

PhD scholarship application in geomechanics

Stability of galleries intersections drilled at great depth in rock

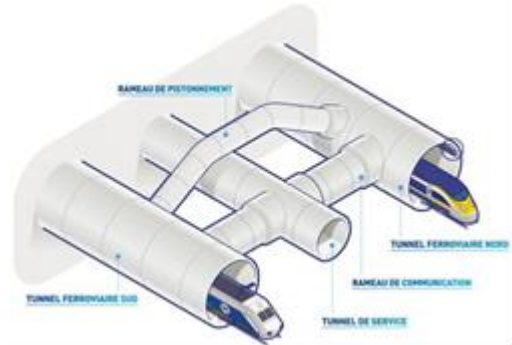
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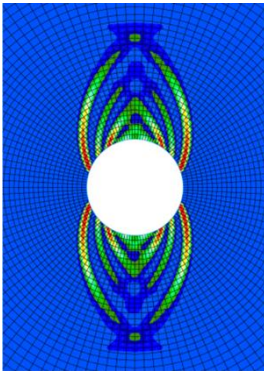
Project description

Context:

In the context of **underground engineering** (e.g.: transport, deep disposal, etc.), the design of the support is crucial in order to ensure the **stability and sustainability of the structures**. If their structural integrity is not maintained, operational difficulties or loss of stability of the underground structure may occur. This stability is mainly conditioned by the rheological behaviour of the excavated rock mass, the structural behaviour of the gallery supports, and the excavation process. **Particular 3D geometries** (intersections of galleries or tunnels) and particular anisotropy conditions (in situ stress anisotropy, structural anisotropy of the rock) make the stability study of underground structures particularly complex. These aspects remain not well investigated in the field of underground constructions.



Particular geometries of underground networks.



Underground deformation and fracture around tunnel.

Objectives and method:

The objective of the project is to study the **stability of gallery intersections**, drilled at great depth **in rock**, through a **numerical approach**. Numerical modelling will be carried out by finite element method. The stability will be analysed regarding the behaviour of the support structure and the surrounding rock. The carried-out studies should consider:

- The geological context and the properties of the materials involved (anisotropies of geostatic stresses and of the material fabric).
- The fractured zone likely to develop (plasticity and rupture) around the structure during its construction phase. A 2D and 3D elastoplastic law able to reproduce the structural anisotropy of the material and its damage will be implemented.
- The behaviour of complex 2D/3D retaining structures of tunnel intersection and their design. The rheological and structural model will be validated based on in situ measurements around gallery intersection during their drilling. The expected results include the reproduction of the stress redistribution around the structure, the deformation and loading of the support, the gallery convergence, and the development of the fractured zone.

Candidate profile

Candidates can apply for a **3-year PhD scholarship at University of Lyon** (ENTPE engineering school, LTDS laboratory), co-supervised by an industrial partner. **Candidates must come from the European Union** and have a Master / Engineer degree in the fields of civil engineering, underground works, mechanics of materials or of structures. The research project requires a basic knowledge in geotechnics, underground works, constitutive modelling, continuum mechanics, and an interest in numerical modelling in geomechanics. The project will give the applicant the opportunities to develop various skills (advanced numerical methods, rock mechanics, elastoplasticity, damage approach, structural design, etc.) and to integrate a dynamic geomechanics network having a large experience in underground studies and numerical modelling. The ability to communicate orally and write in English is required and European mobility is encouraged.

Application

Applications should be submitted by the **10th of March 2021** by emailing a CV, academic grades (detail of marks), scientific/academic references, and recommendation letter to the supervisors at benoit.pardoën@entpe.fr and denis.branque@entpe.fr. Any additional document relevant for the application can also be transmitted. The scholarship of the successful applicant is due to start on the 1st October 2021.