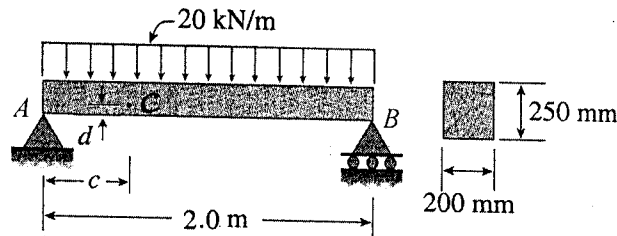1. A simple beam AB of rectangular cross section is subjected to a uniform load of 20 kN/m. Point C is located at distance $c = 0.5$ m from point A and distance $d = 80$ mm from the bottom of the beam. Determine the principle stresses and maximum shear stress at point C and show the results on properly oriented elements. (20%)

2. An overhanging beam ABC is subjected to two different loading conditions: (a) a concentrated load P acting at point C, and (b) a uniform load of intensity q_0 on the overhang BC and a couple M_0 at C, as shown in the figure. For what ratios q_0/P and M_0/P will the two loading conditions produce the same maximum upward and downward deflections. (The beam has constant flexural rigidity EI.) (20%)
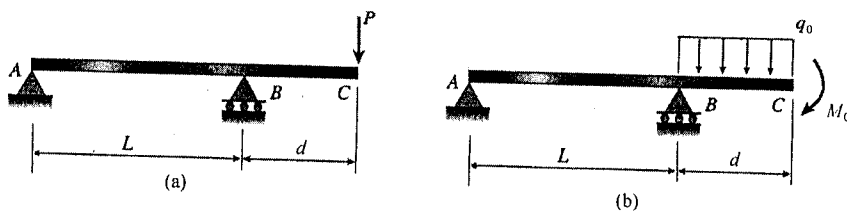
3. A rigid horizontal bar BDF is designed to be supported by three circular rods of the same diameter and same material. The material has modulus of elasticity $E = 70$ GPa. If rod AB is manufactured too short 2 mm, how much stress will be induced in each of the rods by stretching rod AB, inserting the pin at B, then releasing forces required to mate the parts? (20%)
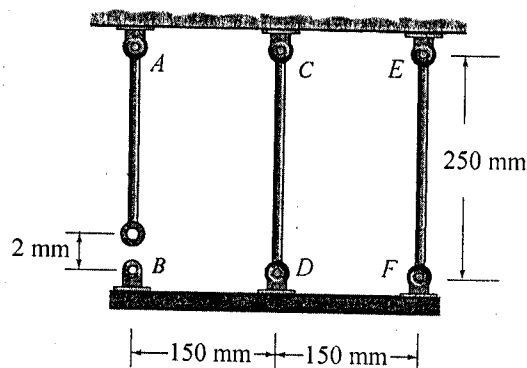
(背面仍有題目,請繼續作答)

4. A solid circular shaft of diameter $d = 100$ mm is subjected to a torque $T = 10 \, \text{kN} \cdot \text{m}$. The shaft is made of elastic-perfectly plastic material with the shear stress-shear strain diagram shown in the figure. (a) Determine the maximum shear strain. (b) What is the distribution of residual shear stress in the shaft after the torque is completely removed? (20%)
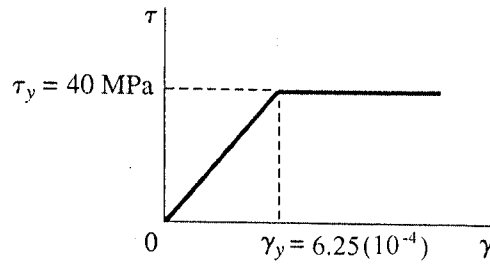
5. A slender, prismatic, linearly elastic column AB with length L is pin-supported at B by a linearly elastic rotational spring of stiffness β_R and compressed by an axial load P (see figure). Assuming that buckling occurs in the plane of the figure and the column has flexural rigidity EI, determine the critical load P_{cr} for the column when $\beta_R = EI/L$. (20%)