CIVIL-444

Energy geostructures

Laloui Lyesse

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

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	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
- 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:

- Develop your understanding of the behaviour and performance of energy geostructures, such as energy piles, energy walls and energy tunnels.
- Increase your knowledge about the energy, geotechnical and structural analysis of energy geostructures with practical application exercises, including analytical and numerical simulation exercises.
- Learn how to 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
- Research project: 20% of the final mark (10% project report, 10% oral presentation)

Supervision

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

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