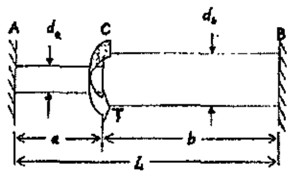
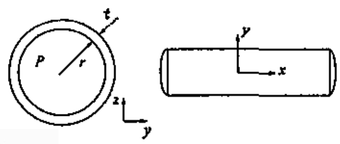
國立臺灣大學97學年度碩士班招生考試試題

1. **(25%)** A solid circular steel shaft AB, held rigidly at both ends, has two different diameters (see Figure 1). Assuming that the maximum permissible shear stress is 60 MPa, determine the allowable torque T that may be applied at the junction C.
(d_a = 20 mm, d_b = 40 mm, a = 0.2 m, b = 0.5 m, L = 0.7 m)

2. **(25%)** The internal pressure (P) of a closed cylindrical vessel is 2 MPa. The radius (r) is 20 cm and the thickness (t) is 1 mm. The configuration is shown in Figure 2.
(a) Calculate the circumferential stress (σ_{yy}) and longitudinal stress (σ_{xx}). **(5%)**
(b) Calculate the principal stresses at lateral outer surface. **(5%)**
(c) What is the absolute maximum shear stress at the lateral outer surface? **(10%)**
(d) Calculate the principal stresses at lateral inner surface. **(5%)**



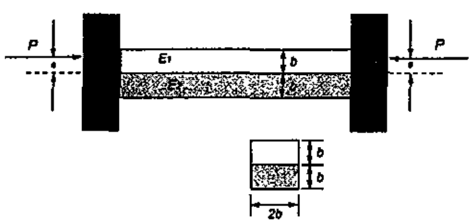
(Figure for Problem 1)



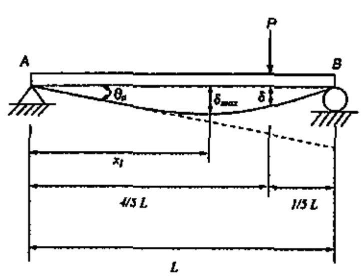
(Figure for Problem 2)

3. **(20%)** A composite bar of square cross section with dimension $2b$ x $2b$ is constructed of two different materials having moduli of elasticity E_1 and E_2. Both parts of the bar have the same cross-sectional dimensions. (see Figure 3)
(a) Assuming that the end plates are rigid, derive a formula for the eccentricity e of the load P so that each part of the bas is stressed uniformly in compression. **(10%)**
(b) Under these conditions, what are the axial forces P_1 and P_2 carried by materials 1 and 2, respectively? **(10%)**

4. **(30%)** A simple beam AB supports a concentrated load P as shown in the Figure 4. Determine the followings:
(a) angle of rotation θ_a at support A. **(6%)**
(b) the deflection δ under the load P. **(8%)**
(c) the location of the maximum deflection x_1. **(8%)**
(d) the maximum deflection δ_{max}. **(8%)**
(Use these symbols in your derivation ~ *Young's modulus: E, moment of inertial: I*)



(Figure for Problem 3)



(Figure for Problem 4)

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