14661

B. Tech 4th Semester Examination

Structural Analysis-I (O.S.)

CE-4001

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt one question each from A, B, C and D sections. Section E is compulsory.

SECTION - A

1. (a) A cantilever is loaded as shown in Fig. 1. Determine reaction R_A and moment at B using strain energy method.
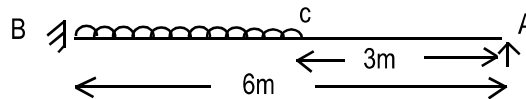
(10)

Fig. 1

(b) Analyse the hinged base portal frame as shown in Fig. 2 by strain energy method.   (10)
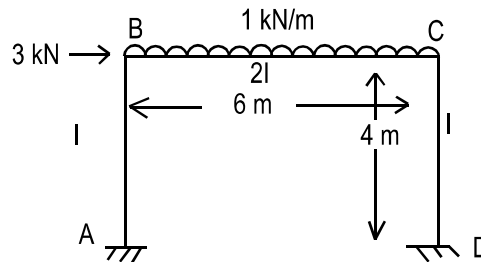

Fig. 2

2. Find the forces in the member of the truss as shown in Fig. 3 using castigliano's second theorem

Horizontal members : 4000mm^2

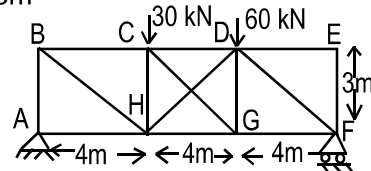Vertical members : 3000mm^2

Diagonal members : 5000mm^2

30 kN 60 kN
B   C   D   E

A   H   G   F

←4m → ←4m→ ← 4m

3m

Fig. 3   (20)

SECTION - B

3. Analyse the continuous beam loaded as shown in Fig. 4 by slope deflection method and sketch the bending moment diagram given $2I_{AB} = I_{BC} = 2I_{CD} = 2I$ (20)
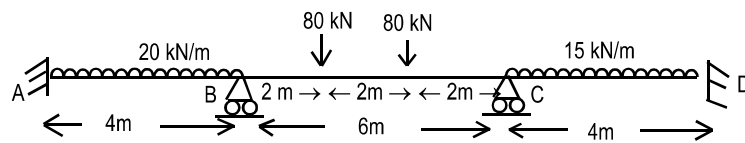
80 kN   80 kN

20 kN/m   15 kN/m

A   B 2 m → ← 2m → ← 2m C   D

← 4m →   ← 6m →   ← 4m →

Fig. 4

4. Analyse the structure loaded as shown in Fig. 5 by moment distribution method. Sketch bending moment and shear force.   (20)

20 kN
20 kN/m   50 kN
A ↓ B   C   ↓   D
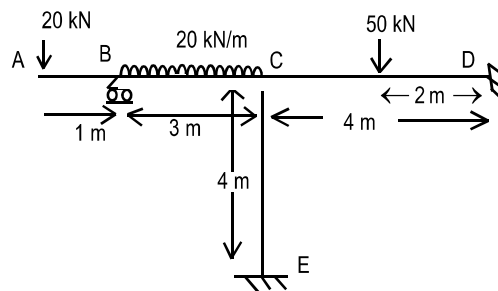
← 2 m →
1 m   3 m   ← 4 m →

4 m

↓ E

Fig. 5

SECTION - C

5. A parabolic arch hinged at the ends has a span of 60m and a rise of 12m. A concentrated load of 8kN acts at 15m from the left hinge. The second moment of area varies as the secant of the inclination of the arch axis. Calculate the horizontal thrust and the reaction. Also calculate the net bending moment at the section. (20)

6. An I section beam has 200 mm wide flanges and an overall depth of 500 mm. Each flange is 25 mm thick while the web is 20mm thick. At a certain section the bending moment is M newton millimetre and the shear force is S newton. Find what percentage of M and S are resisted by the flanges and wells. (20)

SECTION - D

7. (a) Derive the expression of maximum and minimum tension for the cable subtracted to a uniform distributed load with the horizontal span of length l and dip d. (10)

   (b) A symmetrical unstiffened suspension cable is parabolic in shape and has a span of 300 metres and a dip of 30 meters. It supports a uniformly distributed level of 20 kN/m over the whole span. If the maximum allowable stress is 150 N/mm^2, determine the length of the cable and area of the cable. What would be the increase in length and the gap for a rise of temperature of 50°F. Coefficient of expansion $\alpha = 6 \times 10^{-6}$ per °F. (10)

8. (a) A three hinged stiffening girder of suspension bridge of span 120m is subjected to two point loads of 480 kN and 600 kN at a distance 25m from the left support and 40m from the right support respectively. The dip of the cable is 12m. Determine (i) maximum tension in the cable (ii) shear force and bending moment for girder at 40m from the left support. (10)

[P.T.O.]

(b) A suspension bridge of span 60 metres and a central dip of 6m is shiffened by three hinges with the two hinges at supports and one at the mid span. It carries a dead load of 15 kN/m and a moving load of 25 kN/m to cover the full span.

    (i) Calculate the maximum tension in the cable.

    (ii) When moving load extends left half of the span draw the shear force diagram and bending moment diagram. (10)

SECTION - E

9 (a) Define static and kinematic indeterminacy.

(b) State castigliano's second theorem.

(c) What are the assumptions made in slope deflection method?

(d) What is the difference between absolute and relative stiffness?

(e) State the difference between strain energy method and unit load method in the determination of deflection of structures.

(f) Under what conditions will the bending moment in an arch be zero throughout?

(g) Explain rib-shortening in the case of arches.

(h) What are the similarities in the structural actions of arches and suspension bridges?

(i) What is the degree of static indeterminacy of a suspension bridge with two hinged stiffening girder?

(j) What is the effect of lack of fit in redundant frames?

                                        (2×10=20)