Module Nr.	Credits	Workload	Semester	Frequency	Duration
SE-CO-10	6 CP	180 h	2	Yearly (SS)	1 Semester

Courses	Contact time	Self-study	Group size
a) FEM for Nonlinear Analyses of Inelastic Materials and Structures	2 h/week	60 h	---
b) Advanced Constitutive Models for Soils	2 h/week	60 h	

Computational Methods 2

Learning outcomes

After successfully completing the modules, the students are able to

- formulate and to implement inelastic material models for ductile and brittle materials within the context of the finite element method and to perform nonlinear ultimate load structural analyses
- model the material behavior of soil using suitable, complex constitutive models,
- select suitable numerical methods and constitutive models for practical questions and assess limitations according to the selected approaches.

Content

a) FEM for Nonlinear Analyses of Inelastic Materials and Structures

The course is concerned with inelastic material models including their algorithmic formulation and implementation in the framework of nonlinear finite element analyses. Special attention will be paid to efficient algorithms for physically nonlinear structural analyses considering elastoplastic models for metals, soils and concrete as well as damaged based models for brittle materials. As a final assignment, the formulation and implementation of inelastic material models into an existing finite element program and its application to nonlinear structural analyses will be performed in autonomous teamwork by the participants.

b) Advanced Constitutive Models for Soils

The course extends the existing knowledge on soil behaviour and its mathematical description:

- Hardening Soil, Hardening Soil Small Strain
- Modified Cam-Clay
- Softsoil Creep (SSC) model
- Hypoplasticity
- Viscohypoplasticity
- Bounding surface plasticity models SaniSand / SaniClay
- Calibration process of advanced constitutive models
- Effects of the constitutive model on the FE-prediction (selected examples)

Teaching methods / Language

a) Lectures (1 h/week) and Exercises (1 h/week) / English

b) Lectures (2 SWS) / English

Modes of assessment

Final written examination: project work (60 h) with oral presentation

Requirements for the award of credit points

Project works with oral presentation for a) and b) (Date for presentation will be announced at the start of the semester)
Module applicability (in other study programs) Master Computational Engineering, Master Civil Engineering
Weight of the mark for the final score 5 %
Module coordinator and lecturer(s) a) Prof. Dr. Günther Meschke (coordinator) b) Dr.-Ing. A. Lavasan, Dr.-Ing. F. Prada, MSc. C. Schmüdderich
Other information