

PROJECT DESCRIPTION

BeFo (Swedish Rock Engineering Research Foundation)

Stockholm, Sweden



A research project on tunneling in mixed face conditions (rock-soil) was carried out with the aim to increase the knowledge and to better understand deformation mechanisms when these particular conditions arise. A back-analysis of a case study involving the tunnel passage under the Maria Magdalena church was performed as a second task of the project, in which soil stratigraphy, rock/soil reinforcement, and extraction sequence were simulated explicitly and in detail.

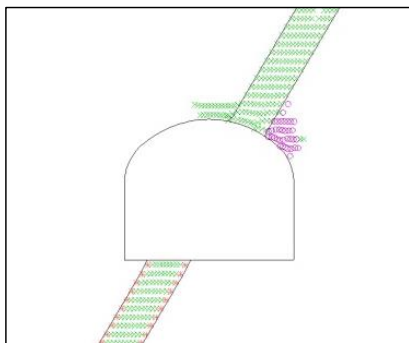
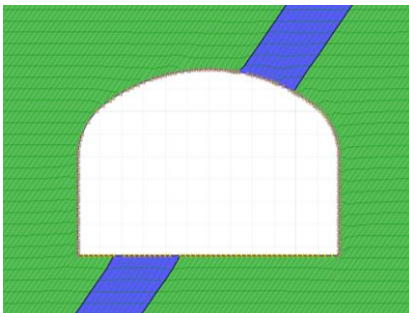
ITASCA'S ROLE

Itasca conducted two-dimensional numerical analysis using *FLAC* for the generic study to increase the state-of-the-art knowledge. For the case study, Itasca performed *FLAC3D* analysis to validate the conclusions drawn from the first study.

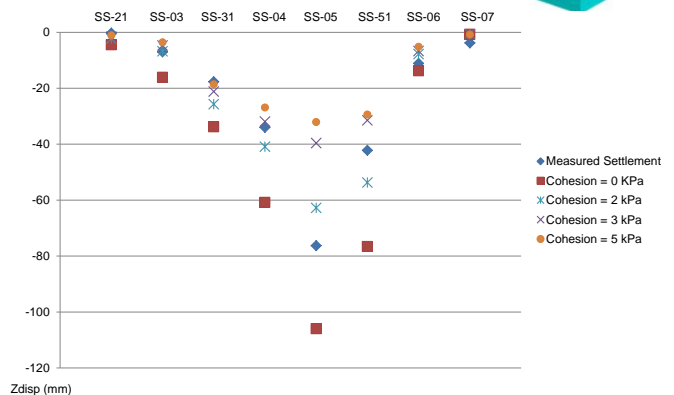
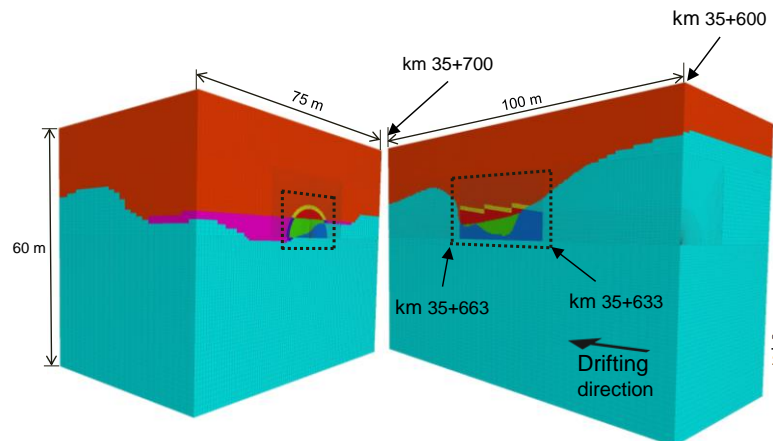
PROJECT RESULTS

The results of the generic study showed that the stratigraphy of the soil and the soil properties are the most important factors governing deformations developing on ground surface, followed by the location of the water table. Rock mass properties and initial rock stresses have minor influence on the resulting deformations.

For the case study of the tunnel under Maria Magdalena church, a good correlation with measured deformations was achieved after model calibration, varying the cohesion of the soil layer. The deformations were found to be very sensitive to: (i) variations in the strength parameters for the soil, (ii) pipe umbrella system installation, and (iii) grouted soil.



Example of *FLAC* model geometry (clay layer in blue) and calculated yielding



FLAC3D model geometry and calculated settlement