Master project (MP, 5 ECTS)

Working title   Numerical investigation of the influence of weak/stiff blocks in the vicinity of a tunnel on the ground behaviour

Description

Using the two-dimensional software code UDEC from Itasca Consulting Group, Inc., the influence of a block in the vicinity of a tunnel excavation on the deformation of the excavation boundary and on the distribution of the secondary stresses within the surrounding rock mass shall be investigated.

Starting with a homogeneous rock mass, a block different in strength and deformability compared to the surrounding rock mass shall be included. In addition to a variation of the strength (Mohr-Coulomb failure criterion) and deformability (linear elastic, perfectly plastic), following arrangements and geometries of the block shall be investigated:

- Increasing/Decreasing distance of the block from the excavation boundary
- Increasing/Decreasing size of the block in relation to the size of the excavation
- Variation of the orientation of the block with regard to the Cartesian coordinate system: aligned horizontally, aligned vertically, inclined with 15°, 30°, 45°, 60° and 75° to the horizontal axis

For the evaluation of the deformation of the excavation boundary at least five measuring points shall be selected (e.g. crown, left sidewall, right sidewall, left shoulder, right shoulder). As the magnitude of the deformation depends on several parameters (e.g. primary stress state, size of excavation, rock mass strength and deformability), the deformation shall be investigated in a qualitatively way. Not the final deformation but any change of the orientation of the deformation vector and ratios of the two deformation components, vertical displacement and horizontal displacement, as well as the ratios of the deformation components of two different measuring points (ratio between the vertical displacement at the left sidewall and the vertical displacement at the right sidewall) shall be analysed.

Besides, comparing with the results of the simulation model with homogeneous rock mass parameters, the change of the magnitude of the major and minor principle stresses as well as the orientation of the stress tensors shall be analysed.

If time is still left or if the student wants to work on the task described herein before mentioned as part of a Master's thesis, the research can be extended by including

- different shapes of the excavation or
- one predominant discontinuity set to highlight the difficulty to interpret monitored displacement data (differentiation between the influence of the discontinuity set and the influence of weak/stiff blocks on the deformation of the excavation boundary)

The code to run the simulation with UDEC already exists for some cases and must be modified for the research only. The post-processing of the data (e.g. plot of displacements) has to be done with the programming language R (code exists too).

Aim of this research is to identify definite trends the geotechnical engineer can make use of at the tunnel site when interpreting monitored displacement data. Moreover, the mechanical processes as a weak/stiff block approaches the tunnel excavation shall be highlighted to sensitise the engineer to stability problems that can arise.

Supervisor   Dipl.-Ing. Alexander Kluckner
Graz University of Technology
Institute of Rock Mechanics and Tunnelling
Phone: +43 (0) 316 / 873 4226
Email: kluckner[/\T]tugraz[dot]at

Start / Duration   Immediately / max. 120 hours

Research language   English