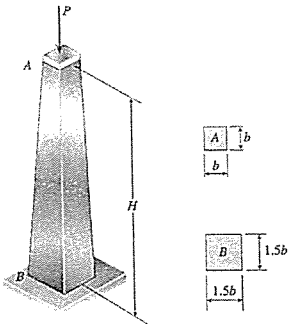
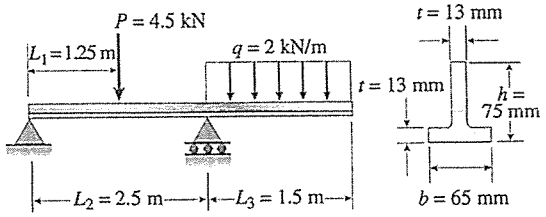
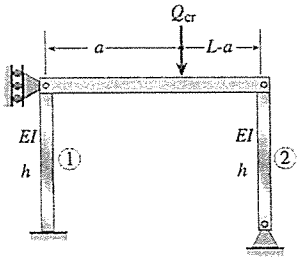
Question 1 (25%)
A post AB supporting equipment in a laboratory is tapered uniformly throughout its height H, as shown in the figure. The cross sections of the post are square, with dimensions b × b at the top and 1.5b × 1.5b at the base. Derive a formula for the shortening δ of the post due to the compressive load P acting at the top. (Assume that the angle of taper is small and disregard the weight of the post itself)



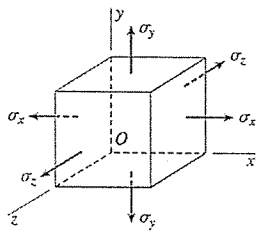
Question 2 (25%)
A beam of T-section is supported and loaded as shown in the figure. The cross section has width b = 35 mm, height h = 75 mm, and thickness t = 13 mm. Determine the maximum tensile and compressive stresses in the beam.



Question 3 (25%)
A beam is pin-connected to the tops of two identical pipe columns, each of height h, in a frame. The frame is restrained against sideways at the top of column 1. Only buckling of columns 1 and 2 in the plane of the frame is of interest here. Determine the ratio (a/L), where the load Q_{cr} causes both columns to buckle simultaneously.



Question 4 (25%)
An element of aluminum is subjected to triaxial stress shown in the figure. If the following stress and strain data is known: normal stresses are σ_x = 36 MPa (tension), σ_y = -33 MPa (compression), and σ_z = -21 MPa (compression) and normal strains in the x and y directions are $\varepsilon_x = 713.8\times10^{-6}$ (elongation) and $\varepsilon_y = -502.3\times10^{-6}$ (shortening). Calculate the normal strain in z direction ε_z and the bulk modulus K of the aluminum.



試題隨卷繳回