EME 150A FALL 2015 LECTURE 27 Dec 2

Final Exam

Friday, 11th 10:30-12:30

- Same style as the midterm
- T/F, MC, Short Ans, Long Ans
- Comprehensive: Focused on things after midterm
- Equation sheet provided before the exam
- pencil / non-programable calculator and rulers/protractors/compass
- no notes, no book
- review notes, book sections, homework

4-1 to 4-13

5-1 to 5-11, 5-13

6-1 to 6-4, 6-7 to 6-15

6-12: Langer line (yielding) and modified Goodman

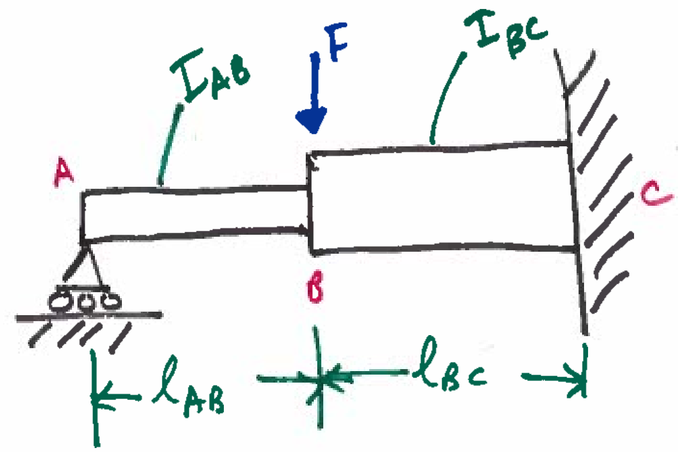
+ sections for midterm

Requested Review Topics

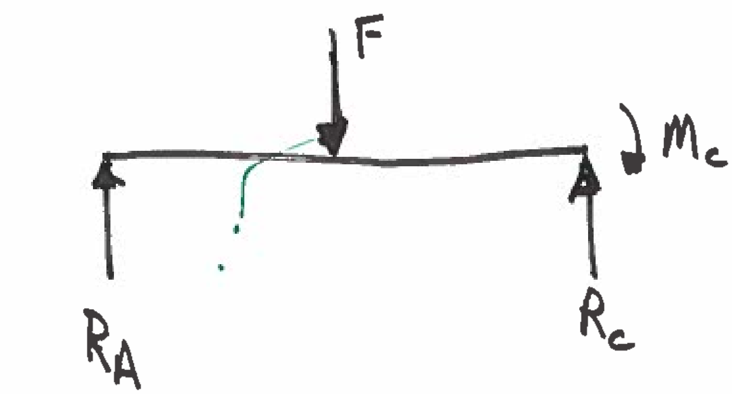
fluctuating stress	6
strain energy deflectoin	5
compound loading	5
brittle fracture	3
fatiigue	3
non ferrous fluctutating stress	2
fatigue stress concentraion	2
bucklng	2
stress cube/multi axial	2
FoS for fatigue	1
transverse shear stress (Q)	1
finite life fluctuating stress	1
compound stress strain	1
statically indeterminant	1
probability	1
conceptual questions	1
cumlative loading	1
curved beam	1
kf marin	1
material after midterm	1
sample problems	1
static failure theories	1
equation sheet	1

Ex

What is the deflection at point B?



FBD



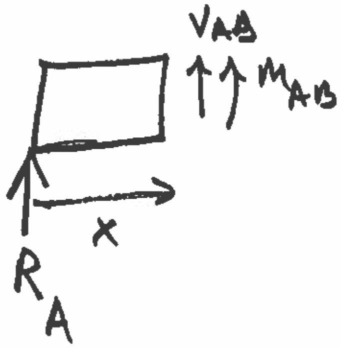
$$\left.\begin{aligned} \Sigma F = 0: &\quad R_A + R_c - F = 0 \\ \Sigma M_c = 0: &\quad M_c + R_A(l_{AB} + l_{BC}) - F(l_{BC}) = 0 \end{aligned}\right\}$$

3 unknowns only 2 equations

$$y_A = 0 = \frac{\partial U}{\partial R_A}$$

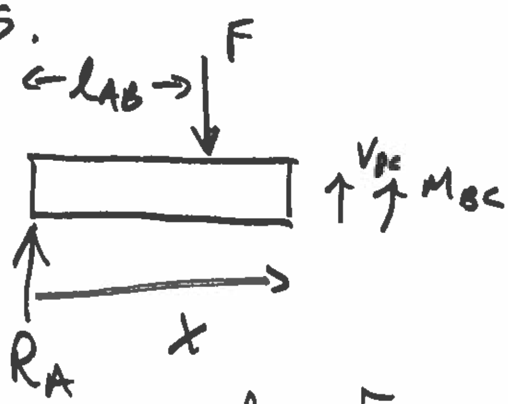
Castigliano's thereom to get a ~~se~~ third equation

Take x from the lhs can avoid dealing reactions @ rhs.



$$V_{AB} = R_A$$

$$M_{AB} = R_A x$$



$$V_{BC} = R_A - F$$

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

Neglect shear: long slender beam the stress/strain due to bending dominates.

$$y_A = 0 = \frac{\partial U}{\partial R_A} = \int^{l_{AB}} \frac{1}{EI_{AB}} \left(M_{AB} \frac{\partial M_{AB}}{\partial R_A} \right) dx$$

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

$$0 = \int_0^{l_{AB}} \frac{R_A x^2}{EI_{AB}} dx + \int_{l_{AB}}^{l_{AB}+l_{BC}} \frac{x\left[F(l_{AB} - x) + R_A x\right]}{EI_{BC}} dx$$

Solve for R_A!

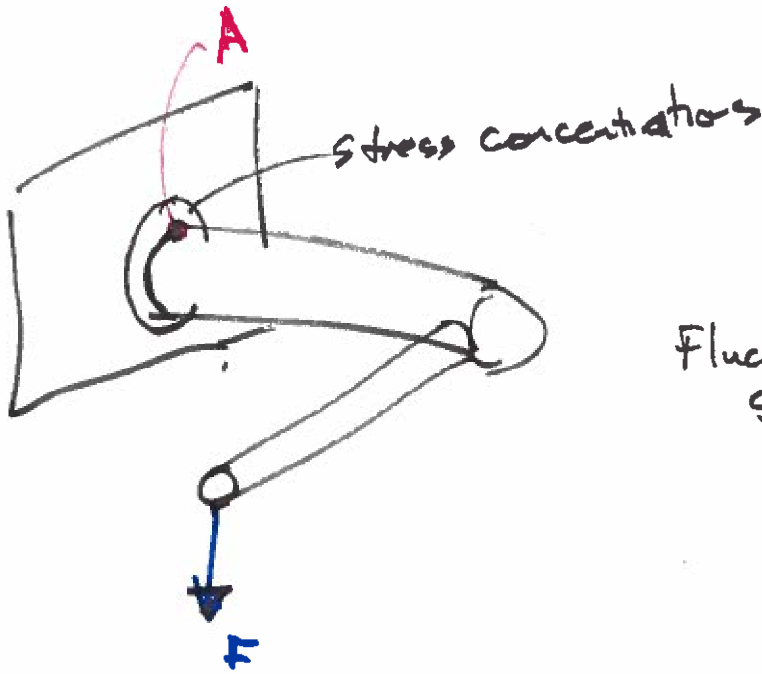
$$R_A = \frac{F I_{AB}\left[l_{AB}^3 - 3 l_{AB}(l_{AB}+l_{BC})^2 + 2(l_{AB}+l_{BC})^3\right]}{2\left(-I_{AB} l_{AB}^3 + I_{AB}(l_{AB}+l_{BC})^3 + I_{BC} l_{AB}^3\right)}$$

<u>Deflection @ B</u>

$$y_B = \frac{\partial U}{\partial F} = \cancelto{0}{\int_0^{l_{AB}} \frac{1}{EI_{AB}}\left(M_{AB}\frac{\partial M_{AB}}{\partial F}\right)dx} + \int_{l_{AB}}^{l_{AB}+l_{BC}} \frac{1}{EI_{BC}}\left(M_{BC}\frac{\partial M_{BC}}{\partial F}\right)dx$$

$$y_B = \int_{l_{AB}}^{l_{AB}+l_{BC}} \frac{(l_{AB}-x)\left[-F(x-l_{AB}) + R_A x\right]}{EI_{BC}}\,dx$$

$$\boxed{y_B = \frac{F l_{AB}^2 l_{BC}\left(3 I_{AB} l_{BC} + 4 I_{BC} l_{AB}\right)}{12 EI_{BC}\left(3 I_{AB} l_{AB}^2 l_{BC} + 3 I_{AB} l_{AB} l_{BC}^2 + I_{AB} l_{BC}^3 + I_{BC} l_{AB}^3\right)}}$$



Fluctuating stress

Find state of stress @ $\underline{\underline{A}}$

Torsional shear τ_{max} τ_{min}

Bending normal σ_{max} σ_{min}

σ_A, σ_m

- stress concentration factors
- Endurance limit
- von mises fluctuating stress
- modified Goodman to check for failure

$$K_f \quad K_{fs} =$$

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

notch size 1/8" weld

$$\sigma_a = K_f \sigma_{ao} \qquad \sigma_m = K_f \sigma_{mo}$$

$$\tau_a = K_{fs} \tau_{ao} \qquad \tau_m = K_{fs} \tau_{mo}$$

$$\left\{ \begin{array}{l} k_a \Rightarrow \text{surface finish} \\ k_b \Rightarrow \text{size} \end{array} \right.$$

$k_c \Rightarrow$ don't use it

$$\sigma_a' = \left[\sigma_a^2 + 3(\tau_a)^2\right]^{1/2}$$

$$\sigma_m' = \left[\sigma_m^2 + 3(\tau_m)^2\right]^{1/2}$$

$$\frac{\sigma_a' + \sigma_m'}{\text{yielding}}$$