Student Steel Bridge Competition

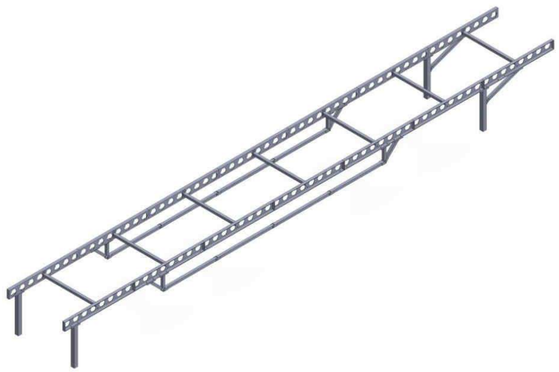
2026 ASCE Intermountain Southwest Student Symposium

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Bridge Overview

Our design consists of two c-channel stringers that have been castellated to reduce weight. We included a tension chord under the stringers to increase the moment capacity of our bridge. One of our primary goals was to have as little members as possible and our other proposed designs had more complex members and truss systems which would require more connections and members. This design had fewer members and fewer connections which allowed us to build our bridge more quickly. We built off the idea of previous Utah Valley University bridges using a larger stringer with fewer members and iterated our design to include a castellated stringer to reduce weight.



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Connections

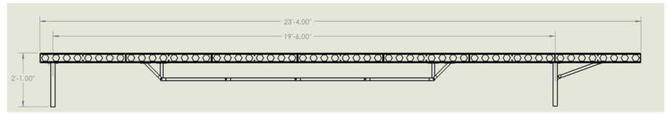
The C-channel stringers were designed as fixed moment connections using 2 bolted assemblies connecting each member which allows the stringers to act continuously through the whole span. This increased stiffness and was verified by our calculations and load testing.

Tension member joints were detailed as pinned shear connections to efficiently transfer axial forces while allowing rotation where needed

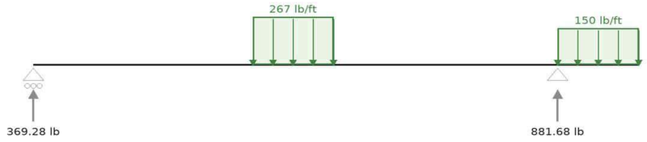
Analysis

The bridge was designed and analyzed using the Bently RAM Elements software. The structural analysis was done using the given load cases. This model was used to check member forces, member stress, maximum moment and shear, and vertical and lateral deflections based on different load cases.

Bridge Side View

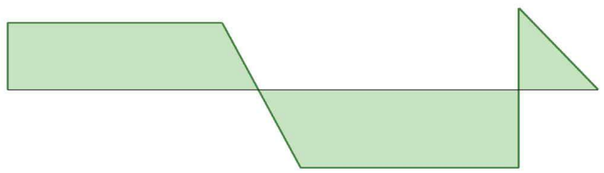


Free Body Diagram (Load Case 7)

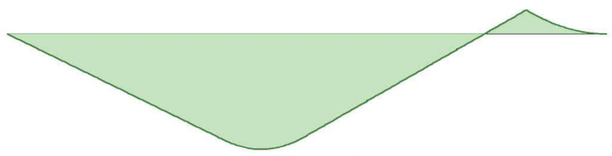


Shear Diagram

Max Shear = 450 lb



Moment Diagram



Max Moment = 3266 lb-ft

Calculations

Stringer

$V_{u3} = 1.38\ k$	Max Shear in member from model
M_{u3} = 1.74 k-ft	Max moment in member from model

Shear check

$V_{n3} = 0.6F_{yplate} \times A_{s3} = 0.6 \times 36ksi \times 1.32\ in^2 = 28.5\ kips$	Shear capacity
$\frac{V_{u3}}{V_{n3}} = \frac{1.38\ k}{28.5\ k} = 4.84\%$	Percent stressed

Moment Check

$M_{n3} = F_{yplate} \times Z_{x3} = 36\ ksi \times 1.85\ in^3 = 5.55\ k*ft$	Moment capacity
$\frac{M_{u3}}{M_{n3}} = \frac{1.74\ kip*ft}{5.55\ k*ft} = 31.35\%$	Percent stressed

Bolts

$M_{max} = 1.74\ k*ft$	Max moment
$d = 2.5\ in$	Distance between bolts
$T_u = \frac{M_{max}}{d} = \frac{1.74kip*ft}{2.5\ in} = 8.4\ kip$	Tension at bolt locations
$b_d = 0.375\ in^2$	Bolt diameter
$b_a = \left(\frac{pi}{4}\right) \times b_d^2 = \left(\frac{3.142}{4}\right) \times (0.375in)^2 = 0.110in^2$	Cross sectional area of bolt
$f_{ybolt} = 120\ ksi$	Tensile strength of grade 5 bolts
$\Phi R_{nb} = 0.75 \times b_a \times f_{ybolt} = 0.75 \times 0.110\ in^2 \times 120\ ksi = 9.9\ kip$	Tensile capacity of each bolt
$\frac{T_u}{\Phi R_{nb}} = \frac{8.4\ kip}{9.9\ kip} = 84.8\%$	Percent Stressed

Acknowledgements

We would like to thank Dr. Paul McMullin, S.E., Ph.D, our faculty advisor, for guiding and assisting us when needed. We would also like to thank Schuff Steel and Nucor for donating the steel and bolts used in the fabrication of the bridge.

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