

Research Topic for the ParisTech/CSC PhD Program

***Field :** Urban planning, Transport – Civil engineering

Subfield: Geotechnical engineering

Title: Decision Aid Tools for tunnel excavation in complex geotechnical conditions

ParisTech School: Mines ParisTech- PSL University

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(Lab, website): Centre de Géosciences

Short description of possible research topics for a PhD:

The excavation of deep tunnels in complex geotechnical conditions (squeezing rock, rock prone to burst, major fault crossings) often leads to rock instabilities which may cause delays in construction and sometimes casualties. To prevent such hazard, comprehensive risk assessment approaches need to be cautiously performed. For this purpose deterministic numerical modeling of the tunnel construction process associated with stochastic analyses provides a valuable tool. Moreover, it helps the constructor to overcome unexpected events with flexible and appropriate countermeasures.

In this research program, it is planned to develop numerical simulations with the Finite Element Method, accounting for the complexity of geomaterials behavior (hydro-mechanical couplings, etc) and realistic boundaries and initial conditions. Cases of deep tunnels realized through the Alps will be studied. Simulations will be coupled with probabilistic analysis software to account for uncertainties and representativeness bias (scale effect). In the final stage, the candidate will propose a Decision Aid Tools to run the methodology he/she developed to account for complex geotechnical conditions in tunneling.

Required background of the student: Civil Engineering, Numerical Modelling

A list of 5(max.) representative publications of the group: (Related to the research topic)

- Pellet F.L. (2017) Underground Urban Development and Geo-Environmental Issues, Editorial, Environmental Geotechnics, vol 4, 1: 1-2 (doi.org/10.1680/jenge.2017.4.1.1)
- Pellet, F.L. (2016), Rock creep mechanics, Chapter 24, In Rock Mechanics and Engineering: Vol. 1 Principles, ISRM Book series, CRC Press / Balkema – Taylor & Francis Group, Leiden, pp 745-770.
- Pellet, F. L. (2009) Contact between a tunnel lining and a damage-susceptible viscoplastic medium, Computer Modeling in Engineering and Sciences, Tech Science Press, 52 (3): 279-296.
- Pellet, F.L., Roosefid, M., Deleruyelle, F., On the 3D numerical modelling of the time-dependent development of the Damage Zone around underground galleries during and after excavation, Tunnelling and Underground Space Technology, 2009, 24 (6): 665-674.
- Pellet, F.L, Viscoplasticity and rock damage in modelling the long-term behaviour of underground excavations, Chapitre 14, X Ciclo di Conferenze di Meccanica e Ingegneria delle Rocce - MIR, Patron Editore, Torino, Italie, 2004, pp 423 - 448.