ANALYSIS AND DESIGN OF STRUCTURES

Time : Three hours

Maximum Marks : 100

Answer FIVE *questions, taking* ANY TWO *from* **Group A,** ANY TWO *from* **Group B** *and* ALL *from* **Group C.**

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answers may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. Using moment distribution method, analyse the portal frame shown in Fig. 1 : 20

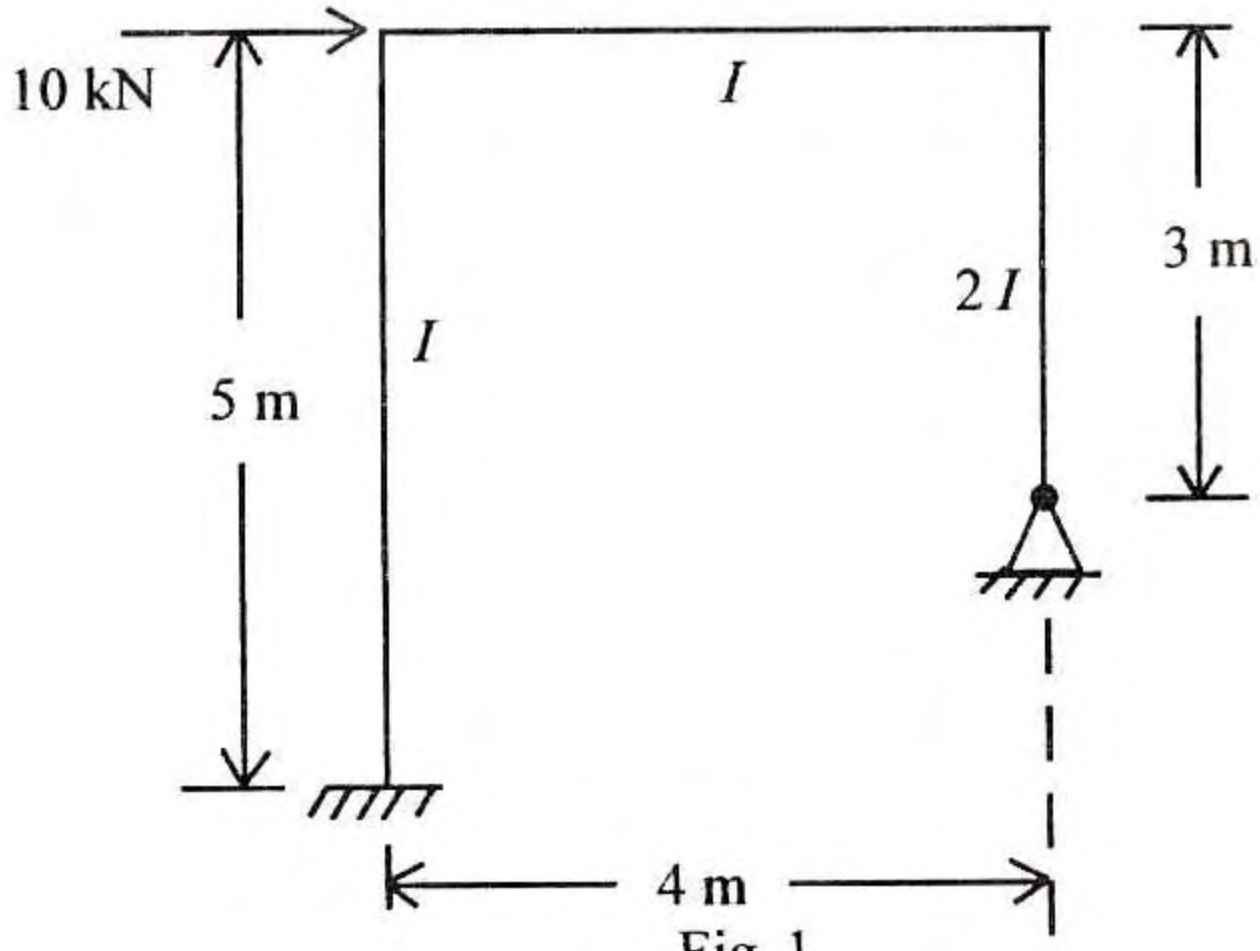


Fig. 1

(*Turn Over*)

2. (*a*) For a two hinged parabolic arch (Fig. 2), moment of inertia of the section varies as secant of the slope. Determine (*i*) reactions at the supports; (*ii*) normal thrust and radial shear at section *D*; and (*iii*) bending moment at *C*. 10

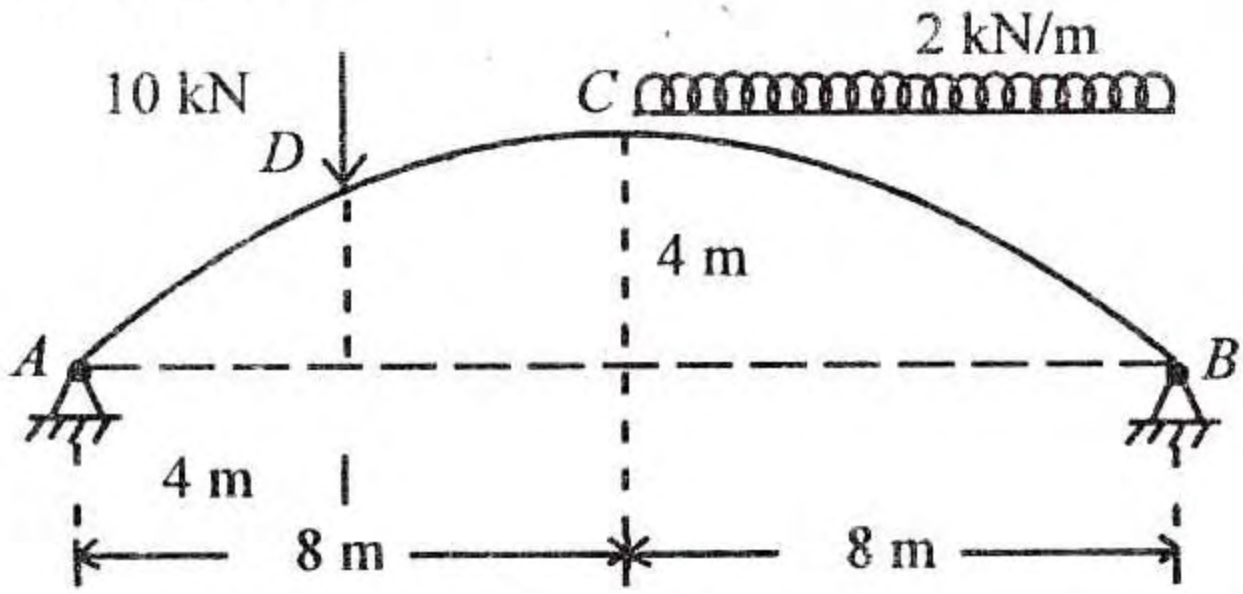


Fig. 2

(*b*) Derive the general expression of the horizontal thrust in a parabolic two-hinged arch due to a rise of temperature $\theta^{\circ}C$. Coefficient of linear expansion α per $^{\circ}C$. Moment of inertia varies as the secant of slope of the rib axis. 10

3. Draw the influence lines for forces in the members U_2U_3, U_2L_3 and L_2L_3 of a truss (Fig. 3). If a line load of 8 kN/m traverses from L_1 to L_5, find the value of maximum forces in these members. 20

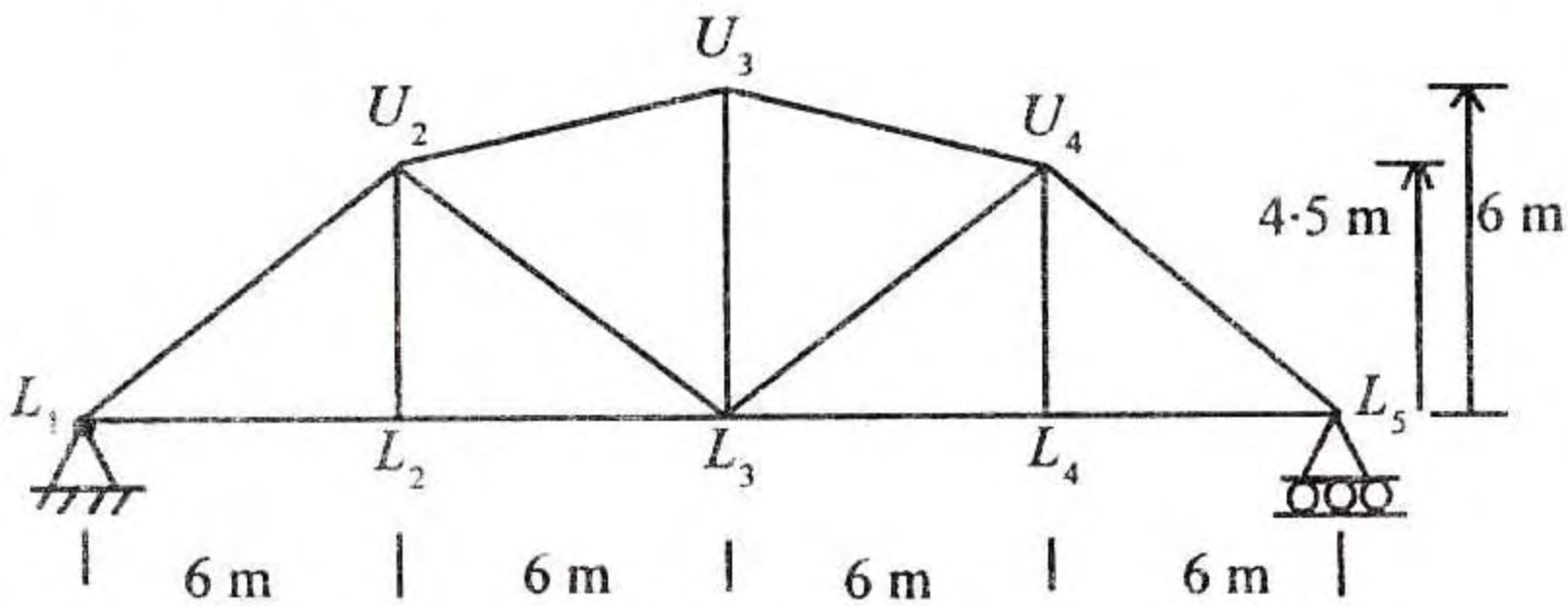


Fig. 3

4. (*a*) A beam AB of length *l* is fixed at both the ends. It carries a distributed load varying linearly from zero at left end to *w* at the right end. Calculate the fixed end moments. 10

(*b*) A beam AB of span 6 m is fixed at A and simply supported at B. It carries two concentrated loads 150 kN and 90 kN at C and D distant 1·5 m and 4·5 m from the fixed end A. Draw the bending moment diagram. 10

Group B

5. (*a*) Design a seated connection for a beam ISLB 275 @ 324 N/m supported on the web of a column ISHB 250 @ 500 N/m. End reaction of the beam is 100 kN. 10

(*b*) An I-section purlin has to be provided for a roof with an effective span of 12 m. The principal rafters are placed 3·6 m c/c. Spacing of purlins is 1·8 m. Pitch of the roof is 30°, weight of roofing material is 200 N/m², and normal wind pressure is 1·2 kN/m². Design a suitable section of purlin. 10

6. Design a suitable lacing for a composite column consisting two ISLC 350 with the back-to-back spacing of 220 mm. The flanges of channels are 100 mm. The rivets are to be attached at 60 mm from the web. Slenderness ratio of the column is $\lambda = 40$. Size of rivets has to be 20 mm. 20

7. The cross-section of a singly reinforced simply-supported beam is 500 mm × 800 mm. Reinforcement consists of 5 bars of 20 mm diameter. Determine the maximum stress in concrete when steel is stressed to 200 N/mm². M20 concrete and Fe415 steel are used. Also, determine the load it can carry for an effective span of 6 m. 20

8. (*a*) A reinforced concrete slab 20 m × 4 m in plan has to carry 6 kN/m², inclusive of its own weight. Determine (*i*) effective depth of slab, and (*ii*) reinforcement. M20 concrete and Fe 415 steel are to be used. 10

(*b*) Design a short circular column to carry an axial load of 1500 kN using M20 concrete and Fe 415 steel. 10

Group C

9. Answer the following in brief : 10 × 2

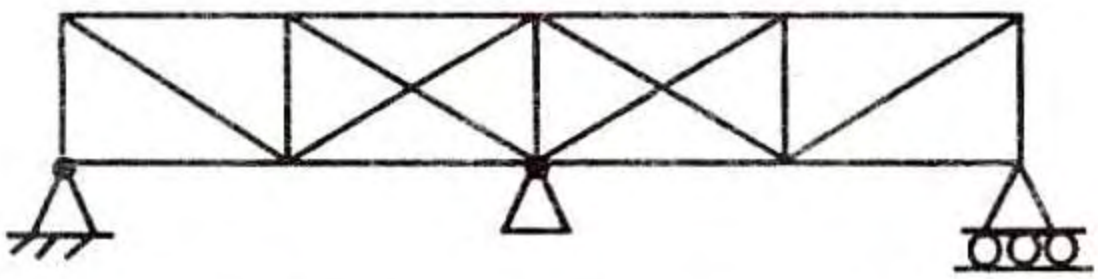
(*i*) What is the relative stiffness of members as required for moment distribution method.

(*ii*) Distinguish between lacing and batten for composite columns.

(*iii*) Write salient features of Kani's method.

(*iv*) Compare the Euler's concept and Rankine concept for analysis of a column.

(*v*) Give the degree of internal indeterminacy and external indeterminacy of a plane truss.



(*vi*) Write the Castigliano's first strain energy theorem.

(*vii*) Differentiate between a riveted connection and a welded connection of steel plates.

(*viii*) Explain the concept of splicing a plate girder.

(*ix*) Explain the term 'bond length of reinforcement bar.'

(*x*) What are the functions of proving 2-legged stirrups in beam ?