AISC Student Steel Bridge Competition

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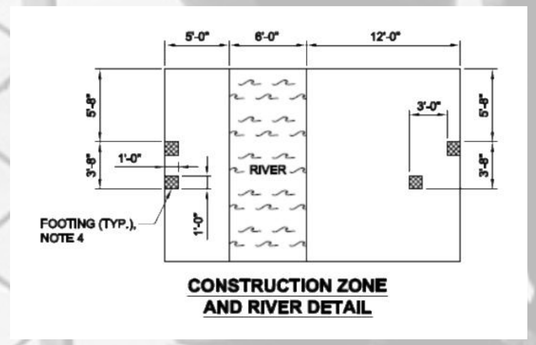
Abstract:

The student-led Steel Bridge project is an inter-collegiate competition, hosted by the American Institute of Steel Construction (AISC), that challenges students to design, fabricate, and construct a model steel bridge. This project serves as a way for civil engineering students to demonstrate their critical thinking skills, work collaboratively with others, and implement their engineering knowledge to achieve a common goal of completing a large scale project. Through this project, the UC Irvine Steel Bridge Team aims to provide students with a hands-on engineering experience that supplements the technical lessons learned from university to help them develop into professional engineers.

Design Background:

The steel bridge team designed the 2018-2019 bridge after a hybrid between a cantilever and beam bridge design. The offset footing constraint from the rules challenged the team to engineer a solution that will effectively overcome the constraint and be serviable. With these considerations, the team decided on a beam/cantilever hybrid design.



Design Process:

Structural Analysis:

Before beginning the design process, load analysis was done using the six different loading combinations provided in the rule set. Shear and moment diagrams were developed, as seen in the figures below, to determine the stress demands.

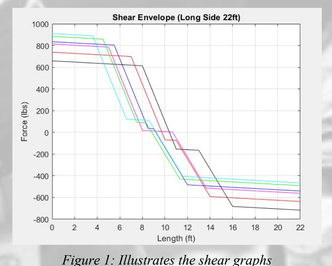


Figure 1: Illustrates the shear graphs derived from six load analyses.

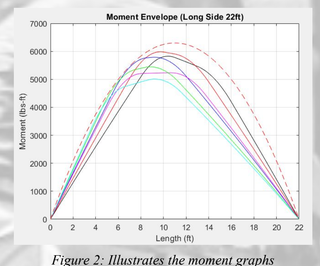


Figure 2: Illustrates the moment graphs derived from six load analyses.

Structural Design:

Once the stress demands were obtained, engineering programs like MATLAB and SAP2000 were used to design the adequate steel member sizes and dimensions. In addition to load capacity checks, dimensional constraints set by the rules were also taken into account.

After extensive analysis, rectangular hollow structural shape, HSS, were selected for the bridge stringers and decking.

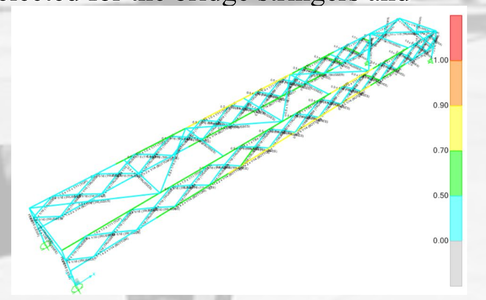


Figure 3: Displays the structural representation of the 2018-2019 bridge in SAP2000. The coloration illustrates the stress experienced by each member

Fabrication:

Once the bridge design is finalized, the fabrication process usually begins winter quarter. All of our fabrications are completed by students in Engineering Tower (ET) 146 lab. For constructability during the build competition, the bridge will consists of tube-in-tube couplings and double plate connections.

The main tool utilized for cutting to the specific length is the bandsaw. Once cut, holes will be drilled with the drill press for connections and welding. Before the welding process can begin, the team creates a welding 'jig' to serve as a template for welding the steel together. When welding the different members together, implementation of camber is necessary to counteract the natural deflection from the self weight of the bridge. Before the bridge is completed, all of the members will be tested in the dimension box to ensure we met all of the dimensional requirements. Once complete, the designated build team will practice constructing the bridge in accordance the the rules. Using nuts and bolts, the team will erect the 23ft long bridge while minimizing the total time necessary for completion.

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