Total No. of Printed Pages—8

PAR/CCM-13/13

2014

CIVIL ENGINEERING

FIRST PAPER

Full Marks : 200

Time : 3 hours

The questions are of equal value

GROUP—A

Answer *any* **ten** questions

1. Analyze the portal frame shown in Fig. 1 by moment distribution method :

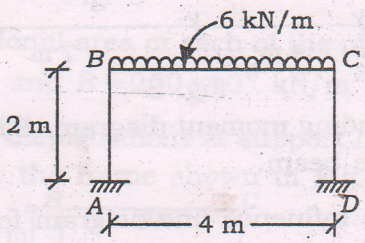

Fig. 1

The frame is fixed at *A* and *D*, and has rigid joints at *B* and *C*. Draw the bending moment diagram. Assume *EI* constant.

2. Determine the forces in the truss shown in Fig. 2 by method of joints :

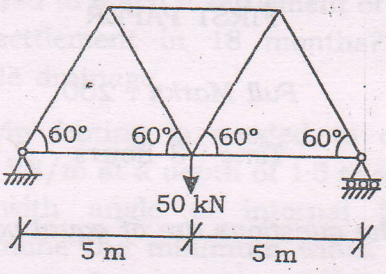

Fig. 2

3. Solve the continuous beam shown in Fig. 3, using slope deflection method :

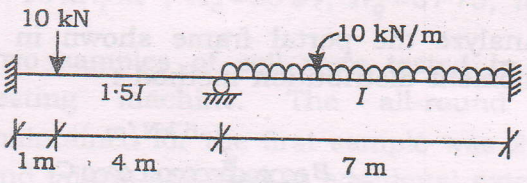

Fig. 3

Draw bending moment diagram. E is constant for the whole beam.

4. Draw the influence line diagram for the force in the member U_1L_2 shown in Fig. 4 :

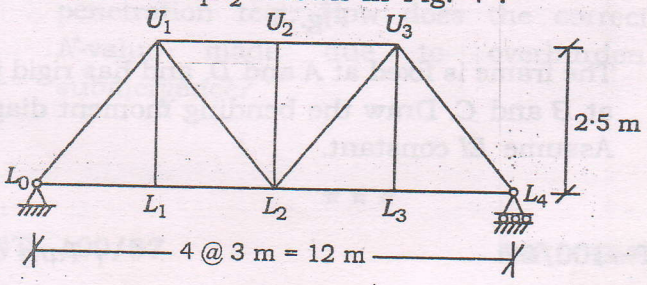

Fig. 4

(Continued)

Find also the maximum tensile force in this member when a udl of 5 kN/m of length longer than the span crosses over the girder from left to right.

5. A beam *PQ*, 12 m long has supports at ends *P* and *Q*. It carries a point load of 5·5 kN at 3 m from *P* and a point load of 5·5 kN at 9 m from *P* and a uniformly distributed load of 1·5 kN/m between the point loads. Draw SF and BM diagrams for the beam.

6. Determine the vertical deflection at node *A* of the truss shown in Fig. 5 :

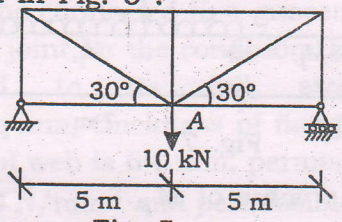

Fig. 5

The cross-sectional area of each of the member is 500×10^{-6} m^2 and $E = 200\times10^{6}$ kN/m^2.

7. The horizontal displacement at support *D* is to be determined for the frame shown in Fig. 6 :

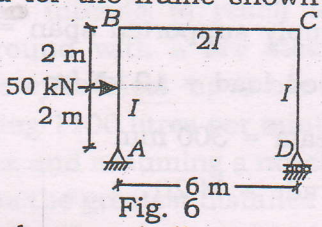

Fig. 6

Relative *I* values are indicated along the members. $E = 200\times10^{6}$ kN/m^2 and $I = 300\times10^{-6}$ m^4.

8. A two-hinged semicircular arch of span 12 has its hinged supports at the same horizontal level. The arch is loaded at the crown with a concentrated load of 10 kN acting vertically. Calculate the thrust at the hinged supports.

9. The plastic moment capacities of the different spans of the continuous beam are shown in Fig. 7 :

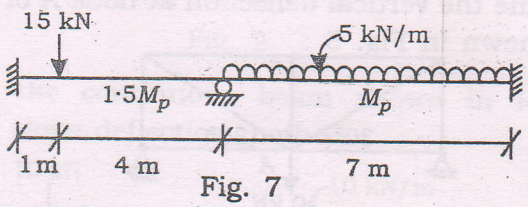

Fig. 7

Determine the value of M_p.

10. Design a reinforced concrete beam for flexure and shear by limit state method for the data given below :

(a) Effective simply supported span = 12 m

(b) Superimposed load = 12 kN/m

(c) Width of beam = 300 mm

(d) Concrete grade = M 20

(e) Steel grade = Fe 415

11. A rectangular prestressed concrete beam 200 mm wide and 300 mm deep is prestressed by 10 wires of 7 mm dia initially prestressed to 1200 N/mm^2. The wires are located at a depth of 180 mm from the top of the beam. Assuming all losses to be 15% of the initial prestress, calculate the stresses developed in the mid-span of the beam, if the beam carries a uniformly distributed load of 20 kN/m over a simply supported span of 4 m.

12. A tension member consisting of two channel sections 200 mm×75 mm @ 22·1 kg/m back to back is to be connected to a gusset plate. Design the welded joint for the condition that the section is loaded to its full strength. Take $A = 2821$ sq mm, thickness of flange is 11·4 mm, thickness of web is 6·1 mm, permissible stress in weld is 110 N/mm^2 and permissible stress in the section in axial tension is 150 N/mm^2.

GROUP—B

Answer *any* **five** questions

13. A fireman intends to reach a window 25·5 m above ground with a fire steam from a nozzle having a cylindrical tip 3 cm in diameter and discharging 1100 litres per minute. Neglecting air resistance and assuming a nozzle height of 1·5 m, determine the greatest distance from the building at which the fireman can stand and still play the steam upon the window.

14. If the velocity distribution within the laminar boundary layer on the flat plate is assumed to be in the form, $u = a\sin(by) + c$, where a, b and c are constants, determine the velocity distribution law.

15. Prove that the vertical component of the resultant pressure on a submerged curved surface is equal to the weight of the liquid supported by the curved surface.

16. A 30 cm diameter pipeline carries water at a velocity of 3·5 m/s. If the friction factor $f = 0{\cdot}028$, determine the roughness height by assuming fully rough turbulent flow to exist. Also find the velocity gradient at a radial distance of 5 cm from the axis.

17. Crude oil of $\mu = 1{\cdot}5$ poise and relative density 0·9 flows through a 20 mm diameter vertical pipe. The pressure gauges fixed to two different points 20 m apart read 58·86 N/cm^2 (at lower point) and 19·62 N/cm^2 (at upper point). Find the direction and rate of flow through the pipe.

18. In a rectangular channel 3·5 m wide laid a slope of 0·0036, uniform flow occurs at depth of 2 m. Find how high the hump can be raised without causing efflux. If the upstream depth of flow is raised to 2·5 m, what should be the height of the hump? Take Manning's n equal to 0·015. (Manning equation, $V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/2}$)

(Continued)

19. The discharge of 16 m^3/s flows in 8 m wide rectangular channel under critical condition of flow. Find the critical depth and minimum specific energy for the given discharge. Also find the critical slope if Manning's $n = 0{\cdot}015$.

GROUP—C

Answer *any* **five** questions

20. What do you understand by the terms 'tilt' and 'shift' of well foundation? What are the precautions required to avoid tilt and shift? Discuss the rectifying measures to be taken once tilt and shift exceed permissible limits.

21. Sandy soil in a borrow pit has unit weight of soil solid as 26·4 kN/m^3, water content equal to 10·5% and bulk unit weight equal to 16·3 kN/m^3. How many cubic metres of compacted fill would be constructed of 4000 m^3 of sand excavated from the borrow pit, if the required value of porosity in the compacted fill is 30%? Also compute the change in degree of saturation.

22. What is flow net? What is the utility of flow net? Draw a typical flow net and explain its characteristics.

23. A compressive layer is expected to have a total settlement of 15 cm under a given loading. It settles by 3 cm at the end of two months after application of load. How many months will be required to reach a settlement of 7·5 cm? What is the settlement in 18 months? The layer has double drainage.

24. A strip footing is needed to carry a load of 1000 kN/m at a depth of 1·5 m in a cohesionless soil with angle of internal friction of 36°. Determine the minimum width of footing for a factor of safety of 3·0 against shear failure. The water table may rise the base of the footing. Take sp. gravity of the soil as 2·65, $e = 0{\cdot}7$, $\gamma = 16\ kN/m^3$, $N_c = 50{\cdot}59$, $N_q = 37{\cdot}75$, $N_\gamma = 56{\cdot}31$.

25. Two samples of soil were tested in a triaxial testing machine. The all-round pressure maintained for the first sample was 2·0 kg/cm^2 and failure occurred at additional axial stress of 8·7 kg/cm^2, while for the second sample the values were 5 kg/cm^2 and 14·7 kg/cm^2 respectively. Find C and ϕ of the soil.

26. Explain briefly the test procedure of standard penetration test. How does the correction in N-value made due to overburden and submergence?

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