Course syllabus

Faculty of Technology

Department of Building Technology

4BY368 Finita elementmetoden 2, 5 credits
Finite Element Method 2

Main field of study
Civil Engineering, Mechanical Engineering

Subject Group
Building Technology

Level of classification
Second Level

Progression
A1F

Date of Ratification
Approved 2019-06-10
Revised 2022-05-16 by Faculty of Technology. Content and examination is revised. The course syllabus is valid from spring semester 2023

Prerequisites
Structural Mechanics or Solid Mechanics 7.5 hp, Finite element method 7.5 hp, or equivalent knowledge

Objectives

Knowledge and understanding
To pass, the student is expected to

- be able to account for sectional forces in a shell element and how these are defined,
- be able to account for isoparametric mapping of a shell element; how normals are determined and how integration in the element thickness direction is made,
- be able to describe how buckling of a shell structure occurs and how the buckling load is calculated,
- have knowledge of how non-linear finite elements problems are solved and which tolerance criteria control convergence and
- be able to use a material routine and describe how an elastoplastic material model with isotropic or kinematic hardening works

Competence and skills
To pass, the student is expected to

- understand how to implement and use a general 3D shell element for structural analysis and
- be able to implement and use a general solution algorithm for non-linear finite element problems.

Judgement and approach
To pass, the student is expected to

- be able to judge when shell elements is a suitable choice for structural analyses and
- be able to assess and interpret convergence and error messages from a commercial FE program

Content

The course is a continuation of the basic course in FEM. The course deals with general shell theory, solution of the non-linear systems of equations resulting from FE applied to material or geometrically nonlinear problems and its relation to the buckling problem. Furthermore, the basic components of plasticity theory are presented.
The content of the course is summarized as follows:

- Isoparametric mapping of shell elements, determination of normal and rotational matrix
- The sectional forces of shell elements and their connection to stresses.
- The degrees of freedom of the shell element, deformation and the relation to strains at an arbitrary point.
- Weak formulation of 3D continuum and its connection to general shells.
- Solution methods for non-linear systems of equations.
- Error measures and tolerances for convergence criteria.
- Linear vs. nonlinear material model with state variables.
- Components and relationships included in an elastomeric material model; yield criteria, consistency conditions and evolution laws.

Type of Instruction

The teaching consists of lectures where theory is introduced, exercises and computer exercises where practical skills are practiced. Computer exercises and seminars are compulsory elements in the course.

Examination

The course is assessed with the grades A, B, C, D, E, Fx or F.

The grade A constitutes the highest grade on the scale and the remaining grades follow in descending order where the grade E is the lowest grade on the scale that will result in a pass. The grade F means that the student’s performance is assessed as fail (i.e. received the grade F).

The course includes two assignments that constitute examination. The students are individually examined on the assignments and how these have been implemented. Examination of the course is divided into the following parts.

- Assignment 1, 3 hp, A-F
- Assignment 2, 2 hp, A-F

The final grade is based on a weighting of the two assignments, where Assignment 1 is given the weight 60% and Assignment 2 is given the weight 40%.

Repeat examination is offered in accordance with Local regulations for courses and examination at the first and second-cycle level at Linnaeus University.

If the university has decided that a student is entitled to special pedagogical support due to a disability, the examiner has the right to give a customised exam or to have the student conduct the exam in an alternative way.

Course Evaluation

During the implementation of the course or in close conjunction with the course, a course evaluation is to be carried out. Results and analysis of the course evaluation are to be promptly presented as feedback to the students who have completed the course. Students who participate during the next course instance receive feedback at the start of the course. The course evaluation is to be carried out anonymously.

Other

Grade criteria for the A–F scale are communicated to the student through a special document. The student is to be informed about the grade criteria for the course by the start of the course at the latest.

The course material is presented on a web study site that the students access from Internet. Access to the Internet and computers is available in the university's computer rooms or at the university library.

Required Reading and Additional Study Material

Required reading

Course book, lecture notes, and exercises. Instructions for assignments. In total the literature consists of approximately 500 pages.