than just a materials supplier, but a solution provider.

Fosroc has an extensive network of offices and manufacturing locations across Europe, Africa, the Middle East, India, North and South Asia, and is further represented in other regions across the world by distributor and licensee partners.

Selecting from the full portfolio of Fosroc products and services and integrating expert technical support, world class customer service and innovation, Fosroc goes beyond just product selling to ensure that we partner with our customers to deliver complete constructive solutions.

- > Admixtures
- > Adhesives
- > Protective Coatings
- > Concrete Repairs
- > Industrial Flooring
- > Grouts & Anchors
- > Joint Sealants
- > Surface Treatments
- > Grinding Aids
- > Waterproofing



FOSROC DELIVER SOLUTIONS NOT JUST PRODUCTS

CAD Details

A library of standard CAD details are available, bespoke CAD details can be created for your specific project

Project Specifications

Dedicated specification managers on hand to assist with correct system choices and tailored solutions

Site Support

Expert product and application support made available from our specialist teams

Seminar & Training

Comprehensive programme of seminars and training courses designed to expand and reinforce your knowledge

Leader in delivering
Constructive Solutions
Worldwide!





FOSROC HOLISTIC CONCRETE REPAIR SOLUTIONS

Fosroc has concrete durability in our DNA. We are involved in concrete from the early stage process of cement grinding, through to concrete production, placement and finishing. Therefore we understand concrete in its deterioration phase and all the factors that contribute to that deterioration. We have the solutions to repair and protect that concrete.

Our mission in concrete repair is to provide the most durable systems that will provide best life-cycle costs for the project. We aim to do this by providing a comprehensive range of repair, strengthening and protection systems that give us the right tools to manage the varying problems that occur.

The deterioration of concrete is a complex matter, influenced by numerous physical, chemical and environmental factors. This makes each concrete repair a little bit different from

the last. Understanding concrete repair is hard to learn, as it is more often related to experience and little is taught in colleges and universities.

Fosroc was among the pioneers of genuine concrete repair materials, we have been repairing concrete structures for over 30 years. Our involvement in thousands of concrete repair projects every year around the world builds daily on our years of experience. This experience filters into everything we do, from assistance with repair specifications, contractor training, know-how in application and our internal development of materials and systems.



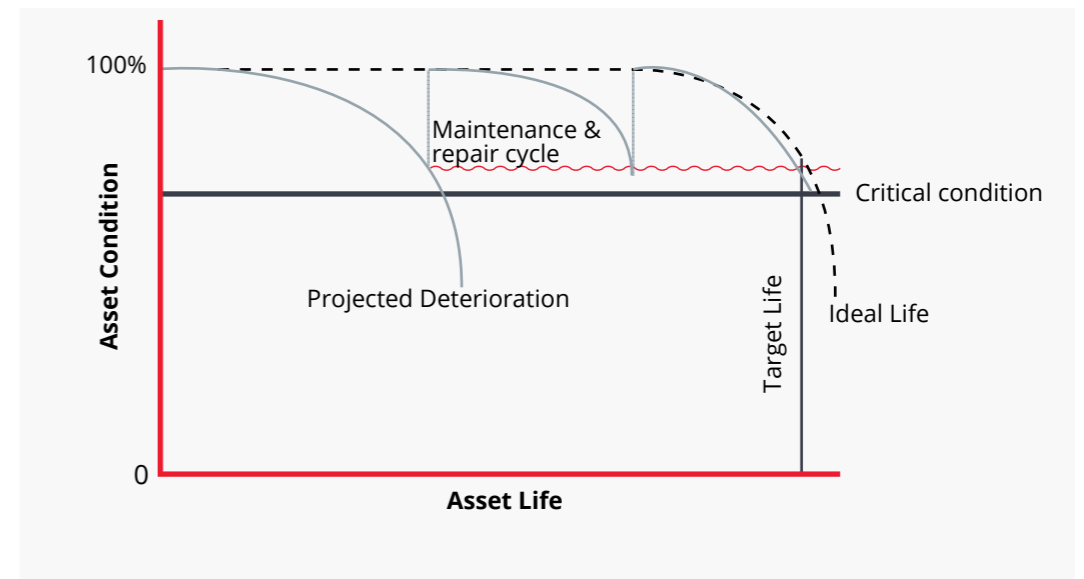
PROTECTING THE FUTURE

Billions are wasted every year demolishing and re-building structures that deteriorate or are deemed no longer fit for purpose. The energy and resources that are spent in waste management and re-construction has an immense impact on our planet.

Fosroc firmly believes that concrete should be built to last and that the application of our high-quality protective systems and repair materials can prolong the life of a structure well beyond its original design life. Lightweight modern strengthening systems mean that structures can be enhanced and changed to have an entirely new function. Protective systems can dramatically inhibit the impact of aggressive elements on the concrete. Our wide array of repair systems can make damaged concrete as good as new. Not only does this have a positive environmental impact, but structure owners see the benefits of improved management costs over the life of the structure.

Many Fosroc mortars are manufactured with the inclusion of recycled materials which have been designed to reduce the amount of cement included in the mortar. Far from reducing quality, the overall performance of the materials are enhanced with properties such as rapid strength gain and reduced alkalinity.

It is never too early to start enhancing. Every penny spent on improved concrete quality, protection and enhancement pays off in long term durability. Reducing the impact construction has on our environment makes a better future for all our sakes, choosing Fosroc materials enhances durability and makes that aim a reality.



INDUSTRY STANDARDS: EN1504

In 2009 the harmonised standard of EN1504 for the repair and protection of concrete came into force in all member states of the European Union. Outside of Europe the standard and CE marking that comes with it is not normally legally binding, however the standard is growing in significance globally and the principals of it are commonly regarded as good practice. One of the main reasons for this is that the standard moves beyond simple product testing and encompasses a holistic attitude towards the process of repair, monitoring and maintenance of concrete structures from start to finish.

It is important to note that following the standard requires more than simply requesting CE marked products; many products are CE marked, but this does not necessarily make them appropriate for the particular task in hand. A number of remedial solutions offered in the standard do not have CE marking available to them. Where they have been tested in accordance with EN1504 requirements, Fosroc products go above and beyond the minimum requirements of the standard.

Of course there are many other standards both national and industry specific. Fosroc local companies look to comply with those standards where appropriate and meet the requirements of our customer base.

A number of our repair and protection systems have been tested to ensure they are safe for contact with drinking water by bodies such as the DWI and WRAS. Some of our products are included in London Underground's 'Deemed to Comply' register for fire safety. Esteemed bodies such as Tawwood Engineering and Bureau Veritas test and certify Fosroc's manufacturing processes and our products.

CE	
Fosroc Ltd, Drayton Manor Business Park, Coleshill Road, Tamworth, STAFFS, B78 3TL 09 0370-CPD-0845	
EN 1504-3 Concrete repair products for structural repair CC mortar (based on hydraulic cement)	
Compressive strength	Class R4 (≥45 MPa)
Chloride ion content	≤ 0.05%
Adhesive bond strength	≥ 2.0 MPa
Adhesive bond strength after freeze thaw thermal cycling	≥ 2.0 MPa
Carbonation resistance	dk ≤ control concrete
Elastic modulus in compression	≥ 20 GPa
Reaction to fire	Class A1
Dangerous substances	Complies with 5.4

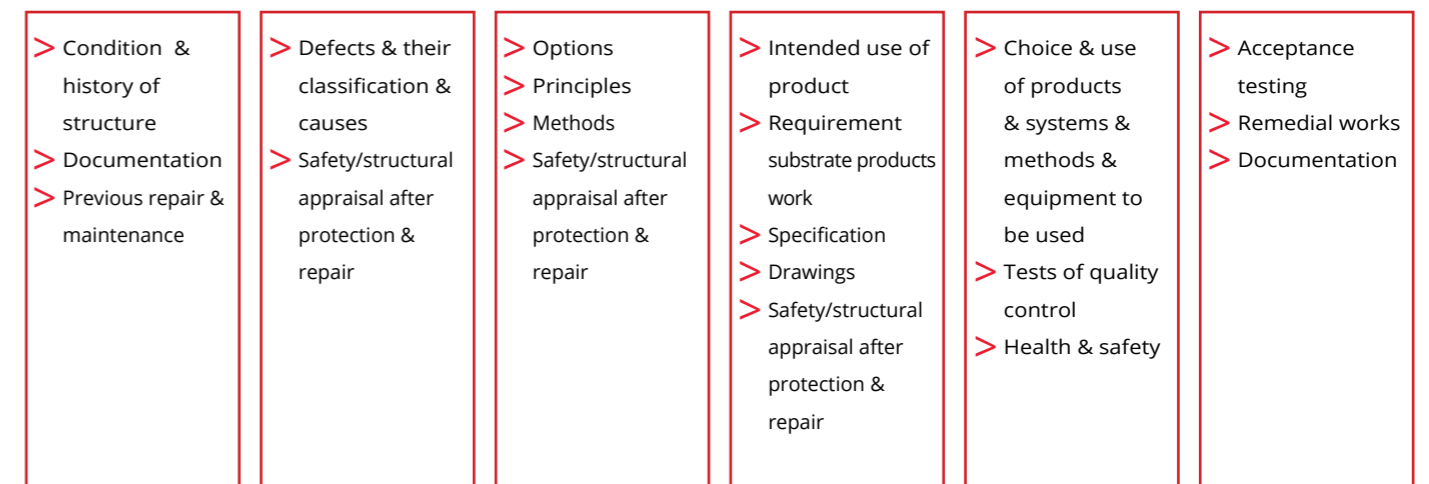


EN1504 is 6 step process that requires specifier, manufacturer and applicator to work together to produce the most appropriate solution. EN1504-9 lays out clearly the process that each project should adopt to ensure and effective repair and protective solution is adopted.

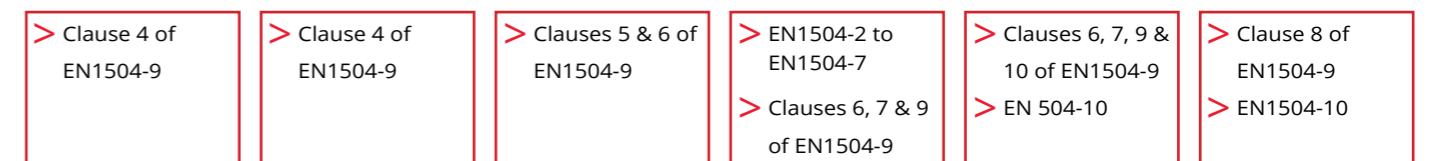
PROJECT PHASES



BASIC CONSIDERATIONS & ACTIONS



RELEVANT CLAUSES IN THE EUROPEAN STANDARD & OTHER PARTS OF THE EN 1504 SERIES





AVOID REPAIR FAILURE

There are occasions where concrete repairs fail prematurely. There are a number of reasons why this might happen. Repairs can be costly and re-application of failed repairs can be yet more costly as well as time consuming and disruptive.

Some of the most common causes of premature repair failure are:

- > Incorrect root cause diagnosis
- > Incorrect selection of repair strategy
- > Selection of inappropriate repair materials
- > Inadequate protection from further deterioration
- > Poor surface preparation
- > Incorrect product application

By using this guide and working with Fosroc we hope you will be able to avoid these problems and achieve effective and durable repair and protection for your project.



STRUCTURE INFORMATION

Before a full condition survey is undertaken it is important to understand the structure, history, its use, intended working life and any future plans that the client may have for it. Identify any obvious defects from reports or visual surveys. Identify unseen issues from concrete tests such as chloride and carbonation reports.

If the structure is in a poor condition it is important that efforts are made immediately to ensure that it is safe for the users and nearby people.

PROCESS OF ASSESSMENT

After specific areas of concern are identified it is important that full diagnostic testing of the concrete is undertaken. This is critical in terms of fully understanding the root causes of any defects. Unless this is undertaken, repairs have a high possibility of failure as they are likely to be treating symptoms instead of causes.

Qualified assessors are able to undertake a full condition assessment incorporating some or all of the following testing:

- > Location of defects
- > Covermeter survey
- > Carbonation depth testing
- > Half-cell potential
- > Hammer testing
- > Petrographic analysis

The amount of testing will be proportionate to the level of importance, age and condition of the structure. As with all diagnostic work, more information will yield a better understanding of existing issues affecting the concrete and the likely future condition of the structure. An experienced professional will be able to diagnose the root causes of the problems and begin to determine the most appropriate remedial strategy once the survey results are completed.



COMMON PROBLEMS IN REINFORCED CONCRETE

As defined in EN1504-9 there are 8 generic defect types, which are sub-divided into defects concerning the concrete and defects concerning the reinforcement. It is very common that these defects are combined to create a problem or that one issue leads to another issue.

CONCRETE DAMAGE



Mechanical

Overloading or movement of the structure causes cracking

Physical impact cases or loss of concrete section

Vibration or earthquakes



Chemical

Contaminants from the soil such as sulphates can weaken and crack the cement matrix

Aggressive chemicals from a variety of sources may contaminate the concrete and weaken the cement matrix

Alkali Aggregate Reaction



Physical

Breakage by impact.

Water in the capillaries of the concrete may freeze and expand causing sections of the concrete to spall

Abrasion & wear from traffic or other moving elements

Thermal movement



Fire

Extremes of heat may cause loss of section, concrete embrittlement and weakening of the steel

REINFORCEMENT CORROSION



Concrete Cover

Low cover caused by poor placement or slipping of formwork

Damaged cover

Porous concrete due to poor quality concrete or bad workmanship



Loss of Concrete Alklnity

The ingress of CO₂ as a naturally occurring acidic gas is accelerated by moisture within the concrete. The loss of concrete alkalinity provides the steel reinforcement with an environment in which it may corrode.



Contamination of Concrete

Chlorides can be cast into concrete during construction. Chlorides may penetrate the structure in a salt rich environment.

In high concentrations the chlorides break down the passivating layer and initiate the corrosion cycle. In very high concentrations they may even attack the steel itself.



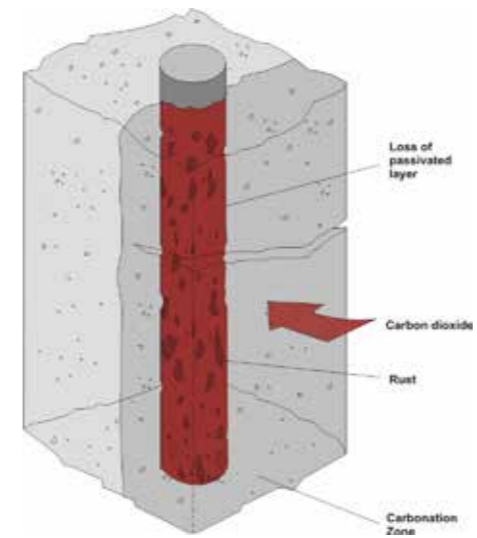
Stray Current

Stray electrical currents from wiring of poorly installed cathodic protection systems may induce corrosion.

Metals with different electrochemical potential will induce the onset of corrosion if they are connected.

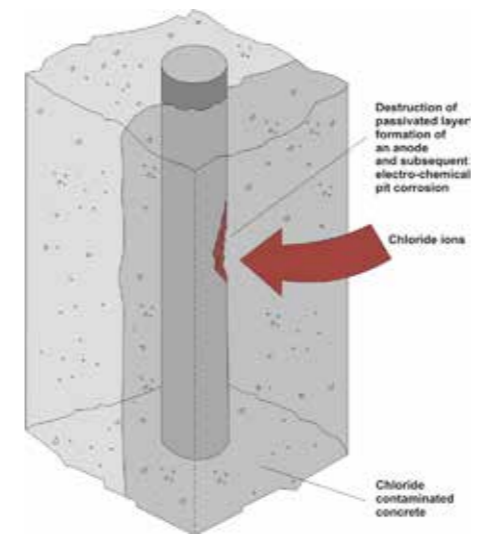


CORROSION PROCESS



CO₂ is a naturally occurring gas and enters every concrete, especially in mid-range humidity. The slightly acidic nature of the Carbon Dioxide, weakens the protective alkaline nature of the concrete and slowly permeates to the level of the steel. Once at the steel, it changes the naturally protective environment into one that is neutral and erodes the passivating film on the steel. In this environment the presence of moisture and oxygen begin the corrosion process.

A covermeter survey combined with phenolphthalein testing is a good way to check for the progress of carbonation.



Chlorides can enter concrete for a variety of different reasons, the most common are from a marine environment or use of de-icing salts. Chlorides may also be bound into the concrete during its initial casting, by use of accelerators or unwashed sands and aggregates.

The aggressive nature of chlorides means that in high concentrations they can create an acid erosion of the steel that creates pits, rather than expansion, reflecting in a significant loss of steel cross-section.

This is hard to detect unless proper testing is undertaken, using concrete sample analysis and a covermeter survey initially, moving on to



REINFORCEMENT CORROSION

The corrosion of reinforcement is a common problem around the world. The most common causes of corrosion are carbonation and chloride ingress. Contaminants penetrate the concrete and gradually change the chemical composition of it until they reach the depth of the reinforcement. The length of time this takes is very dependent upon the quality of the concrete, the depth of reinforcement and the exposure levels.

Once the carbonation or chlorides reach the reinforcement they attack the passivating layer surrounding the steel.

When this passivating layer is lost, the corrosion process can begin. The presence of moisture and oxygen are essential for the corrosion process to start, and will determine the corrosion rate.

Corrosion creates an electrical cell with anodic and cathodic sites. Corrosion occurs on the anodic sites and expands the steel molecules by up to 10 times their original size. This places stress on the concrete causing cracking.

Cracking allows moisture and oxygen a direct passage to the steel which further

accelerates the corrosion. After a period of time the concrete spalls away in sections, sometimes with devastating consequences. As the steel is more exposed, more corrodes and eventually leads to partial or total collapse of the structure.



THE BASIC CORROSION STEEL IN CONCRETE RELIES UPON THE FOLLOWING:

MOISTURE

OXYGEN

PASSIVE ENVIRONMENT

STEEL

+/- CURRENT OUTPUT



MANAGEMENT STRATEGY

Once the underlying causes of deterioration have been diagnosed, these are combined with the structural information, health and safety issues and the client's requirement for the structure both during the repair and in the future. A strategy can then be devised to assess what can be done to the structure. The options range from 'do nothing', all the way through to partial or complete demolition. If the decision to repair or repair and improve is made, the management strategy should look at the options for repair and protection.

EN1504-9 Provides 11 Principals for Repair and further protection of concrete. Some of the principals have overlapping strategies, and it is frequently the case that a number of these repair principals are selected to create a complete system solution.

Strategies 1 to 6 deal broadly with the repair and improvement of concrete and strategies 8 to 11 focus upon protection of reinforcement from corrosion. Items 7-11 are to be considered carefully if instances of Chloride ingress or Carbonation are affecting the concrete. Failure to manage them will mean that further deterioration of the reinforcement and concrete is inevitable. A number of single solutions occur in numerous management strategies.

PRINCIPLES AND METHODS CONCERNING CONCRETE DEFECTS

The principles for controlling reinforcement corrosion rely upon reducing or eliminating the effects of the contributing input and output of the corrosion process.



1
Protection against Ingress
The basic principle is to keep the concrete dry by reducing its permeability by closing up pores and cracks.



2
Moisture Control
The principle of controlling moisture with acceptable levels using coatings and membranes.



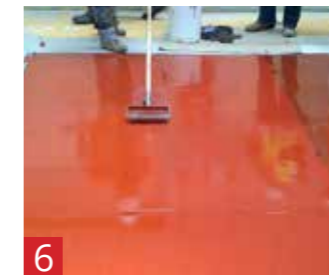
3
Concrete Restoration
Repairing or replacing concrete using a variety of mortars.



4
Structural Strengthening
Replacing lost strength or increasing strength by adding steel, additional reinforced concrete or Fibre Reinforced materials.



5
Increasing Physical Resistance
Replacing lost concrete or providing additional cover and protection.



6
Increasing Resistance to Chemicals
Application of surface protection to improve resistance to chemical attack



7
Preserving Restoring Passivity
Using mortars or concrete to replace contaminated concrete. Also techniques for re-alkalisation and chloride extraction.



8
Increasing Resistivity
Using coatings and protective systems to reduce the level of moisture in the concrete thereby increasing the electrical resistivity of the concrete and reducing the potential for corrosion.



9
Cathodic Control
Restricting the access of Oxygen to the cathodic site by coating the steel.



10
Cathodic Protection
Cathodic protection manages the output of current through the steel to channel currents to specific anodic sites. This may be done using external currents or sacrificial anodes.



11
Control of Anodic Areas
Corrosion of the reinforcement is controlled by a complete film formation, using coatings or corrosion inhibitors.

FOSROC PRODUCTS

Fosroc's outstanding range of products meets all of the major repair management options and nearly all of the more specialist applications. This means that once you have selected the strategy, Fosroc is an ideal partner to look at the more specific issues of the repair design. The product selector below highlights the range of options available and the product type. The direct application should be validated with your local Fosroc technical team to ensure the product is correct for the application conditions, and specific material that is available in your country.

(Products mentioned in this table may or may not be CE marked depending upon a variety of factors, including country of origin, availability of test criteria and other factors. Always consult your local Fosroc office before selecting products and refer to the technical data sheet.)

Principals	Protection Against Ingress								Moisture Control				Concrete Restoration				Structural Strengthening							Physical Resistance		Chemical Resistance			Preserving or Restoring Passivity					Increasing Resistivity			Cathodic Control	Cathodic Protection	Control of Anodic Areas											
	Hydrophobic Impregnation	Impregnation	Coating	Surface Bandaging of Cracks	Filling of Cracks	Transferring Cracks into Joints	Erecting External Panels	Applying Membranes	Hydrophobic Impregnation	Impregnation	Coating	Erecting External Panels	Electrochemical Treatment	Hand Applied Mortar	Recasting with Concrete or Mortar	Spraying with Concrete or Mortar	Replacing Elements	Adding or Replacing Reinforcement	Anchoring Reinforcement	Bonding Plate Reinforcement	Adding Mortar or Concrete	Injecting Cracks and Voids	Filling Cracks	Prestressing & Post-Tensioning	Coating	Impregnation	Adding Mortar or Concrete	Coatings	Impregnation	Adding Mortar or Concrete	Increasing Concrete Cover	Replacing Contaminated Concrete	Electrochemical Realkalisation	Realkalisation by Diffusion	Chloride Extraction	Hydrophobic Impregnation	Impregnation	Coating	Limiting Oxygen at Steel	Cathodic Protection	Active Reinforcement Coating	Barrier Reinforcement Coating	Corrosion Inhibitors							
Repair Method Number	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	4.7	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	7.4	7.5	8.1	8.2	8.3	9.1	10.1	11.1	11.2	11.3							
Nitocote SN511, SN502	■								■																																									
Nitoflor Lithurin		■								■																■																								
Dekguard E2000, S, W, PU			■								■														■				■																					
Nitoflor Systems			■								■														■				■																					
Expoband H45				■																																														
Nitofill LV, TH, Conbextra EPLV					■																		■	■																										
Nitoseal & Colpor Sealants						■																																												
Nitofill WS60, UR63					■																																													
Polyurea WPE								■				■																	■																					
Nitodek Car Park System								■				■																	■																					
Renderoc & Patchroc mortars														■														■																						
Renderoc LA															■												■																							
Renderoc DS, RenderocSP																■											■																							
Nitobond EP, PE																	■										■																							
Auracast & Auramix Admixtures																		■										■																						
Lokfix S, P, Lokfix DUR																		■										■																						
Nitowrap, Nitoplate, Nitorod																				■																														
Conbextra Cable Grout																										■																								
Fosroc Marine Jacket																																																		
Nitoprime Zincrich																																																		
Conplast CN																																																		

Fosroc Products

APPLICATION OF REPAIR WORK: REPAIR MORTARS

Principles 3,4 & 7 all utilise the application of repair mortars, either to replace concrete or to provide additional protection. Repair Mortars come in 3 main application types, Hand applied, Sprayed and Cast.

EN1504-3 categorises the types of repair mortar into 4 main classes. These classes are predominantly defined by their strength and adhesion characteristics. Stronger concrete requires a stronger repair mortar as typically the repair should exhibit a similar modulus to ensure compatibility. However, it is important to note that unless the load is transferred during the repair and curing process the patch repair may not be taking much structural load.

EN1504 states that repair works should be undertaken by experienced and qualified contractors. Experience has proven that correct preparation, priming, application and

curing is every bit as critical as obtaining high quality repair materials when it comes to getting maximum performance of the system.

Fosroc works closely with specialist applicators to develop an understanding of the challenges that they face on site. Products are adapted to suit local markets and local conditions. This means that the materials we make are site friendly, helping to create the highest quality finish on site.

Fosroc's range of Renderoc Repair materials are world renowned for their consistency, high quality and usability. The products are designed with dimensional stability in mind, meaning that factors like adhesion, shrinkage and durability are considered.

Classification	Compressive Strength	Adhesion	Grade
Non-Structural	≥10 MPa	≥0.8 MPa	R1
	≥15 MPa	≥0.8 MPa	R2
Structural	≥25 MPa	≥1.5 MPa	R3
	≥45MPa	≥2.0MPa	R4



HAND APPLIED REPAIR MATERIALS

Hand-Placed repair materials are excellent for small patches and detailed work. While the applicator requires skill to obtain the correct bond and finish the material, the requirement for specialist equipment is minimal.

Hand placed repair materials come varying grades and strengths depending upon the requirement for which they are used. Generally, the lower the material strength, the better repair depth and material workability.

Selecting the right repair material for the project enables the engineer to ensure that the material is matched to the requirements of the parent concrete. Over specifying strengths reduces material workability, slowing down the contract and making it more expensive. Therefore Fosroc offer a range of materials to suit the contract both technically and practically.



Steel Primer – Nitoprime Zincrich

Nitoprime Zincrich has an active zinc content making it an excellent primer for steel reinforcement in corrosive environments. The zinc content means that even if the primer has some small pin-holes in application, there will be no corrosion hot-spot on the affected area.



R2 grade repair material - Renderoc FC

Renderoc FC is a trowel applied re-profiling mortar for filling minor surface blemishes, obtaining a smooth and pinhole free surface for subsequent coatings.



R2 grade repair material - Renderoc HB

Renderoc HB is a repair material with exceptional build-up qualities and high workability. It is ideally suited for non-structural applications requiring deep section repairs, ease of workability and material detailing.



R3 & R4 grade repair materials – Renderoc HB30, HB45, TG, S & HS

Fosroc supplies a variety of hand application grades of repair materials with strengths to match the substrate. They are suitable for buildings and civil structures, exhibiting excellent workability, durability, and resistance to shrinkage.



R4 grade pavement repair materials - Patchroc

Patchroc products are designed for large scale deck repairs where rapid reinstatement is required. Depending on the product selected, bay sizes may be as large as 18m² without cracking. They are designed to go from thin to thick section, may be laid to falls and have great abrasion resistance without the need for additional coatings.

SPRAYED REPAIR MATERIALS

The application of sprayed repair materials can be done in two different processes: Dry Spray and Wet Spray. Both systems typically produce high strength well compacted concrete repairs. As the systems are applied with spray equipment, they are excellent at building up material thickness and applying large volumes in a short time.

Dry spray materials are mixed at the nozzle and are generally regarded as more suitable for stop/start applications, such as patch repairs. Wet spray systems are mixed and then pumped, making them generally more suitable for more constant applications, such as overlays or tunnel linings.

The expensive equipment for spray application and the longer set up times make the application of sprayed systems well suited to large repair projects. The dust and noise means that they are commonly used for repairs in civil structures.



CAST REPAIR MATERIALS

For large section repairs where high strength is required, re-casting with a proprietary pourable repair material is the perfect solution.

Renderoc LA

The unique formulation of Fosroc's Renderoc LA materials mean that the highly fluid material casts easily but will not shrink or crack away from the host concrete.

It's high strengths make it most suitable for civil works, and is often used in areas where congested reinforcement means that hand and spray applied systems cannot access. Unlike a concrete it has finer aggregates and does not require agitation or vibration to settle and form a strong bond.



Renderoc DS

A high-strength dry spray repair mortar, Renderoc DS is an excellent material for large patch repair applications. It has high bond to the concrete substrate and low rebound of material, making it very cost effective to work with.

Renderoc SP

Renderoc SP can be dry sprayed, but is most commonly used for wet spray applications up to 200mm thick. This means it is perfect for overlay systems or large scale repairs. It has exceptional material stability and negligible shrinkage.

Sprayset HBL

Sprayset is a rapid setting admixture for shotcrete overlay systems. It is typically added to concrete as it exits the nozzle to assist in the build-up of materials for overlay systems and soil stabilisation works. It is alkali free making it safer to work with.

SEALING & BONDING CRACKS

Cracks can be sealed and bonded in a number of ways. However, it is important to understand what has caused the cracks, as failure to address any underlying cause will normally lead to a later re-occurrence. Although this can be a detailed process it is often an effective method for fast repairs.

Injection materials come in many forms and depend upon the project requirement. Typically static cracks are bonded with cementitious or epoxy materials. These can be used to create structural repairs. Live cracks may sometimes be filled with a flexible material such as a polyurethane, alternatively they may be transformed into movement joints by bandaging or cutting and sealing with flexible sealants.



Bonding - Nitofil EPLV

To inject and re-bond cracks epoxy resin is injected into the concrete using a variety of techniques.

Filling

Static cracks may be filled using epoxy pastes such as Nitobond EP or Nitomortar TC2000, which are trowelled into the surface.



Water Stopping

Cracks subject to water ingress can be filled using polyurethane systems that react to the presence of water to foam or to create a complete seal. These systems do not bond the concrete.

Jointing

Cracks subject to continual movement should be treated as joints unless the movement can be stopped. Fosroc has a range of Nitoseal joint sealants for standard and challenging applications that offer high flexibility and may also provide chemical or physical resistance if required.



STRUCTURAL STRENGTHENING

Structural strengthening may be necessary when concrete has been damaged, whether by loss of steel section, physical or fire damage, or by overloading. Reinforced Concrete may also require strengthening due to problems or changes in design, change of structural load requirements, or perforations into structural elements.

Fosroc Nitoplate, Nitowrap and Nitorod carbon fibre systems offer designers an opportunity to strengthen reinforced concrete using ultra-modern lightweight materials that require no intrusion into the structure and can be applied very quickly with a minimum of disruption to surrounding activities. Moreover, the non-corrosive nature of the products means that they require no protection from chlorides. For this reason they are frequently used in strengthening busy highways or live buildings.

Design and installation must be undertaken by experienced and qualified professionals. Fosroc, being a key solution provider understands the major advantages that can be provided by the application of fibre composite solutions, and also where design limitations may apply. We understand compatibility of the surrounding concrete and the appropriate materials to conduct repairs.

Or systems use the highest quality carbon, glass and aramid fibres combined with bespoke manufactured epoxy adhesives. We are able to provide protective coatings for environments where UV or aggressive chemicals may be of concern.

Nitowrap – Uni-directional fabric provided in aramid, carbon or glass fibres, of varying strengths. Nitowrap is supplied in rolls and has the advantage of being able to be applied to undulating and curved surfaces such as beams, columns or masonry walls.

Nitoplate – Uni-directional plates of carbon fibres, pre-laminated in epoxy resin. These are provided in aramid or carbon, in varying strengths, thicknesses and widths. Nitoplate is especially useful when strengthening overhead on beams as they are narrow and easy to manoeuvre.

Nitorod – Uni-directional carbon fibre rods, pre-laminated in epoxy resin. These are provided in aramid and carbon, in varying strengths, thicknesses and widths. Nitorod is ideal for where the reinforcement must be buried in the surface of the concrete as their shape makes them simple to insert using disc cutter or coring rigs.



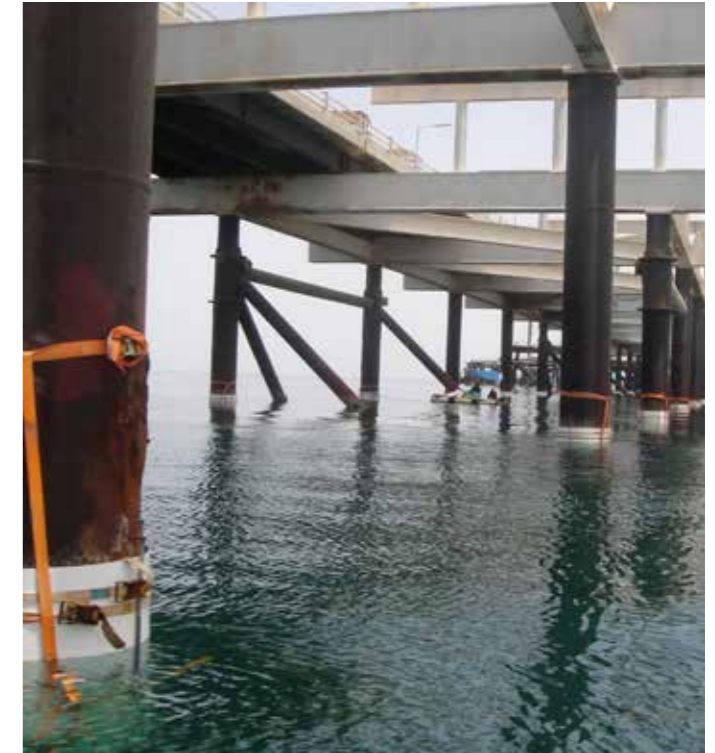
CATHODIC PROTECTION

Fosroc Marine Jacket is a cathodic protection system provided specifically for marine piles. It is used on piers and jetties where the specific environment of high chlorides, moisture and oxygen combine adding erosion and mechanical abrasion into the mixture. This combination creates accelerated corrosion in the tidal and splash zones which is hard to combat using standard repairs and coatings.

Fosroc Marine Jacket uses self-regulating zinc mesh anodes to control corrosion, these anodes are protected by the strong GRP casing and grouted into place. This high quality solution is ideal to create a robust and durable repair and

protection of these critical elements. Their installation can be undertaken relatively easily and with a minimum of disruption to port activity.

Like all high quality jackets, ours is made to measure, meaning the zinc sections fit into place before grouting perfectly. Once completed the sections are easily cleaned and maintain a good appearance. Like all good Cathodic Protection systems, remote monitoring can also be employed on Fosroc Marine Jackets, meaning that in many years, when the zinc anodes reach the end of their working life, the client can have plenty of notice and make provision for new works.



CONCRETE PROTECTION SYSTEM

One of the most effective and reoccurring techniques for protecting concrete is to protect the surface. This can be achieved using a wide variety of product types, applied in a number of ways. It is never too early to begin to protect the surface of the concrete and the most effective asset managers will apply systems to the surface of their structure as it is being built. This applies particularly to structures under aggressive attack from harsh environments such as chemical treatment works, marine areas and those subject to high abrasion. Protective coatings can also be very decorative and enhance a structure's appearance, functionality and safety.

Selecting the right protection requires a clear understanding of all the factors that will be important to the structure and those using it. Some considerations may include:

- > Carbonation resistance
- > Slip resistance
- > Aesthetic Appeal
- > UV Stability
- > Durability
- > Resistance to chloride ions
- > Chemical resistance
- > Application Speed
- > Waterproofing

Fosroc offer comprehensive range of products for protecting concrete, utilising a variety of impregnations, coatings, coverings and membranes. Our technology type includes Polyurethanes, epoxies, acrylics, silanes, siloxanes, methacrylates.



Dekguard Anti-carbonation coatings

Anti-carbonation coatings and anti-chloride coatings meet a prescribed set of properties defined in EN1504 to ensure that the concrete receives an appropriate level of protection. They are applied in thicknesses of less than 1mm but provide protection equivalent to many metres of concrete. Fosroc's Dekguard systems provide protection way in excess of the Carbon Dioxide permeability stated as a requirement in EN1504. This is because this layer of protection is often the most important part of the entire repair process when it comes to future durability.

Dekguard Elastic and Dekguard E2000 have exceptional crackbridging capabilities, meaning that if fine cracks move below the surface of the protective film, they remain covered and protected. As a very visual part of the repair process Dekguard coatings come in a range of colours, meaning that the products are decorative as well as functional. They have exceptional UV stability and overall durability with independently audited applications lasting well in excess of 10 years.

Nitocote chemical resistant coatings

Fosroc's Nitocote brand offers a wide variety of coatings that provide resistance to chemical attack and abrasion. This makes them ideal for situations where concrete is under attack from aggressive environments, such as chemical storage and bund areas, water treatment works, desalination plants, oil & gas processing sites. The specific coating requirement will be matched to the customer requirements by Fosroc's technical team.

Nitodek Car Park Decking

Busy Car Park decks take an extraordinary amount of wear and attack. Clients require systems that provide protection from oil spills, de-icing salts, etc, while being able to withstand traffic and providing good ant-slip properties. The nature of the long span construction methods frequently mean that decking systems should be flexible to bridge small cracks caused by flexure and thermal changes, keeping the decks watertight. Nitodeck, epoxy, polyurethane and PMMA systems can achieve all of this while bringing a beautiful, durable and maintainable finish to the car park, with coloured demarkation improving safety and improved brightness that can even reduce lighting costs.

ACCEPTANCE OF THE REPAIR WORK

Supervision of the contract ensures that the project completion is a simpler process. Having understood the issues causing the damage to the structure and addressed any latent defects with high quality materials will ensure that the repairs should last for many years.

Repairs should normally be undertaken by a suitably trained and experienced applicator. Fosroc has connections with these contractors and can make recommendations. This will mean that the quality of the application will match the high quality of the material, providing maximum durability.

Wherever possible Fosroc will attend site to assist the contractor and specifier to ensure that the materials are applied in accordance with best practice. We also offer applicator training.

It is normally advisable that the structure is monitored regularly to ensure that there are no further issues. This should form part of the client handover document and form part of the strategy for the continued management of the structure.

CASE STUDIES



King Fahad Port, Saudi Arabia

The jetties at this important industrial port were suffering from deterioration due to chloride ingress. Fosroc's complete solution of Renderoc repairs, galvanic protection systems using Fosroc Life Jacket and protective coating systems for the tidal zones and above provided the client with a durable system while being relatively quick to install.



Mount Pleasant Office, UK

This landmark local building in London was suffering from the effects of old age cracking and carbonation. Fosroc's Renderoc repair system was able to repair the damage and re-profile the finish to a very high standard. The application of Dekguard E2000 provided durable and elastomeric protection, in the colour scheme desired by the designer.



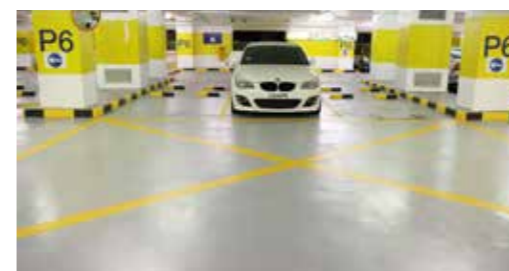
Ratcliffe Power Station, UK

These concrete cooling towers stand at well over 100 m high and are severely exposed to the elements. Spalling concrete due to carbonation was creating a problem for health and safety. Fosroc's Renderoc Repair System was selected because for its high strength and exceptional durability. Because it is easy to mix and apply, it was ideal for use when undertaking repairs from a hanging access platform.



Almerimar Reservoir, Spain

This drinking water reservoir suffered from cracking and reinforcement corrosion and repairs were required to reinstate it to a workable condition. Renderoc cementitious repair materials were applied to the damaged areas of concrete. The reservoir was relined with a Nitocote flexible sprayed system. All works were undertaken to allow the reservoir to be rapidly returned to service.



Parkway Car Park, Singapore

After 20 years of use the Parkway car park in Singapore required upgrading and protection. Fosroc supplied a fast curing epoxy system to protect the decks, enabling the areas to be returned to service with minimum disruption. The products are able to withstand oil and fuel spillages, and provide mechanical protection to the surface of the concrete. The final finish also gave the car park a fresh and modern look, and improved the safety of the area.



Piata Muncii, Romania

Due to the increase in traffic and deterioration of the structure, the soffit of this underpass required repairs and strengthening. Renderoc Resin and cementitious repairs were used to make good. Nitoplate carbon fibre provided the additional support without compromising the headroom. Subsequently Dekguard and Nitocoat coatings provided protection against further deterioration. All works were done at night minimising disruption to the local traffic.



Fosroc offers a full range of construction chemical solutions, helping to protect structures throughout the world. Please refer to our brochures, which include:



Details of your local Fosroc office can be found at www.fosroc.com

Important Note

Fosroc products are guaranteed against defective materials and manufacture and are sold subject to its standard terms and conditions of sale, copies of which may be obtained on request. Whilst Fosroc endeavours to ensure that any advice, recommendation, specification or information it may give is accurate and correct, it cannot, because it has no direct or continuous control over where or how its products are applied, accept any liability either directly or indirectly arising from the use of its products, whether or not in accordance with any advice, specification, recommendation or information given by it.



constructive solutions