<u>Truss Design Technical Report</u>

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E-231 - Engineering Design III – Stevens Institute of Technology

11/7/14

Section G Group 2

I Pledge My Honor that I have abided by the Stevens Honor System.

Signature___________________________

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Abstract:

In this Engineering Design 3 project, the goal was to design a planar truss that is capable of holding a specified amount of weight using a specified amount of brass. The class tested the strength of the planar truss by using Buster, which applied a load to the truss. The class also tested the team's computer analysis skills, which involved the use of Planar Truss Analysis, to design three trusses, and the use of Microsoft Excel, which was used to analyze the results provided by Planar Truss Analysis. The project also tested the team's ability to construct theoretical models. The teams had to blueprint their chosen truss design and construct them using brass rods, Gusset plates (see A6 for a look at gusset plates) and solder to hold everything together. Finally, the written and management parts of the report consisted of the creation of a technical report and Gantt chart, respectively.

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Introduction

The purpose of this report is to complete one of the E-231 (Engineering Design 3) requirements, which is to go through the engineering motions to develop a brass truss that on paper holds at least 325 pounds and in practice holds a similar amount of weight determined from the theory. In this project, the team will apply the theoretical knowledge that the team is concurrently learning in Mechanics of Solids, E-124. The group will also see where the practical application diverges from the theory and where the factor of human error and impurities in the material comes into play. The team will also focus on the engineering design process by going through several iterations of designs and adjusting them until the predicted failure load is optimized.

Once the truss with the highest theoretical failure load is designed in the MatLab program, Planar Truss Analysis, the team will enter it into a contest with our classmates to determine which truss has the highest theoretical failure load. The results will play a factor into our final grade. Once the highest theoretical truss is determined, the team will create a matrix to determine which truss the group will eventually build. The highest theoretical trusses will not necessarily translate to the truss that the team creates as other factors, such as difficulty of construction and aesthetics must be taken into account. Once the team determines which truss the group is building based on the matrix that the team created, they will test the truss on a machine that will apply a load directly to the center until the truss cannot support the weight which will be due to compressive force.

The team must follow a certain set of guidelines if they are to succeed in this report. The most important project requirement is that the team must produce a truss that can support a certain weight. While the truss they create will not have to support that weight, the design the team submits, which is an indication of the theoretical weight the truss can hold, must hold a direct load of 325 lbs. There are several other requirements that they must be aware of such that the bridge must span a minimum length of 15 inches across and can be a maximum of 4 inches high. In the design, they are also not allowed to use more than 84 inches of brass.

A portion of the grade is also based on the adherence to a schedule set by the professor as well as how well the team works together in a group. The team created a Gantt Chart (see A1), which was imperative in staying on schedule throughout the project. Team meetings were imperative throughout the course as they allowed the team to discuss problems they were having and how they would get through said problems. Another thing that contributed to the teams groups success was an awareness of what each member was doing. This was done using a well designed work breakdown structure. Overall the team dynamic was one of support and mutual respect.

Overall the Planar Truss design project is a pivotal project in the engineering design curriculum that gives group members a chance to apply the theoretical knowledge they learn in E-126, in a practical, controlled setting.

Discussion

The discussion section servers to explain the steps and the process the team took when designing the truss. In this section, the report will discuss the design process and the several iterations that the team went through before choosing their final design. Also discussed in the design section is how the team calculated the predicted failure load and what formulas they used in Microsoft Excel to calculate which member will fail. The design section will also elaborate on the difficulties the team faced while they were in the construction phase such as concerns with running out of material and how to best conserve the material. Next, this report will discuss the fabrication where the team will discuss what assembly techniques and what soldering consideration they used while creating the actual truss. The team will also discuss the final weight of the truss and its strength to weight ratio. Finally the team will discuss the testing phase, which includes the test with "Buster", the testing apparatus, which applied a force to the center of the truss and in attempt to compress its members. The report will then discuss how the actual load to failure compares against the predicted failure load as well as which specific member was the failure member. Finally the report will discuss the ranking in the contest between groups that attempted to determine which truss held the most in the theoretical truss designer, Planar Truss Analysis.

Design Section

The design portion of this project can be broken down into two main components: truss design and truss analysis. The truss design portion for this project uses LabView software to build truss designs. Our group designed three working trusses using the LabView design software; all three of these designs can be seen in the pictures below:

Figure 1 - The form factor of our first, chosen design

Figure 2 - The form factor of our second design

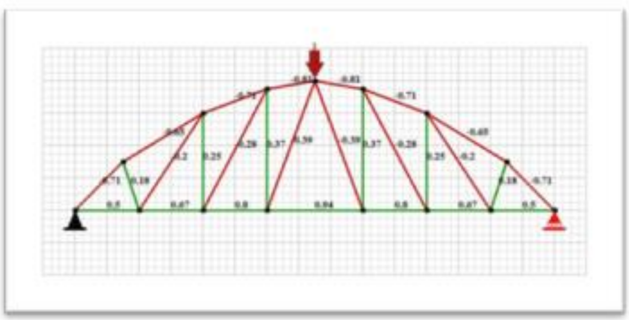
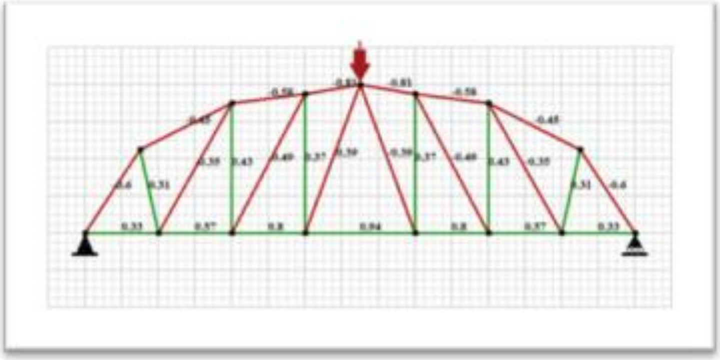


Figure 3 - The form factor of our third design



All three of the above trusses were constructed using the LabView software and all of the trusses meet the specifications of the project; they are all at least 15 inches long, no more than four inches high, and can hold a minimum load of 325 pounds. To calculate the maximum load that each truss can hold there is a series of calculations that must be done. First, using the class data from the Buckling lab you must obtain an equation for the strength of the brass with respect to the member's length (The equation obtained from our class's data is $y=-33.21x + 318.52$; x being the length of the brass). Once you obtain the strength of the brass member from the equation you can then find how much load can be applied to the truss before this member fails by dividing the strength of the brass by the load ratio that is obtained from the LabView software. These calculations must be done for all the members of each truss and the member with the lowest load that can be applied to the truss determines the maximum strength of the entire truss. For practicality, all members that are in tension can be ignored; only look at the members that are in compression (in the LabView software compression is denoted by a negative load ratio). The data/calculations for the truss that we chose are shown below.

Member	Length	Max Strength	Ratio	Actual Load	Total Length
1	2	252.1	0.3333	756.37564	77.536
2	3.606	198.7647	-0.6009	-330.7784	
3	2.693	229.0855	-0.6058	-378.15363	

4	3.909	188.7021	0.358	527.10087
5	3	218.89	0	#DIV/0!
6	2.5	235.495	0.3333	706.55566
7	3.5	202.285	-0.5625	-359.61778
8	2	252.1	0.225	1120.4444
9	2	252.1	-0.275	-916.72727
10	4.031	184.6505	0.5039	366.44273
11	4.031	184.6505	-0.5039	-366.44273
12	3.5	202.285	0.5625	359.61778
13	4.031	184.6505	-0.5039	-366.44273
14	4	185.68	-0.5	-371.36
15	3.5	202.285	-0.5625	-359.61778
16	4.031	184.6505	0.5039	366.44273
17	3.5	202.285	0.5625	359.61778
18	2	252.1	0.225	1120.4444
19	2.693	229.0855	-0.6058	-378.15363
20	2	252.1	-0.275	-916.72727
21	2.5	235.495	0.3333	706.55566
22	3.905	188.835	0.358	527.47193
23	3	218.89	0	#DIV/0!
24	3.606	198.7647	-0.6009	-330.7784
25	2	252.1	0.3333	756.37564

The truss that our group chose to construct is the one shown in Figure 1. There were multiple factors that went into this decision such as the maximum load that it can hold, which

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members will fail, and the ease of construction. A full breakdown of why the team chose which design they did is found in A18. The appendix also describes the teams chosen design, the first alternate design and the second alternate design in appendix A2-A5, A9-A12, and A13-A16, respectively. The truss in Figure 1 can hold a maximum load of 330.78 pounds, which is .03 pounds more than the other two designs. In order to figure this out the team used the brass compression sheet found in the appendix (A18, A19, A20) This is a small amount difference, but it is where the failures occur that make this truss stronger. Since the failures will happen at members 2 and 24 this reduces the probability of failure due to joint slippage. Also the truss shown in Figure 1 can be constructed using minimal cutting and soldering of the brass (this will be explained further in the fabrication section of this report) which makes it stronger in actual practice. Overall, the truss in Figure 1 was considered to be the stronger truss; its data, along with the data for the other two considered truss designs can be found in the attachments section of the report. This design matrix shown below also shows the thought behind the decision of picking the truss in Figure. 1

	Design 1			Design 2			Design 3		
Number of Members	27			27			25		
Number of Joints	15			15			14		
Total Amount of Brass	71.768			77.189			77.536		
Length	15			15			16		
Height	4			4			4		
	Score	Weighted Score	Total Score	Score	Weighted Score	Total Score	Score	Weighted Score	Total Score
Maximum Load (x1.5)	10	15	40.25	10	15	43	10	15	49.75

Ease of Assembly (x2)	5	10	6	12	9	18
Aesthetics (x.75)	7	5.25	8	6	9	6.75
Total Amount of Brass (x1)	10	10	10	10	10	10

After choosing to construct the truss shown in Figure 1 our group had to look at the fabrication concerns that accompanied this truss. The main problem that our group faced was the concern for joint slippage or in other words having the joints fail before the members buckle due to inadequate soldering. This was a concern because there are multiple joints where four members meet. However, the team was able to solve this problem by using the "notch and bend" technique. This will be explained more thoroughly in the fabrication section of the report, but by using this method they were able to solder five-member joints with the ease of a three-member joint and four-member joints with the ease of a two-member joint. This technique enhances not only the strength of the truss, but also the overall neatness of the truss.

Fabrication

Fabrication of the truss began with drawing a 1:1 scale model on grid paper with each member labeled with its respective length. The outer members of the truss were constructed first. The largest piece of brass was placed on the schematic, marked for cutting, notched with a band saw, and bent to the correct angle. This was repeated until the brass completely looped around and joined at the top remaining as one solid piece of brass (See appendix A8 for a visual). The goal was to minimize how many individual pieces the truss consists of. Essentially the truss contains very few, but very long, bent pieces of brass. It was decided that cutting two members then soldering them back together at a joint is less stable than notching, bending, then soldering. They team then moved into the next class as they were halfway done with the truss, see appendix A7. In addition, this made soldering much easier resulting in better joints. For example, joints that have four members meeting would only require two pieces of bent brass to be soldered rather than four individual pieces. This method of minimizing shear cuts was repeated for all members when able. However, the entire truss cannot be constructed with one whole piece of brass without any shear cuts. Knowing that every member wouldn't meet at a bend forced a decision to be made as to which joints would have shear cuts. The joints that would undergo the least amount of stress were chosen to have the end pieces of the brass meet at. In the end the truss would only be constructed out of five individual pieces of brass.

In addition to minimizing total amount of individual lengths of brass to reduce the chance of joint popping, much care was taken when soldering the joints. Each joint was heated up only once and all solder was applied at once. This was done because most of the flux burns off after the first solder is made. If the joint is reheated after some solder is already applied then the solder currently on the joint will melt and have significantly less flux under it to help it reattach. In order to apply all the required solder while only heating the joint once multiple people were required to apply solder and all members at a specific joint must be present during the solder. All of these precautions are an attempt to minimize how much structural integrity is lost due to construction. The planar truss analysis program that was used to design the truss is in an ideal setting. The most important goal with construction is to assemble the truss so that it fails at a member not a joint.

Testing

The truss buster, the apparatus used to test the truss' maximum load, is designed to test the truss in a two dimensional plane similar to the truss designing program used to create the schematics for the truss. A load is placed on the top and center of the truss and steadily increases until the truss gives. When the truss gives, the maximum force of the load is recorded. However, the test was incorrectly conducted on the group's truss. When the force on the load was increased there was a gap between the load and the truss. The force was increased until the load couldn't hold back any more and came down onto the truss with an unknown and very high force. The machine was quickly shut off seeing as the test was a fluke. A quick inspection of the truss showed that nothing was visibly broken* and the test was run again. The second test was done correctly but only yielded a load to failure value of 192 lbs. This was much lower than the theoretical load to failure value, 330.78 lbs, and is most likely due to the first faulty test severely weakening the joint between members 15, 19, and 18 redirecting the force into member 13, the member to fail. This is contradictory to the expected members to fail, 2 and 24, but due to a faulty test many of the expectations were nullified. Group 2 came in 8th place out of 8 groups in the class.

*After later speculation it was clear that the first test popped a joint. This was not obvious when the truss was inspected before the second test because the members that popped out of the joint consisted of one piece of bent brass. Despite the joint technically being popped it still held together but was severely weakened. The gusset plate was not attached but the two members were still held together by the thin piece of brass at the notched bend between them.

Conclusion

Overall, the teams accomplished several things throughout the course of the Truss Design project experiment. The team successfully constructed a truss that in theory could hold 330.78 pounds and created one that could hold 192 pounds while undergoing test at the buster testing machine. The team was also very proud of their management of materials. They optimized construction by carefully planning out all segments and in the end, ended up with a significant amount of brass leftover. Other team accomplishments include creating a professional, full length design report. The teams only unsuccessful endeavor was the management of time in certain scenarios. The team did not complete their three designs in a time efficient manner but more than made up for it by being one of the first to complete their final truss design in class. Overall the team felt like they accomplished a lot with the creation of their truss and it ultimately helped them understand the material they are learning in the Mechanics of solids better.

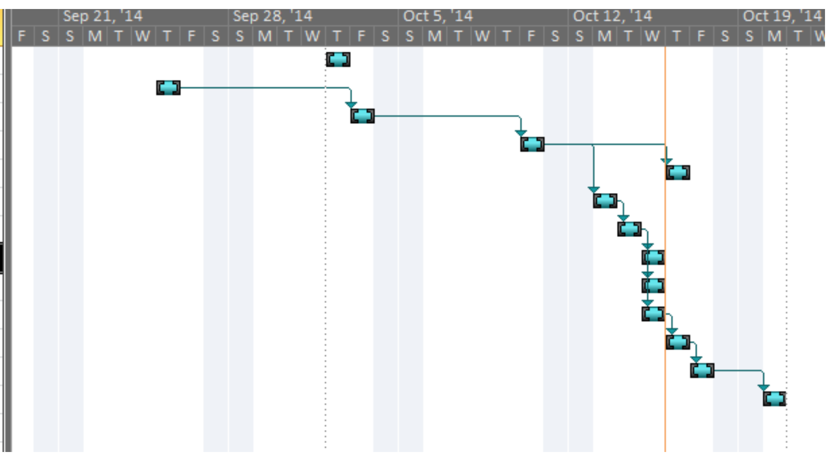
Recommendations

While the team feels the project was largely successful, they have several recommendations to help make future classes more successful.

- The team was disappointed by the condition that buster was in. It impacted the truss two times at around the same load which they feel decreased the actual failure load of the truss
- The team believes that more explanation should be given when using the planar truss editor. The team and most of the class had trouble understanding the different errors that the program would return. A simple guide should be created.
- The team believes that the competition results should be based on who can create the best practical truss instead of who can create the best with the planar truss analysis. Someone clicking around in random points could create a better truss than someone who understands their objective.

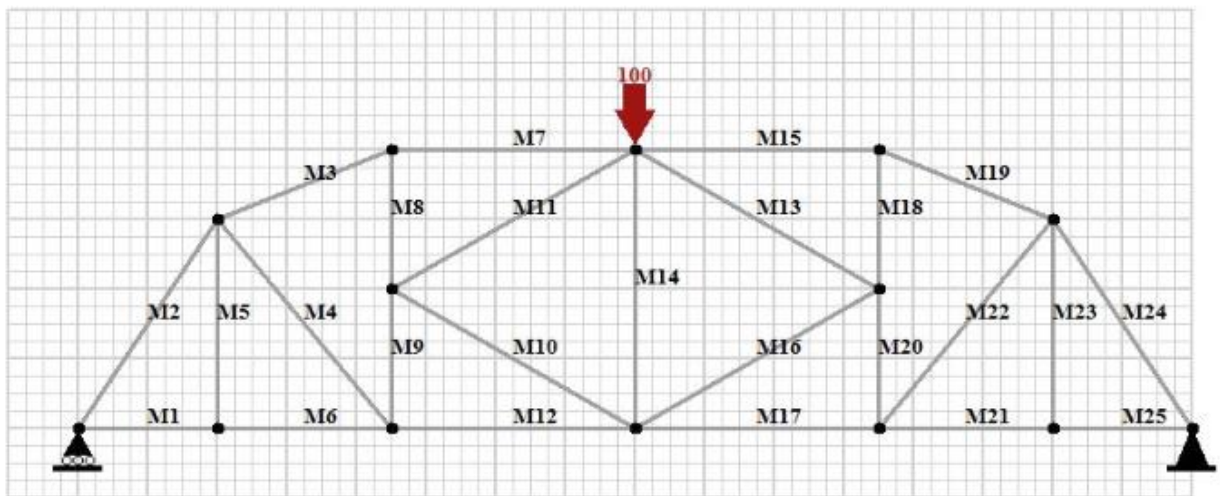
Appendix

Task Mode	Task Name	Duration	Start	Finish	Predecessors
	Practice Soldering	1 day	Thu 10/2/14	Thu 10/2/14	
	3 Working Truss Designs	1 day	Thu 9/25/14	Thu 9/25/14	
	Build Truss	1 day	Fri 10/3/14	Fri 10/3/14	2
	Test Truss	1 day	Fri 10/10/14	Fri 10/10/14	3
	project 2 Intro	1 day	Thu 10/16/14	Thu 10/16/14	4
	Oral Review	1 day	Mon 10/13/14	Mon 10/13/14	4
	Test Truss	1 day	Tue 10/14/14	Tue 10/14/14	6
	Oral Reports	1 day	Wed 10/15/14	Wed 10/15/14	7
	Final Design Beam	1 day	Wed 10/15/14	Wed 10/15/14	7
	Economics	1 day	Wed 10/15/14	Wed 10/15/14	7
	Build Beams	1 day	Thu 10/16/14	Thu 10/16/14	10
	Oral Reports	1 day	Fri 10/17/14	Fri 10/17/14	11
	Test Beam/Final Report	1 day	Mon 10/20/14	Mon 10/20/14	12

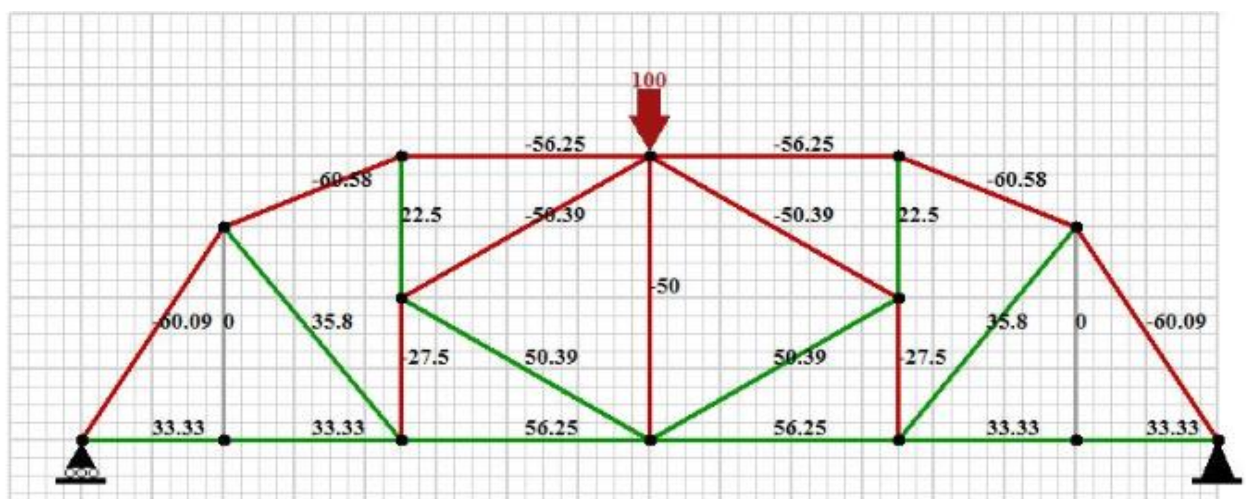


A1 - Gantt Chart

A2 - Chosen Truss Design - Member Labels



A3 - Chose Truss Design - Member Load Ratios



A4 - Chosen Truss Design - Member Lengths

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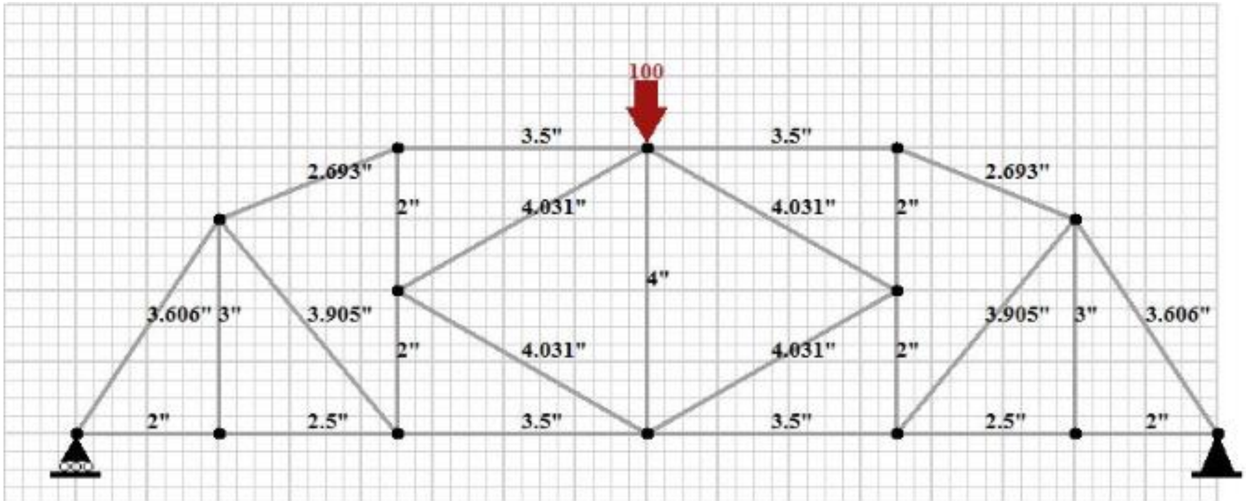

A5 - Chosen Truss Design - txt. Printout

[JOINTS}

J1 (x=4, y=24) ysup

J2 (x=12, y=12)

J3 (x=12, y=24)

J4 (x=22, y=8)

J5 (x=22, y=16)

J6 (x=22, y=24)

J7 (x=36, y=8)

J8 (x=36, y=24)

J9 (x=50, y=8)

J10 (x=50, y=16)

J11 (x=50, y=24)

J12 (x=60, y=12)

J13 (x=60, y=24)

J14 (x=68, y=24) xup ysup

[LOADS}

L1 (at J7) Fx=0 Fy=100

[MEMBERS}

M1 (from J1 to J3)

M2 (from J1 to J2)

M3 (from J2 to J4)

M4 (from J2 to J6)

M5 (from J2 to J3)

M6 (from J3 to J6)

M7 (from J4 to J7)

M8 (from J4 to J5)

M9 (from J5 to J6)

M10 (from J5 to J8)

M11 (from J5 to J7)

M12 (from J6 to J8)

M13 (from J7 to J10)

M14 (from J7 to J8)

M15 (from J7 to J9)

M16 (from J8 to J10)

M17 (from J8 to J11)

M18 (from J9 to J10)

M19 (from J9 to J12)

M20 (from J10 to J11)

M21 (from J11 to J13)

M22 (from J11 to J12)

M23 (from J12 to J13)

M24 (from J12 to J14)

M25 (from J13 to J14)

[STATISTICS}

14 joints

1 load(s)

25 members

[SOLUTION}

M1= +33.33

M2= -60.09

M3= -60.58

M4= +35.8

M5= +0

M6= +33.33

M7= -56.25

M8= +22.5

M9= -27.5

M10= +50.39

M11= -50.39

M12= +56.25

M13= -50.39

M14= -50

M15= -56.25

M16= +50.39

M17= +56.25

M18= +22.5

M19= -60.58

M20= -27.5

M21= +33.33

M22= +35.8

M23= +0

M24= -60.09

M25= +33.33

[ERROR/VALIDITY STATUS}

Valid result

A6 - Example of a soldered joint using a gusset plate

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A7 - The truss at the halfway completed stage

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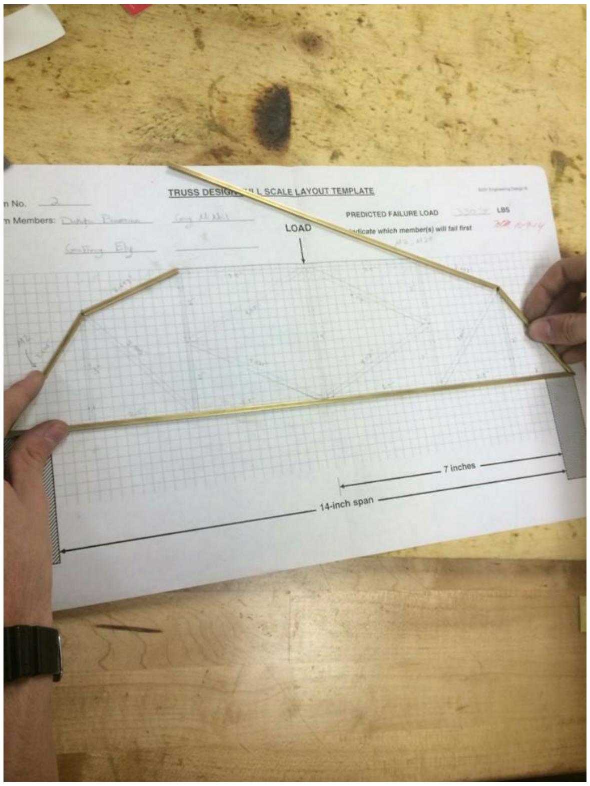
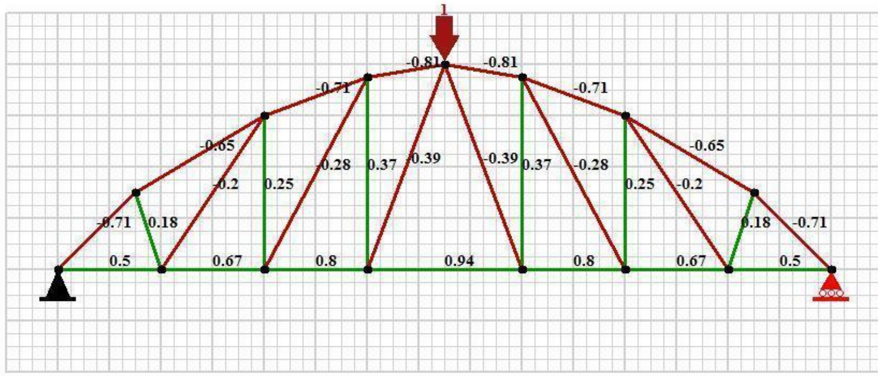
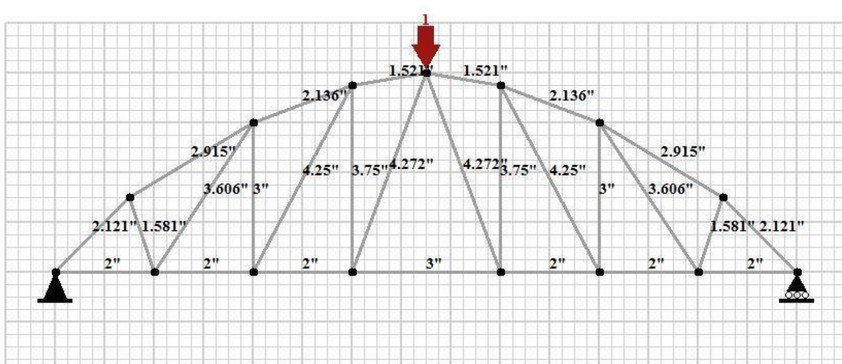


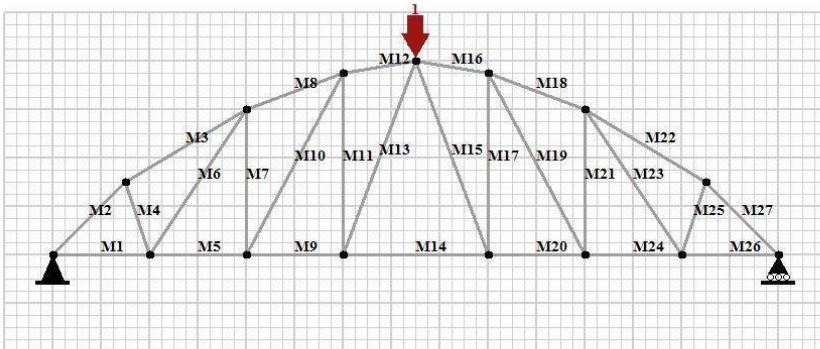
A8 - The truss frame almost completed



A9 - Load ratio jpg of one of the alternate designs

A10 - Member length jpg of one of the alternate designs





A11 - Member label jpg of one of the alternate designs

A12 - txt printout of one of the alternate design

[JOINTS}

J1 (x=4, y=20) xup ysup

J2 (x=10, y=14)

J3 (x=12, y=20)

J4 (x=20, y=8)

J5 (x=20, y=20)

J6 (x=28, y=5)

J7 (x=28, y=20)

J8 (x=34, y=4)

J9 (x=40, y=5)

J10 (x=40, y=20)

J11 (x=48, y=8)

J12 (x=48, y=20)

J13 (x=56, y=20)

J14 (x=58, y=14)

J15 (x=64, y=20) ysup

[LOADS}

L1 (at J8) Fx=0 Fy=1

[MEMBERS}

A2 M1 (from J1 to J3)

M2 (from J1 to J2)

M3 (from J2 to J4)

M4 (from J2 to J3)

M5 (from J3 to J5)

M6 (from J3 to J4)

M7 (from J4 to J5)

M8 (from J4 to J6)

M9 (from J5 to J7)

M10 (from J5 to J6)

M11 (from J6 to J7)

M12 (from J6 to J8)

M13 (from J7 to J8)

M14 (from J7 to J10)

M15 (from J8 to J10)

M16 (from J8 to J9)

M17 (from J9 to J10)

M18 (from J9 to J11)

M19 (from J9 to J12)

M20 (from J10 to J12)

M21 (from J11 to J12)

M22 (from J11 to J14)

M23 (from J11 to J13)

M24 (from J12 to J13)

M25 (from J13 to J14)

M26 (from J13 to J15)

M27 (from J14 to J15)

[STATISTICS}

15 joints

1 load(s)

27 members

[SOLUTION}

M1= +0.5

M2= -0.71

M3= -0.65

M4= +0.18

M5= +0.67

M6= -0.2

M7= +0.25

M8= -0.71

M9= +0.8

M10= -0.28

M11= +0.37

M12= -0.81

M13= -0.39

M14= +0.94

M15= -0.39

M16= -0.81

M17= +0.37

M18= -0.71

M19= -0.28

M20= +0.8

M21= +0.25

M22= -0.65

M23= -0.2

M24= +0.67

M25= +0.18

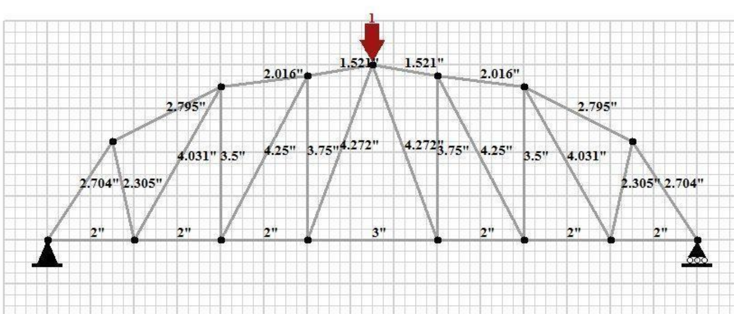
M26= +0.5

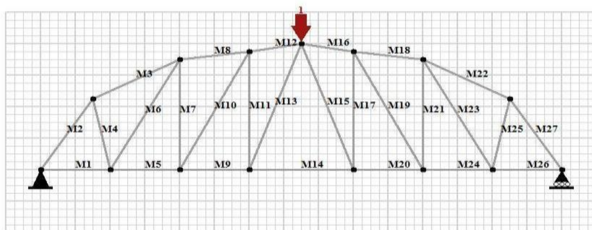
M27= -0.71

[ERROR/VALIDITY STATUS}

Valid result

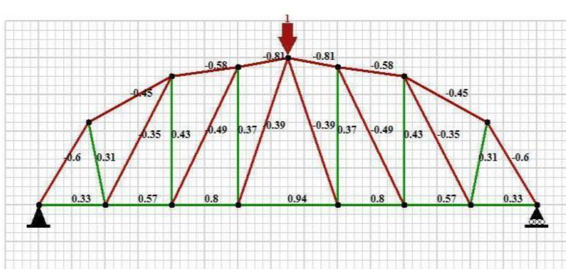
A13 - Member lengths jpg of one of the alternate designs





A14 - Member label jpg of one of the alternate designs

A15 - Member ratio jpg of one of the alternate designs



A16 - txt of one of the alternate designs

[JOINTS}

J1 (x=4, y=20) xup ysup

J2 (x=10, y=11)

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J3 (x=12, y=20)

J4 (x=20, y=6)

J5 (x=20, y=20)

J6 (x=28, y=5)

J7 (x=28, y=20)

J8 (x=34, y=4)

J9 (x=40, y=5)

J10 (x=40, y=20)

J11 (x=48, y=6)

J12 (x=48, y=20)

J13 (x=56, y=20)

J14 (x=58, y=11)

J15 (x=64, y=20) ysup

[LOADS}

L1 (at J8) Fx=0 Fy=1

[MEMBERS}

M1 (from J1 to J3)

M2 (from J1 to J2)

M3 (from J2 to J4)

M4 (from J2 to J3)

M5 (from J3 to J5)

M6 (from J3 to J4)

M7 (from J4 to J5)

M8 (from J4 to J6)

M9 (from J5 to J6)

`

M10 (from J5 to J7)

M11 (from J6 to J7)

M12 (from J6 to J8)

M13 (from J7 to J8)

M14 (from J7 to J10)

M15 (from J8 to J10)

M16 (from J8 to J9)

M17 (from J9 to J10)

M18 (from J9 to J11)

M19 (from J9 to J12)

M20 (from J10 to J12)

M21 (from J11 to J12)

M22 (from J11 to J14)

M23 (from J11 to J13)

M24 (from J12 to J13)

M25 (from J13 to J14)

M26 (from J13 to J15)

M27 (from J14 to J15)

[STATISTICS}

15 joints

1 load(s)

27 members

[SOLUTION}

M1= +0.33

M2= -0.6

M3= -0.45

M4= +0.31

M5= +0.57

M6= -0.35

M7= +0.43

M8= -0.58

M9= -0.49

M10= +0.8

M11= +0.37

M12= -0.81

M13= -0.39

M14= +0.94

M15= -0.39

M16= -0.81

M17= +0.37

M18= -0.58

M19= -0.49

M20= +0.8

M21= +0.43

M22= -0.45

M23= -0.35

M24= +0.57

M25= +0.31

M26= +0.33

`

M27= -0.6

[ERROR/VALIDITY STATUS}

Valid result

A17 - Design Matrix - This spreadsheet explains why the team chose the design that they chose and what factors they emphasized when deciding. (The highlighted design is the chosen design.)

	Design 1			Design 2			Design 3		
Number of Members	27			27			25		
Number of Joints	15			15			14		
Total Amount of Brass	71.768			77.189			77.536		
Length	15			15			16		
Height	4			4			4		
	Score	Weighted Score	Total Score	Score	Weighted Score	Total Score	Score	Weighted Score	Total Score
Maximum Load (x1.5)	10	15	40.25	10	15	43	10	15	49.75
Ease of Assembly (x2)	5	10		6	12		9	18	
Aesthetics (x.75)	7	5.25		8	6		9	6.75	
Total Amount of Brass (x1)	10	10		10	10		10	10	

A18 - Brass Compression sheet First Alternate design

Member		Max Strength	Ratio	Actual Load	Length(in)
1		252	0.5	504	2
2		247.98159	-0.71	-349.2698451	2.121
3		221.61285	-0.65	-340.9428462	2.915
4		265.91499	0.18	1477.3055	1.581
5		252	0.67	376.119403	2
6		198.66474	-0.2	-993.3237	3.606
7		218.79	0.25	875.16	3
8		247.48344	-0.71	-348.5682254	2.136
9		177.2775	-0.28	-633.1339286	4.25
10		252	0.8	315	2
11		193.8825	0.37	524.0067568	3.75
12		267.90759	-0.81	-330.7501111	1.521
13		176.54688	-0.39	-452.6843077	4.272
14		218.79	0.94	232.7553191	3
15		176.54688	-0.39	-452.6843077	4.272
16		267.90759	-0.81	-330.7501111	1.521
17		193.8825	0.37	524.0067568	3.75
18		247.48344	0.71	348.5682254	2.136
19		271.46106	-0.28	-969.5037857	1.414
20		252	0.8	315	2
21		175.617	0.25	702.468	4.3
22		221.61285	-0.65	-340.9428462	2.915
23		198.66474	-0.2	-993.3237	3.606
24		252	0.67	376.119403	2
25		265.91499	0.18	1477.3055	1.531
26		252	0.5	504	2
27		247.98159	-0.71	-349.2698451	2.121
					71.768

A19 – Brass Compression Sheet for second Alternate design

Member		Max Strength	Ratio	Actual Load	Length(in)
1		252	0.33	763.6363636	2
2		228.62015	-0.6	-381.0336	2.704
3		225.66447	-0.45	-501.4766	2.793
4		241.87095	0.31	780.228871	2.305
5		252	0.57	442.1052632	2
6		184.55049	0.35	527.2871143	4.031
7		202.185	0.43	470.1976744	3.5
8		251.46864	-0.58	-433.5666207	2.015
9		252	-0.49	-514.2857143	2
10		177.2775	0.8	221.596875	4.25
11		193.8825	0.37	524.0067568	3.75
12		267.84117	-0.81	-330.6681111	1.523
13		176.54683	0.39	452.6843077	4.272
14		218.79	0.94	232.7553191	3
15		176.54683	-0.39	-452.6843077	4.272
16		267.90759	-0.81	-330.7501111	1.521
17		193.8825	0.37	524.0067568	3.75
18		251.46864	-0.58	-433.5666207	2.015
19		184.55049	0.49	376.6336531	4.031
20		252	0.8	315	2
21		202.185	0.43	470.1976744	3.5
22		221.61285	-0.45	-492.473	2.915
23		184.55049	-0.35	-527.2871143	4.031
24		252	0.57	442.1052632	2
25		241.87095	0.31	780.228871	2.305
26		252	0.33	763.6363636	2
27		228.62015	-0.6	-381.0336	2.704
					77.139

A20 – Brass Compression Sheet for Selected design

Truss Design #3					
Member	Length	Max Stren	Ratio	Actual Load	Total Length
1	2	252.1	0.3333	756.37564	77.536
2	3.606	198.7647	-0.6009	-330.7784	
3	2.693	229.0855	-0.6058	-378.15363	
4	3.909	188.7021	0.358	527.10087	
5	3	218.89	0	#DIV/0!	
6	2.5	235.495	0.3333	706.55566	
7	3.5	202.285	-0.5625	-359.61778	
8	2	252.1	0.225	1120.4444	
9	2	252.1	-0.275	-916.72727	
10	4.031	184.6505	0.5039	366.44273	
11	4.031	184.6505	-0.5039	-366.44273	
12	3.5	202.285	0.5625	359.61778	
13	4.031	184.6505	-0.5039	-366.44273	
14	4	185.68	-0.5	-371.36	
15	3.5	202.285	-0.5625	-359.61778	
16	4.031	184.6505	0.5039	366.44273	
17	3.5	202.285	0.5625	359.61778	
18	2	252.1	0.225	1120.4444	
19	2.693	229.0855	-0.6058	-378.15363	
20	2	252.1	-0.275	-916.72727	
21	2.5	235.495	0.3333	706.55566	
22	3.905	188.835	0.358	527.47193	
23	3	218.89	0	#DIV/0!	
24	3.606	198.7647	-0.6009	-330.7784	
25	2	252.1	0.3333	756.37564	

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PROJECT 1 SECTION G GROUP 2 DRAFT SCORE COMMENTS

Report Grading Breakdown:

	Grading Item		MAX Score	
1.	Title & Cover Page w/ Signed Pledge (Team Mem Names, Section, Group, Date, Course, Proj. Name)		2 1	DATE
2.	Abstract (One paragraph should suffice, minimal specifics, labeled as Page "i")		5 3	PAST TENSE page i
3.	Table of Contents (with numbered pages)		3 1	ii, FIGS + TABLES
4.	Introduction		20	
	• Purpose of Report	5	5 GOOD	
	• Project Objective (I.E.: design, build, test the truss with the highest predicted failure load)	5	5 GOOD	
	• Summary of Project Specifications (requirements, restrictions, construction material)	5	5 GOOD	
	• Approach to Project Completion, planning and Scheduling	5	3 - WEAK	
5.	Discussion		40	
	• Introductory Paragraph to the discussion Section Content	3	3 GOOD	
	• Design Section			
	a) Overview of the Design Process	3	3	
	b) Truss Design with Alternatives Considered and some insight into your design decisions (SIMPLE GRAPHICS)	8	→ GOOD GRAPHICS 6 NEED SUMMARY TABLE + PUGH MATRIX	
	c) Design Analysis Summary as developed from ELICA Truss Analysis with interpretation of data (DESIGN MATRIX)	8	0	
	d) Summary of calculations of predicted failure load and failure member(s)	4	0	
	e) Fabrication concerns considered in the design phase	4	4	
	• Fabrication			
	a) Assembly techniques and soldering considerations	2	2	
	b) Finishing and final weight of the truss in pounds	2	2	
	• -Testing		NOT PART OF DRAFT	
	a) Test results as compared to predicted load to failure and predicted failure member(s)	2		
	b) Type of failure and rational for the test results	2		
	c) Ratio of Load to failure (lb.) to truss weight (lb.)	2		
	d) Ranking within your section	2		
6.	Conclusions and Recommendations		10 NOT PART OF DRAFT	
	• Describes the results in terms of accomplishments, both successful and unsuccessful.	3		
	• Provides recommendations to improve the project in terms of basic knowledge, material, equipment,	3		
	• or other guidance			
	• What would you have done differently if given the opportunity?	4		
7.	Attachments (Tables, Figures and Appendixes labeled numerically (1, 2, 3, and A1 etc.)		15	
	• WBS, Gantt Chart and Organization Chart with roles and responsibilities	3	1	NO WBS OR ORG
	• Full size schematic of the final truss design with members and joints labeled as referred to by the ELICA	3	0	
	• Truss Analysis program.			
	• ELICA Truss Analysis text printout for final truss design, as generated by the ELICA "export" button	3	3	
	• Sketches of alternative truss designs considered and analyses summary	3	3	
	• Brass compression data, chart and formula	3	0	
	• Attachments are referenced within the main body of the report			
8.	Overall Flow of the report, grammar, proofreading, and spellchecking		5 4	
	ALL FIGS NEED # AND TITLE (-1) Final Report Grade		100 MAX	

GOOD START + GOOD WRITING - DISCUSSION NEEDS SUMMARY TABLES PUGH MATRIX. (PUT DESIGN MATRIX ON PAGE 22 INTO DISCUSSION

DRAFT SCORE 56/87

See his sheet for details on what needs to be fixed

HIGHLIGHT EVERYTHING THAT YOU CHANGE

Work Breakdown:

Title - Greg - Done

Abstract - Greg - done

TOC - Greg - will complete when doc is finalized

Introduction - Greg - Done

Discussion - Greg - Done (no changes)

Design - Dakota

Fabrication - Geoff

Testing - Geoff

Conclusions - Greg - done

Recommendations - Greg - done

Appendix - Dakota