6-56

$$\sigma_m' = \sqrt{\left[K_{f_B}\sigma_{m_B} + K_{f_{ax}}\sigma_{ax}\right]^2 + 3\left[K_{fs_t}\tau_{tor}\right]^2}$$

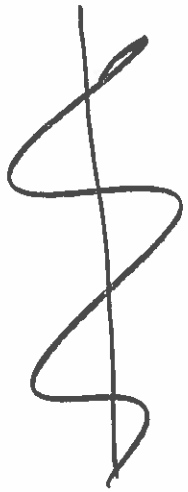
$$S_e = K_c S_e'$$

6-55

σ_a'

$$K_{f_{ax}}\frac{\sigma_{av}}{0.85}$$

→ K_c for axial

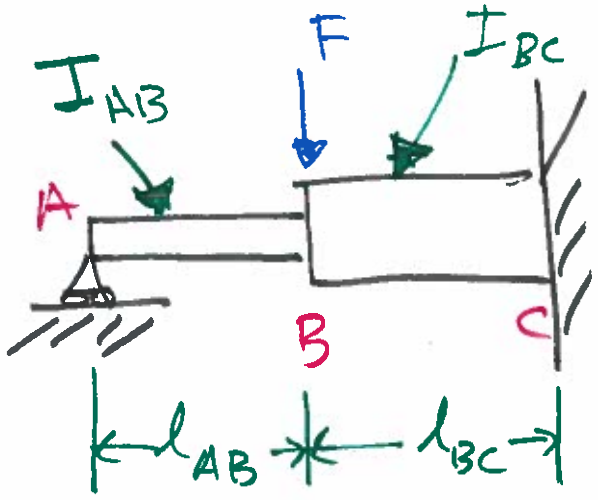


$$\frac{1}{n} = \frac{\sigma_m'}{S_{[illegible]t}} + \frac{\sigma_a'}{S_{[illegible]e}}$$

U: Strain energy

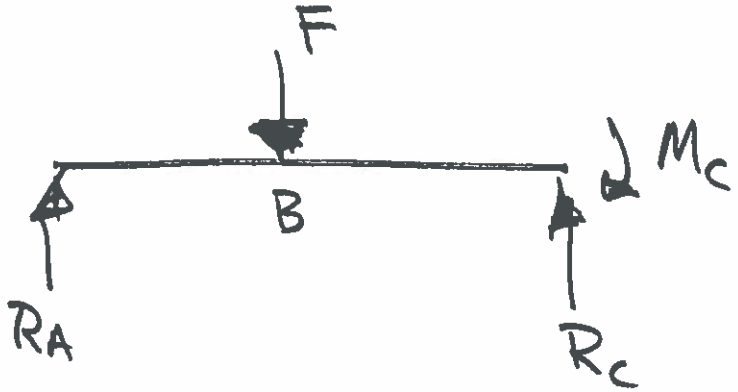
Castigliano's theorem: $y = \frac{\partial U}{\partial Q}$

U: total strain energy; Q: load; y: deflection in direction of load



What is the vertical deflection at the load F?

assume that neglect transverse shear



$\Sigma F = 0$: $R_A + R_C - F = 0$

$\Sigma M_a = 0$: $M_C + R_A(l_{AB} + l_{BC}) - F(l_{BC}) = 0$

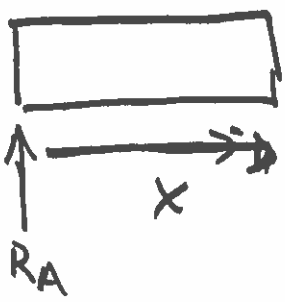
} 3 unknowns, 2 equations → Statically indeterminate

$$y_A = 0 = \frac{\partial U}{\partial R_A} \Rightarrow 3^{rd} \text{ eq.}$$

make use of Castigliano's theorem to have 3rd eq.

Take x from the rhs of beam.

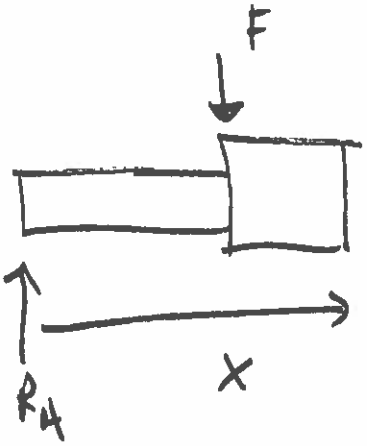
(1)



$V_{AB} = R_A$

$M_{AB} = R_A x$

(2)



$V_{BC} = R_A - F$

$M_{BC} = R_A x - F(x - l_{AB})$

$$y_A = 0 = \frac{\partial U}{\partial R_A} = \overset{①}{\int_0^{l_{AB}} \frac{1}{E I_{AB}} \left(M_{AB} \frac{\partial M_{AB}}{\partial R_A} \right) dx}$$

$$+ \overset{②}{\int_{l_{AB}}^{l_{AB}+l_{BC}} \frac{1}{E I_{BC}} \left(M_{BC} \frac{\partial M_{BC}}{\partial R_A} \right) dx}$$

Solve for R_A:

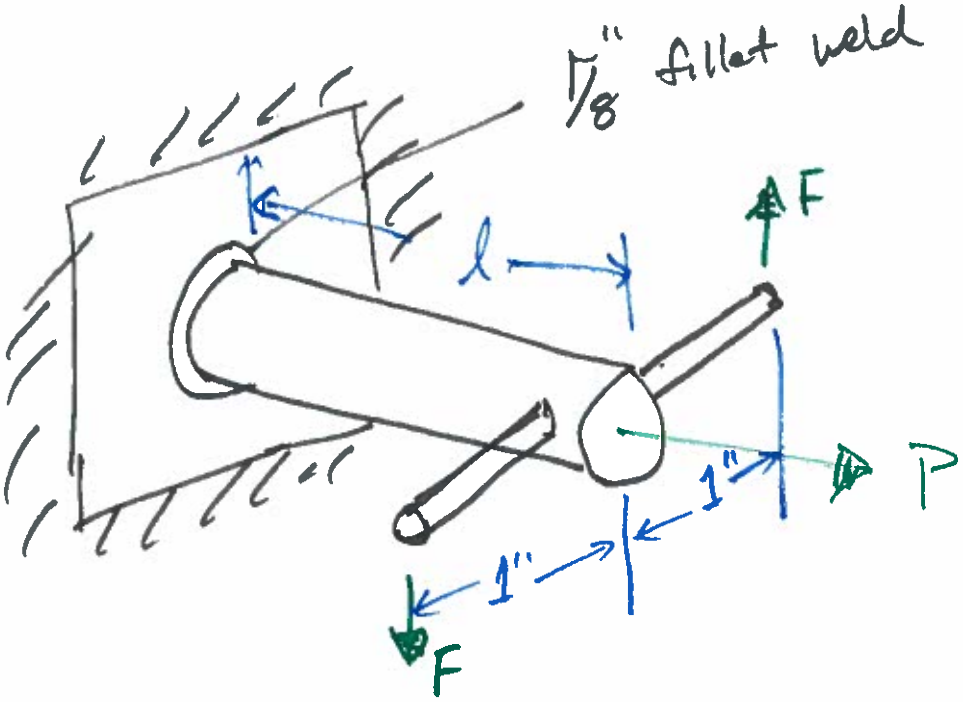
$$R_A = \frac{F I_{AB} \left[l_{AB}^3 - 3 l_{AB} (l_{AB} + l_{BC})^2 + 2(l_{AB} + l_{BC})^3 \right]}{2\left(-I_{AB} l_{AB}^3 + I_{AB} (l_{AB} + l_{BC})^3 + I_{BC} l_{AB}^3 \right)}$$

Deflection at B (where F is applied)

$$y_B = \frac{\partial U}{\partial F} = \int_0^{l_{AB}} \frac{1}{E I_{AB}} \left(M_{AB} \frac{\partial M_{AB}}{\partial F} \right) dx +$$

$$\int_{l_{AB}}^{l_{AB}+l_{BC}} \frac{1}{E I_{BC}} \cdot \left(M_{BC} \frac{\partial M_{BC}}{\partial F} \right) dx$$

calculate integral to find deflection.



AISI 1020 HR Steel

$K_{ts} = 1.6$
$K_t = 1.3$
} would com from literature or testing yourself

$l = 2$ ft

F = cycles from 150 to 500 lb
P = cycles from 600 to 800 lb
} in phase

How many cycles to failure?

1) S_{ut}, S_{yt} for AISI 1020 HR Steel

2) $S_e' = ?$ $S_e' = 0.5\ S_{ut}$ if $S_{ut} < 200$ kpsi

$S_e' = 100$ kpsi if $S_{ut} > 200$ kpsi

3) Marin parameters

$k_a \Rightarrow$ surface finish

$k_b \Rightarrow$ size factor

$k_c \Rightarrow$ 1 (but use compounding loading stress equations)

$k_d, k_e, k_f = 1$

4) ~~Calculate~~ Calculate F_a, F_m, P_a, P_m

5) Find ~~nominal~~ nominal stresses.

σ_o, τ_o

6) Find stress concentrations...

$q \Rightarrow$ notch sensitivity (use 1/8" for the weld dimension)

K_t

⋮