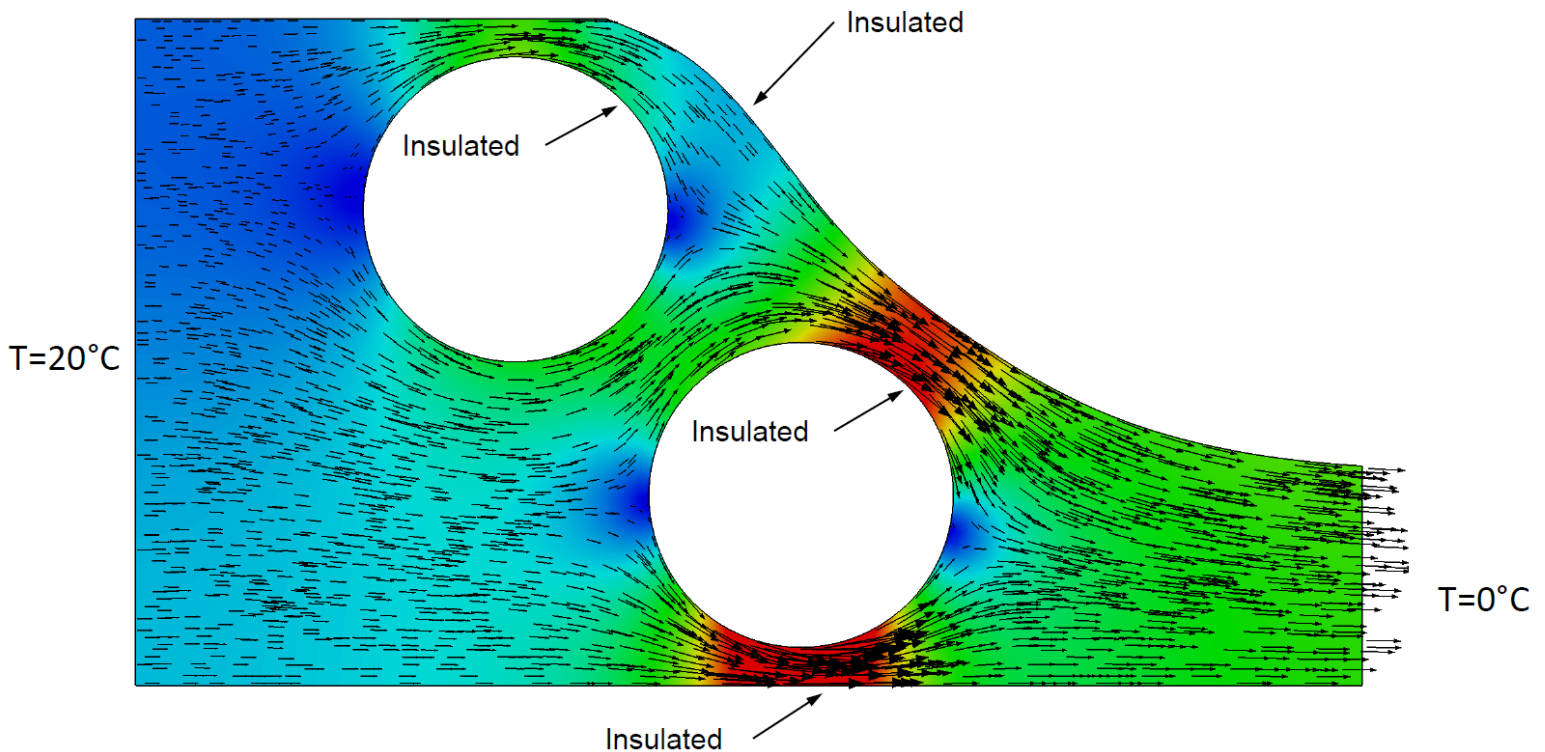


Finite Element Method - flow analysis

VSMN25

Preliminary
Course programme 2021



Finite Element Method – flow problems

The course aims at giving the ability to analyse various types of flow problems by means of the finite element (FE) method. The FE formulation is studied containing the direct approach, strong and weak formulations, approximating functions and weighted residual methods. Focus is on flow problems: heat flow, diffusion and groundwater flow in stationary and transient conditions. Design assignments are studied to illustrate the procedure of transferring a design problem into FE-model.

Course Plan

The lectures are held 8.15-10.00 and the problem-solving classes are held 10.15-12 at dates and locations according to the schedule below.

Day	Room	Chapter in "Introduction to the Finite element method"	Exercise problems
Tue 31/9	8.15-10 10.15-12	1 Introduction 2, 3 Repetition - Zoom Exercise – Zoom, V:P1,P2, Dator 11,12 Presentation of hand-in assignment 1	2-1, 2-2, 2-3, 2-4 3-1, 3-2, 3-3, 3-5, 3-8
Fri 3/9	8.15-10 10.15-12	4 Strong and weak formulation 1-dim. heat flow - Zoom Exercise - Zoom, V:R1,R2, Dator 11,12	4-1, 4-2, 4-3, 4-4, 4-5
Tue 7/9	8.15-10 10.15-12	5 Gradient, Gauss theorems, Green-Gauss theorem - Zoom Exercise - Zoom, V:P1,P2, Dator 11,12	5-1, 5-2, 5-3, 5-4, 5-5
Fri 10/9	8.15-10 10.15-12	6 Strong and weak formulation, 2- and 3-dim. heat flow - Zoom Exercise – Zoom, V:P1,P2 Hand in of assignment 1 (11/9, 08.15)	6-1, 6-2, 6-3
Tue 14/9	8.15-10 10.15-12	7 Approximating functions – Zoom Exercise – Zoom, V:P1,P2	7-1, 7-2, 7-3, 7-4,7-5,7-6,7-7 7-8, 7-9, 7-11, 7-10, 7-12
Fri 17/9	8.15-10 10.15-12	8 Weighted residual methods – Zoom Exercise – Zoom, V:P1,P2	8-1
Tue 21/9	8.15-10 10.15-12	9 FEM-formulation, 1-dim. heat flow – Zoom Exercise – Zoom, V:Q1, Q2	9-1, 9-2, 9-3, 9-4, 9-5
Fri 24/9	8.15-10 10.15-12	10 FEM-formulation, 2- and 3-dim. heat flow – Zoom Exercise - Zoom, V:R1,R2, Dator 11,12 Presentation of hand-in assignment 2	10-1, 10-2, 10-3

Day	Room	Chapter in "Introduction to the Finite element method"	Exercise problems
Tue 28/9	8.15-10 10.15-12	10 FEM-formulation, 2- and 3-dim. heat flow – Zoom Exercise - Zoom, V:R2, Dator 11,12	10-4, 10-5, 10-6
Fri 1/10	8.15-10 10.15-12	11 Element mesh and node numbering – Zoom Exercise - Zoom, V:P2, Dator 11,12	11-1, 11-2, 11-3, 11-4, 11-5, 11-6, 11-7
Tue 5/10	8.15-10 10.15-12	T Transient heat flow - basic equations, 1-dim – Zoom Exercise - Zoom, V:P2, Dator 11,12 Presentation of hand-in assignment 3	T-1
Fri 8/10	8.15-10 10.15-12	T Transient heat flow 2- and 3-dim. – Zoom Exercise - Zoom, V:P2, Dator 11,12 Hand in of assignment 2 (9/10, 08.15)	T-1
Tue 12/10	8.15-12	TBD Time for work with assignment Exercise - Zoom, V:P1, Dator 11,12	
Fri 15/10	8.15-10 10.15-12	Repetition Exercise Zoom, V:R1,R2 Hand in of assignment 3 (16/10, 08.15)	
Wed 27/10	8-13	Examination 8:00-13:00 MA 9A, 9B	

Literature (The books are available at KFS, Studiecentrum)

- Ottosen, N.S., Petersson, H.: Introduction to the Finite Element Method, Prentice Hall 1992.
- Olsson, K.-G and Heyden, S.: Introduction to the finite element method, Problems, Byggnadsmekanik, Lund 2001.

Handed-out material.

- PDF-manual: CALFEM ver 3.4 - A finite element toolbox to MATLAB, Dep. of Struc. Mech. and Dep. of Solid Mechanics, Lund 2004.

Computer programs

The educational MATLAB toolbox CALFEM will be used continuously during the course. CALFEM will be available in the students' computer laboratory and can be downloaded from the course homepage.

Hand-in assignments

Two compulsory hand-in assignments are included in the course. Groups of 2-3 students work together to solve the assignments and write reports. The first assignment is smaller aiming at introducing the use of CALFEM. The other one is a larger application assignment.

The assignments will be judged and awarded points according to the table below. The points will be accounted for in the final grade:

Assignment 1: max 2p, minimum 0p

Assignment 2: max 9p, minimum points required for passing 4.5p

Assignment 3: max 9p, minimum points required for passing 4.5p

The assignments must be handed in no later than what is indicated in the course programme. A too late handed in assignment 1 gives 0p and assignment 2 and 3 give 4.5p each when passed.

The following criteria are used for judging the assignments:

Ability to

- state the assumptions made,
- perform calculations,
- summarize and draw conclusions,
- limit to important matters and give a proper and logical account of them.

Examination

In addition to the hand-in assignments, a written examination is given at 28/10-2020, 8.00-13.00, location announced later. The maximum number of points and the requirement for passing are:

	Max. points	Requirement for passing
Examination	40p	20p

Grades

For a final grade it is required that the hand-in assignments and the examination are passed. The points achieved for the hand-in assignments and the examination are summed to get a final grade according to the following:

Points	Grade
29 – 39	3
40 – 49	4
50 – 60	5

Allowed means of assistance during examination: Calculator.

Teachers

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This programme together with other course information is available on the web on Canvas and the homepage of the div. of Structural Mechanics: <http://www.byggmek.lth.se/>