



Fosroc Solutions for Tunnelling

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, 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!



FOSROC TUNNELLING SOLUTIONS

Due to the growing concern from environmental issues and the decrease of available urban land, the demand for tunnel construction is on the increase. Alongside these demands, the technological developments in construction methods, applications and products have shown substantial progress in recent years.

In today's tunnel construction market, clients and contractors are searching for more efficient ways that can result in tangible cost savings. Recognizing this fact, Fosroc have developed their business to give guidance to Engineers and Contractors, providing them with the tools to choose the best possible system solutions, specifically tailored to meet their project requirements. Fosroc are constantly improving the technology performance of their products, striving to provide solutions that reduce construction times, maintenance and safety concerns whilst simplifying installation methods and increasing long term durability.

Fosroc Tunnelling can provide you with customised solutions which include:

- > Our site specialists advise on the most efficient and economical solution for your project in close collaboration with the project site personnel. Supported by regional development and research centres, our tailored solutions are innovative, practical and economical.
- > Project specific mixes using admixtures that deliver low hazard, high productivity and long-term durable concrete and shotcrete
- > Accelerators for high performance shotcrete
- > Multi-system choices for waterproofing, grouting, repairs, injection resins, waterstops, drainage membranes, polypropylene fibres, release agents and surface retarders
- > Technical specifications, testing and reports

TUNNEL CONSTRUCTION METHODS

Tunnel construction is a sophisticated process that requires a complete range of “smart” materials that are capable of performing with concrete structures, soil, and machines. Depending on the tunnel construction method, Fosroc provides the appropriate solution to ensure that the construction process progresses smoothly and efficiently.

The four main types of tunnel construction methods are:



TUNNEL BORING MACHINE



NEW AUSTRALIAN TUNNELLING METHOD



CUT & COVER METHOD



DRILL & BLAST METHOD



SHOTCRETE

Getting the correct concrete mix design is key to successful Shotcrete application. Blending the superplasticisers, pumping admixtures and accelerators with the local cements and chosen spray equipment is a unique challenge for every project. Fosroc has experience with getting the right mix design, obtaining rapid set while still achieving the required ultimate strengths.

With or without fibres, Fosroc's range of accelerators work to gain good adhesion to the substrate and develop strength early, creating a safer working environment for all. We look to minimise dust and rebound, improving productivity in the tunnel and making a healthier working area. If there are project delays, we provide set retarders to reduce wastage.

Fosroc is your ideal partner to provide assistance from design phase to on-site support, selecting from their extensive range of Shotcrete admixtures.

Product	Benefits
Sprayset HBL Range	Liquid accelerator Alkali-free and low dust emission - improved working environment Rapid set - fast application Low rebound - less wastage
Conplast Sprayset Range	Powder accelerator Suitable for concrete and mortar applications Allows faster build and permits rapid overhead spraying
Fosfiber TL	PP fibers - No corrosion problems >750J energy absorption Economical system



FIBER-REINFORCED SHOTCRETE

Fibre-reinforced shotcrete is a perfect combination for a versatile, cost-effective and quality shotcrete applications. It will give:

- > Considerable improvement in the sprayed concrete ductility
- > Higher tensile strength
- > Improved adhesion strength
- > Reduced early shrinkage cracking

Typical applications:

- > Road & Rail Tunnels
- > Hydropower Tunnels
- > Concrete Repair
- > Water Channels
- > Slope Stabilization
- > Artificial Rock

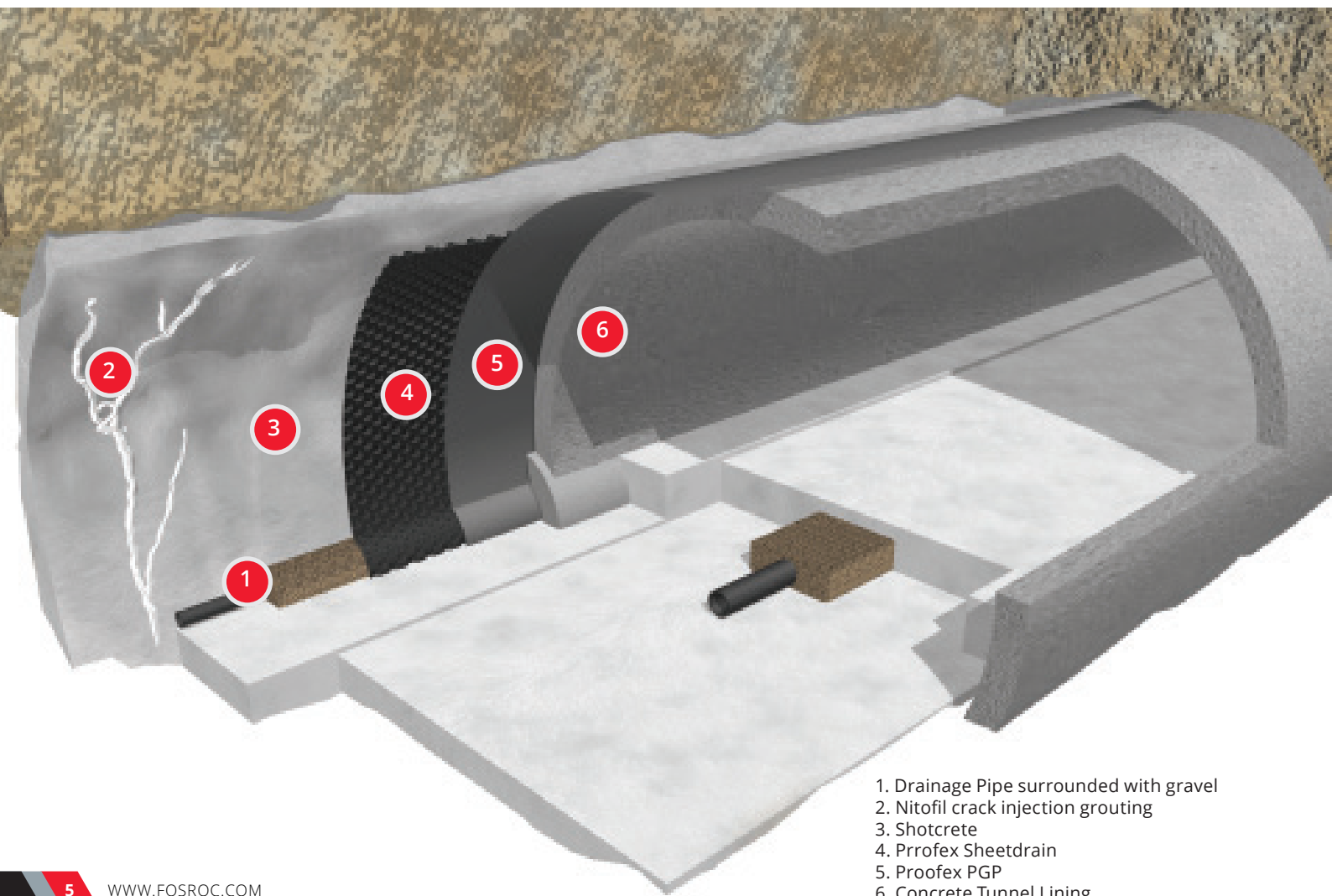
WATERPROOFING

Most major decisions for tunnelling projects begin with adequate knowledge of the specific ground conditions and how to design the structure around these. The method of dealing with water from the surrounding ground is an important consideration; and if not designed, assessed and applied properly in the first place, it will cause leakages that can result in expensive remedial costs.

Fosroc have extensive worldwide experience in the waterproofing of below-ground structures and can offer several solutions for the tunnel sector from their broad portfolio. Fully-bonded waterproofing systems provide the highest level of waterproof protection, these can be either in sprayed form or by pre-applied membrane.

Fosroc comprehensive waterproofing range provides solutions that are applicable for TBM, NATM, Cut/Cover and Drill/Blast tunnel methods.

Application	Product	Benefits
Fully bonded waterproofing	Proofex Engage Fosroc Polyurea WPE	Assured waterproofing due to mechanical bond to fresh concrete Excellent non water-tracking performance Easy and quick installation
Loose-laid waterproofing	Proofex PGP	Highly flexibility PVC membrane for tunnels Suitable for compartment system applications
Drainage membrane	Proofex Sheetdrain	Rapid water dispersion due to high flow capacity
Concrete joints	Supercast SW Supercast PVC Supercast Predimax Inj.Hose Expoband H45	Basic polymer swellable waterstops giving excellent long term wet/dry cycle durability Economical PVC profiles Injection hose for protection against potential and active leak in joints in concrete Hypalon sheet - giving high movement capability
Segment Gaskets	Tunnel Segment Gasket	Excellent long-term wet/dry cycle durability



1. Drainage Pipe surrounded with gravel
2. Nitofil crack injection grouting
3. Shotcrete
4. Proofex Sheetdrain
5. Proofex PGP
6. Concrete Tunnel Lining

FOSROC PROOFEX ENGAGE

A pre-applied fully bonded waterproofing system

- > Unique mesh system that bonds permanently to concrete, remaining in place even if settlement occurs
- > Smart anti-tracking design prevents lateral migration of water
- > Robust and resistant to hydrocarbons and aggressive soil salts

It is the ideal waterproofing system for Tunnels, TBM Shafts and Stations

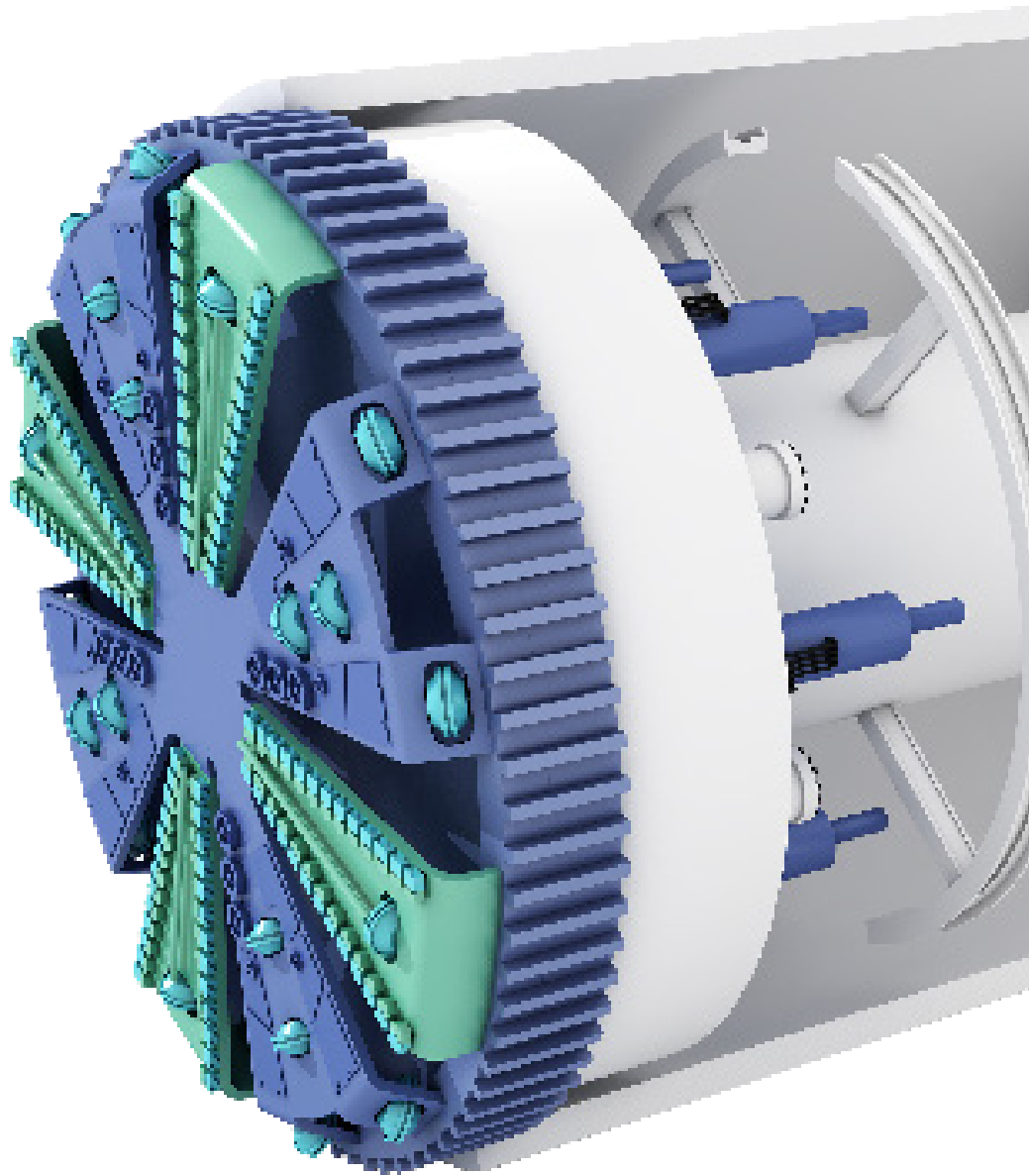


TUNNEL BORING MACHINE SOLUTIONS

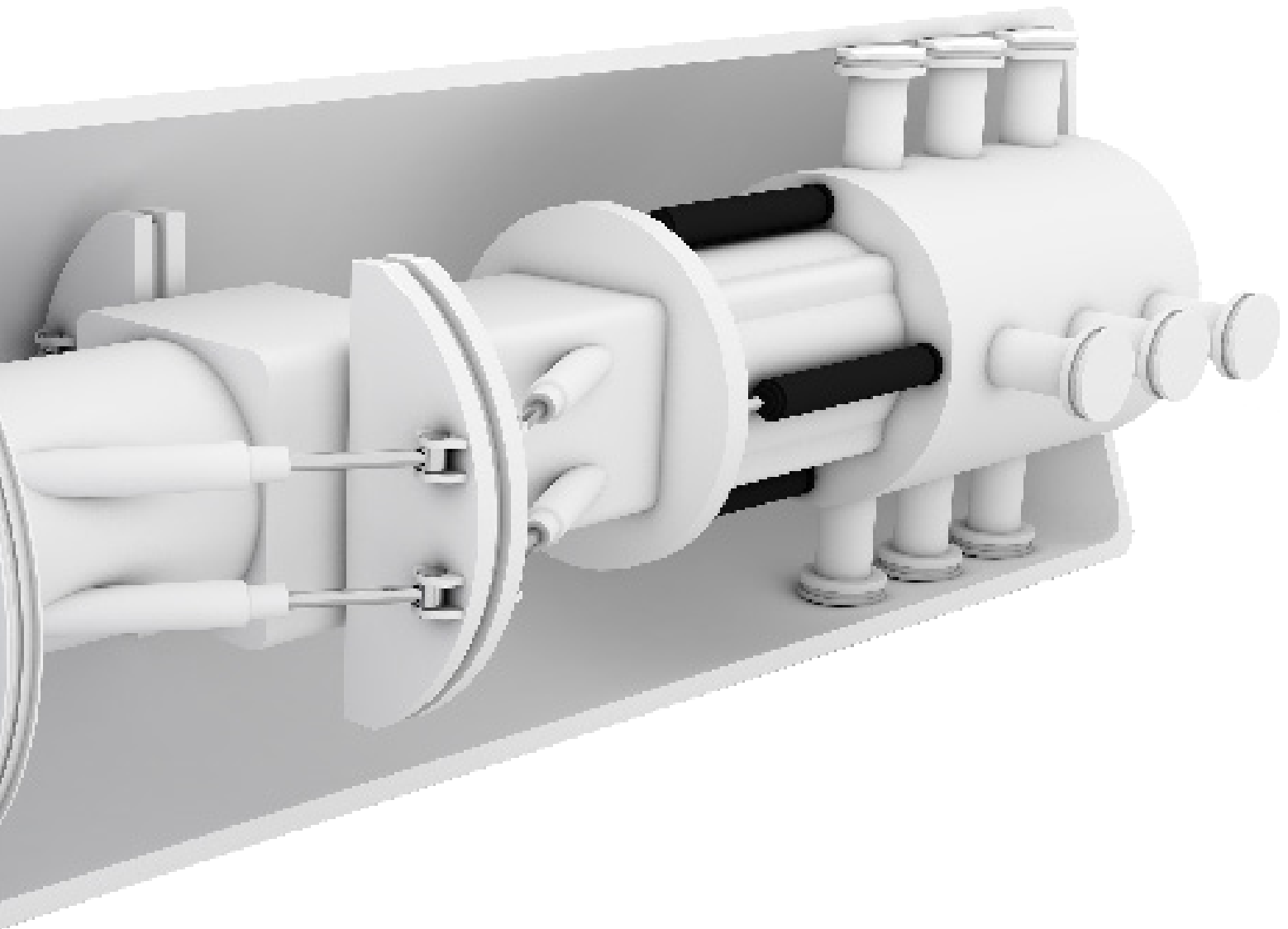
TBM mechanized tunnelling is the safest tunnelling construction method. It is especially efficient in long tunnels in urban areas, and especially where soft ground is encountered. The optimum TBM performance requires "smart" materials that can be customized to suit different geological conditions as the tunnel building progresses.

Fosroc TBM materials are engineered to ensure that tunnel boring operates efficiently and smoothly. Fosroc is a one-stop solution provider for TBM tunnelling products. With its highly experienced technical team, Fosroc provides a tailored solution that can be customized to suit different types of TBM's and for different geological and soil conditions. Fosroc TBM materials are:

- > Annulus grout
- > Segment admixtures
- > Soil conditioners & Foaming agents
- > Anti-wear & Dust suppressors
- > Chamber cleaners
- > Tail sealants bearing grease



Product	Description	Benefits
Nitotunnel TFA	Soil conditioning foam for shielded Tunnel Boring Machines	Easier mucking, improved soil behaviour, better environment
Nitotunnel TFA2	Soil conditioning foam for shielded Tunnel boring machine	Improved transfer of muck and wetting agent for dry soil conditions
Nitotunnel TFA3	Soil conditioning foam for shielded TBM for clay conditions	Improved transfer of muck, Reduction of wear on cutter head
Nitotunnel MA	Liquid anti-abrasion agent for hard rock	Reduced abrasive wear on cutter head and improved transfer of muck
Nitotunnel DS P1	Soil conditioning liquid Polymer agent	For poorly graded water saturated ground, turns wet soil into manageable consistency
Nitotunnel DS P2	Soil conditioning liquid Polymer agent	Reduce wear on moving mechanical parts of the TBM
Nitotunnel T1	First fill tail sealant for shielded tunnel boring machines	Seals gaps between shield and segments to prevent ingress of water grout and soil
Nitotunnel T2	Tail sealant for shielded tunnel boring machines	Seals gaps between shield and segments to prevent ingress of water grout and soil
Conbextra AGB	Bentonite based Annulus Grout	Ground stabilisation and reaction to water preventing hydrostatic build up.



TUNNEL BORING MACHINE MATERIALS



Soil Conditioners & Foaming Agents

Foaming agents are essential to facilitate ground excavation while boring. Foams are the backbone structure of soil conditioning system for heterogeneous soils.

They help modify the compressibility of the soil, reduce its inner friction and create a homogeneous paste inside the working chamber.

To ensure cleaner working environment and maximize TBM efficiency.

Fosroc Product Range: **Nitotunnel TFA & Nitotunnel DS**



Annulus Grout

The annulus grout applications must be safe and reliable; they require specific selection of accelerators, retarders and stabilizers to ensure permanent filling of the annulus void around the tunnel segments and prevent settlement.

To fill of the annulus void and provide permanent stability for the tunnel segments.

Prevents water pressure build up and contains anti-wash-out properties and bentonite.

Fosroc Product Range: **Conbextra AGB**



Tail Sealant

The tail sealant must be reliable and cost-effective in sealing the TBM tail shield and prevent the ingress of water, and soil as well as the annulus grout.

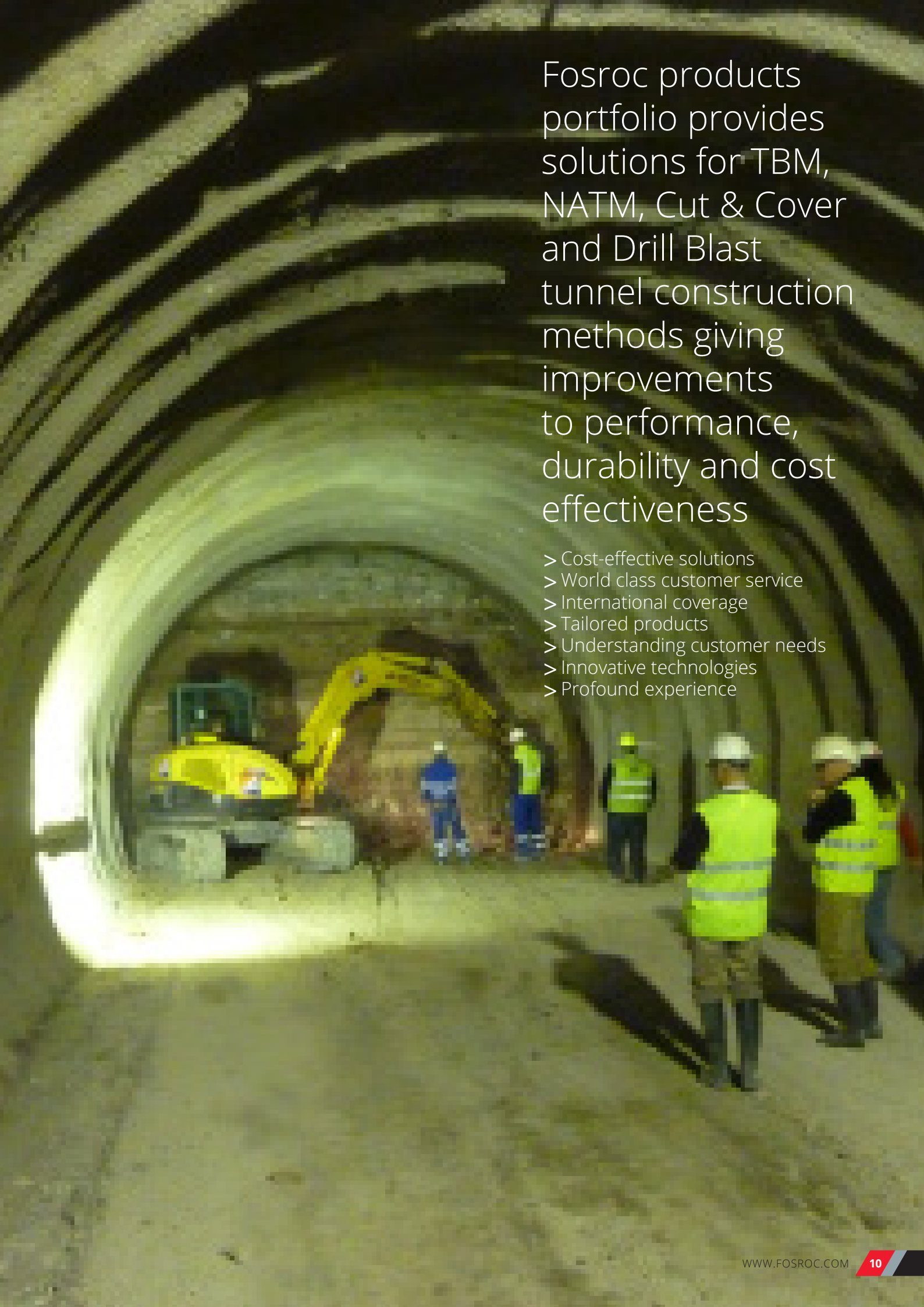
To protect the machine from pressurized water, soil and the like.

Fosroc Product Range: **Nitotunnel T**

FOSROC TUNNELS SOLUTION RANGE

Application	Product	Benefits
Readymix, Precast & in-situ concrete	Structuro PC admixtures	Low w/c ratios with extended flow even in hot climate Self-compacting Increased early & long term strength of concrete Quicker turnaround for moulds in precast applications Reduced overall application costs
	Conplast SP Superplasticiser admixture	Reduced w/c ratio Improved strength development Improved fresh and hardened concrete properties Reduced overall application costs
Pumped Concrete	Conplast RP Hydration control admixture	Improved flexibility in site logistics and application
	Conplast PA Pumping aid	Improved concrete pumping even for longer distances with lower pumping pressures Enhanced performance of concrete when using crushed or poorly graded aggregates
Fibre reinforcement & passive fire protection	Fosfibre PP fibres	No long term corrosion issues Reduced equipment wear – less downtime and maintenance costs
Concrete repair	Renderoc	Fast setting, high strength, high-build
Crack repairs	Nitofil Range	Resin injection – for dry and wet repairs
Anchoring	Lokfix range	1K and 2K systems for vertical, overhead & horizontal
Grouting	Cebex and Conbextra range	Cementitious and resin systems Thixotropic and pumpable grades
Waterproofing	Proofex & Supercast Range	Fully bonded waterproofing systems and waterstops
TBM Materials	Cebex TFA range Cebex DS range Conbextra AGB Nitotunnel T range	Full range of TBM materials: Soil conditioners, Dust Suppressors, Anti-clay materials, Foaming Agents, Tail Sealants, Bearing Grease and Annulus Grout

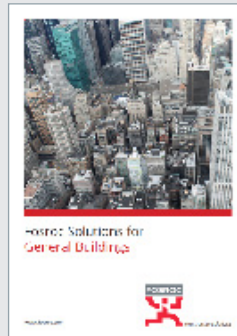
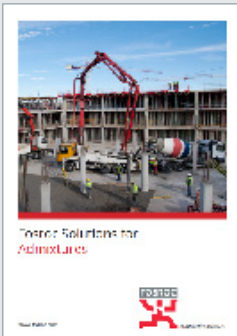
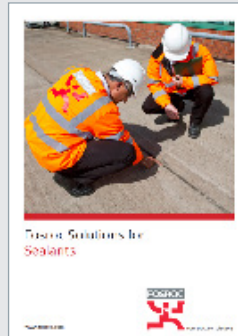


A large tunnel under construction, illuminated by bright lights. In the foreground, several workers wearing high-visibility yellow vests and hard hats are standing. In the background, a yellow excavator is visible, working on the tunnel walls. The tunnel's structure is made of concrete or steel, with a series of arches visible.

Fosroc products portfolio provides solutions for TBM, NATM, Cut & Cover and Drill Blast tunnel construction methods giving improvements to performance, durability and cost effectiveness

- > Cost-effective solutions
- > World class customer service
- > International coverage
- > Tailored products
- > Understanding customer needs
- > Innovative technologies
- > Profound experience

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.



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