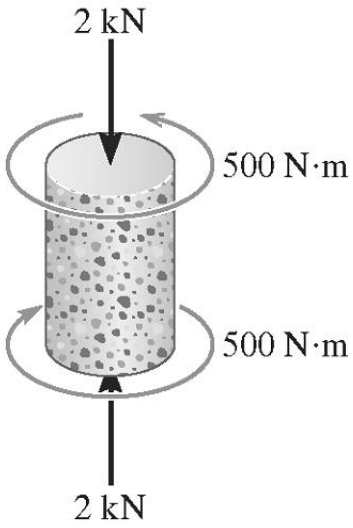
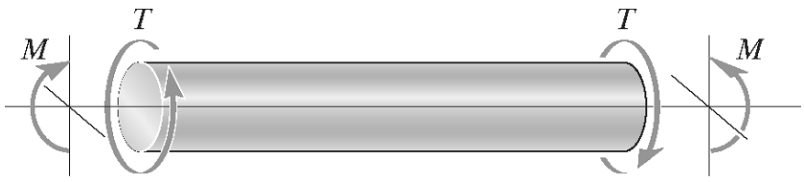
1. The short concrete cylinder having a diameter of 50 mm is subjected to a torque of 500 N • m and an axial compressive force of 2 kN. Determine if it fails according to the maximum normal stress theory. The ultimate stress of the concrete is 28 MPa.



2. If a solid shaft having a diameter *d* is subjected to a torque *T* and moment *M*, show that by the maximum normal stress theory the maximum allowable principal stress is $[\sigma]=\left(16/\pi d^3\right)\left(M+\sqrt{M^2+T^2}\right)$



3. A material is subjected to plane stress. (a) Express the distortion energy theory of failure in terms of σ_x, σ_y, and τ_{xy}. (b) Express the maximum shear stress theory of failure in terms of σ_x, σ_y, and τ_{xy}. Assume that the principal stresses are of different algebraic signs.

4. The components of plane stress at a critical point on a structural steel shell are shown. Determine if failure (yielding) has occurred on the basis of the maximum shear stress theory and maximum distortion energy theory, respectively. $\sigma_Y = 250$ MPa.