Energy geostructures are an innovative technology that couple the structural role of foundations and the heating-cooling role of geothermal heat exchangers. The goal of the course is to provide a comprehensive understanding of the structural, geotechnical and energy behaviour.

Content

- Energy geostructures: concepts, developments and challenges
- Heat and mass transfers in the context of energy geostructures
- Analytical modelling of steady state heat and mass transfers
- Analytical modelling of transient heat transfer
- Estimation of thermal potential of sites and design parameters
- Thermo-mechanical behaviour of single and groups of energy piles
- Thermo-mechanical behaviour of energy walls and energy tunnels
- Alternative applications: deck de-icing
- Thermo-hydro-mechanical behaviour of soils
- Thermo-mechanical behaviour of soil-concrete interfaces
- Development of projects of energy geostructures
- Performance-based design in the framework of Eurocodes

Keywords

Energy geostructures, geothermal energy, renewable energy, energy piles, energy tunnels, energy walls, thermo-mechanical behaviour, structural performance, geotechnical performance, energy performance, analysis, design, Eurocodes, analytical modelling, numerical modelling, in-situ testing, laboratory testing.

Learning Prerequisites

Required courses
Geotechnical engineering (Ouvrages géotechniques).

Recommended courses
Geomechanics.
Important concepts to start the course
Interdisciplinary and proactive attitudes of the students are the main prerequisites to follow this course.

Teaching methods
*Ex cathedra* discussions, exercises and practical work with the aid of computers.

Expected student activities

**Learning outcomes**
By the end of the course, the student is expected to be able to:

- Explain the behaviour and performance of energy geostructures, such as energy piles, energy walls and energy tunnels.
- Perform the energy, geotechnical and structural analysis of energy geostructures with practical application exercises, including analytical and numerical simulation exercises.
- Design energy geostructures following current standards through appropriate procedures.

Assessment methods
Evaluation:
- 2 written exams during the semester (theoretical questions and exercises): 55% of the final mark
- 4 assigned exercises: 20% of the final mark
- 1 practical work report: 5% of the final mark
- Design project: 20% of the final mark

Supervision
- Office hours: Yes
- Assistants: Yes
- Forum: No

Resources

**Bibliography**

**Ressources en bibliothèque**
- Laloui, Lyesse, and Alice Di Donna, eds. *Géostructures énergétiques.*

**Notes/Handbook**
Dedicated notes will be given to the students.

**Websites**

- https://www.epfl.ch/labs/lms/research-research-fields-energy-ressources/

**Moodle Link**