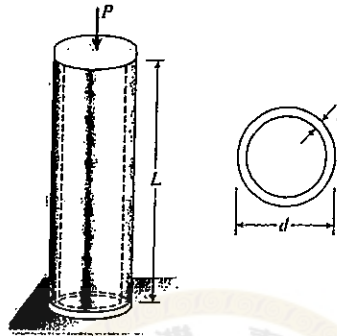1. A hollow, circular, steel column ($E = 210$ GPa) is subjected to a compressive load $P$. The column has length $L = 2.5$ m and outside diameter $d = 200$ mm. The load $P = 500$ kN. If the allowable compressive stress is 55 MPa and the allowable shortening of the column is 0.60 mm, what is the required wall thickness $t_{min}$? (15%)



2. A solid circular bar $ABC$ ($G = 80$ GPa) consists of two segments. One segment has diameter $d_1 = 50$ mm and length $L_1 = 1.25$ m; the other segment has diameter $d_2 = 40$ mm and length $L_2 = 1$ m. What is the allowable torque $T_{allow}$ if the shear stress is not to exceed 30 MPa and the angle of twist between the ends of the bar is not to exceed 1.5°? (15%)
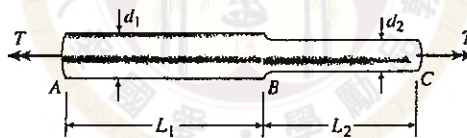


3. A simply supported wood beam $AB$ with span length $L = 3.75$ m carries a uniform load of intensity $q = 6.4$ kN/m. Calculate the maximum bending stress $\sigma_{max}$ due to the load $q$ if the beam has a rectangular cross section with width $b = 150$ mm and height $h = 300$mm. (15%)
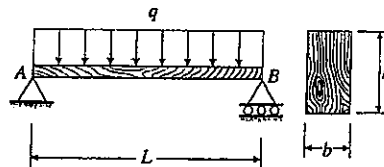
4. A plate in plane stress is subjected to normal stresses $\sigma_x$ and $\sigma_y$ and shear stress $\tau_{xy}$. At counterclockwise angles $\theta = 40°$ and $\theta = 80°$ from the $x$ axis the normal stress is 50 MPa tension. If the stress $\sigma_x$ equals 20 MPa tension, what are the stresses $\sigma_y$ and $\tau_{xy}$? (15%)
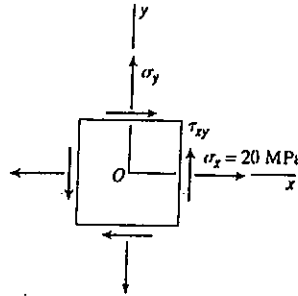


5. A cylindrical pressure vessel with flat ends is subjected to a torque $T$ and a bending moment $M$. The outer radius is 300 mm and the wall thickness is 25 mm. The loads are as follows: $T = 90$ kN·m, $M = 100$ kN·m, and the internal pressure $p = 6.25$ MPa. Determine the maximum tensile stress $\sigma_t$, maximum compressive stress $\sigma_c$, and maximum shear stress $\tau_{max}$ in the wall of the cylinder. (20%)
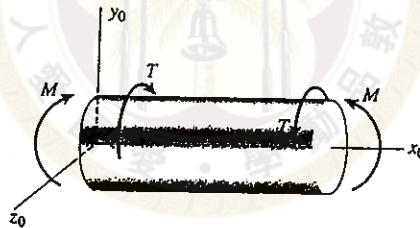


6. The fixed-end beam $ACB$ supports a concentrated load $P$ at the midpoint. Analyze this beam by solving the fourth-order differential equation of the deflection curve (the load equation). Determine the reactions, shear forces, bending moments, slopes, and deflections of the beam. (20%)



試題隨卷繳回