

Minor Exam

CAD and Finite Element Analysis (MCL 311)

Date: 16/02/2022

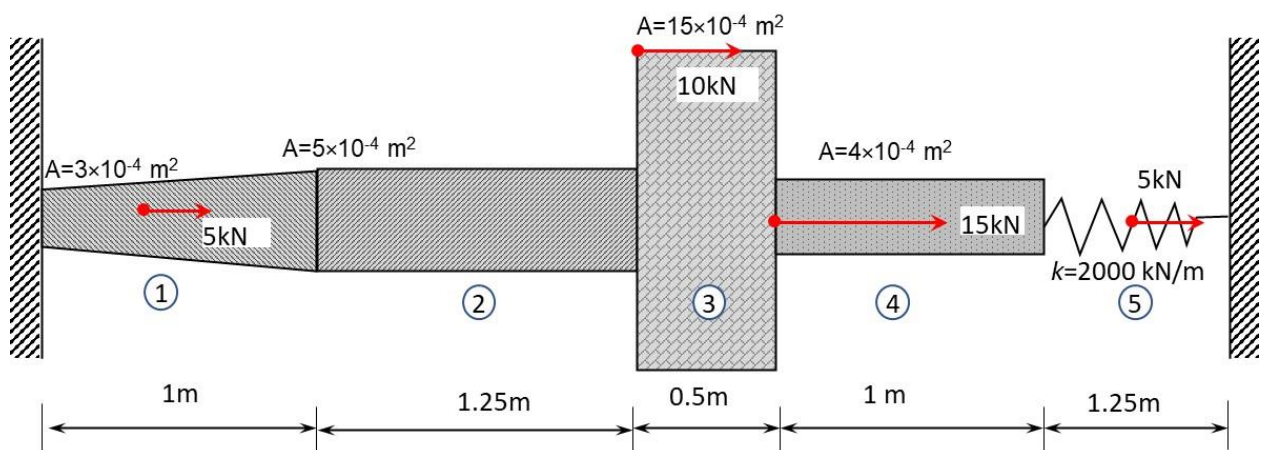
Start Time: 01:30 pm

Duration: 1 Hr

Total marks: 50

1. For the given system (Fig. 1), please answer the following:
 - (i) What would be the assumptions to model the following system as 1D system?
 - (ii) What kind of 1D elements should have been used for discretization and what information would we miss while solving the model using the chosen element type?
 - (iii) How many minimum nodes do you need for discretizing the model? What are the assumptions associated with the choice of minimum nodes? Draw a neat diagram of the discretized model.
 - (iv) With the minimum nodes for the model, write down the stiffness matrices for each of the five segments.
 - (v) Write down the global stiffness matrix.
 - (vi) Write down the global force vector.
 - (vii) Solve the FE problem and find out the deformation of each segment.
 - (viii) Using the deformation obtained in (vii), find out stresses in each segment.
 - (ix) How do you verify the convergence of the model with the minimum number of nodes?

[4+4+4+(3x5)+5+5+5+5+3=50]



$E_1 = 210 \text{ GPa}$;

$E_2 = 70 \text{ GPa}$;

$E_3 = 110 \text{ GPa}$;

$E_4 = 210 \text{ GPa}$

Take Poisson's ratio as 0.3 for all segments.

Both the 5kN forces are acting at the mid-points of segments 1 and 5.

Assume any other values, if required. However, clearly state all the assumptions you have considered.