Homework 2	ED5015 COMPUTATIONAL METHODS IN DESIGN	Posted on: 13/02/2025 Deadline: 20/02/2025 11:59PM

Instructions

- File name: < HW2_RollNumber > .pdf [for eg. HW2_ed21d022]. The report should be in .pdf format.
- Late submissions will not be accepted.
- Provide a properly SCANNED copy of your work. Please do not submit pictures (only PDF files will be accepted).

Problem

1. For the plane truss structures shown in Figure 1. Find (a) the local element matrices, (b) the global element matrices, and (c) unknown displacements and forces.

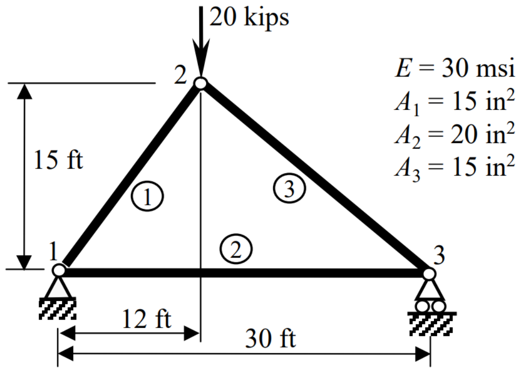

Figure 1:

2. For the system of springs, arbitrarily numbered nodes are shown in Figure 2. Obtain (a) the global stiffness matrix, (b) the nodal displacements, and (c) the reaction forces at nodes 1 and 2. A force of 4000 lb is applied at node 4 in the x direction. (Follow the node numbering as given in Figure 1)

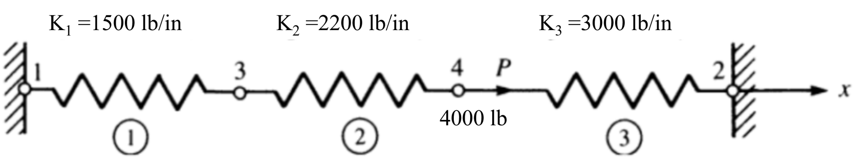

Figure 2:

3. Figure 3 shows a system of three rigid bodies, 2, 3, and 4, connected by six springs and supported by the rigid walls 1 and 5. A horizontal force $F_3 = 500N$ and $F_4 = 1000N$ is applied on body 3 and body 4 respectively in the direction shown in the figure. Find the displacements of the three bodies and the forces (tensile/compressive) in the springs.

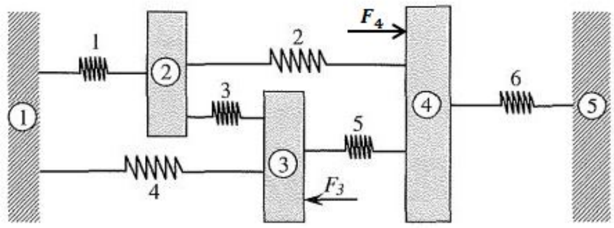

Figure 3:

Given that the bodies can undergo only translation in the horizontal direction, calculate the reactions at the walls. The spring constants of springs 1, 2, 3, 4, 5 and 6 are 500 N/mm, 550 N/mm, 300 N/mm, 280 N/mm, 300 N/mm and 400 N/mm respectively.

4. The truss shown in Figure 4 supports a force of $F = 2,000$ N. Both elements have the same axial rigidity of AE $= 10^7$ N, the thermal expansion coefficient is $\alpha = 10^{-6}/°C$, the length of each element is $L = 1m$. While the temperature of Element 1 remains constant, the temperature of Element 2 is dropped by $100°C$.

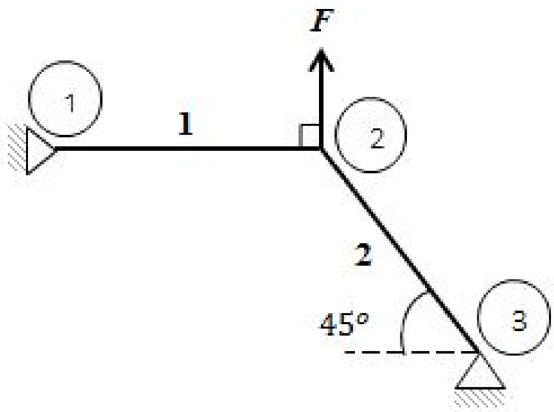

Figure 4:

(a) Write the 4×4 element stiffness matrices $[k]$ and the 4×1 thermal force vectors $\{f_T\}$ for Elements 1 and 2.

(b) Assemble the two elements and apply the boundary conditions to obtain the global matrix equation in the form: $[K_s]\{Q_s\} = \{F_s\} + \{F_T\}$

(c) Solve for the nodal displacements.