

**MASTER<sup>®</sup>**  
**» BUILDERS**  
SOLUTIONS

# Waterproofing

**Solutions for Underground Construction**



# The Bonded Waterproofing Concept



## Continuous Structure with a Bonded Membrane

An innovative approach, the MasterRoc® MSL 345 waterproofing membrane.

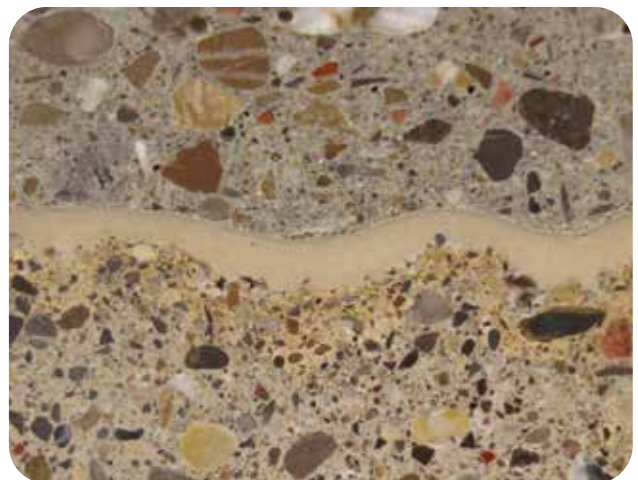
- This bonded waterproofing membrane establishes a new concept for waterproofing.
- A bonded waterproofing membrane can resolve technical challenges which have proved difficult to resolve with conventional sheet membranes.
- The double bonded membrane prevents migration of water along the concrete-membrane interfaces on either side of the membrane.

## Composite Mechanical Behavior

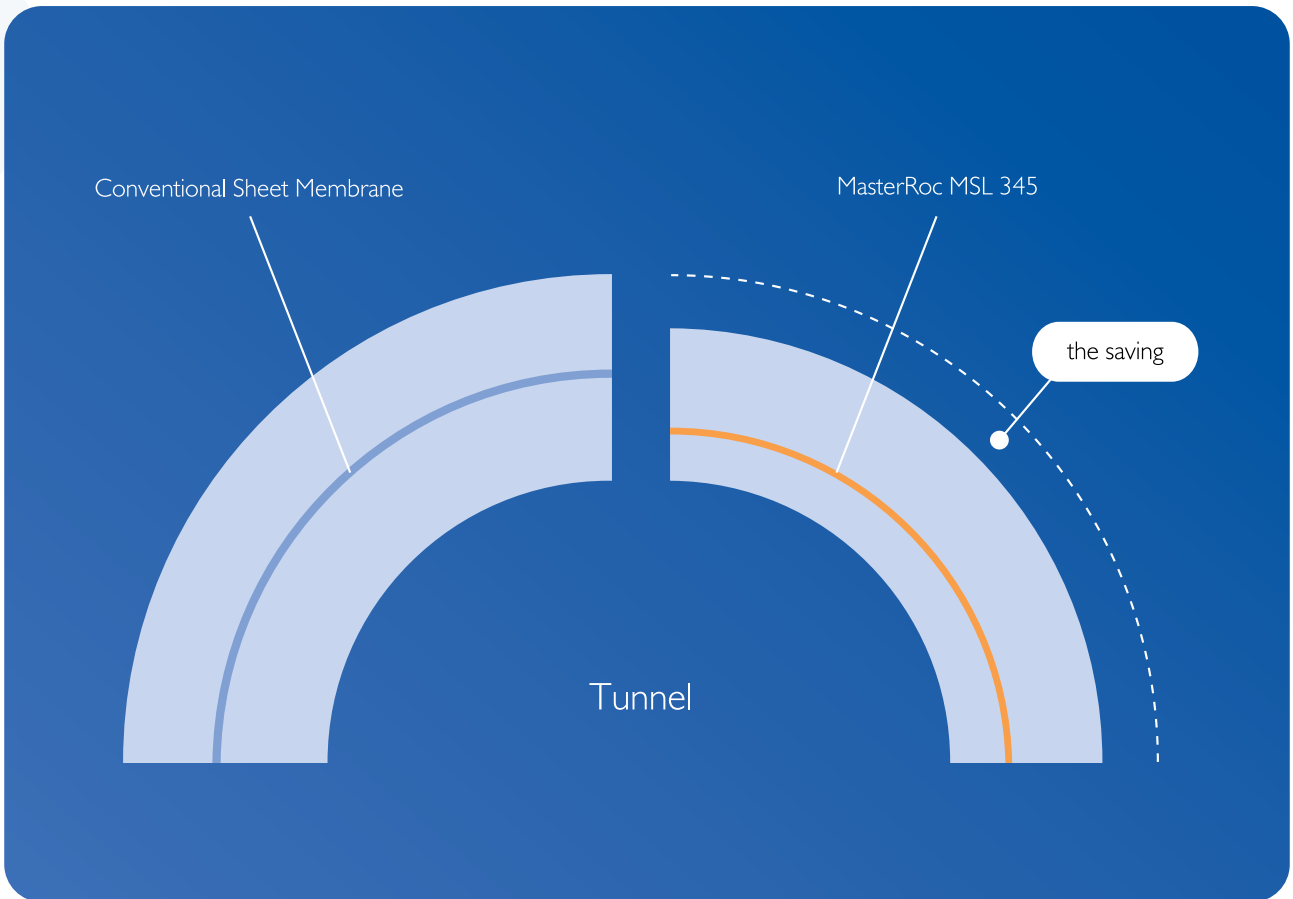
- The tensile bonding and shear strengths of the concrete-membrane result in a mechanical behavior of a composite structure. Therefore the primary support lining and inner final lining act together and can be considered as part of the permanent support structure.

## Permanent Long-term Durable Tunnel Lining

- Combined properties of primary and secondary lining with double bonded membrane can be incorporated for permanent structures requiring a long term durable waterproof lining system.



Waterproof composite shell tunnel lining



### For Owners

Main system advantages

- Reduced total construction time and costs
- Minimize maintenance and operational costs
- Versatile and reliable technical solution

### For Designers

- Composite waterproof tunnel lining provides opportunities for (new) cost effective design options.
- Potential for reduction in overall lining thickness when designed as composite structure or when composite structure design philosophy is applied.
- Versatile system compatible with other waterproofing techniques allows for flexibility in design.
- Cost effective system for the rehabilitation upgrading of existing tunnels & underground structures, transport envelope maintained.

### For Contractors

- Straightforward application methods
- High-rate of application
- Robotic, fully automatic application available
- Fiber reinforced spray concrete application direct to cured membrane using standard methods



# Design Flexibility



## Cost-effective Waterproof Single-shell Tunnel Linings

Enhanced opportunities.

- The spray-applied membrane facilitates the construction of monolithic, single-shell tunnel linings using permanent sprayed concrete. Recent projects adopting this approach have shown significant project savings over the double-shell method. Master Builders Solutions® can assist you with this design concept.
- MasterRoc® MSL 345 in combination with sprayed concrete can be applied with minimum reduction of transportation envelope profile or kinematic profile for refurbishment of existing tunnels.

## Drained and Undrained Design Options Possible

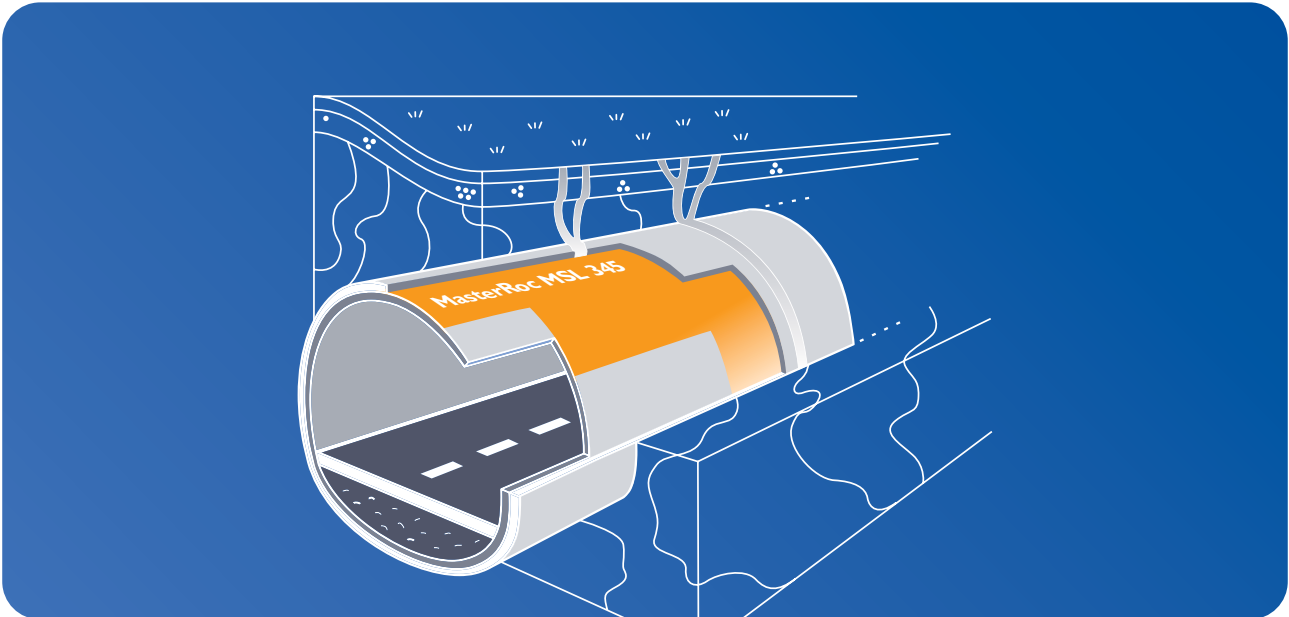
- MasterRoc® MSL 345 can be used in combination with sheet membranes. Standard joint details between MasterRoc® MSL 345 and sheet membranes have been established, providing a versatile and flexible waterproofing system.

- Both drained and undrained or tanked solutions are possible. For drained solutions systematic drainage pipes (conduits) can be used.
- Master Builders Solutions® can supply you with a generic specification compiled by an international tunnel consultant.

## Ideal for Complex Shapes of Underground Structures

- The MasterRoc® MSL 345 spray applied system is ideally suited to underground structures with complex geometries, such as lay-by niches, cross passages, turnouts and crossover caverns.
- MasterRoc® MSL 345 may be applied to discrete sections such as crown section only to waterproof above overhead conductor cables for electric trains.
- MasterRoc® MSL 345 is a continuous waterproofing system that requires no water stops or compartmentalization.

# Application



## Cost-effective in Challenging Conditions

Simple and flexible application methods

- Manual application rates up to 100 m<sup>2</sup>/hour.
- Mechanized robotic application rates up to 180m<sup>2</sup>/hour.
- A small team of 3 operators is required for application.

## Cost-effective in Challenging Conditions

- Water seepages in substrate are handled using small temporary drainage holes.
- Suitable surface roughness for the application of MasterRoc<sup>®</sup> MSL 345 is achieved through adjustments of the mix design of the primary lining sprayed concrete.

## Fast and Safe Application with a Small Working Team and Simple Equipment

- Application using dry spray equipment.
- Basic Personal Protective Equipment required for application crew.
- MasterRoc<sup>®</sup> MSL 345 can be used in conjunction with fibre reinforced sprayed – and cast concrete.

## Final Inner Lining

- The final inner lining is applied when the waterproofing membrane has achieved a sufficient curing condition.
- Final inner lining is established by either cast or sprayed concrete.



# Operational Security

## Less Risk of Water Ingress

- Technically functional and reliable system.
- The bonding characteristics of MasterRoc® MSL 345 ensure that no migration of water along the concrete-membrane interfaces occurs.

## Low Maintenance and Repair Costs

- Eventual rehabilitation or repairs of leaks simpler and less time consuming than most other waterproofing systems.

## Long-term Durability

- MasterRoc® MSL 345 contains long-term durable chemical compounds.
- No decomposition of MasterRoc® MSL 345 under most known groundwater conditions.
- Functional requirements for waterproofing fulfilled over the design life of the underground facility.

## New Life to Old Tunnels

- A unique asset of the MasterRoc® MSL 345 system is its versatility and cost-effectiveness in rehabilitation situations.

## Challenging Project Solutions



### 1. D18 Kronstad Tunnel, Bergen, Norway

The D18 Kronstad Tunnel is a new pedestrian and cycle path which provides safer and easier transport connections between the city centre of Bergen and the southern part of the city, and helps reduce greenhouse gas emissions and traffic noise. The tunnel is part of the Bergen light rail development, which is one of Norway's largest and most ambitious transport projects, and thanks to the innovative sprayable waterproofing membrane, MasterRoc® MSL 345, the tunnel is protected against water ingress and has a long service life.



### 2. Elizabeth Line (Crossrail), London, UK

Built by Crossrail Limited, the new Elizabeth Line opened in May 2022 and is the largest construction project ever undertaken in Europe. As the design made undrained spray-applied waterproofing necessary, MasterSeal 345 was selected after extensive testing. Thanks to accurate production planning, transport, and emergency stocks kept available, Master Builders Solutions® was able to supply over 200,000 m<sup>2</sup> of MasterRoc® MSL 345 on schedule.



### 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 m<sup>2</sup> could be applied per hour, while cars crossed through the tunnel as usual. 11,000 m<sup>2</sup> MasterRoc® MSL 345 were used in total.

# Practical Training and Technical Services



## Assistance During Design

Master Builders Solutions® provides assistance to owners and designers in the layout of complete system solutions with permanent sprayed concrete and MasterRoc®.

Important issues in this process are:

- interface possibilities with other waterproofing systems
- specification details of the required properties of sprayed concrete
- correct substrate characteristics.

Master Builders Solutions® brings extensive know-how gained through many years' experience solving challenging situations.

## Assistance During Design

Master Builders Solutions® provides technical training of operator personnel for all phases of the application of MasterRoc®. Technical training is generally offered as on-site practical education in which all details of the application process, including the correct substrate treatment, are covered. During ongoing works with the application of MasterRoc®, technical specialists from Master Builders Solutions® are available for assistance and troubleshooting in order to secure a good technical result, as well as optimizing the application process.

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

## MasterCem®

Solutions for cement manufacture

## MasterCO<sub>2</sub>re™

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

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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

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Solutions for sand and gravel in concrete

## MasterSure®

Solutions for extraordinary workability retention

## Master X-Seed®

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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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