Utah Valley University Steel Bridge

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Background and Selected Bridge

General Overview

- The competition is designed to encourage students to gain hands-on experience in bridge design and fabrication while promoting the use of steel as a construction material
- The competition consists of two main components: bridge design and bridge fabrication. The design component requires teams to create a bridge that meets specific criteria, including weight, stiffness, and construction constraints. The fabrication component involves the actual construction of the bridge, which must be done within a set time frame and with limited resources.

The overall bridge configuration selection

- Three truss bridges were considered: Howe, Pratt, and Warren. After careful analysis, the Warren truss bridge was the most economical, simple, and effective for the AISC steel bridge competition.



Figure 1 Warren truss selected for the AISC steel Bridge competition https://www.teachengineering.org/lessons/view/ind-2472-analysis-forces-truss-bridge-lesson

Front View of the Bridge

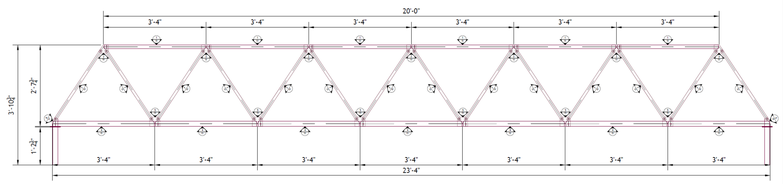


Figure 2 Scaled, dimensioned front view of the bridge,

Side View of the Bridge and Connections

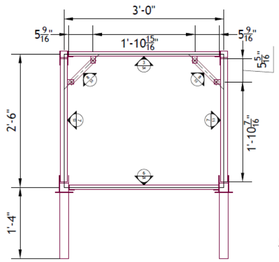


Figure 3 Scaled, dimensioned side view of the bridge,

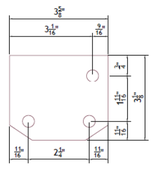


Figure 4 Top chord main connection

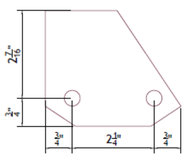


Figure 5 Top chord end connection

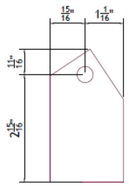


Figure 6 Bottom chord End connection

Accelerated Bridge Construction (ABC)

- The bridge was designed symmetrically with many repeated member sizes, which made the design and fabrication much faster.
- To ease construction time, we used the same size bolts and nuts on all parts of the bridge.
- Minimize the amount of material for the bridge by removing unnecessary members to achieve the lightest possible bridge that we could.

Results and Discussion

Analysis

- The bridge was designed using RISA 3D software. We followed the AISC 15th (360-16): ASD guidelines to consider lateral and vertical deflections. Both point loads and area loads at multiple locations were placed on the bridge to ensure it could withstand the loading criteria given by the 2023 SSBC handbook. After fabrication, the bridge was slowly loaded to verify it could hold up the vertical load.

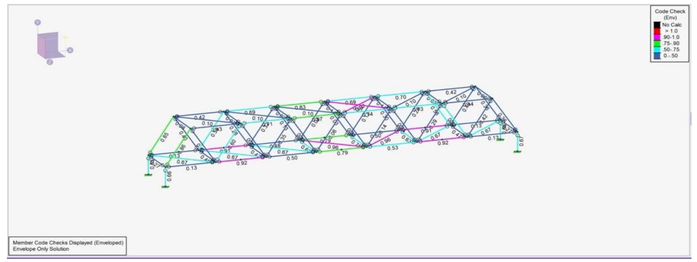


Figure 7 RISA 3D software analysis of the designed bridge

Free-Body Diagram of a Single Beam

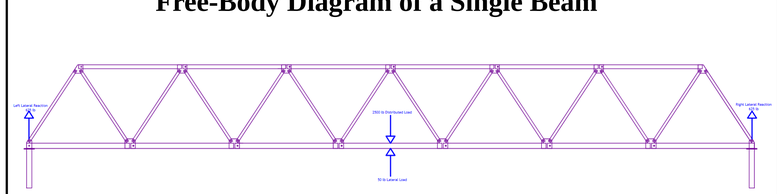


Figure 8 Free-body diagram of a single beam that represents one of the bridge stringers

Shear and Moment Diagrams of The Same Beam

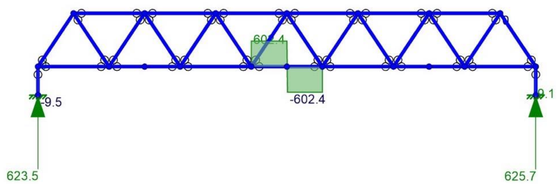


Figure 9 Shear diagram

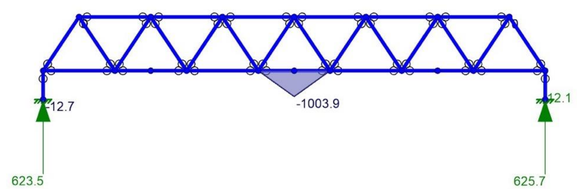


Figure 10 Moment diagram

Social Implications

Stakeholder Map

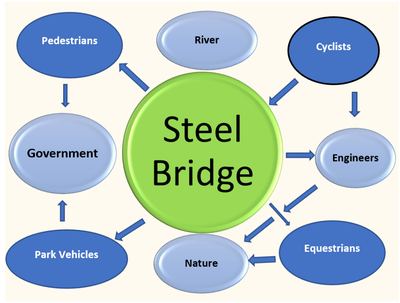


Figure 11 The steel bridge stakeholder map and stakeholder interrelationships

Ethical Analysis

- Designing and building a steel bridge requires careful consideration of various ethical factors. Engineers must balance the need to meet all necessary safety, sustainability, and social responsibility standards with the need to remain cost-effective and efficient. By adopting a rigorous ethical analysis process, engineers can ensure that their projects meet the highest standards of ethical behavior and contribute to the greater good of society.

Future Work and Recommendation

- The AISC steel bridge competition emphasizes efficient fabrication and construction techniques. Future UVU students who would want to participate in this competition will have to work on their connections and take into account all aspects of the competition from the beginning
- Deep research on previous winners and their strategies. This could include analysis of bridge designs, construction techniques, and performance data. This should also be done at the beginning of the year.

Integrative Conclusions

- The AISC Steel Bridge Competition serves as an excellent platform for promoting excellence in steel bridge design and construction while preparing the next generation of civil engineers to address future infrastructure challenges.

Acknowledgements

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1. TeachEngineering. (n.d.). Analysis of Forces in a Truss Bridge. Retrieved April 10, 2023, from https://www.teachengineering.org/lessons/view/ind-2472-analysis-forces-truss-bridge-lesson
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