Important Equations Used in This Chapter

See the referenced sections for information on the proper use of these equations.

The Stress Cubic—its roots are the 3-D principal stresses (Section 4.3):

$$\sigma^3 - C_2\sigma^2 - C_1\sigma - C_0 = 0 \tag{4.4c}$$

where

$$C_2 = \sigma_x + \sigma_y + \sigma_z$$
$$C_1 = \tau_{xy}^2 + \tau_{yz}^2 + \tau_{zx}^2 - \sigma_x\sigma_y - \sigma_y\sigma_z - \sigma_z\sigma_x$$
$$C_0 = \sigma_x\sigma_y\sigma_z + 2\tau_{xy}\tau_{yz}\tau_{zx} - \sigma_x\tau_{yz}^2 - \sigma_y\tau_{zx}^2 - \sigma_z\tau_{xy}^2$$

Maximum Shear Stresses (Section 4.3):

$$\tau_{13} = \frac{|\sigma_1 - \sigma_3|}{2}; \qquad \tau_{21} = \frac{|\sigma_2 - \sigma_1|}{2}; \qquad \tau_{32} = \frac{|\sigma_3 - \sigma_2|}{2} \tag{4.5}$$

Two-Dimensional Principal Stresses (Section 4.3):

$$\sigma_a, \sigma_b = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$
$$\sigma_c = 0 \tag{4.6a}$$

$$\tau_{max} = \tau_{13} = \frac{|\sigma_1 - \sigma_3|}{2} \tag{4.6b}$$

Axial Tension Stress (Section 4.7):

$$\sigma_x = \frac{P}{A} \tag{4.7}$$

Axial Deflection (Section 4.7):

$$\Delta s = \frac{Pl}{AE} \tag{4.8}$$

Direct Shear Stress (Section 4.8):

$$\tau_{xy} = \frac{P}{A_{shear}} \tag{4.9}$$

Direct Bearing Area (Section 4.8):

$$A_{bearing} = \frac{\pi}{4} l\, d \tag{4.10b}$$

Maximum Bending Stress—Straight Beams (Section 4.9):

$$\sigma_{max} = \frac{Mc}{I} \tag{4.11b}$$

Maximum Bending Stress—Curved Beams (Section 4.9):

$$\sigma_i = +\frac{M}{eA}\left(\frac{c_i}{r_i}\right) \tag{4.12b}$$