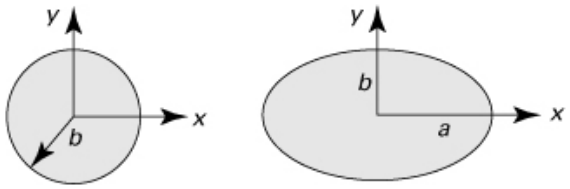
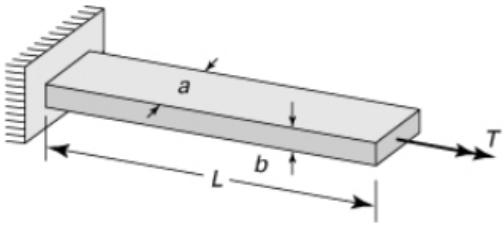
Homework 10

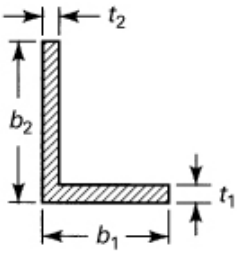
1) Consider two bars, one having a circular section of radius b, the other an elliptic section with semiaxes a and b. Determine (a) for equal angles of twist, which bar experiences the larger shearing stress, and (b) for equal allowable shearing stresses, which bar resists a larger torque.



2) The torque T produces a rotation of $15°$ at the free end of the steel bar shown. Use $a = 24\ mm$, $b = 16\ mm$, $L = 400\ mm$, and $G = 80\ GPa$. What is the maximum shearing stress in the bar?



3) A steel bar ($G = 200\ GPa$) of cross section shown is subjected to a torque of $500\ N \cdot m$. Determine the maximum shearing stress and the angle of twist per unit length. The dimensions are $b_1 = 100$ mm, $b_2 = 125$ mm, $t_1 = 10$ mm, and $t_2 = 4$ mm.



4) A torque T is applied to a thin-walled tube of a cross section in the form of a regular hexagon of constant wall thickness t and mean side length a. Derive relationships for the shearing stress τ and the angle of twist θ per unit length.

5) Two thick-walled, closed-ended cylinders of the same dimensions are subjected to internal and external pressure, respectively. The outer diameter of each is twice the inner diameter. What is the ratio of the pressures for the following cases? (a) The maximum tangential stress has the same absolute value in each cylinder. (b) The maximum tangential strain has the same absolute value in each cylinder. Assume axial strain is negligible and take $\nu = 1/3$.

6) A cylinder, subjected to internal pressure only, is constructed of aluminum having a tensile strength σ_{yp}. The internal radius of the cylinder is a, and the outer radius is $2a$. Based on the maximum energy of distortion and maximum shear stress theories of failure, predict the limiting values of internal pressure.