CIVIL-512

Reinforced concrete structures - advanced topics

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

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

Remark

Pas donné en 2024-25

Summary

This course will focus on advanced behavioural modelling of reinforced concrete through analytical and numerical methods. It will build on previous studies to further the student's understanding of the mechanics of reinforced concrete at the material, element, and structure level.

Content

Introduction and review of mechanics of reinforced concrete
Mechanical properties of concrete, steel, and crack interfaces
Linear and nonlinear models for plain concrete
Failure criteria for plain concrete
Modelling of planar, cracked reinforced concrete
Nonlinear finite element implementation
The Modified Compression Field Theory
Pre-strains and plastic offsets
Fixed crack models and cyclic loading
Advanced behaviour modelling (dowel action, bond, etc.)
Extension to member-level behaviour and design codes
Comparison of linear vs. nonlinear analysis
Case studies of nonlinear finite element analysis

Keywords

Reinforced concrete, Nonlinear finite element analysis, Failure criteria, Constitutive modelling

Learning Prerequisites

Required courses

Structural mechanics (for GC), Continuum mechanics (for GC), Reinforced concrete structures

Recommended courses

Nonlinear analysis of structures

Important concepts to start the course

Statics, mechanics of materials

Learning Outcomes

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

- Describe the mechanical properties of concrete, steel, and crack interfaces
- Make calculations of concrete stress tensors from given strain tensors for different models
- Explain the differences between different types of models for cracked reinforced concrete (i.e. fixed/rotating crack; smeared/discrete crack)
- Formulate and iteratively solve nonlinear 2D stress/strain states
- Use nonlinear finite element analysis software to model reinforced concrete structures
- Identify potential shortcomings in using linear analysis for design

Transversal skills

- Use a work methodology appropriate to the task.
- Respect relevant legal guidelines and ethical codes for the profession.
- Demonstrate the capacity for critical thinking
- Continue to work through difficulties or initial failure to find optimal solutions.
- Manage priorities.
- Access and evaluate appropriate sources of information.

Teaching methods

- Ex cathedra
- Powerpoint
- Discussion
- Computational tools
- In-class exercises
- Problem sets

Expected student activities

- Attend lectures
- Participate in exercises
- Home study
- Problem sets

Assessment methods

- Continuous assessment (40% of total grade)
- Final written exam (60% of total grade)

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Moodle Link

- https://go.epfl.ch/CIVIL-512