

Arch314

STRUCTURES I

Fall 2025
Recitation

FACULTY: Prof. Peter von Bülow
Mohsen Vatandoost

Arch314: STRUCTURES I

Welcome to Recitation session 10/31

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Office hours:

Room 3128

Wed: 11:30 – 12:30

Mon, Fri: 11:30 - 12:30

Please feel free to ask questions.

Arch314: STRUCTURES I

Welcome to Recitation session 10/31

Outline:

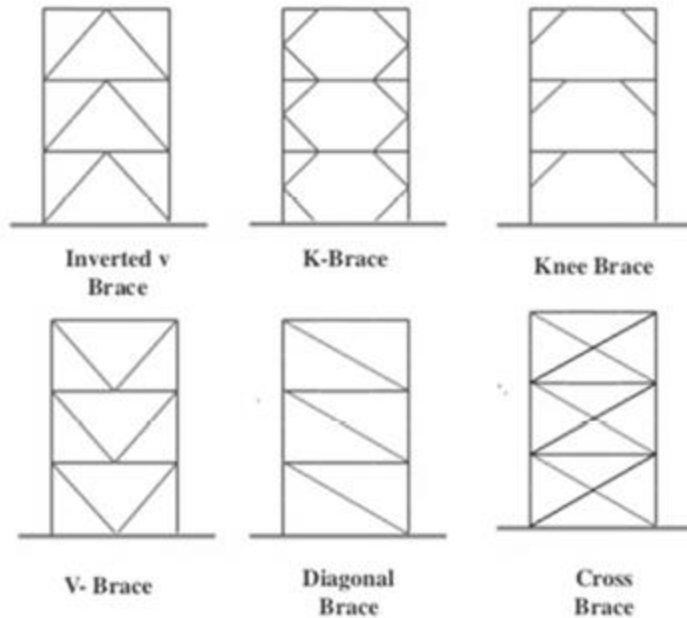
- Quick **Recap** of the week
- Provide the solution for the assignment (**Homework 10**)
- Answering student's questions
- Lab: **Elasticity**
- **Bridge_1** project (Monday is the test day!)

Please feel free to ask questions.

Recap of the week

Frame Bracing

types of bracing

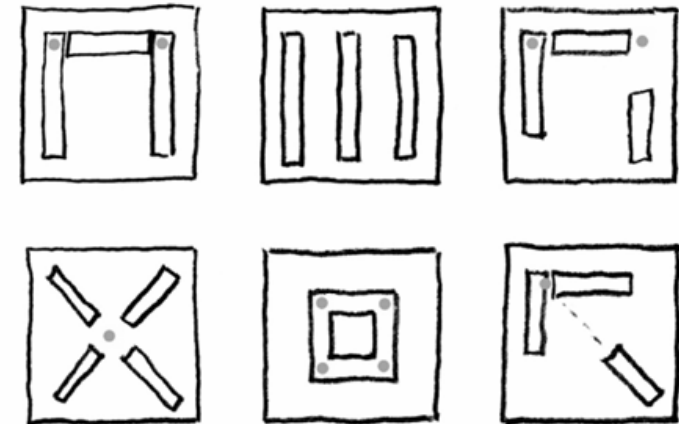


Lateral Force Resistance

Stability requires at least 2 points of intersection.

Force is more evenly resisted with centroid of walls in the kern of slab

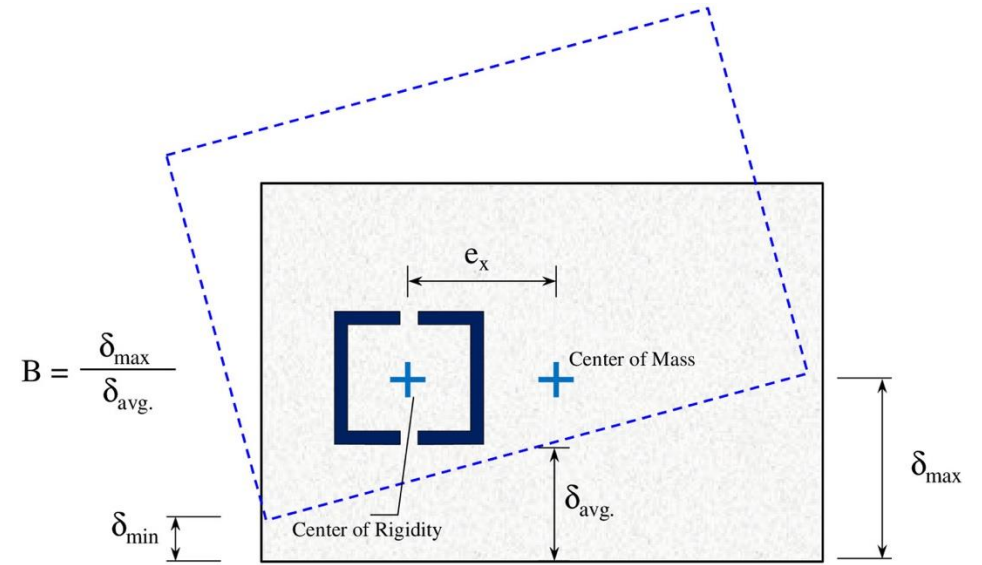
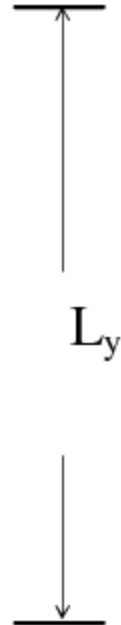
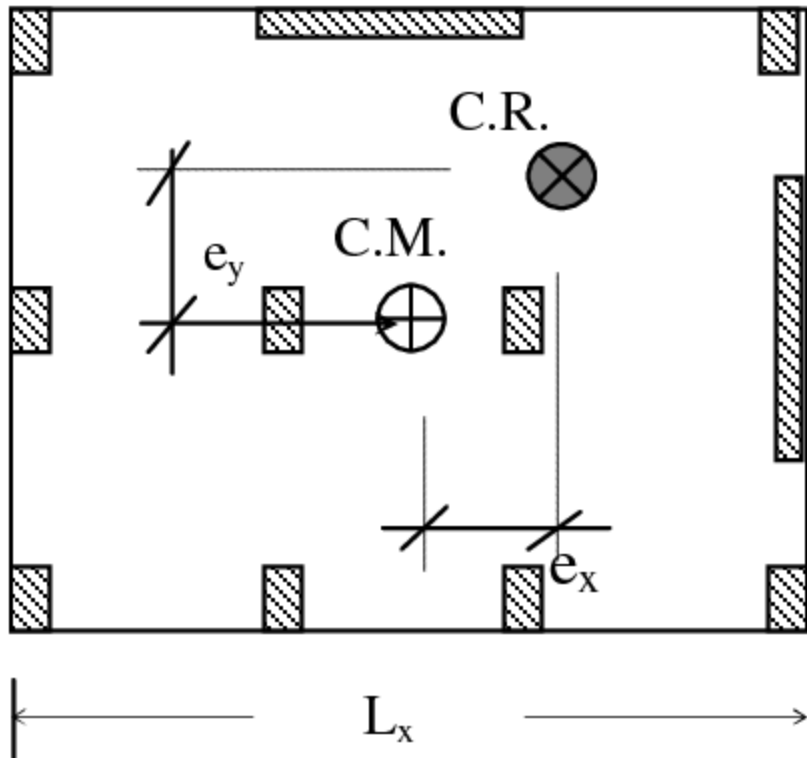
Center of Mass
Center of Rigidity



Recap of the week

Center of Mass

Center of Rigidity



$$B = \frac{\delta_{\max}}{\delta_{\text{avg.}}}$$

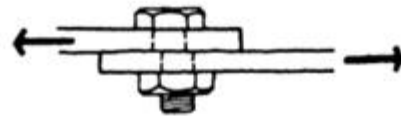
Eccentricity will lead to rotation

Recap of the week

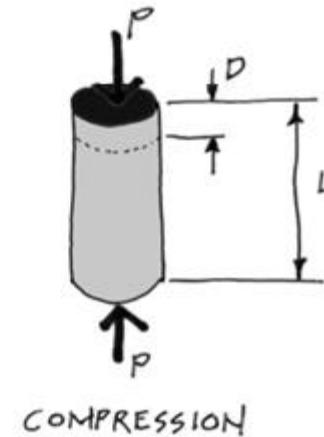
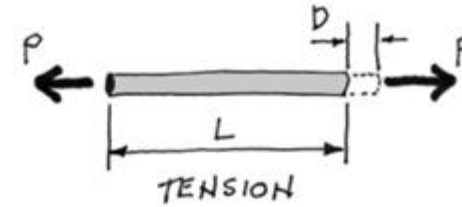
Stress

Stress is the result of a force being applied to the area of a material.

$$\sigma = \frac{P}{A}$$



Shear Stress



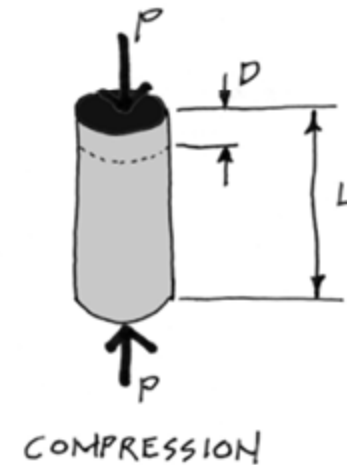
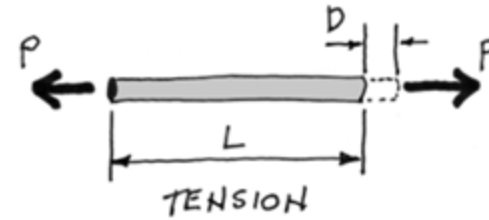
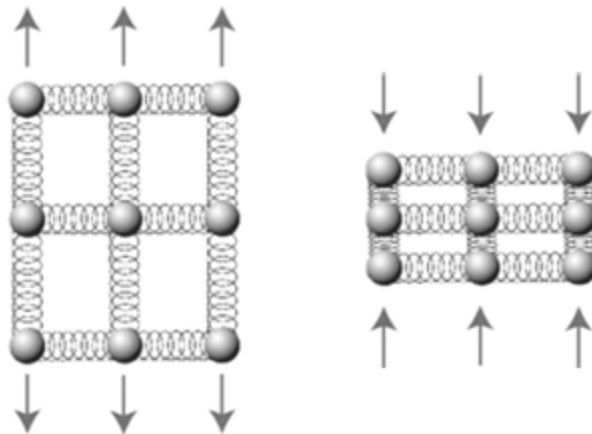
Recap of the week

Strain

Strain is the amount of deformation in the material, per unit length.

$$\varepsilon = \frac{D}{L}$$

Deformation occurs either in stretching (tension) or in compressing (compression) but not always at the same rate.



Provide the solution for the assignment – HW10

- Problem:

11. Elastic Deformation

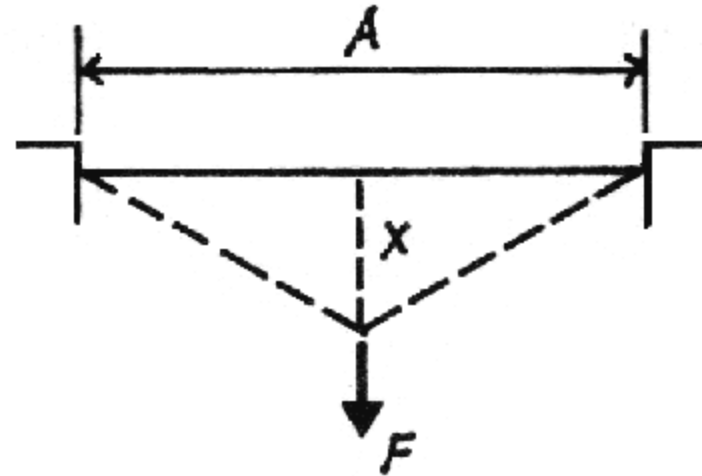
Find the final stretched length of the cable deflected distance x , and the load F needed to cause the deflection. Determine the resulting tensile force in the cable along with the stress and strain.

DATASET: 1

-2-

-3-

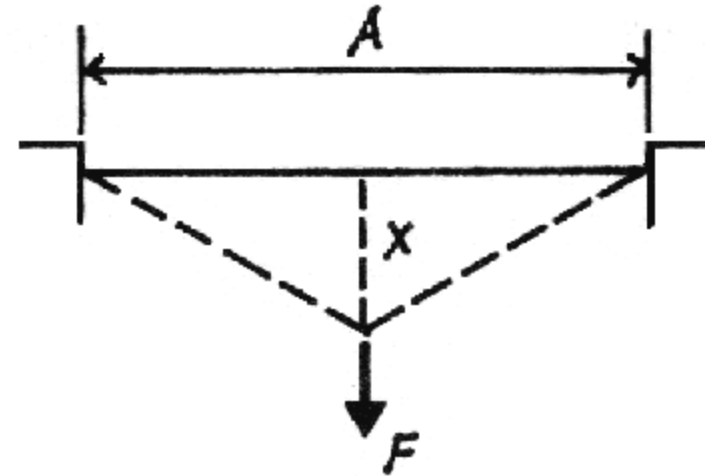
Span, A	56 FT
Sag, x	1.6471 FT
Cable Area	1.8065 IN ²
Young's Modulus, E	20185 KSI



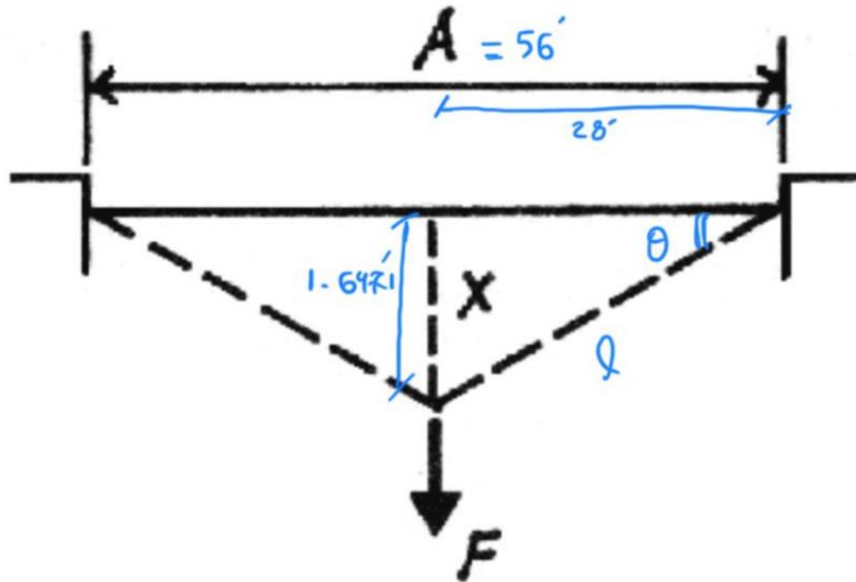
Provide the solution for the assignment – HW10

- Problem:

#	Question	Your Response
1	Final stretched length of the full cable	<input type="text"/> FT
2	Deformation D of full cable	<input type="text"/> FT
3	Force in the stretched cable	<input type="text"/> KIPS
4	Horizontal component of the force in the cable	<input type="text"/> KIPS
5	Vertical component of the force in the cable	<input type="text"/> KIPS
6	Total force F applied to cable	<input type="text"/> KIPS
7	Stress in the cable	<input type="text"/> KSI
8	Strain of the cable	<input type="text"/> IN/IN



Provide the solution for the assignment – HW10



elongated cable length: (l) [half of cable]

$$l^2 = \left(\frac{A}{2}\right)^2 + x^2$$

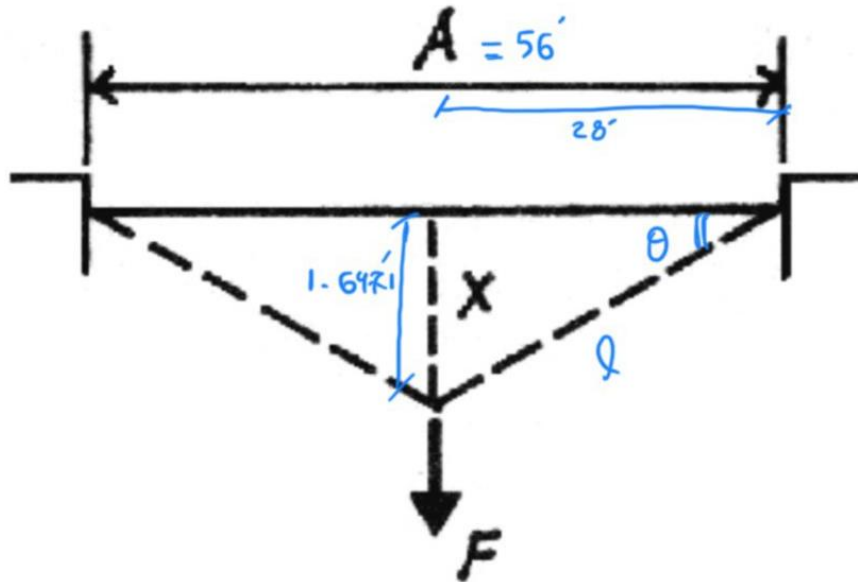
$$l^2 = \left(\frac{56}{2}\right)^2 + (1.6471)^2 \rightarrow l = 28.048 \text{ FT}$$

Final strength length of full cable:

$$2l = \underline{\underline{56.0968}} \quad \textcircled{1}$$

Q1

Provide the solution for the assignment – HW10



$$\text{Stress} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Strain} = \frac{\text{Deformation}}{\text{original Length}}$$

Deformation of Full cable:

$$\Delta = L' - L = 56.0968 - 56 = \underline{\underline{0.0968 \text{ FT}}} \text{ (2)}$$

Stress & Strain Relation:

$$\sigma = E \epsilon \rightarrow \frac{\sigma}{E} = \frac{\Delta}{L}$$

$$\epsilon = \frac{\Delta}{L} = \frac{0.0968}{56} = 0.001728 \text{ (8)}$$

$$\sigma = (20185) \text{ KSI} \times \frac{0.0968}{56} \rightarrow \sigma = 34.8912 \text{ KSI} \text{ (7)}$$

$$\sigma = \frac{P}{A} \rightarrow P = \sigma \cdot A = 34.8912 \text{ KSI} \times 1.8065 \text{ IN}^2 = 63.0309 \text{ KIPS} \text{ (3)}$$

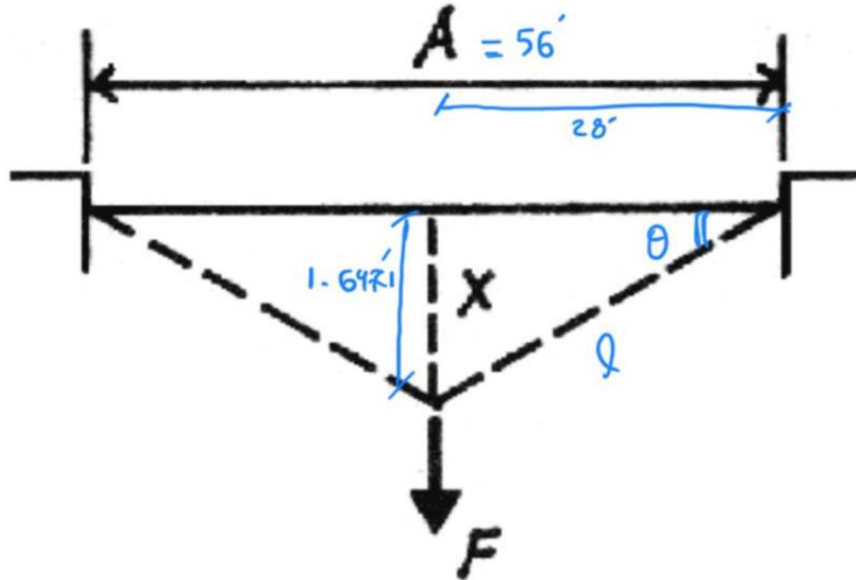
Q2

Q8

Q7

Q3

Provide the solution for the assignment – HW10



Free body diagram of the force F at the bottom vertex, showing its horizontal component P_x and vertical component P_y . The angle θ is indicated between the force vector and the horizontal axis.

$$\theta = \tan^{-1}\left(\frac{1.6471}{28}\right) \rightarrow \theta = 3.3665^\circ$$

$$\begin{cases} P_x = P \cos \theta \\ P_y = P \sin \theta \end{cases}$$

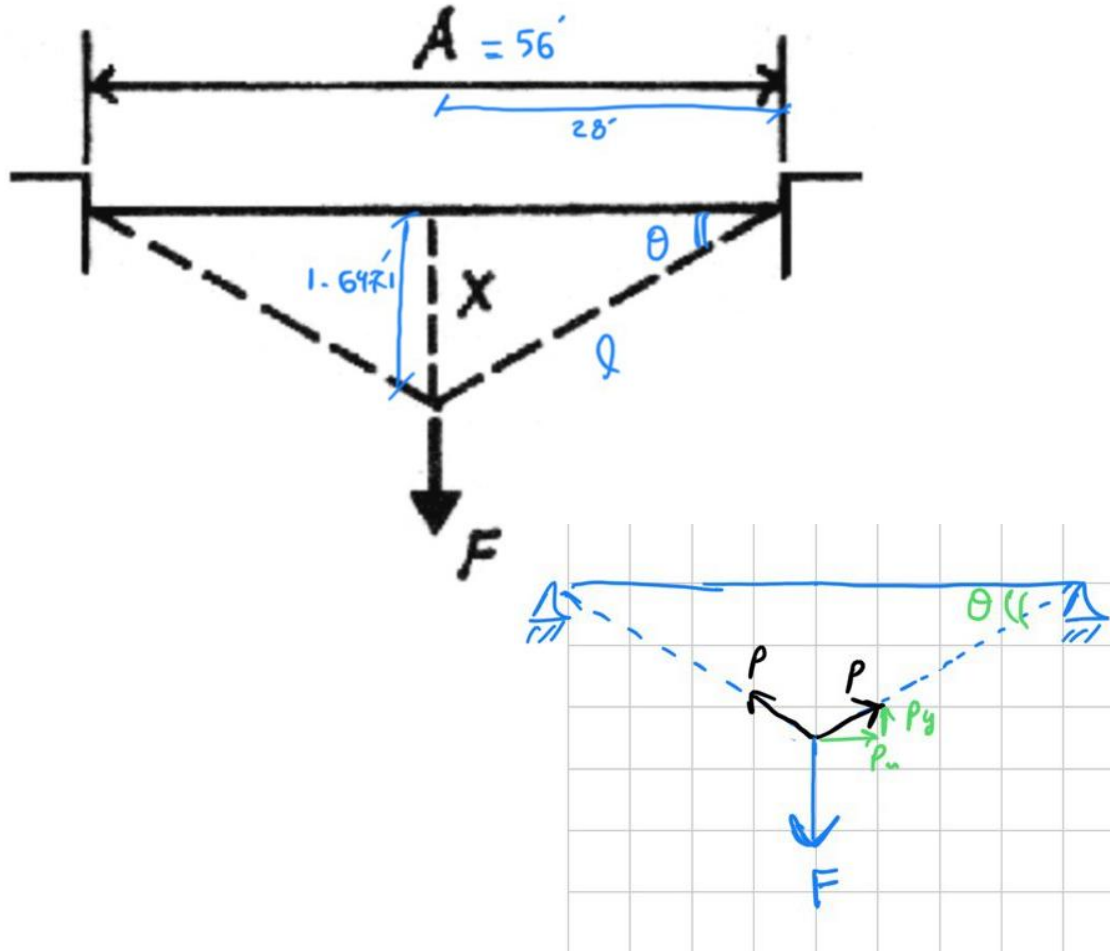
$$\begin{cases} P_x = 63.0309 \cos(3.3665) = 62.9221 & \textcircled{4} \\ P_y = 63.0309 \sin(3.3665) = 3.7013 & \textcircled{5} \end{cases}$$

Q4

Q5

Method 2: Use slope to determine the relation between horizontal and vertical components of the force

Provide the solution for the assignment – HW10



"F" should be balanced by
the Tension Force in the Cable:

$$\sum F_y = 0$$

$$F = 2P_y = 2(3.7013) = 7.4026$$

Q6

Lab: Elasticity

Elasticity

Description

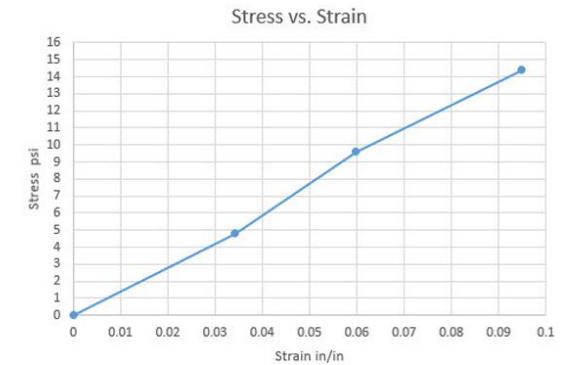
This project uses Hooke's Law to find the elastic modulus of a material.

Goals

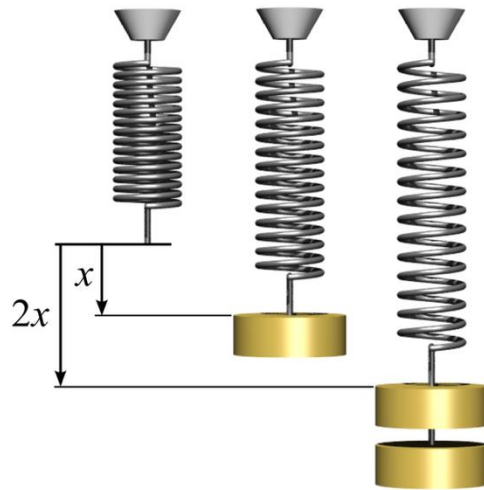
To observe elastic behavior of a material.

To calculate stress and strain from a physical test.

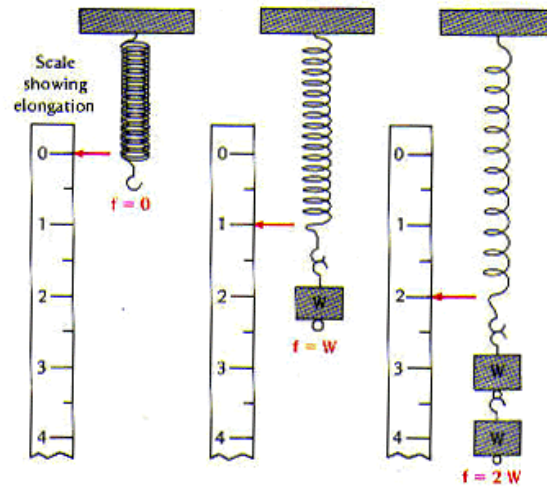
To produce a stress vs. strain graph and calculate the E modulus.



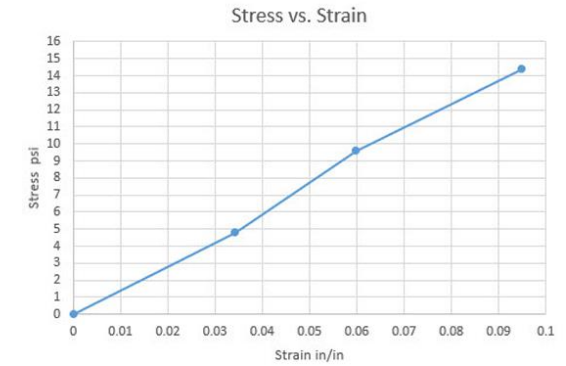
Lab: Elasticity



Hook's law



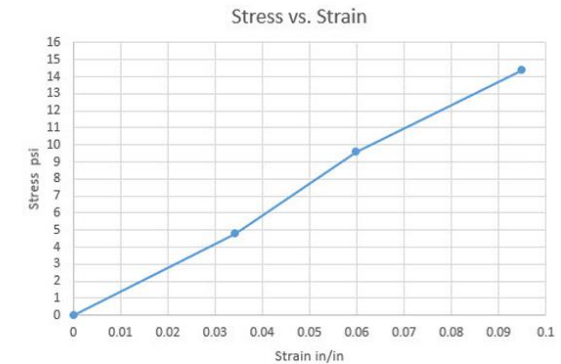
Hookes Law - Force proportional to Stretch



Lab: Elasticity

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 $\frac{1}{2}$ 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 ($\epsilon=D/L$). The area of the $\frac{1}{8}$ "x $\frac{1}{16}$ " cord is 0.007813 in^2 and each washer weighs $\frac{1}{2} \text{ oz.} = 0.03125 \text{ lbs.}$
9. Plot the stress vs. strain.
10. Find the slope of the line to determine the modulus of elasticity, $E = f/\epsilon$.

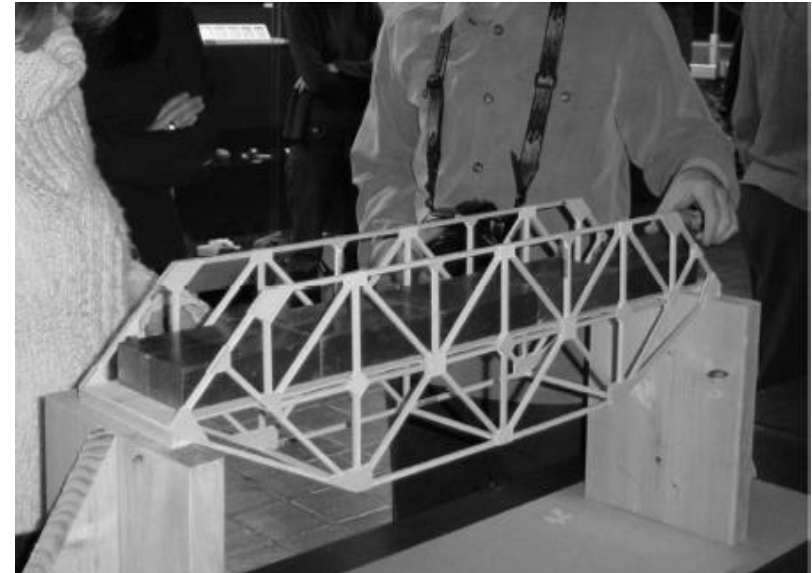


Bridge Project

FEEDBACKS + Evaluations + Comments Answering Questions

Span=160 ft (scaled = 30 in)
Max. Depth = 53 ft (10 in)
Max. Deck = 8 in (1/8 in thick)

Max Weight = 68k (4 oz)
Material = wood + glue



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Thank you.

Any question?

Please feel free to ask questions.