Mechanics of Materials April 1995

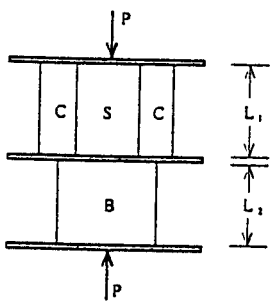
(25%) 1. A circular cylinder S and a hollow tube C having the same length L_1 are compressed between two rigid plates, one of which is attached to another cylinder B with an end plate as shown below.

(a) Determine the compressive stresses in the three parts S, C, B.

(b) Find the shortening δ of the assembly.

(c) What is the value of the strain energy *density* stored in cyclinder S?

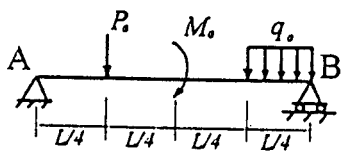
(d) What information do you need to determine the occurrence sequence of *yielding* of the three parts?



(25%) 2.(a) Draw the shear-force and bending-moment diagrams for the simply supported beam shown below, where $M_0 = \frac{P_0 L}{2}$, $q_0 = \frac{4P_0}{L}$.

(b) If the beam has a solid rectangular cross section of width b and height h, find the maximum values of bending stress and shear stress, respectively, in the beam.

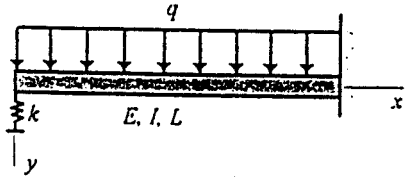
(c) Will the above results change if the beam *material* is changed?



(25%) 3. A beam with flexural rigidity EI and length L is supported by a linear spring at one end and is fixed at the other end as shown below. The stiffness of the spring is $k = EI/L^3$.

(a) Find the equation of the deflection curve for the beam.

(b) Draw the shear-force and bending-moment diagrams for the beam, labeling all critical coordinates including maximum and minimum values.



(25%) 4. The column shown below is fixed at the base and free at the upper end. A compressive load P acts at the top of the column with an eccentricity e from the axis of the column. Beginning with the differential equation, derive formulas for:

(a) the maximum deflection δ of the column,

(b) the maximum bending moments M_{max} in the beam,

(c) the critical load P_{cr}.