



Geomechanics

LABORATORY INTRODUCTION

PROJECTS AT LMS

DR. ALESSIO FERRARI

Laboratory of soil mechanics – Fall 2024

12.09.2024

Nuclear waste storage

Engineered geomaterials

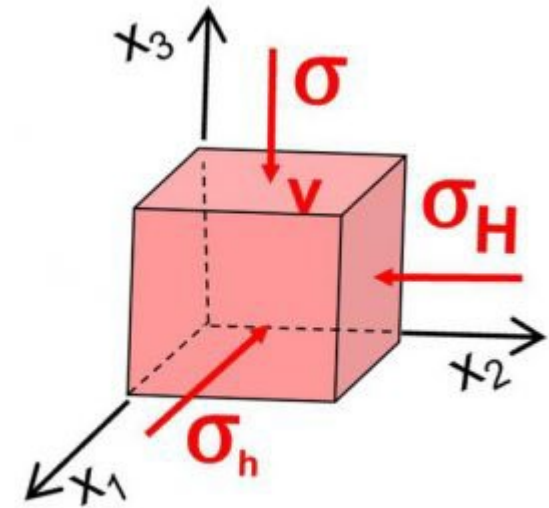
1. Engineering geomaterials: how to reuse millions of tons of excavated clay to seal the most dangerous waste ever produced – Contact: alessio.ferrari@epfl.ch



Boreholes and underground stress assessments for geo-energy applications

1. Boreholes for geo-energy applications: a numerical study.
2. Underground stress state assessments for geo-energy applications.

Contact: angelica.tuttolomondo@epfl.ch

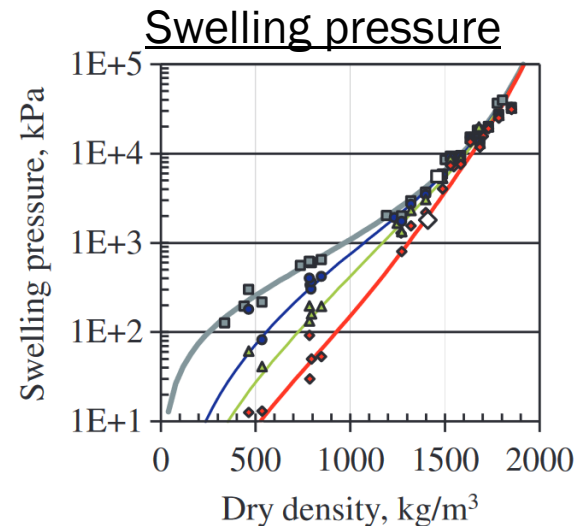
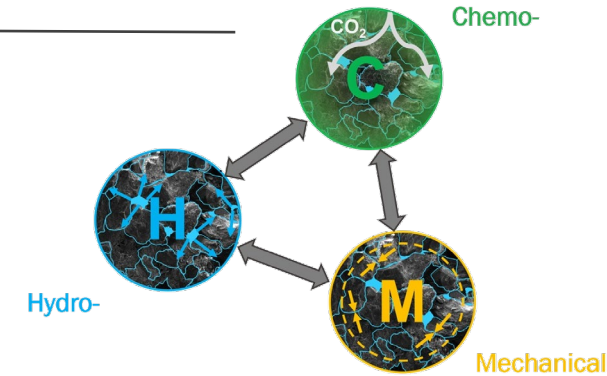


Chemo-mechanical modelling of compacted expansive clays

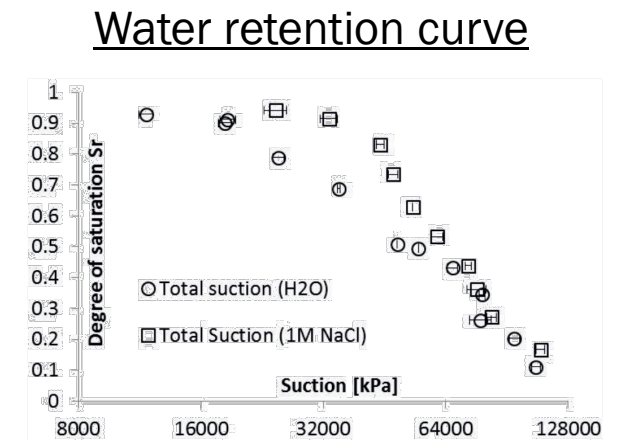
- Calibration of the stress-strain constitutive model
- Simulations of different stress-paths
- Analysis and comparison of numerical and experimental results

Basic Python knowledge is a plus

Contact: alessandro.parziale@epfl.ch



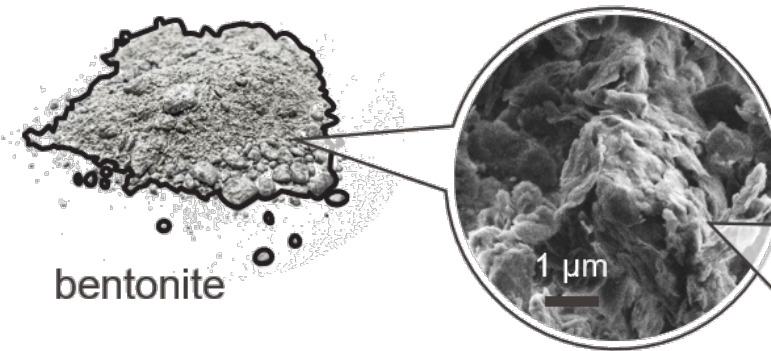
From Karnland 2007



From Kuusela-Lahtinen et al., 2016

Adsorbed water investigation - effective solute suction measurements (laboratory work)

Contact: svetlana.babiy@epfl.ch

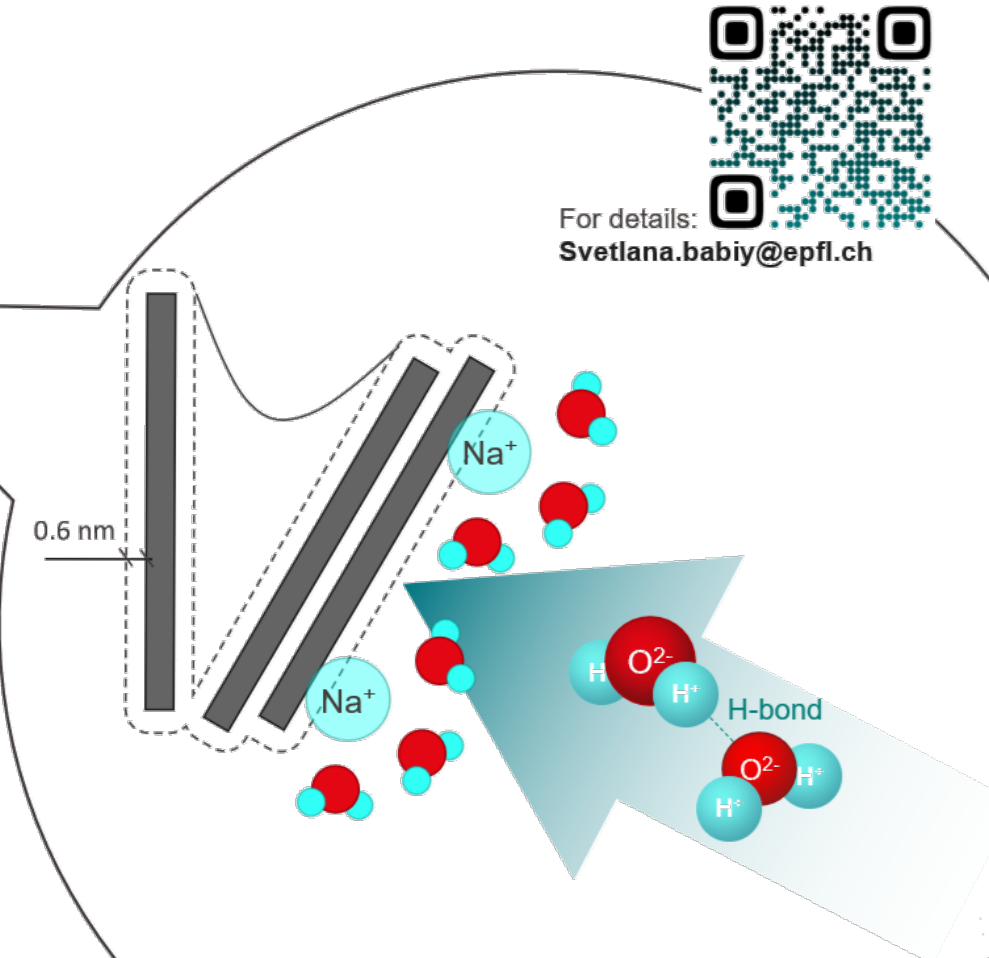


bentonite

Project investigates:

- Mechanisms of adsorbed water attraction to the surface of clays;
- That adsorbed water has distinctive properties (density higher than 1000 kg/m³, higher viscosity and etc)

Knowledge of basic chemistry is a plus

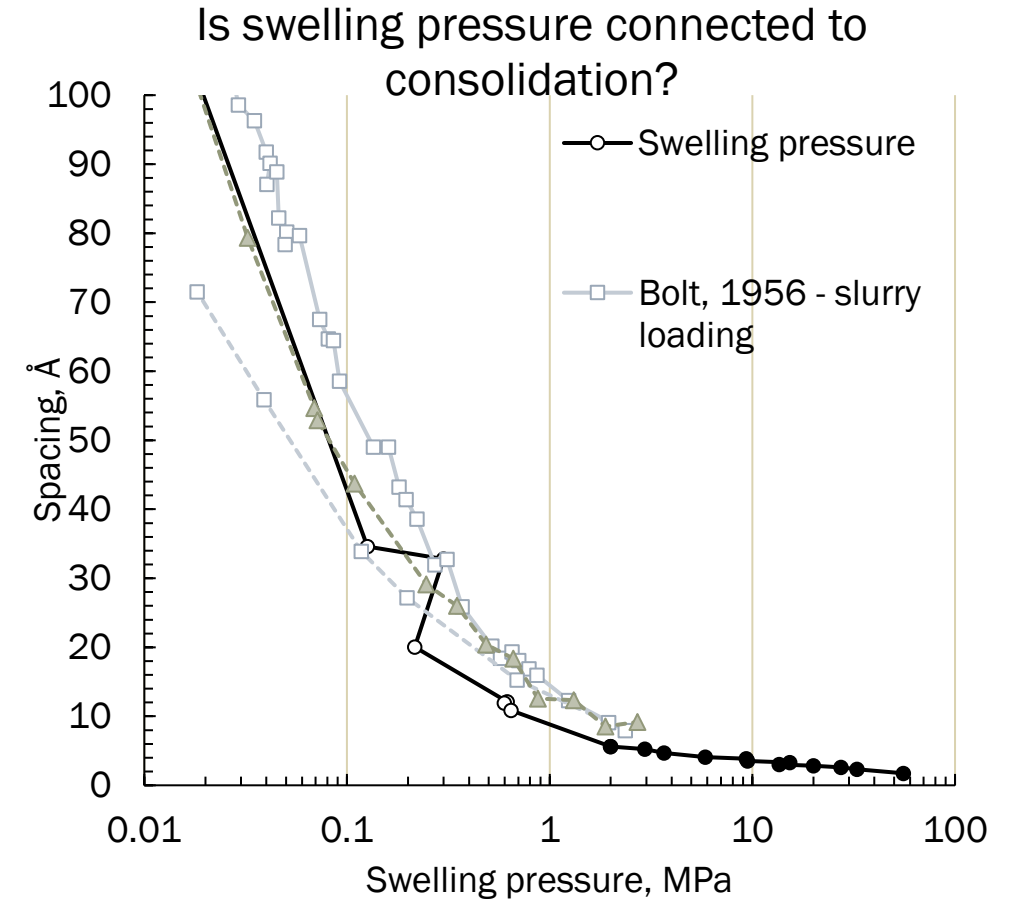


Connection between swelling and consolidation of expansive clays (laboratory work)

Contact: svetlana.babiy@epfl.ch

Semester project includes:

- Measurements of bentonite swelling pressure upon wetting;
- Loading of a slurry in oedometric conditions;
- Analysis of results

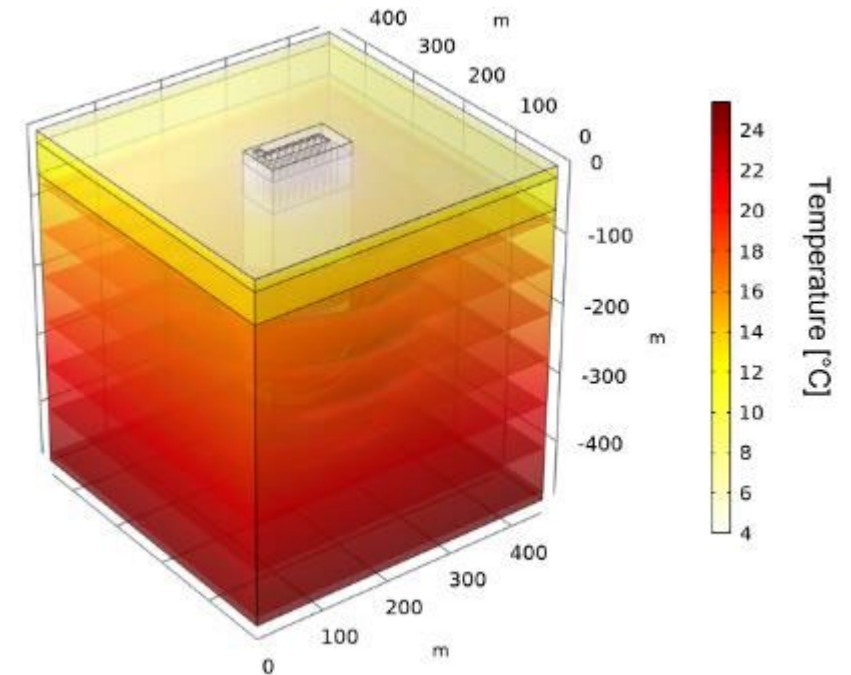


Energy Geostructures

Advancing Energy Geostrutures: Modelling and Analysis Techniques for Heat Exchanger Design

1. Modeling, Analysis, and Optimization of a Hydronic System Coaxial Borehole Heat Exchanger.
2. Development of a Machine Learning Approach to Facilitate the Design of Borehole Heat Exchangers.
3. Thermo Hydro Mechanical Analysis of a Novel Offset Pipe Configuration within a Helical Steel Energy Pile.

Contact: elena.ravera@epfl.ch



Bio-improved soils

Biocementation modelling: link calcite content & tip resistance

Objectives

Primary goal is to developing a way to link calcite content measurements with dynamic tip resistance profiles. Then a comparison of experimental observations with numerical modelling results can be made.

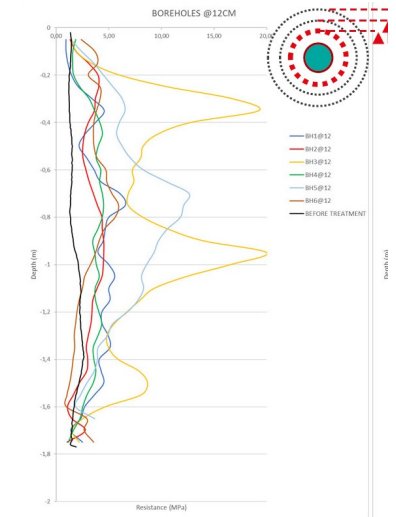
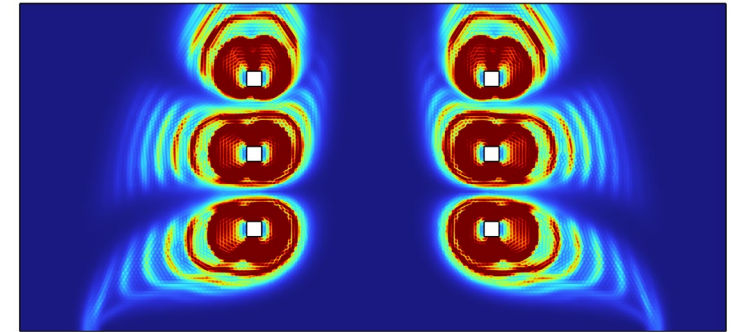
Activities

Literature evaluation calcite content to tip resistance impact

Data analysis & interpretation

Contact: sofie.tenbosch@epfl.ch

Calcite content



Biocementation modelling: calibration and evaluation framework

Objectives

Primary goal is to perform a model calibration to find the optimal modelling parameters to represent experimentally obtained results.

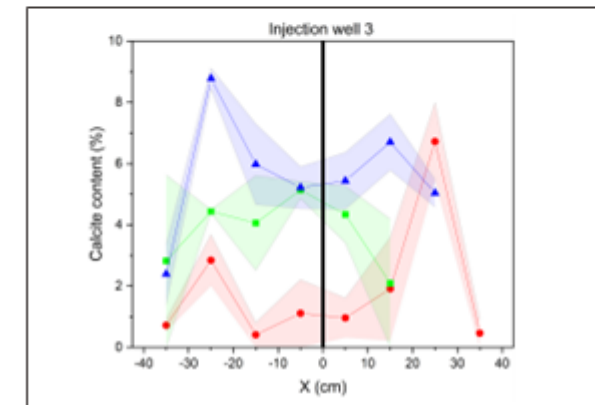
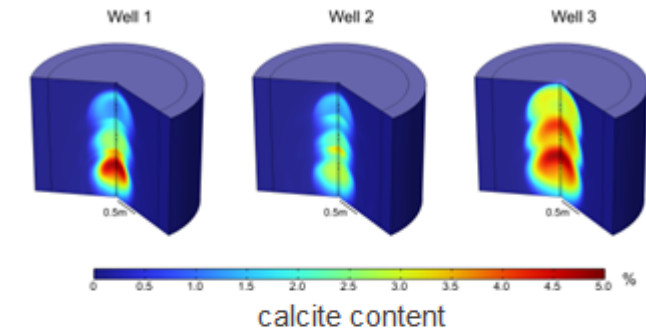
Activities

Understand current modelling framework & limitations

Define experimental results for calibration

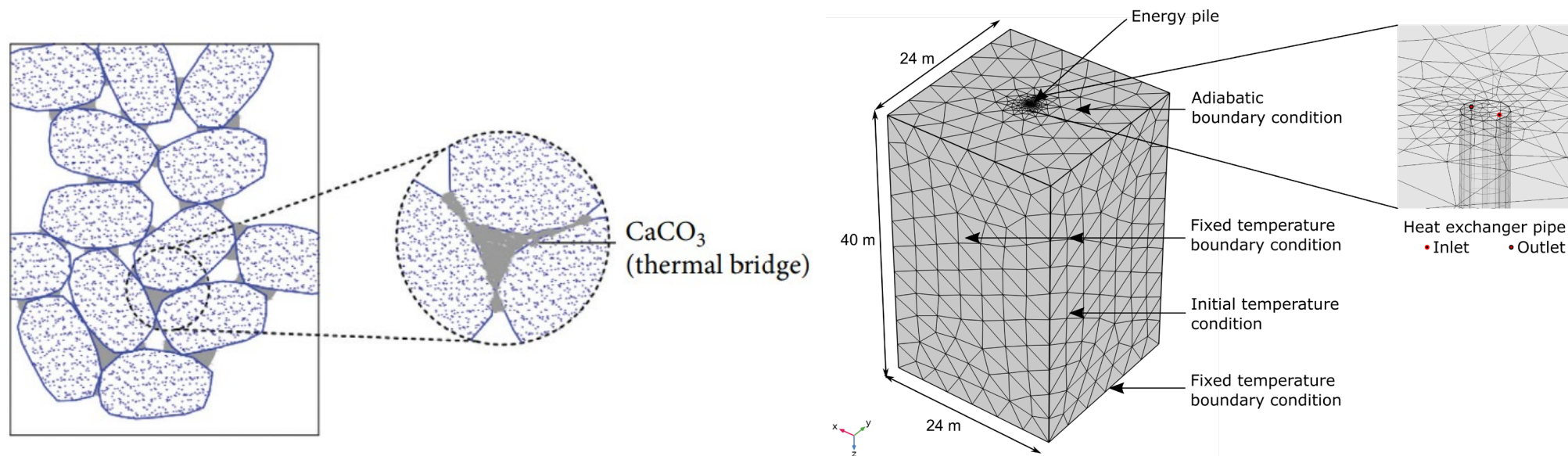
Model calibration & conclusions

Contact: sofie.tenbosch@epfl.ch



Enhancing soil energy capacity using biocementation

Contact: sofie.tenbosch@epfl.ch, ziad.sahlab@epfl.ch

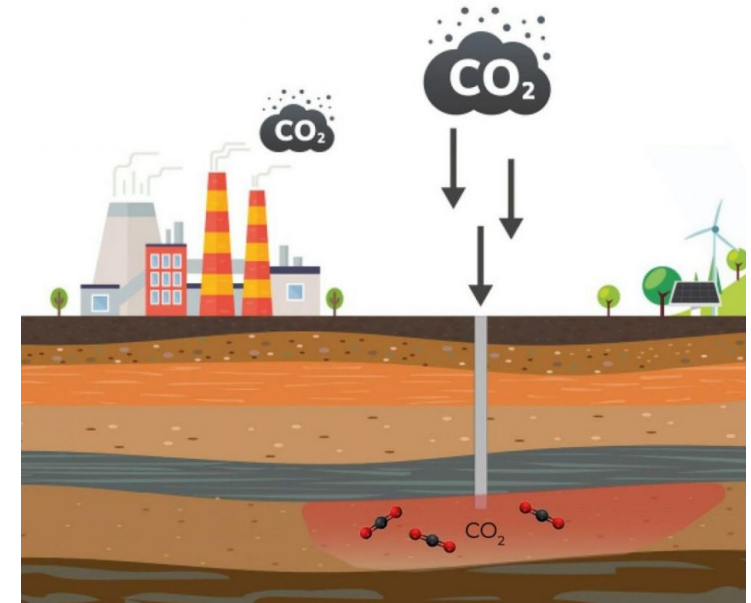


CO₂ storage

CO₂ storage modelling and experiments

1. Temporary storage of captured CO₂
2. Study of Swiss subsoil for permanent CO₂ storage
3. Impact of CO₂ storage on its environment
4. Modeling CO₂ injection into a geological reservoir
5. CO₂ storage in basalts via mineralization

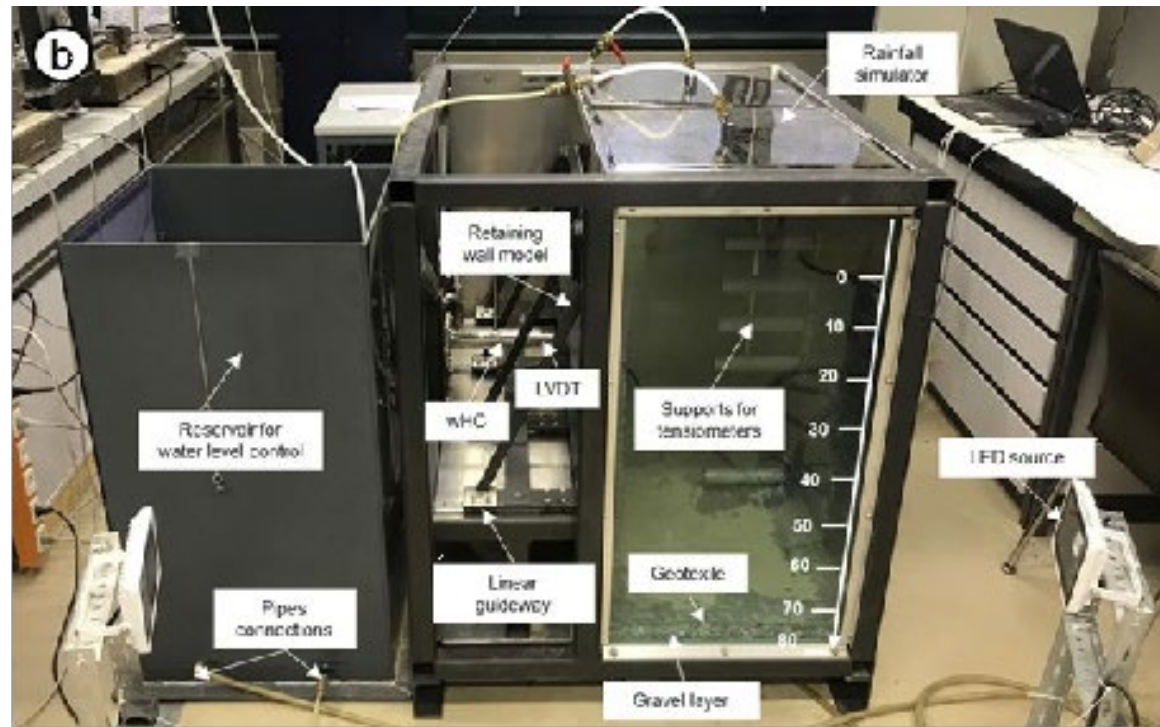
Contact: eleni.stavropoulou@epfl.ch



Climate change impacts

Will retaining structures remain stable as climate change progresses?

Contact: alessio.ferrari@epfl.ch



Projects in industry

Geotechnical projects

1. Design and analysis of energy geostructures (GEOEG <https://geoeg.net/>) – Contact: elena.ravera@epfl.ch
2. Soil structure interaction for retaining walls (Gruner) – Contact: angelica.tuttolomondo@gruner.ch / (john.eichemberger@gruner.ch)
3. Geotechnical projects (BG <https://bg-21.com>) – Contact: lyesse.laloui@epfl.ch

Propose your own project

Contact: lyesse.laloui@epfl.ch / alessio.ferrari@epfl.ch

