Calculation Methods for Tunnel Design – Draft Programme

The objective of this training session is to present the design methods commonly used to assess tunnel stability.
Each method is illustrated by an example. Advantages and difficulties when applied to a tunnel project will be highlighted.

This course requires no prior knowledge or specific skills in numerical simulation or calculation methods as it is an introduction to these issues. Numerical Simulation is dealt with on a more in-depth level in the course programme entitled "Numerical Simulation for Tunnel Design".

Day 1
Session 1: Introduction
- Welcome and opening
- Introduction to the different types of ground: soil and rock (scale effects)
- Overview of the constitutive models for ground, concrete, steel and interfaces
        (+ short/long term behaviour + sensitivity studies)
- Introduction to the different calculation methods

Session 2: Geomechanical classifications
- RMR, Q system, GSI
- Failure criteria (Mohr-Coulomb, Hoek-Brown)
- Empirical Correlations
- Application fields and limits of the method

Session 3: Block stability analysis
- Structural analysis of the rock mass
- Stereographical projection
- Equilibrium
- Application fields and limits of the method

Session 4: Modulus reaction method
- Active loads (Terzaghi…)
- Reaction modulus
- Lining modelling
- Lining design
- Application fields and limits of the method

Day 2
Session 5: Convergence confinement method
- Principles of the method
- Determination of the ground reaction curve
- Determination of "lining confinement curve"
- Evaluation of the stress release coefficient
- Isotropic or anisotropic state of stress
- Application fields and limits of the method

Session 6: Numerical methods

- Continuous approach (FEM, FDM), discontinuous approach (DEM)
- Model definition : mesh, initial and limit conditions, loading
- Simulation of construction phases
- 2D numerical models in plane deformations: use of the decompression rate
- 3D numerical models
- Application fields and limits of the method

Session 7: Face stability
- Observed failure mechanisms
- Limit equilibrium methods
- Plastic limit analysis
- Application fields and limits of the method

Session 8: Settlements
- Evaluation of settlement by volume loss method
- Use of numerical methods
- Application fields and limits of the method

Session 9: Conclusion
- Progressive use of the different methods in a tunnel project
- Relationship between the different approaches (empirical, analytical and numerical)