# Behavioural Modes of 3D Geological Structures in Underground Construction

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ABSTRACT

In underground engineering the prediction of the ground and system behaviour is very important for the selection of appropriate construction methods and supports. The ground structure very much influences the reaction of the ground to the excavation of an underground opening. Very rarely the stress distribution and the displacements are uniform and isotropic. Quite in the contrary, variations in the ground properties, kinematical freedoms, the influence of the stress situation, and other influencing factors lead to characteristic deformation and stress patterns. Simple analyses, where geological features, like joints and faults are neglected, or “smeared” into the continuum do not provide realistic results.

A realistic assessment of the ground behaviour is important as well in the design stage, as in the construction stage. In the design stage, the knowledge of the ground behaviour is essential for the selection of appropriate excavation methods, sequences and supports. To allow assessing monitored displacements during construction, one has to know the “normal” behaviour under certain geological conditions and influences. Only then is it possible to check if the system behaves as it should, and identify hazards in case of significant deviations from the normal behaviour.

Information on the behaviour under certain geological conditions can be obtained either by analysing monitoring data, or by running numerical analyses. Our group has collected and evaluated displacement monitoring data from a considerable number of underground projects under different geotechnical conditions. Also quite a number of relatively simple analyses with 3D numerical models and 2D distinct element models were performed in order to detect influences of geological features on the displacement characteristics and system behaviour. Comparisons with site data show a good agreement.

To establish a comprehensive database of behavioural modes, a systematic investigation is planned. Basis for the models are geotechnical situations from construction sites, where also monitoring results are available. Using 3D finite element and distinct element codes, back analyses will be performed. The models are adjusted until good agreement between observed and calculated behaviour is achieved. The results then can be used to assist in design and interpretation of monitoring data of underground structures. The goal is to enhance the description of the behaviours of underground structures during design, and to minimise misinterpretation of monitoring data during construction. This should allow for safe and economical tunnel construction.

Examples will be shown and an outlook on future work given.