

**Thesis Project Portfolio**

**AISC/ASCE Student Steel Bridge Competition**

(Technical Report)

**The Development of Mass Timber as a Substitute for Structural Steel**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2022

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## **Table of Contents**

Sociotechnical Synthesis

AISC/ASCE Student Steel Bridge Competition

The Development of Mass Timber as a Substitute for Structural Steel

Prospectus

## **Sociotechnical Synthesis**

Our capstone team designed and fabricated a steel bridge to compete in the 2025 ASCE Student Steel Bridge Competition. The bridge was designed to fit dimensional requirements outlined in the competition rules and to model improvements for the Skunk River Trail. The team optimized structural performance, constructability, and aesthetics through iterative modeling and analysis in Revit and RAM Elements. The Revit drawings include plans, sections, a 3D rendered view, and a detail sheet for bolted connections. The analytical model in RAM Elements is used for finding the weight, displacement, and member stresses. The primary goal was to create the lightest bridge possible that is easy to construct and has minimal vertical and lateral displacement during the load test. After completing the model, steel was ordered, and the bridge was fabricated by the team. The fabrication process included welding, cutting, bolt-hole drilling, grinding, and painting. The bridge was tested under an oscillating 2500lb load in the UVA structures laboratory. Alongside technical objectives, the team prioritized reviving the UVA Steel Bridge Team by recruiting underclassmen, structuring leadership roles, and holding workshops. The report includes detailed drawings, design evolution, and compliance documentation with AISC and ASCE competition standards. Our team was successful in constructing the bridge and competing in the ASCE Regional Symposium at the end of March 2025. Although the bridge was disqualified due to slightly exceeding the 45-minute construction time limit, the bridge performed well under load tests, and the competition provided valuable insights for future years. Future teams will look to build a lighter bridge with fewer connections and smaller members. Our team satisfied its goals of constructing the bridge, attending the competition, and building a strong foundation of the UVA Steel Bridge Club for the future.

My STS research paper focuses on mass timber, a possible alternative material to structural steel. We were required to use steel for the design competition, but perhaps a different

material would have performed just as well while minimizing harm to the environment. Efforts have been made to make steel a more sustainable material, but it still has a substantial carbon footprint. Mass timber is made from layering and gluing together lumber boards at an angled pattern. These built-up members have a comparable bearing capacity to steel beams but are lighter and emit less carbon dioxide during the manufacturing process. Wood's ability to sequester carbon also contributes to the lower net carbon emissions. This new structural material was first introduced in Europe in the 1990s and has since gained popularity due to the efficiency of fabrication, delivery, & construction, the reduction of construction noise, the aesthetics of exposed wood, and the environmental benefits. Various types of mass timber have also recently been published in product standards and building design codes. My research lists various advocacy groups, trade associations, and lobbying groups that have either aided or hindered the adaptation of mass timber in new construction. Some environmental groups that support mass timber development include the Natural Resource Defense Council and American Forests. A few companies currently investing in mass timber development include the International Association for Mass Timber Construction, Mass Timber Strategy, Boston Mass Timber Accelerator, Woodworks, and the American Wood Council. On the other hand, the American Institute of Steel Construction and the American Iron and Steel Institute are working to promote steel as the most sustainable choice since it is technically a recyclable material. This competition will likely delay widespread adaptation of mass timber as a primary structural material. My research outlines necessary steps to overcome the reluctance to transition from steel to mass timber in the construction industry.