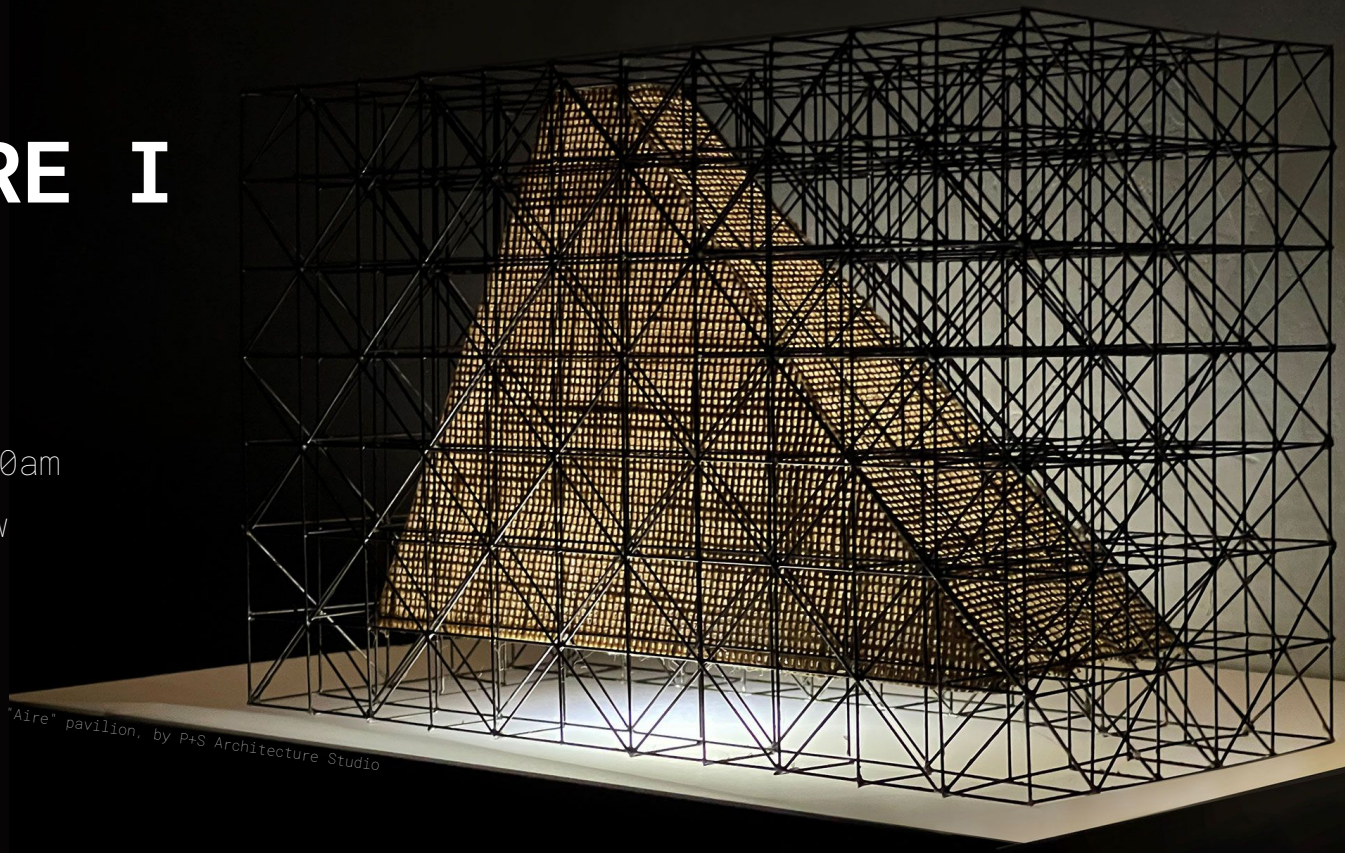
STRUCTURE I

ARCH-314

9:30am - 10:30am

East Review


"Aire" pavilion, by P+S Architecture Studio

Today:

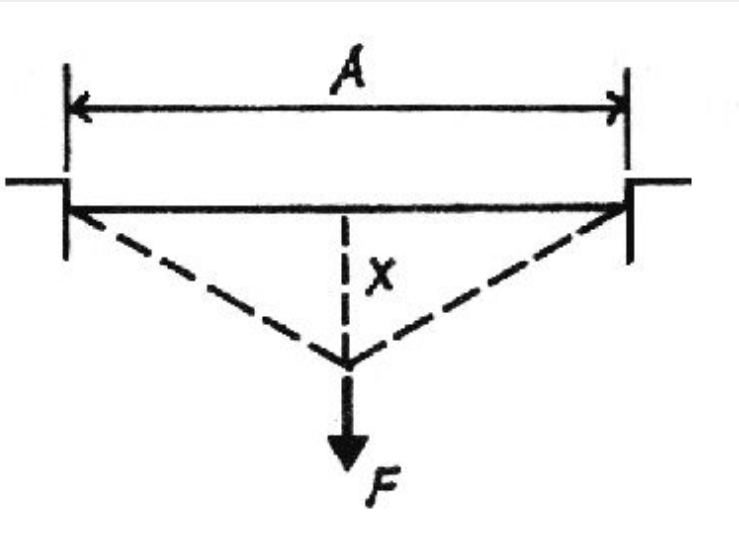
- Problem No.10: Elastic Deformation
- Lab 08: Stress & Strain Elasticity

PROBLEM NO.10

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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI



PROBLEM NO.10

Question 1: **Final stretched length of the full cable**

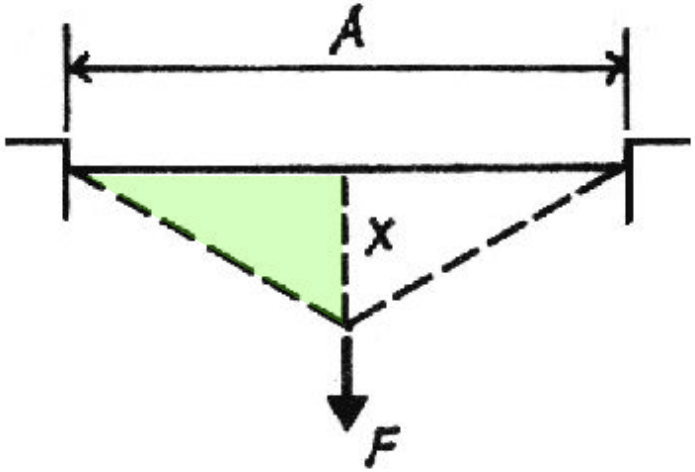
$L = Actual\ Lenght$

$L' = Stretched\ Lenght$

$$L' = \sqrt{X^2 + \left(\frac{A}{2}\right)^2} \times 2$$

$$L' = \sqrt{2.5^2 + \left(\frac{40}{2}\right)^2} \times 2$$

$$L' = 40.31129\ FT$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

PROBLEM NO.10

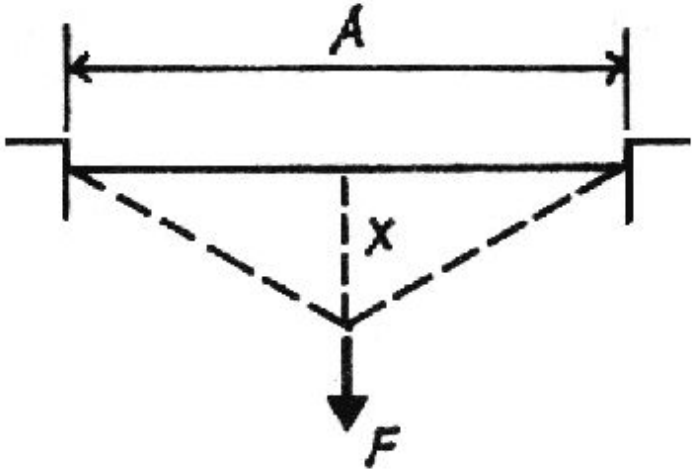
Question 2: **Deformation D of full cable**

$$D = Stretched\ Lenght - Actual\ Lenght$$

$$D = L' - L$$

$$D = 40.31129' - 40'$$

$$\boxed{D = 0.31129\ FT}$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

PROBLEM NO.10

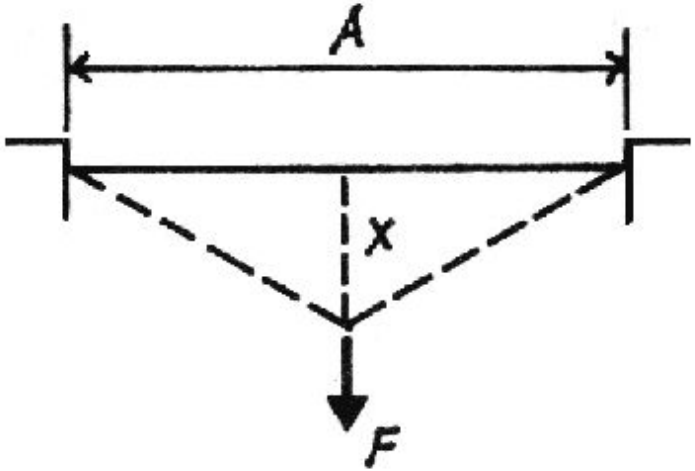
Question 3: **Force in the stretched cable**

$$P = \frac{D \times E \times A}{L}$$

$$P = \frac{Def ormation\ (\ Question2) \times Young's\ Modulus \times Area}{Actual\ Lenght}$$

$$P = \frac{0.31129 \times 23341 \times 0.869565217}{40}$$

$$P = 157.9589\ KIPS$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

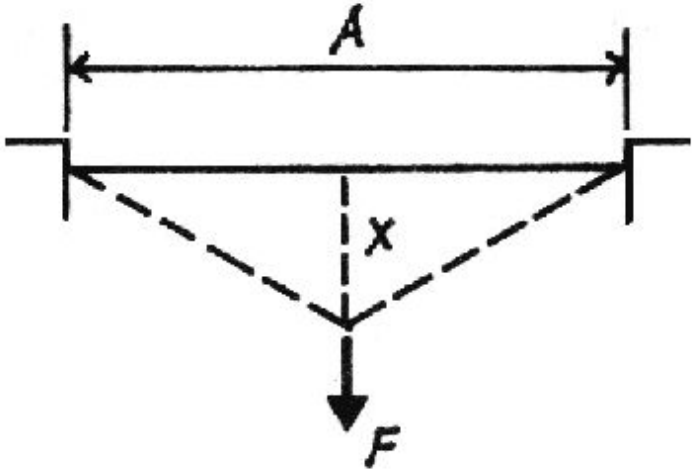
PROBLEM NO.10

Question 4: **Horizontal component of the force in the cable**

$$\frac{P_x}{P(Question3)} = \frac{\frac{L}{2}}{\frac{L'}{2}}$$

$$\frac{P_x}{157.9589} = \frac{\frac{40}{2}}{\frac{40.3113}{2}}$$

$$P_x = 156.739\ KIPS$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

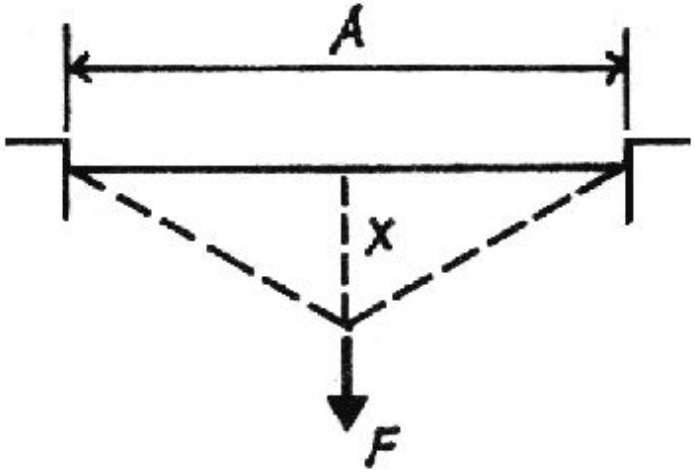
PROBLEM NO.10

Question 5: **Vertical component of the force in the cable**

$$\frac{P_y}{P(Question3)} = \frac{X}{\frac{L'}{2}}$$

$$\frac{P_y}{157.9589} = \frac{2.5}{\frac{40.3113}{2}}$$

$$P_y = 19.592\ KIPS$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

PROBLEM NO.10

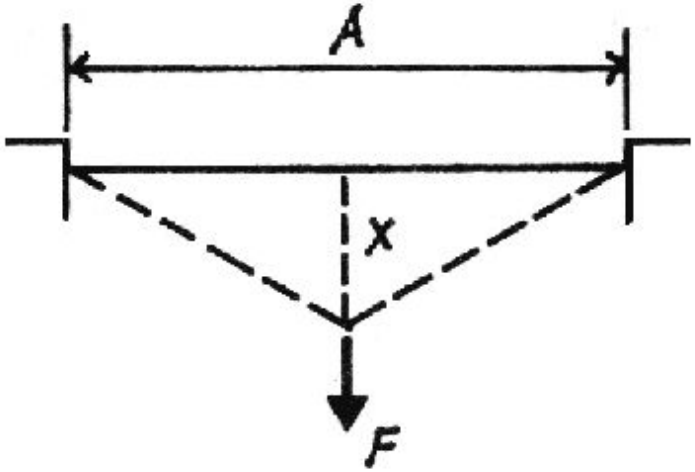
Question 6: **Total force F applied to cable**

$$\sum_{F_V} = 0$$

$$-F + P_y(Question\ 5) + P_y(Question 5) = 0$$

$$F = 19.592 + 19.592$$

$$F = 39.184\ KIPS$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

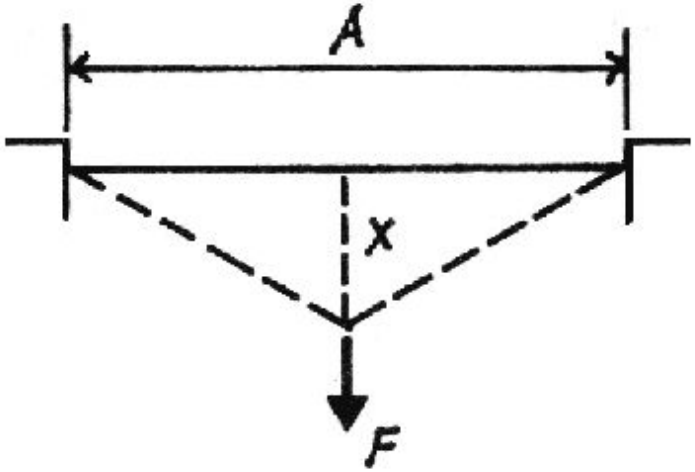
PROBLEM NO.10

Question 7: **Stress in the cable**

$$Stress = \frac{P(\ Question3)}{A(\ Area)}$$

$$Stress = \frac{157.9589}{0.8695}$$

$$Stress = 181.6455\ KSI$$



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	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

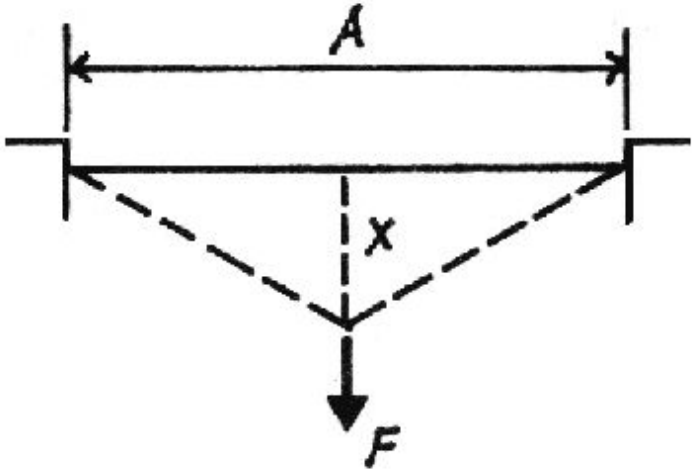
PROBLEM NO.10

Question 8: **Strain of the cable**

$$Strain = \frac{D(\ Question\ 2)}{L(\ Actual\ Lenght)}$$

$$Strain = \frac{0.31129}{40}$$

$$Strain = 0.007782\ \frac{IN}{IN}$$



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.

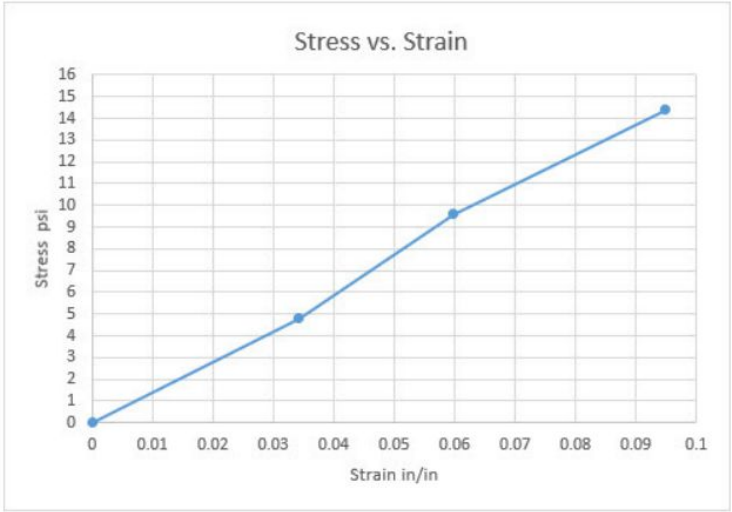
DATASET: 1 -2- -3-

Span: A	40 FT
Sag: x	2.5 FT
Cable Area	0.869565217 IN^2
Young's Modulus: E	23341 KSI

Lab 08: Elastic Deformation

Procedure

1. Pin the large graph paper to the wall.
2. Put a clip on each end of the rubber cord hanging it so that the top clip is at the top of the graph paper. Adjust the bottom clip to the edge of a large, dark square. The larger squares are each ½ inch.
3. Measure the length of the cord between the ends by counting the squares.
4. Hang one weight from the cord.
5. Measure the deformation of the cord (the amount it stretches). Each small square is 0.1 inch.
6. Next hang two weights on the chord and measure the total deformation.
7. Finally hang three weights on the chord and measure the total deformation again.
8. Calculate the stress (f=P/A) and strain (ε=D/L). The area of the 1/8"x1/16" cord is 0.007813 in^2 and each washer weighs ½ oz. = 0.03125 lbs.
9. Plot the stress vs. strain.
10. Find the slope of the line to determine the modulus of elasticity, E = f/ε.



$$Stress = \frac{P(\ Washer\ Weights)}{A(\ Cord\ Area)}$$

$$Strain = \frac{D(\ Cord\ Def\ ormation)}{L(\ Cord\ Actual\ Lenght)}$$

$$Young's\ Modulus = \frac{Stress}{Strain}$$