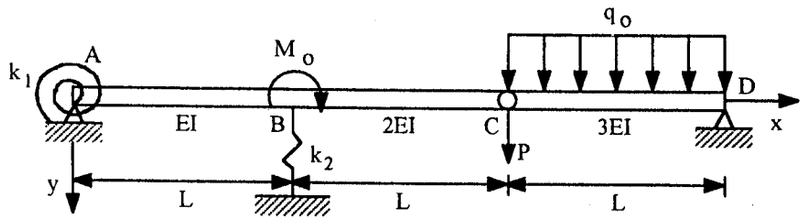
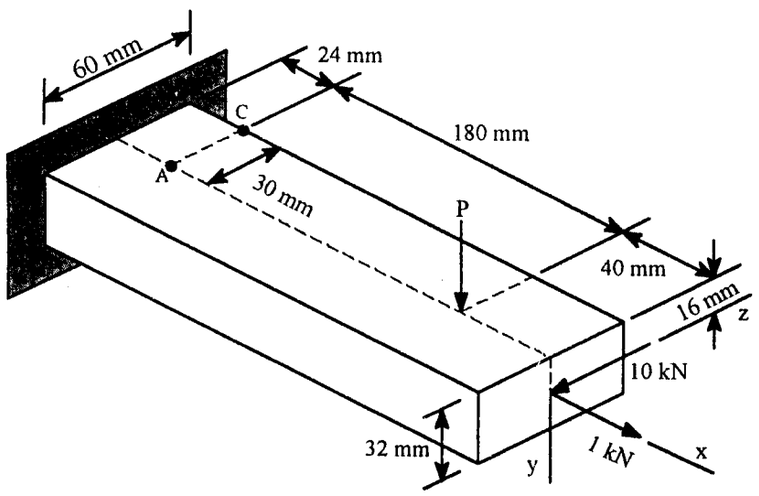
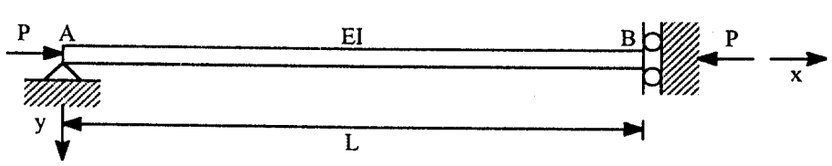
1. The beam ABCD has a rotational spring support (spring constant k_1) at A, a translational spring support (spring constant k_2) at B, a pin at C, and a hinge support at D. The beam is subjected to a concentrated moment M_O at B, a concentrated force P at C, and a distributed load of constant intensity q_O in CD region. The flexural rigidities of AB, BC, and CD portions are EI, 2EI, and 3EI, respectively. Set up the load-deflection differential equations and write down the boundary conditions that can be used to determine the deflection w(x) of the entire beam. Do not solve the differential equations. (20%)



2. A cantilever beam is subjected to three forces as shown. If the normal stress at point C is 128.2 MPa, calculate: (i) the magnitude of force P, (ii) the normal and shear stresses at point A, (iii) the three principal stresses and the absolute maximum shear stress at point A. (20%)

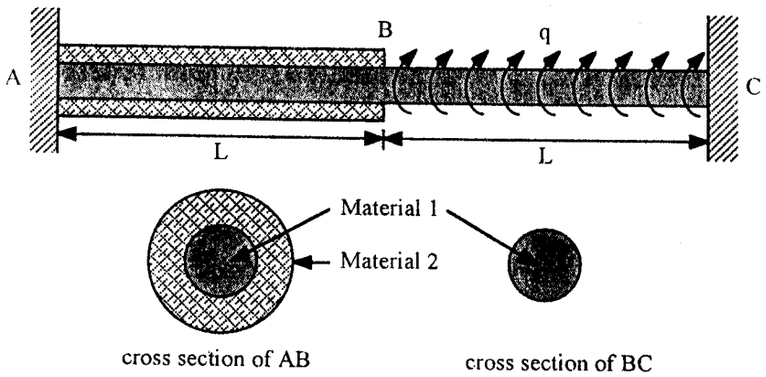


3. A column AB having a hinge support at A and a sliding support at B is subjected to axial force P at both ends. (i) Derive the differential equation in terms of the deflection curve w(x) for the beam. (ii) Solve the differential equation to obtain the critical buckling load P_{cr} and the critical buckling mode shape. (iii) What is the effective length factor K for the column? (20%)



(背面仍有題目,請繼續作答)

4. A solid circular bar ABC is made up of material 1 with shear modulus G_1 and polar moment of inertia I_{p1}. The AB portion of the bar is perfectly bond with a sleeve made up of material 2 with shear modulus G_2 and polar moment of inertia I_{p2}. The bar is fixed at both ends and subjected to a distributed torque of constant intensity q per unit length acting along the BC portion of the bar. Assume $G_2I_{p2} = 3G_1I_{p1}$. Calculate: (i) the fixed end torques at ends A and C, (ii) the angle of twist at point B. (20%)



5. A two-bar truss is subjected to a concentrated load P. Both bars have the same cross section area A and are made up of the same material with a nonlinear stress-strain relation as $\sigma = K\sqrt{\varepsilon}$. Use the complementary energy theorem (Crotti-Engesser theorem) to calculate the vertical and horizontal displacements of point B. (20%)