



Tunnel Engineering and Construction Course: TBM, NATM, Segmental Linings and Tunnel Safety



Tunnel Engineering and Construction Course: TBM, NATM, Segmental Linings and Tunnel Safety

Introduction:

Tunnel engineering and construction, covering TBM, NATM, segmental linings and tunnel safety, is a ten-day course for civil, geotechnical and project engineering teams, ending with a Tunnelling Method Statement and Risk Register for a case metro tunnel. Tunnel schemes overrun when the method is chosen before the ground is understood, settlement is poorly controlled and fire life safety arrives late. Nominees already design, supervise or manage underground works and learn through case studies built on borehole data, TBM logs and monitoring records. CoreConcept Training Center delivers this course on tunnel engineering and construction.

Course Objectives:

- Select a tunnelling method among TBM, NATM sequential excavation, drill and blast, cut-and-cover and immersed tube for a given alignment and ground model
- Interpret a geotechnical baseline report and classify rock mass with RMR and the Q-system to assign excavation and support classes
- Specify TBM type, face pressure, soil conditioning, segmental lining and annulus grouting requirements for soft ground and rock drives
- Design sprayed concrete, rock bolt and forepoling support together with groundwater control and waterproofing measures
- Predict surface settlement, set instrumentation trigger levels and manage tunnel risk and contract risk allocation with a tunnel risk register
- Plan tunnel ventilation, fire life safety, mechanical and electrical systems, inspection and maintenance for the operating phase

Target Audience:

- Civil engineering teams responsible for tunnel alignment, excavation sequence and lining design
 - Geotechnical teams responsible for ground models, baseline statements and support class definitions
 - Contractor site and production teams responsible for TBM drives, sprayed concrete headings and cut-and-cover works
 - Owner and consultant engineering teams responsible for reviewing tunnelling method statements and monitoring data
 - Project control and commercial teams responsible for tunnel risk registers and ground-related claims
 - Asset teams responsible for tunnel systems, inspection regimes and maintenance closures
-

Course Outline:

Day 1: Tunnel Types, Uses and Ground Behaviour Around Openings

- Road, Metro, Utility and Hydraulic Tunnel Functions Compared
- Tunnel Cross-Section Shapes and Clearance Envelope Definition
- Ground Response Curve and Stand-Up Time Concepts
- Soft Ground, Mixed Face and Hard Rock Tunnelling Conditions
- ITA-AITES Guidelines Map for Tunnel Project Teams

Day 2: Tunnel Ground Investigation, Geotechnical Baseline and Rock Mass Classification

- Corridor Investigation Scope Along the Proposed Tunnel Alignment
- Geotechnical Baseline Report Structure and Baseline Statement Wording
- RMR Rating Sheet Using RQD and Discontinuity Data
- Q-System Index Calculation for Rock Support Class Selection
- Geotechnical Data Report Versus Baseline Report Responsibilities

Day 3: Tunnelling Method Selection and Excavation Techniques

- EPB, Slurry and Hard Rock TBM Application Ranges
- NATM Sequential Excavation Principles and Face Subdivision Options
- Drill and Blast Cycle and Overbreak Control Overview
- Cut-and-Cover Bottom-Up and Top-Down Station Box Sequences
- Immersed Tube Element Fabrication and Placement Overview

Day 4: TBM Selection, Machine Operations and Segmental Lining

- Cutterhead Layout, Disc Cutters and Tool Wear Monitoring
- EPB Face Pressure Setting and Foam Soil Conditioning
- Slurry Separation Plant and Bentonite Circuit Management
- Precast Segment Ring Geometry, Key Segment and Ring Build
- Annulus Grouting, Ring Tolerance and Segment Damage Repair

Day 5: Sprayed Concrete, Ground Support, Waterproofing and a Guided Method Case

- Sprayed Concrete Lining Mix, Thickness and Early-Age Strength Testing
 - Rock Bolts, Lattice Girders and Forepoling Support Classes
 - Dewatering, Ground Freezing and Permeation Grouting for Inflow Control
 - Sheet Membrane Versus Sprayed Waterproofing Systems for Tunnels
 - Guided Case Selecting Method and Support for Mixed Ground
-

Day 6: Settlement Prediction, Instrumentation and Construction Monitoring

- Volume Loss and Gaussian Settlement Trough Estimation
- Building Damage Category Assessment Above Bored Tunnels
- Convergence Arrays, Extensometers and Piezometer Layout Plan
- Trigger Action Response Plan Alert and Alarm Levels
- TBM Data Logging and Monitoring Database Review Routines

Day 7: Tunnel Risk Management and Contract Risk Sharing

- Joint Code of Practice for Risk Management of Tunnel Works
- Hazard Identification for Face Collapse, Inrush and Sinkholes
- Tunnel Risk Register Scoring and Mitigation Ownership
- FIDIC Emerald Book Risk Allocation for Underground Works
- Differing Site Conditions Claims Measured Against Baseline Statements

Day 8: Tunnel Ventilation, Fire Life Safety and Emergency Coordination

- Longitudinal and Transverse Ventilation Systems With Jet Fans
- Critical Velocity and Smoke Backlayering Control Concepts
- NFPA 502 Fire Protection Provisions for Road Tunnels
- Cross Passage Spacing and Emergency Egress Route Planning
- Emergency Response Plan Coordination With Fire and Rescue Services

Day 9: Tunnel M&E Systems, Inspection, Operation and Maintenance

- Tunnel Lighting, Drainage Pumping and Power Supply Systems
- SCADA Supervision of Ventilation, Fire Detection and Pumps
- Lining Inspection for Cracks, Leakage and Concrete Spalling
- Tunnel Condition Rating Scheme and Defect Severity Scoring
- Maintenance Closures, Availability Indicators and Rehabilitation Planning

Day 10: Case Study Capstone: Metro Tunnel Method Statement and Risk Register

- Case Metro Tunnel Brief With Ground and Interface Data
 - Method Statement Excavation Sequence and Support Class Schedule
 - Case Settlement Monitoring Plan With Trigger Levels
 - Case Risk Register Entries With Owners and Contract Allocation
 - Method Statement and Risk Register Defence Before Review Panel
-

Skills You Will Gain:

- Tunnelling Method Selection
- Rock Mass Classification
- TBM Face Pressure Control
- Segmental Lining Specification
- Sprayed Concrete Support Design
- Settlement Trough Prediction
- Tunnel Fire Life Safety Planning
- Tunnel Condition Assessment

Why Attend This Course:

- Deliver a Tunnelling Method Statement and Risk Register for a case metro tunnel to the project director and the owner's engineering review team
- Decide between bored, sequential, blasted and cut-and-cover options on ground evidence rather than equipment availability
- Avoid face losses, damaging surface settlement and ground-related claims that follow weak baselines and late trigger levels
- Pass baseline review, support class, monitoring and risk register templates to colleagues starting the next underground package

Conclusion:

Back at work, the participant gives the project director and the owner's engineering team a Tunnelling Method Statement and Risk Register that set out the excavation method, support classes, settlement controls and risk ownership for a tunnel drive. Reviewers use it to approve the method before mobilisation and to agree which ground risks sit with the contractor and which with the owner. After the first drive or heading, the unit should compare measured settlement and face pressure records with predictions, review trigger level breaches and update the risk register.

Frequently Asked Questions FAQ:

What should participants know before the tunnel engineering and construction course?

Participants should already work on civil, geotechnical or project tasks for underground or heavy civil works and read borehole logs and construction drawings. Bringing a ground report, method statement or monitoring record from a current tunnel helps them apply the case work.

How does the tunnel engineering and construction course differ from a geotechnical investigation or rail systems course?

It concentrates on building and running tunnels: method choice, TBM and NATM headings, segmental and sprayed linings, settlement control, contract risk sharing, ventilation and tunnel systems. Investigation courses stop at ground data, and rail systems courses address signalling, safety assurance and train operations.

When is NATM preferred over a TBM in tunnel engineering and construction?

NATM sequential excavation suits short drives, variable cross-sections, junctions, caverns and station enlargements where a machine cannot be justified. A TBM usually wins on long, uniform drives in soft or water-bearing ground where face pressure control and fast ring building matter.

What do participants take back from the tunnel engineering and construction course?

Participants take back a Tunnelling Method Statement and Risk Register for a case metro tunnel, together with support class, trigger action response plan, risk register and lining inspection templates that can be adapted to their own underground projects.
