



Road & Rail

Solutions for Underground
Construction





Master Builders Solutions

The Master Builders Solutions brand brings all of our expertise together to create chemical solutions for new construction, maintenance, repair and renovation of structures. Master Builders Solutions is built on the experience gained from more than a century in the construction industry.

Our know-how and experience as a global community of Master Builders Solutions construction experts form the core of Master Builders Solutions. We combine the right elements from our portfolio to solve your specific construction challenges. We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide. We leverage global Master Builders Solutions 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.

The comprehensive portfolio under the Master Builders Solutions brand encompasses concrete admixtures, cement additives, chemical solutions for underground construction, waterproofing solutions, sealants, concrete repair & protection solutions, performance grouts, and performance flooring solutions.

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
- Sealants
- Concrete repair and protection solutions
- Performance grouts
- Wind turbine grouts
- Performance flooring solutions



Introduction



Railways have formed the backbone of public transport since their widespread introduction in the 19th century. Demand for railway transportation is constantly on the increase, particularly in urban areas where commuter networks are being expanded and introduced, the latter especially in Asia and South America. High speed railways are likewise on the increase, with a reduction in travel time being a key factor for passengers today. These developments not only require the construction of new build tunnels, but also the updating and refurbishment of existing infrastructure, including the separation of passenger and freight traffic to allow for faster passenger travel.

The motor vehicle remains the primary method of transport for many, and with more than 50% of the world population living in cities today, the need to expand road networks to avoid traffic and congestion is greater than ever. City bypasses, which often require tunneling, are on the rise as is the use of underground space, not only for metro networks but also for roads. Furthermore, motorway networks are constantly being expanded, often needing tunnels in mountainous or hilly areas.

Master Builders Solutions' commitment is to contribute to the construction of safe, robust and sustainable underground structures, not only by providing specialty chemicals for underground construction, but also by providing expert engineering advice at every stage of a project: during planning, the construction phase and through to completion.

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.



Solutions for the Construction of Running Tunnels – TBM Method



Mechanized tunneling is the safest and quickest way of tunneling especially under difficult geological conditions and in urban areas. The optimum TBM (Tunnel Boring Machine) performance is achieved by combining both mechanical and chemical engineering. Master Builders Solutions provides specialty chemicals for safe and efficient TBM tunneling.

Soil conditioners

EPB (Earth Pressure Balance) tunneling requires the correct use of soil conditioners to reduce cutterhead torque and tool abrasion and increase advance rates.

- MasterRoc SLF foams
- MasterRoc ACP anti-clay agents
- MasterRoc SLP polymers

In addition, the MasterRoc SLP range offers superabsorber modified polymers. They have the ability to absorb and retain large volumes of free water, facilitating the conveying of the excavated ground and compensating the lack of fines by acting as binding agents and enhancing lubrication properties. Used at very low concentration they have the ability to dry out free water in highly permeable soils. They

are also suitable for the sealing of the excavation face during hyperbaric interventions in combination with the injection of bentonitic/filler slurries.

Anti-wear and Anti-dust

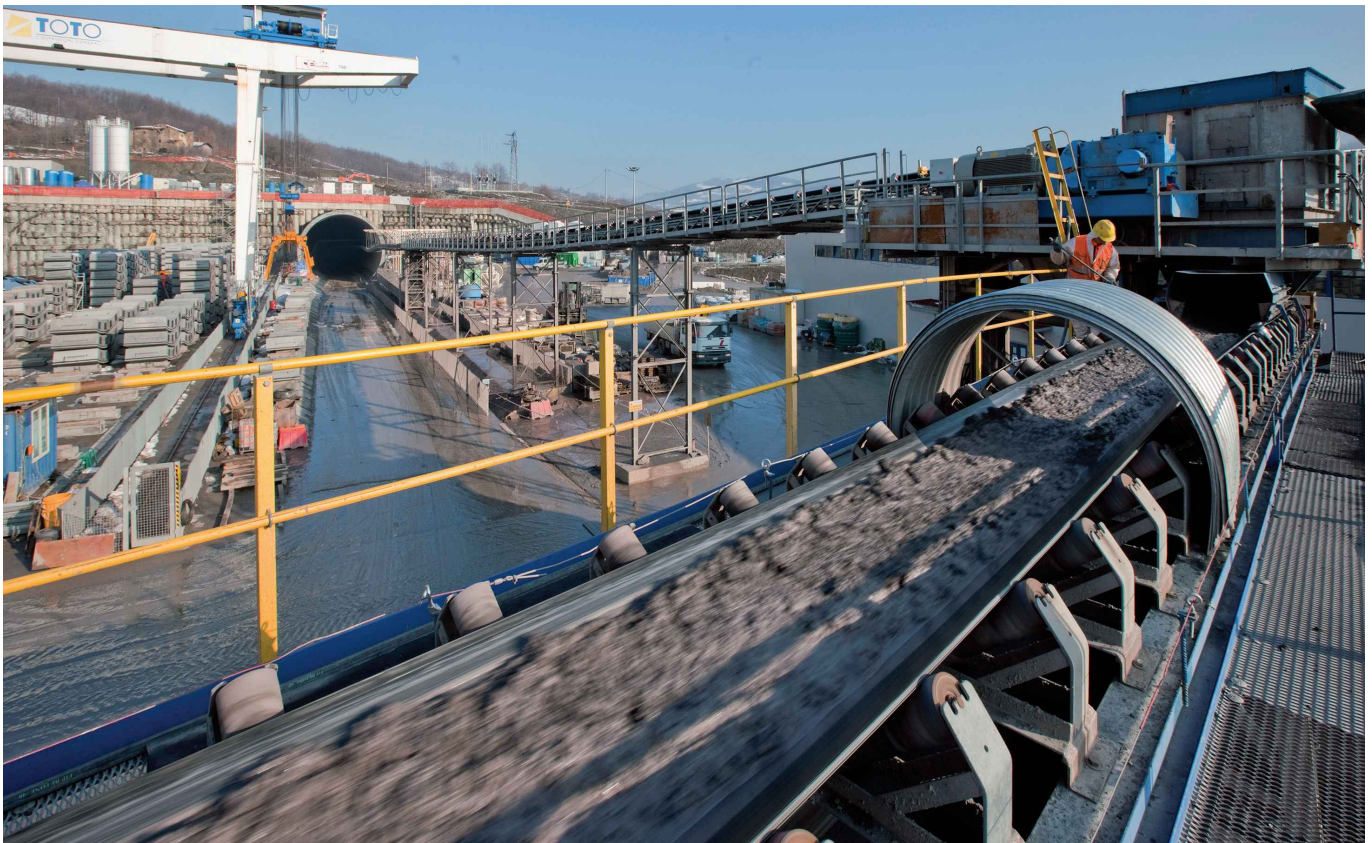
Hard rock TBMs as well as soft ground TBMs may experience excessive wear and high temperatures of the cutting tools. MasterRoc ABR anti-wear agents ensure a longer cutter life and a dust-free working environment, especially for hard rock TBMs.

Tail sealants

The TBM tail shield needs to be sealed against water, soil and annulus grout ingress. MasterRoc TSG Tail sealants have been developed to ensure reliable sealing together with the brush system.

Main bearing greases

Every main bearing needs to be protected and lubricated as this is the most costly part of the TBM. MasterRoc BSG sealing greases and MasterRoc EPB lubrication greases are also available in a renewable raw material version, leading the industry towards the highest environmental standards.



Annulus grouts

When the segmental lining is installed inside the TBM, the space between the ground and the segments – the annulus gap - must be filled in an efficient and reliable way to prevent settlements. In most cases, this space is filled by a cementitious grout, for which Master Builders Solutions provides a full range of admixtures (retarders, accelerators, superplasticizers and air entrainers) which ensure a reliable and easy to handle grout formulation.

Concrete segments

High performing concrete additives are necessary to ensure not only durability but also efficient production. The Zero Energy system combines products and technical expertise to enhance concrete durability and achieve energy savings in the form of productivity, power and efficient use of resources:

- MasterGlenium hyperplasticiser
- MasterMatrix viscosity modifying admixture
- MasterFinish form release agents
- Master X-Seed advanced accelerator

In addition, the accelerated curing process makes steam treatment unnecessary. This reduces energy consumption and equipment requirements while increasing productivity and improving work safety.

Injection

Pre-injecting the ground is an important measure to stabilize fractured rock and to prevent water ingress, especially in geological fault zones. Post-injection on a TBM can be used for emergency ground support and consolidation, void filling, water stopping and concrete repair.



Solutions for the Construction of Running Tunnels – Drill & Blast Method



Sprayed concrete lining

Sprayed concrete applications must ensure safety and be formulated to last. Master Builders Solutions offers a wide range of admixtures for addition during concrete batching and on site.

- MasterRoc SA alkali-free set accelerators to accelerate the setting and hardening of the sprayed concrete, providing high early strength gain and long-term strength development, as well as reducing dust and rebound levels.
- MasterGlenium water-reducing superplasticizer for reduced accelerator consumption, reduced bleeding and lower levels of segregation of sprayed concrete.
- MasterRoc HCA cement hydration control system to maintain the open time of sprayed concrete for up to 72 hours.
- MasterRoc TCC 780 pumping aid for improved thixotropy of the sprayed concrete mix, eliminating the risk of segregation, thus improving pumpability.
- MasterRoc TCC 735 concrete improving admixture for substantial reduction of initial shrinkage, enhanced bonding characteristics and for increased density and compressive strength.
- MasterRoc MS microsilica and colloidal silica for improved pumpability and workability and less rebound of sprayed concrete in the fresh state, while reducing permeability and increasing density and long-term strength performance in the hardened state.
- MasterFiber structural polypropylene and steel fibers for enhanced load absorption capability and cracking resistance of sprayed concrete linings.
- MasterRoc LUB 1 pump lubrication aid for lubricating concrete pumps, hoses and pipelines prior to concrete pumping or spraying.



Sprayable waterproofing membrane

MasterSeal 345 is a double-bonded sprayable waterproofing membrane, and establishes a new concept for waterproofing. 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.

Application areas:

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

This innovative membrane is particularly suitable for projects with limited space due to the clearance outline. It brings great benefits for concrete structures with complex geometries, offering a flexible and continuous waterproofing system without discrete joints, water stops or compartmentalization. Furthermore, MasterSeal 345 is also compatible with most other waterproofing systems.

Injection solutions for water stopping and ground consolidation

Pre-injection: unexpected water ingress and poor ground conditions cause significant delays, escalate costs, and can have a negative influence on the environment. To counteract these risks, an economical approach is to pre inject the ground ahead of the advancing face.

- 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.

Post-injection: water stopping and ground consolidation

- 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.



Solutions for Inner Linings



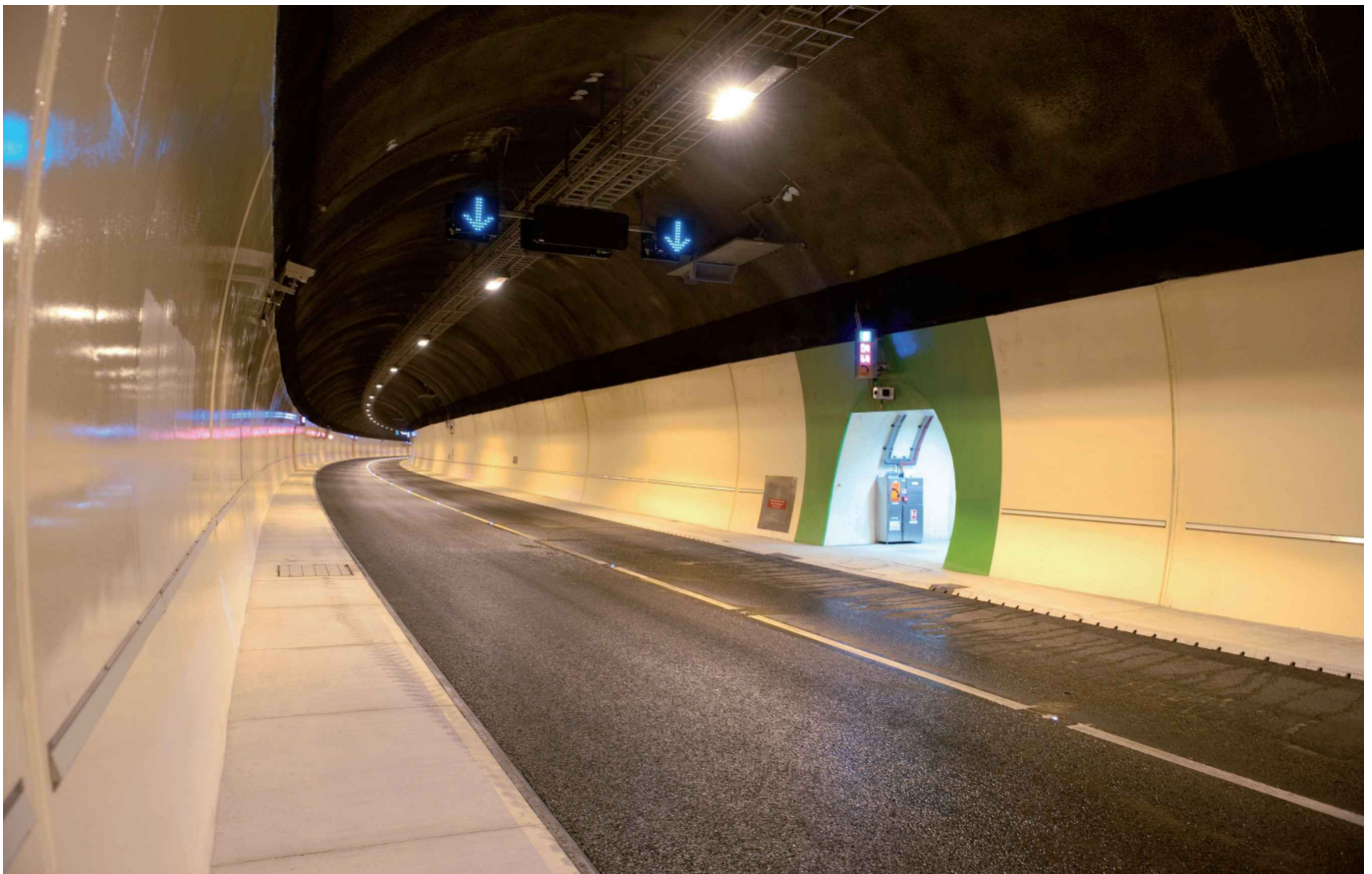
Admixtures for ready-mix concrete

Master Builders Solutions admixtures aid in the production of high-strength, durable concrete – a prerequisite for intricate architectural designs. They render unnecessary the mechanical compacting by vibration allowing the concrete to flow, thus increasing performance and making it easier to use. They aid in the curing process of the concrete, preventing the concrete's components from segregating. After curing they leave the concrete with a smooth and clean surface – and ensure an extremely long service life for the construction. The increased energy efficiency, higher concrete durability and better construction process contributes to reducing CO² emissions and save time and costs.

- MasterGlenium superplasticizer to provide high water reduction and slump retention, accelerated strength development and extended workability without delayed setting characteristics.
- MasterMatrix advanced rheology control solutions for self-compacting concrete.
- MasterPozzolith to plasticize, accelerate or retard concrete, improving its performance and making it more uniform and predictable.
- MasterPolyheed water reducing admixture to ensure superior workability and finishing. It improves concrete performance with a wide range of cements, fly ashes, granulated slags, and aggregates, including coarse and manufactured sands.
- MasterRheobuild to impart rheoplastic qualities to concrete and to improve the pumpability of fresh concrete.
- MasterFinish form release agents to enhance the appearance of pre-cast and poured in place concrete by allowing easy separation from the concrete surface.



Coatings, Finishing and Surface Solutions



Master Builders Solutions offers coating and finishing solutions for road tunnels from its MasterTop, MasterSeal and MasterProtect product ranges.

Ranging from epoxy acrylic to geo-polymer coatings, these finishing solutions provide numerous benefits:

- Surface hardening and sealing
- Smooth finish to facilitate cleaning and maintenance
- High dirt pick up resistance
- High abrasion resistance for water jet cleaning
- Resistance to freeze-thaw cycles and de-icing salts
- Protection against concrete carbonation



Tunnel Refurbishment



Injection solutions for concrete repair and protection

Crack repair

- MasterRoc MP series of acrylic resins for permanent and instant sealing of the finest cracks in concrete, for curtain injection behind leaking tunnel linings and diaphragm walls, as well as for the stabilization of weak soil and sand and sealing off of water.
- MasterInject epoxy resins for structural crack repair, often used in conjunction with MasterBrace or MasterEmaco products.

Concrete repair and protection to prolong the life span of concrete structures

- MasterEmaco repair solutions resist cracking and are compatible with the base structure.
- MasterProtect protection solutions comprise passive cathodic protection, anti-carbonation and protective coating and can be used on both existing and new concrete to prolong its life cycle.

Concrete and masonry structural strengthening

- MasterBrace composite strengthening solutions for increased load bearing capacity, high load limits of floors and seismic retrofit for concrete and masonry.

Structural repair solutions

Particularly in the case of rail tunnels, the minimum clearance outline leaves little space for new final linings. This requires the old lining to be excavated in small sections and reapplied without increasing its thickness. Sprayed concrete as a final lining combined with the MasterSeal 345 sprayable waterproofing membrane is an ideal solution (see pages 6 and 7), not only due to the minimal thickness of the sprayed concrete lining, but also because the sprayable waterproofing membrane can be applied in small sections, which is not feasible with a sheet membrane.



Know-how and Service



Training and Education

Master Builders Solutions brings extensive know-how gained through worldwide experience in solving challenging situations in mechanized tunneling.

In addition, support is offered frequently for clients, contractors and consultants by offering technical training courses 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 <https://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

MasterBrace

Solutions for concrete strengthening

MasterCast

Solutions for the manufactured concrete product industry

MasterCem

Solutions for cement manufacture

MasterEase

Low viscosity for high performance concrete

MasterEmaco

Solutions for concrete repair

MasterFinish

Solutions for formwork treatment and surface improvement

MasterFlow

Solutions for precision grouting

MasterFiber

Comprehensive solutions for fiber reinforced concrete

MasterGlenium

Solutions for high performance concrete

MasterInject

Solutions for concrete injection

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

MasterProtect

Solutions for concrete protection

MasterRheobuild

Solutions for high strength concrete

MasterRoc

Solutions for underground construction

MasterSeal

Solutions for waterproofing and sealing

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

MasterTop

Solutions for industrial and commercial floors

Master X-Seed

Advanced accelerator solutions for concrete

Ucrete

Flooring solutions for harsh environments



QUANTIFIED SUSTAINABLE BENEFITS ADVANCED CHEMISTRY BY MASTER BUILDERS SOLUTIONS

Let the numbers do the talking: We have portrayed some of our most eco-efficient product solutions for concrete and precast production, construction, civil engineering, and flooring.

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