
Master thesis/Semester project
Spring Semester 2024

Underground stress state assessments for geo-energy applications

EPFL Supervisors: Prof. Lyesse Laloui and Dr. Angelica Tuttolomondo

Motivation of the project

Geomechanical analyses for geo-energy and underground climate change mitigation projects require knowledge of the in-situ stress state. Compared to conventional geotechnical applications (e.g., foundations, retaining structures), the knowledge of the in-situ stress state for these engineering applications has additional complexities due to the high depth (up to kilometers), complex stress history (current tectonic stresses, and residual stresses associated with past tectonic events, erosive and diagenetic processes) and often anisotropic stress states. An incorrectly assessed stress state can affect the effectiveness and safety of the project. Existing estimation methodologies have limitations and do not allow reliable determination of the complete stress state. The Laboratory of Soil Mechanics is developing new methodologies and tools to overcome these limitations.

Keywords

Geo-energy applications, stress-state, laboratory experiments, micro-technique

Goal of the project

The anticipated results of this project include:

- proposal of advanced technical solutions
- implementation of a proof of concept

To achieve these outcomes, numerical analyses and/or laboratory experiments will be performed.

Tasks and work to carry out

The student is expected to perform the following tasks:

- understanding and compiling the requirements for the technical solution of interest
- research for advanced technical solutions to be modified and implemented for the purposes of interest
- execution of a proof of concept

Deliverables

- Report

The student will have to prepare a technical report containing the introduction and motivation for the project, the description of the accomplished work and related results as well as conclusions. The

technical report will have to be prepared in an electronic format and send to the supervisors by the end of the semester.

- **Final Presentation**

The student will have to present his work during a presentation at the end of the semester. The day and the place of the presentation will be communicated to the student.

Planning

- **Meetings and presentations**

A weekly meeting (on Friday pm) with one of the supervisors is suggested to discuss the progress of the project. One meeting per month will be organized with Prof. Laloui (dates will be communicated to the student).

During the meetings, the student will have to present (i) the progress of the work, (ii) possible questions and remarks, and (iii) a summary of the next steps for the project. During these meetings, the supervisors may vary the foreseen goals of the project, if necessary. The student will have to prepare all the possible questions before the meeting in written form and a summary of each meeting for the next fixed meeting.

- **Report**

The report will be written in English. Graphs will be built with the Gapher software, Matlab, or with the aid of Microsoft Excel. Particular attention will be given to the writing of the report. In the document, the student will have to introduce the topic, highlight the hypotheses made, present the considered methodology, discuss the obtained results, and draw related conclusions.

- **Electronic files**

At the end of the project, the student will have to send to the supervisors a folder containing a clear classification of all the electronic files developed during the project, including those related to the reports, obtained data, presentations, posters, and graphs.

Grading

The final grade will be assigned considering the following proportions of contribution:

- Implication and initiative during the semester 30%
- Technical report 50%
- Oral presentation 20%

The evaluation will also consider the work methodology, discipline, and resourcefulness of the student.

General rules of the project

The schedule of the project is defined by the EPFL Academic Calendar:

<https://memento.epfl.ch/academic-calendar/?period=180>

The student signature on the submitted report certifies that the work is original and developed by him/herself. This work is property of the EPFL and cannot be disseminated without the approval of the considered Institution.

Contacts

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