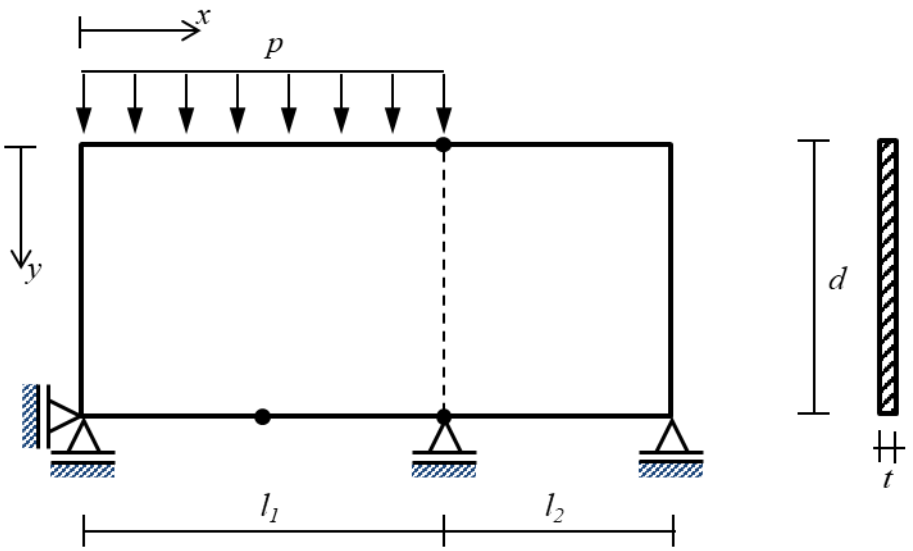
Assignment (Finite Element Method):

This assignment is a computer exercise using the finite element method. Make a linear finite element analysis of a plate with dimensions $l_1 + l_2$ by d, see the figure below. The plate has an uniform thickness t. Young's modulus is E and Poisson's ratio is ν.

The plate is supported at 3 points. The plate is loaded, in-plane, by a uniformly distributed load p at the top of the plate over a length l_1. There is no dead load.

The x- and y-axes are indicated in the figure. The origin of the axes system is at the top-left corner of the plate.



Main assignment (Finite Element Modelling)

Use 4-noded (i.e. linear) plane stress elements and make a finite element model with element size h. It is advised to have a mesh line along $x = l_1$.

Additional assignment (Discrete Element Approximation)

Solve the same problem of the deep beam using discrete element approximation. Use a spreadsheet, like MS Excel. Take $\nu = 0$. Use a grid size h.

Parameters

The values for the various parameters (material, geometrical, loading, mesh) can be obtained by filling in your student ID number in the attached MS Excel file (download first).

Results

The expected results include:

- The displacement in y-direction along the horizontal line $y = d$ for $0 \leq x \leq l_1 + l_2$ (and specifically for the point with $x = ½\, l_1$).
- The stresses σ_{xx} and σ_{yy} along the vertical line $x = l_1$ for $0 \leq y \leq d$ (and specifically for the two points with $y = 0$ and $y = d$).

A single page report

You are asked to make a single page report.

- An MS Word template for this report is attached (download first). This template should be strictly followed.
- This report includes the results of the FE analysis part and, possibly, the results of the additional assignment part.
- The report should be submitted in Brightspace as a PDF.

Grading

The grade of this assignment is composed of a maximum of 8 points for the FE analysis part and a maximum of 2 points for the additional assignment part.

Data summary

Apart from making and submitting your report, you are also requested to submit the following data in this form:

- u_y for point $(x, y) = (½\, l_1, d)$
- σ_{xx} for the points $(x, y) = (l_1, 0)$ and (l_1, d)
- σ_{yy} for the points $(x, y) = (l_1, 0)$ and (l_1, d)

When inputting your data summary in Brightspace, please note:

- Use the following units: mm and MPa (also if you have used different units in your FE analysis).
- Use the sign conventions as used in the course (also if the FE software uses a different sign convention)
- Use the axes systems as indicated in the figure above (also if you are using a different axes system in you FE model)

Submitting your assignment (Before the due time and date):

1. Submit the single page PDF document via Brightspace.
2. Submit your spreadsheet of the additional assignment (in case you also finished the Discrete element approximation part of the assignment).
3. Submit your "data summary" via this form.

That is, submitting your assignment requires three actions! See Brightspace for the due time and date.