CIVIL-444

Energy geostructures

Laloui Lyesse

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

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Energy geostructures are an innovative technology that couple the structural role of foundations and the heatingcooling 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:
Oral exams during the semester: 60% of the final mark (à la place de deux examens écrits)
5 assigned exercises: 10% of the final mark
Design project: 30% of the final mark.
Rendu d'un exercice, rendu d'un projet et examen oral par visio-conference en juin.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

Laloui, Lyesse, and Alessandro F. Rotta Loria. Analysis and Design of Energy Geostructures,1st Edition: Theoretical Essentials and Practical Application. Academic Press, ISBN:9780128206232
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 Alessandro F. Rotta Loria. Analysis and Design of Energy Geostructures
- 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://www.epfl.ch/labs/lms/research-research-fields-energy-ressources/

Moodle Link

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