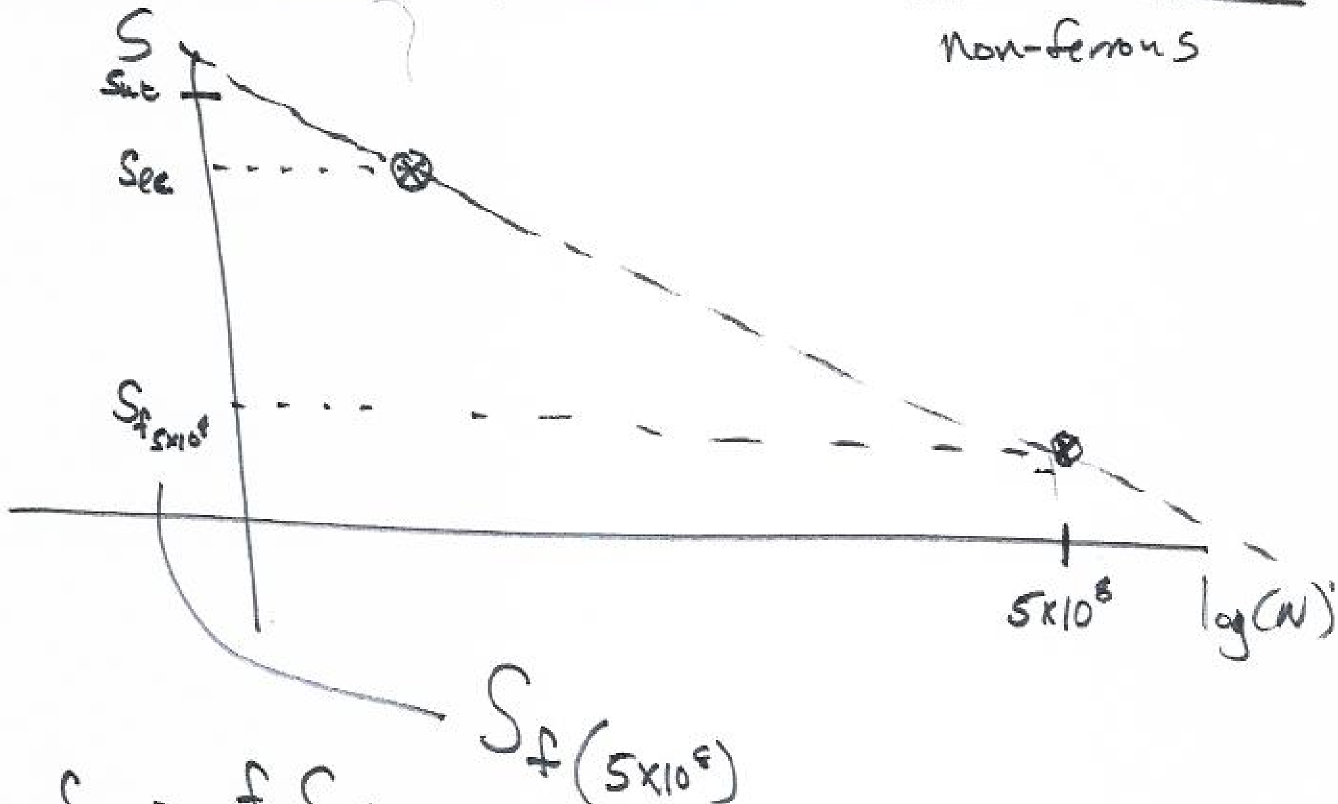
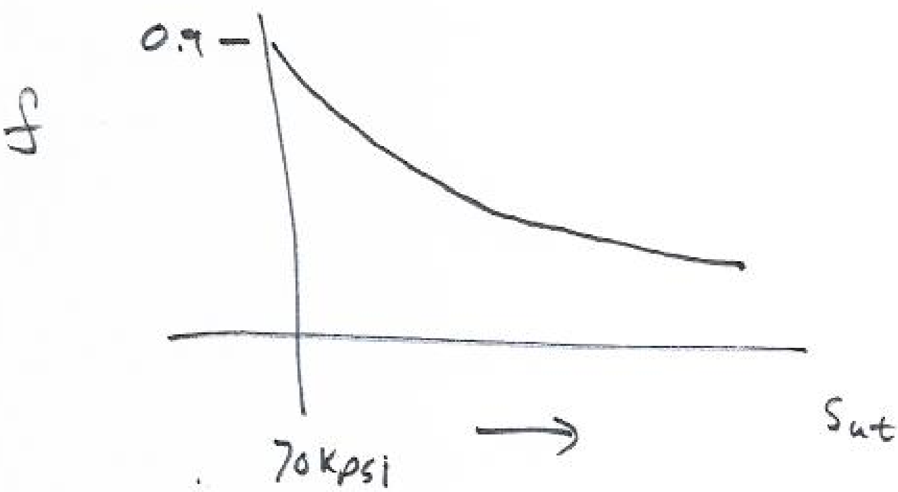
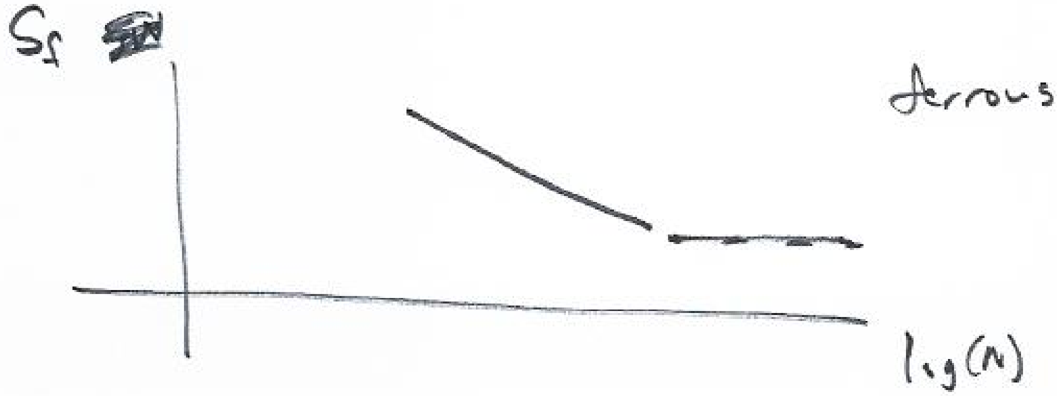
Non-ferrous

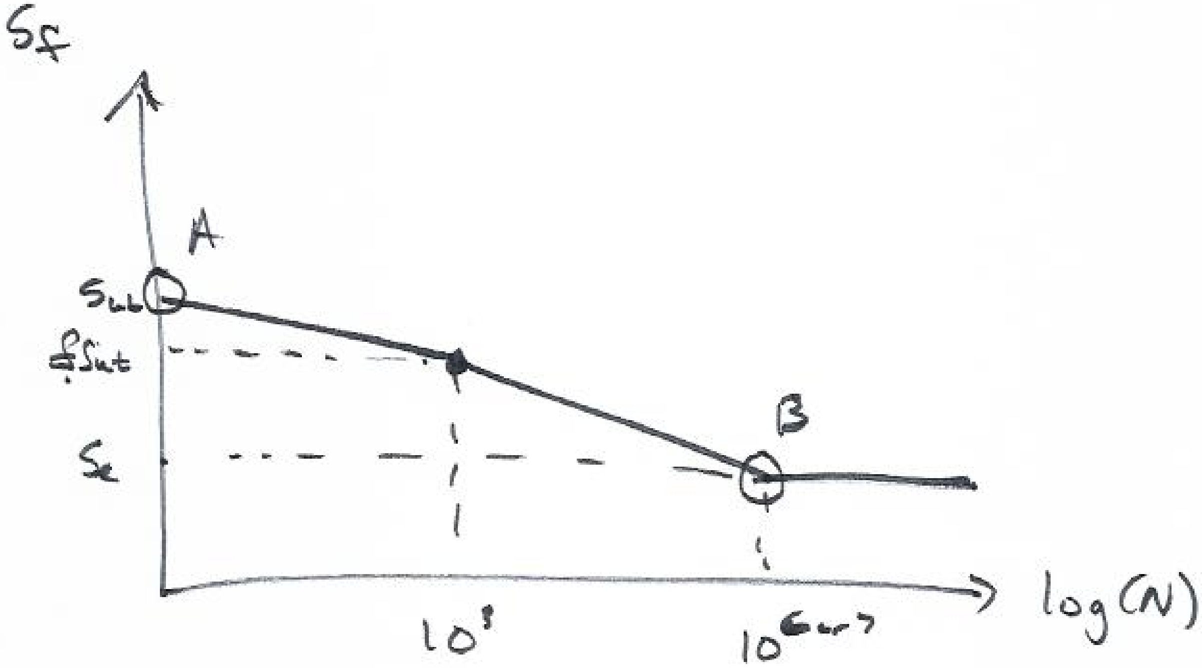


$S_{ee} = f\, S_{ut}$

↳ $f = 0.9$ if $S_{ut} < 70$ kpsi







f(point A, point B)

Steps for fatigue design

1. Determine S_e' from test data or

$$S_e' = \begin{cases} 0.5\, S_{ut} & \text{if } S_{ut} \leq 200\,\text{kpsi } (1400\,\text{MPa}) \\ 100\,\text{kpsi } (700\,\text{MPa}) & \text{if } S_{ut} > 200\,\text{kpsi } (1400\,\text{MPa}) \end{cases}$$

2. Find S_e using Marin modifying parameters

$$S_e = k_a k_b k_c k_d k_e k_f S_e'$$

Surface Finish

$k_a = a\, S_{ut}^{\,b}$ Table 6-2

Size

bending/torsion

$$k_b = \begin{cases} 0.879\, d_e^{-0.107} & 0.11 \leq d \leq 2\,\text{in} \\ 0.91\, d_e^{-0.157} & 2 \leq d \leq 10\,\text{in} \end{cases}$$

Axial: $k_b = 1$

$d_e \Rightarrow$ effective diameter (needed for odd shapes or non-rotating)

Load

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

Temp

Table 6-4 $\quad k_d = 1$ for room temp

or use eq

Reliability

k_e from Table 6-5

Stress Con. Factors

smaller than the static stress con. factors

$$K_f = 1 + q(K_t - 1) \qquad K_{fs} = 1 + q(K_{ts} - 1)$$

↳ static stress con. fac

q : notch sensitivity figs 6-20 or 6-21

$$\sigma = K_f \sigma_o \quad \text{or} \quad \tau = K_{fs} \tau_o$$

equivalent but use above!

$$k_f = \frac{1}{K_f}$$

Low Cycle Limit (10^3)

$S_{ec} = f\, S_{ut}$ $\qquad f$: from test data or Fig 6-16

$f = 0.9$ if $S_{ut} < 70$ kpsi

High Cycle

$$S_f = a N^b \quad \text{or} \quad N = \left(\frac{\sigma_{rev}}{a}\right)^{1/b}$$

where $a = \frac{(f S_{ut})^2}{S_e}$ $\qquad b = -\frac{1}{3}\log\left(\frac{f S_{ut}}{S_e}\right)$

Fluctuating Stress

Find σ_m and σ_a (K_f must be applied to both!)

$$\sigma_m = \frac{(\sigma_{max} + \sigma_{min})}{2} \qquad \sigma_a = \frac{|\sigma_{max} - \sigma_{min}|}{2}$$

Apply failure criteria for tension:

modified Goodman

$$\frac{\sigma_a}{S_e} + \frac{\sigma_m}{S_{ut}} = \frac{1}{n} \quad \text{if } \sigma_m \geq 0$$

or Gerber line

$$\frac{n\sigma_a}{S_e} + \left(\frac{n\sigma_m}{S_{ut}}\right)^2 = 1 \quad \text{if } \sigma_m \geq 0$$

or compression:

$$\sigma_a = \frac{S_e}{n} \quad \text{if } \sigma_m < 0$$

also check for yielding:

$$\sigma_a + \sigma_m = \frac{S_y}{n}$$

$$\tau_a + \tau_m = 0.5777 \frac{S_y}{n}$$

Note that for torsion:

$K_c = 0.59$, $S_{su} = 0.67 S_{ut}$, $S_{sy} = 0.577 S_y$

↑ marin par. ↑ Joerres correction ↑ Distortion energy theory

Finite life

Mod. Goodman

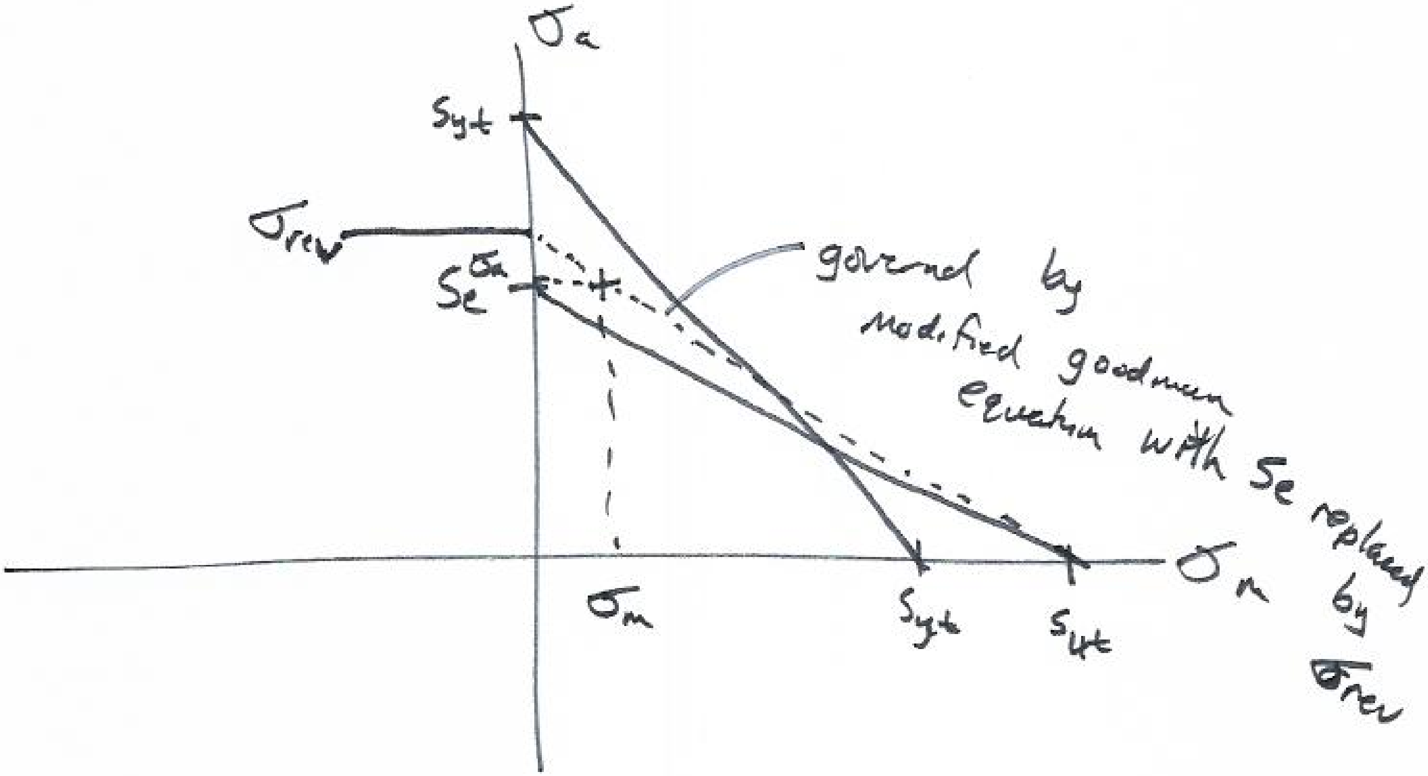
$$\sigma_{rev} = \frac{\sigma_a}{1 - (\sigma_m / S_{ut})}$$

Gerber

$$\sigma_{rev} = \frac{\sigma_a}{1 - (\sigma_m / S_{ut})^2}$$

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

(n = F.o.S)



σ_{rev} : equivalent fully reversed stress for that particular σ_m and σ_a in the finite life area