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ET-502(A)

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B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

Term-End Examination

December, 2010

ET-502(A) : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions. All questions carry **equal** marks.*

1. Fig. 1 (a) shows state of stress at a point with respect to x-y axis while fig. 1 (b) shows the state of stress with respect to principal axes 1-2. Determine σ_x, σ_y, τ_{xy} and max. Shearing stress, the orientation of plane of max shearing stress and direct stress on this plane. Show the results on sketches. **14**

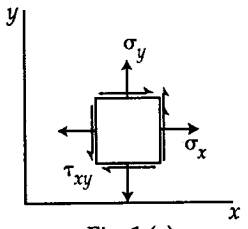

Fig. 1 (a)

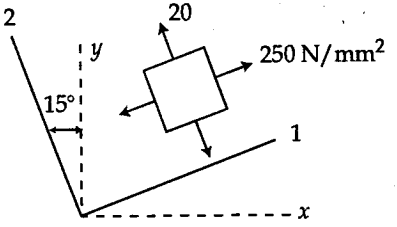

Fig. 1 (b)

2. (a) The rigid yokes B and C of Fig. 2 are securely fastened to 50 mm square steel bar AD. Determine total elongation of 5.5 m length. E = 200 GPa. 7

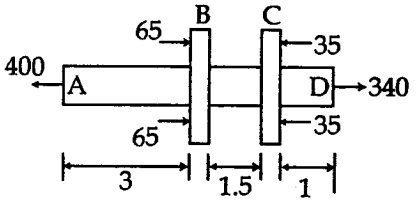

Fig. 2

(b) What do you understand by Polar moment of inertia ? Explain briefly. 7

3. A simply supported beam of 4 m span is loaded by a *udl* of intensity *W* N/m over half the span from left support (see Fig. 3) The beam has a T-section whose dimensions are as shown in Fig.3. If tensile flexural stress is not to exceed 9 N/mm^2 and horizontal shearing stress is not to exceed 0.7 N/mm^2, determine the intensity of loading (w N/m). 14

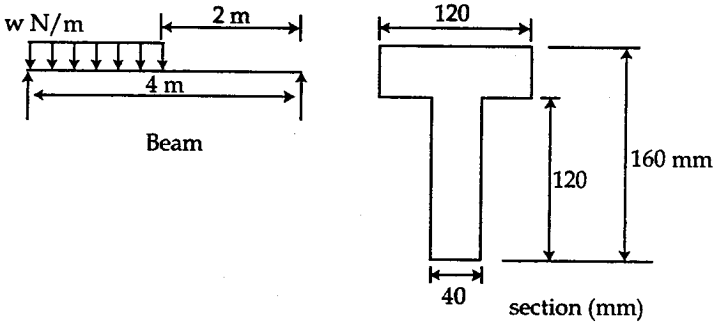

Fig. 3

4. Draw SFD and BMD by writing equations for SF and BM for length segments AB, BC, CD and DE for the beam shown in Fig. 4. **14**

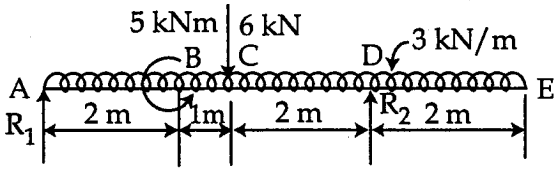

Fig. 4

5. (a) Compare the shearing stresses produced on the surfaces of a solid shaft of dia. d_0 and a hollow shaft, of outer dia. d_0 and inner dia. $x\ d_0$, where $x<1$. Both shafts are subjected to same torque. **7**

(b) A composite shaft A, B, C, D is made of three different materials in segments AB, BC and CD. What torque it can carry at section D if θ_{DA} is not to exceed 6°. The dimensions and properties are described below. **7**

AB – $d_1 = 50$ mm, $l_1 = 1200$ mm, $G_1 = 59 \times 10^3$ N/mm^2.

BC – $d_2 = 45$ mm, $l_2 = 800$ mm, $G_2 = 71 \times 10^3$ N/mm^2.

CD – $d_3 = 35$ mm, $l_3 = 400$ mm, $G_3 = 82 \times 10^3$ N/mm^2.

6. (a) Calculate the thickness of a steel plate to fabricate a spherical pressure vessel of 1.2 m diameter. The maximum pressure in the vessel may be 3 MPa. The ultimate tensile strength of steel σ_u is 450 MPa and a factor of safety of 4 is desirable $E = 2.1 \times 10^5$ MPa. What will be the change in the diameter of sphere ? **7**

(b) State the assumptions of theory of simple bending in beams. **7**

7. Find forces in members of truss shown in fig. 5. **14**

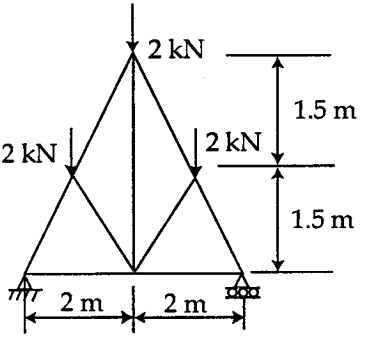

Fig. 5

8. (a) A short column, of rectangular cross section 200 mm by 150 mm, carries a load of 400 kN at a point 50 mm from longer side and 87.5 mm from shorter side. What are maximum compressive and tensile stresses in the section ? **10**

(b) What do you understand by middle third rule for a rectangular section ? **4**