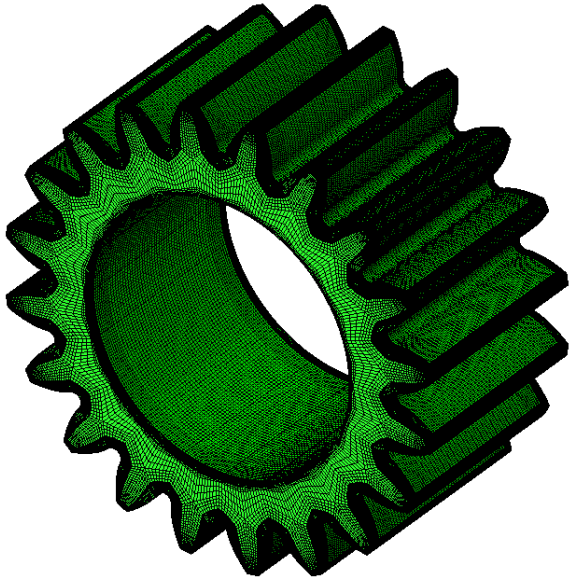
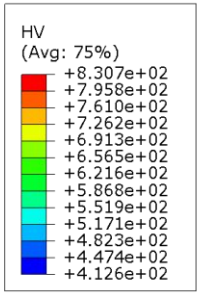
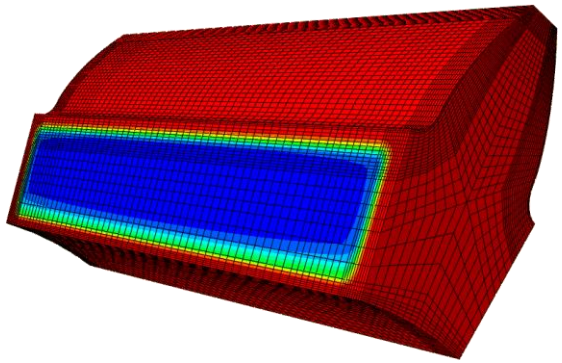
FEM for engineering applications SE1025

Erik Olsson







Teachers

- Erik Olsson, Lecturer and course organizer (erolsson@kth.se) Room 6380
- MohammadAli Asgharzadeh, Tutorials (asgmoh@kth.se)
- Prashanth Srinivasa , computer labs, (pns@kth.se)
- Jonas Neumeister, examiner, (jonasn@kth.se)

Literature

- Course compendium – pdf on the web site
- Compendium with example problems – Buy at course expedition for 80 SEK
- Course book *The Finite Element Method* E-book

Lectures

- 18 2 h lectures in the course
- Lecturer Erik Olsson
- Notes on my personal home page, link from the news feed
- Both theory and problem solving

Tutorials

- 8 2 h Tutorials – Focuses on problem solving
- MohammadAli Asgharzadeh
- I will have the first tutorial on Friday

Home assignments

- 3 Home assignments
- Deadlines 18:00 13 September, 12 October, and 17 October
- Submission to the teachers or in the post-pox at the student office
- 1.5 credits and up to 5 bonus points on the exam
- Please do and spend some time on the home assignments!!!

Computer labs

- 2 computer labs 9th or 15th September and 3rd or 6th of October
- Mandatory but 0 credits
- Registration by doodle on the home page

Exam

- Exam 24th of October 14:00-19:00
- Mandantory registration from 6 weeks before the exam period to 2 weeks before on ”My pages”
- I will do the exam in collaboration with previous teachers in the course

What is the finite element method?

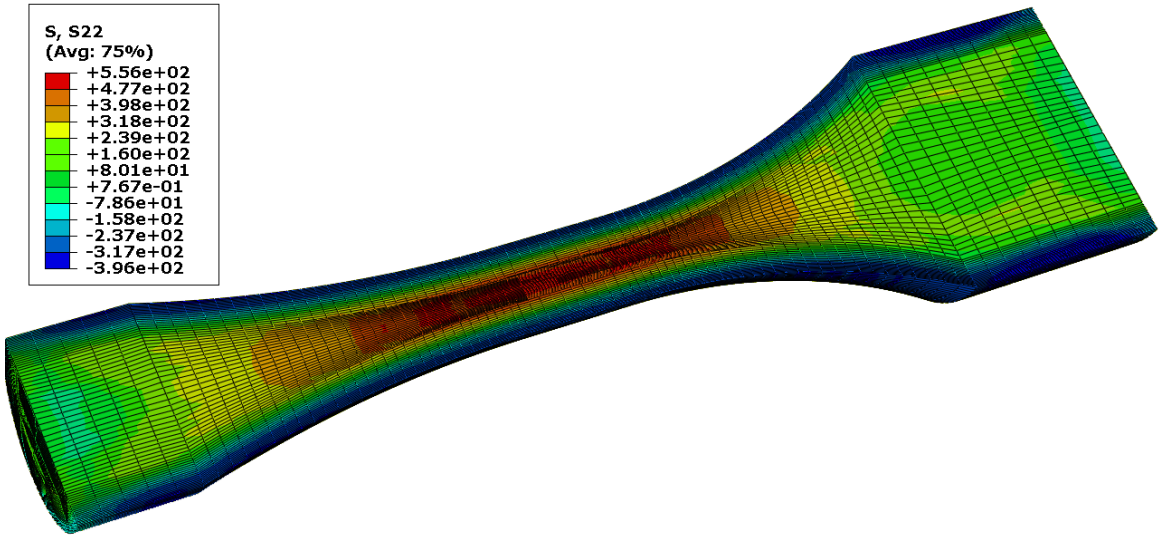
And why use it?

FEM

- An approximate method for solving differential equations
- “Invented” in 1943
- Development of FEM codes in 1960
- Development Today: Large deformations, fracture, solid-fluid interaction etc.

FEM – basic idea

- Divide the problem in small domains (elements)
- Simple approximation of the fields in the elements



What can we do?

- Accurately compute deformations, stresses, temperature distribution…
- If we now the material behavior

- Predicting if it will fail – difficult problem

- FEM is a tool for when solving problems but does not solve the problem!

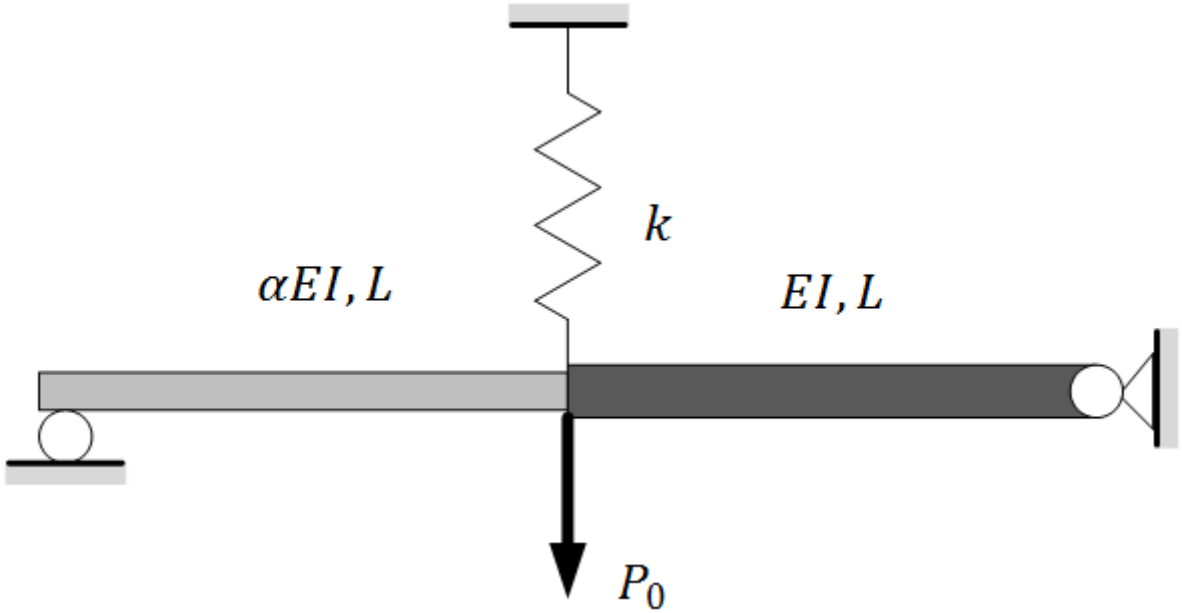
Engineering applications?

- Solid Mechanics and Heat conduction
- Applicable to:
  - Electrostatics
  - Diffusion
  - Piezo-electricity
  - Fluid Mechanics
  - …
- Every physical phenomena controlled by differential equations

Contents

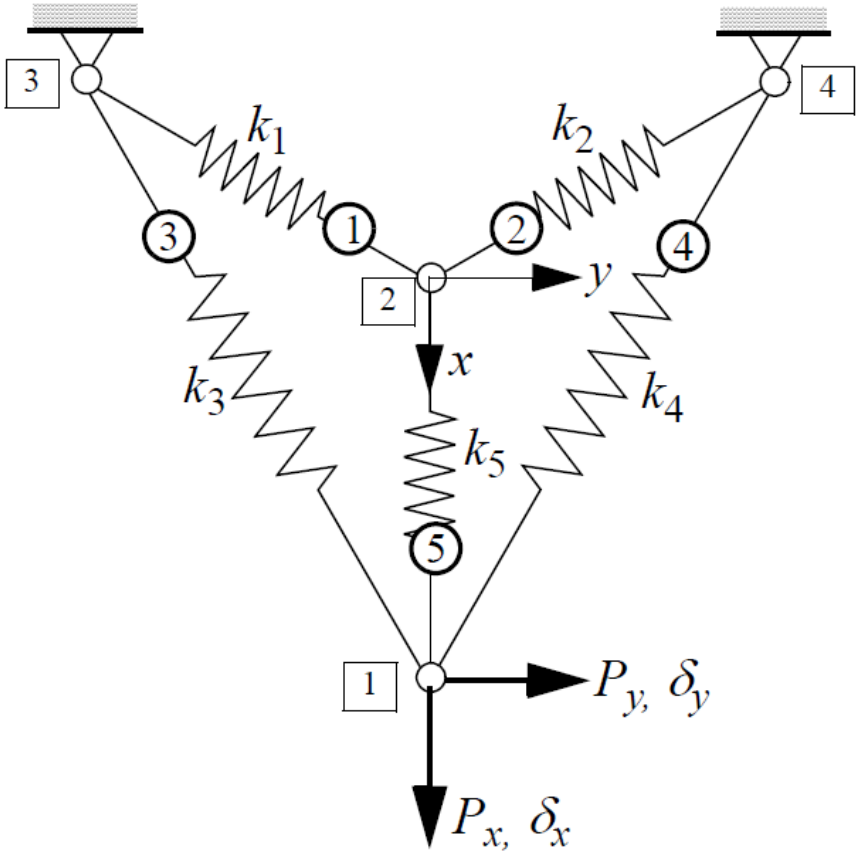
Energy methods

- 2 Lectures 1/2 tutorial and 1/2 home assignment
- Elastic problems with point loads



Matrix formulated Structure/Solid Mechanics

- 2 Lectures 1/2 tutorial and 1/2 home assignment
- FEM ”light”
- Network of springs

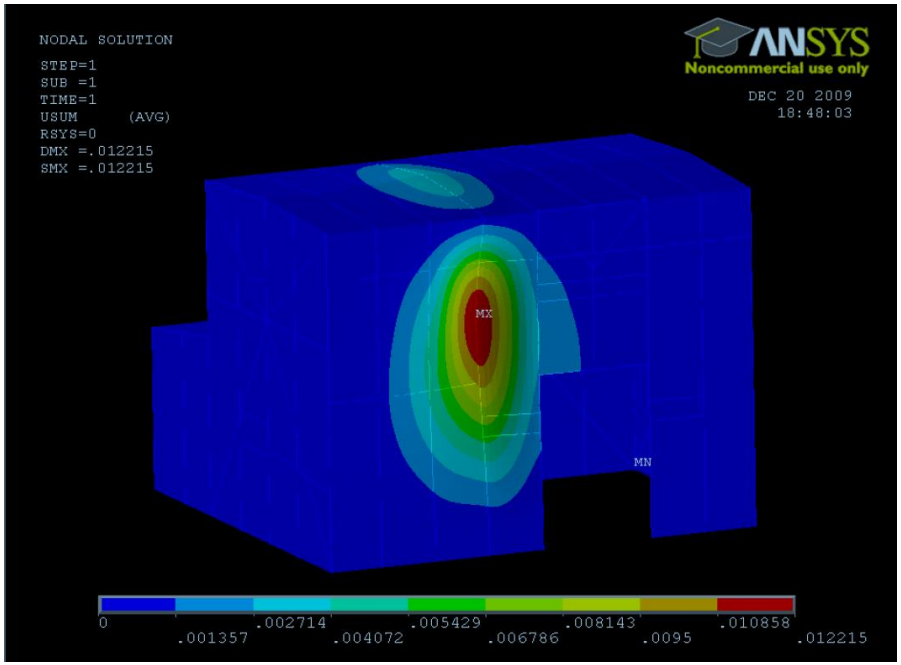


Deriving FEM equations

- Lecture 5 and part of tutorial 2
- From equilibrium + compatibility + material to matrix equations

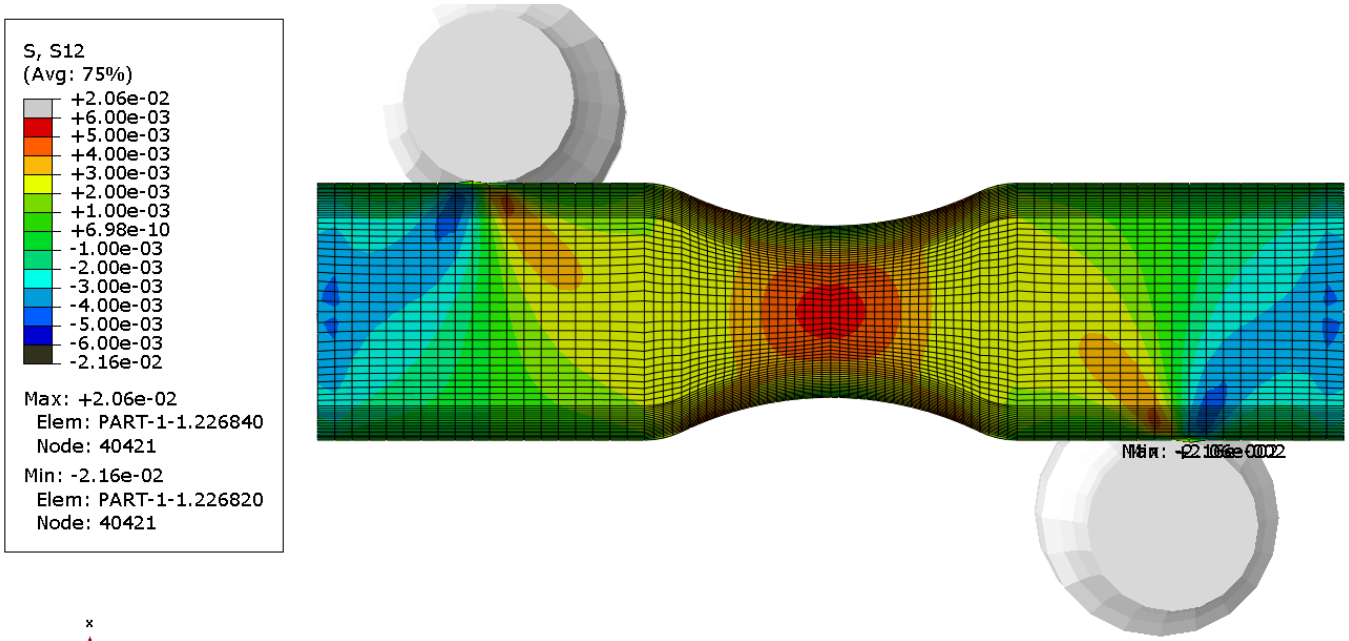
FEM for 1D elements

- Trusses and beams
- Lecture 6-10 and tutorial 2-3
- Home assignment 2.1
- One workshop



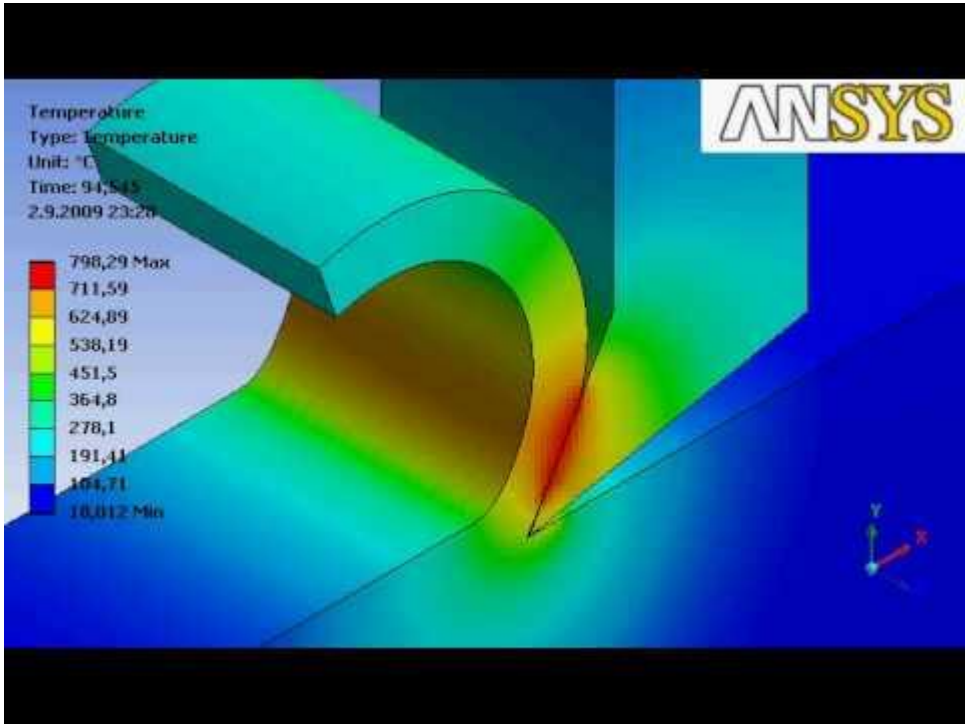
FEM for 2D/3D elements

- Mostly 2D, 3D requires 24x24 matrices
- Lecture 11-15 and tutorial 4-6
- Home assignment 2.2 and 3
- Evaluating results



FEM for heat conduction

- Lecture 16-17 and tutorial 7
- One workshop



What is the course about then?

- Methods for solving problems in the computer - Algorithms
- Interpret and knowing if the results are useful!
- Understand what is going on in the program

Don’t forget to register for the course

KTH homepage-> my pages