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Sem.	Туре	Language of	English
MA1, MA3	Opt.	teaching	Linglish
MA1, MA3	3 Opt. Credits Session	Credits Session	6 Winter
		Semester Exam Workload Weeks Hours Lecture Exercises	Fall Written 180h 14 <b>5 weekly</b> 3 weekly 2 weekly
	Sem. MA1, MA3 MA1, MA3	Sem.TypeMA1, MA3Opt.MA1, MA3Opt.	Sem.TypeMA1, MA3Opt.MA1, MA3Opt.MA1, MA3Opt.CreditsSessionSemesterExamWorkloadWeeksHoursLectureExercises

#### Summary

This course provides an introduction to the nonlinear modelling of civil engineering structures.

#### Content

The course is based on assignments in which students either implement the nonlinear analysis from scratch (for models with truss elements) or use an open-source software (for models with beam elements). The topics that are covered are the following:

• Truss models: Hand calculations and finite element calculations of truss models with material and geometric nonlinearity; Nonlinear material laws: Plasticity

• Beam element formulations: Total and incremental compatibility and equilibrium relations of beams, accounting for large displacements. Differential equations for Euler-Bernoulli and Timoshenko beams. Sectional analysis of RC sections. Beam formulations with concentrated and distributed plasticity approaches (force-based and displacement-based).

- Nonlinear analyses: Solution methods for nonlinear static and dynamic analysis. Damping models.
- Review of past blind prediction tests and comparison between numerical and experimental results.
- Use of nonlinear simulations in civil engineering practice.

## **Learning Prerequisites**

Required courses

CIVIL-321 Numerical modelling of solids and structures (or similar) Courses on structural mechanics

## Learning Outcomes

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

- Implement nonlinear finite element approaches for truss elements
- · Assess / Evaluate the consequences of modelling hypotheses on analysis results
- Choose appropriate finite element formulations for nonlinear structural analysis problems
- Develop models that represent the essentials of the nonlinear response of structures

## Assessment methods

Assignments



positions

Project during the semester Final exam

# Resources

# Ressources en bibliothèque

• Finite element analysis for building assessment / Lourenço & Gaetani

# Moodle Link

• https://go.epfl.ch/CIVIL-449