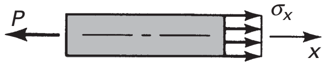
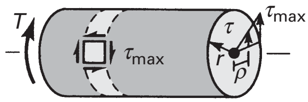
Table 1.1. *Commonly Used Elementary Formulas for Stress*[a]

1. *Prismatic Bars of Linearly Elastic Material*

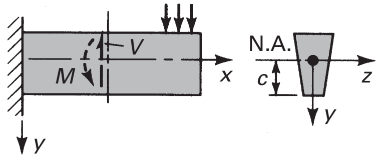


Axial loading: $$\sigma_x = \frac{P}{A} \qquad \text{(a)}$$



Torsion: $$\tau = \frac{T\rho}{J}, \qquad \tau_{\max} = \frac{Tr}{J} \qquad \text{(b)}$$

Bending: $$\sigma_x = -\frac{My}{I}, \qquad \sigma_{\max} = \frac{Mc}{I} \qquad \text{(c)}$$

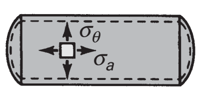


Shear: $$\tau_{xy} = \frac{VQ}{Ib} \qquad \text{(d)}$$

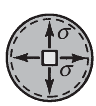
where

σ_x = normal axial stress
τ = shearing stress due to torque
τ_{xy} = shearing stress due to vertical shear force
P = axial force
T = torque
V = vertical shear force
M = bending moment about z axis
A = cross-sectional area
y, z = centroidal principal axes of the area
I = moment of inertia about neutral axis (N.A.)
J = polar moment of inertia of circular cross section
b = width of bar at which τ_{xy} is calculated
r = radius
Q = first moment about N.A. of the area beyond the point at which τ_{xy} is calculated

2. *Thin-Walled Pressure Vessels*



Cylinder: $$\sigma_\theta = \frac{pr}{t}, \qquad \sigma_a = \frac{pr}{2t} \qquad \text{(e)}$$



Sphere: $$\sigma = \frac{pr}{2t} \qquad \text{(f)}$$

where

σ_θ = tangential stress in cylinder wall
σ_a = axial stress in cylinder wall
σ = membrane stress in sphere wall
P = internal pressure
t = wall thickness
r = mean radius

[a]Detailed derivations and limitations of the use of these formulas are discussed in Sections 1.6, 5.7, 6.2, and 13.14.