



# Fosroc Solutions for Bridge and Viaduct Repair

[www.fosroc.com](http://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, the Middle East, Africa, India, North, South and East 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!**





# BRIDGES & ELEVATED SECTIONS

Bridges are important and economically valuable structures that should be constructed with maximum durability and minimum requirements for maintenance.

Fosroc has been involved in bridge construction since its earliest days. Customers turn to Fosroc because of a tradition of producing strong and reliable products that are made to last.

Solutions are diverse and cover many of the most challenging aspects of construction from foundation to finish. The range of products is constantly developing to find better, more effective and greener construction specialities.

With an unrivalled array of product solutions, global know-how and local

technical support, Fosroc leads the industry with its problem solving approach.

Fosroc works extensively in the repair and refurbishment sector around the world. This provides a special insight into some of the problems that bridges face and what the consequences of failure can be. This experience helps create solutions for the new construction market.

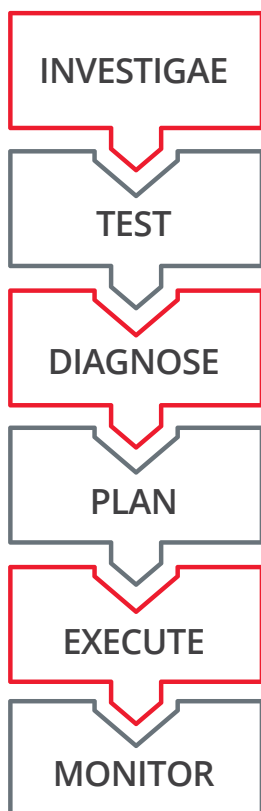
Fosroc has a reputation for durability, reliability and its people have a culture of proactive problem solving. This means that Fosroc people and products contribute to the successful construction, maintenance and repair of bridge structures all across the globe.



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# REPAIR STRATEGY



The development of a successful repair strategy depends upon obtaining a clear understanding of the issues being faced and the underlying causes. Failure to adopt a good strategy results in repeated repairs meaning continued disruption and higher end costs.

The first objective should be to thoroughly survey the structure, ideally as part of a periodic cycle. Identify any issues and address any safety concerns.

Testing should be conducted for the structure as a whole, though additional focus may be given to areas where damage is visible or that are deemed to be high risk (these include areas around joints, drainage, splash zones, bearings etc.).

With quality test data, the process of correct diagnosis can begin. Problems may be multi-faceted with complex interaction. A small leak in one part of the structure may cause problems to a more significant component such as a bearing, which in turn can cause much damage elsewhere. Experience and know-how is an important part of both diagnosis and planning. It is

good practise to involve industry experts, be they engineers, applicators or material suppliers such as Fosroc.

Planning repairs to busy and complex bridge structures requires consideration of many factors. As well as the technical factors, these may include: how to manage bridge use during works, safety, environmental impact, contractor access and project scheduling.

In the execution phase, communication is vital. The applicators must fully understand the overall works as well as their own specific function. Any unexpected problems must be managed as a team. Supply chain must be incorporated to avoid delays.

After the completion of works it is vital that the bridge remains closely monitored, ensuring snags do not become major works and that issues such as reinforcement corrosion do not return.



# REPAIR QUALITY ASSURANCE

At the heart of any value for money repair strategy there must be a focus on quality. All aspects of a remedial solution should be of high standard, incorporating products, engineering and application.

Products are designed with the user in mind, as Fosroc firmly believes that if a material is good to use, the end result will be of higher quality. Systems are extensively tested to ensure that they are fit for purpose and meet local or international standards. All materials are subject to rigorous QC testing regularly audited in compliance with international norms.

Quality comes from skilled applicators using the correct product in the correct circumstances. Fosroc frequently trains applicators, ensuring that they possess the skills to prepare, use and finish materials correctly. Fosroc's first-class project support ensures that designers are assisted to ensure systems are specified and detailed correctly.

From start to finish, Fosroc will work to produce the best quality and most durable repair for your project.







# 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, corrosion accelerates. Left unchecked reinforcement corrosion will lead to partial or total structural failure. Bridges, which have long spans with reinforcement acting in tension, are particularly at risk.





# CORROSION PROTECTION

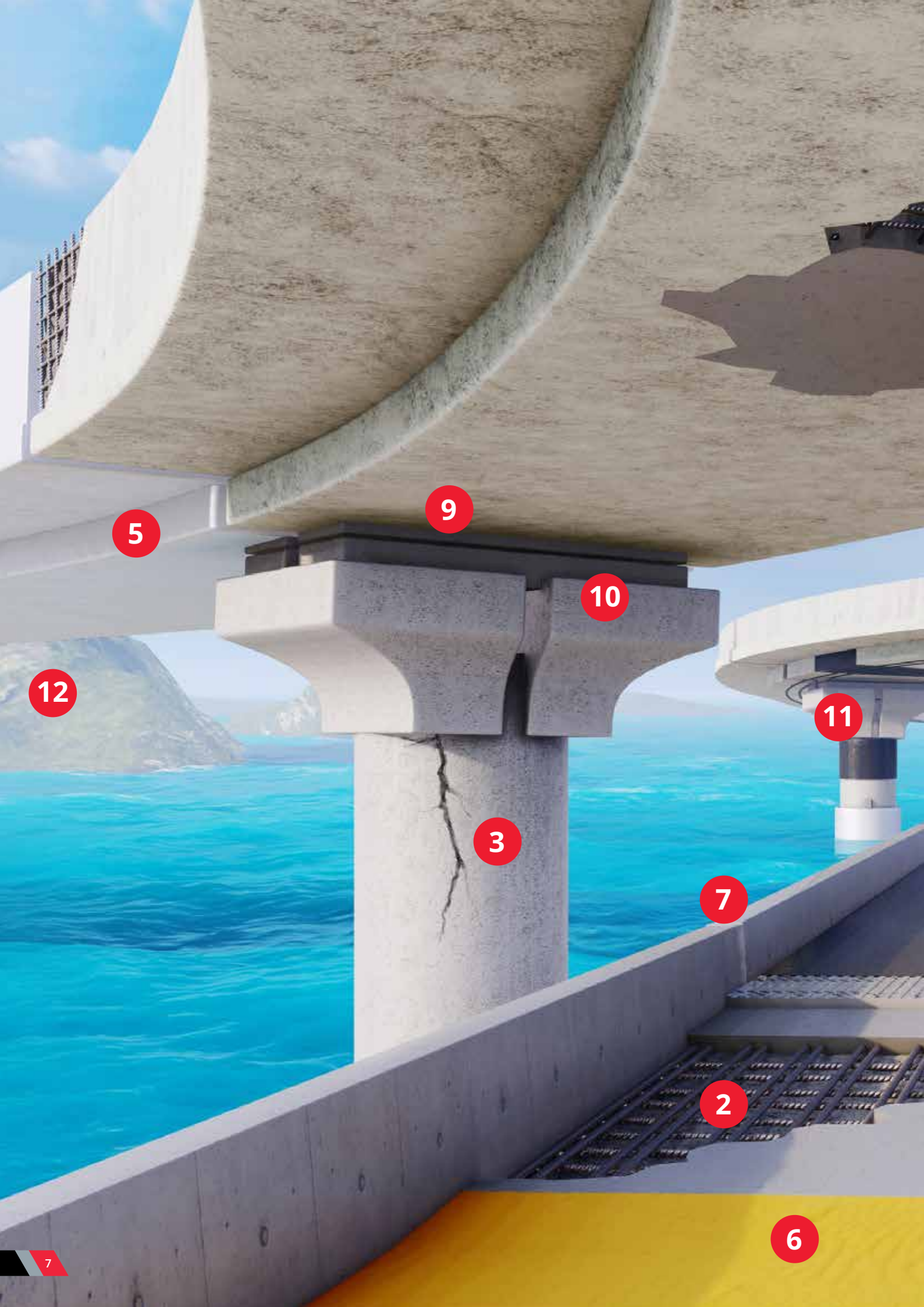
Repairing physically damaged concrete is a start, however, it may not address the root causes of the deterioration if corrosion is the problem. Left unchecked there is high potential for contaminated areas in the surrounding parent concrete to begin corroding. Therefore a pattern of continuing deterioration, disruption and repairs begins.

To initiate corrosion, the reinforcement requires oxygen, moisture and a passive environment. The output of these contributors is an electrochemical corrosion cell. Strategies to control corrosion commonly focus on limiting or controlling one or more of the moisture, oxygen or passive environment or by controlling the corrosion current.

Fosroc has a long history of providing systems to control ongoing corrosion using specialist coatings, impregnations and inhibitors. Fosroc partners with and works along side suppliers of electrochemical systems, that manage and suppress corrosion. Renderoc, Dekguard and other Fosroc brands are tried and tested in this environment. While each structure faces its own unique challenges, the experience of Fosroc in working on multi-faceted solutions is second to none in the repair market.

More detailed information on reinforcement corrosion and concrete repair strategies can be found in our brochure 'Fosroc Solutions for Concrete Repairs in Accordance with EN1504'.





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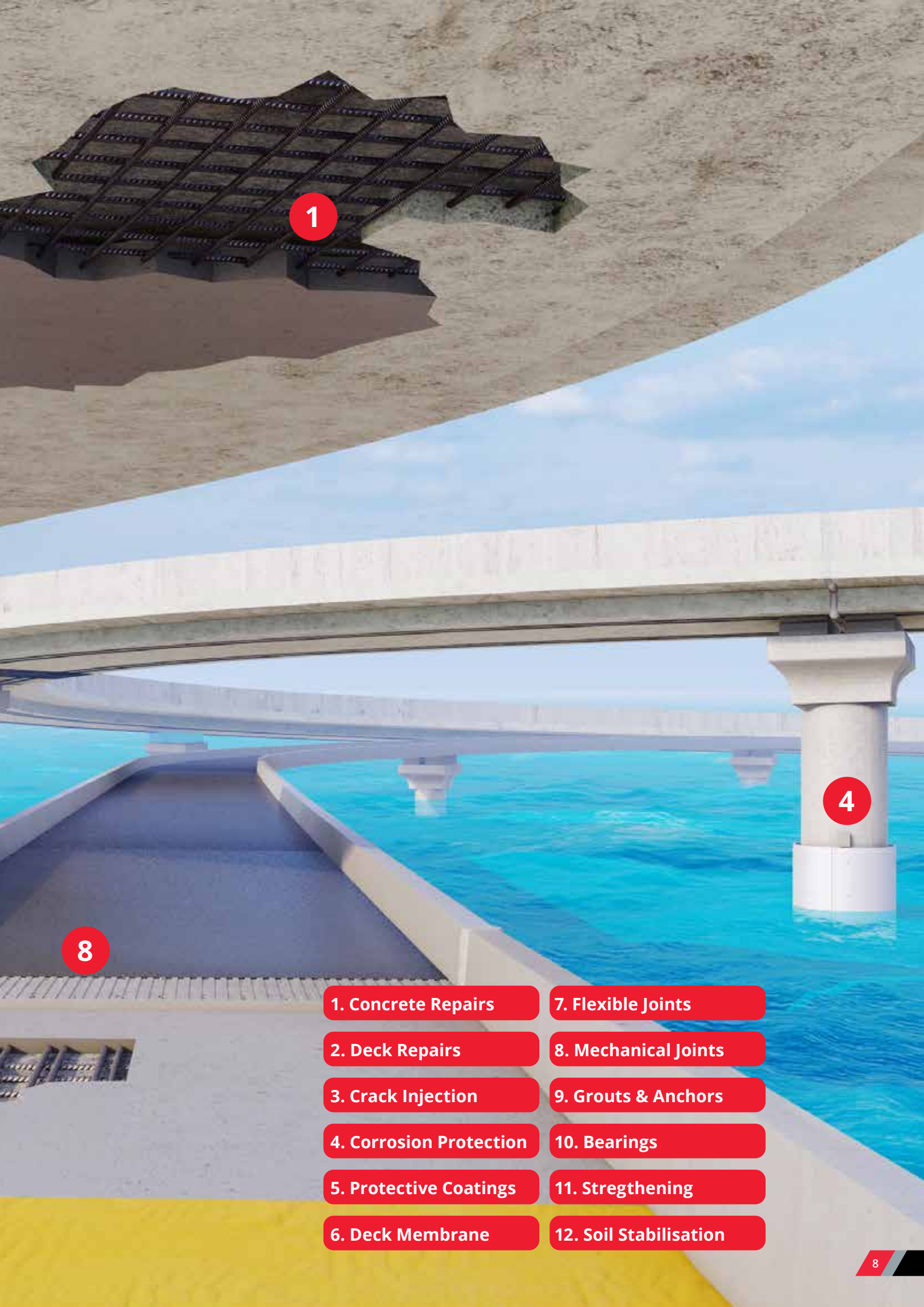
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1. Concrete Repairs

7. Flexible Joints

2. Deck Repairs

8. Mechanical Joints

3. Crack Injection

9. Grouts & Anchors

4. Corrosion Protection

10. Bearings

5. Protective Coatings

11. Strengthening

6. Deck Membrane

12. Soil Stabilisation



# CONCRETE REPAIR

Fosroc's solution portfolio for repairing damaged concrete is second to none. Renderoc mortars are tested for resistance to moisture and contaminants such as chlorides and carbon dioxide. They are modified to ensure that they do not shrink or crack.

The range of products includes:

- > Nitoprime Zincrich active reinforcement primer
- > Renderoc S & HB range of hand-applied cementitious mortars
- > Renderoc SP and DS spray applied cementitious systems
- > Renderoc LA fluid microconcrete
- > Renderoc FC reprofiling mortar
- > Nitomortar S high strength epoxy mortar
- > Nitofill Epoxy and Polyurethane crack injection materials

Repair systems are selected according to the problems encountered on site and the working conditions faced. Large or small repairs can be undertaken with minimum complication. Repair mortars are designed to perform systematically with the concrete to extend the life of the structure.

For small patches, or in difficult to access areas, hand applied repair mortars are ideal. Renderoc cementitious repair range allows applicators to build up repairs to depths of 30 to 80mm in vertical and overhead applications. This means that repairs can be applied swiftly and with minimal disruption and mess; making them a good solution for cradle or cherry-picker access.





# CONCRETE REPAIR

Larger section and structural repairs can often be conducted more effectively by casting. This technique involves the creation of formwork into which the repair compound is poured. Renderoc LA range of microconcretes are highly fluid with a fine aggregate that enables them to flow around congested reinforcement. They are ideal for deep section repairs.

In spite of its highly fluid nature, Renderoc LA does not shrink and has remarkable early age strengths. Formwork can be struck quickly and loads can be applied in only a few days in many circumstances. Importantly, Renderoc LA has a very smooth and impervious finish, restoring and maintaining reinforcement in its passive state.

Large section reinstatement repairs or overlays can be efficiently sprayed with proprietary mortar systems. Systems can be wet sprayed (mixed with water and fed through the hose) or dry sprayed (water added at the nozzle).

Spray systems are frequently used in conjunction with titanium mesh cathodic protection systems. The resistivity generally being suitable for this purpose.

Fosroc also supplies Nitoprime Zincrich steel primer, for enhanced corrosion protection, as well as acrylic primers to promote mortar adhesion.





## DECK REPAIRS

The repair of concrete decks is commonly the result of impact, abrasion or chloride attack. In bridges frequently this occurs around joints.

Because of the location, the repairs will interfere with bridge usage and therefore it is imperative that repairs are conducted rapidly and the structure is returned to service as fast as possible.

Repair sections are frequently wide and deep, so systems must be applied in bulk without shrinking or cracking. Trafficked surfaces must be hard wearing. Products applied beneath membranes must cure rapidly to ensure that they can be applied quickly and bond without issues or blistering.

Fosroc utilises many different formulation chemistries to ensure that repairs are functional and cost effective. Systems are optimised to meet the needs of the project in terms of speed and durability.

- > The Nitomortar range has ultra-rapid curing polyester mortars and hard wearing epoxies.
- > The Patchroc range of products contains high strength cementitious systems.





# CORROSION MANAGEMENT

Management of ongoing issues caused by chlorides, carbonation or other contaminants is critical to the long term performance of the structure.

Depending on the accessibility, severity and criticality of the structure, different techniques may be selected, either independently or as part of a combined system.

Surface applied corrosion inhibitor Protectosil® CIT, migrates through the concrete to protect reinforcement and also diminishes water uptake. Fast and economic to apply, in the correct applications it has been proven to increase service life by more than 10 years.

For semi-submerged piles and columns Fosroc Marine Jacket cathodic protection system has been used extensively on bridges and jetties. Forming a protective shell which encases a zinc mesh anode, it may be designed to provide galvanic protection for up to 50 years.

Renderoc DS and SP systems are frequently used as part of titanium mesh anode systems. Most Fosroc repair mortars and primers are compatible with leading galvanic anode systems.





## PROTECTIVE COATINGS

Although resilient, concrete and steel are subject to atmospheric attack over time. The action of moisture, chlorides and carbon dioxide cause corrosion of steel reinforcement which left unchecked can lead to premature repairs or even failure.

Coatings and impregnations can be applied at the time of construction as well as being part of a remedial solution. By impeding the ingress of moisture and contaminants they can add many years of life to a structure.

Accessing most bridges for application of coatings is difficult, disruptive and costly. It is therefore critical that coatings are selected with high durability in mind to increase times between maintenance cycles.

The Dekguard range of products are specifically formulated for the protection of reinforced concrete structures such as bridges. The range has been used and proven over many decades, exhibiting high resistance to atmospheric contaminants at the same time allowing the concrete to breathe. While being decorative in appearance, Dekguard coatings applied in a few microns thickness can provide many centimetres of equivalent concrete cover.

Nitocote SN range offers high range efficiency clear impregnations. Applied to concrete surfaces, they enhance water run off and minimises absorption, improving concrete performance with no visual effect.



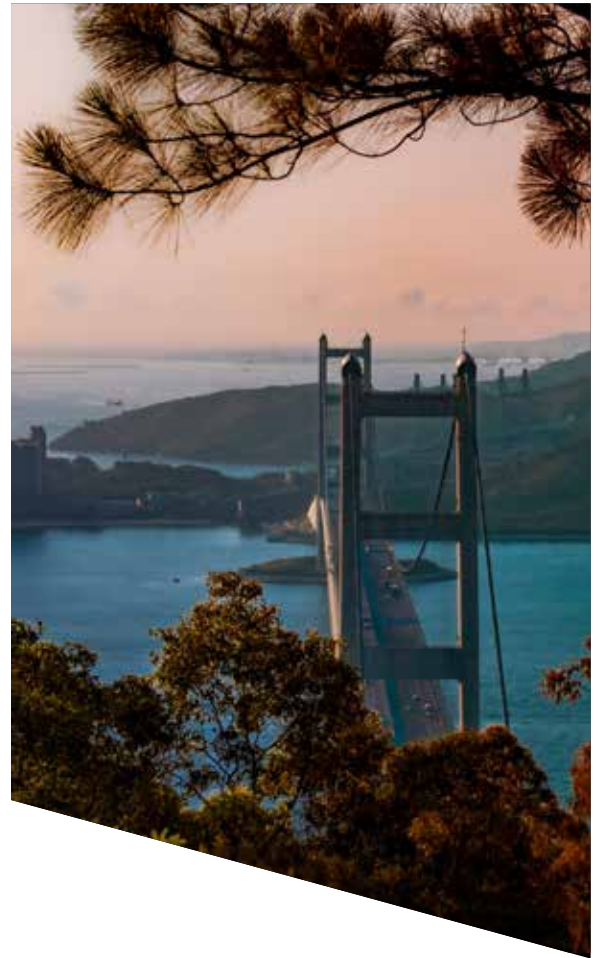


# PROTECTIVE COATINGS

Dekguard E2000 and Dekguard Elastic are water-based coatings with crack bridging properties. The elastomeric nature of the product means that fine cracks do not rupture the coating and allow ingress of contaminants. This makes them ideal for more dynamic structures or bridges affected by extremes of thermal changes.

Dekguard PU Polyurethane systems have excellent abrasion resistance and corrosion protection. Frequently used in areas where exposed steels are encountered or where loose chippings are likely to damage more lightweight systems.

- > Anti-carbonation coatings
- > Crack-bridging coatings
- > Zinc primers
- > Corrosion resistant coatings
- > Silane and siloxane impregnations
- > Surface applied corrosion inhibitors
- > Chemical resistant coatings
- > Abrasion resistant coatings
- > Surface repair and pre-treatments





# STRENGTHENING

Bridges frequently require strengthening. This may be due to loss of reinforcement, errors in design or construction, changes in load bearing requirements, changes in design standards or mechanical damage.

The use of composites to strengthen bridges is well established in the refurbishment sector. Fully composite bridges are now also becoming part of the market. Typically carbon fibre is preferred due to its high strengths and durability, though glass and aramid fibres may also be employed.

A major benefit of composites is that they are light and easy to handle. This means that systems can be applied in small shut-down windows such as night closures as only temporary access is required.

Key carbon fibre benefits are:

- > lightweight systems
- > rapid installation
- > minimal thickness
- > can follow curves
- > cut to size on site
- > highly durable and corrosion resistant
- > non-penetrative
- > no dead-load





# STRENGTHENING

Nitoplate CP are pultruded and resin bound strips, packed densely together for manoeuvrability. This makes them especially suited to strengthening overhead and on narrow sections such as beams. They are available in standard, medium and high tensile modulus grades in varying thicknesses and widths.

Nitowrap carbon fibre fabrics are ultra-light weight and flexible, making them ideal for strengthening irregular or curved sections such as columns and beams. Their wide spread of fibres also makes them suitable for distributing loads, such as on masonry structures or in seismic situations. Nitowrap is available in standard, high and very high e-modulus grades.

Nitorod CR are pultruded and resin bound rods, packed densely together. This makes them especially suited to being embedded in concrete as it minimises required break-out. They are ideal for carriageway surfaces or for inserting into cored areas. The surface profile is restored to normal and the fibres are protected from potential mechanical damage.

Fosroc provides bespoke epoxy resin systems for laminating and adhering our fibre systems. The fibre systems may be supplied in aramid or glass fibre upon request.





# JOINTS

The balance between flexibility and robustness required of bridge joints can be hard to find. With incorrect specification, movement joints rapidly become weak points of a bridge, allowing water ingress or causing mechanical damage. At important intersections this can substantially reduce the structures service life and lead to costly repairs of elements such as concrete, tendons or bearings.

Correct understanding of the bridge joints is vital to designing successful structures. Fosroc has a problem-solving suite of products and systems including mechanical joints and flexible sealants. Our team can assist with the correct specification and installation of joints considering the relevant movement and planes of movement, trafficability and chemical resistance.

Fosroc's range of solutions for bridge joints includes:

- > Trafficable neoprene mechanical joints
- > Steel and aluminium finger joints
- > Embedding mortars & grouts for mechanical joints
- > Transition strip mortars
- > 1 & 2 component polyurethane sealants
- > Polysulfide sealants
- > MS Sealants
- > Backing boards





# BRIDGE BEARINGS

Selecting the correct bearings for bridges is an important decision. Designers must consider the roles played by dead and dynamic loads, vibration, movements in different planes caused by wind loading, tensioning and thermal differentials as well as numerous other factors.

Importantly, high quality bearings should be designed to be durable and resist corrosion. Bearings placed near joints and half joints can be exposed to leakages which can cause bearing seizure if they have insufficient resistance. Damage caused by bearing failures can be considerable. Replacement of bearings and the damage caused by their failure is technically challenging, highly costly and disruptive.

Conbextra grouts offer full load support, in connecting the bearing with the structure. High early strengths can allow loading within just days, making the ideal for replacement bearing projects.

Fosroc can supply the following product solutions, individually or as part of a comprehensive package:

- > Elastomeric bearing pads
- > Bespoke manufactured pot bearings
- > Cementitious bearing grouts
- > Epoxy bearing grouts
- > Resin anchors





## DECK WATERPROOFING

A key element of maintaining structural integrity is ensuring that the bridge remains watertight, as moisture and environmental contaminants can cause corrosion of reinforcement and delamination of road surfaces. Deck membranes play a major role in this.

To ensure water tightness, materials and application must be of a high quality. Fosroc supports applicators in the field with inspection, training and advice. This covers specification, surface preparation, product mixing and application. Products are developed with usability in mind, to ensure that when they are on site in difficult conditions they have the best chance of successful application.

Fosroc offers two main systems for bridge deck waterproofing overlaid with hot rolled asphalt:

- > Fosroc Polyurea WH500 – Spray applied Polyurea
- > Nitoproof ET Slurry

Fosroc Polyurea WH 500 is EAD 030675-00-0107 certified (ETAG 033) giving high quality performance for use in bridge deck waterproofing projects.

The rapid spray application provides high productivity especially beneficial for large bridges where construction times can be kept to a minimum. Polyurea technology provides excellent waterproofing, crack bridging, elongation, puncture and chemical resistance found in typical bridge structures. Hot rolled asphalt is laid on top of the membrane as the finished wearing surface.



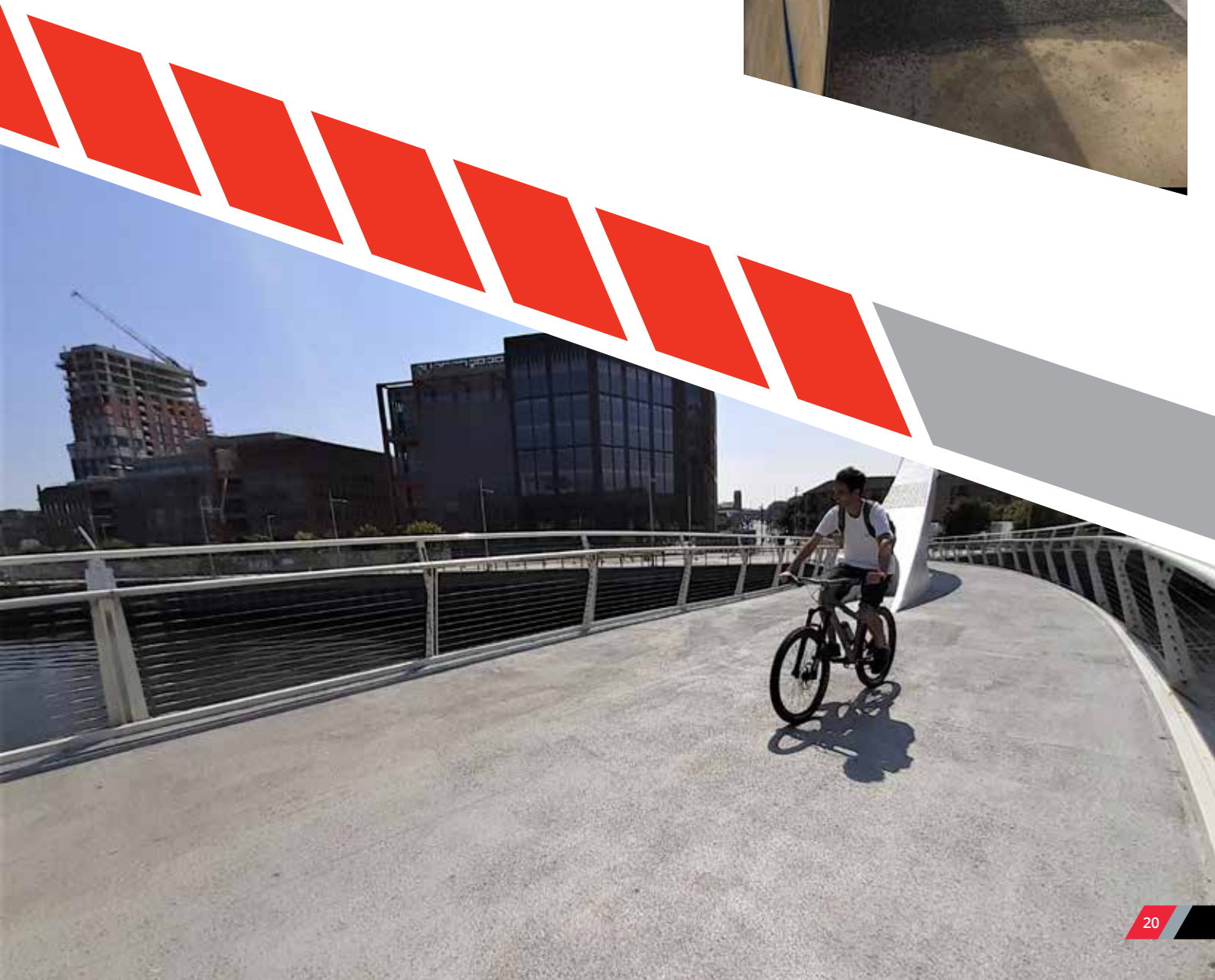


# DECK SURFACING

With a track record stretching back over 40 years Nitoflor ET Slurry (formerly Cicol ET Slurry) is an industry stalwart for finished bridge deck surfacing in many countries, from the cold climates of Scandinavia to the heat of the Middle East.

Nitoflor ET Slurry is hand-applied without the need for specialist equipment. Due to its good abrasion, impact and chemical resistance its finished surface provides an excellent final wearing layer for foot, cycle or vehicle traffic. It has excellent adhesion to common substrates like concrete and steel. It is also available in solvent and tar-free grade Nitoflor NT Slurry.

For pedestrian traffic, Nitodek FS system of PMMA membrane is highly popular due to the ultra-rapid application times, meaning it can be applied in short weather windows, cold temperatures and when fast return to service is just hours. It is highly elastic, ensuring watertightness even on very lively bridge decks. The variety of colours and textures available make it perfect for creating brighter streetscapes or demarkating special zones.



# CONSTRUCTIVE SOLUTIONS IN ACTION

Fosroc has supplied products, expertise, support and training to bridges, viaducts and elevated sections in many countries around the world. Below is a small selection of examples showing the depth and quality of work.



## Tsing Ma Bridge - Hong Kong

The Tsing Ma Bridge connects Hong Kong Island to Lantau Island and the airport, it is a iconic and vital part of the City's transport network.

High humidity caused fungal growth on the concrete and airborne chlorides were also a cause for concern. Therefore Fosroc Nitocote SN Creme was chosen as a highly effective impregnation to resist moisture. Applied as a cream, it meant reduced risk of spray and droplets falling to the traffic below or contaminating the sea. Dekguard E2000 provided crack bridging protection to lower parts of the structure.



## Haramin High Speed Rail - Saudi Arabia

The bridge, forming part of the rail connection between Mecca and Madina, was found to have deflecting beams caused by insufficient reinforcement.

Fosroc solved the problem by supplying Nitoplate carbon fibre laminates to provide load resistance and Nitowrap carbon fibre fabric to resolve shear issues. Cracks that had occurred as part of the deflection were injected with Conbextra EP10 epoxy resin to seal and structurally re-bond the concrete.



## Midland Links Network - UK

The repair of the Midland Links road network was estimated to be the largest concrete repair project in the UK. Fosroc developed solutions for repairs such as Patchroc 250, which could reinstate and entire deck depth in one application and be ready to receive membrane within hours. This accelerated construction programmes and reduced road closure time.

Many Renderoc repair products were supplied in 1 ton bags to accelerate mixing, reduce manual handling and save storage. The project received numerous industry awards for collaboration and innovation.



## King Christian X Bridge - Denmark

The historic and cherished bascule bridge in the heart of Sonderberg was constructed in the 1920's. As part of major renovation works Fosroc supplied Nitoflor NT Slurry to create a lightweight, trafficable deck membrane. The system was hand-applied and cured rapidly to enable the flow of traffic through the town throughout the works duration.

As part of the wider refurbishment solution, Fosroc supplied repair and protection products for the bridge deck and the structure.



# PRODUCT RANGE SELECTOR

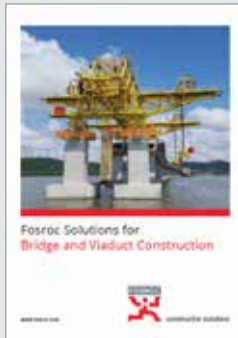
Below is a selection of Fosroc products that are particularly suited to bridge construction. They sit among many hundreds of supplementary solutions in our portfolio. Fosroc's technical team can help to select the right material for the specific need.

Application	Product	Description
Concrete Repair	Renderoc HB & S Range	Cementitious hand-applied repair mortars for high strength and resistance for use on new or old concrete defects.
	Renderoc LA	Fluid microconcrete for large section repairs or casting round congested reinforcement.
	Renderoc DS & SP	Cementitious repair mortar for dry or wet spray applications. May be used for large section repairs and overlays. May be used as part of a cathodic protection overlay system.
	Patchroc Range	Rapid setting deck repair compounds for repair and reinstatement of bridge decks. High early and ultimate strengths, in large sections without shrinkage.
	Nitomortar Range	Range of polymer mortars using epoxy or polyester resins for rapid return to service. Products are characterised by high early and ultimate strengths, wear resistance and resistant to water.
	Nitofill LV	Low viscosity epoxy injection resin for injection. Structurally bonds and permanently seals fine static cracks in concrete and masonry.
Corrosion Solutions	Protectosil® CIT	Surface-applied corrosion inhibitor. Dual action silane and corrosion inhibiting properties reduces the corrosion of reinforcement in contaminated concrete.
	Galvashield® XP & CC	Embedded galvanic anodes for control of ongoing reinforcement corrosion and prevention of incipient anode formation.
	Fosroc Marine Jacket	Cathodic protection system for concrete and steel marine piles. Prevents on-going corrosion and provides a durable physical protective jacket.
Concrete Protection	Dekguard E2000	Crack bridging anti-carbonation coating. Provides a decorative finish and high resistance to contaminants such as chlorides and CO <sub>2</sub> .
	Dekguard S	Robust anti-carbonation coating. Good resistance to abrasion and protection from contaminants. Ideal for areas exposed to road spray.
	Nitocote SN Range	Clear silane impregnations for concrete. Effective for concrete exposed for high moisture, humidity and airborne contaminants.
Structural Strengthening	Nitoplate CP	Thin section pultruded carbon laminates, providing high strength and ease of overhead application in strengthening bridge decks and beams.
	Nitowrap CW	Carbon fibre fabric, site laminated to provide additional strength to beams, decks and columns.
Mechanical Movement Joints	Fosroc Expansion Joint EJR	Moulded neoprene mechanical movement joint with reinforced steel joints. Accommodates high movement and traffic. Waterproof with high life expectancy.
	Fosroc Expansion Joint EJS	Steel mechanical finger joints. Waterproof movement in high trafficked areas. Compliant with AASHTO and EN standards.
	Nitomortar TS	Epoxy mortar with wear resistance for transition between mechanical joints and carriageway. Rapid setting with good CoTE and adhesion to steel, concrete and asphalt.
Bridge bearings	Conbextra BB	High strength cementitious grout for setting below or above bridge bearings.
	Fosroc Elastomeric Bearings	Rubber encased bloc bearing with embedded steel reinforcement plates. High absorption and movement accommodation with protection from water.
	Fosroc Pot Bearings	Steel pot bearings with multiple movement planes. Bespoke manufactured to size and movement requirements.
Bridge Deck Membranes	Nitoproof ET	Hard-wearing bridge deck membrane. Hand applied for use as an intermediate membrane. (Formerly know as Cicol ET Slurry)
	Nitoflor ET & NT Slurry	Hand-applied coal tar epoxy membrane overlaid with hot rolled asphalt. NT grade is coal tar free. (Formerly know as Cicol ET & NT Slurry)
	Polyurea WH 500	Highly elastic polyurea bridge deck membrane. Rapid spray application and fast setting with robust finish and crack bridging properties. EAD (ETAG) accredited system.

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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](http://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.



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