Fosroc Solutions for
Structural Strengthening

www.fosroc.com

FOSROC

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	Project Specifications	Site Support	Seminar & Training
A library of standard CAD details are available, bespoke CAD details can be created for your specific project	Dedicated specification managers on hand to assist with correct system choices and tailored solutions	Expert product and application support made available from our specialist teams.	Comprehensive programme of seminars and training courses designed to expand and reinforce your knowledge.

Leader in delivering
Constructive Solutions
Worldwide!

DEPENDABLE STRENGTH

The use of carbon fibre to strengthen reinforced concrete structures has been common practise for many years. The benefits of a strong, yet flexible material, which may be simply applied, are clear. Rapid installation and fast return to service are advantageous to installers and users of the structures. As designers become more familiar with the benefits of composites, the variety of uses increases.

Fosroc has been helping applicators, constructors and designers all over the world to strengthen and improve their concrete. Typically using carbon fibre solutions and bespoke epoxy adhesives which can be incorporated with a comprehensive concrete repair product range to provide an industry leading refurbishment portfolio.

With a track record of over 80 years in the construction chemicals industry, Fosroc is the ideal partner to select for any strengthening project. Nitoplate, Nitorod and Nitowrap are brands that have been literally upholding structures for decades. With performance characteristics that are among the best in the market, Fosroc's fibre strengthening solutions are the natural

ADVANTAGES OF FOSROC FIBRE STRENGTHENING

The use of Nitowrap, Nitoplate and Nitorod carbon fibre materials gives a variety of benefits to designers, installers and users of a structure. While the material prices of fibres may be initially higher than traditional materials, advantages gained in the speed of installation, reduced disruption to existing services and fast return to service, frequently means that whole project costs are substantially cheaper.

Lightweight Materials

- No additional dead loads from the materials
- No special lifting or propping required on site
- Reduced risk for operative safety

Slimline & Flexible

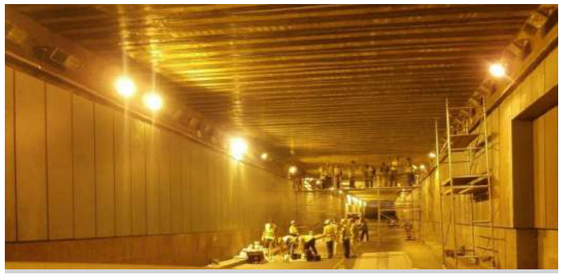
- Minimal impact on headroom or floor space
- Can shape to contours using fabric
- Easy to disguise application using overlays

Speed

- Installation with lightweight access
- Materials cut to size on site
- Minimum disruption to existing services - materials may be threaded under existing services

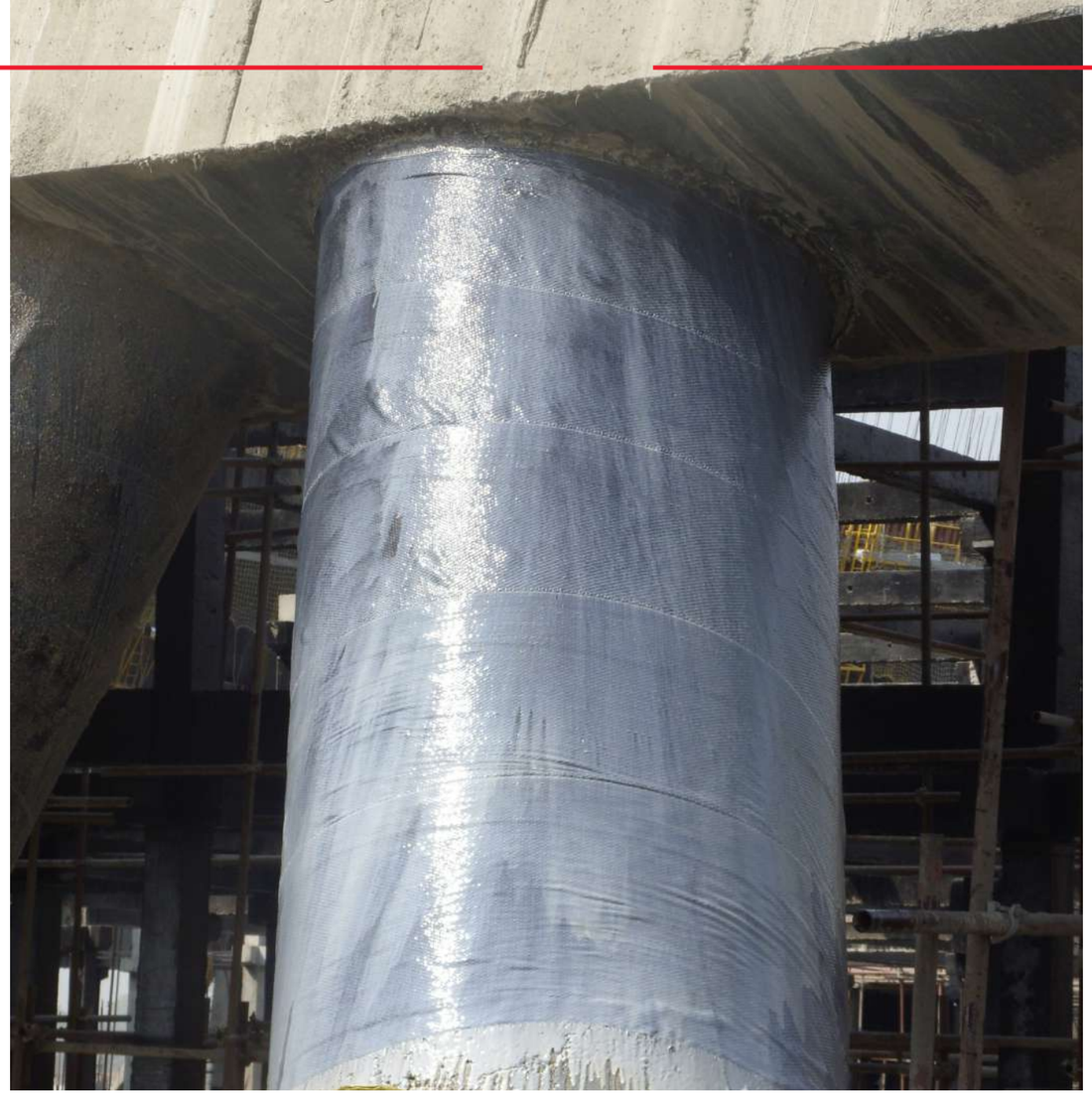
Durability & Strength

- No corrosion
- Industry design life >30 years
- High adhesion to concrete
- Nitorod may be embedded in concrete for protection against mechanical or chemical damage.



Nitoplate installed in night shifts using temporary access scaffolds

Nitoplate threaded beneath existing services



TECHNOLOGY & SUPPORT

Ensuring materials meet and exceed international requirements is a critical function of the technology team in every product that Fosroc sells, but few more so than in structural strengthening.

Resins are manufactured to the highest quality and tested to ensure peak performance. We select only the highest grade fibres for our Nitowrap, Nitoplate and Nitorod materials. Products have been tested to ensure engineering confidence for our users and specifiers.

The precise application of materials by trained specialists is critical to the performance of any strengthening system. Detailed guidance on best practise and precise method statements are available. Contractors and designers can be recommended to undertake works. Fosroc's local technical teams provide contractor support and training as part of a service package. They are on hand to recommend the most appropriate systems of repair and protection to complement the fibre range and provide a comprehensive structural solution.

All of this is factored in as standard practise to ensure designers, applicators, users and owners have peace of mind when Fosroc products are selected.

STRENGTHENING CIVIL STRUCTURES

Civil structures generally carry the greatest loads. Fosroc's systems are comfortably able to meet the demand.

Common Uses:

- Increase in live load capacity
- Changes to design codes
- Repair after fire damage
- Repair after corrosion damage
- Replacing lost pre-stress force
- Seismic strengthening
- Impact resistance

It is possible to apply Nitowrap, Nitoplate or Nitorod strengthening materials to structures while they remain in service. If dead-load propping is not required, fibres can be applied rapidly using temporary access, minimising disruption to the use of the infrastructure. Fibres add only a few millimetres to column radius or slab clearance, meaning that there is negligible change to the appearance and usage of the structure.

As Fosroc's strengthening products are ultra-lightweight, they have negligible impact on design dead-loads. Generally used as non-intrusive systems, carbon fibre strengthening techniques do not generally need to work around existing reinforcement. All of this makes the work of the designer much easier.

- Nitowrap surface applied fabric can strengthen columns and beams
- Nitoplate surface applied laminates can strengthen beams and slabs
- Nitorod near surface mounted reinforcing rods can strengthen slabs columns and beams.

- Nitowrap surface applied fabric can strengthen columns , beams , masonry and concrete walls.
- Nitoplate surface applied laminates can strengthen beams and slabs

STRENGTHENING BUILDINGS

Buildings have increasing demands for changes in use and improvements often lead by updated design codes. Fosroc systems are sleek and fast to install, meaning downtime is minimised and space is maximised.

Common Uses:

- Increase in live load capacity
- Adding additional levels
- Change of use/design codes
- Wind loadings
- Cutting through structural members
- Removing supporting members
- Repair after fire damage
- Repair after corrosion damage
- Replacing lost pre-stress force
- Seismic strengthening
- Impact/blast resistance

Strengthening works using Nitoplate and Nitowrap are frequently undertaken while structures are still in use. The lightweight and thin nature of the materials means that the fibres can be placed in and around services and access can be obtained using simple temporary platforms.

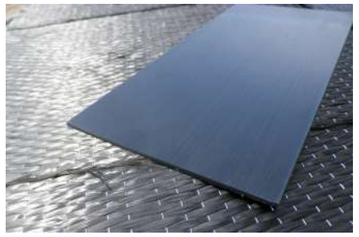
For owners and users of the structure the benefits are many. The impact of shutting down a structure may be reduced or eliminated entirely and return to full service is rapid. There is negligible impact on headroom, floor space and sightlines, opening structures to all sorts of possibilities.

THE PRODUCTS

Fosroc have been strengthening structures with carbon fibres since 2001. Our range of products includes epoxy adhesives for each system, carbon fibre wraps, plates and rods, as well as glass and aramid materials for bespoke applications.

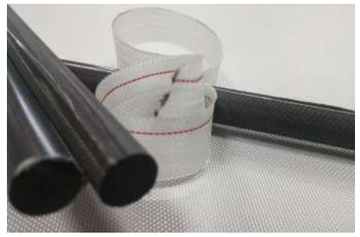
NITOWRAP CW

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 is standard , high and very high e-modulus grades



NITOPLATE CP

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.



NITOROD CR

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.

NITOPLATE CPA30

Nitoplate CPA30 is used with both a thixotropic epoxy paste that has excellent high grab, ensuring no dripping resin or plate peeling when working overhead.

ARAMID & GLASS FIBRES

As well as carbon fibres, Fosroc can supply glass fabrics, aramid fabrics and plates upon request.
Glass fabrics are normally an economic option for lightweight strengthening but do not offer the benefits of strengths that come with carbon fibre. Aramid fibres generally exhibit better elongation values, and are therefore regarded as a good option for impact protection.

NITOWRAP RESINS

Nitowrap Encapsulation Resin is designed specifically to saturate the fabric as it is placed onto the concrete, using the dry-wrap method. Its exact viscosity allows it to sit on the concrete but penetrates the fabric perfectly when rolled. Nitowrap Primer ensures that the Encapsulation resin is not absorbed by the concrete.

PROTECTION SYSTEMS

Depending upon the structure, it may be necessary to cover the strengthening system for a number of reasons, such as aesthetics, UV protection, chemical protection, impact protection.

Fosroc provides a wide variety of compatible coatings and overlays for use with our strengthening systems, and can fit them to the needs of your project.

MATERIAL PROPERTIES - NITOPLATE CP

Product Grade	Product Code	Thickness (mm)	Width (mm)	Cross Sectional Area (mm^2)	Fibre Density (g/cm^3)	Tensile Modulus (N/mm^2)	Tensile Strength (N/mm^2)	Tensile strength at break (x N /mm^2)	Flexural Strength (N/mm^2)	Ultimate Elongation (%)
CPS	212	1.2	20	24	1.5	165,000	>3,000	3,050	1,670	1.7
	512		50	60						
	612		60	72						
	812		80	96						
	912		90	108						
	1012		100	120						
	1212		120	144						
	214	1.4	20	28	1.5	165,000	>3,000	3,050	1,670	1.7
	514		50	70						
	614		60	84						
	814		80	112						
	914		90	126						
	1014		100	140						
	1214		120	168						
	1514		150	210						
CPM	514	1.4	50	70	1.6	>210,000	>2,800	2,900	1,470	1.2
	614		60	84						
	814		80	112						
	914		90	126						
	1014		100	140						
	1214		120	168						




MATERIAL PROPERTIES - NITOROD CR

Product Grade	CRS					CRH			
Product Code	060	080	100	120	160	080	100	120	160
Diameter (mm)	6	8	10	12	16	8	10	12	16
Cross Sectional Area (mm^2)	28.3	50.3	78.5	113.1	201.1	50.3	78.5	113.1	201.1
Fibre Content	>68%					>68%			
Fibre Density (g/cm^3)	1.8					1.82			
E Modulus (N/mm^2)	165,000					210,000			
Tensile Strength (N/mm^2)	3,000					2,800			
Tensile Strength at break (N/mm^2)	3,100					2,900			
Flexural Strength (N/mm^2)	1,670					1,470			
Ultimate Elongation (%)	1.7					1.5			

MATERIAL PROPERTIES - NITOWRAP CW

Product Grade	CWS						CWH	CWHM	
Product Code	200	230	300	450	530	610	300	300	400
Fibre Density g/cm^3	1.8						1.82	2.12	
Fibre Area Weight (g/m^2)	200	230	300	450	530	610	300	300	400
Standard Roll Width mm	500						500	500	
Standard Roll Length m	100	100	100	50	50	50	100	100	50
Design Thickness (mm)	0.111	0.131	0.166	0.255	0.293	0.337	0.167	0.145	0.190
Ultimate Elongation	2.1%						1.4%	0.4%	
Fibre Strength (MPa)	>4,900						>4,600	>1,900	
Fibre E-modulus (GPa)	>230						>340	>640	
Tensile Strength (kgf/cm^2)	390	450	590	875	1050	1200	544	280	360
Tensile Strength - Design Value (kgf/cm^2)	35,500						32,630	19,370	
Tensile E-modulus - Design Value (kgf/cm^2)	$2.35x10^6$						$3.467x10^6$	$6.526x10^6$	

The tables are provided for general material properties and not for use to design. Check Local Technical Data Sheet for most up to date information for use in design.

GLOBAL CASE STUDIES

Below are a number of selected case studies from around the world showing some the variety of structures and solutions available using Fosroc's Carbon Fibre Strengthening Solutions.

Piata Muncii, Bucharest, Romania

The need for improved city infrastructure in the expanding city of Bucharest meant that a tram link was to be installed on the busy plaza. Beneath the plaza, the live load carrying capacity of the underpass' slabs required strengthening, as well as repairs and protection due to age-induced corrosion. Repair mortars and Nitoplate CPS strips were installed in night shifts, requiring only minimal disruption to the daily traffic flow while the works progressed. The works were then over-coated and the soffit protected using Fosroc Nitocote and Dekguard products.

Nation Towers, Abu Dhabi, UAE

Improvements to the structure meant that a new ventilation shaft was needed in the basement. As vital services were running across the soffit of the slab, it was imperative that the installed system should cause as little disruption as possible to the function of the building. Nitoplate CPS was an ideal solution to redistribute the lead around the cut opening, as it could be threaded through and beneath ducts without removing them.

NTPC Power Station, Simhadri, India

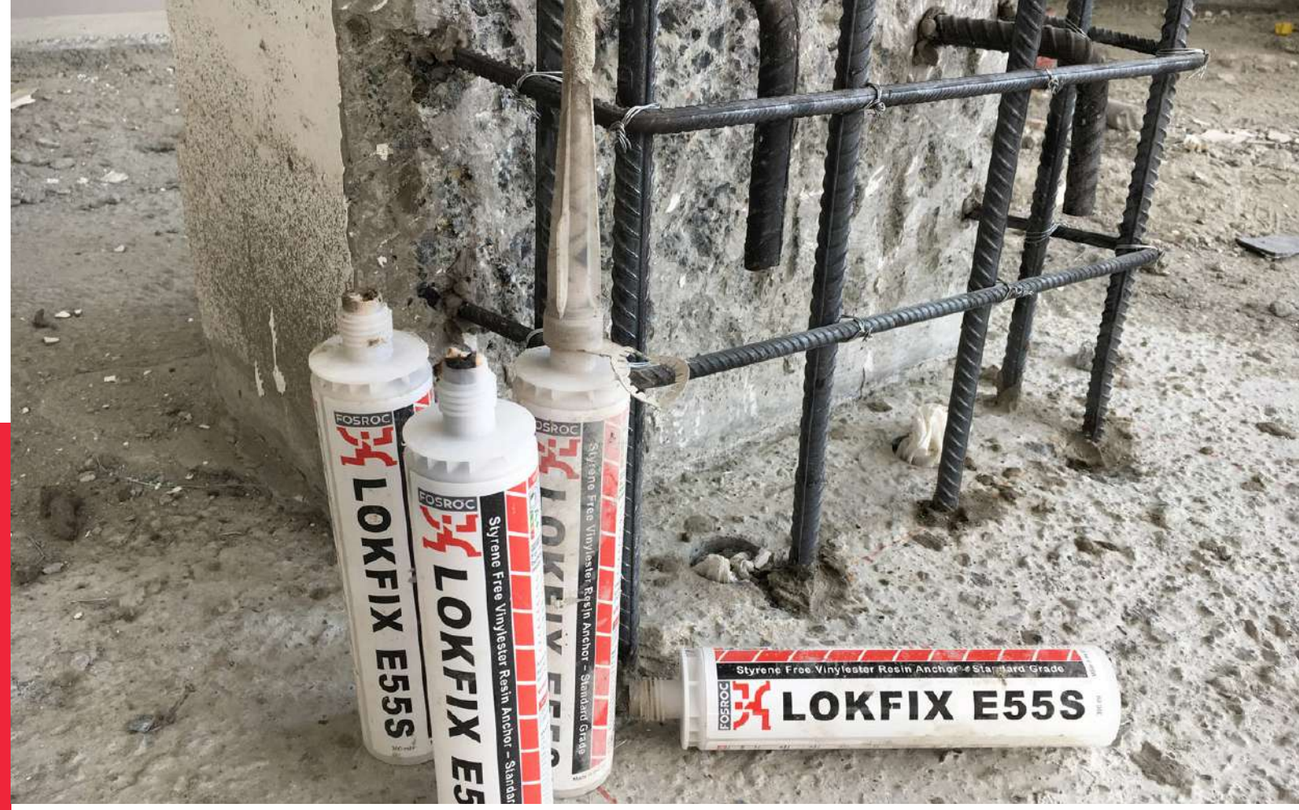
A large typhoon caused such damage that a pile was broken on the vital seawater intake jetty, causing major deflection in the main deck. Re-piling would have meant shutting off the power station for weeks, even months. Designed in conjunction with IIT Madras, a steel brace was hoisted into place to support the span. The steel was strengthened with Nitowrap CWS300 to improve flexural rigidity and provide a layer of reinforced corrosion protection. The repair was implemented without the power station being shut down.

Banco de Espana, Toledo, Spain

This disused bank in the historic old quarter of Toledo was transformed into a regional administrative building. As part of the process, the structure had to be strengthened to improve load carrying capacity. Fosroc's Nitoplate CPS was able to provide the structural improvements while retaining the old building's original appearance and not impacting headroom. The speed of the installation method assisted the construction schedule.

Haramain High Speed Railway, Saudi Arabia

The 444km high speed rail link is a key piece of new infrastructure linking the main cities of the Kingdom. A miscalculation in the original design of one span of elevated section lead to deflection and cracking of the beams. If it could not be strengthened it would have to be replaced at great cost and delay to the project. The section was propped up while Nitoplate and Nitowrap materials were applied and cured, and the cracks were sealed using Nitomortar. When the props were removed, dead-load was transmitted into the fibres.



OTHER FOSROC SOLUTIONS FOR STRUCTURAL REPAIRS AND UPGRADES

Although the use of carbon and other types of Fibre is increasingly common, it is not the only method for strengthening concrete. Fosroc is also able to provide a number of solutions to other types of strengthening works that are undertaken every single day.

Crack Injection

Structural cracking may be repaired using Nitofill LV. This low viscosity epoxy is easy to inject using packers, surface flanges or gravity feeding. It structurally bonds cracks to restore the concrete's original strength and resistance.

Anchoring Reinforcement

Lokfix E resin anchors are used to structurally fix in new reinforcement to existing concrete. Their high strength ensures that load is transferred into to new bar without stressing the surrounding concrete. They have been tested rigorously to European design codes and have seismic testing.
Fosroc also supplies structural adhesives for bonding concrete such as Nitobond EP.

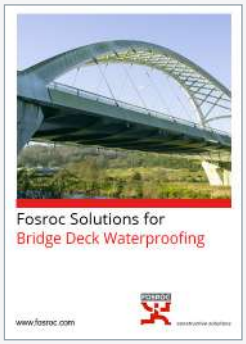
Spray Overlays

For adding large overhead and vertical layers of additional concrete, spraying is a fast and accurate placement method which requires no formwork.
Dry Spray with Renderoc DS or wet Spray with Renderoc SP as pre-bagged materials. Sprayset HBL range of liquid shotcrete accelerators is ideal for concrete.

Re-casting Concrete

Additional layers of reinforced concrete may also be cast. With small aggregate and no shrinkage, Renderoc LA pre-bagged microconcrete products have been designed for this purpose. They get round congested reinforcement with ease, leave an excellent cast finish and develop high early strengths

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



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