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09ENG3.5

Third Semester B.Arch. Degree Examination, June / July 2014
Structures – III

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Any missing data may be assumed suitably.***

1 a. Define : i) Pure torsion ii) Polar modulus iii) Torsional rigidity. **(06 Marks)**

b. Find polar modulus for the following sections:
i) Solid shaft with diameter 'd'.
ii) Hollow shaft with external dia d_1 and internal dia d_2. **(04 Marks)**

c. A 2 meters long hollow cylindrical shaft has 80 mm outer diameter and 10 mm wall thickness, when the torsional load on the shaft is 6 kN-m, determine maximum stress induced and angle of twist. Also draw the distribution of shear stress in the wall of the shaft. **(10 Marks)**

2 a. Derive the torsional equation, $\frac{T}{J} = \frac{q_s}{R} = \frac{G\theta}{L}$ with usual notation. **(08 Marks)**

b. A solid circular shaft and a hollow circular shaft whose inside diameter is $\frac{3}{4}$ of the outer diameter, are of same material, of equal lengths and are required to transmit a given torque. Compare the weights of these two shafts if the maximum shear stress developed in the two shafts are equal. **(12 Marks)**

3 a. Define : i) Effective length of column. ii) Slenderness ratio of column. **(05 Marks)**

b. Explain the limitations of Euler's formula. **(05 Marks)**

c. Calculate the Euler's critical load for a strut of T-section, the flange width being 10 cm, overall depth 8 cm and both flange and stem 1 cm thick. The strut is 3 meter long and is fixed at both ends. Take E = 200 GPa. **(10 Marks)**

4 a. Derive Euler's formula for crippling load of long columns with both ends fixed. **(10 Marks)**

b. Using Euler's formula calculate the critical stresses for a series of struts having slenderness ratio of 40, 80, 120, 160 and 200, under the following conditions: i) Both ends hinged ii) Both ends fixed. Take E = 2.05×10^5 N/mm^2. **(10 Marks)**

5 a. Derive the Rankine's formula for crippling load of a column. **(08 Marks)**

b. A hollow cylindrical cast iron column is 4 m long with both ends fixed. Determine the minimum diameter of the column, if it has to carry a safe load of 250 kN with a factor of safety of 5. Take the internal diameter as 0.8 times the external diameter. Take $f_c = 550$ N/mm^2 and $a = \frac{1}{1600}$ in Rankine's formula. **(12 Marks)**

6 a. Derive the relationship between slope, deflection and radius of curvature. **(08 Marks)**

b. Determine the maximum slope and deflection in a simply supported beam of span L subjected to a point load W at mid span. Use double integration method. **(12 Marks)**

7 a. What are the assumptions made in deriving the equation for moment, curvature relationship? **(05 Marks)**

b. A simply supported beam of span 5 meters is subjected to downward point loads of 20 kN and 30 kN at distances 2 m and 3 m respectively from the left hand side support. Determine i) Slopes at supports ii) Deflections at the points of application of loads. Take E = 200 GPa and I = 80×10^{-5} m^4. **(15 Marks)**

8 An overhanging beam ABC, supported at A and B is loaded as shown in Fig. Q8. Using Mecaulay's method determine i) Deflection at free end C and ii) Maximum deflection between A & B, $I = 450\,cm^4$, $E = 2\times10^5\,N/mm^2$. **(20 Marks)**

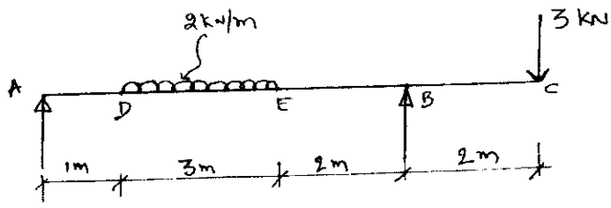

Fig. Q8

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