

# Metro

**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 CO<sub>2</sub> 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.

## Our comprehensive portfolio:

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

## 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.

# Metro: From Construction to Completion



## Introduction

With cities becoming increasingly overcrowded and congested, the use of underground space for transport infrastructure, such as metro lines, has continuously increased. Although great advances in underground construction technology have taken place over the past decades, urban tunneling is still seen as a process which involves a certain amount of risk. The primary concerns of underground construction are safety, cost, sustainability and the environment. Making efficient use of underground space in cities remains a great challenge - tackling issues such as ground movement, groundwater and low overburden, with buildings and roads lying in close proximity above construction sites.

Master Builders Solutions®'s 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



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 to build or extend metro lines.

## 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® SLP polymers
- MasterRoc® ACP anti-clay agents

## 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 void filling, water stopping and concrete repair.

# Solutions for Stations, Cross Passages, Shafts and Cut-and-Cover Sections



As metro stations go deeper and structures become more complex, the right quality of concrete with the desired properties to consistently achieve a high performance is vital. With its numerous products and solutions, Master Builders Solutions® helps master the numerous challenges during the construction or update of metro stations.

## 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 CO<sub>2</sub> 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.





Application of MasterSeal® 345 waterproofing membrane



Permanent sprayed concrete lining with MasterSeal® 345 waterproofing membrane

## 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 plastic and steel fibers for enhanced load absorption capability and cracking resistance of sprayed concrete linings.
- MasterRoc® LUB I pump lubrication aid for lubricating concrete pumps, hoses and pipelines prior to concrete pumping or spraying.



# Solutions for Waterproofing, Ground Consolidation and Injection



## Sprayable waterproofing membrane

MasterRoc® MSL 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, MasterRoc® MSL 345 is also compatible with most other waterproofing systems.

## Further waterproofing solutions

A range of further waterproofing solutions are available, from the acrylic and cementitious products for internal waterproofing to preformed membranes and high tech liquid applied polyurethane systems.

- MasterRoc® acrylic and cementitious acrylic membrane provides secure waterproofing for all internal wet areas, including products suitable for constant immersion and contact with potable water.
- MasterPren® preformed membrane for large area waterproofing jobs including both “peel and stick” self-adhesive membranes as well as “torch on” bitumen sheet membranes suitable for roof top and underground applications. The range includes a hose system and a range of reactive resins to provide a watertight joint, as well as swellable gaskets against water ingress through cold joints below the water table.



## 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.

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

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

## Grouting and anchoring systems

The MasterFlow® range of cementitious, polymer and epoxy based grouts offer precision, dimensional stability, durability and toughness for the following applications:

- Structural stabilization
- Load transfer
- Equipment
- Rails



# Solutions for Joint Sealants and Performance Flooring



## Joint sealants and sealing systems

Joint sealants are used to seal joints and openings between two or more substrates. Their main purpose is to prevent air, water, and other external elements from entering a structure while permitting limited movement of the substrate. The Master Builders Solutions® range of joint sealants are silicone, polyurethane, hybrid and polysulfide based and suited for a variety of applications such as façade work, floors, windows and roofing terminations.

The MasterSeal® range includes hydro-swelling gaskets, products for sealing joints subject to solvent contact, products with anti-pick capability for use in public areas and for thin high movement joints.

## Performance flooring solutions

The MasterTop® cementitious flooring system is applied together with the concrete installation to ensure long lasting durability where floors are subject to high traffic loads or an abrasive environment. It also offers a polyurethane range for decorative and durable commercial flooring systems with various texture and performance properties.



# Know-how & 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:

[ugc.master-builders-solutions.com](http://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

**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

**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

**MasterSure®**

Solutions for extraordinary workability retention

**Master X-Seed®**

Advanced accelerator solutions for concrete

## 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.

[sustainability.master-builders-solutions.com](https://sustainability.master-builders-solutions.com)

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