TAUBMAN COLLEGE
ARCHITECTURE & URBAN PLANNING
UNIVERSITY OF MICHIGAN

Arch314
STRUCTURES I

Fall 2024
Recitation

FACULTY: Prof. Peter von Bülow
Mohsen Vatandoost

Arch314: STRUCTURES I

Welcome to Recitation session 09/27

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Office hours:

By appointment

Click here to schedule

Please feel free to ask questions.

Welcome to Recitation session 09/27

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.

Contact: Mohsenv@umich.edu

Recap of the week

Stability and Determinacy of 2D Trusses

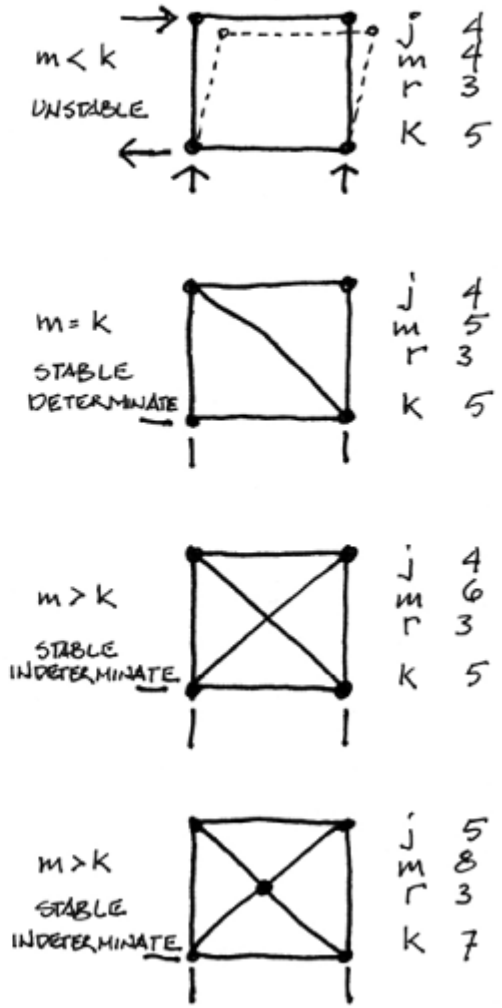
For:

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

$$k = 2j - r$$

Three conditions

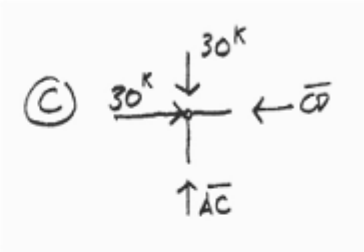
- m < k unstable
- m = k stable and determinate
- m > k stable and indeterminate

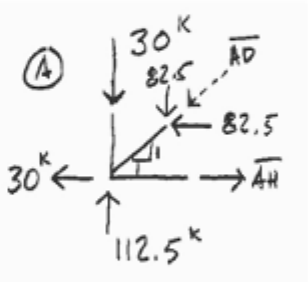


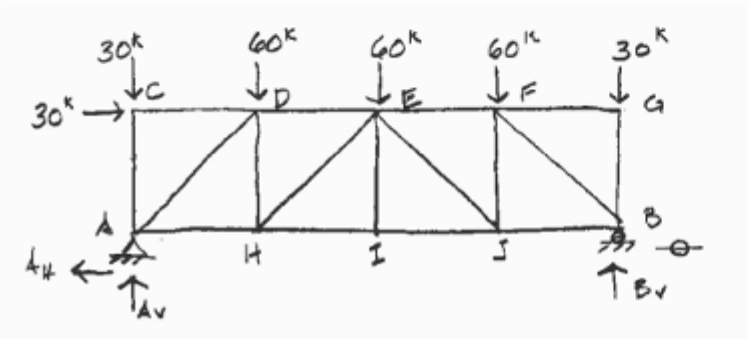
Recap of the week

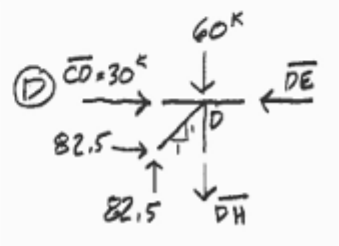
Method of Joints – procedure

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)







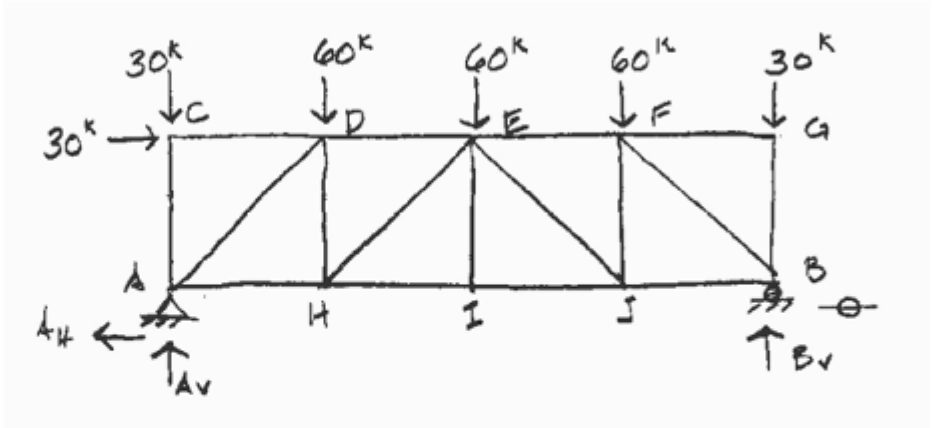


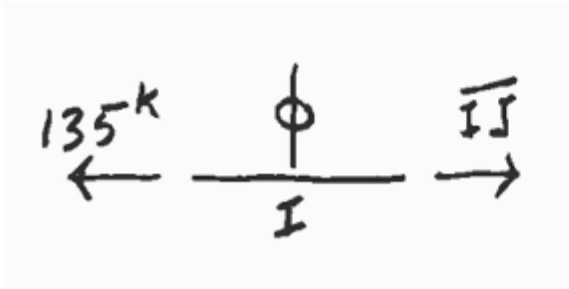
Recap of the week

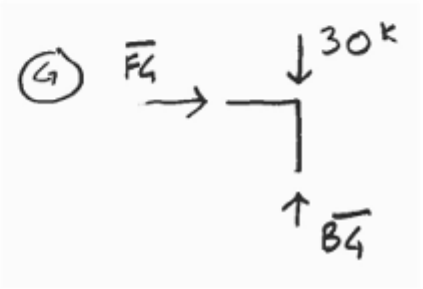
Inspection of Zero Force Members

T – joints

L – joints







Provide the solution for the assignment – **HW7**

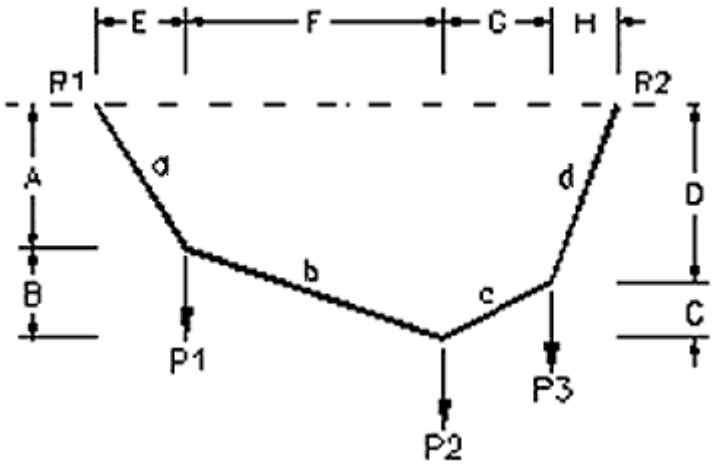
- Problem:

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-

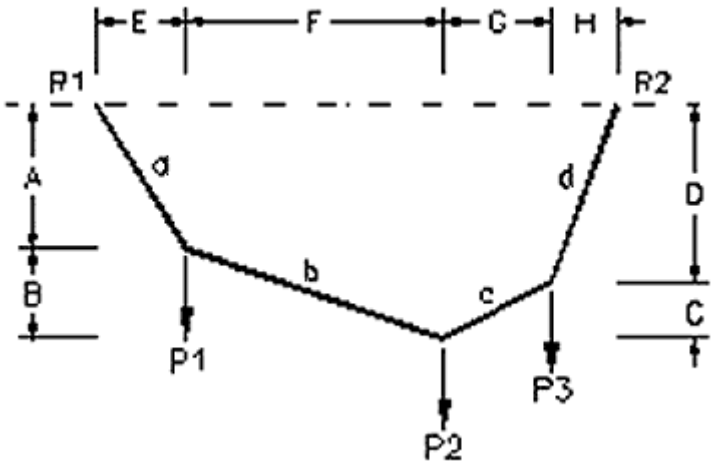
Length E	6 FT
Length F	6 FT
Length G	13 FT
Length H	3 FT
Center height (A + B)	14 FT
Force P1	3 KIPS
Force P2	7 KIPS
Force P3	9 KIPS



Provide the solution for the assignment – **HW7**

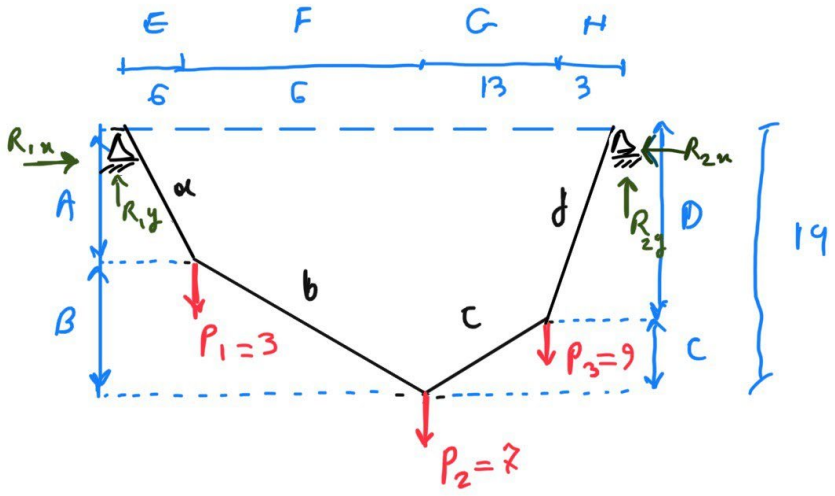
- **Problem:**

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



Provide the solution for the assignment – HW7

- Solution:



Solve external reactions:

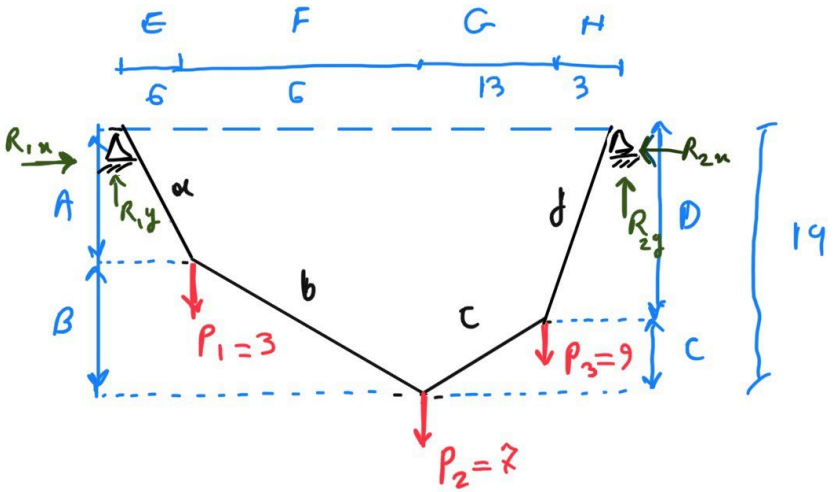
$$\sum M_{@1} = 0$$

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

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

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

Provide the solution for the assignment – **HW7**



$$\sum M_{@2} = 0$$

$$R_{1y}(E+F+G+H) - P_1(F+G+H) - P_2(G+H) - P_3(H) = 0$$

$$R_{1y}(28) - 3(22) - 7(16) - 9(3) = 0$$

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

Right_side

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

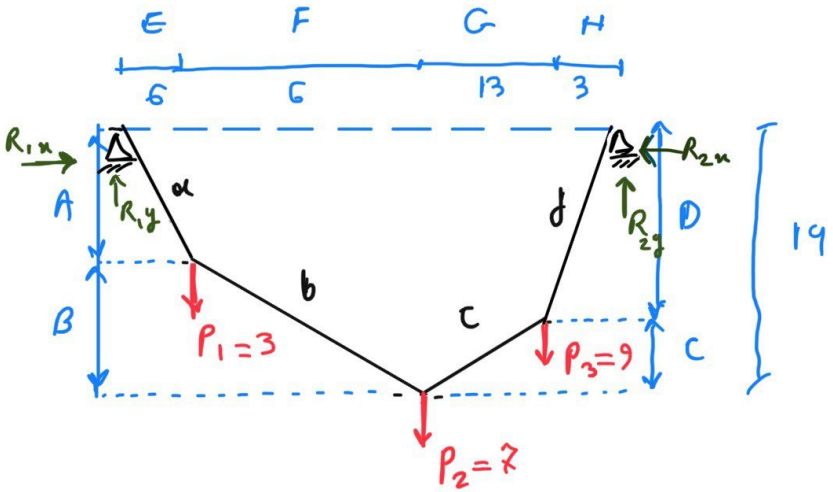
$$P_3 \times G - R_{2y}(G+H) - R_{2x}(A+B) = 0$$

$$9 \times 13 - 11.68(16) - R_{2x}(14) = 0$$

$$\rightarrow R_{2x} = \boxed{-9.99}$$

Provide the solution for the assignment – **HW7**

- Solution:

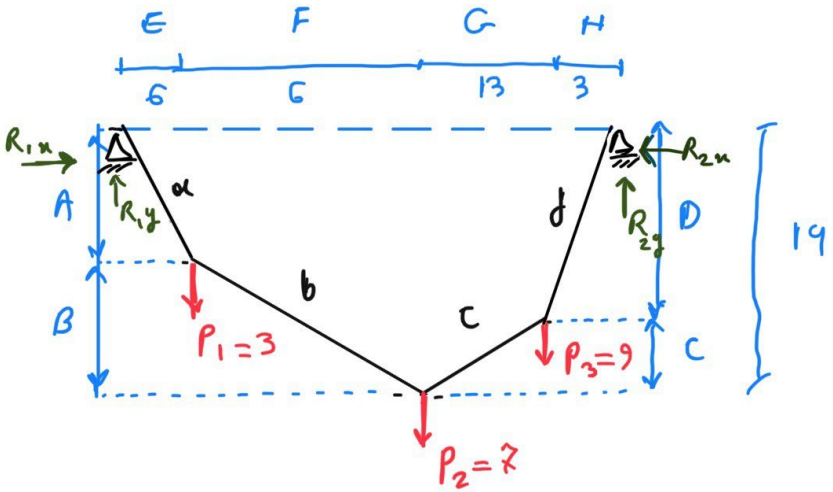


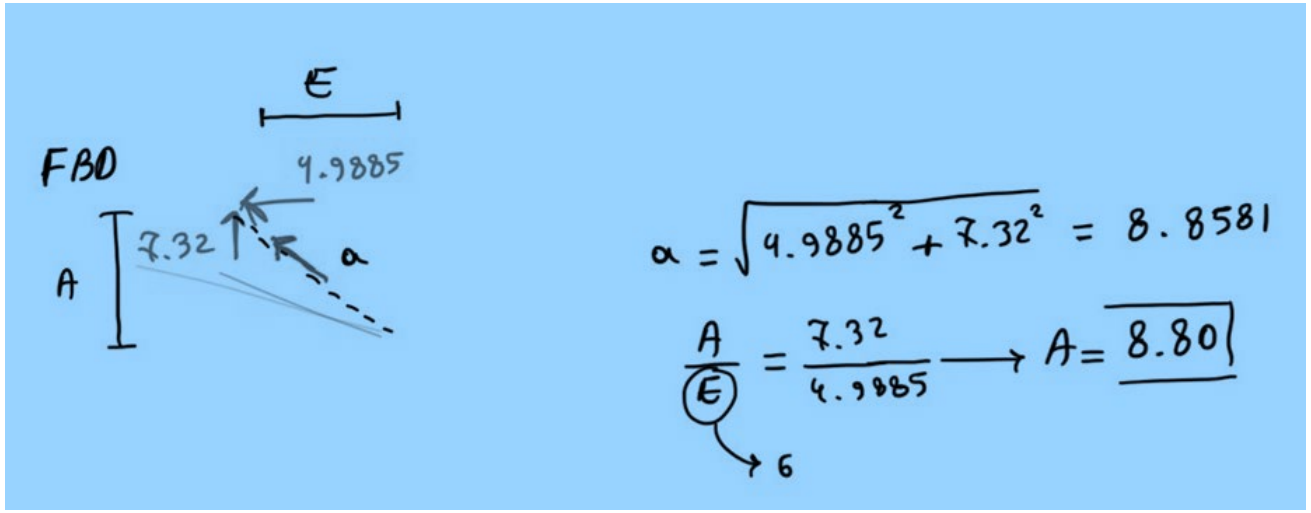
$$\sum F_x = 0 \longrightarrow R_{1x} + R_{2x} = 0$$

$$R_{1x} + (-4.99) = 0 \longrightarrow R_{1x} = \boxed{4.99}$$

Provide the solution for the assignment – HW7

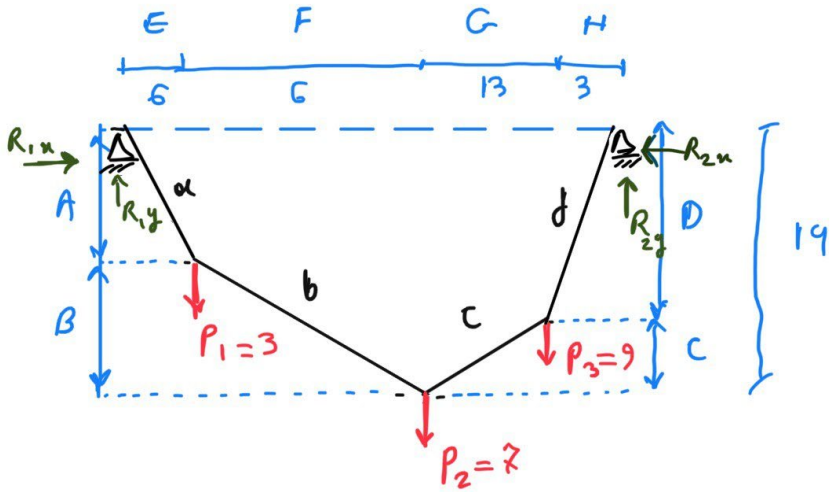
- Solution:



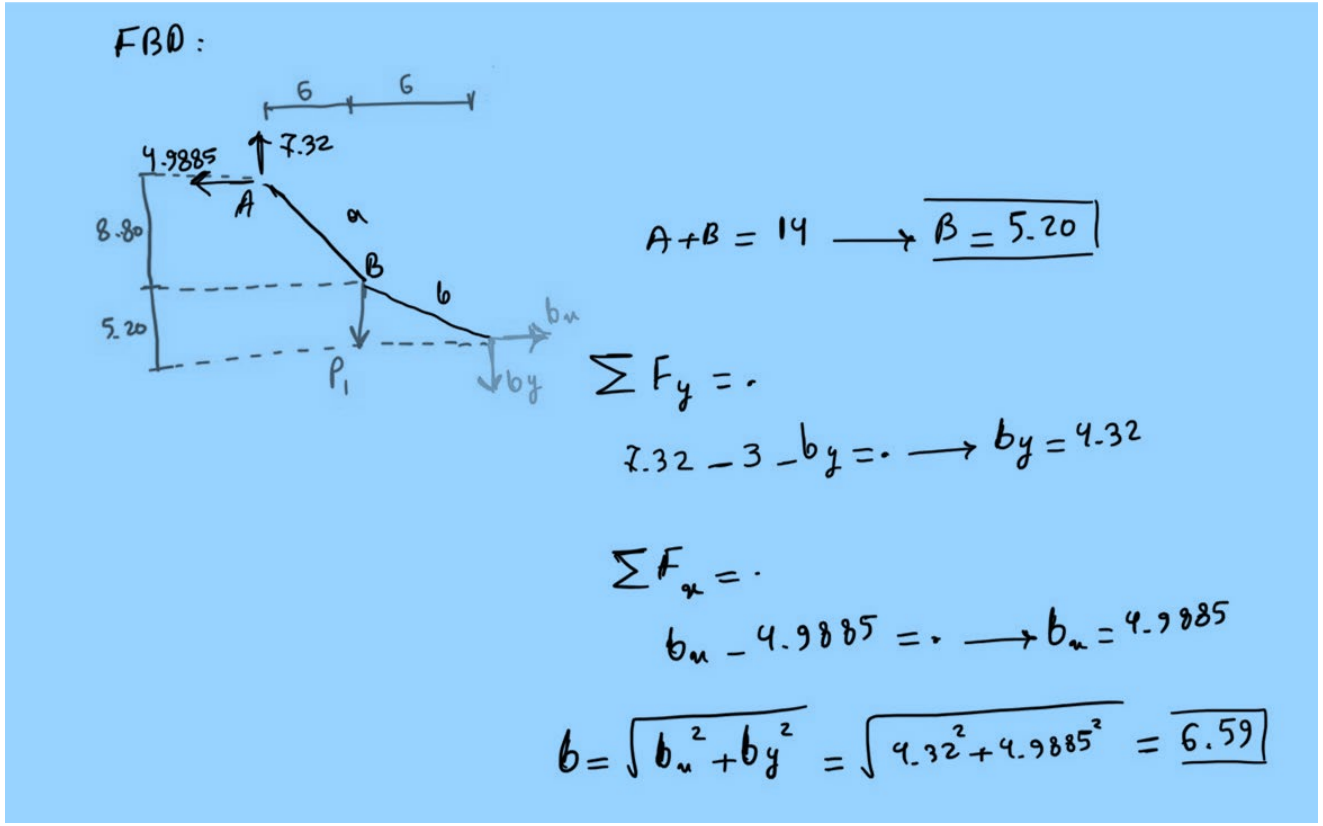


Pythagorean

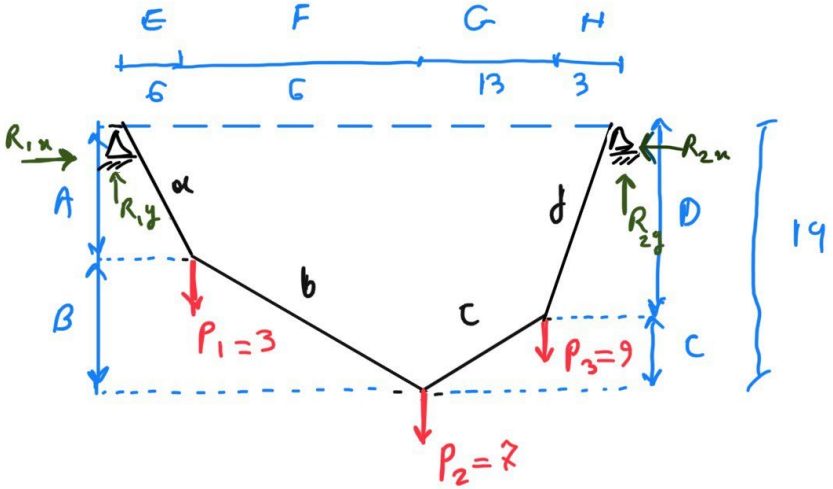
Provide the solution for the assignment – **HW7**



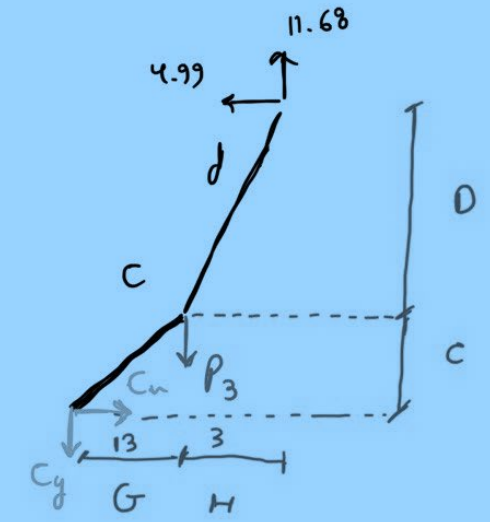
- Solution:



Provide the solution for the assignment – **HW7**



FBD:



$\sum F_x = 0$

$C_x - 4.99 = 0 \longrightarrow C_x = 4.99$

$\sum F_y = 0$

$C_y + 9 - 11.68 = 0$

$C_y = \boxed{2.68}$

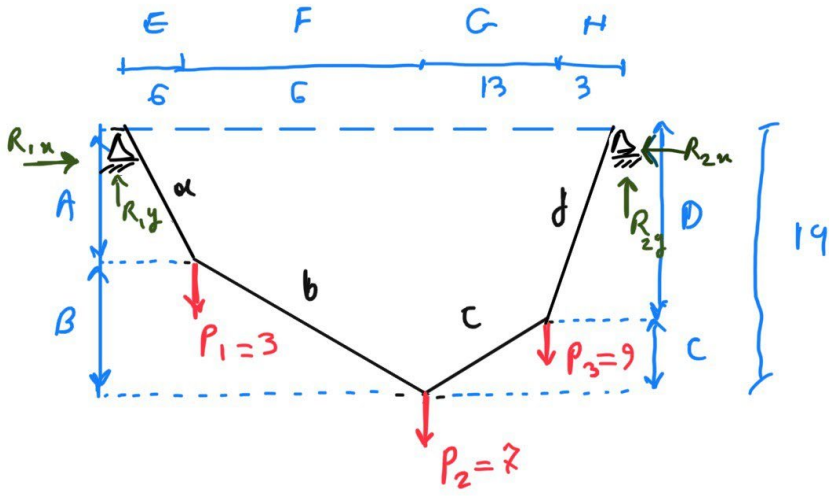
$C = \sqrt{4.99^2 + 2.68^2} = 5.66$

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

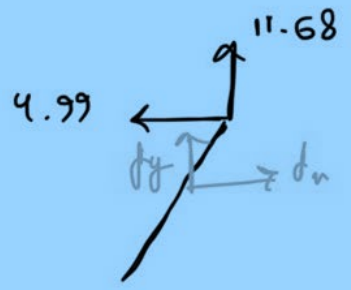
$D + C = 14 \longrightarrow \boxed{D = 7.02}$

Provide the solution for the assignment – HW7

- Solution:



FBD :



$\Sigma F_x = 0$

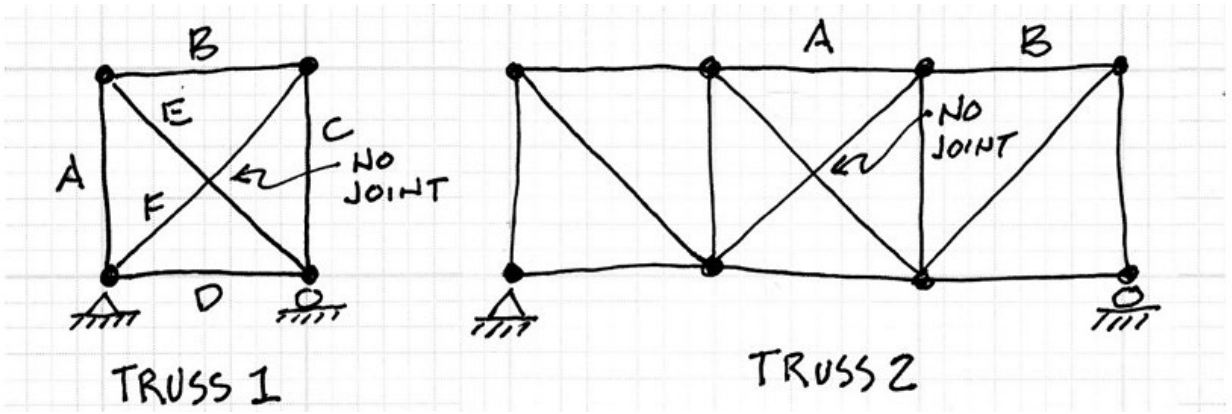
$d_x - 4.99 = 0 \longrightarrow d_x = 4.99$

$\Sigma F_y = 0$

$-d_y - 11.68 = 0 \longrightarrow d_y = -11.68$

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

Lab: Truss Stability



Truss Stability

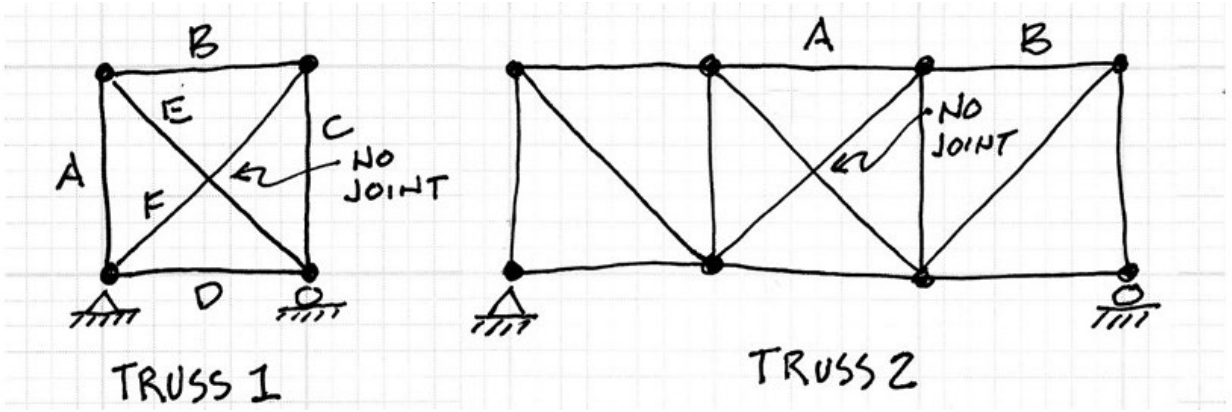
Description

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.

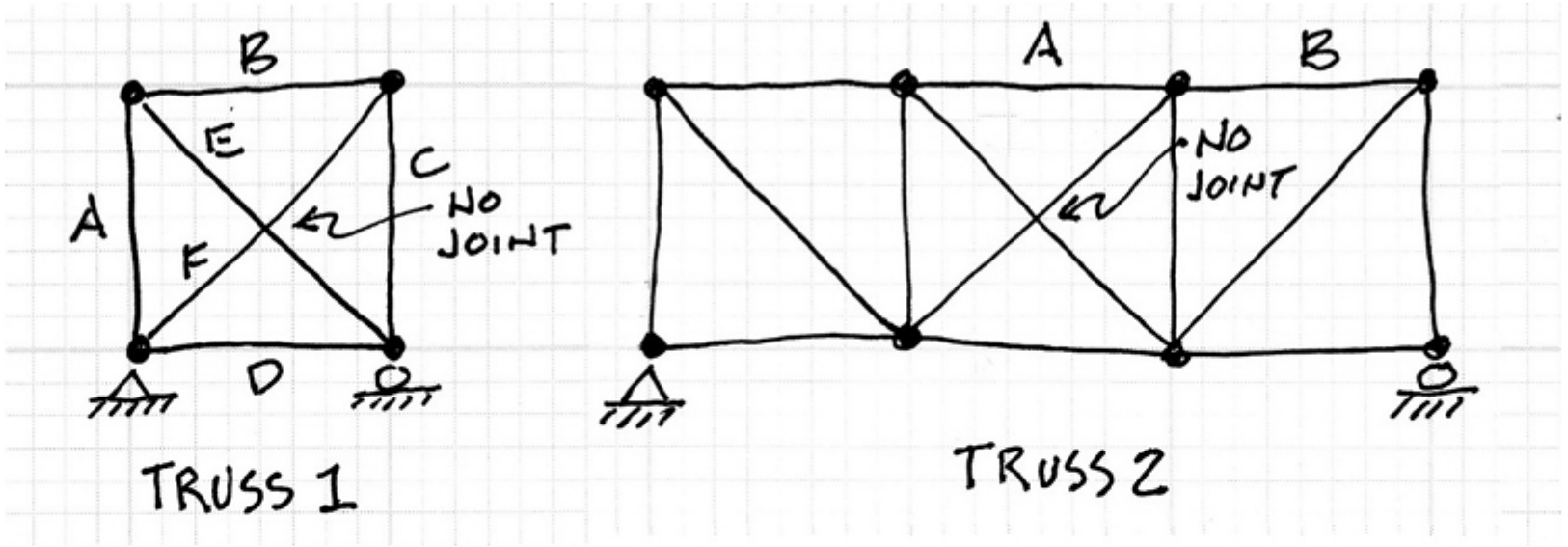
Lab: Truss Stability



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

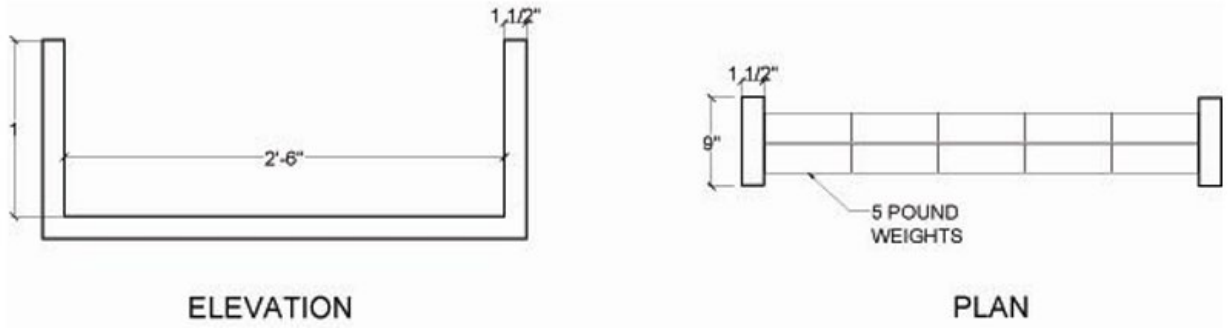


k = 2j – r if

m < k then unstable
m = k then stable and determinate
m > k then stable and indeterminate

Bridge Project

Testing Frame:



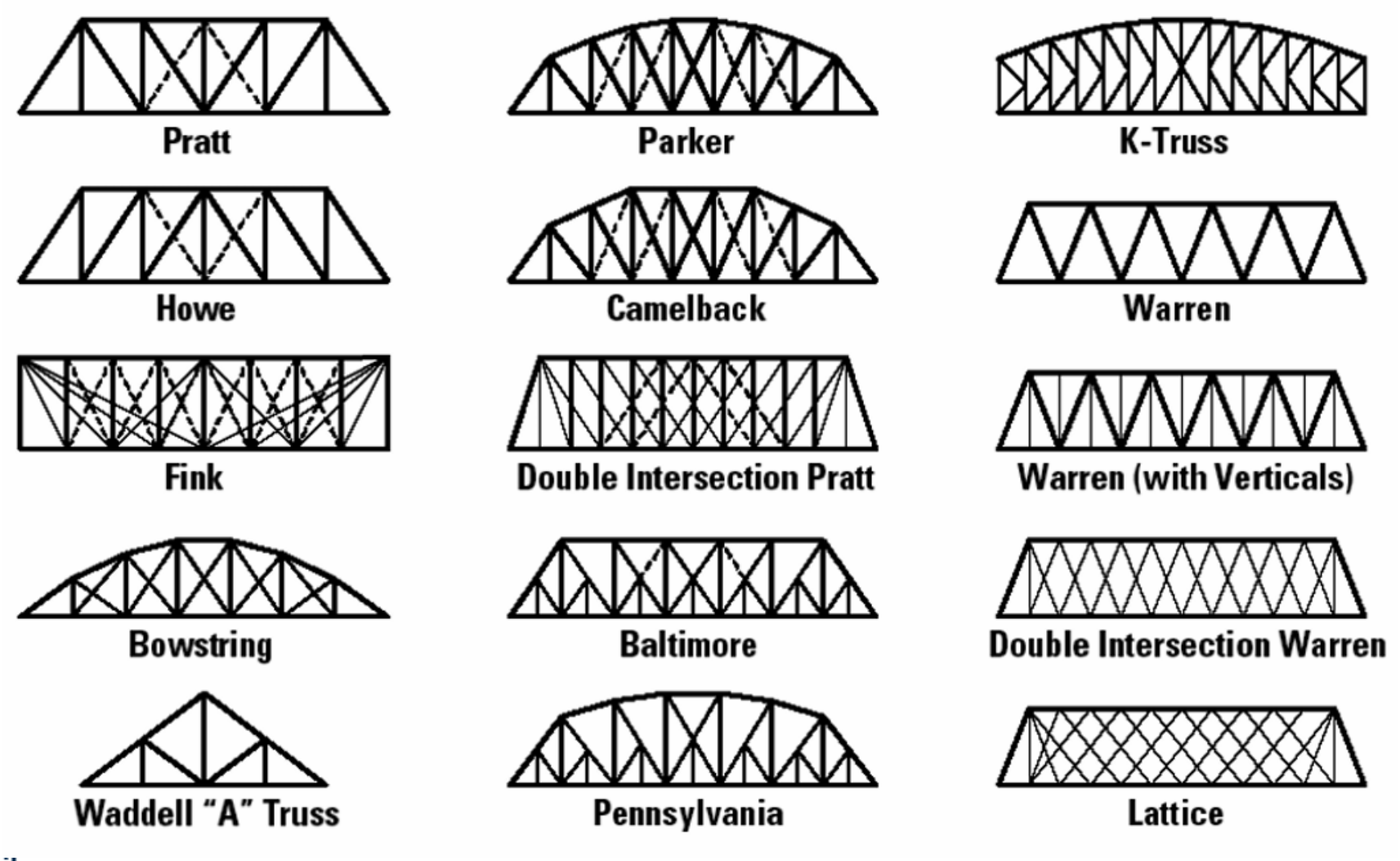
Description

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



Thank you.

Any question?

Please feel free to ask questions.

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