CIVIL-444

Energy geostructures

Laloui Lyesse

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Civil engineering minor	E	Opt.
Energy minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.
Mechanics		Opt.

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

Summary

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

Content

- Introduction: Energy geostructures general principles
- Heat and mass transfer theory for energy geostructures
- Analytical modelling of heat and mass transfer
- Thermo-mechanical behaviour of single energy piles
- Thermo-mechanical behaviour of energy pile groups
- Thermo-mechanical behaviour of energy walls and tunnels
- Design of energy geostructures
- Construction of energy geostructures
- Thermal potential of sites and determination of design parameters (testing)
- Thermo-mechanical behaviour of soils and soil-concrete interfaces

Keywords

Energy geostructures â## design â## thermo-mechanics

Learning Prerequisites

Required courses

Any EPFL bachelor degree

Learning Outcomes

By the end of the course, the student must be able to:

- Describe the thermal and mechanical behavior of energy geostructures referring to the latest scientific advances.
- Advise on how the exploit the energetic, geotechnical and structural design of energy geostructures.
- Use the standards in force at the European level (i.e. the Eurocodes) for the design of energy geostructures.
- Design energy geostructures with participal exercices covering all the key steps involved in this process.

• Recognize the potential of this technology based on practical examples of recent projects carried out around the world.

Transversal skills

• Set objectives and design an action plan to reach those objectives.
• Collect data.
• Take feedback (critique) and respond in an appropriate manner.
• Use both general and domain specific IT resources and tools
• Make an oral presentation.
• Write a scientific or technical report.

Teaching methods

Powerpoint ; discussion ; in-class exercises ; group project

Expected student activities

Attend lectures ; participate in exercises ; home study ; project group work

Assessment methods

• Written exam (theoretical questions and exercises) : 45% of the final mark
• 5 assigned exercises : 25 % of the final mark
• Design project : 30% of the final mark (20% design project report, 10% design project presentation), group work

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

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

Moodle Link

- https://go.epfl.ch/CIVIL-444

Prerequisite for