CIVIL-444

Energy geostructures

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Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Mechanics		Obl.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The goal of this course is to introduce students to the technology of energy geostructures. The course covers both theoretical and practical aspects of paramount importance for the analysis and design of energy geostructures. Dedicated illustrative and practical examples are foreseen.

Content

- Energy geostructures: concepts, developments and challenges
- Energy considerations
- *In-situ* testing of energy piles and main observations
- Thermal laboratory testing and *in-situ* thermal response testing of energy piles
- Thermo-mechanical testing of soils and main observations
- Soil-structure interactions and the behaviour of the soil-concrete interface
- Design of a single energy pile
- Design of energy pile groups
- Extension of Eurocodes to such structures
- Alternative energy geostructures: energy tunnels and energy walls

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:

- Describe the theoretical fundamentals governing the structural, geotechnical and energy support operations of energy geostructures;
- Analyse and interpret the thermo-mechanical behaviour of both single and groups of energy piles;
- Describe the response of soils and concrete-soil interfaces subjected to thermo-mechanical loads and the associated experimental techniques devoted to analyse their behaviour;
- Describe the thermal response testing technique;
- Perform the design of both single and groups of energy piles in various design conditions;
- Describe the main theoretical aspects characterising the analytical and numerical modelling of energy piles and other geostructures;
- Be acquainted with the main features characterising other energy geostructrues such as energy tunnels and energy walls;

Assessment methods

The evaluation of the student will be based on the final oral exam (70%), group project (10%) and homework evaluations (20%)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Bibliography

Laloui, Lyesse, and Alice Di Donna, eds. *Energy geostructures: innovation in underground engineering*. Wiley-ISTE, 250 pages, ISTE Ltd. and John Wiley and Sons, Hoboken, NJ, ISBN: 9781848215726
Laloui, Lyesse, and Alice Di Donna, eds. Géostructures énergétiques. Hermes science Publications, 250 pages, ISBN: 978-2-7462-4577-8.

Ressources en bibliothèque

- Laloui, Lyesse, and Alice Di Donna, eds. Energy geostructures: innovation in underground engineering.
- Laloui, Lyesse, and Alice Di Donna, eds. Géostructures énergétiques.

Notes/Handbook

Dedicated notes will be given to the students.

Websites

- https://dessinemoiunproton.com/portfolio/geostructures_energie_epfl_mecanique_sols/

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=15310