Postdoctoral position in geotechnics and underground works

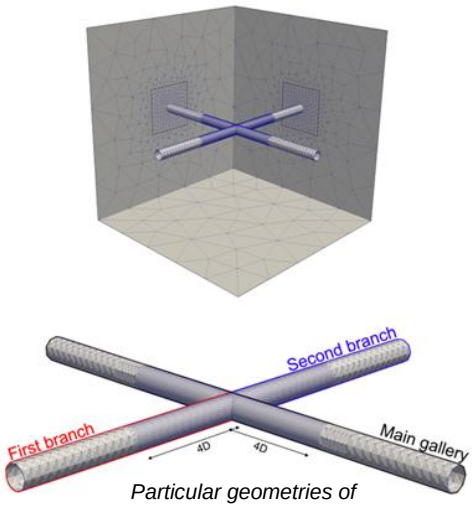
Stability of galleries intersections excavated at great depth in rock

Contacts: Denis Branque and Benoît Pardoen
University of Lyon, ENTPE-LTDS, France, denis.branque@entpe.fr , benoit.pardoen@entpe.fr

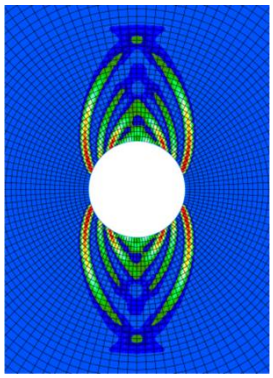
Project description

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), anisotropic conditions (in situ stress anisotropy, structural anisotropy of the rock), and long-term behaviour 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 gallery 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 behaviour of the materials involved (anisotropies, viscosity, hydromechanical coupling).
- 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 viscosity 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

The postdoctoral position is available **for 18 months at University of Lyon** (ENTPE engineering school, LTDS laboratory, Lyon, France) and is co-supervised by an industrial partner. Applications are welcome from PhDs graduated in the fields of civil, mechanical, and materials engineering, or geosciences. PhDs in geomechanics / geotechnics / tunnelling / underground works are mostly welcome. A good knowledge of mechanics of porous media, constitutive modelling of geomaterials, geotechnics, underground works, and numerical methods is required. The 18-months project will give the applicant opportunities to develop various technical skills (advanced numerical methods, elastoplasticity, damage approach, poromechanics, etc.). The successful applicant will use and improve the non-linear finite element code ASTER. The ability to communicate orally and write in English is required and international mobility is encouraged.

Application

Applications should be submitted before the **end of September 2025** by emailing a CV, a PhD summary, publications list, academic grades (detail of marks), scientific/academic references, and recommendation letter to the supervisors at denis.branque@entpe.fr and benoit.pardoen@entpe.fr. Any additional document relevant for the application can also be transmitted. The postdoctoral position of the successful applicant is due to start between October 2025 and January 2026.