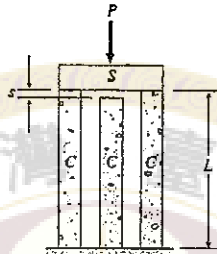
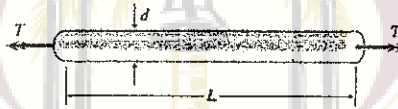


(15%) 1. A rigid steel plate is supported by three posts of high-strength concrete each having an effective cross-sectional area $A = 40,000 \text{ mm}^2$ and length $L = 2 \text{ m}$. Before the load P is applied, the middle post is shorter than the others by an amount $s = 1.0 \text{ mm}$.

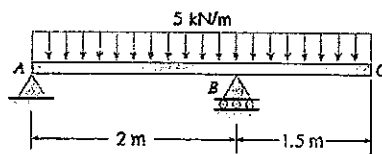
Determine the maximum allowable load P_{allow} if the allowable compressive stress in the concrete is $\sigma_{\text{allow}} = 20 \text{ MPa}$. (Use $E = 30 \text{ GPa}$ for concrete.)



(15%) 2. A propeller shaft for a small yacht is made of a solid steel bar 104 mm in diameter. The allowable stress in shear is 48 MPa, and the allowable rate of twist is 2.0° in 3.5 meters. Assuming that the shear modulus of elasticity is $G = 80 \text{ GPa}$, determine the maximum torque T_{max} that can be applied to the shaft.



(20%) 3. The uniformly loaded beam ABC has simple supports at A and B and an overhang BC . Draw the shear-force and bending-moment diagrams for this beam.

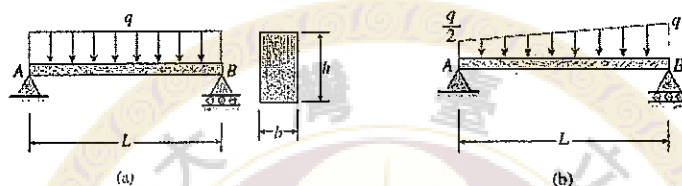


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(20%) 4. A simply supported wood beam AB with span length $L = 4$ m carries a uniform load of intensity $q = 5.8$ kN/m.

(a) Calculate the maximum bending stress σ_{\max} due to the load q if the beam has a rectangular cross section with width $b = 140$ mm and height $h = 240$ mm.

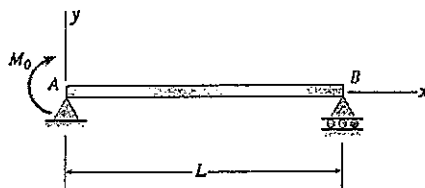
(b) Repeat (a) but use the trapezoidal distributed load shown in the figure part (b).



(15%) 5. A segment of a generator shaft is subjected to a torque T and an axial force P . The shaft is hollow (outer diameter $d_2 = 300$ mm and inner diameter $d_1 = 250$ mm) and delivers 1800 kW at 4.0 Hz. If the compressive force $P = 540$ kN, what are the maximum tensile, compressive, and shear stresses in the shaft?



(15%) 6. Derive the equation of the deflection curve for a simple beam AB loaded by a couple M_0 at the left-hand support. Also, determine the maximum deflection δ_{\max} .



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