




Recitation 004

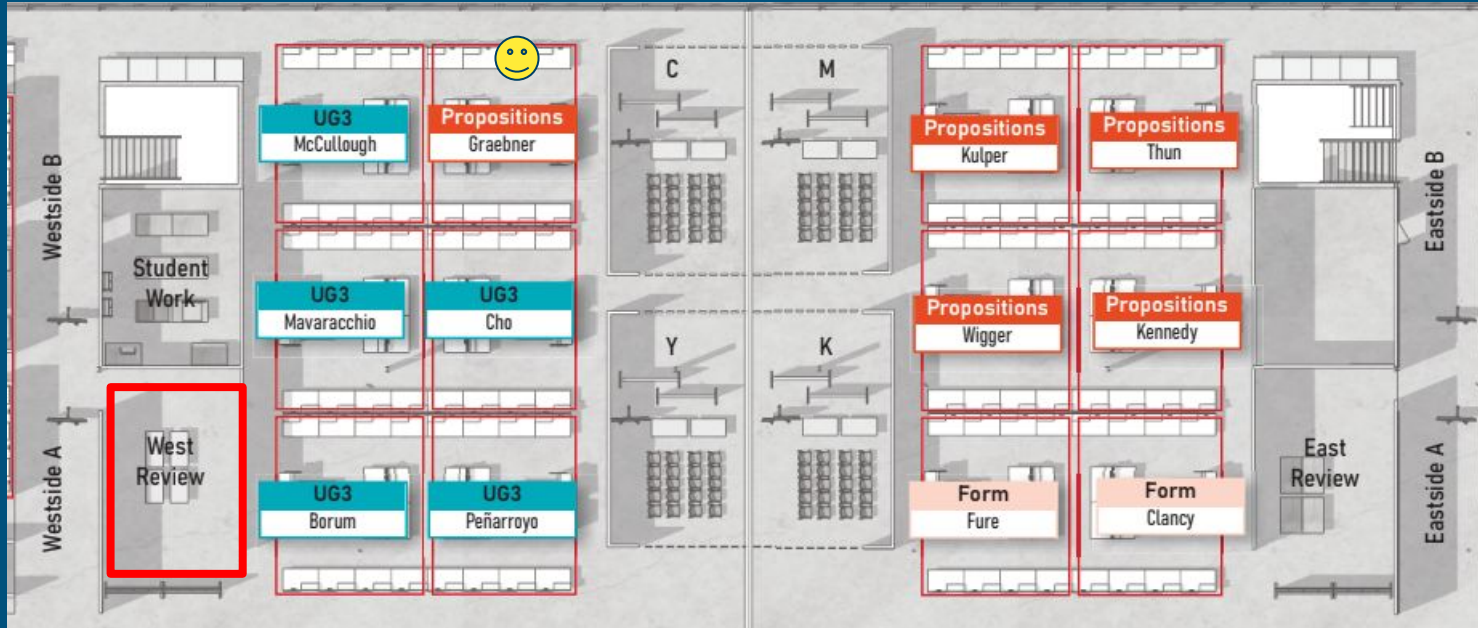
11/01/2024



GSI Info

Aaron Comstock

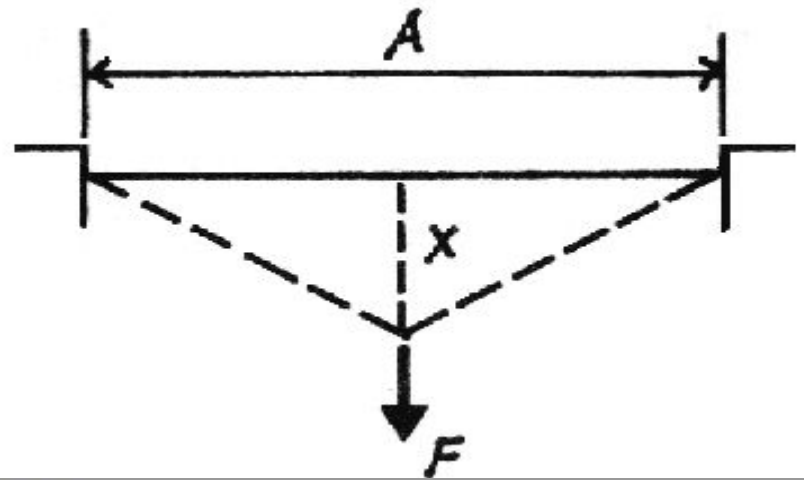
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Questions

Bridge Testing Monday!

HW #10



10. Elastic Deformation

Find the final stretched length of the cable deflected distance x , and the load F needed to cause the deflection. Determine the resulting tensile force in the cable along with the stress and strain.

DATASET: 1

-2-

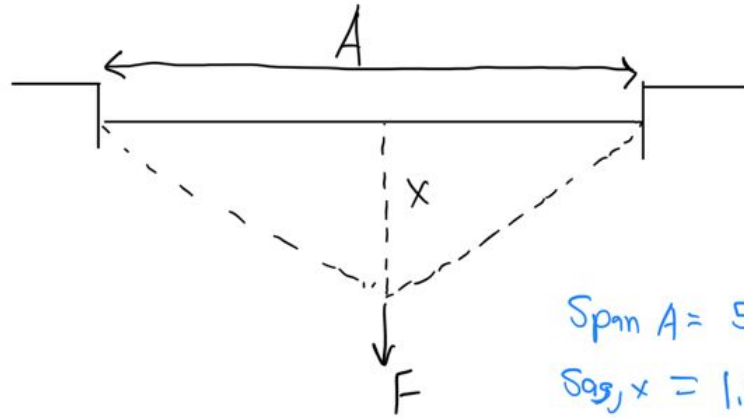
-3-

Span: A	56 FT
Sag: x	1.4 FT
Cable Area	1.191489362 IN ²
Young's Modulus: E	27242 KSI

#

Question

- 1 Final stretched length of the full cable
- 2 Deformation D of full cable
- 3 Force in the stretched cable
- 4 Horizontal component of the force in the cable
- 5 Vertical component of the force in the cable
- 6 Total force F applied to cable
- 7 Stress in the cable
- 8 Strain of the cable



$$\text{Span } A = 56'$$

$$\text{Sag, } x = 1.4'$$

$$\text{Cable Area} = 1.1915 \text{ in}^2$$

$$\text{Young's modulus} = 27242 \text{ ksi}$$

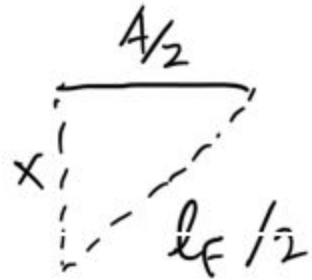
Equations

$$\text{Young's Modulus} = \frac{\text{Stress}}{\text{Strain}} \quad E = \frac{\sigma}{\epsilon}$$

$$\text{Stress} = \frac{\text{force}}{\text{area}} \quad \sigma = \frac{F}{A}$$

$$\text{Strain} = \frac{\text{deformation}}{\text{original length}} \quad \epsilon = \frac{\Delta l}{l_0}$$

1.) Stretched length of the full cable



$$\frac{l_F}{2} = \sqrt{x^2 + (A/2)^2}$$

$$l_F = 2 \sqrt{1.1915^2 + \left(\frac{56'}{2}\right)^2}$$

$$l_F = 56.0507'$$

↑
#1.

2.) Deformation D of full cable

$$D = l_f - l_o = 56.0507' - 56'$$

From #1 ↑

$$= 0.0507'$$

↑ #2

3.) Strain of the Cable

$$\epsilon = \frac{D}{l_0} = \frac{0.0507' \leftarrow \text{From \#2}}{56'} = 0.001249 \text{ kips}$$

\uparrow #8

4.) Stress in the Cable

$$E = \frac{\text{Stress}}{\text{Strain}}$$

$$27242 \text{ ksi} = \frac{\text{stress}}{0.001249}$$

↑ From #8

$$\text{Stress} = 34.0253 \text{ kips}$$

↑ #7

5.) Force in stretched cable

$$\sigma = \frac{F}{A_{ren}}$$

↙ From #7

$$34.0253 \text{ kips} = \frac{F}{1.1914 \text{ in}^2}$$

$$F = 40.5478 \text{ kips}$$

↑ #3

6.) Horizontal Force Component

$$\frac{F_{\#}}{\left(\frac{A}{2}\right)} = \frac{F_c}{\left(\frac{L_c}{2}\right)} \quad \frac{F_{\#}}{\left(\frac{56'}{2}\right)} = \frac{40.5478}{\left(\frac{56.0507'}{2}\right)} = 40.4972 \text{ kips}$$

Annotations:
- Red arrow pointing to 40.5478: From #3
- Red arrow pointing to 56.0507': From #1
- Green arrow pointing to 40.4972 kips: #4

7.) Vertical force Component

$$\frac{F_v}{x} = \frac{F_c}{\left(\frac{L}{2}\right)}$$

$$\frac{F_v}{1.4'}$$

$$= \frac{40.5478}{\left(\frac{56.0507'}{2}\right)}$$

from #1

=

$$2.02485 \text{ kips}$$

from #3

#5

8.) Total Force applied to Cable

$$\sum F_v = 0 = 2(F_v) - F$$

$$F = 2(2.0249) = 4.0497 \text{ kips}$$

↙ From #5 ↘ #6

LAB

