

1. (a) Determine the stress state at point A on the cross section a-a of the hanger. (9%)
- (b) Determine the strain state at point A on the cross section a-a of the hanger. (6%)
- (c) Determine the principle strains, maximum in-plane strain, and their orientations by Mohr's circle. (10%) $E = 70 \text{ GPa}$ and $\nu = 0.33$

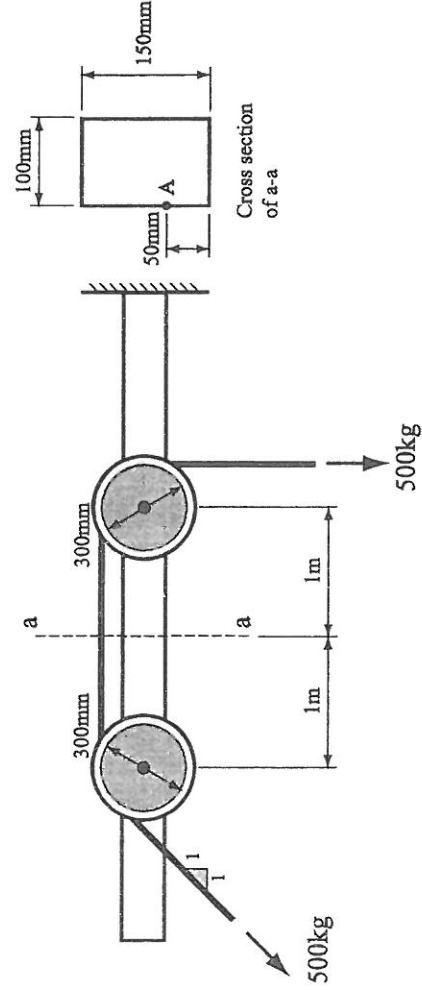


Fig. 1

2. The cylindrical pressure vessel can be made by using hemispherical end caps or flat end caps.
 - (a) If flat end caps were used, the bending stress would occur along the seams between the caps and tank. Please explain the cause of the bending stress. (5%)
 - (b) If hemispherical end caps were used, the bending stress could be reduced. Please explain the reason of stress reduction. (5%)
 - (c) If the engineers want to further eliminate the bending stress, the ratio of t_c / t_h should be properly chosen. Based on your knowledge, should the ratio be smaller or larger than 1.0? (5%)

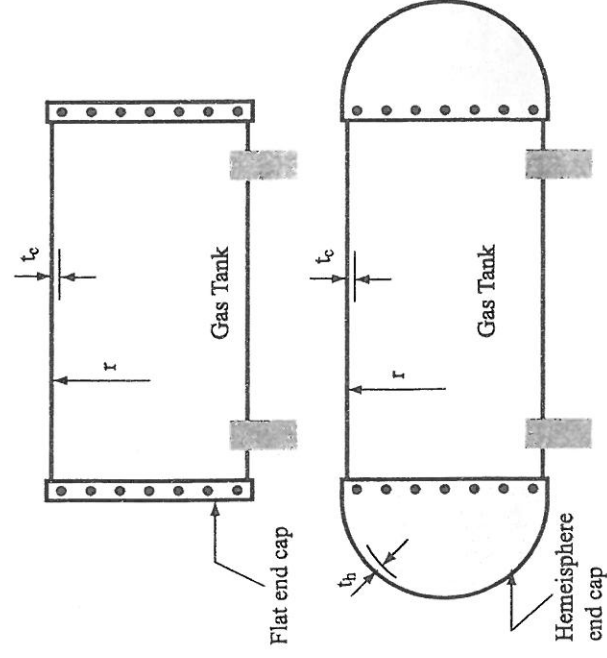


Fig. 2

3. The following beam has $I = 25 \times 10^{-6} \text{ m}^4$ and $E = 200 \text{ GPa}$. Determine the displacement at E of the beam by the method of discontinuity functions (or called singularity functions). (20%)

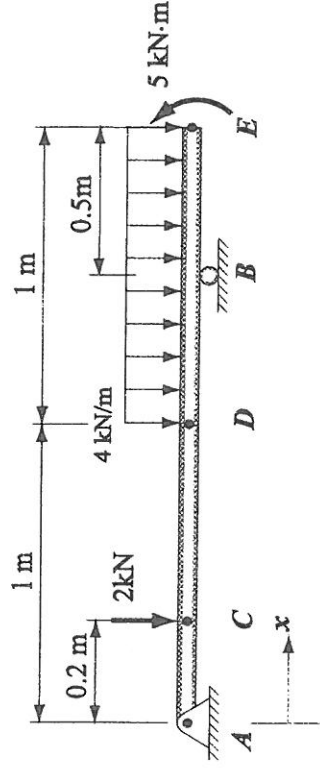


Fig. 3

4. A beam having rectangular cross section is subjected to load of 250 N at both ends and a distributed load of 150 N/m in the middle between two supports as shown in Fig. 4. The cross sectional of the beam has a height of $h = 0.2 \text{ m}$ and a width of $b = 0.15 \text{ m}$.
- Determine the shear force throughout the beam as function of x and draw the shear force diagram for the beam. (8%)
 - Determine the bending moment throughout the beam as function of x and draw the bending moment diagram for the beam. (9%)
 - Determine the maximum bending stress and maximum shear stress at section located 4 m from left end (section at support A) (8%)

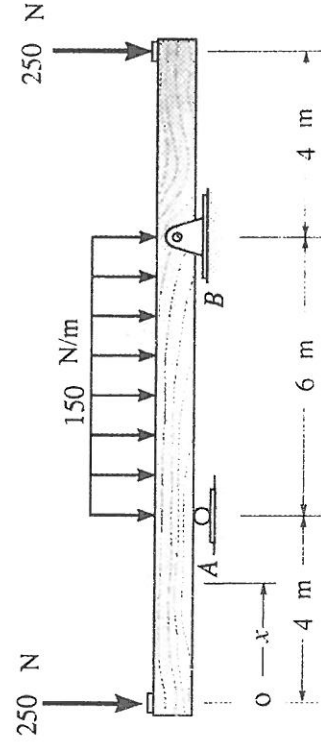


Fig. 4

5. A shaft ACE and a shaft BDF having diameter of 25mm shown in Fig.5 are connected using the gear set fixed to their ends at E and F. The radii of the gears are 100mm and 50mm respectively. The other ends of the shafts are attached to fixed supports at A and B. The shafts are also supported by bearing at C and D, which allow free rotation of the shafts along their axes. A torque of 500 N·m is applied to the gear at E, the shear modulus of the shaft G is 75 GPa,
- (a) Determine the reactions at A and B. (10%)
(b) Determine the angle of twist at E. (5%)

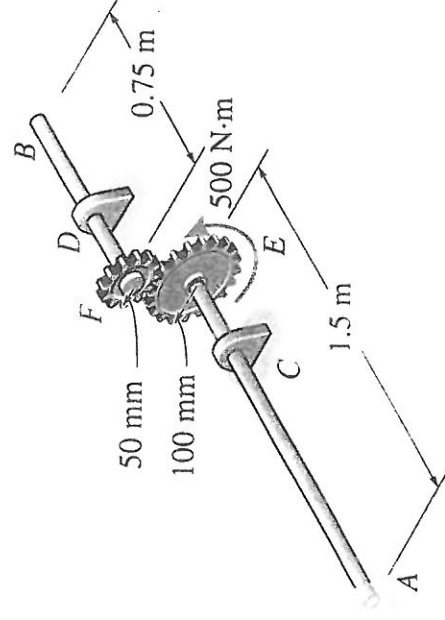


Fig. 5

