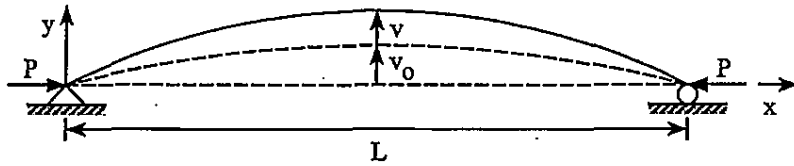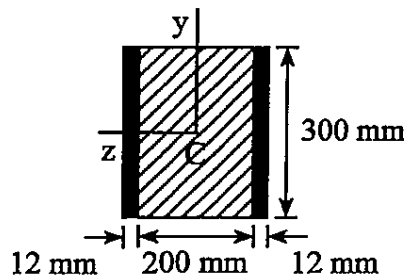※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。
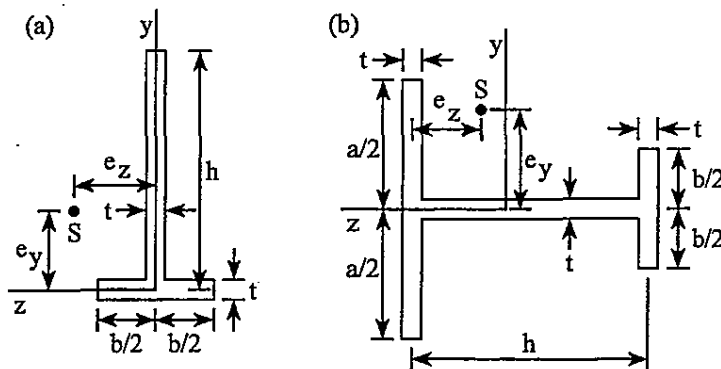
1. A simply supported beam has initial imperfection $v_0 = \delta \sin(\pi x / L)$, where δ is a given constant. The beam is subjected to axial compressive forces P at both ends. (i) Obtain the expression for the additional deflection v(x) of the beam. (ii) Calculate the critical buckling load P_{cr} of the beam. (20%)
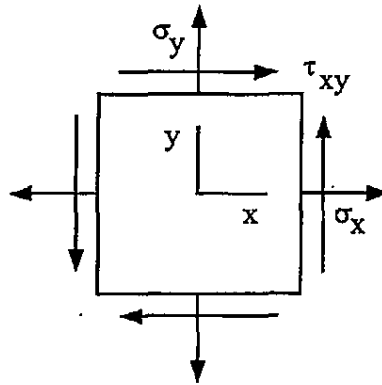

2. A wood beam with cross-sectional dimensions $200 \text{ mm} \times 300 \text{ mm}$ is reinforced on its sides by steel plates 12 mm thick. The moduli of elasticity for the steel and wood are E_s=190 GPa and E_w=11 GPa, respectively. Also, the corresponding allowable stresses are σ_s=110 MPa and σ_w=7.5 MPa. Calculate the maximum permissible bending moment M_{max} when the beam is bent about the z axis. (20%)

3. Determine the distances e_y and e_z to locate the shear center S of the following 2 thin-walled beams with uniform thickness t as shown. (20%)

4. An element in plane stress condition is subjected to stresses as shown. At counterclockwise angles $\theta = 32^\circ$ and $\theta = 78^\circ$ from the x axis, the normal stress is 29 MPa in tension. If the stress $\sigma_x = 18\,\text{MPa}$, what are the stresses σ_y and τ_{xy} ? (20%)

5. A steel bar (E = 206 GPa) is subjected to axial compressive forces $P_1 = 400\,\text{kN}$ and $P_2 = 720\,\text{kN}$ as shown. The cross section areas of segment AB and BC are $A_{AB} = 11000\,\text{mm}^2$ and $A_{BC} = 3900\,\text{mm}^2$, respectively. (a) Calculate the total shortening δ_{AC} of the bar AC. (b) How much additional compressive load P_0 can be applied at point C, if the total shortening δ_{AC} is not exceed 4 mm. (20%)