METC 111

Lab Notebook
Spring 2014
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LAB 1: Hooke's Law

Theory

- Hooke's Law describes the relationship between the amount of force and the amount of stretch for an "ideal" spring. The law states that the force and the stretch are directly proportional. In other works, the ratio of the force divided by the stretch is a constant, k. the constant is called the "spring constant".
- In this lab we found force by pulling a spring. The amount the spring is stretched is proportional to the applied force. In this experiment we used the known force divided by the gravity pulling on calibrated masses to investigate the properties of Mounted Spring Scale.

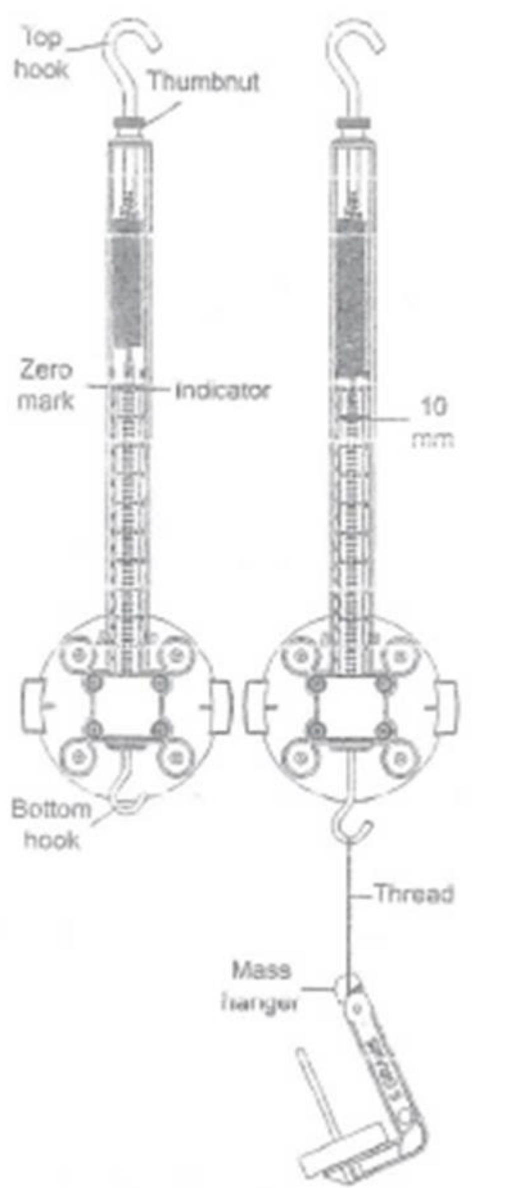


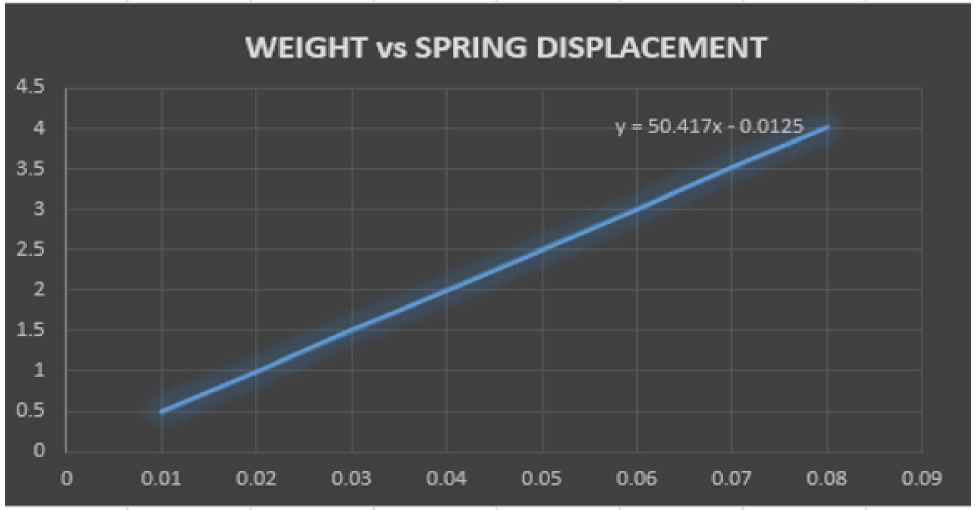
Figure 1.1: Setup and Procedure

LAB 1
Hooke's Law Results and Conclusion

We found that by using the appropriate spring gives us accurate results and makes Hooke's law useful when calibrating a spring for measuring forces.

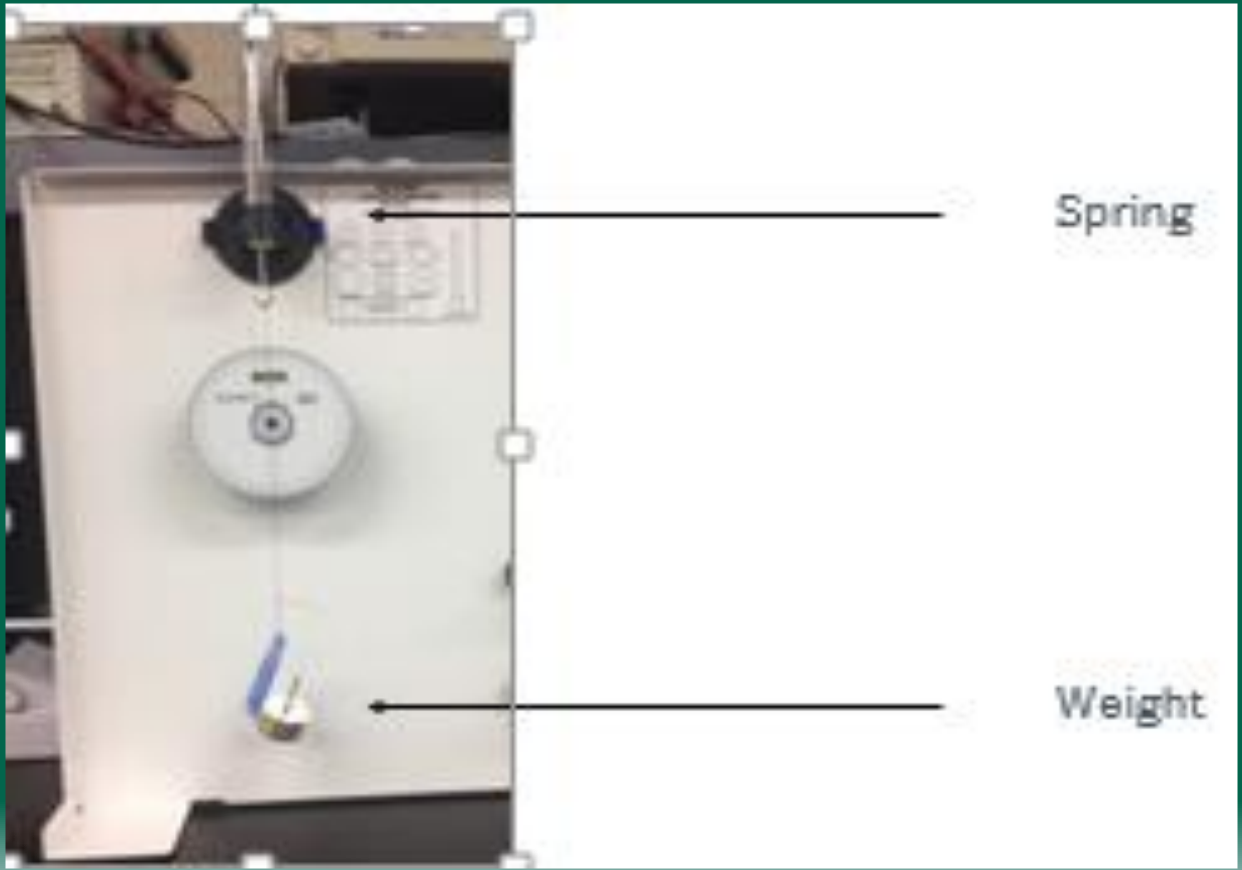
RESULTS

Lab 1 Measureed Value						
Spring Displacement	(m)	Mass	(kg)	Weight	(N)	
0.01	m	0.05	kg	0.49	N	
0.02	m	0.102	kg	0.99	N	
0.03	m	0.155	kg	1.52	N	
0.04	m	0.205	kg	2	N	
0.05	m	0.255	kg	2.5	N	
0.06	m	0.31	kg	3	N	
0.07	m	0.36	kg	3.53	N	
0.08	m	0.41	kg	4.02	N	
Lab 1 Calculated Value				F=mg	g=	9.81
Spring Displacement	(m)	Mass	(kg)	Weight	(N)	
0.01	m	0.05	kg	0.4905	N	
0.02	m	0.102	kg	1.00062	N	
0.03	m	0.155	kg	1.52055	N	
0.04	m	0.205	kg	2.01105	N	
0.05	m	0.255	kg	2.50155	N	
0.06	m	0.31	kg	3.0411	N	
0.07	m	0.36	kg	3.5316	N	
0.08	m	0.41	kg	4.0221	N	



F=mg

LAB 2
ADDING FORCES-RESULTANTS AND EQUILIBRIANTS



LAB 2: Adding Forces

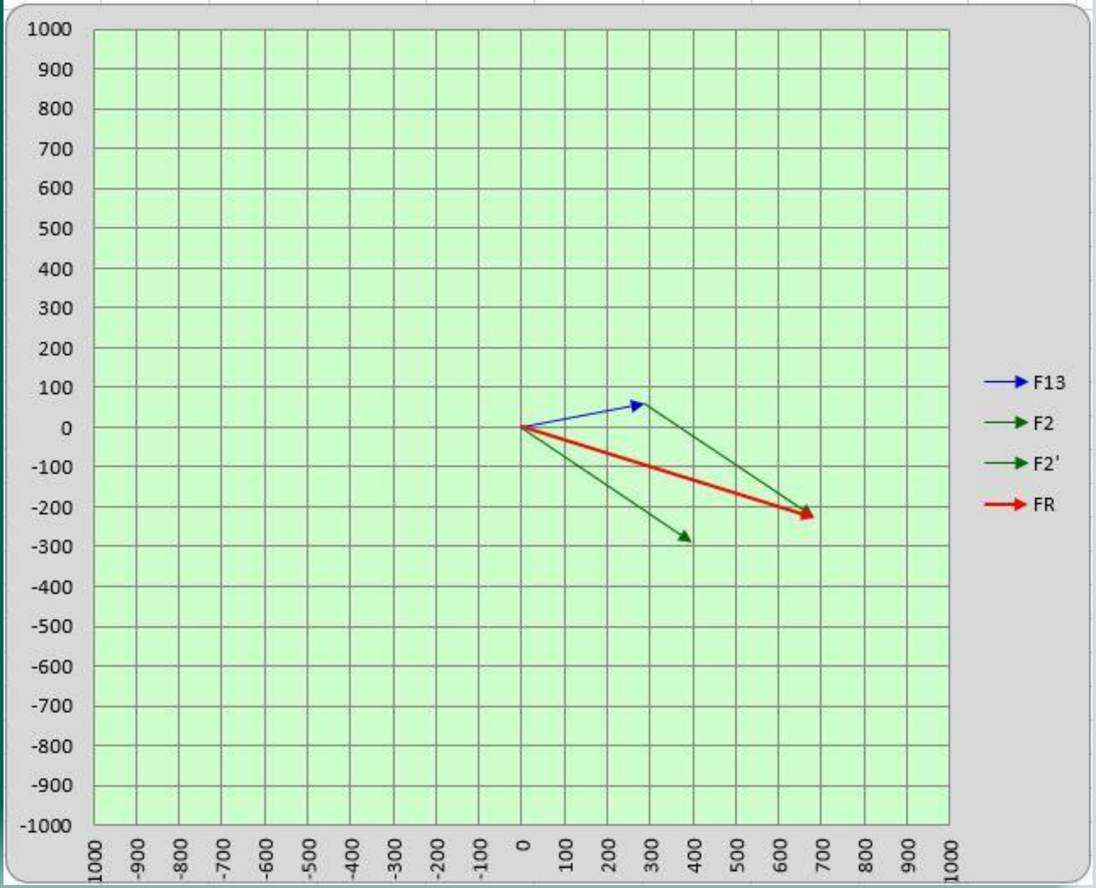
Results

	r	theta	x	y		
F13	0	0	0	0		Mag F1
	294.00	12.00	287.58	61.13		
						Ang F1
F2	0	0	0	0		
	490	324	396.42	-288.01		Mag F2
F2'			287.58	61.13		Ang F2
			683.99	-226.89		36
FR	0	0	0	0		
	720.64	-18.35	683.99	-226.89		

These values have been scaled 1000 times

Actual values are

F1	0.294	N
F2	0.49	N
FR	0.72	N



LAB 2: Adding Forces

Conclusion

Lab Questions

1. Does the magnitude of equilibrant force vector, F_E, exactly balance the magnitude of the resultant force vector, F_R. If not, what are some possible reasons for the difference?

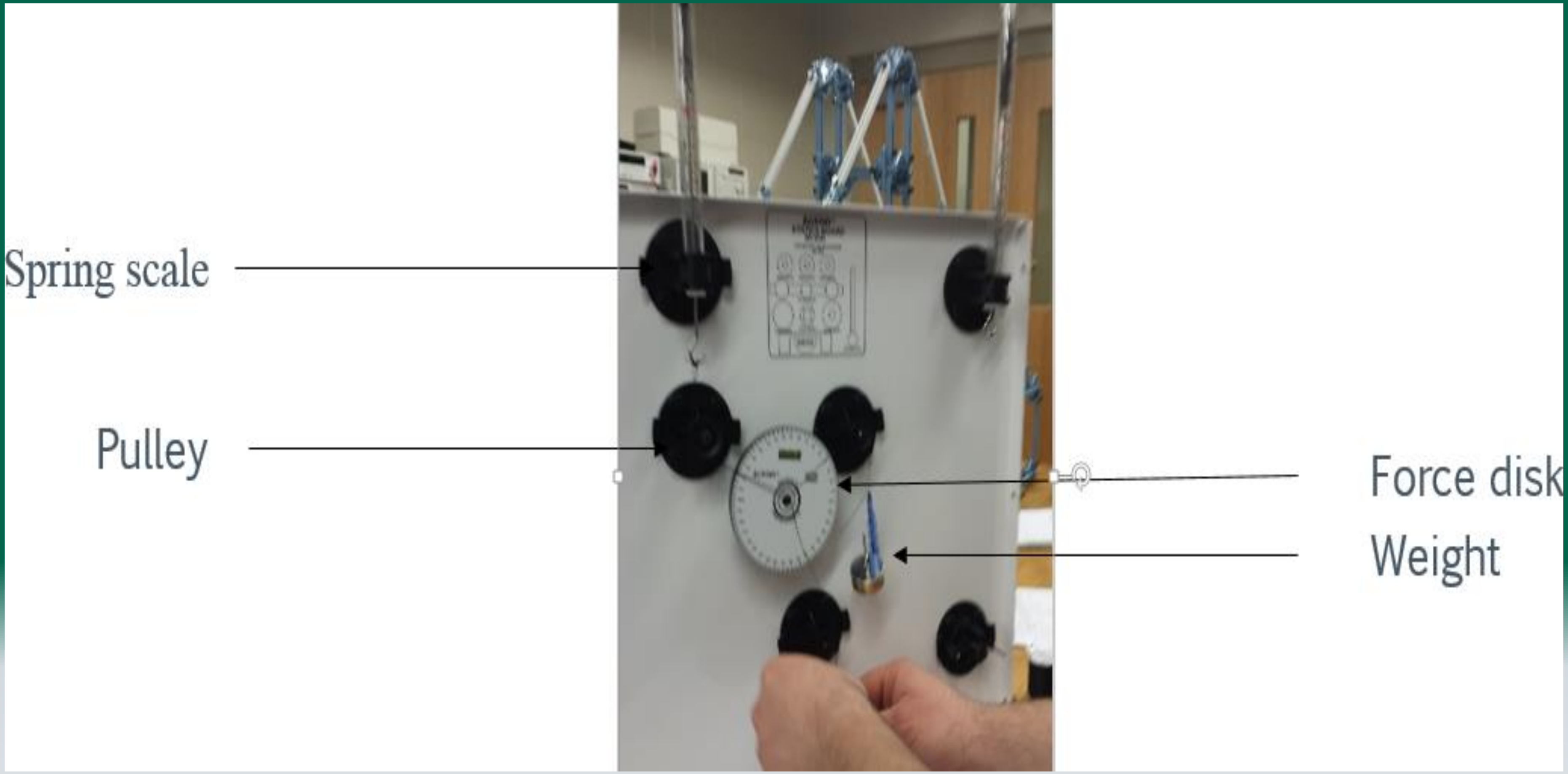
2. How does the direction of the equilibrant force vector, F_E, compare to the direction of the resultant force vector F_R?

Answers

1. Yes, it balances closely, however, the angles are slightly off because of inaccurate drawing.

2, It's exactly 180° opposite of Resultant Force.

LAB 3: Resolving Forces



LAB 3: Resolving Forces
Results

Rersolving Component Forces										
PASCO LAB 3										
PROCEDURE 1						PROCEDURE 2				
	CALCULATED		OBSERVED				CALCULATED		OBSERVED	
ΣR_x	0.28	N	0.28	N		ΣR_x	0.40	N	0.40	N
ΣR_y	0.25	N	0.25	N		ΣR_y	0.15	N	0.15	N
F_R=	0.37	N	0.34	N		F_R=	0.43	N	0.43	N
θ_R=	41.19	°	43.00	°		θ_R=	20.18	°	20.20	°

LAB 3: Resolving Forces

Conclusions

- We added concurrent forces vertically to determine the magnitude and direction oft combined forces in lab 2.
- This experiment we found two sources when added together have the same magnitude and direction as the original force.
- What we found out was that is at equilibrium in the center of the force wheel because in is in Static Equilibrium.
- We also found that as the Vector F1 and F2 becomes closet to parallel, it does not directly effect the x component. Also only an x component would be required if it is was not in equilibrium.

LAB 4: Simple Truss Design

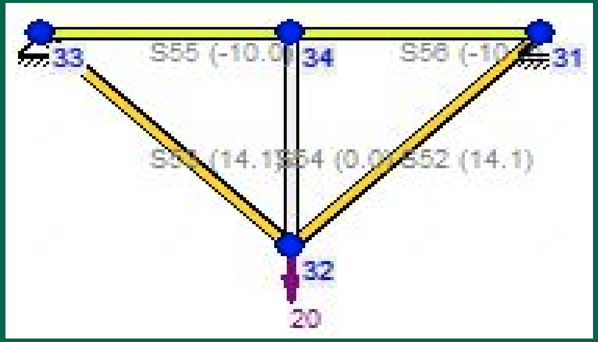
Inverted Triangle Truss

- Basic truss used as an introduction to truss design
- Special attention noted to the vertical truss with a nearly 0 net force.
- After resolving for the Y component of all three trusses, it can be concluded that our lab data is fairly accurate, and summates to a force nearly equal to the original hanging force

LAB 4: Simple Truss Design

Inverted Triangle Truss

- A
  - Simulate Truss Design
- B
  - Calculate Force Distribution
- C
  - Compare to Results of Lab Data



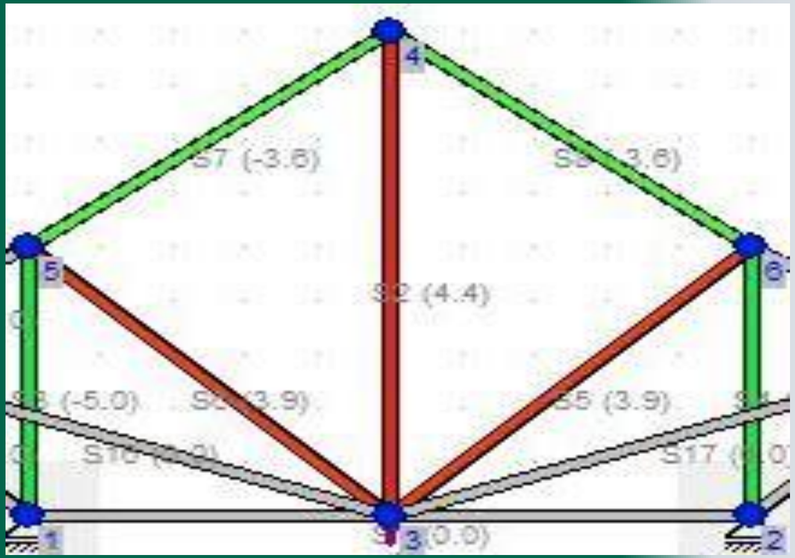
Truss ID	Lab Results	Simulated Results	Resolving For Lab Results
$F_{32,31}$	-1.27 N	-1.4 N	-0.898025612 N
$F_{32,33}$	-1.38 N	-1.4 N	-0.975807358 N
$F_{32,34}$	-0.05 N	0 N	-3.1E-18 N
Force Hanging			Sum of "Y" Components
1.98 N			-1.87383297 N

Force 1, Ch P2 (N)	Force 2, Ch P2 (N)	Force 3, Ch P2 (N)
-1.27	-1.38	-0.05

LAB 5: Baltimore Bridge Design

LAB 5: Baltimore Bridge Design

- A: Simulate Truss Design
- B: Calculate Force Distribution
- C: Compare to Results of Lab Data

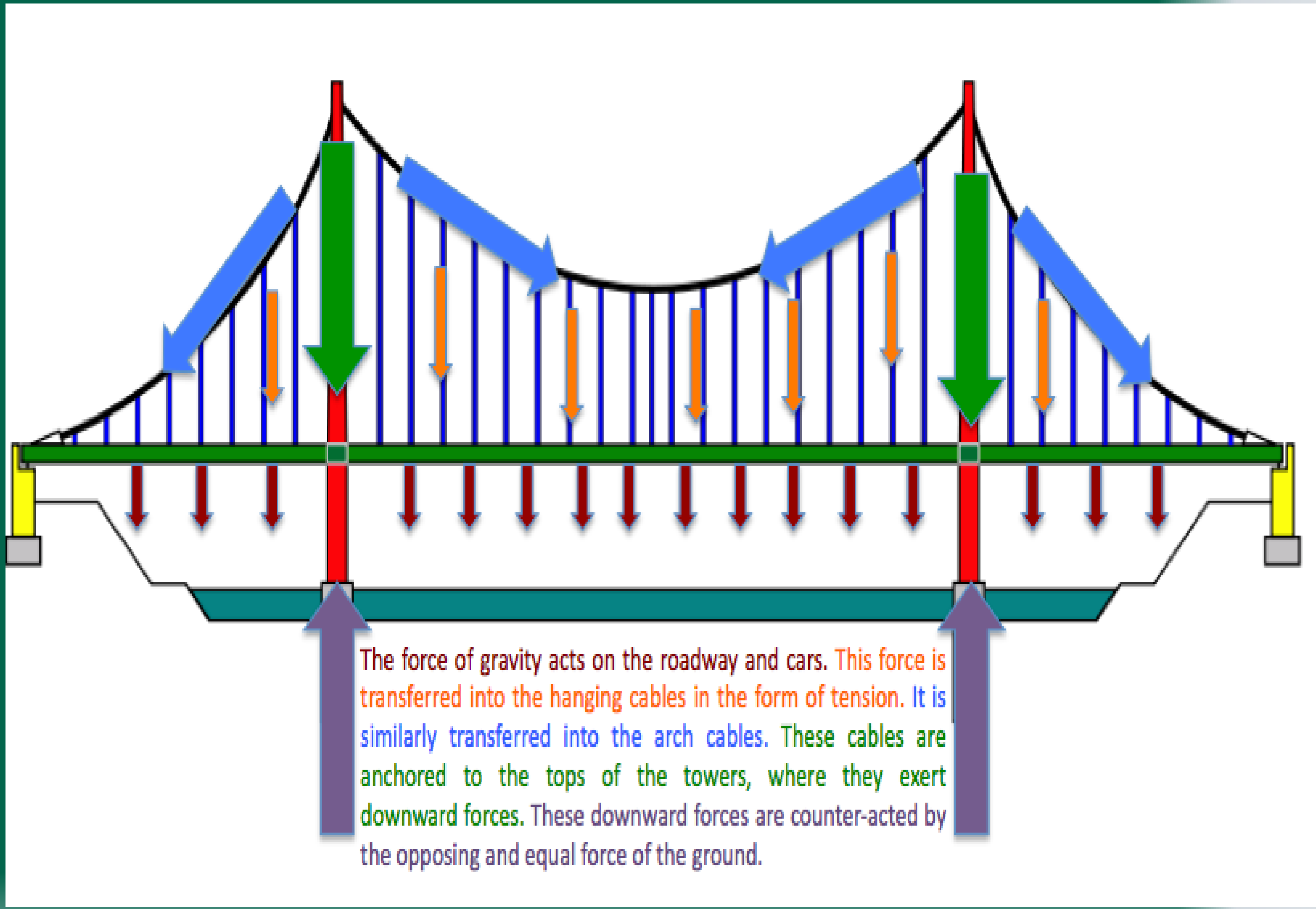


Truss ID	Lab Results		Simulated Results		Resolving F_y from Lab Results	
$F_{3,1}$	-8.15	N	0	N	-4.99248E-16	N
$F_{3,5}$	-3.85	N	-3.9	N	-2.722361108	N
$F_{3,4}$	-1.23	N	-4.4	N	-75.3E-18	N
$F_{3,6}$	-6.63	N	-3.9	N	-4.7E+0	N
$F_{3,2}$	-6.25	N	0	N	-382.9E-18	N
Force Hanging					ΣF_y	
-9.8	N				-7.410479067	N
IF $F_{3,5}$ was equal to $F_{3,6}$, our forces would have resolved muched closer to the hanging weight						

LAB 6: Golden Gate Bridge Design

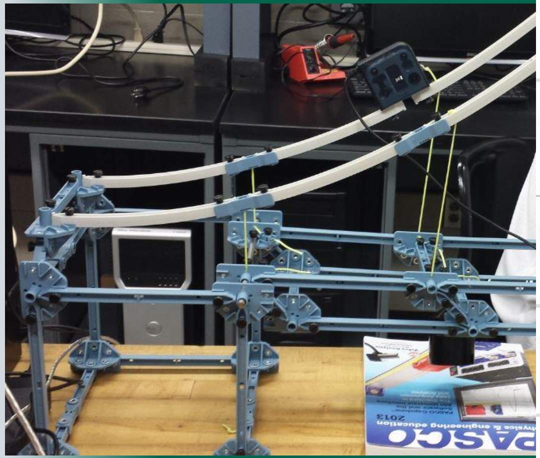
Suspension Bridge

- We Tested this theory by using 5 load cells placed at various locations, and then moved a load along the bridge.
- The data we recorded in the lab matches the tension and compression trends indicated.



LAB 6: Golden Gate Bridge Design

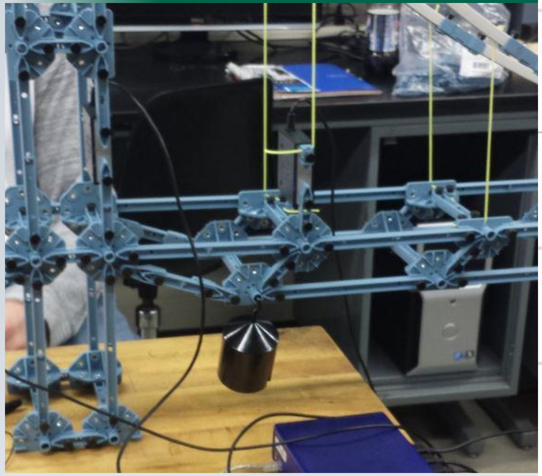
Suspension Bridge



Force 1 (N) Run #1
-0.78N
[Digits title here]
Force 2 (N) Run #1
-2.91N
[Digits title here]
Force 3 (N) Run #1
-0.11N
[Digits title here]
Force 4 (N) Run #1
2.66N
[Digits title here]
Force 5 (N) Run #1
-0.59N

Load Location A1

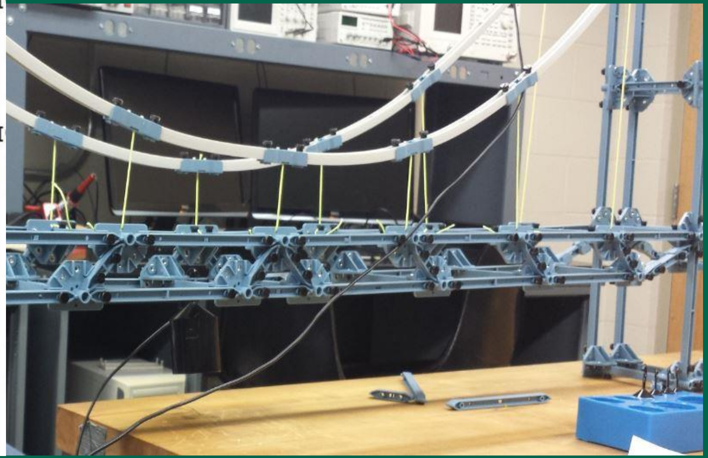
Load Location B1



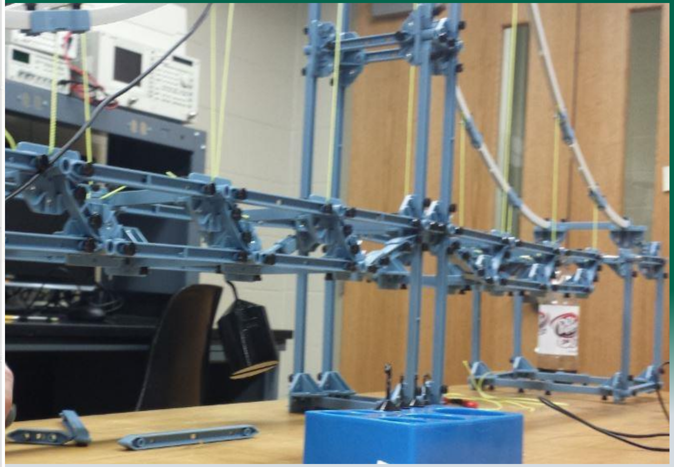
Force 1 (N) Run #1
0.14N
[Digits title here]
Force 2 (N) Run #1
1.69N
[Digits title here]
Force 3 (N) Run #1
-0.32N
[Digits title here]
Force 4 (N) Run #1
-2.59N
[Digits title here]
Force 5 (N) Run #1
0.16N

Force 1 (N) Run #1
-1.74N
[Digits title here]
Force 2 (N) Run #1
7.06N
[Digits title here]
Force 3 (N) Run #1
0.13N
[Digits title here]
Force 4 (N) Run #1
-16.28N
[Digits title here]
Force 5 (N) Run #1
-4.30N

Load Location C1



Force 1 (N) Run #1
-0.47N
[Digits title here]
Force 2 (N) Run #1
0.24N
[Digits title here]
Force 3 (N) Run #1
-0.01N
[Digits title here]
Force 4 (N) Run #1
-4.39N
[Digits title here]
Force 5 (N) Run #1
-0.70N

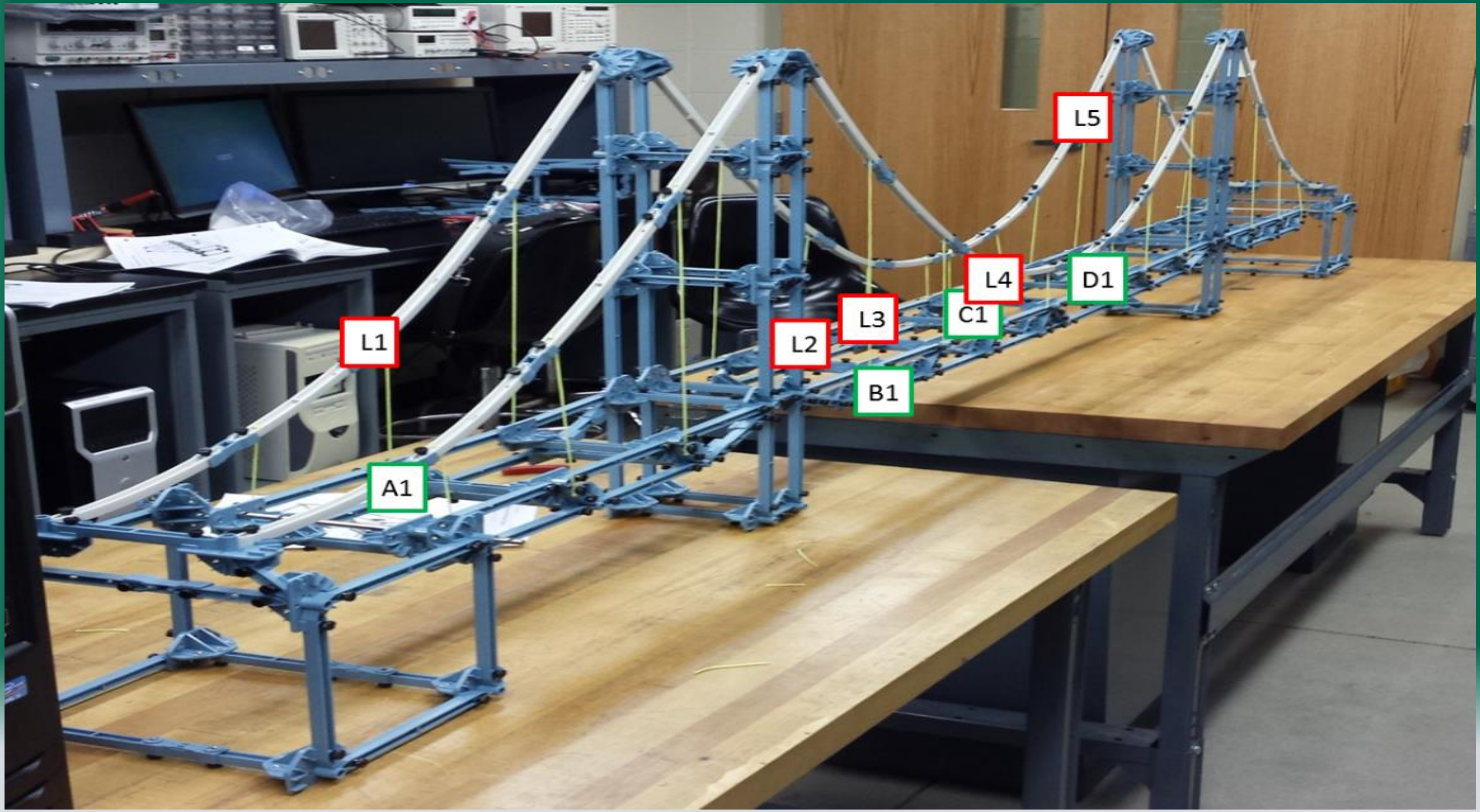


Load Location D1

LAB 6: Golden Gate Bridge Design

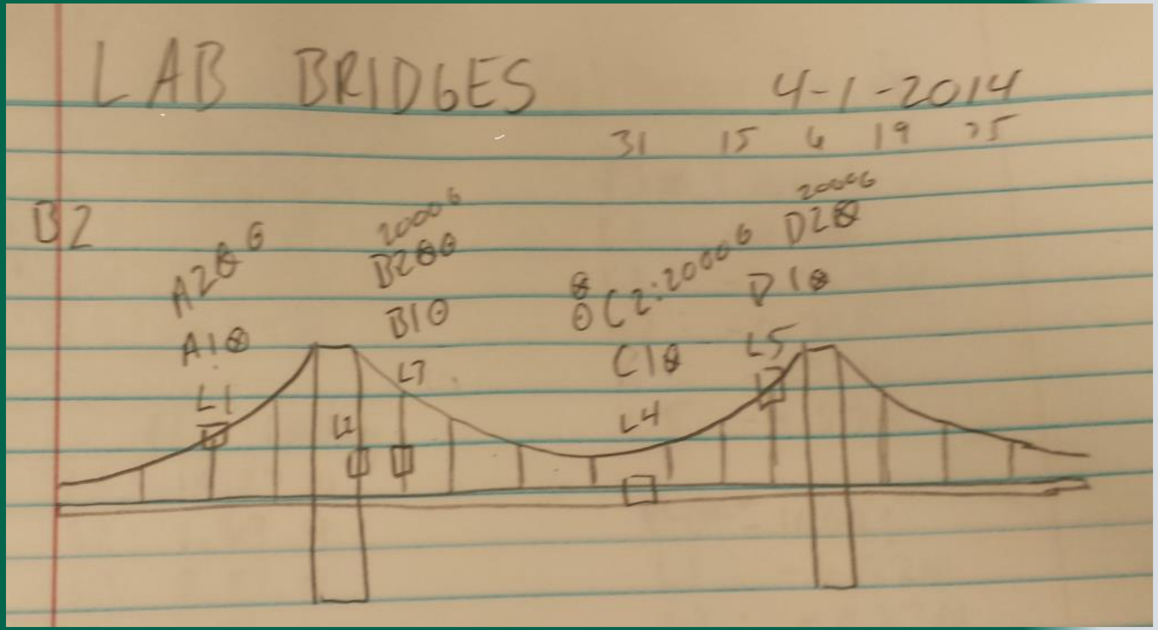
Suspension Bridge

Load Cell Locations and Load Locations



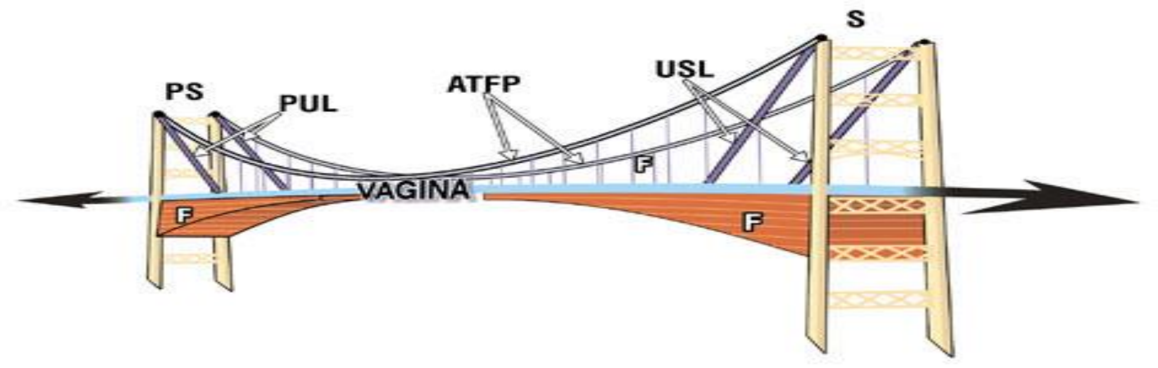
LAB 6: Golden Gate Bridge Design

Suspension Bridge

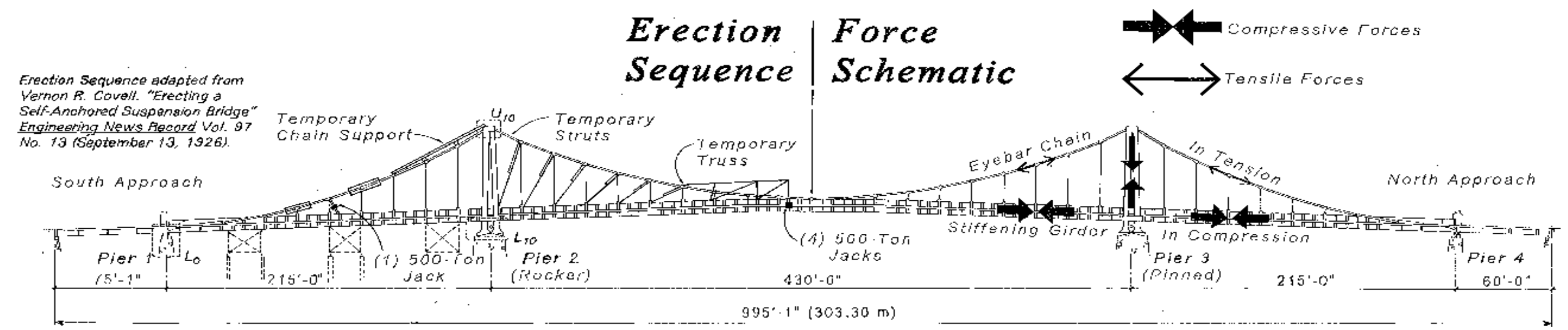


LAB 6: Golden Gate Bridge Design
Suspension Bridge

› Anatomy of a Suspension Bridge

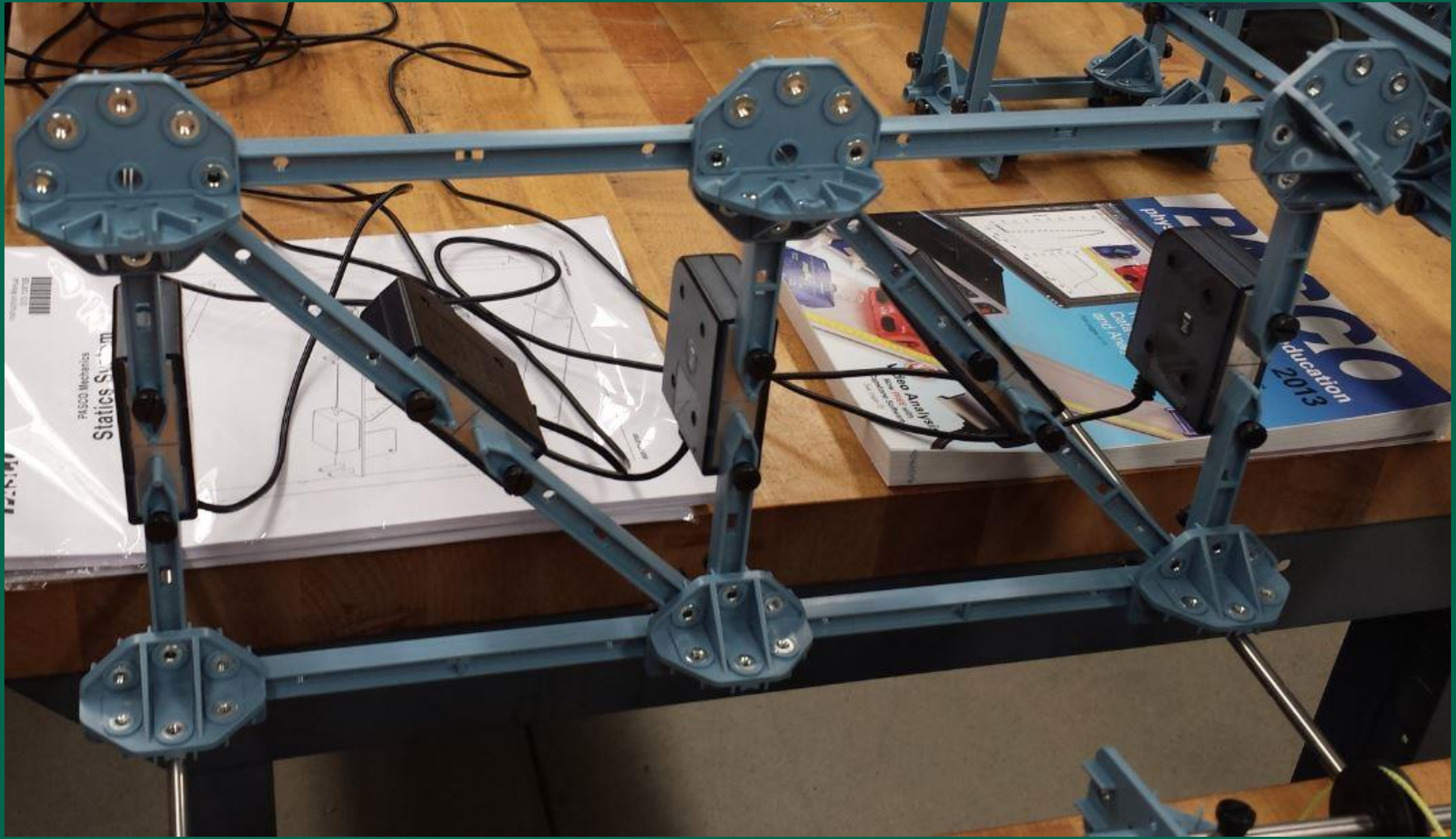


› Erection Sequence Force Schematic

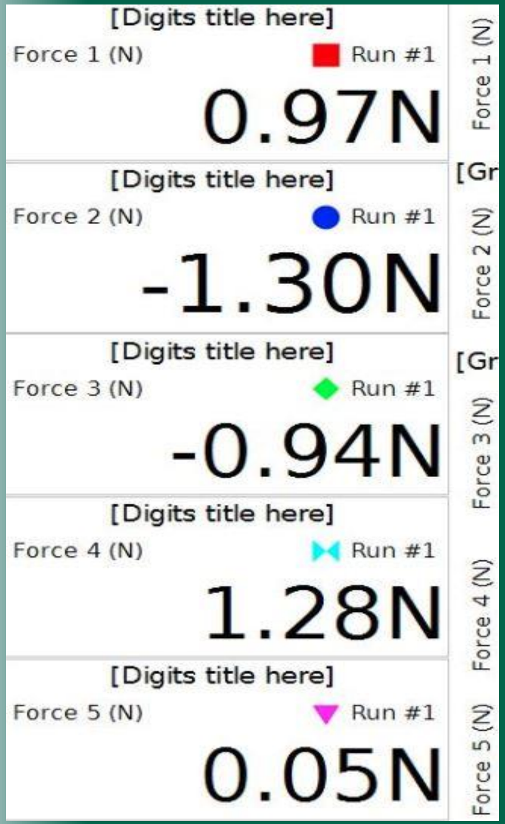


LAB 7

45 Degree Angle Truss Design



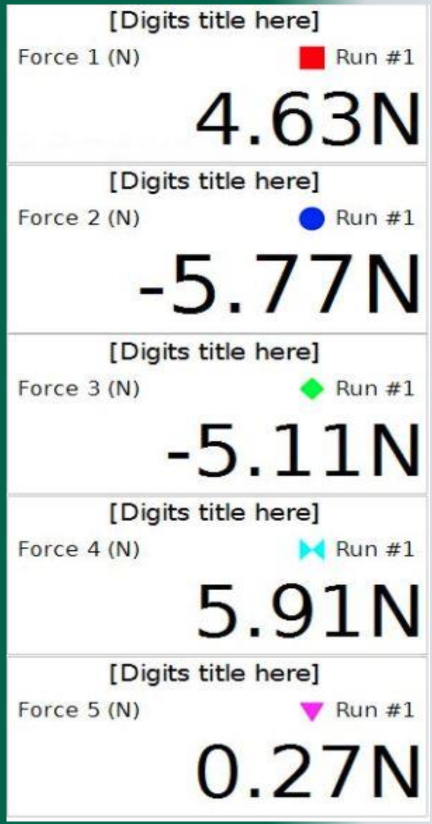
LAB 7
45 Degree Angle Truss Design



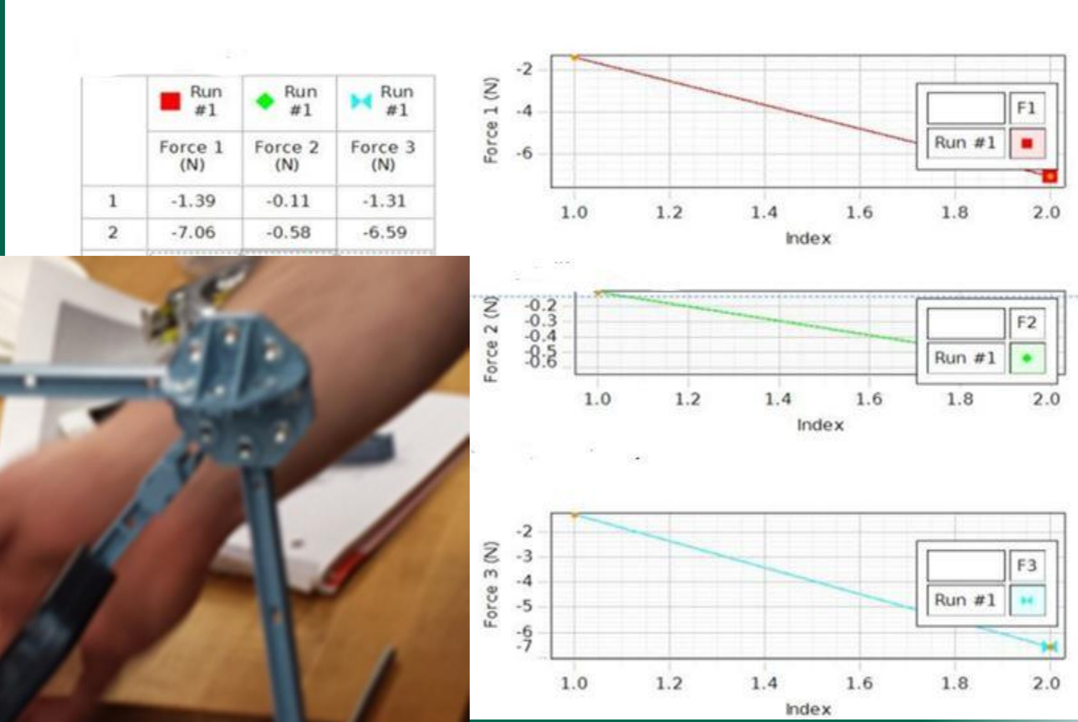
We noticed a direct correlation between the amount of the hanging mass, and the resulting forces from this lab.

The data set on the left is from 200g hanging, the data set on the right, 5 times that amount.

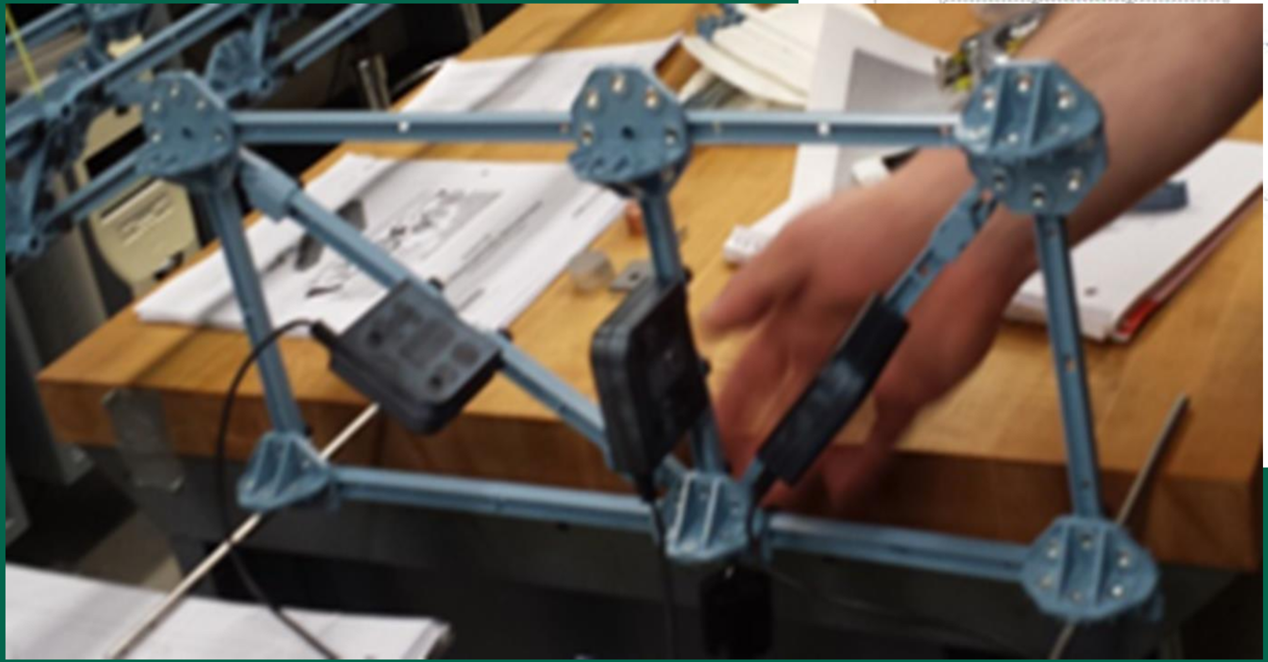
200g Values		1000g Values		1000g Values Divided by 5	
970.0E-3	N	4.6E+0	N	926.0E-3	N
-1.3E+0	N	-5.8E+0	N	-1.2E+0	N
-940.0E-3	N	-5.1E+0	N	-1.0E+0	N
1.3E+0	N	5.9E+0	N	1.2E+0	N
50.0E-3	N	27.0E-3	N	5.4E-3	N



LAB 8
Truss Lab with Different Angles



	Run #1	Run #1	Run #1
	Force 1 (N)	Force 2 (N)	Force 3 (N)
1	-1.39	-0.11	-1.31
2	-7.06	-0.58	-6.59



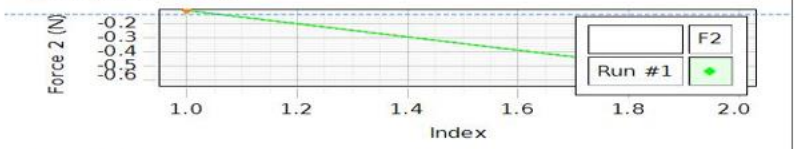
Lab Testing

[Table title here]

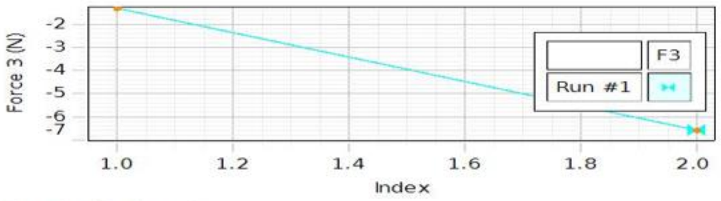
LOAD (N)	Run #1 Force 1 (N)	Run #1 Force 2 (N)	Run #1 Force 3 (N)
1.96N	-1.39	-0.11	-1.31
9.8N	-7.06	-0.58	-6.59

Beams 1 and 3 carry the force load with a small force on the vertical beam 2. Beam 2 has both tension and compression forces on it resulting a overall minimal force.

[Graph title here]



[Graph title here]



[Graph title here]