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RP–IX–XII–13

42

CIVIL ENGINEERING

2011

FIRST PAPER

Full Marks : 200

Time : 3 hours

The questions are of equal value

GROUP—A

Answer *any* **ten** questions

1. A simply supported beam is loaded as shown in Fig. 1. Analyze the beam to locate the point of maximum deflection and its magnitude. Also draw the bending moment diagram for the beam. Take, $E = 200$ kN/mm^2 and $I = 1{\cdot}5\times10^8$ mm^4.

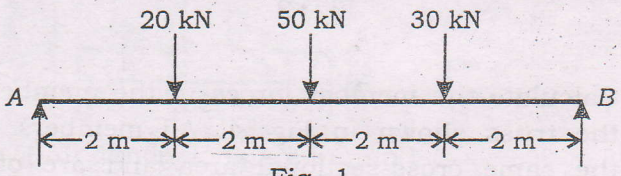


Fig. 1

2. Using the three-moment equation, analyze the continuous beam shown in Fig 2. Hence obtain the bending moment diagram and shear force diagram for the beam :

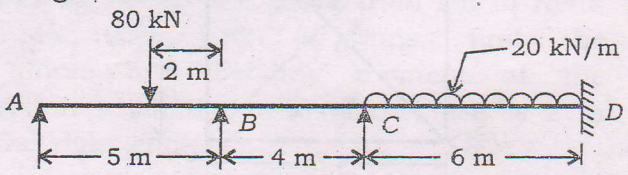


Fig. 2

3. A portal frame *ABCD* is shown in Fig. 3. Draw the bending moment diagram for the structure using moment distribution method.

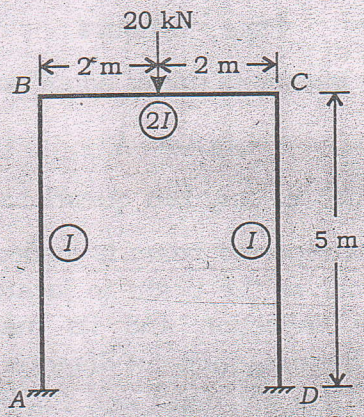


Fig. 3

4. Calculate the member forces in the members of the truss shown in Fig. 4. All members have the same cross-sectional area and are of the same material.

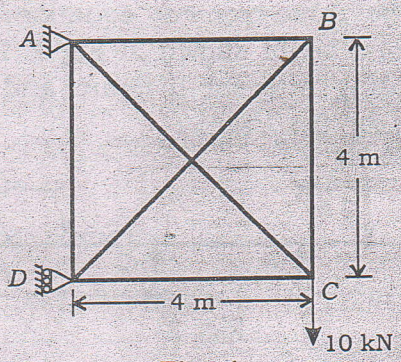
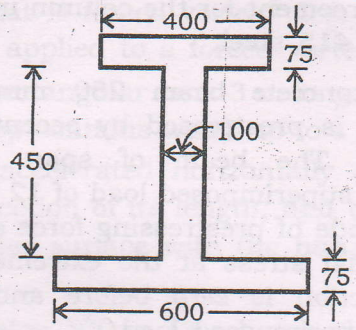


Fig. 4

5. A two-hinged parabolic arch of span 25 m and rise 5 m carries a uniformly distributed load of 50 kN/m run on the right half of the span. Evaluate the support reactions. What are the magnitude and location of the maximum bending moment in the arch?

6. An I-section is shown in Fig. 5. Find the shape factor for the section. For a yield stress of 250 N/mm^2, calculate the plastic moment capacity of the section.



(All dimensions are in mm)

Fig. 5

7. A simply supported beam is of span 12 m. A uniformly distributed load of 10 kN/m and 6 m long moves on the girder from left to right. Using influence line diagrams, find the shear force and bending moment at the mid-section when the head of the load is 2 m from the right end.

8. A reinforced concrete beam 300 mm wide is subjected to a bending moment of 100 kN-m. Design the beam as a balanced section in working stress method. Use M 20 concrete and Fe 415 steel.

9. A reinforced concrete column of size 400 mm × 600 mm is subjected to a working load of 1800 kN. The unsupported length of the column is 3 m. Design the longitudinal and transverse reinforcement for the column in M 25 concrete and Fe 415 steel.

10. A prestressed concrete beam 250 mm wide × 450 mm deep is prestressed by eccentrically placed tendons. The beam of span 10 m is subjected to a superimposed load of 12 kN/m. Find the magnitude of prestressing force and its eccentricity if final stress at the extreme layer of mid-span section is zero before and after application of superimposed load.

11. Design a built-up column using channel sections to carry a factored axial load of 2000 kN. The length of the column is 8 m. It is effectively held in position and restrained against rotation at both ends. Also design the lacing system for the column.

12. A simply supported beam 5 metres span carries a uniformly distributed load of 40 kN/m on the entire span. In addition, the beam carries a central point load of 50 kN. Design the beam using rolled steel section of Fe 410 grade. Assuming the beam to be laterally supported, perform checks for safety in shear and deflection.

GROUP—B

Answer *any* **five** questions

13. What is centre of pressure? Obtain an expression for the depth of centre of pressure when the lamina is immersed in a liquid and is at an angle θ with the horizontal.

14. What is forced vortex? Can Bernoulli's equation be applied to a forced vortex flow? Justify.

A rectangular tank 3 m long, 2·5 m wide and 3 m deep contains water up to a depth of 1·60 m. If it is accelerated horizontally at 2 m/sec^2 in the direction of its length, find the inclination of the water surface with the horizontal.

15. A pipe 300 m long has a slope of 1 in 100 and is tapered from 1·20 m diameter at the high end to 0·60 m diameter at the low end. The rate of flow of water through the pipe is 0·10 m^3/sec. If the pressure at the high end is 73·575 kPa, find the pressure at the low end.

16. A 1 : 20 scale model was tested in freshwater at a corresponding velocity. The prototype flying boat has to move in seawater of density 1030 kg/m^3 at a velocity of 18 m/sec. Find the corresponding speed of the model.

17. What do you mean by energy correction factor and momentum correction factor? Derive expressions for both of them.

18. The energy loss and Froude's number after a hydraulic jump are 9·00 m and 0·12 respectively. Estimate the discharge intensity q and initial depth y of the hydraulic jump in a horizontal rectangular channel.

19. A rectangular channel 7·5 m wide carries a discharge of 12 m^3/sec. If Manning's n is 0·015 and bed slope is 1 in 1440, calculate—

    (a) normal depth of flow;

    (b) specific energy;

    (c) depth at minimum specific energy.

GROUP—C

Answer *any* **five** questions

20. What do you mean by normally consolidated (NC) clay and overconsolidated (OC) clay? How can one find whether a clay is NC or OC? Explain.

21. Explain Fellenius method of slices for analyzing stability of finite slopes.

22. A sample of soil extracted in its natural state using a sampling tube of volume 0·001 m^3 was found to have a mass of 1740 gm, the degree of saturation being 62·8%. The oven-dried mass of soil was 1425 gm. Determine—

(a) natural moisture content;

(b) specific gravity of soil solids;

(c) saturated density.

23. Describe the Indian Standard Classification of soils.

24. Explain the physical meaning of soil consolidation. In a consolidation test, when the load was changed from 50 kN/m^2 to 100 kN/m^2, the void ratio changed from 0·75 to 0·60. Determine the compression index, C_c and coefficient of volume compressibility, m_v.

25. What do you understand by bearing capacity of soil? A square column foundation is 2 m × 2 m in plan. Let D_f = 1·5 m, γ = 16·5 kN/m^3, ϕ = 36° and c = 0. Assuming general shear failure in soil, use Terzaghi's equation and a factor of safety of 3 to determine the gross allowable vertical load that the column should carry.

26. What is pile foundation? Based on the methods of construction, describe the various types of pile foundations used. How is the axial load capacity of pile estimated?

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