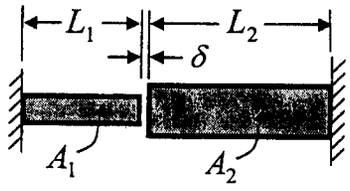
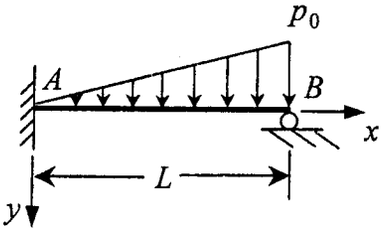
編號： 189　系所：航空太空工程學系乙組　　科目：材料力學

本試題是否可以使用計算機： ☑可使用 ， ☐不可使用 （請命題老師勾選）

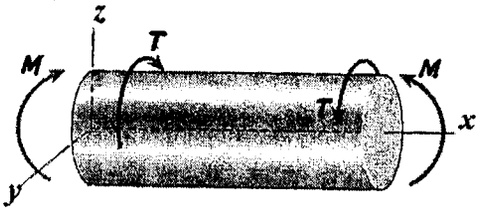
1. (25%) Two bars of the same material are arranged so that the gap between their free ends is $\delta = 0.10$ mm at room temperature. Lengths of bars are $L_1 = 40$ mm and $L_2 = 80$ mm; cross-sectional areas are $A_1 = 80\ \text{mm}^2$ and $A_2 = 120\ \text{mm}^2$. The coefficient of thermal expansion and Young's modulus of the material are, respectively, $\alpha = 10 \times 10^{-6}/^\circ\text{C}$ and $E = 70 \times 10^9$ Pa. Calculate the stresses in the two bars when the temperature increase is (a) 50°C, and (b) 300°C.



2. (25%) Determine the equation of the deflection curve and the reactions at A and B for the beam shown. The beam is subjected to a triangular load of maximum intensity p_0.



3. (25%) A cylindrical pressure vessel with flat ends is subjected to a torque T, a bending moment M (as shown), and the internal pressure p. The outer radius is r_0 and the wall thickness is t.



(a) Consider a stress element on the top of the cylinder. Derive the formulas for calculating the corresponding plane stresses σ_x, σ_y, and τ_{xy}.

(b) How would you find the maximum tensile stress, maximum compressive stress, and the maximum shear stress in the wall of the cylinder?

4. (25%) The system shown below consists of two bars AB and BC, each of bending stiffness EI and length L, elastically hinged together at B with a *torsional* spring of stiffness K.

(a) Derive an equation for the buckling load P_{cr} of the system.

(b) Find the lowest buckling loads when (i) $K \to \infty$ and (ii) $EI \to \infty$, respectively.

(c) Justify the results in (b) based on physical concepts.