

Arch 314

Structures I

Fall 2025 Recitation 004

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Recitation 004

Welcome to session 4!

- Bridge!!
- Quick Recap of this week's lectures
- Homework Review (#6 Cable Systems)
- Lab: Trusses by Joints

Feel free to ask questions anytime

Bridge

[Contact](#)[Schedule](#)[Lectures](#)[Recitation](#)[Bridges 1](#)[Bridges2](#)[Problems](#)

[Bridge Project Brief 2025](#)



[Prelim Report Guidelines 2025](#)



[Final Report Guidelines 2025](#)



[Scoring Rubric 2025](#)



[Examples of Bridge Types](#)



[Example Reports](#)



[Dr. Frame Software \(download\)](#)



[Dr. Frame Tutorial](#)



[Dr. Frame User's Guide](#)



[West Point Bridge Designer](#)



[Videos of Bridge Testing](#)



Bridge

Due Dates:

- **Preliminary Report - 10.03 (next Friday!!)**
- Bridge Testing - 11.03
- Final Report - 11.25 (right before Thanksgiving break)

Scoring:

- See rubric linked on website for more specifics
- 40 points = prelim report
- 60 points = performance
 - Hold at least 50lbs = 16pts
 - Correct materials/rules followed = 14pts
 - Class rank using formula based on weight of bridge & load carried

150 points = final report

250 pts total!

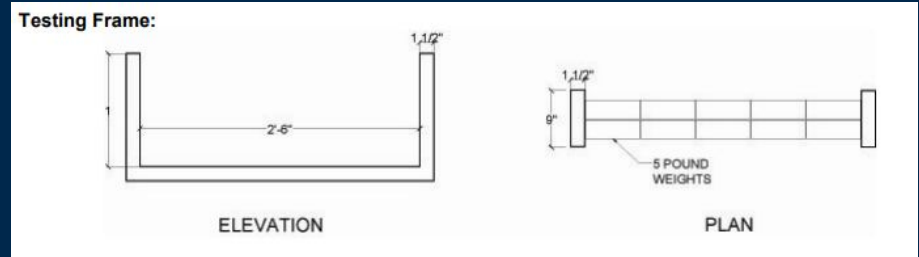
Bridge

Key Rules:

- Must load bricks on the deck
- Cannot perforate the deck
- Wood + Glue only
- MUST BE UNDER 4OZ
 - Scales will be down in Peter's office - do NOT remove them & make sure they are in oz not Toz
- Must span the distance - double check!!

Tips:

- Expect the bridge to sink a little under the weight (give it a bit of a lip on both ends)
- Account for 10% weight = glue
- Test bridge!
- Don't wait until the last minute!!



Bridge

Report Sneak Peak

Any questions over the next week feel free to email me! :)

Lecture: Trusses by Joints (9/24)

Stability and Determinacy of 2D Trusses

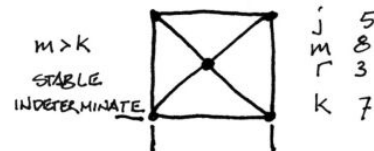
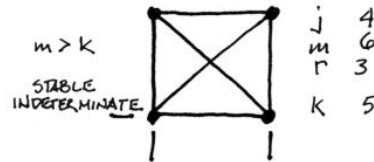
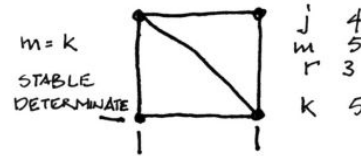
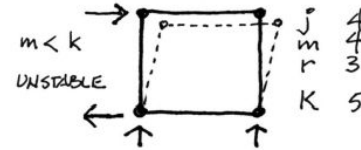
For:

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

$$k = 2j - r$$

Three conditions

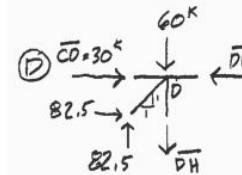
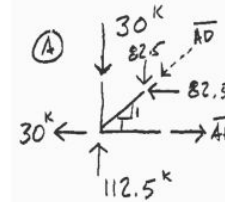
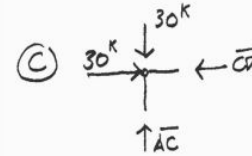
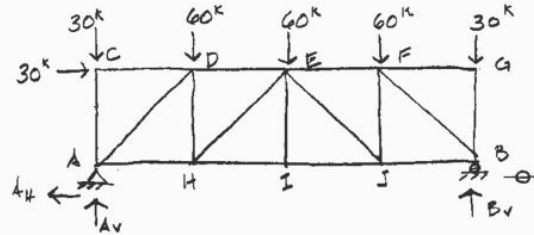
- $m < k$ unstable
- $m = k$ stable and determinate
- $m > k$ stable and indeterminate



Lecture: Trusses by Joints (9/24)

Method of Joints – procedure

1. Solve reactions (all external forces)
2. T & L Joints by Inspection
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)

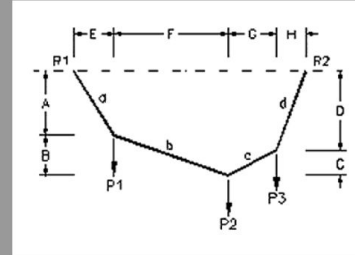


HW #6: Cable Systems

6. 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	
Length E	5 FT
Length F	16 FT
Length G	26 FT
Length H	5 FT
Center height (A + B)	26 FT
Force P1	1 KIPS
Force P2	5 KIPS
Force P3	1 KIPS

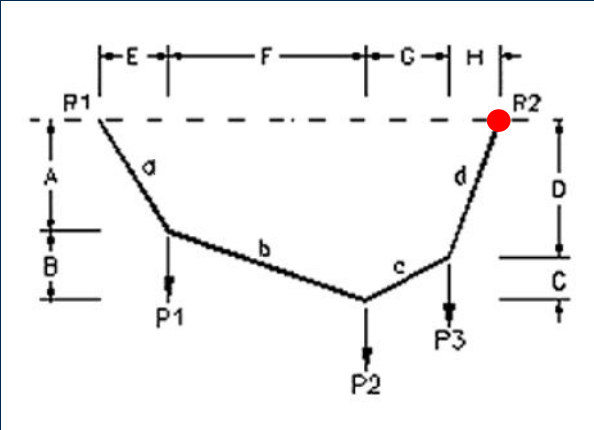


Your answer was correct.
You scored 5 points.

#	Question	Your Response	Correct Answer	Score
1	HORIZONTAL component of R1 (+ = to the right)	-2.599 KIPS	-2.59985 KIPS	5
2	VERTICAL component of R1 (+ = upward)	3.9808 KIPS	3.98077 KIPS	5
3	HORIZONTAL component of R2 (+ = to the right)	2.599 KIPS	2.59985 KIPS	5
4	VERTICAL component of R2 (+ = upward)	3.0912 KIPS	3.01923 KIPS	5
5	Total Force in member 'a' (+ = tension)	4.7546 KIPS	4.75455 KIPS	5
6	Horiz. Force in member 'b' (absolute value)	2.599 KIPS	2.59985 KIPS	5
7	Vertical Force in member 'b' (absolute value)	2.9808 KIPS	2.98077 KIPS	5
8	Total Force in member 'b' (+ = tension)	3.955 KIPS	3.95528 KIPS	5
9	Horiz. Force in member 'c' (absolute value)	2.599 KIPS	2.59985 KIPS	5
10	Vertical Force in member 'c' (absolute value)	2.0192 KIPS	2.01923 KIPS	5
11	Total Force in member 'c' (+ = tension)	3.2919 KIPS	3.29189 KIPS	5
12	Total Force in member 'd' (+ = tension)	3.9844 KIPS	3.98434 KIPS	5
13	Height A	7.658 FEET	7.65576 FEET	5
14	Height B	18.342 FEET	18.3442 FEET	5
15	Height C	20.1928 FEET	20.1935 FEET	5
16	Height D	5.8072 FEET	5.80654 FEET	5

HW #6: Cable Systems

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Force P1	1 KIPS
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Force P3	1 KIPS



Solve for horizontal + vertical components of R1
 use the moment about R2 to solve for R1 *

Use the moment about R2 to solve for R1 *

$$\sum M_{R2} = 0 = +P_3(H) + P_2(G+H) + P_1(F+G+H) - R_{1y}(E+F+G+H)$$

$$= +1\text{kips}(5') + 5\text{kips}(26'+5') + 1\text{kips}(16'+26'+5') - R_{1y}(5'+16'+26'+5')$$

$$= +5\text{kips} + 155\text{kips} + 47\text{kips} - 52R_{1y}$$

$$52R_{1y} = 207\text{kips}$$

$$R_{1y} = \boxed{+3.9808\text{ kips}} \leftarrow \text{Answer to \#2}$$

Vertical component of R₁

Use the moment about P2 to solve for R_{1x}

$$\sum M_{P2} = M_{P1} + M_{R1y} + M_{R1x} = 0$$

$$0 = -F(P1) + R_{1y}(E+F) - R_{1x}(A+B)$$

$$\frac{R_{1x}(A+B)}{A+B} = \frac{-P_1(E) + R_{1y}(E+F)}{A+B}$$

$$R_{1x} = \frac{-P_1(E) + R_{1y}(E+F)}{A+B}$$

Just solved for step 1

$$R_{1x} = \frac{-1\text{kips}(16) + 3.9808(5+16)}{26'}$$

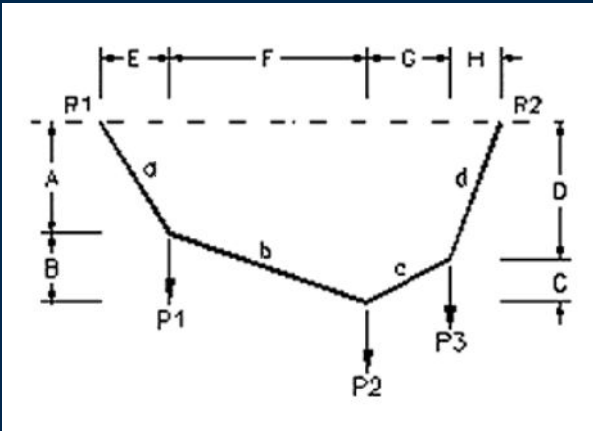
center of mass

$$= -R_{1x} = \boxed{-2.599\text{ kips}} \leftarrow \text{Answer to \#2}$$

Horizontal component of R₁

HW #6: Cable Systems

DATASET: 1	-2-	-3-
Length E	5 FT	
Length F	16 FT	
Length G	26 FT	
Length H	5 FT	
Center height (A + B)	26 FT	
Force P1	1 KIPS	
Force P2	5 KIPS	
Force P3	1 KIPS	



3. Sum horizontal components to determine R_{2x}

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

$-R_{2x} = R_{1x}$ ← Just solved Answer to #1

$-R_{2x} = -2.599$

$R_{2x} = \boxed{2.599 \text{ kips}}$ ← Answer to #3

4. Sum vertical forces to find R_{2y}

$$\sum F_y = R_{1y} - P_1 - P_2 - P_3 + R_{2y} = 0$$

$0 = +3.98 \text{ kips} - 1 \text{ kip} - 5 \text{ kips} - 1 \text{ kip} + R_{2y}$

From 1st step (#2) $R_{2y} = \boxed{+3.0912 \text{ kips}}$ ← Answer to #4

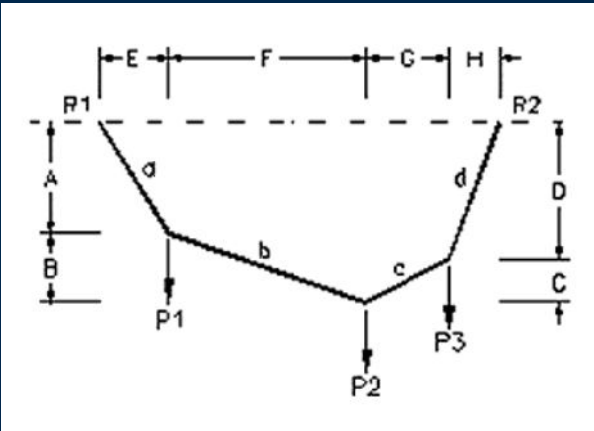
HW #6: Cable Systems

DATASET: 1

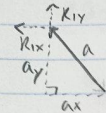
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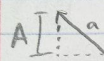


5. Total force in member a



$$a = \sqrt{(-2.599)^2 + (3.9808)^2}$$

$$= \boxed{4.7546} \leftarrow \text{answer to \#5}$$



$$\frac{A}{E} = \frac{3.9808}{2.599}$$

$$2.599(A) = 3.9808(5)$$

$$A = \boxed{7.658} \leftarrow \text{Answer to \#13}$$

$$A + B = 26' = \text{given}$$

$$7.658' + B = 26'$$

$$B = \boxed{18.342} \leftarrow \text{Answer to \#14}$$

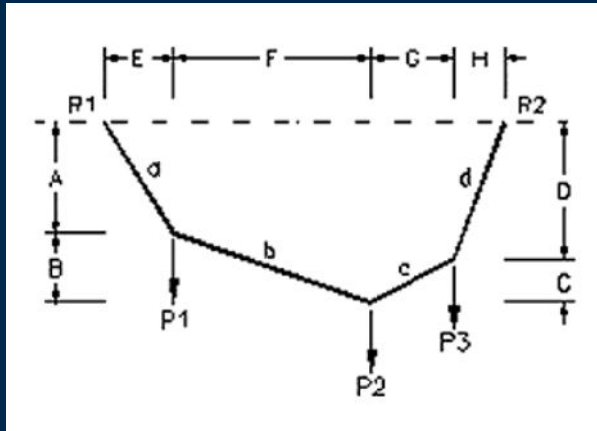
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6. FBD: $E=5$ $F=16$

$R_x = 2.599$ $R_y = 3.9808$

$A = 9.658$ $B = 18.342$

$a = 4.9546$ $b = ?$

$P_1 = 1$ $P_2 = 5$ $P_3 = 1$

$b_x = ?$ $b_y = ?$

$$\sum F_y = R_y - P_1 - b_y$$

$$= 3.9808 - 1 - b_y$$

$$b_y = \boxed{2.9808 \text{ kips}} \leftarrow \text{Answer to \#7}$$

$$\sum F_x = b_x - R_x$$

$$= b_x - (2.599)$$

$$b_x = \boxed{2.599 \text{ kips}} \leftarrow \text{Answer to \#6}$$

$$b = \sqrt{b_x^2 + b_y^2}$$

$$= \sqrt{(2.599)^2 + (2.9808)^2}$$

$$= \boxed{3.955 \text{ kips}} \quad \text{Answer to \#8}$$

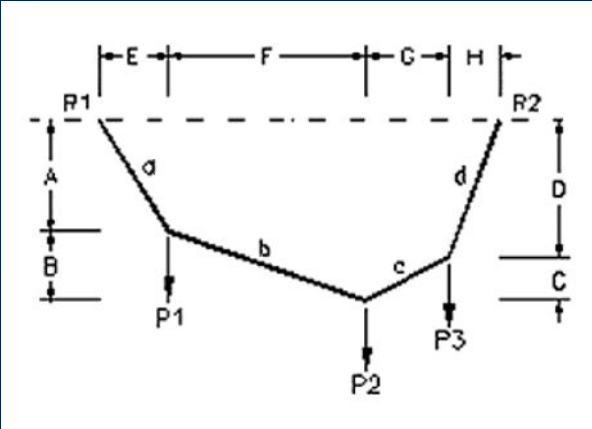
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9.

Free body diagram of a cable segment. The cable is supported at R1 (top) and R2 (bottom). Forces shown are R_{1x} (horizontal), R_{1y} (vertical), P_3 (vertical), and C (vertical). Dimensions $G=26'$ and $H=5'$ are shown.

$\sum F_x = C_x - 2.599$
 $C_x = 2.599 \text{ kips}$ ← Answer to #9

$\sum F_y = C_y + P_3 - R_{2y}$
 $C_y = 2.0192 \text{ kips}$ ← Answer to #10

$C = \sqrt{C_x^2 + C_y^2}$
 $= \sqrt{2.599^2 + 2.0192^2}$
 $= 3.2919 \text{ kips}$ ← Answer to #11

$\frac{C_y}{C_x} = \frac{C}{6} \rightarrow \frac{2.0192}{2.599} \times \frac{C}{26} \rightarrow 52.499 = 2.599C$
 $C = 20.1928'$ ← Answer to #15

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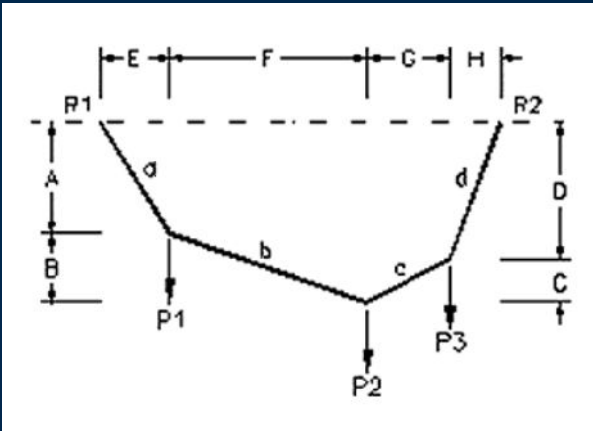
12

$\sum F_x = d_x - R_{2x}$
 $d_x = 2.599 \text{ kips}$

$\sum F_y = -d_y - R_{2y}$
 $d_y = -3.0912 \text{ kips}$

$d = \sqrt{d_x^2 + d_y^2}$
 $= \sqrt{2.599^2 + (-3.0912)^2}$
 $= 3.9844 \text{ kips}$

Answer to #12



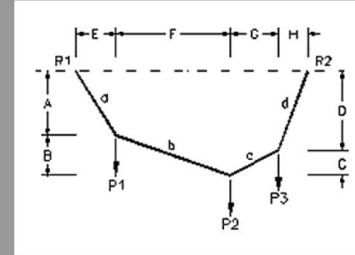
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LAB!