# Geotechnical engineering

Anything can be calculated today, the question is, whether the method is appropriate and what features need to be abstracted. Furthermore, a correct and technically profound interpretation of the calculated results is essential for a reliable design of complex underground structures.

Based on 50 years of tunnelling and underground infrastructure experience, AMBERG defines the correct analysis method, relevant questions to be asked and integrates the entire process into the overall design process.

The custom – tailored analysis is performed with highest competence and efficiency, and the answers to the questions are prepared in an easy-to-understand, logical way.

The special knowledge of AMBERG employees allows the seamless transfer from complex geometries from 3D-BIM-Models into the numerical model-ling software. This allows detailed and efficient geotechnical analysis and supports the design and goes hand in hand with the BIM-Modelling.
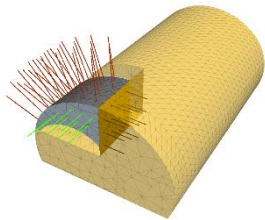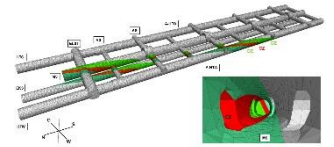

Excavation sequences and support installation
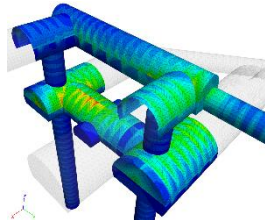
Semmering Base Tunnel –numerical Model of the shaft head caverns SBT 1.1
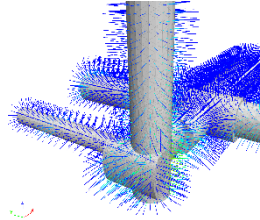
Semmering Base Tunnel – numerical model of the cavern expansion at shaft foot SBT3.1

Brenner Base Tunnel – numerical model of the emergency station St. Jodok

Our Services

Model Building

- 2D and 3D Modelling of complex underground structures (caverns, underground stations, tunnel intersections, etc.) with AutoCAD and Rhino
- Modelling of weakness zones and geological features
- Seamless geometry transfer from the 3D-BIM-Model into the meshing module with Griddle (Rhino Plugin from Itasca)
- Geometry and mesh Clean-up and De-Featuring of existing 3D-Models
- Import of external loads from 3rd party structures (foundations, piles, cables)
- Inclusion of support (shotcrete, rock bolts, etc.)
- Multi-Stage models and complex excavation sequences
- Custom-developed scripts for various detailed tasks are used: excavation sequence automatization, parameter studies, back analysis and results evaluation.

Discontinuous numerical analysis

- Data acquisition via remote sensing equipment (photogrammetry) and reliable and fast determination of all relevant structural information (joint orientation, persistence, spacing et cetera)
- Check of potential block failure due to the presence of unfavourably orientated discontinuities

- Analysis of cases where the failure mechanism can't be identified reliably beforehand, and the stress-induced failure is in direct interaction with the present discontinuities
- Transfer of structural data (persistence, orientation, frictional properties) of the discontinuities into the model
- Application of advanced modelling techniques (probabilistic joint networks) based on the remote sensing results
- Support design and validation (shotcrete, rock bolts) according to technical standards

Continuous numerical analysis

- Identification of critical areas and stress concentrations in the rock (e.g., weakness zones, remaining pillars, areas of increased interference)
- Determination of all relevant field variables (stress, strain, displacements etc.)
- Support design and validation (shotcrete, rock bolts)
- Displacements, surface settlements and influences on 3rd party structures (buildings, tunnels, streets, etc.)
- Experience with all state-of-the-art constitutive laws (Mohr-Coulomb, Hoek-Brown, Hardening Soil, etc.)
- In-house implementation of custom tailored, empirical constitutive laws (brittle failure according to Diederichs and Martin, etc.)
- Verification of serviceability
- Development of monitoring concepts (comparison of calculation and measurement data), their validation and back analysis

AMBERG ENGINEERING

Our Competence

- Extensive expertise
- Top experts in Rock Mechanics and numerical modelling
- Advanced modelling and simulation tools (ROCSCIENCE, ITASCA, RHINO, Plaxis)
- Experience with solving complex non-standard problems
- Advanced library of evaluation tools: we don't deliver colourful, meaningless plots, but palpable and interpretable data
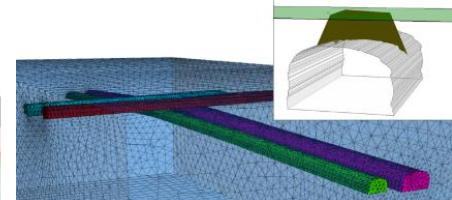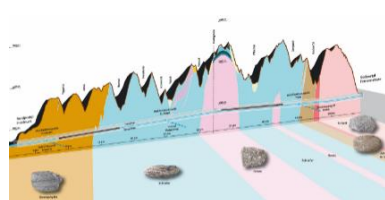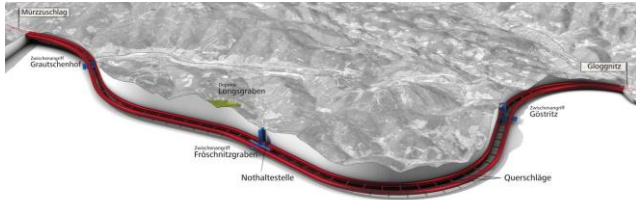
Your Benefits

- Applied knowhow customised to your requirements and infrastructure project
- Integration of BIM Modelling with geotechnical analysis and support design
- Optimisation of complex underground structures
- Reduction of construction cost
- Determination of specific monitoring concepts

Selected References

Project	Semmering Base Tunnel Austria		Project	Tunnelbana Stockholm Sweden
Services	Modelling and numerical investigation of the shaft head caverns in construction lot SBT1.1 and of the cavern expansion at shaft foot in lot 3.1: Design of rock support, verification of serviceability		Services	Modelling and numerical investigation of the complex underground construction circumstances with implementation of the complex fault zone structure: Design of rock support, sensitivity analysis regarding the fault zone influence, verification of serviceability, development of optimal construction sequence, numerical discontinuity analysis and permanent support validation, compilation of the relevant monitoring variables to be observed.
Client	ÖBB INFRA		Client	WSP
Project	Brenner Base Tunnel – Construction lot H51 Austria		Project	Hydropower plant Grimsel 3 Switzerland
Services	Modelling and numerical investigation of the emergency station St. Jodok		Services	Modelling and numerical investigation of powerhouse and transformer caverns.
Client	BBT SE		Client	KWO (Kraftwerke Oberhasli AG)

We are pleased to advise you in detail.
Contact us.

Gerd Wieland
Head of Tunnelling Europe

gwieland@amberg.ch

AMBERG ENGINEERING

Amberg Engineering AG
Trockenloostrasse 21
8105 Regensdorf Watt, Switzerland
Tel: +41 44 870 91 11
information@amberg.ch
www.ambergengineering.ch

Regensdorf, Sargans, Chur, Nyon (Switzerland), Brno (Czech Republic), Madrid (Spain), Lysaker (Norway), Gurgaon-Haryana (India), Kuala Lumpur (Malaysia), Bratislava (Slovakia)