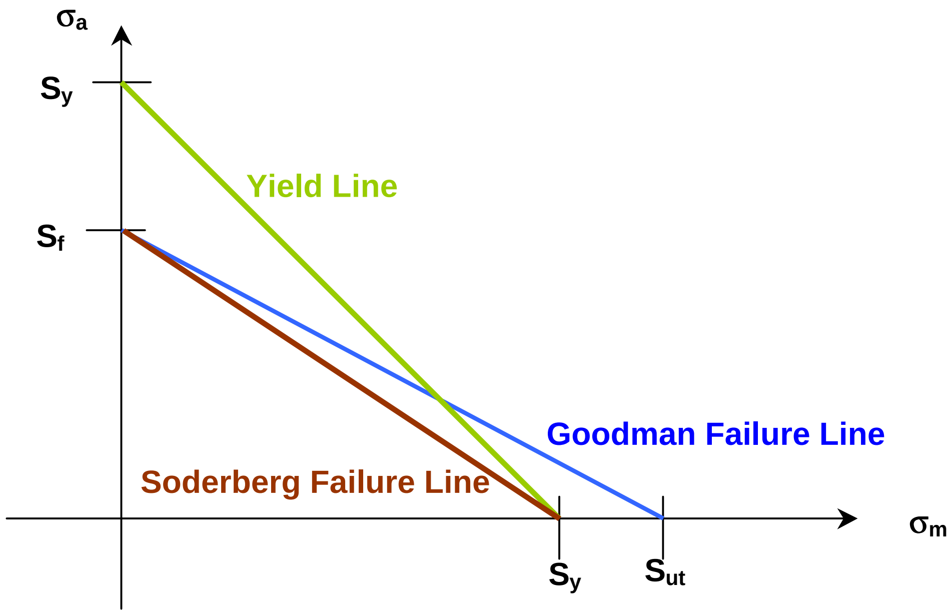
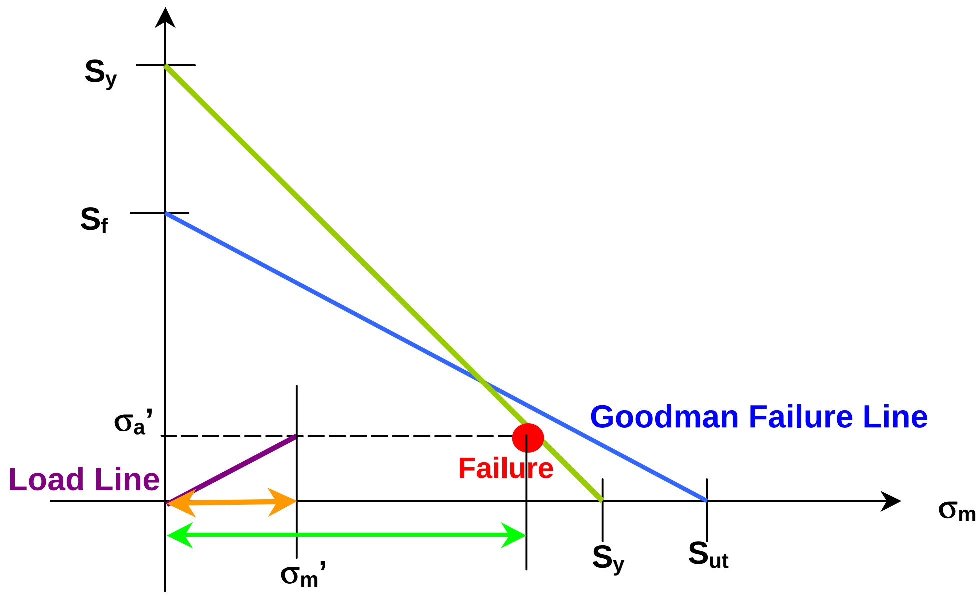
Goodman and Soderberg Failure Criteria



Soderberg	*Goodman*
$m s_m + b = s_a$	$m s_m + b = s_a$
$m(0) + b = S_f$	$m(0) + b = S_f$
$m(S_y) + b = 0$	$m(S_{ut}) + b = 0$
$b = S_f$	$b = S_f$
$m = -\dfrac{S_f}{S_y}$	$m = -\dfrac{S_f}{S_{ut}}$
$-\dfrac{S_f}{S_y} s_m + S_f = s_a$	$-\dfrac{S_f}{S_{ut}} s_m + S_f = s_a$
$S_f\left(1 - \dfrac{s_m}{S_y}\right) = s_a$	$S_f\left(1 - \dfrac{s_m}{S_{ut}}\right) = s_a$

What happens if the alternating stress is low and constant, but the mean stress continues to increase ?



The ratio of to is the factor of safety

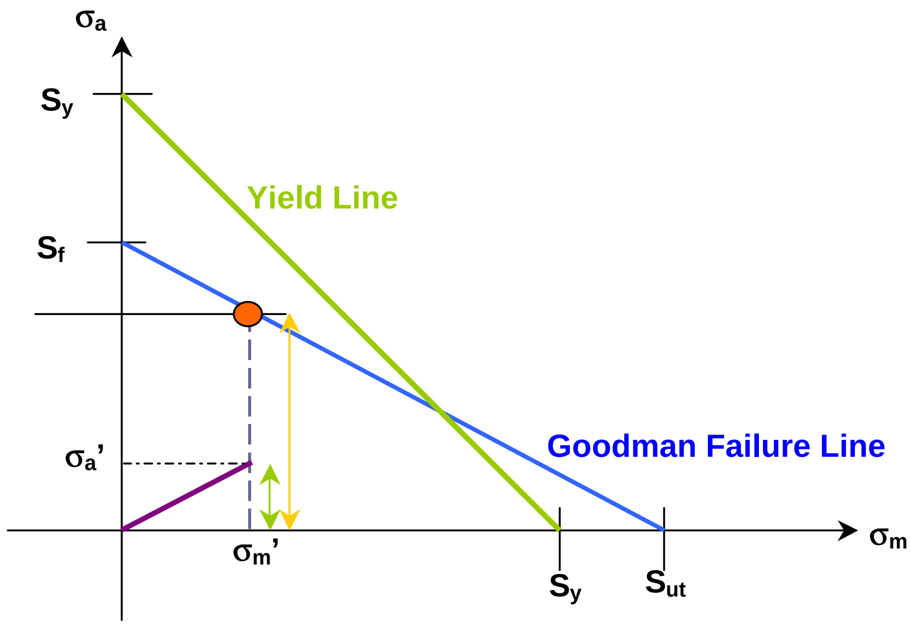
$$-s_m + S_y = s'_a$$

$$(equation\ of\ \ yield\ \ line)$$

$$s_m = -s'_a + S_y$$

$$n = \frac{s_m}{s'_m}$$

Vary alternating stress and hold mean stress constant

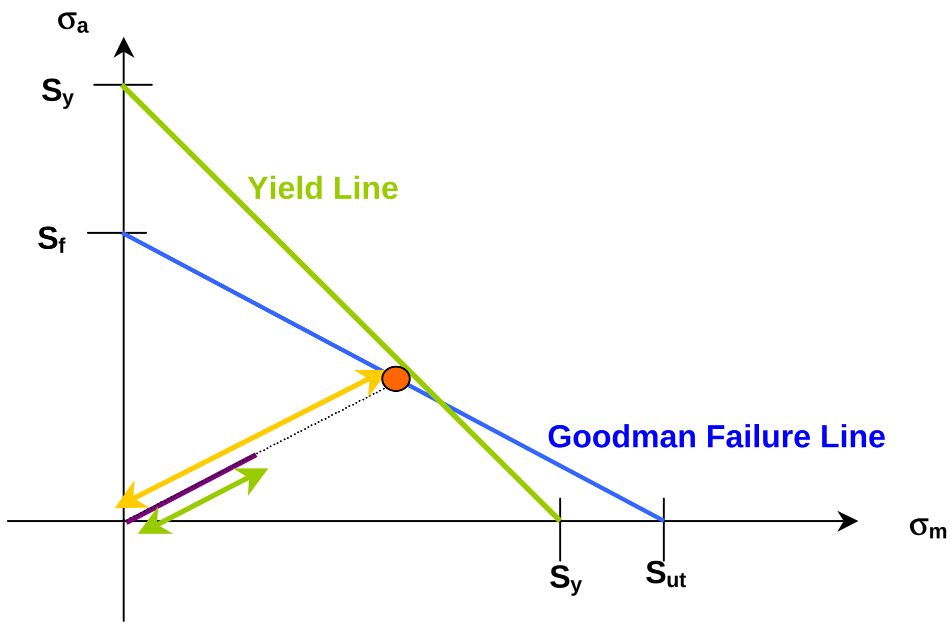


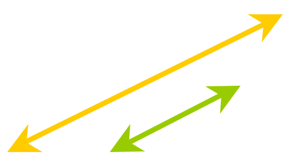
$$S_f\left(1-\frac{s'_m}{S_{ut}}\right)=s_a$$

$$n=\frac{s_a}{s'_a}$$

ratio of **to** **is the factor of safety**

maintain load line ratio, increase alternating and mean stresses





$$\frac{s'_a}{s'_m} s_m = S_f\left(1 - \frac{s_m}{S_{ut}}\right)$$

$$s_m\left(\frac{s'_a}{s'_m} + \frac{S_f}{S_{ut}}\right) = S_f$$

$$s_m = \frac{S_f}{\left(\frac{s'_a}{s'_m} + \frac{S_f}{S_{ut}}\right)}$$

$$n = \frac{s_m}{s'_m}$$

Given the following information, construct a Goodman Failure Diagram and determine factors of safety considering constant alternating stress and increasing mean stress, constant mean stress and increasing alternating stress, and increasing mean and alternating stress with a constant load line slope.

σ_a' = 8.72 ksi
σ_m' = 10.5 ksi
S_{ut} = 80 ksi
S_y = 60 ksi
S_f = 21.8 ksi