TU Delft - CIE4180: Plate analysis, theory and applications – 2022/2023 – Assignment 1

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Assignment

A deep beam has a depth of 3 m and a length of 400 mm + l_1 + l_2 (See figure). The left beam part has an uniform thickness of 200 mm and the right-hand part has an uniform thickness of 100 mm. Young's modulus is E = 30000 N/mm^2 and Poisson's ratio is ν = 0.16. The beam is supported at 3 points. The support areas are 100 x 100 mm. The load is in-plane, 200 kN/m, uniformly distributed at the top edge. Self-weight is not included in this load case.

The *x* and *y* axes are shown in the figure. The origin of the axes system is at the top-left corner of the deep beam.

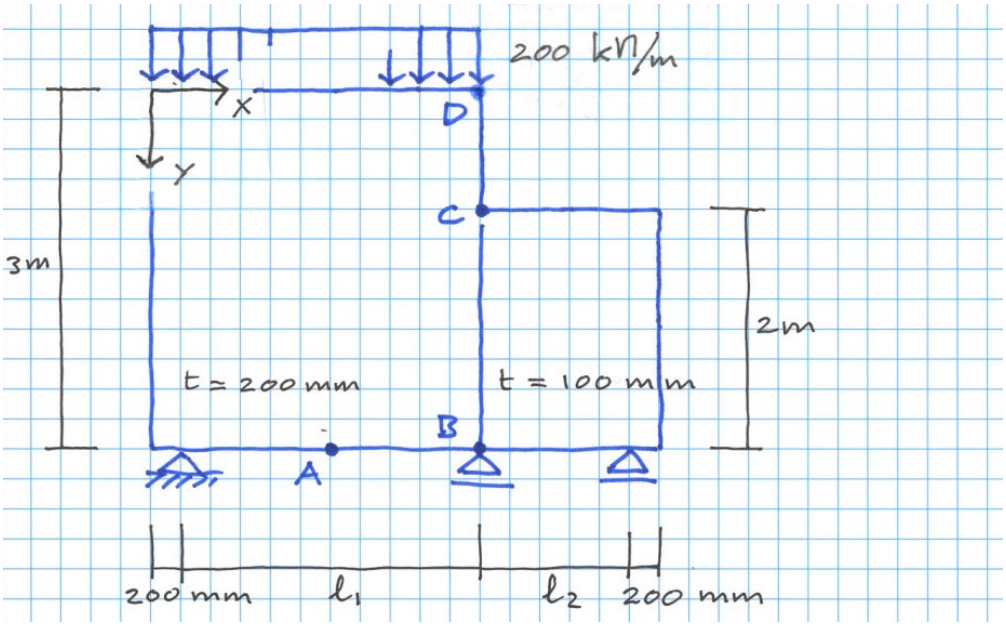

Figure: Deep beam, dimensions, coordinate system, support and loading

Finite Element Method (FEM)

Make a finite element model using plane stress elements.

Finite Difference Method (FDM)

Analyse the deep beam using the finite difference method. Use a spreadsheet, for example MS Excel. Take ν = 0.

Parameters

Ask the teacher for values of the parameters l_1 and l_2 .

Report

Make a report that includes

- Author, date, TU Delft, CIE 4180 …… 0.1 point
- Introduction, the above figure …… 0.2 point
- Material properties, dimensions, load (Can the results of the report be reproduced?) … 0.2 point
- Element type, element size, explanation of your choices …… 0.3 point
- Deformed structure (i.e. deformed mesh) …… 0.5 point
- Comments on the deformation (Checking yourself: e.g. supports work properly, deformation is in the right direction, parts are properly connected, …) …… 0.5 point
- Contour plots of the forces n_{xx}, n_{yy} and n_{xy} including color bars …… 1.0 point
- Comments on the forces (e.g. edge value is correctly zero, jump in …, singularity …) ….. 0.5 point
- Graph: The displacement u_y along the horizontal bottom edge (y = 3 m) …… 1.0 point
- Graph: The forces n_{xx} and n_{yy} along the vertical line BD …….. 1.0 point
- u_y of point A …… * …….. 0.5 point
- n_{xx} in B, C and D …… * …….. 0.5 point
- n_{yy} in B, C and D …… * …….. 0.5 point
- Support reactions … * …….. 0.5 point
- FDM grid size, explanation of your choice …… 0.2 point
- Print screen of the spread sheet …… 1.0 point
- Comments on the FDM results …… 0.5 point
- Comparison of the FEM and the FDM results …….. 0.5 point
- Conclusions (e.g. deflection is small and acceptable in most situations, stresses are too large for reinforced concrete, recommended design changes, …) ……. 0.5 point

*** Notes for the point results**

Use the sign conventions used in the course (also if the FE software uses a different sign convention). Use the coordinate system in the figure above (also if you use a different coordinate system in the FE model).

Submit

Send your report to the teacher by email. You will receive feedback and a grade.