

Strain Life Method

Plastic strain $\frac{\Delta \epsilon_p}{2} = \epsilon_f (2N)^c$

Elastic strain $\frac{\Delta \epsilon_e}{2} = \frac{\sigma_F}{E} (2N)^b$

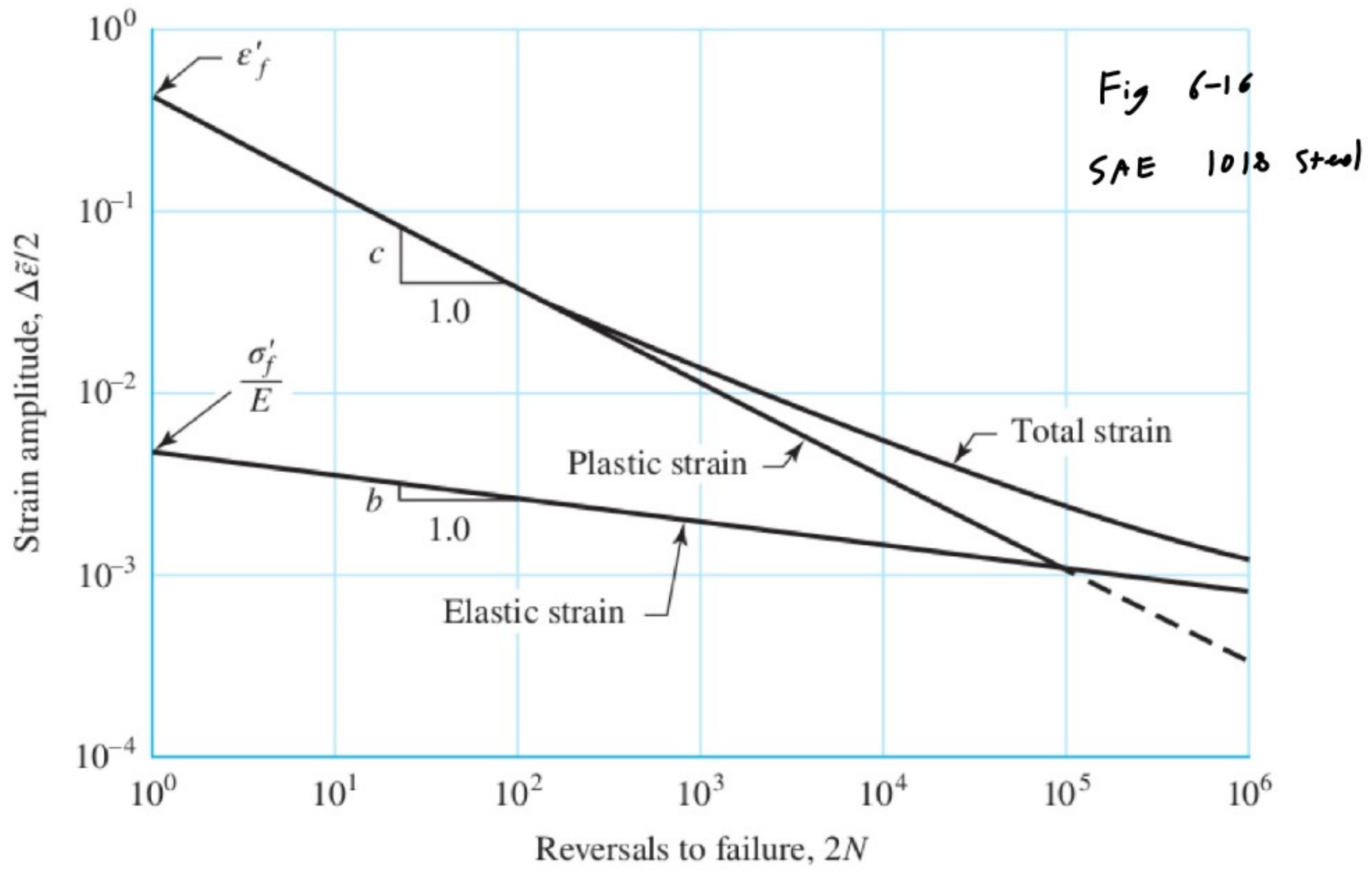
$$\frac{\Delta \epsilon}{2} = \frac{\Delta \epsilon_e}{2} + \frac{\Delta \epsilon_p}{2} = \frac{\sigma_F}{E} (2N)^b + \epsilon_f (2N)^c$$

N number of strain reversals

E modulus of elasticity

ϵ_f strain at fracture

σ_F stress at fracture



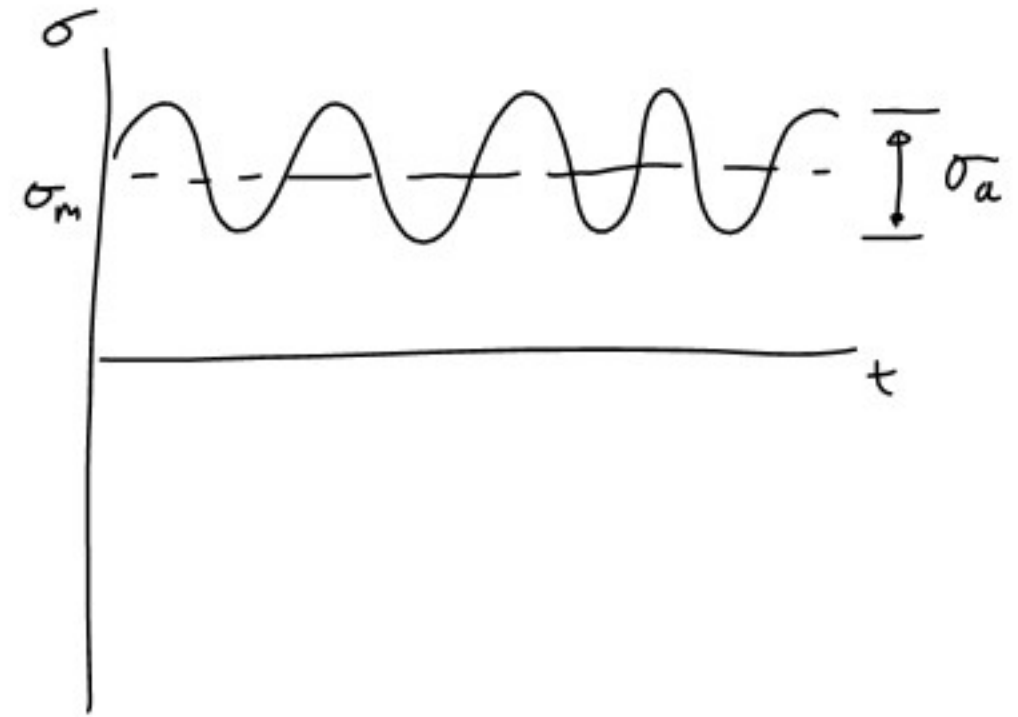
Stress Life Method

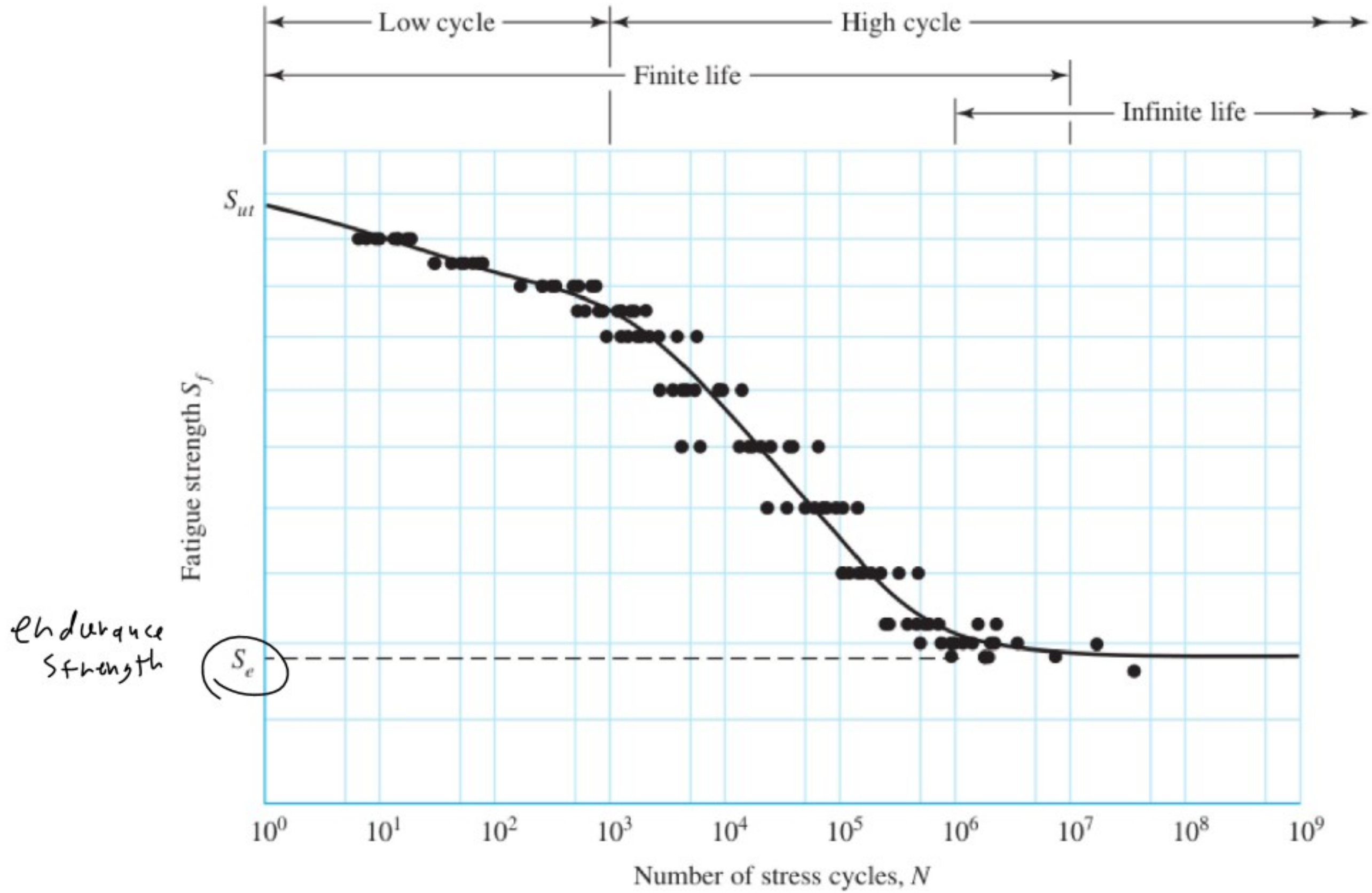
$$\sigma_a = \frac{|\sigma_{\max} - \sigma_{\min}|}{2}$$

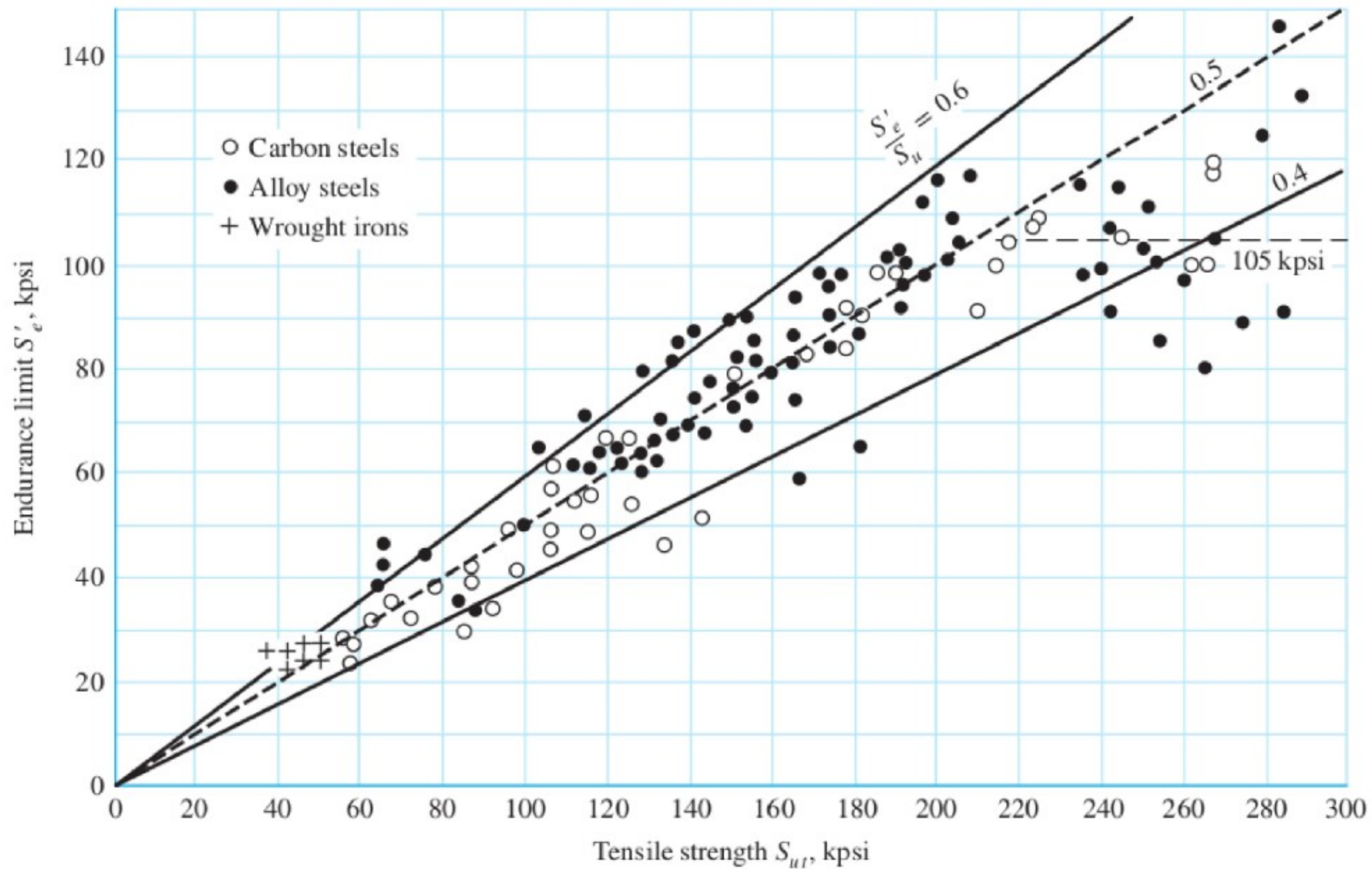
alternating stress

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

mean stress







$$S_e' = \begin{cases} 0.5 S_{ut} & S_{ut} \leq 200 \text{ kpsi (1400 MPa)} \\ 100 \text{ kpsi} & S_{ut} > 200 \text{ kpsi} \\ 7.00 \text{ MPa} & S_{ut} > 1400 \text{ MPa} \end{cases}$$

when $10^3 \leq N \leq 10^6$

$$S_f = a N^b$$

$$N = \left(\frac{\sigma_{ar}}{a} \right)^{1/b}$$

σ_{ar} (completely reversed stress amp ($\sigma_m = 0$))

Marin Factors

$$S_e = k_a k_b k_c k_d k_e S'_e$$

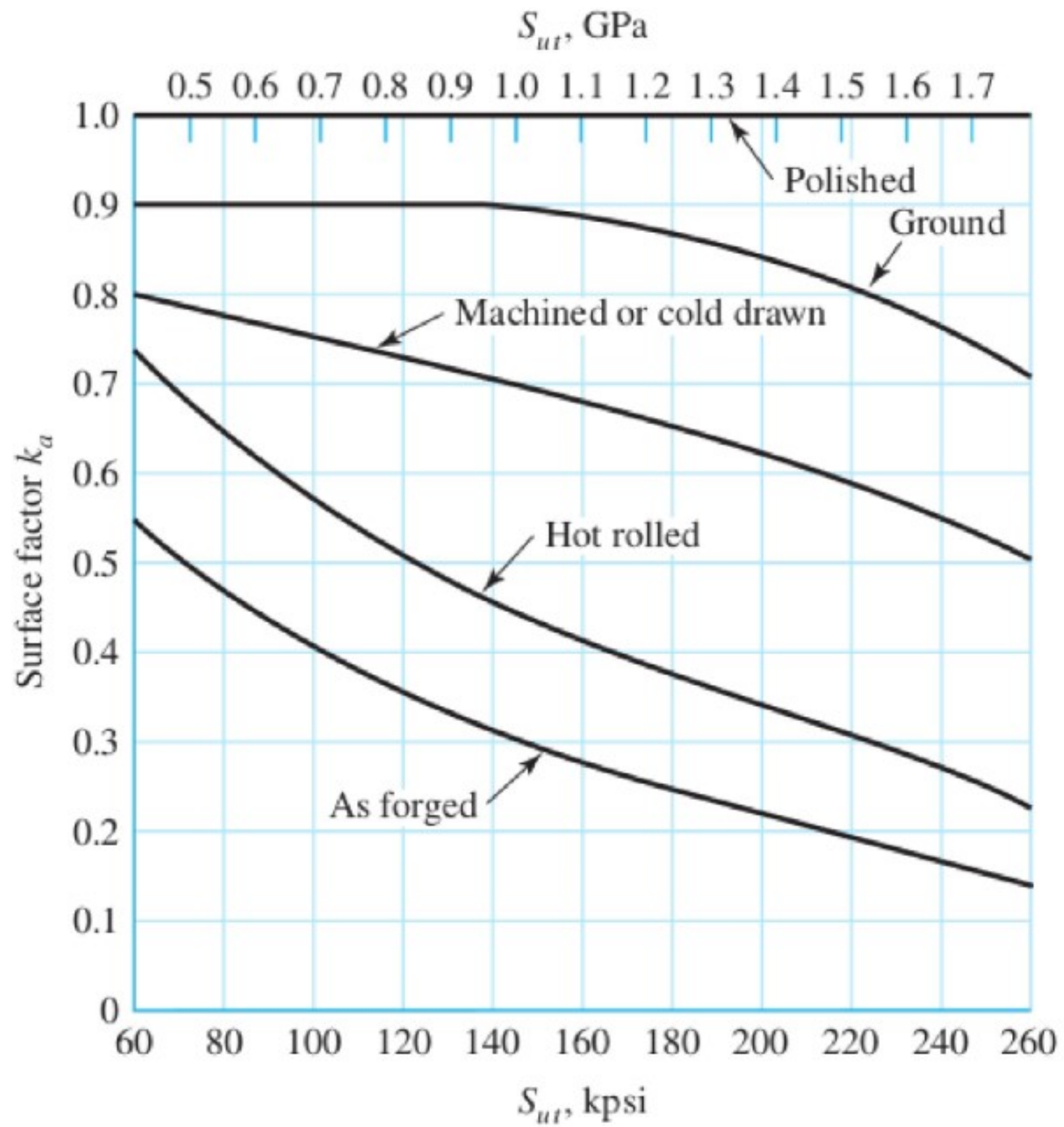


Fig 6-24

$$K_b = \begin{cases} (d/0.3)^{-0.107} = 0.879 d^{-0.107} & 0.3 \leq d \leq 2 \text{ in} \\ 0.91 d^{-0.157} & 2 < d \leq 10 \text{ in} \\ (d/7.62)^{-0.107} = 1.29 d^{-0.107} & 7.62 \leq d \leq 51 \text{ mm} \\ 1.51 d^{-0.157} & 51 < d \leq 254 \text{ mm} \end{cases}$$

For Bending and Torsion

For axial loading $K_b = 1$

Table 6-3 equivalent diameters

$$K_c = \begin{cases} 1 & \text{bending} \\ 0.85 & \text{axial} \\ 0.59 & \text{torsion} \end{cases}$$

$$K_d = \begin{matrix} S_{RT} & \text{Ultimate} & \text{Strength} & \text{at} & \text{room} & \text{temp} \\ S_T & \text{Ultimate} & \text{Strength} & \text{at} & \text{temp} \end{matrix}$$

$$K_d = \frac{S_T}{S_{RT}}$$

$$\frac{S_T}{S_{RT}} = 0.98 + 3.5 \times 10^{-4} T_F - 6.3 \times 10^{-7} T_F^2$$

$$= 0.99 + 5.9 \times 10^{-4} T_C - 2.1 \times 10^{-6} T_C^2$$

Reliability, %	Transformation Variate z_a	Reliability Factor k_e
50	0	1.000
90	1.288	0.897
95	1.645	0.868
99	2.326	0.814
99.9	3.091	0.753
99.99	3.719	0.702

table 6-4

