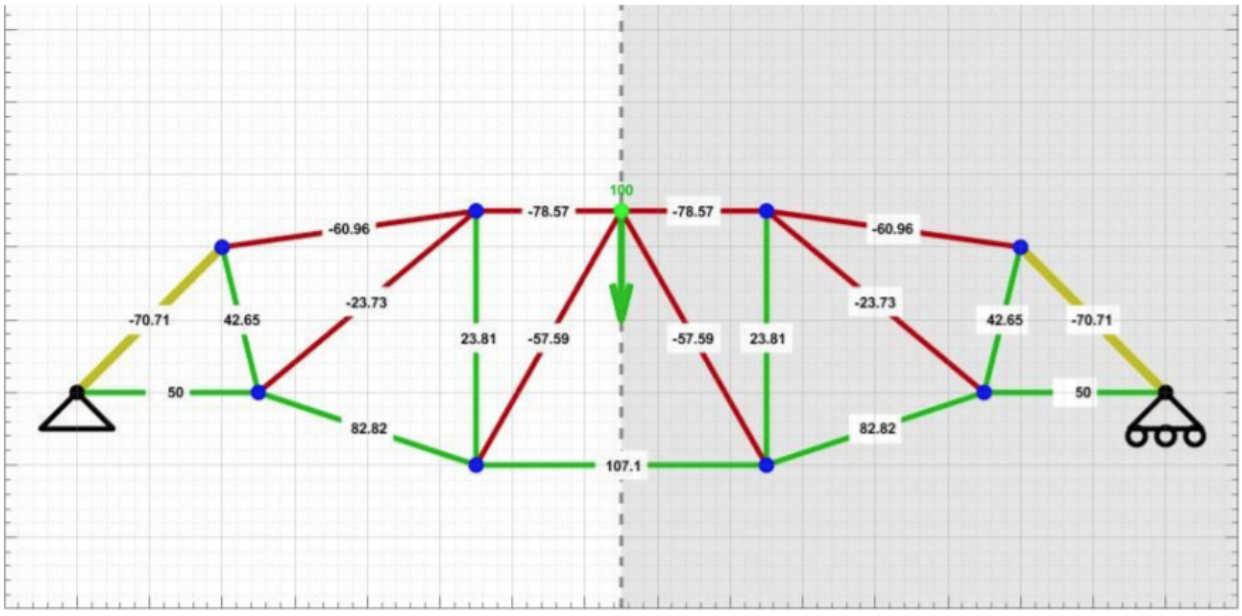
Truss Design Project

Using engineering theory in a clear iterative process our team was tasked to develop three truss designs that result in defined performance improvements in strength between the initial and final design geometries of each truss. We chose one of the three trusses to build, then loaded it to failure. We then Compared the results to the projected failures from the design simulation using the Truss Analyzer. Each truss design must begin with a significantly different initial geometry and include at least four iterative steps leading from initial to final geometry

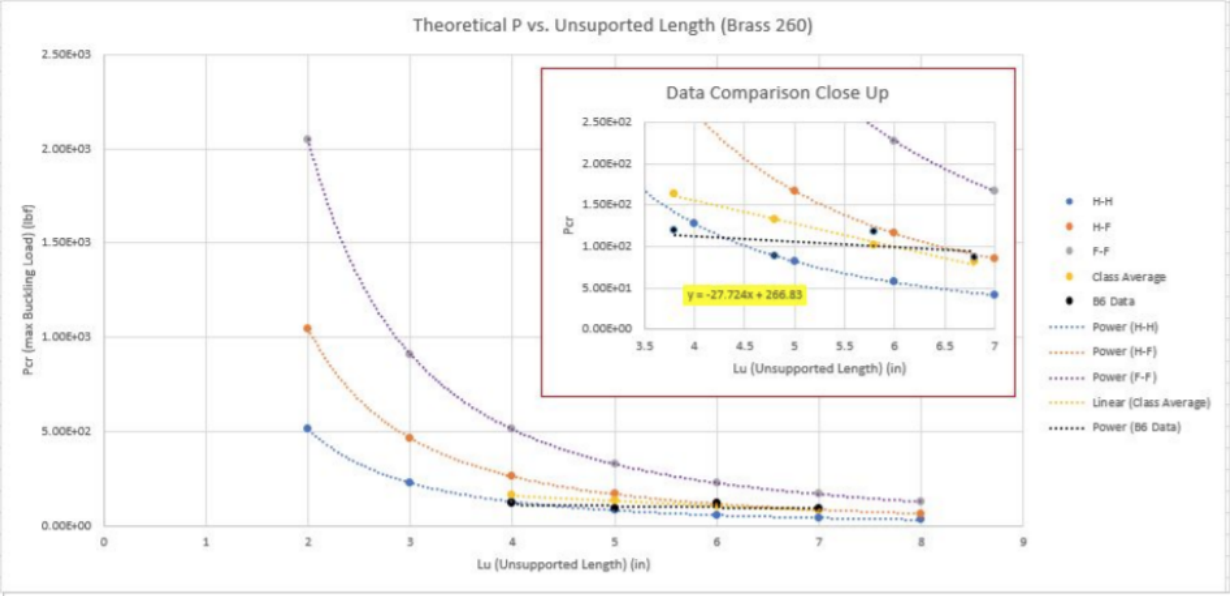
Compression vs Tension

The material used in the project was brass, which can support tensile stress (green) more efficiently compared to compressive strength (red). Zero force members (yellow) are beneficial because they reduce stress by splitting a compressive force as the truss fails. This diagram is a screenshot of the Truss Analyzer software for the final truss design.



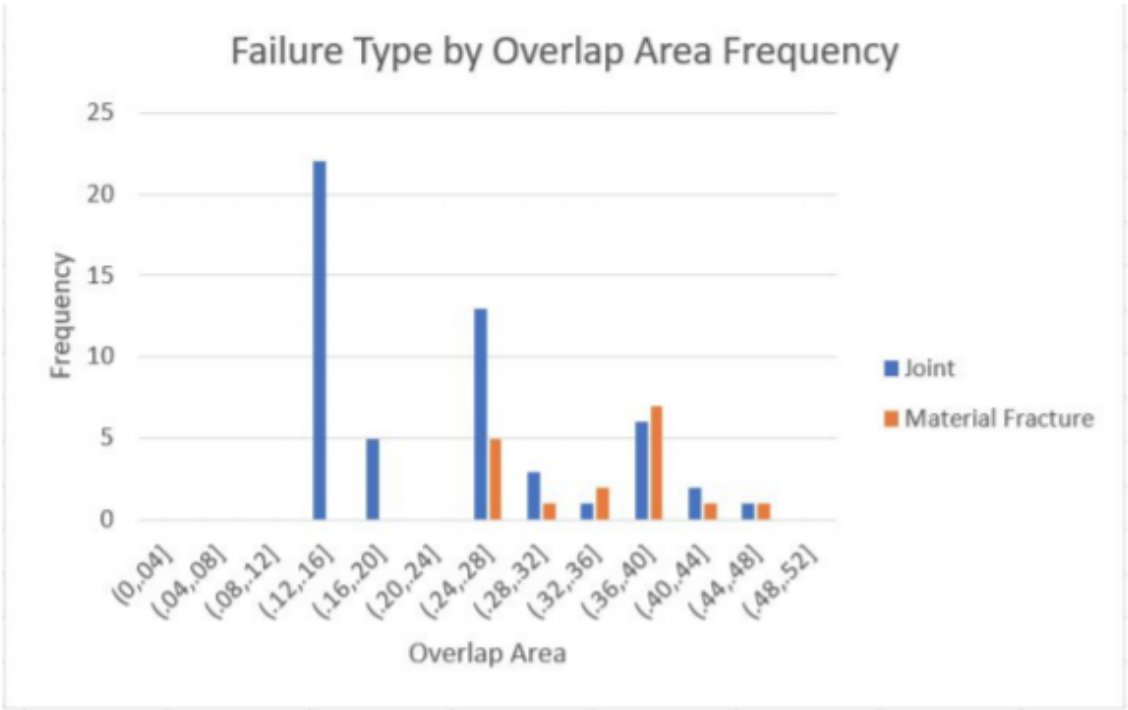
Theoretical Pcr vs Unsupported Length

Shorter members are more ideal, and buckle at a higher load.



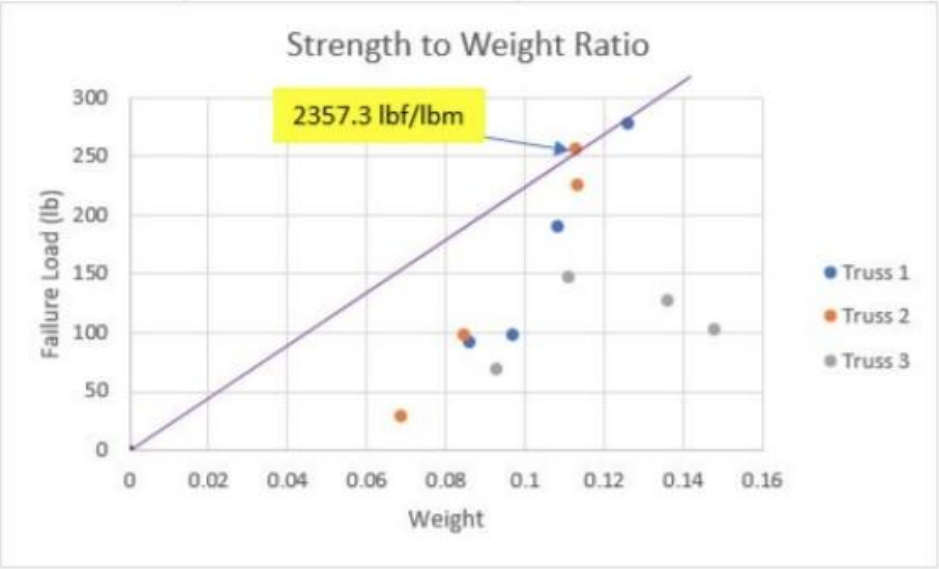
Designing Truss Joints

Failure occurs more frequently from fracture with a larger joint area (desirable).



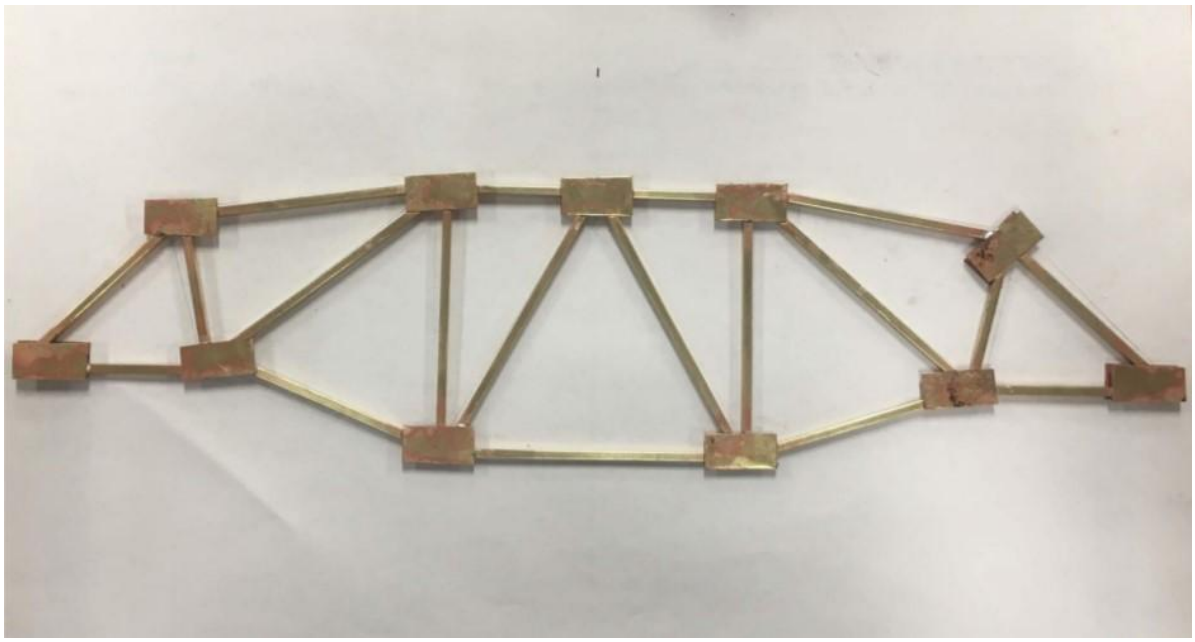
Failure Load Prediction

Using the calculated information from the tests as indicated above, the team designed 3 trusses, and optimized each one with 4 iterations. The last iteration of Truss 2 moved forward because it had the highest strength to weight ratio. Theoretically with a final weight of 0.114 lbm, our truss should fail at 269 lbf.



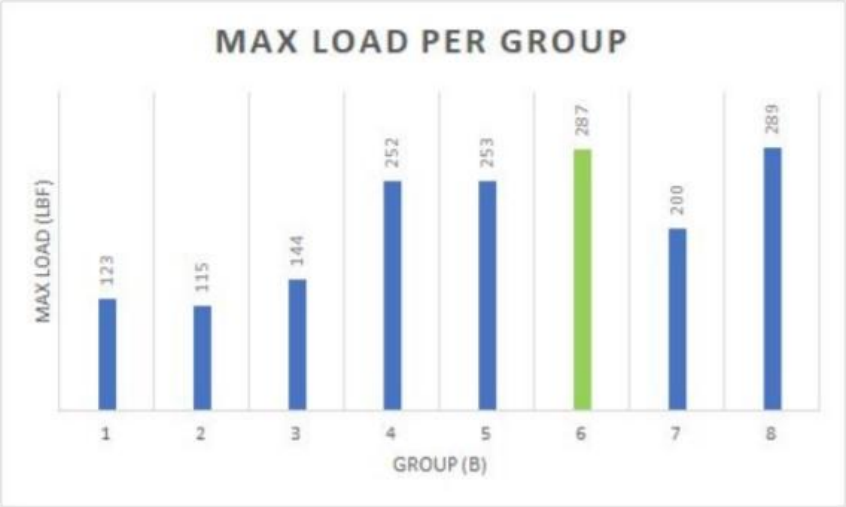
Final Truss Design

Prioritizing strength to weight ratio.



Team Results

Our team had the second highest max load in the class at 287 lb. This was 18 lbf off from our theoretical prediction, with an error of 6.27%



Final Truss Failure Point

The truss member that ended up failing was the bottom left member. While this was not the member indicated in the Truss Analyzer, the group realized this was because the thickness of the brass increased the total length of the truss to an additional inch which was unaccounted for in the Truss Analyzer. This caused the load to be concentrated on the member instead of being distributed to the joint as planned.