A general approach to designing for HCF cases is presented in Section 6.13. The von Mises effective-stress equation is used to create effective alternating and mean components of stress for the most highly loaded points within the part. In some cases the mean stress component may be zero. All appropriate stress-concentration effects should be included in these stress calculations. The mean and alternating von Mises components are then plotted on the modified-Goodman diagram and a safety factor calculated based on an assumption about the way in which the mean and alternating stresses may vary in service. See Section 6.11 and equations 6.18.

6

Important Equations Used in This Chapter

Fluctuating-Stress Components (Section 6.4):

$$\Delta\sigma = \sigma_{max} - \sigma_{min} \tag{6.1a}$$

$$\sigma_a = \frac{\sigma_{max} - \sigma_{min}}{2} \tag{6.1b}$$

$$\sigma_m = \frac{\sigma_{max} + \sigma_{min}}{2} \tag{6.1c}$$

$$R = \frac{\sigma_{min}}{\sigma_{max}} \qquad A = \frac{\sigma_a}{\sigma_m} \tag{6.1d}$$

Uncorrected Fatigue Strength Estimates (Section 6.5):

$$\text{steels:} \quad \begin{Bmatrix} S_{e'} \cong 0.5\,S_{ut} & \text{for } S_{ut} < 200 \text{ kpsi } (1\,400 \text{ MPa}) \\ S_{e'} \cong 100 \text{ kpsi } (700 \text{ MPa}) & \text{for } S_{ut} \ge 200 \text{ kpsi } (1\,400 \text{ MPa}) \end{Bmatrix} \tag{6.5a}$$

$$\text{irons:} \quad \begin{Bmatrix} S_{e'} \cong 0.4\,S_{ut} & \text{for } S_{ut} < 60 \text{ kpsi } (400 \text{ MPa}) \\ S_{e'} \cong 24 \text{ kpsi } (160 \text{ MPa}) & \text{for } S_{ut} \ge 60 \text{ kpsi } (400 \text{ MPa}) \end{Bmatrix} \tag{6.5b}$$

$$\text{aluminums:} \quad \begin{Bmatrix} S_{f'_{@5E8}} \cong 0.4\,S_{ut} & \text{for } S_{ut} < 48 \text{ kpsi } (330 \text{ MPa}) \\ S_{f'_{@5E8}} \cong 19 \text{ kpsi } (130 \text{ MPa}) & \text{for } S_{ut} \ge 48 \text{ kpsi } (330 \text{ MPa}) \end{Bmatrix} \tag{6.5c}$$

$$\text{copper alloys:} \begin{Bmatrix} S_{f'_{@5E8}} \cong 0.4\,S_{ut} & \text{for } S_{ut} < 40 \text{ kpsi } (280 \text{ MPa}) \\ S_{f'_{@5E8}} \cong 14 \text{ kpsi } (100 \text{ MPa}) & \text{for } S_{ut} \ge 40 \text{ kpsi } (280 \text{ MPa}) \end{Bmatrix} \tag{6.5d}^*$$

Correction Factors for Fatigue Strength (Section 6.6):

$$\begin{aligned} &\text{bending:} && C_{load} = 1 \\ &\text{axial loading:} && C_{load} = 0.70 \end{aligned} \tag{6.7a}$$

$$\begin{aligned} &\text{for } d \le 0.3 \text{ in } (8 \text{ mm}): && C_{size} = 1 \\ &\text{for } 0.3 \text{ in} < d \le 10 \text{ in}: && C_{size} = 0.869 d^{-0.097} \\ &\text{for } 8 \text{ mm} < d \le 250 \text{ mm}: && C_{size} = 1.189 d^{-0.097} \end{aligned} \tag{6.7b}$$