Non-linear FEM for Civil Engineers

Course codes: AF3212 (PhD students) & AF2212 (Master students)

Description

The purpose of this course is to give PhD students, engineers and researchers a deeper insight into the finite element method with an emphasis on methodologies and applications for non-linear problems. The course introduces fundamental theoretical background and computer implementations for non-linear FE analyses.

Content and Objectives

The aims of the course are to give knowledge on general concepts in Non-linear FEM

- Different strain measures.
- Derivation of non-linear 2D truss, 2D beams and isoparametric plane elements.
- Basic plasticity.
- Path following solution procedures.
- Linearised buckling and post-buckling analyses.
- Non-linear dynamic analyses

Prerequisites

- Passed courses in basic finite element theory.
- Experience in MATLAB programming.

Literature

- Lecture notes

Teaching

- Professor Jean-Marc Battini, KTH

Examination

The course corresponds to 7,5 ECTS units. To pass the course the student must

- attend at least 80% of the lectures
- perform the homeworks
- pass the exam. The exam can be performed orally at KTH or in writing at another university. The date of exam will be decided in agreement with the participants.

The grades for the course are passed and failed.

Homeworks

The homeworks are an important part of the course. The participants will program in Matlab non-linear 2D truss, 2D beam and isoparametric plane elements as well as path following procedures and use then their programs to solve simple problems.

Organisation

The course will be given during 19-21 April 2027. The course venue is The Royal institute of Technology (KTH), Department for civil and architectural engineering, Drottning Kristinas väg 26, Stockholm, Sweden.

The course will be given in English.

Registration

Registration for the course should be made not later than 7 March 2027 by e-mail to

jeanmarc@kth.se

Please indicate name, address and affiliation.

Registration fee is 15000 SEK, free for PhD-students registered at one of the four technical universities within the national research school in Structural Engineering ("Sveriges Bygguniversitet"), and 8000 SEK for other PhD students.

Course organiser

Professor Jean-Marc Battini
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Detailed timetable

Day/Date	Time	Teacher	Curriculum
Monday 19 April	10.00 – 12.00	Jean-Marc	Introduction, N-R method
	13.00 – 15.00	Jean-Marc	Different strain measures, Non-linear 2D truss elements
Tuesday 20 April	09.00 – 12.00	Jean-Marc	Path-following procedures, Convergence criteria
	13.00 – 15.00	Jean.-marc	Non-linear 2D beam elements
	15.00 – 16.00	Jean-Marc	Basic plasticity 1D, Implementation in a 2D beam element
Wednesday 21 April	09.00 – 10.30	Jean-Marc	Non-linear plane isoparametric element
	10.30 – 11.30	Jean-Marc	Basic plasticity 2D, Implementation in a non-linear plane element
	12.30 – 14.00	Jean-Marc	Stability analyses
	14.00 – 16.00	Jean-Marc	Non-linear dynamic analyses