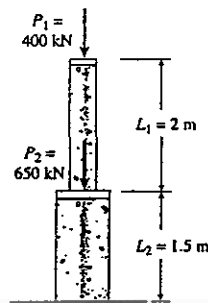
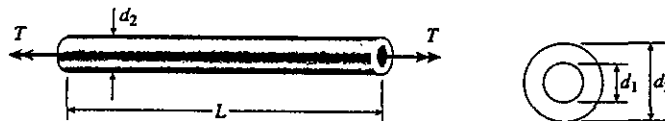


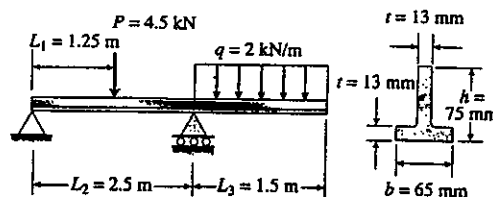
1. A reinforced pedestal ($E = 25 \text{ GPa}$) having dimensions $L_1 = 2 \text{ m}$ and $L_2 = 1.5 \text{ m}$. The loads applied to the pedestal are $P_1 = 400 \text{ kN}$ and $P_2 = 650 \text{ kN}$. Under the action of these loads, the maximum permissible shortening of the pedestal is 1.0 mm . Let A_1 and A_2 represent the cross-sectional areas of the upper and lower parts and A_2 is three times A_1 . What is the minimum permissible area A_1 ? (15%)



2. A hollow aluminum shaft has outside diameter $d_2 = 100 \text{ mm}$ and inside diameter $d_1 = 50 \text{ mm}$. When twisted by torques T , the shaft has an angle of twist per unit distance equal to $2^\circ/\text{m}$. The shear modulus of elasticity of the aluminum is $G = 27.5 \text{ GPa}$.
- What is the maximum tensile stress σ_{max} in the shaft? (10%)
 - What is the magnitude of the applied torques T ? (10%)

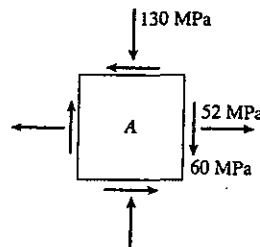


3. A beam of T-section is supported and loaded as shown. The cross section has width $b = 65 \text{ mm}$, height $h = 75 \text{ mm}$, and thickness $t = 13 \text{ mm}$. Determine the maximum tensile and compressive stresses in the beam. (15%)

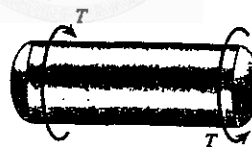


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4. An element in plane stress is subjected to stresses $\sigma_x = 52 \text{ MPa}$, $\sigma_y = -130 \text{ MPa}$, and $\tau_{xy} = -60 \text{ MPa}$.
- Determine the principal stresses and (10%)
 - show them on a sketch of a properly oriented element. (10%)



5. A cylindrical pressure vessel having radius $r = 300 \text{ mm}$ and wall thickness $t = 15 \text{ mm}$ is subjected to internal pressure $p = 2.5 \text{ MPa}$. In addition, a torque $T = 120 \text{ kN-m}$ acts at each end of the cylinder.
- Determine the maximum tensile stress σ_{max} and the maximum in-plane shear stress τ_{max} in the wall of the cylinder. (10%)
 - If the allowable in-plane shear stress is 20 MPa , what is the maximum allowable torque T ? (5%)



6. Derive the equations of the deflection curve for a simple beam AB loaded by a couple M_0 acting at distance a from the left-hand support. (8%) Also, determine the deflection δ_0 at the point where the load is applied. (7%)

