

Arch314

STRUCTURES I

Fall 2025
Recitation

FACULTY: Prof. Peter von Bülow
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Arch314: STRUCTURES I

Welcome to Recitation session 09/26

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Office hours:
By appointment

[Click here to schedule](#)

Please feel free to ask questions.

Arch314: STRUCTURES I

Welcome to Recitation session 09/26

Outline:

- Quick **Recap** of the week
- Provide the solution for the assignment (**Homework 7**)
- Answering student's questions
- Lab: **Truss Stability**
- **Bridge_1** project

Please feel free to ask questions.

Recap of the week

Stability and Determinacy of 2D Trusses

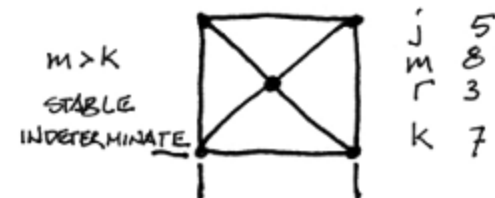
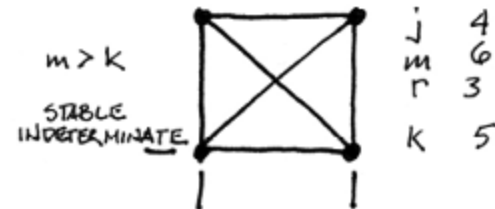
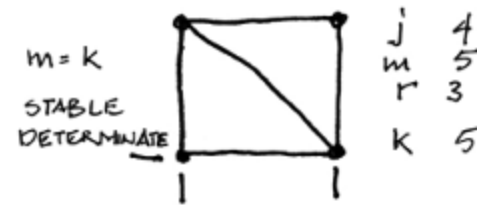
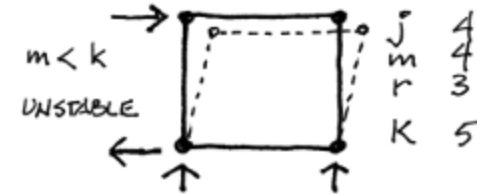
For:

- j joints
- m members
- r reactions (restraints)

$$k = 2j - r$$

Three conditions

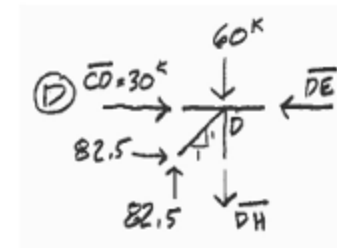
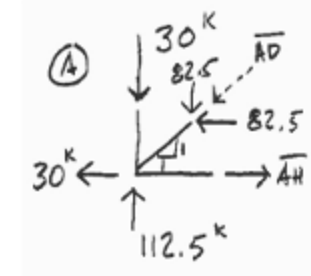
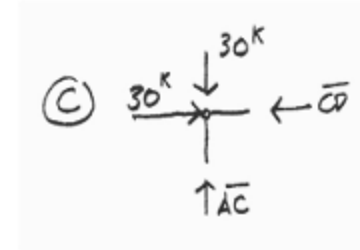
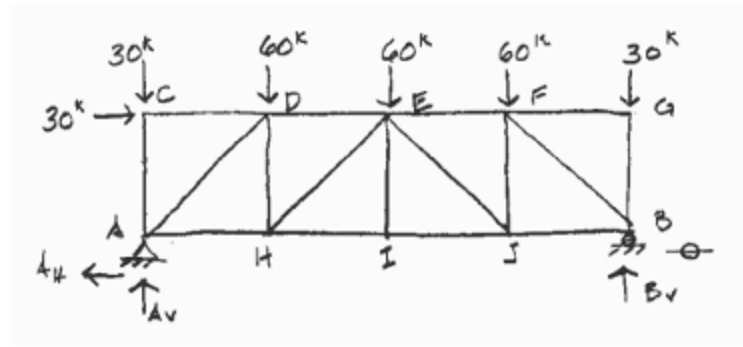
- $m < k$ unstable
- $m = k$ stable and determinate
- $m > k$ stable and indeterminate



Recap of the week

Method of Joints – procedure

1. Solve reactions (all external forces)
2. Inspect for zero force members (T's & L's)
3. Cut FBD of one joint
4. Show forces as orthogonal components
5. Solve with ΣF_H and ΣF_V (no ΣM)
6. Find resultant member forces (Pythagorean Formula)

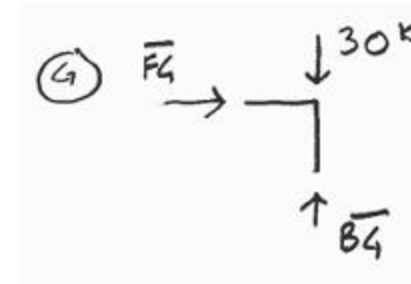
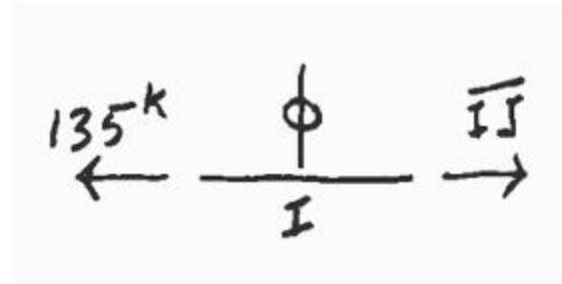
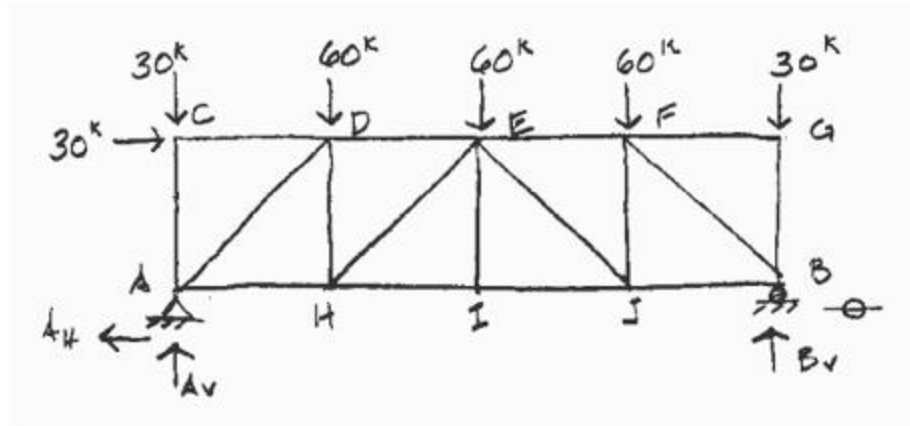


Recap of the week

Inspection of Zero Force Members

T – joints

L – joints



Provide the solution for the assignment – HW7

- Problem:

7. Cable Systems

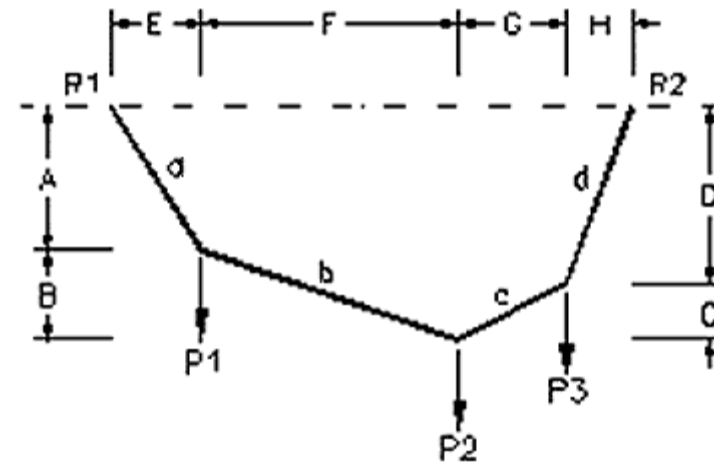
For the cable loaded as shown, determine the horizontal and vertical components of each end reaction, and the tensile force in each cable segment.

DATASET: 1

-2-

-3-

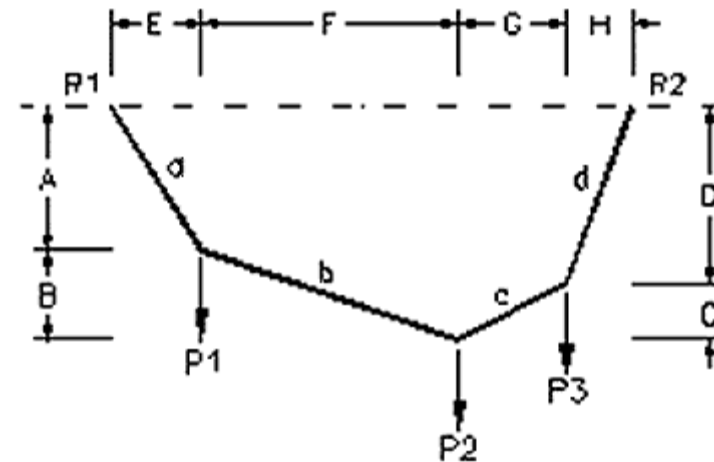
Length E	6 FT
Length F	6 FT
Length G	13 FT
Length H	3 FT
Center height (A + B)	14 FT
Force P1	3 KIPS
Force P2	7 KIPS
Force P3	9 KIPS



Provide the solution for the assignment – HW7

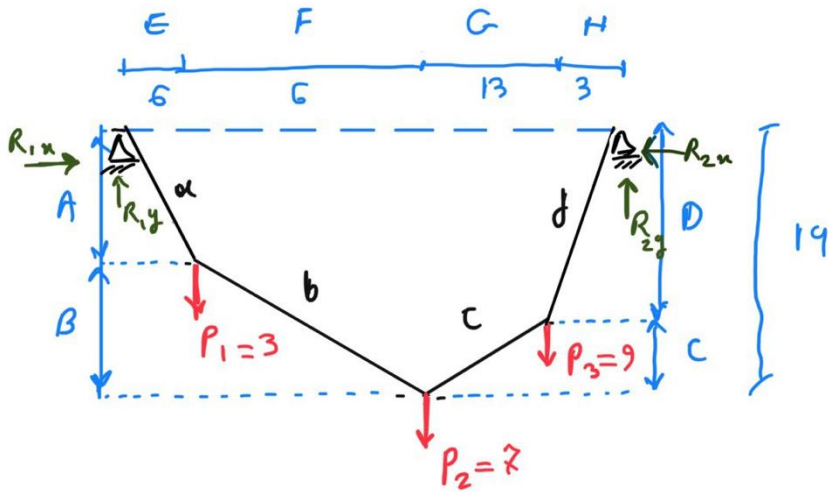
- Problem:

#	Question	Your Response	Correct Answer	Score
1	HORIZONTAL component of R1 (+ = to the right)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
2	VERTICAL component of R1 (+ = upward)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
3	HORIZONTAL component of R2 (+ = to the right)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
4	VERTICAL component of R2 (+ = upward)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
5	Total Force in member 'a' (+ = tension)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
6	Horiz. Force in member 'b' (absolute value)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
7	Vertical Force in member 'b' (absolute value)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
8	Total Force in member 'b' (+ = tension)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
9	Horiz. Force in member 'c' (absolute value)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
10	Vertical Force in member 'c' (absolute value)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
11	Total Force in member 'c' (+ = tension)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
12	Total Force in member 'd' (+ = tension)	<input type="text"/> KIPS	<input type="button" value="SUBMIT"/>	
13	Height A	<input type="text"/> FEET	<input type="button" value="SUBMIT"/>	
14	Height B	<input type="text"/> FEET	<input type="button" value="SUBMIT"/>	
15	Height C	<input type="text"/> FEET	<input type="button" value="SUBMIT"/>	
16	Height D	<input type="text"/> FEET	<input type="button" value="SUBMIT"/>	



Provide the solution for the assignment – HW7

- Solution:



Solve external reactions:

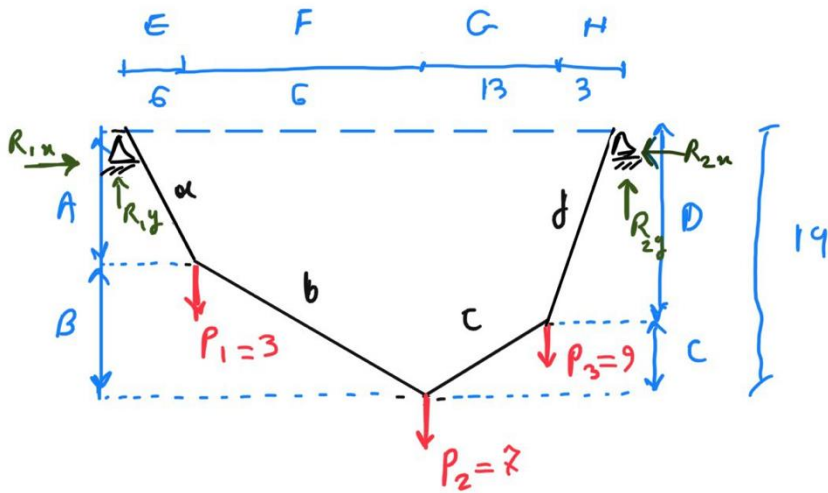
$$\sum M_{@1} = 0$$

$$P_1 \times E + P_2 \times (E+F) + P_3 \times (E+F+G) - R_{2y} \times (E+F+G+H) = 0$$

$$3 \times 6 + 7 \times (6+6) + 9 \times (6+6+13) - R_{2y} \times (6+6+13+3) = 0$$

$$\rightarrow R_{2y} = \boxed{11.68}$$

Provide the solution for the assignment – HW7



$$\sum M_{@2} = .$$

$$R_{1y} (E+F+G+H) - P_1 (F+G+H) - P_2 (G+H) - P_3 (H) = .$$

$$R_{1y} (28) - 3(22) - 7(16) - 9(3) = .$$

$$\rightarrow R_{1y} = \underline{7.32}$$

Right_side

$$\sum M_{@c} = .$$

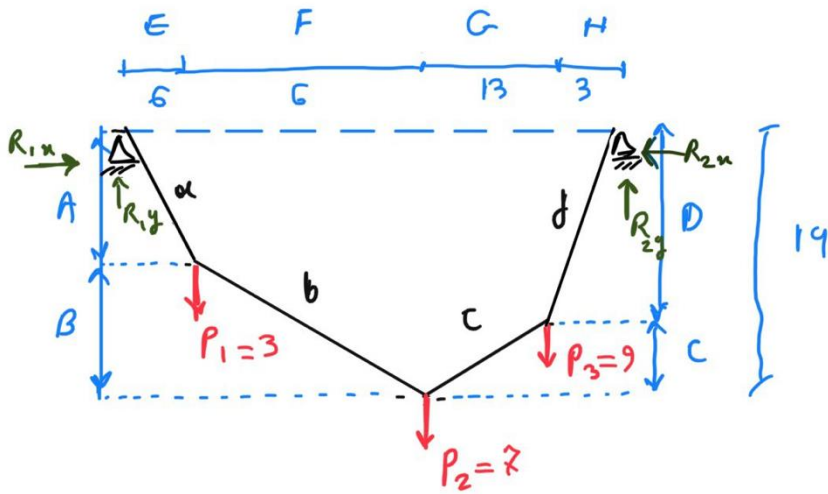
$$P_3 \times G - R_{2y} (G+H) - R_{2x} (A+B) = .$$

$$9 \times 13 - 11.68(16) - R_{2x} (14) = .$$

$$\rightarrow R_{2x} = \underline{-4.99}$$

Provide the solution for the assignment – HW7

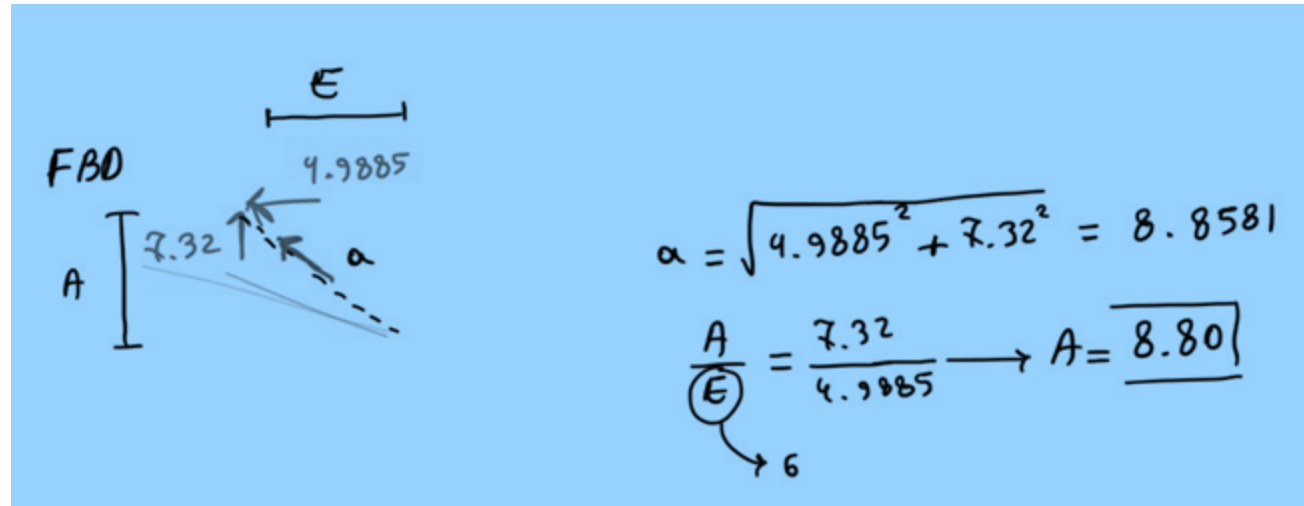
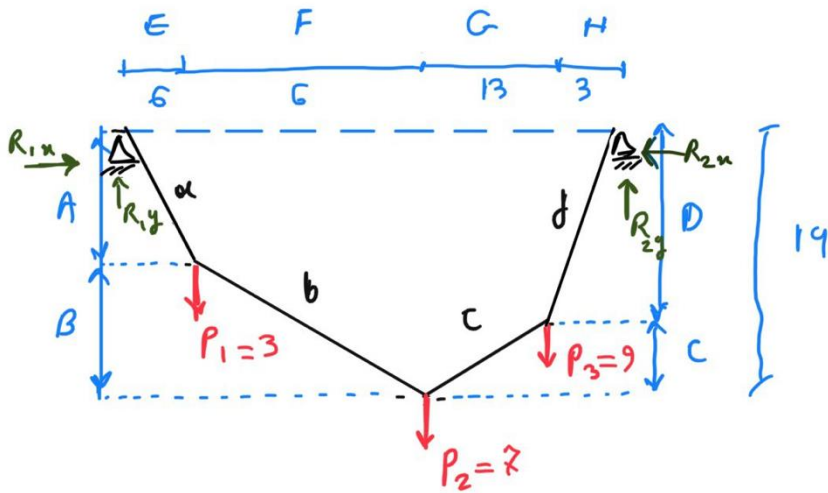
- Solution:



$$\begin{aligned}\sum F_x = 0 &\rightarrow R_{1x} + R_{2x} = 0 \\ R_{1x} + (-4.99) &= 0 \rightarrow R_{1x} = \underline{4.99}\end{aligned}$$

Provide the solution for the assignment – HW7

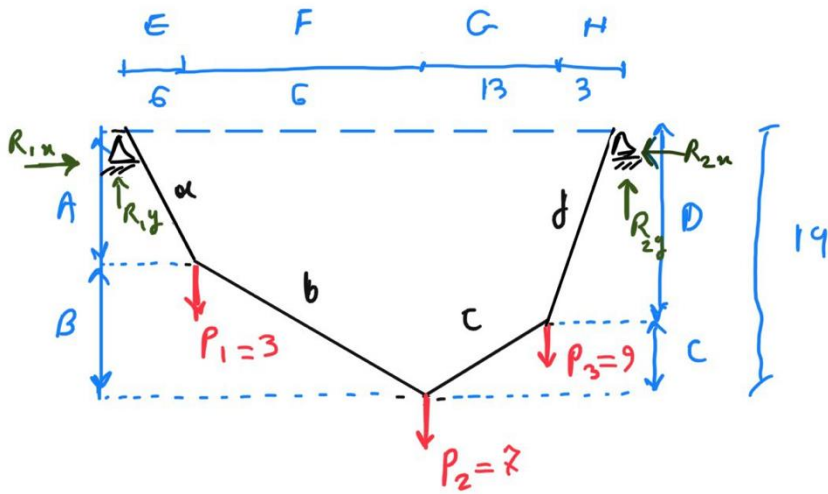
- Solution:



Pythagorean

Provide the solution for the assignment – HW7

- Solution:



FBD:

A Free Body Diagram (FBD) of the trapezoidal frame. The top-left corner is labeled A, and the top-right corner is labeled B. The left vertical edge has a height of 8.80. The right vertical edge has a height of 5.20. The horizontal distance from the left edge to the right edge is 14. The frame is divided into two parts by a horizontal dashed line at height 5.20. The left part has a vertical reaction force $R_{1y} = 7.32$ at the top and a horizontal reaction force $R_{1x} = 4.9885$ at the top. The right part has a vertical reaction force R_{2y} at the top and a horizontal reaction force R_{2x} at the top. The frame is divided into two parts by a horizontal dashed line at height 5.20. The left part has a vertical reaction force $R_{1y} = 7.32$ at the top and a horizontal reaction force $R_{1x} = 4.9885$ at the top. The right part has a vertical reaction force R_{2y} at the top and a horizontal reaction force R_{2x} at the top. The frame is divided into two parts by a horizontal dashed line at height 5.20. The left part has a vertical reaction force $R_{1y} = 7.32$ at the top and a horizontal reaction force $R_{1x} = 4.9885$ at the top. The right part has a vertical reaction force R_{2y} at the top and a horizontal reaction force R_{2x} at the top.

$$A + B = 14 \rightarrow \boxed{B = 5.20}$$

$$\sum F_y = 0$$

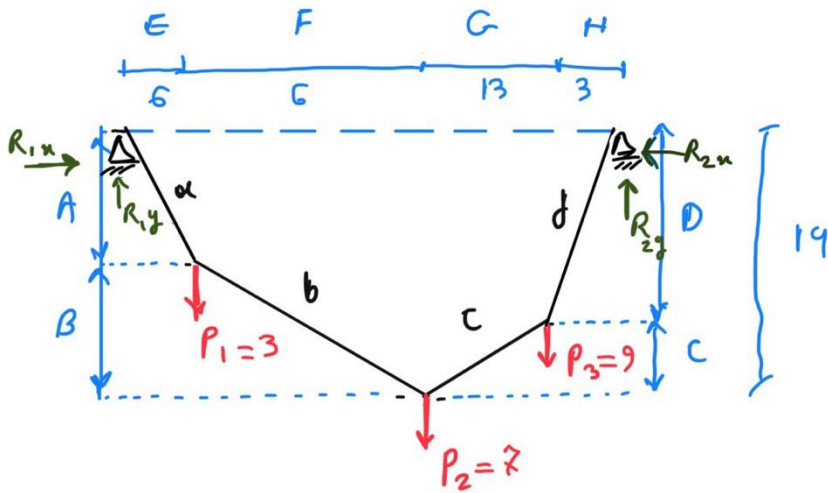
$$7.32 - 3 - b_y = 0 \rightarrow b_y = 4.32$$

$$\sum F_x = 0$$

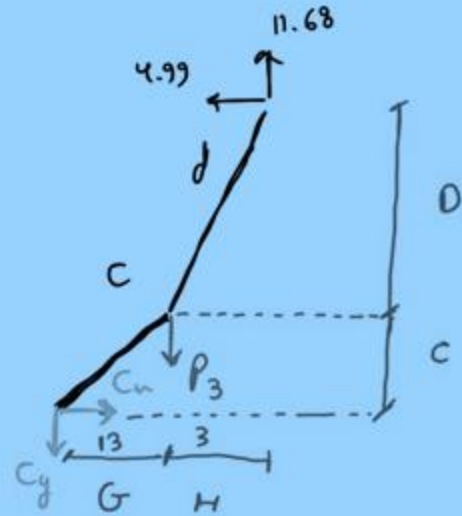
$$b_x - 4.9885 = 0 \rightarrow b_x = 4.9885$$

$$b = \sqrt{b_x^2 + b_y^2} = \sqrt{4.32^2 + 4.9885^2} = \boxed{6.59}$$

Provide the solution for the assignment – HW7



FBD:



$$\sum F_x = 0$$

$$C_x - 4.99 = 0 \rightarrow C_x = 4.99$$

$$\sum F_y = 0$$

$$C_y + 9 - 11.68 = 0$$

$$C_y = \underline{2.68}$$

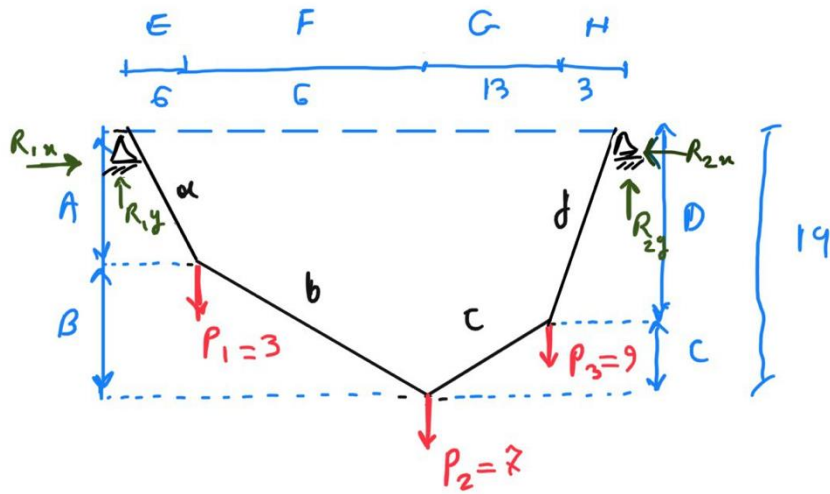
$$C = \sqrt{4.99^2 + 2.68^2} = 5.66$$

$$\frac{C_y}{C_x} = \frac{C}{G} \rightarrow \frac{2.68}{4.99} = \frac{C}{13} \rightarrow \underline{C = 6.98}$$

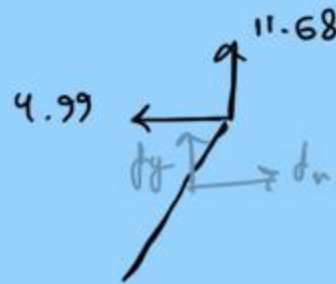
$$D + C = 14 \rightarrow \underline{D = 7.02}$$

Provide the solution for the assignment – HW7

- Solution:



FBD :



$$\sum F_x = 0$$

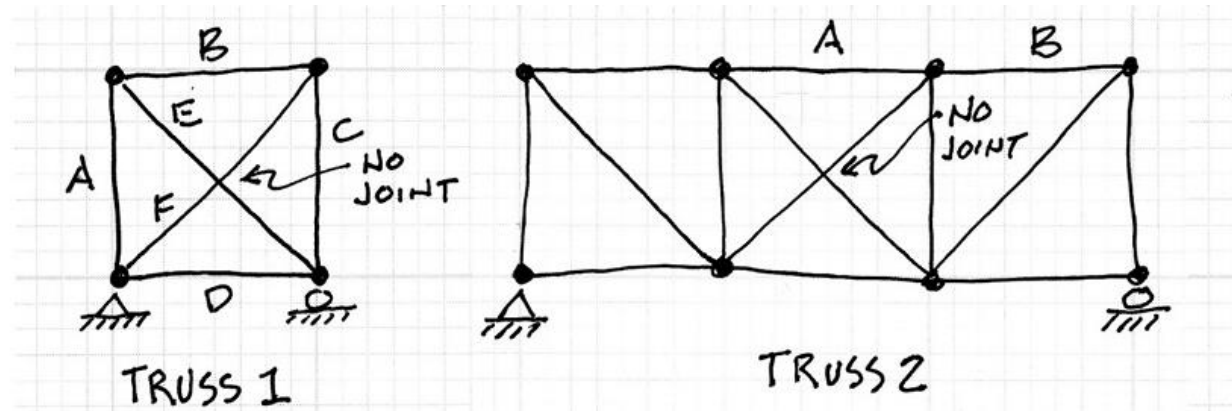
$$d_x - 4.99 = 0 \rightarrow d_x = 4.99$$

$$\sum F_y = 0$$

$$-d_y - 11.68 = 0 \rightarrow d_y = -11.68$$

$$d = \sqrt{d_x^2 + d_y^2} = \sqrt{4.99^2 + (-11.68)^2} = 12.70$$

Lab: Truss Stability



Truss Stability

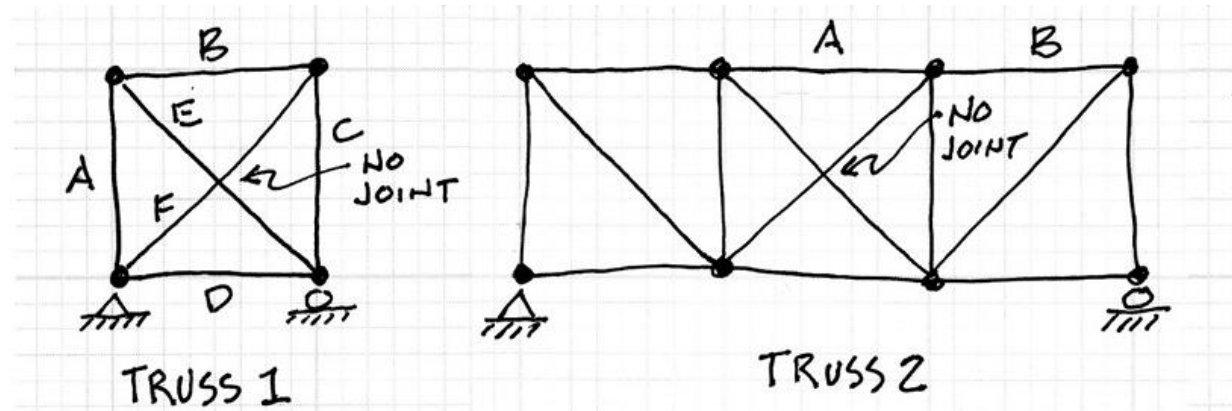
Description

This project takes a look at the stability and instability of trussed structures based on member number and placement

Goals

- To make use to the truss stability equation.
- To observe limitations of the truss stability equation.

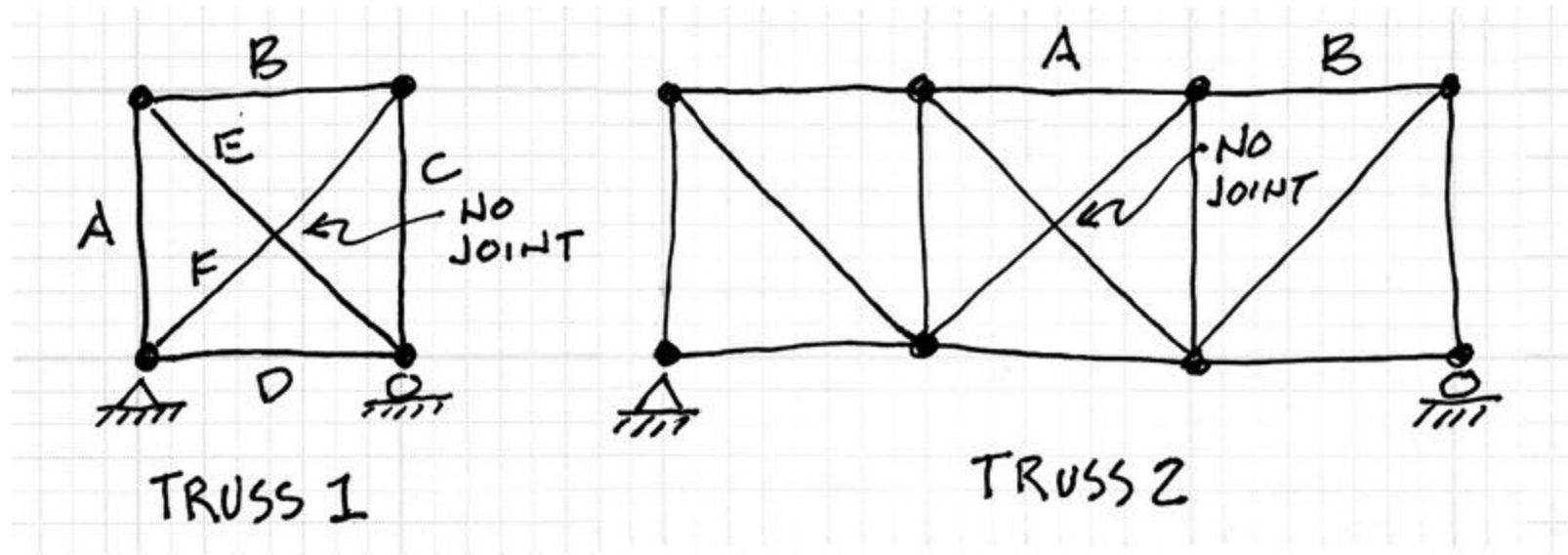
Lab: Truss Stability



Procedure

1. Use the truss stability equation, $k=2j-r$, to determine whether Truss 1 is unstable, stable, or indeterminate.
2. Make a sketch of Truss 1 with member A removed. Based on the stability equation, what is the status of the truss now? Would you agree?
3. Now repeat this for each of members in Truss 1 one at a time. Does the truss remain stable in each case?
4. Use the truss stability equation to determine whether Truss 2 is unstable, stable, or indeterminate.
5. Make a sketch of Truss 2 with member A removed. Based on the stability equation, what is the status of the truss now? Would you agree?
6. Make another sketch of Truss 2 with member B removed. Based on the stability equation, what is the status of the truss now? Would you agree?
7. Try removing other members from Truss 2. Make a sketch of two of these showing one which remains stable and one which becomes unstable with one member removed.

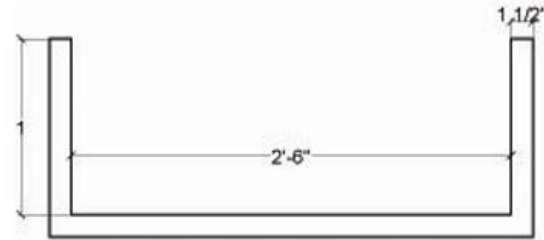
Lab: Truss Stability



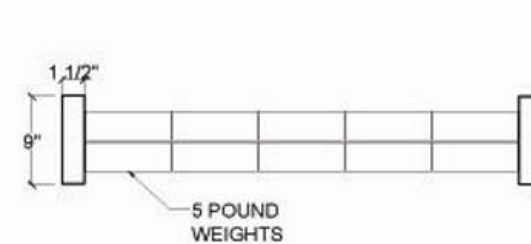
$k = 2j - r$ if $m < k$ then unstable
 $m = k$ then stable and determinate
 $m > k$ then stable and indeterminate

Bridge Project

Testing Frame:



ELEVATION



PLAN

Description

This project gives students the chance to apply concepts learned in truss analysis to the design of a small road bridge. The project also introduces techniques for design and testing of structural models. Work is to be conducted in groups of up to four people. The project is divided into three parts: 1) initial conceptual design and analysis, 2) design development and testing, 3) post analysis and documentation.

Objectives

- to explore the geometric design parameters of a structural truss through bridge design.
- to perform quantitative analysis as a means of testing and evaluating a design.
- to test a design concept using a 1:64 ($3/16" = 1'$) scale structural model.
- to document the results in a clear, well organized report.

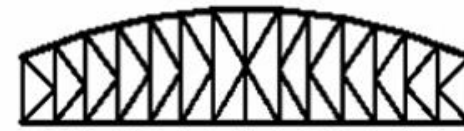
Bridge Project



Pratt



Parker



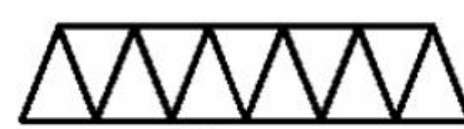
K-Truss



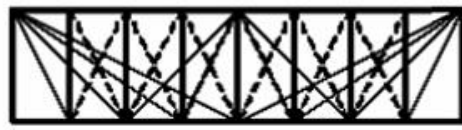
Howe



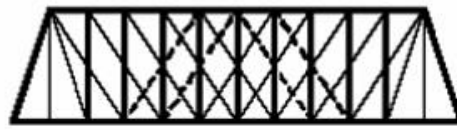
Camelback



Warren



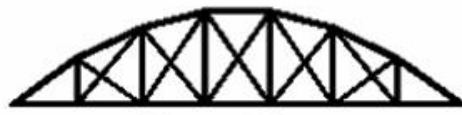
Fink



Double Intersection Pratt



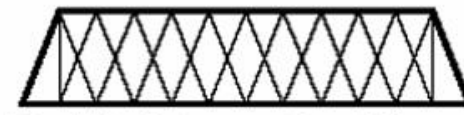
Warren (with Verticals)



Bowstring



Baltimore



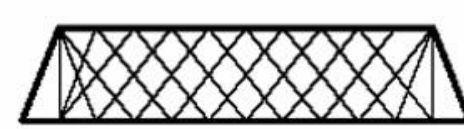
Double Intersection Warren



Waddell "A" Truss



Pennsylvania



Lattice

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Thank you.

Any question?

Please feel free to ask questions.