25-650: Applied FEA
Assignment 5
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Due: 3/20/2024

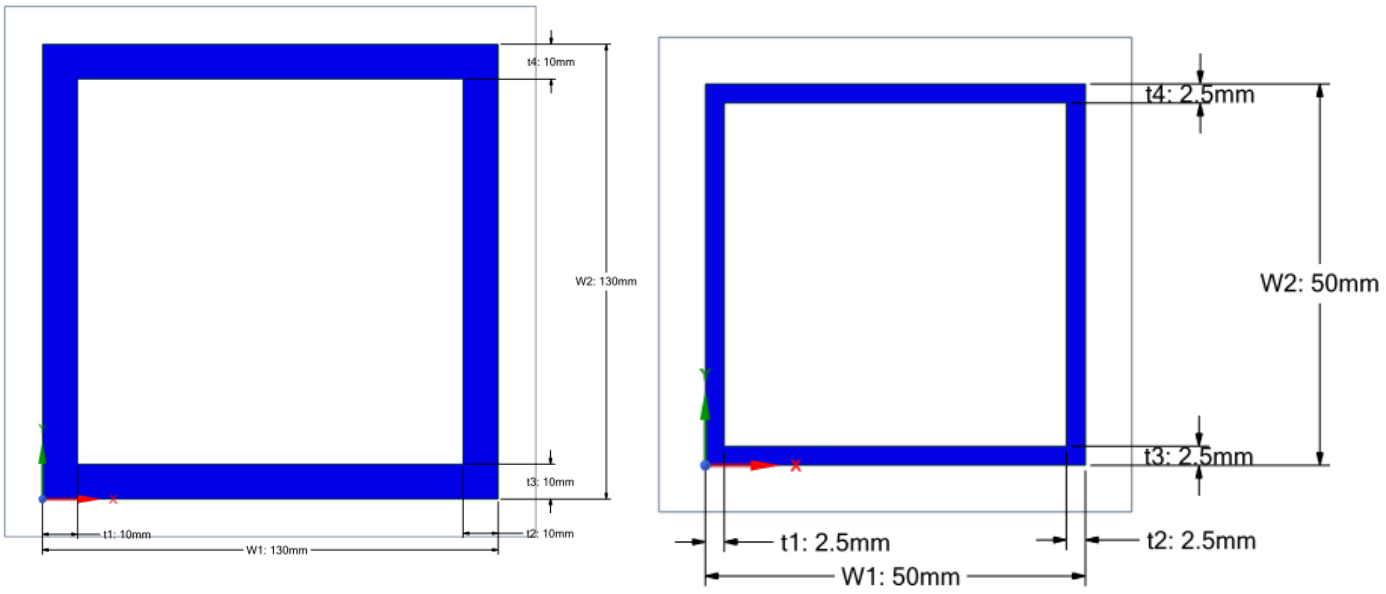
Overall Objective

The goal was to design a tower within a 5m x 5m x 20m volume. This tower must support a 36000kg mass at the top and withstand a 9000N horizontal wind force in addition to gravity.

Assumptions

For all situations below, it is assumed that the 3 bottom vertices of the tower are fixed in place and the 3 top vertices of the tower bear the 36000kg mass and the 9000N horizontal wind force.

Summarized Results



Mass (kg)	3588.8
FS Stress	7.38
FS Buckling	24.251

Material Data

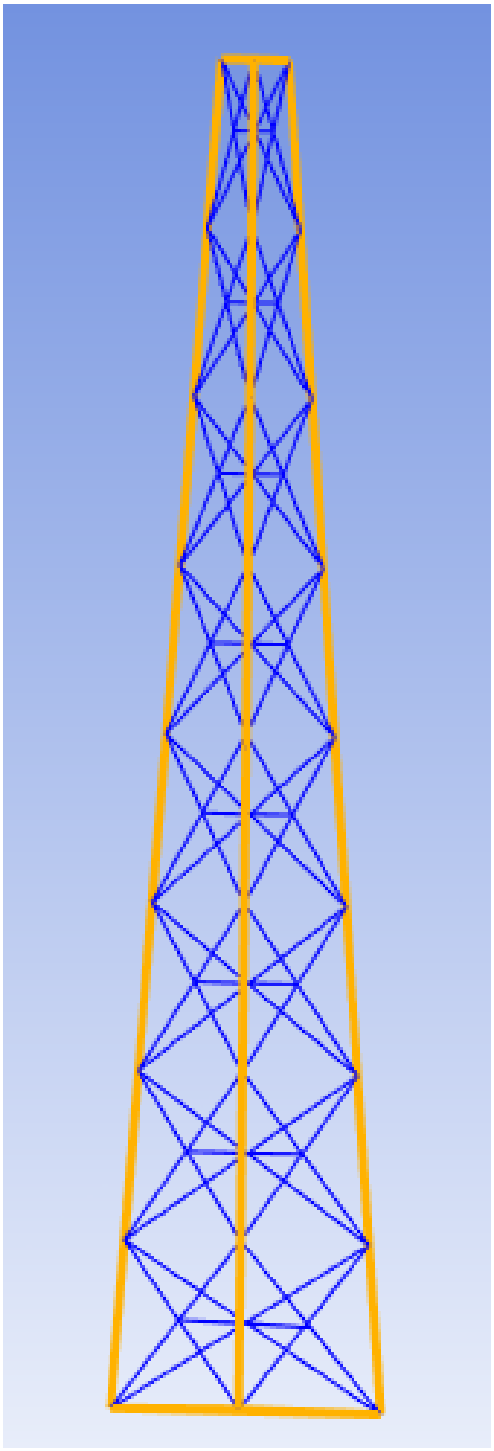
The material used was structural steel (default) from the engineering data tab within Ansys Workbench.

Final Geometry

Thick cross-section: Orange
- 130mm with 10mm thickness

Thin cross-section: Blue
- 50mm with 2.5mm thickness

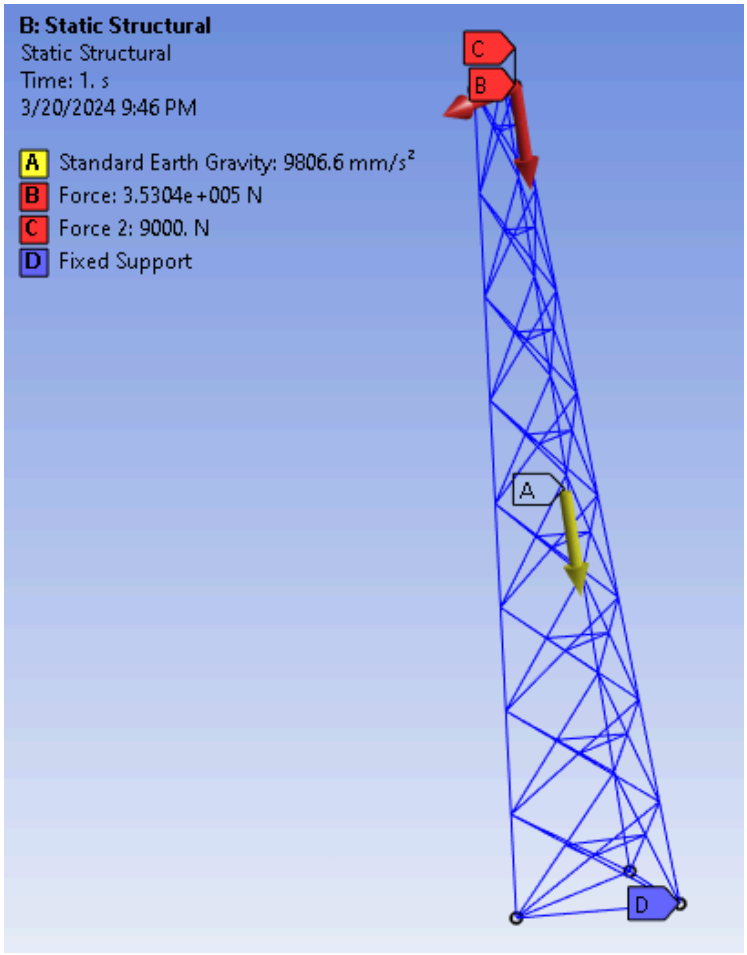
Top Triangle: 1m equilateral triangle
Bottom Triangle: 4m equilateral triangle
20m tall



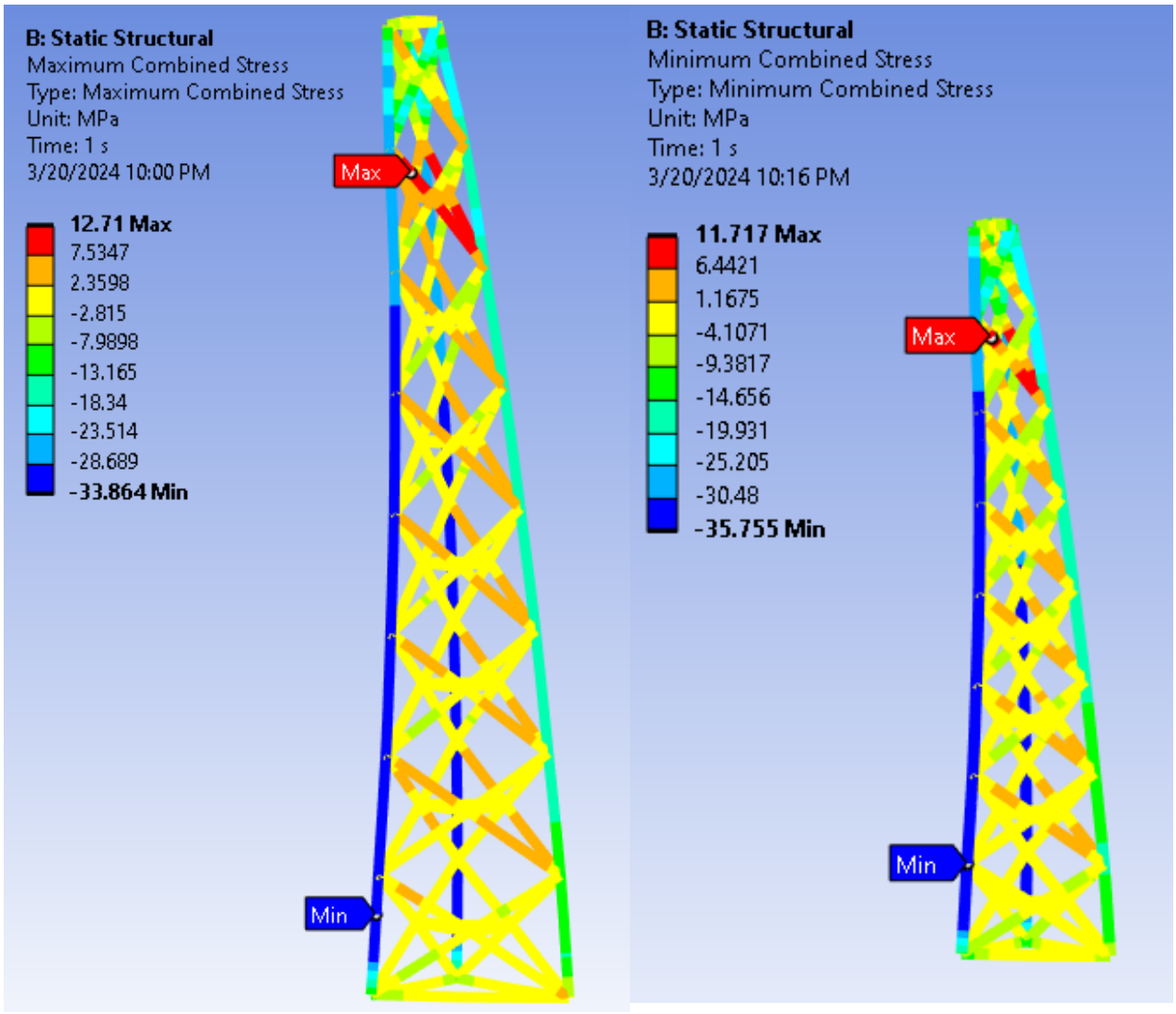
Boundary Conditions

For this analysis, the following conditions were used:

- Fixed support along 3 bottom vertices of the tower
- Gravity in the negative y-direction
- Force along 3 top vertices of the tower
    - 36000kg mass: 3.53e05 N in the negative y-direction
    - 9000N in the positive x-direction



Full Results of Final Geometry

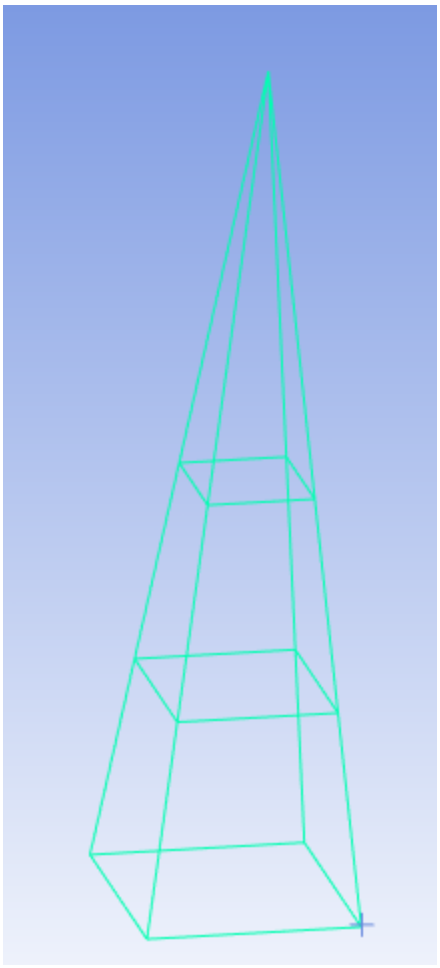


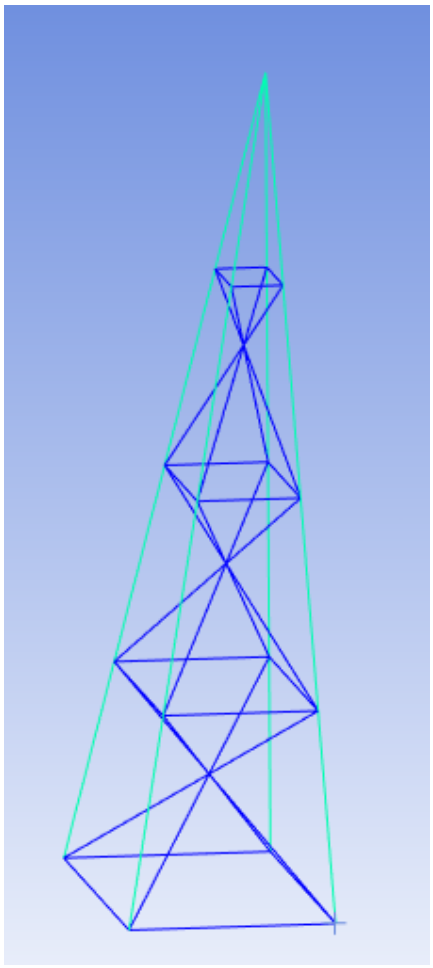
Tabular Data

	Mode	Load Multiplier
1	1.	24.251
2	2.	25.332

Progression of Geometry

	V1 (left)	V2 (right)	V3 (final)
Mass (kg)	>3600kg	<3600kg	3588.8
FS Stress	8.3	8.5	7.4
FS Buckling	2.3	4.5	24.3





Conclusion

Overall, the results of the simulations make sense given the conditions used. It makes sense that triangular load bearing sections would provide the most stiffness while being the least mass expensive.