Term Project

Finite Element Method (ME5130)

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Instructions:

1. Copying is strictly not allowed and will lead to negative marks.

2. Late submission will lead to zero marks.

3. Submit solutions using MATLAB publish.

4. The filename should be in the following format: "Roll No_HW2"

5. The file should be in PDF format.

Q1) Finite Element analysis of 2D truss

Context: The Bogibeel Bridge (over Brahmaputra River) is a large truss bridge with 41 spans and a total length of 4.94km. Each span consists of 125 meters in length. For this analysis, we will focus on one span of the bridge. The structure of this span can be simplified into a series of 2D-triangular trusses, as shown in the figure below.

$$E = 210GPa, A = 1.5m2, F = 200N$$

For the truss shown in the figure below, use MATLAB to perform the following tasks:

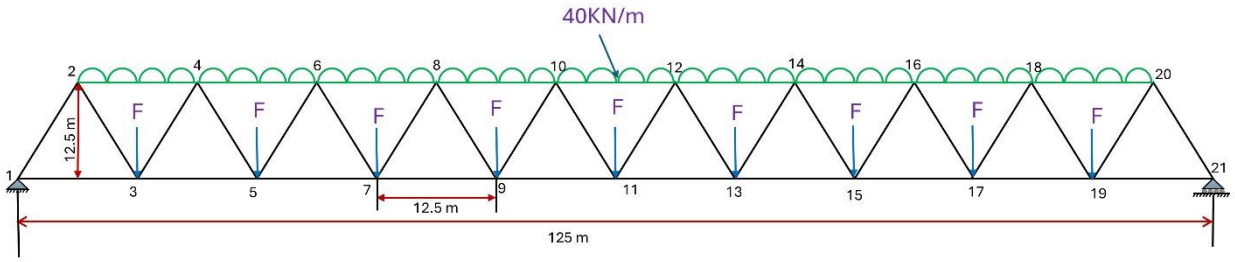

Fig:1

a) Find the member forces using method of joints for the first two triangles.

[1 Mark]

b) Find

I. Elemental stiffness matrix $[K]^{1-2}$ **[0.25 Marks]**

II. Elemental stiffness matrix $[K]^{1-3}$ **[0.25 Marks]**

III. Elemental stiffness matrix $[K]^{2-3}$ **[0.25 Marks]**

IV. Band width[Hint:bandwidth] **[0.25 Marks]**

c) Using elemental stiffness matrices, construct the global stiffness matrix **$[K^G]$** for the given truss. **[0.5 Marks]**

d) Apply Boundary conditions and compute the nodal displacements (**find $[K^G]^{-1}$ efficient method from the Q1**) **[0.5 Marks]** e) Compute

I. Nodal force vectors **[0.25 Marks]**

II. Reactions at the supports. **[0.25 Marks]**

f) Based on the displacement results, plot the deformed shape of the truss and identify the node with the maximum displacement. **[0.5Marks]**

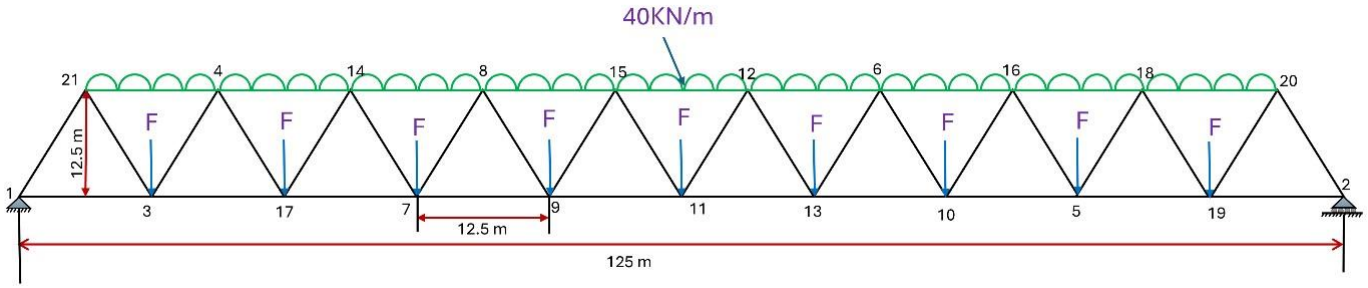

Fig:2

g) Compute

I. The global stiffness matrix $[K^G]$ for the Fig:2. and Comment on how the change in node numbering affects the stiffness matrix. **[0.25Marks]**

II. Band width of $[K^G]$ [Hint:bandwidth] **[0.25Marks]**

h) Does displacement,Force,Band width and computational time change for Fig:2? **.**If YES, comment your thoughts. **[0.25Marks]**