

Water Management

Solutions for Underground Construction



Master Builders Solutions®

As Master Builders Solutions®, we are a leading global producer of responsible solutions for the construction industry, focussed on delivering our vision: *Inspiring people to build better.*

We provide value-added technology and market-leading R&D capabilities to improve the performance of construction materials and to enable the reduction of CO₂ emissions in the production of concrete. The comprehensive portfolio under the Master Builders Solutions® brand encompasses concrete admixtures, cement additives, and solutions for underground construction.

We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide, leveraging global technologies, as well as our in-depth knowledge of local building needs, to develop innovations that help make you more successful and drive sustainable construction.

Founded in 1909, Master Builders Solutions® operates 35 production sites globally, supporting you in mastering your building challenges of today and tomorrow – for a decarbonised future.



Water management for safe, cost-efficient and reliable underground constructions

The tunneling and underground construction industry is facing enormous challenges today: Our clients are aiming at fast economical excavation and construction, low maintenance costs, and 120 years of service life. Stations, caverns, shafts, or tunnels should be attractive, safe and comfortable more than ever. Ground water ingress through concrete and water-proofing systems is feared by contractors and owners because it poses a major threat to their goals.

The challenge is to find the water management solution best suited for the type of tunnel and ground conditions. And this is where we come in. Master Builders Solutions®

provides you with high-end water management solutions that are extremely effective, long-lasting, and easily applied. Depending on the type of underground construction you are working on, we offer some pioneering waterproofing technologies with maximum safety and easy maintenance.

Our product systems are tailored to the specific requirements of underground construction designs and various ground conditions. Our water management solutions not only include sheet and spray-applied membranes for optimum water-tightness in Drill & Blast/NATM tunnels and flexible elastic coatings for Cut and Cover tunnels, but also pre-injection technologies to help protect the environment and improve the ground.

Mastering underground construction challenges requires the right partner. Continuous innovation and customized solutions ensure that customers using Master Builders Solutions® operate successfully, and to the highest safety standards.

Global underground construction team

Master Builders Solutions®, with its global underground construction team, provides reliable, customer-oriented solutions focused on your needs in the tunneling and mining industries all over the world. We recognize that your success is underpinned by our ability to deliver solutions that meet or exceed your critical needs. By accompanying you from the start of your project and understanding the issues that are important to you, we can contribute to your success. We support you with product training and quality control, and our professional technical services team is on hand around the clock, helping you with specialist technical advice and trouble shooting.

Our comprehensive portfolio:

- Concrete admixtures
- Cement additives
- Chemical solutions for underground construction



Waterproofing Solutions for Drill & Blast/NATM Tunnelst

Are mitigating measures necessary to improve conditions and make construction easier? Are proven sheet membranes the right choice, or rather innovative spray-applied double-bonded membranes? We can give you sound advice on which water management technologies are the best match for your specific project. measures to reduce the wear at the cutterhead and at the screw conveyor level. To apply the MasterRoc® ABR additives in the most efficient way, a semi-automatic foam system is needed, specially designed for use on hard rock TBMs.

On the safe side with pre-injection

Unexpected water ingress and bad ground conditions are feared among contractors working in underground construction. There are high costs involved, the environment takes damage, and construction time is delayed. Thankfully, there is a cost- and time-efficient approach to minimize the risk. Pre-injecting the ground ahead of the advancing face helps avoid water ingress and fortify the ground. Microcements and colloidal silica – also known as mineral grout – make underground construction a lot safer. Moreover, they are eco-friendly.

- MasterRoc® MP microcements for pre-injection application, providing extremely effective penetration into fine cracks in rock and fine grained soils
- MasterRoc® MP 320 and MP 325 colloidal silica gels ("mineral grouts") for water sealing and ground stabilization in jointed rock and fine grained soils, as a supplement to microcement injection
- MasterRoc® MP 350 series of polyurethanes and the fire resistant MasterRoc® MP 360 series of polyurea silicates for water stopping and sealing, strata consolidation, and cavity filling applications



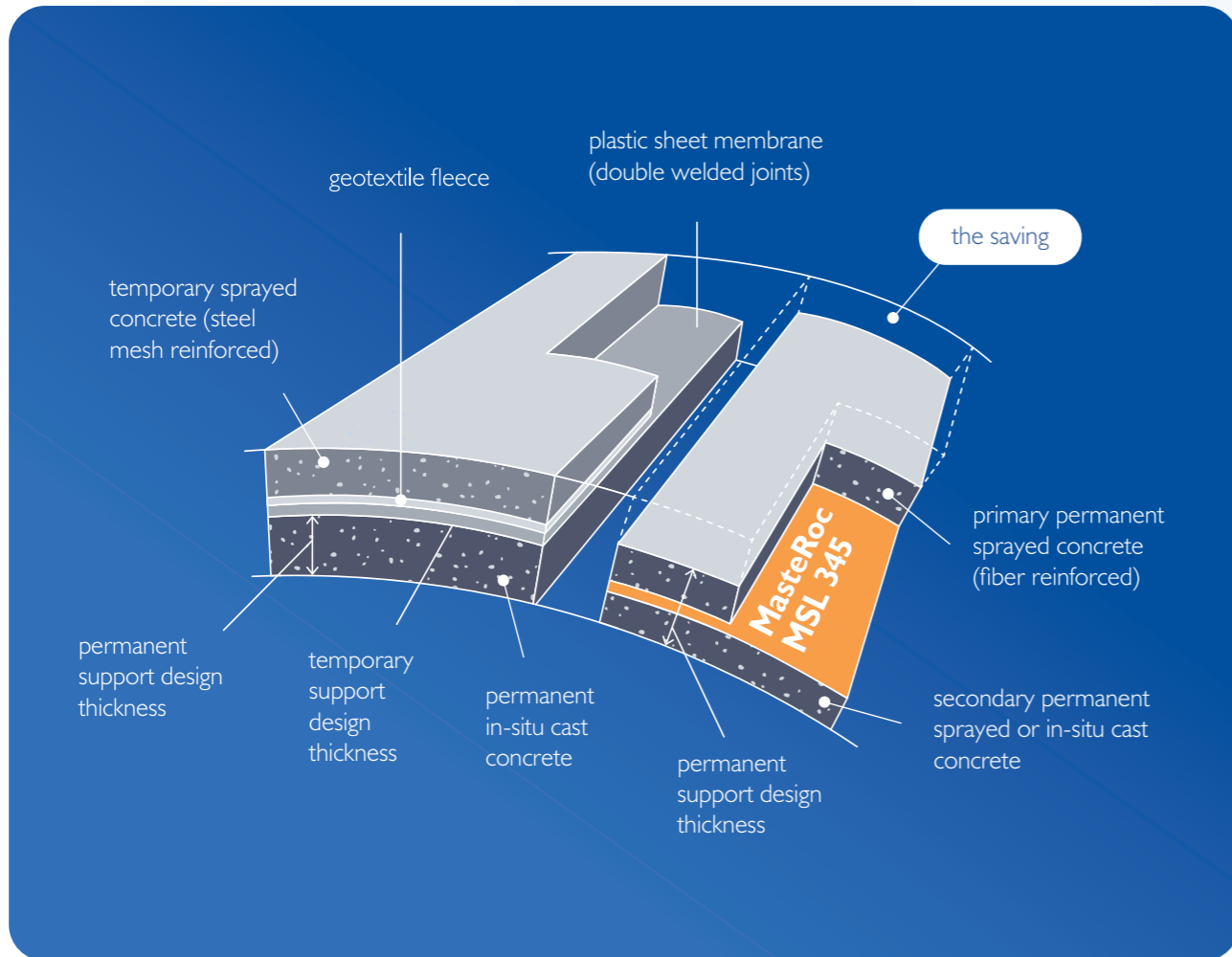
A watertight system with cutting-edge sheet membranes

Sheet membranes offer an economical and reliable way for waterproofing tunnels. To prevent ground water ingress through the tunnel lining, they are installed between the primary sprayed concrete support and the permanent concrete lining.

Depending on the water conditions in the tunnel, there are different design options: single layer with double seam welding, compartmentalization to improve water tightness, and an injection system for easier maintenance and repair. The double layer vacuum system offers maximum quality control and reparability.

- MasterRoc® WP 1700: Synthetic plasticized PVC membrane for horizontal & vertical waterproofing
- MasterRoc® WP 1950: PVC waterstop for construction joints treatment & compartmentalization
- MasterRoc® WP 1780: Re-Injectable hose system for sealing construction & cold joints





Sprayable waterproofing membrane as a clever master plan

MasterRoc® MSL 345 is a new advanced concept for waterproofing based on a double-bonded sprayable waterproofing membrane. It can resolve technical problems which have proved difficult with conventional sheet membranes by preventing the migration of water on either side of the membrane.

In case of rehabilitation of old tunnels, this innovative membrane is particularly suitable for projects with limited space. It brings great benefits for concrete structures with complex geometries, offering a flexible and continuous waterproofing system without discrete joints, water stops, or compartmentalization.

The simple spray-on procedure makes installation very fast getting you ahead of schedule.

Application areas:

- New tunnels
- Refurbishment projects
- Cross passages
- Tunnel intersections

Advantages:

- Easy application by spraying with standard equipment
- Two-sided bond with sprayed-concrete allows for composite behavior
- The fully bonded system provides excellent water tightness preventing development of water migration in both concrete membrane interfaces

Challenging Project Solutions



1. Metro Crossrail, London, UK

Scheduled to be up and running in 2018, the new Elizabeth line built by Crossrail Limited is the largest construction project ever undertaken in Europe. As the design made undrained spray-applied waterproofing necessary, MaterSeal 345 was selected after extensive testing. Thanks to accurate production planning, transport, and emergency stocks kept available, Master Builders Solutions® was able to supply 200,000 m² MasterRoc® MSL 345 on time

2. Spadina Subway, Toronto, Canada

The Toronto-York Spadina Subway Extension Project will be the first rapid transit line to cross the boundary between the City of Toronto and the York Region. As some of the stations were constructed by SEM (sequential excavation sequence), a waterproofing solution was needed that could be applied without large equipment that would disturb the construction works. MasterRoc® MSL 345 was selected because of its flexibility and fast application. 6,000 m² MasterRoc® MSL 345 were used in total.

3. SS106 Jonica Autostrada, Calabria, Italy

The Strada Statale 106 is a traditional highway in Calabria in the south of Italy. It has several tunnels, some of which were refurbished in 2011. These tunnels needed to stay open during refurbishment, so only one half of the tunnel could be waterproofed at a time. As it is fast to apply and flexible, MasterRoc® MSL 345 was chosen. 70 to 100 m² could be applied per hour, while cars crossed through the tunnel as usual. 11,000 m² MasterRoc® MSL 345 were used in total.

Our double-bonded spray-applied waterproofing membrane MasterRoc® MSL 345 merges high-performance, easy application and cost-efficiency, setting new standards for waterproofing. Already, there are various large underground construction projects in different parts of the world where the technology was successfully used.

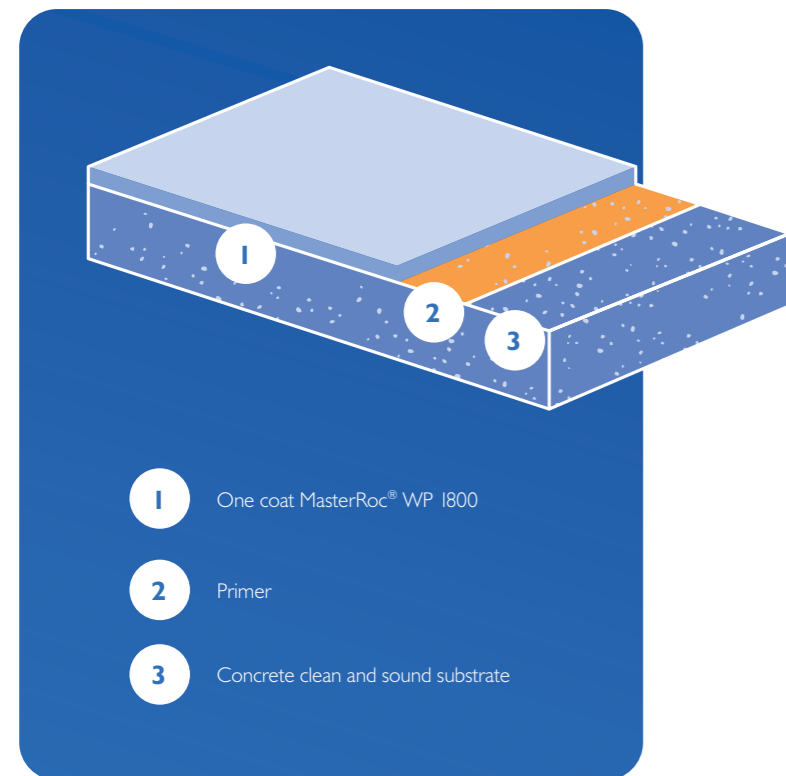


Waterproofing Solutions for Cut and Cover Tunnels

Serviceability and easy maintenance are major concerns when building underground constructions such as Cut and Cover tunnels. Waterproofing is an excellent option to reduce maintenance costs significantly. Waterproofing coatings on the exterior of the tunnel have the advantage that water cannot move behind this barrier, even if the coating is damaged.

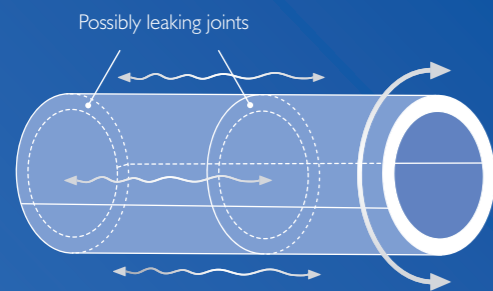
Waterproofing coating

MasterRoc® WP 1800 is a flexible, seamless elastic coating on the extrados of the tunnel with fast application, instantly reacting 2K system, and high durability. The spray applied and fast setting coating can easily be applied on vertical surfaces and has no issues with complex geometries. It is fire-resistant, remains elastic at low temperatures and prevents leakage even when punctured, because it bonds with the concrete.



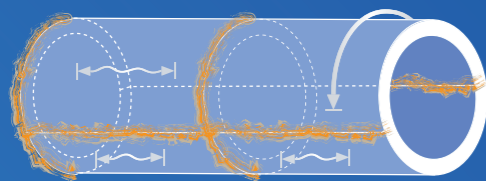
Keeping Water out on the Long Run: Repair and Maintenance after Completion

Crack injection in tunnel linings



Water can flow in every direction, before and during injection

Goal of injection into sections and barriers: subsequently removing water



When the underground construction is completed, the ability to swiftly deal with unexpected water ingress and cracks is paramount. We have the right products to help you stop water and make repairs without hassle or delay. Additionally, you can benefit from our acrylics injection products allowing the repair of sheet membrane systems.

Crack sealing and concrete rehabilitation

Our range of acrylic resins is perfect for rehabilitation injection of cast concrete, segment linings, and brick & masonry lined tunnels.

Acrylic resins:

- MasterRoc® MP 303 CE
- MasterRoc® MP 307 CE

Water stopping

Foaming, water-sensitive polyurethanes are designed to combat water ingress quickly and effectively. For particularly difficult cases, the solution is a combination of drainage and the injection of a fast-reacting foaming resin.

Polyurethanes:

- MasterRoc® MP 355 IK
- MasterRoc® MP 307 CE



Training and education

Master Builders Solutions® brings extensive know-how gained through worldwide experience in solving challenging situations in mechanized tunneling. In addition, we support our clients, contractors, and consultants by frequently offering technical trainings and specialized seminars. Whenever required, and especially in the case of large projects, tailored on-site training can be organized.

Technical services

Master Builders Solutions® supplies more than just specialty products for underground construction, assisting in the selection of the most suitable combination of products for each project specific geology, as well as providing start-up supervision and site support.

More brochures on our underground construction solutions are available at:

ugc.master-builders-solutions.com

Documentation available on request:

- Reference list
- Project reports
- Technical data sheets
- Design guidelines
- Method statements



Master Builders Solutions® for the Construction Industry

MasterAir

Complete solutions for air entrained concrete

MasterCast®

Solutions for the manufactured concrete product industry

MasterCem®

Solutions for cement manufacture

MasterCO₂re™

Solutions for low-clinker concrete

MasterEase®

Low viscosity for high performance concrete

MasterFinish®

Solutions for formwork treatment and surface improvement

MasterFiber®

Comprehensive solutions for fiber reinforced concrete

MasterGlenium®

Solutions for high performance concrete

MasterKure®

Solutions for concrete curing

MasterLife®

Solutions for enhanced durability

MasterMatrix®

Advanced rheology control for concrete

MasterPel®

Solutions for hydrophobization, anti-efflorescence and surface protection

MasterPolyheed®

Solutions for mid-range concrete

MasterPozzolith®

Solutions for water-reduced concrete

MasterRheobuild®

Solutions for high strength concrete

MasterRoc®

Solutions for underground construction and surface improvement

MasterSet®

Solutions for set control

MasterSphere®

Solutions for guaranteed freeze-thaw resistance

MasterSuna®

Solutions for sand and gravel in concrete

MasterSure®

Solutions for extraordinary workability retention

Master X-Seed®

Advanced accelerator solutions for concrete

Unveil the Power of MasterCO₂re™: Intelligent Cluster System for Low-clinker Concrete Production

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