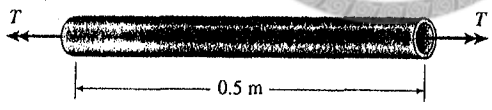
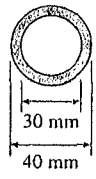
材料力學

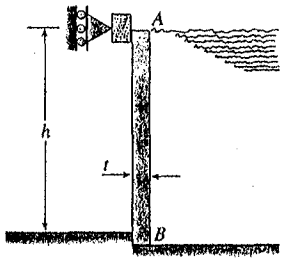
1. An aluminum wire having diameter $d = 2$ mm and modulus of elasticity $E = 75$ GPa is subjected to a tensile load P.
   (a) If the wire stretches 2.25 mm when the tensile force is 175 N, What is the length L of the wire? (10%)
   (b) If the maximum permissible elongation is 3.0 mm, the allowable stress in tension is 60 MPa, and the length of the wire is 3.8 m, what is the allowable load P_{max}? (10%)

2. A circular tube of aluminum is subjected to torsion by torques T applied at the ends. The bar is 0.5 m long, and the inside and outside diameters are 30 mm and 40 mm, respectively. It is determined by measurement that the angle of twist is 3.57° when the torque is 600 N·m. Calculate
   (a) the maximum shear stress τ_{max} in the tube, (10%)
   (b) the shear modulus of elasticity G, and (10%)
   (c) the maximum shear strain γ_{max}. (10%)





3. A small dam of height $h = 2.4$ m is constructed of vertical wood beams AB of thickness $t = 160$ mm. Consider the beams to be simply supported at the top and bottom. Determine the maximum bending stress σ_{max} in the beams, assuming that the weight density of water is $\gamma = 9.81$ kN/m^3. (15%)



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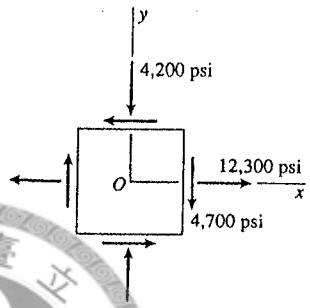
4. An element in plane stress is subjected to stresses σ_x = 12,300 psi, σ_y = -4,200 psi, and τ_{xy} = -4,700 psi. (Consider only the in-plane stresses)
   (a) Determine the principal stresses and show them on a sketch of a properly oriented element. (10%)
   (b) Determine the maximum shear stresses and show them on a sketch of a properly oriented element. (10%)



5. A generator shaft of hollow cross section is subjected to a torque T = 25 kN·m. The outer and inner diameters of the shaft are 200 mm and 160 mm, respectively. What is the maximum permissible compressive load P that can be applied to the shaft if the allowable in-plane shear stress is τ_{allow} = 45 MPa? (15%)