GX499

Ollscoil na hÉireann

National University of Ireland, Galway

SECOND SEMESTER EXAMINATIONS, EASTER 1999

Third Engineering

Theory of Structures

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Time allowed: *Three* hours

Answer *five* questions

1. (a) Calculate the stiffness matrix for member 4 of the truss of Fig. Q1.

   (b) How are the elements of this member stiffness inserted into the global stiffness matrix?

   (c) Calculate the global load vector after application of the boundary conditions (applied forces and constraints imposed by the reactions).

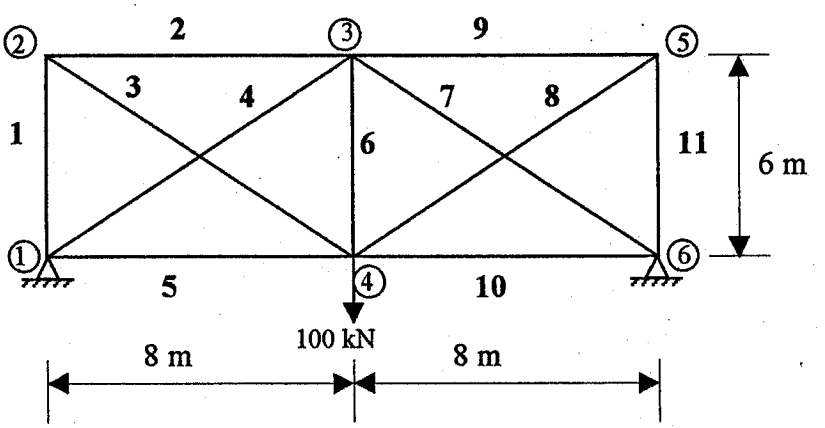

Fig. Q1

2. Draw the influence lines for bending moment, shear force, and normal thrust at the point K in the symmetrical three-hinged parabolic arch shown in Fig. Q2.

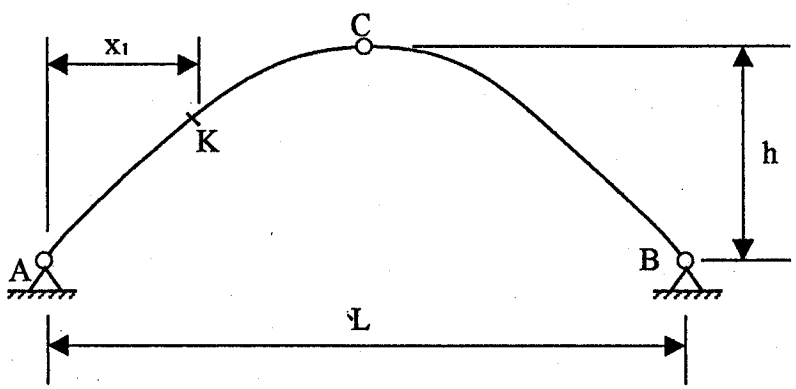

Fig. Q2

3. For the frame of Fig. Q3, use the method of moment distribution to calculate the direction and magnitude of the horizontal force required at node B to prevent sway. The frame is of constant flexural rigidity.

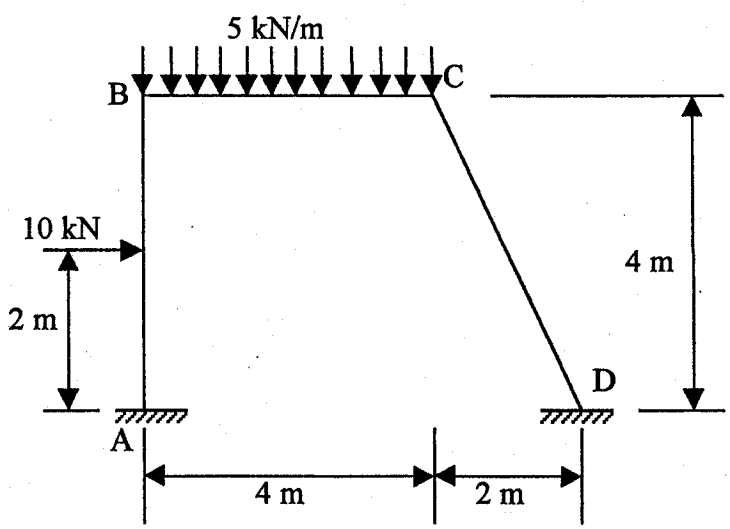

Fig. Q3

4. Draw the bending moment diagram and the shear force diagram for the frame shown in Fig. Q4 (roller support at A, pin at B).

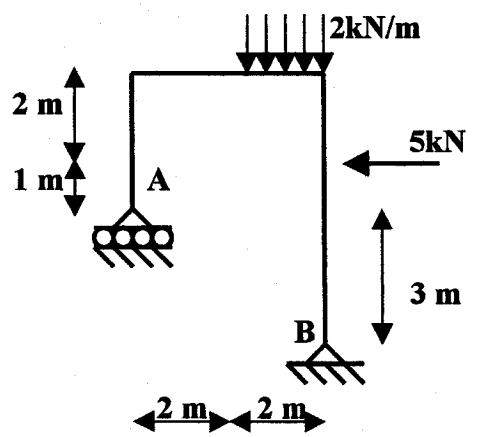

Fig. Q4

5. Determine the vertical deflection at Point A in the pin-jointed truss in Fig. Q5 when (i) the truss is subjected to external loads as shown and (ii) when the members AB and AC are subjected to a 50°C temperature rise. For all truss members, E = 200,000 N/mm^2, A = 100 mm^2, coefficient of thermal expansion = 1.2 x 10^{-5}/°C.

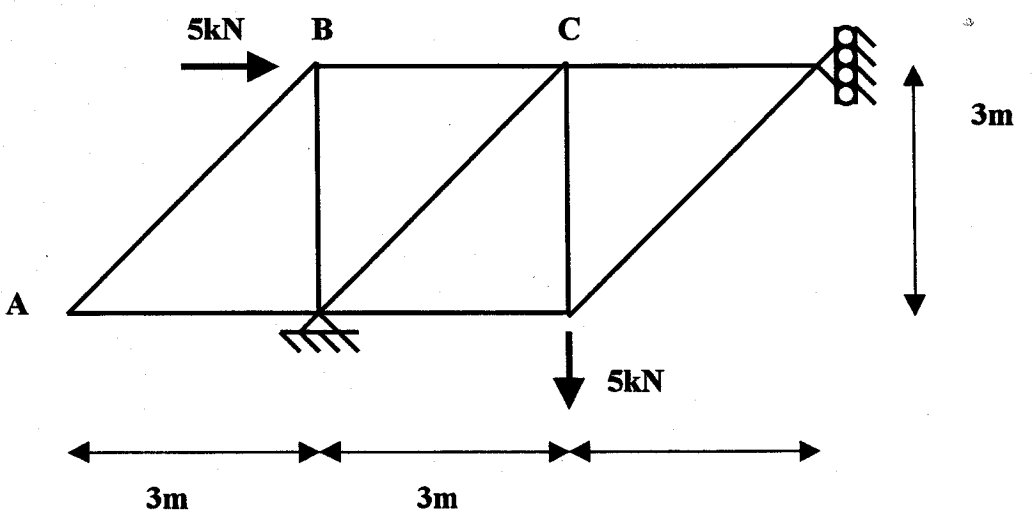

Fig. Q5

6. Discuss the application of the principal of virtual work in the analysis of civil engineering structures.

The beam shown in Fig. Q6 is simply supported at one end and is fully fixed at the other end. The applied loading is a moment, M_o, at end A. Show that the vertical reaction force at this point is $-3M_o/2L$. Use this result to show that the corresponding rotation at point A is $M_oL/4EI$ where E, I and L are the Young's Modulus, stiffness and length respectively.

Fig. Q6