

CIVIL-402

Geomechanics

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| Cursus | Sem. | Type |
|--------------------|----------|------|
| Civil Engineering | MA1, MA3 | Obl. |
| Mechanics | | Obl. |
| Mineur STAS Russie | H | Opt. |

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| Language of teaching | English |
| Credits | 3 |
| Session | Winter |
| Semester | Fall |
| Exam | Written |
| Workload | 90h |
| Weeks | 14 |
| Hours | 3 weekly |
| Courses | 2 weekly |
| Exercises | 1 weekly |
| Number of positions | |

Summary

The course aims at providing future civil engineers with the knowledge of geomechanics for professional practice. It addresses, among others, the main stress-strain constitutive models within the context of elasticity and elasto-plasticity and the estimation methods of the lateral earth pressure.

Content

- Engineering applications and challenges
- Basic concepts of continuum mechanics and geomechanics

Stress-strain behaviour of geomaterials in drained and undrained conditions

Laboratory tests with special focus on triaxial testing

- In-situ stress state
- Stress-strain constitutive frameworks

- Elasticity

Linear and non-linear elasticity

Applications of elastic models

- Plasticity

Plasticity principle and yield criteria for geomaterials

Critical state concept

Elasto-plastic stress-strain constitutive frameworks (among other Modified Cam Clay model)

- Time dependent behaviour of geomaterials

Real cases and time-dependent phenomena

Viscous deformations: basic concepts and experimental evidences

Visco-elasto plastic models

- Behaviour of unsaturated geomaterials

Basic concepts

Hydraulic and mechanical behaviour

Effective stress definition for unsaturated geomaterials

- Retaining structures in saturated and unsaturated geomaterials

Lateral earth pressure for saturated and unsaturated soils (Rankine's theory)

Shear strength of unsaturated geomaterials

Darcy's law for saturated and unsaturated geomaterials

- Thermo-mechanics and soil dynamics

Mechanical behaviour of soils in non-isothermal conditions

Mechanical behaviour of soils under dynamic loads

- Advanced topics in geomechanics

Energy related applications

Bio-improved soils

Keywords

Mechanical behaviour of geomaterial, Constitutive models, elasto-plasticity, numerical modelling in geomechanics, laboratory and in-situ testing

Learning Prerequisites

Required courses

Soil mechanics and groundwater seepage

Learning Outcomes

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

- Recognize the stress path(s) to which the soil is subjected in the context of the engineering application of interest
- Use methods for evaluating the in-situ stress state
- Recognize the most suitable constitutive model for the problem of interest in relation to the soil and the problem itself
- Judge capabilities and limitations of constitutive models
- Assess / Evaluate Evaluate the geotechnical parameters governing the geomechanical problem
- Choose the correct laboratory or in-situ tests for the determination of the needed parameters
- Interpret the experimental data resulting from a laboratory campaign in order to obtain the parameters of interest
- Assess / Evaluate the lateral earth pressure under different hydraulic conditions
- Use consciously a finite element software for creating a geomechanical model appropriate for the problem of interest

Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.
- Demonstrate the capacity for critical thinking
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

Teaching methods

- Ex cathedra and exercises

Assessment methods

Final exam (written) 80% of the final mark

Homework 20% of the final mark

Supervision

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| Office hours | No |
| Assistants | Yes |
| Forum | No |

Resources

Bibliography

Lectures notes and handouts given during the course