EK301 Project 10/30/2020

Section: A1

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Introduction:

Using a computer program to analyze a truss is very efficient and allows exploration of ideas. A computer program would save time in calculations, it would calculate values for any truss structure just by inputting the matrices of your truss design. In addition, the program would allow you to take a theoretical look at the logistics of preliminary designs.

We will use the program to find maximum theoretical yield and its ratio to cost. By finding the ratio, it will help us evaluate the 2 designs and contrast them to each other. The design that has a greater maximum theoretical load to cost ratio is the more efficient design.

Analysis:

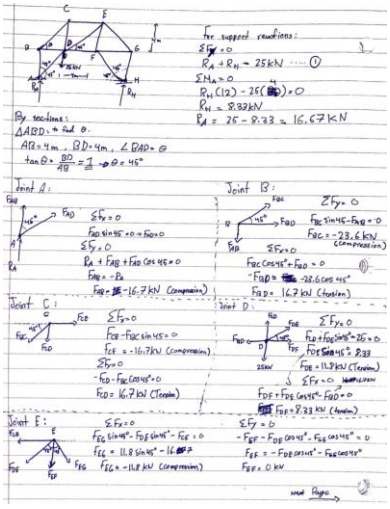

Figure:1- photo of work

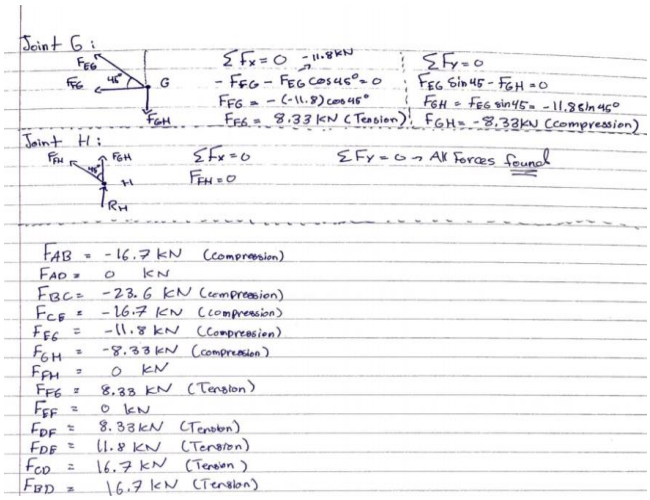

Figure:2 - photo of work

The method used by hand was a straightforward approach. First, we calculated the supports at both A and H, and use equilibrium alongside the 25KN force downwards. By doing so, we were

able to find an equation linking the support force of A and H. Then, using equilibrium for moments at join A, we find both support forces. After that, we draw diagrams for each joint and the forces relative to the join, and repeat this process until all variables are found.

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\% EK301, Section A1, Group: Yury L, Abdulaziz S, Ameen A, 10/30/2020.
Load: 1N
Member forces in Newtons

m1: 16666.667 (C)
m2: 0.000 (T)
m3: 23570.226 (C)
m4: 16666.667 (C)
m5: 11785.113 (C)
m6: 8333.333 (C)
m7: 0.000 (C)
m8: 8333.333 (T)
m9: 0.000 (T)
m10: 8333.333 (T)
m11: 11785.113 (T)
m12: 16666.667 (T)
m13: 16666.667 (T)
Reaction forces in Newtons:
Sx1: -0.000
Sy1: 16666.667
Sy2: 8333.333
Cost of truss: $140.284
fx >>
```

Figure:3 - program output

The only discrepancies seen are in the units and rounding up into the correct amount of sig figs. The units shown in the program are in Newtons, while the hand problem was in kN. The program results were not rounded to 3 sig figs, while the problem done by hand was rounded to 3 sig figs.

Data:

Design #1:

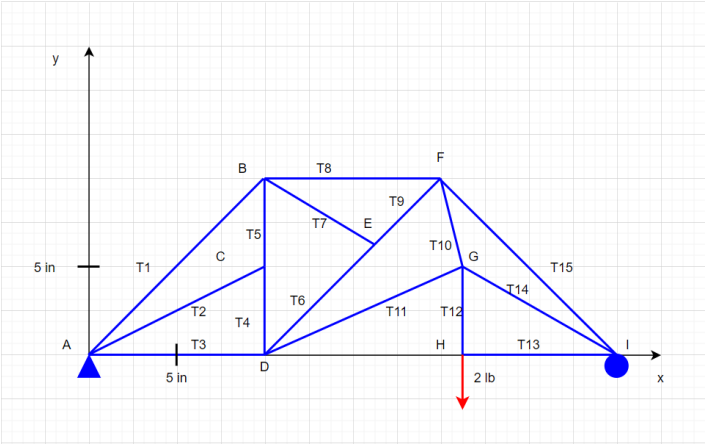

Figure 4 - diagram of design 1

member#	Length (inches):	Tension or compression:	Load (lb):
T1	14.1421	C	0.849
T2	1.1803	C	0.000
T3	10.0000	T	0.600
T4	5.0000	T	0.600
T5	5.0000	T	0.600
T6	8.4853	C	2.263
T7	7.2111	C	0.000
T8	10.0000	C	0.600
T9	5.6569	C	2.263
T10	5.0990	T	4.844
T11	12.0830	T	2.417
T12	5.0000	T	2.000

T13	9.0000	C	0.000
T14	10.2956	T	3.603
T15	14.1421	C	4.455

Table:1 - design 1 data

```
\% EK301, Section A1, Group: Yury L, Abdulaziz S, Ameen A, 10/30/2020.
Load: 1 lb
Member forces in Newtons

m1: 0.849 (C)
m2: 0.000 (C)
m3: 0.600 (T)
m4: 0.600 (T)
m5: 0.600 (T)
m6: 2.263 (C)
m7: 0.000 (C)
m8: 0.600 (C)
m9: 2.263 (C)
m10: 4.844 (T)
m11: 2.417 (T)
m12: 2.000 (T)
m13: 0.000 (C)
m14: 3.603 (T)
m15: 4.455 (C)
Reaction forces in Newtons:
Sx1: 0.000
Sy1: 0.600
Sy2: 1.400
Cost of truss: $222.296
Theoretical max load/cost ratio in N/$: 0.022
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```

Figure 5: output of the program.

Design #2:

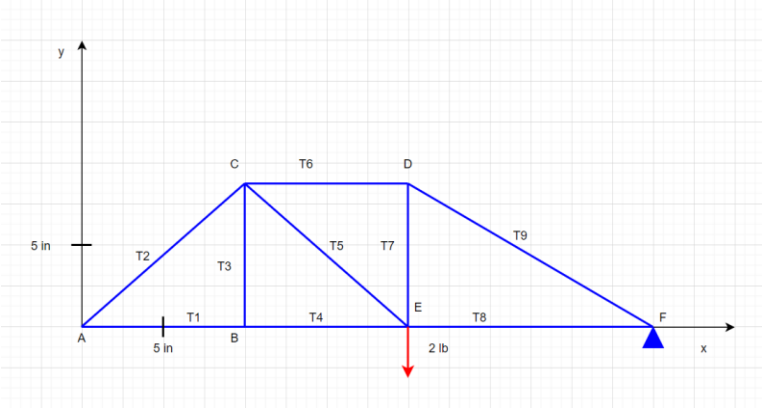

Figure 6: - diagram of design 2

member#	Length (inches):	Tension or compression:	Load (lb):
T1	10.0000	(T)	0.952
T2	13.4536	(C)	1.281
T3	9.0000	(T)	0.000
T4	10.0000	(T)	0.952
T5	13.4536	(T)	1.281
T6	10.0000	(C)	1.905
T7	9.0000	(T)	1.143
T8	15.0000	(T)	1.905
T9	17.4929	(C)	2.221

Table 2: design 2 data

```
\% EK301, Section A1, Group: Yury L, Abdulaziz S, Ameen A, 10/30/2020.
Load: 1 lb
Member forces in Newtons

m1: 0.952 (T)
m2: 1.281 (C)
m3: 0.000 (T)
m4: 0.952 (T)
m5: 1.281 (T)
m6: 1.905 (C)
m7: 1.143 (T)
m8: 1.905 (T)
m9: 2.221 (C)
Reaction forces in Newtons:
Sx1: -0.000
Sy1: 0.857
Sy2: 1.143
Cost of truss: $167.400
Theoretical max load/cost ratio in N/$: 0.013
>>
```

Figure 7: output of the program.

Results:

Design 1:

Max theoretical load = 4.844 lb

Cost = 223.0 $

Load to cost ratio = 0.022

Design 2:

Max theoretical load = 2.221 lb

Cost = 167.4 $

Load to cost ratio = 0.013

Discussion:

_____The cost and the load to cost ratio of the second design have smaller values than those of the first one, which means that the second design is more cost efficient and is cheaper. However, design number 1 has a higher theoretical load which means that it could hold more load at a time.