

- 1 The truss ABC shown in Figure 1 is subjected to a horizontal load P at joint B. Each bar has cross-sectional area A and modulus of Elasticity E .
 - i. Determine the strain energy of the truss. (15%)
 - ii. Determine the horizontal displacement of joint B. (10%)

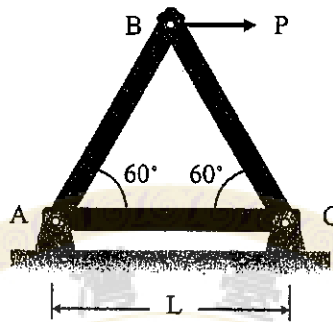


Figure 1

- 2 A plain concrete wall rests on a foundation and serves as a small dam (see Figure 2). The height of the wall is $h = 2$ m and the thickness of the wall is $t = 0.3$ m.
 - i. Assume plain concrete has weight density $\gamma = 23$ kN/m³. Determine the maximum tensile and compressive stresses at the base of the wall when the water level reaches the top ($d = h$). (15%)
 - ii. Determine the maximum permissible depth of the water if there is to be no tension in the concrete. (10%)

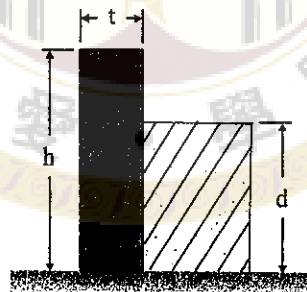
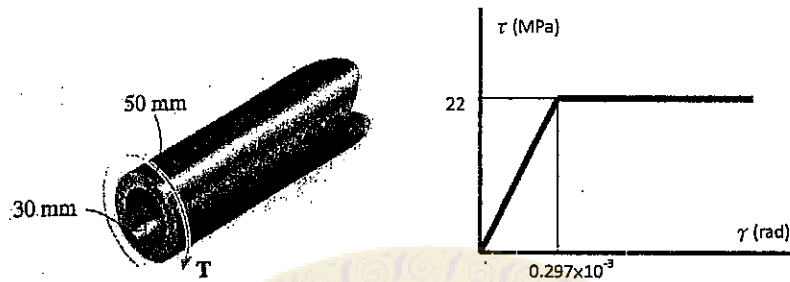


Figure 2

3. In Figure 3 the aluminum alloy tubular shaft is assumed to have an elastic-plastic τ - γ relation as shown.
 - i. Determine the maximum torque that can be applied to the shaft without causing the material to yield. (8%)
 - ii. Find the maximum torque (or plastic torque) that can be applied to the shaft. (8%)

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- iii. In order to develop a fully plastic torque, what should be the minimum shear strain at the outer radius? (9%)



4. Let L be the length of a column, L_e represent the column's effective length, and $K(=L_e / L)$ be the effective-length factor.
- What is the physical meaning of the column's effective length? (5%)
 - Determine the value of K for (a) a pin-ended column, (b) a fixed- and free-end column, (c) a pin- and fixed-end column, and (d) a column fixed at both ends. (8%)
 - Among the above four types of columns with the same length L , cross-section area A , elastic modulus E , and moment of inertia I , which column has a highest critical load P_{cr} before it begins to buckle? Please derive this P_{cr} . (12%)

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