Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design: EDGSN 100 Section 002

Team Ultra-Truss

Design Team 5

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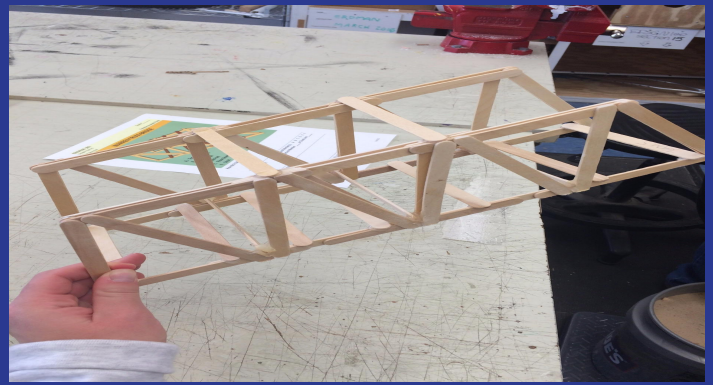
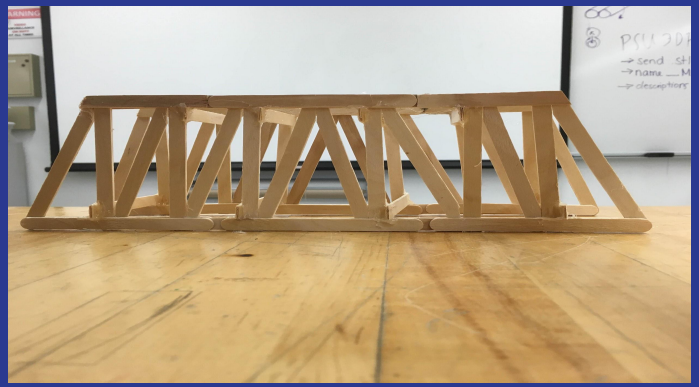


Presented to:

Prof. Berezniak

Fall 2015



Statement of Problem

A recent flood has destroyed a heavily trafficked bridge located in College Township, Centre County, PA.

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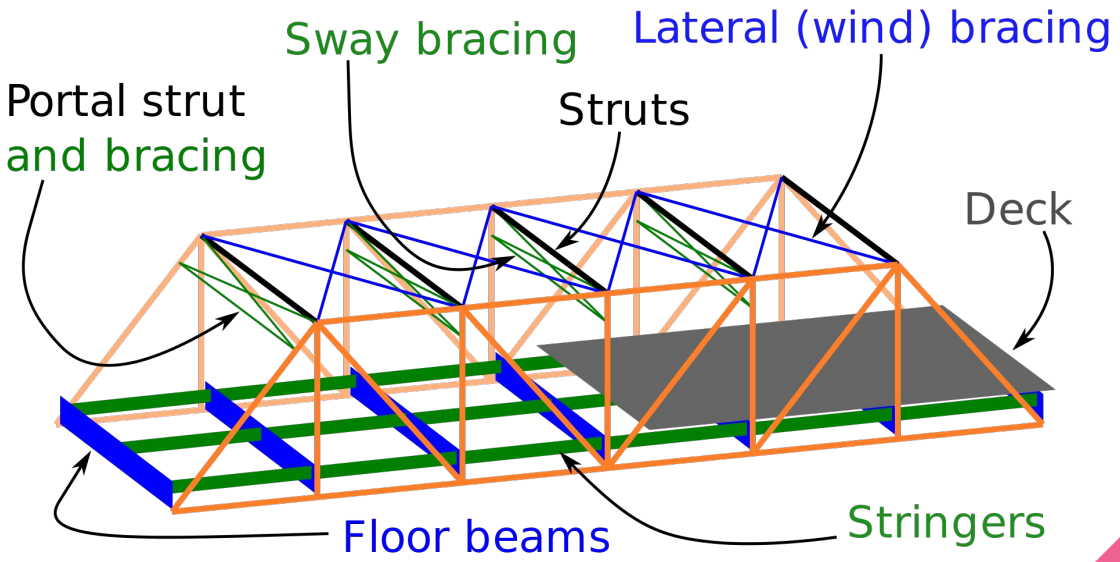
Travelers must now be re-routed more than 10 miles around the destroyed bridge, making transportation for medical and law enforcement officials much more difficult, and increasing the risk for residents in State College.

(PennDOT) Engineering District 2-0 has initiated an emergency, fast-track project to expedite the design a new vehicle bridge over Spring Creek to replace the bridge destroyed by the recent extreme flood event.



Objective

Design Criteria

Standard abutments, no piers (one span), deck material shall be medium strength concrete (0.23 meters thick), no cable anchorages and designed for the load of two AASHTO H20-44 trucks (225kN) with one in each traffic lane. The bridge deck elevation shall be set at 20 meters and the deck span shall be exactly 40 meters. Both a Warren through truss bridge and a Howe through truss bridge shall be analyzed. Members are solid steel bars as well as hollow steel tubes.

Technical Approach

Phase 1: Economic Approach

In order for the solution to be viable, the bridge must be affordable to build. The cost of the Warren and Howe Truss options were compared using the Engineering Encounters Bridge design software.

Technical Approach

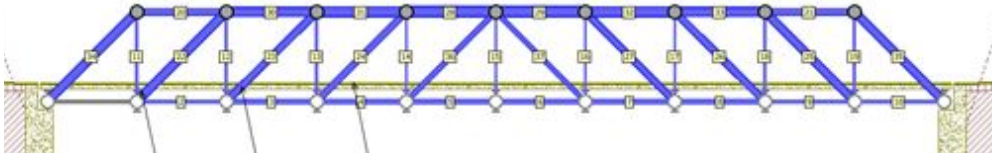
Phase 2: Structural Efficiency

To maximize the cost effectiveness and ensure the optimal design was chosen, we also compared the structural efficiency of howe and Warren Truss bridges. The structural efficiency illustrates the ratio between the amount of weight the bridge can hold and the amount of material used in constructing the bridge. Choosing the bridge with the highest structural efficiency both minimizes the cost of materials and optimizes the effectiveness of the bridge.

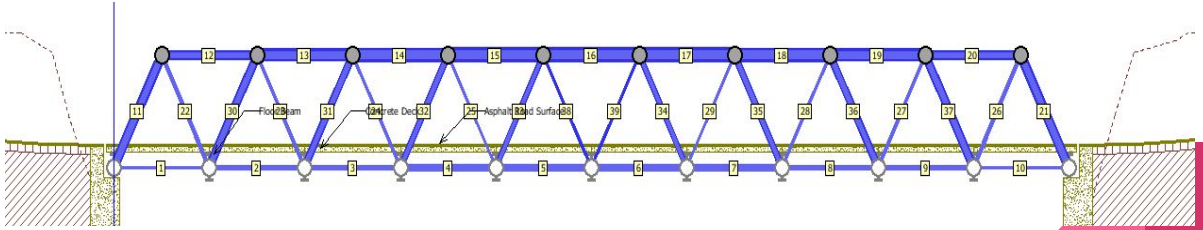
Results

Phase 1: Economic Efficiency

Cost of Howe Truss bridge: $246,168



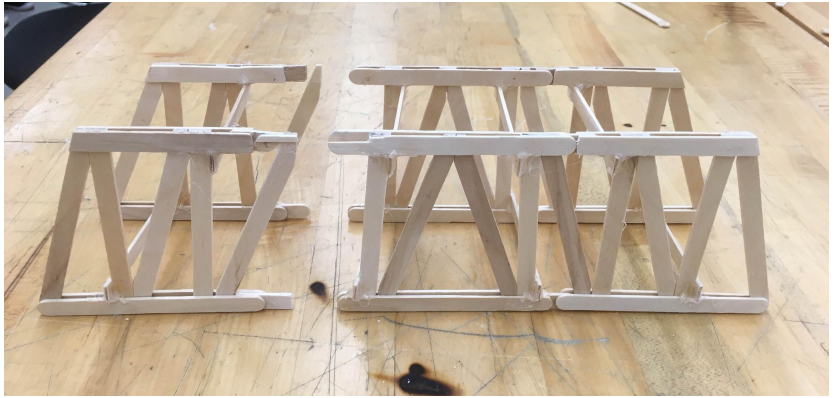
Cost of Warren Truss bridge: $233,902



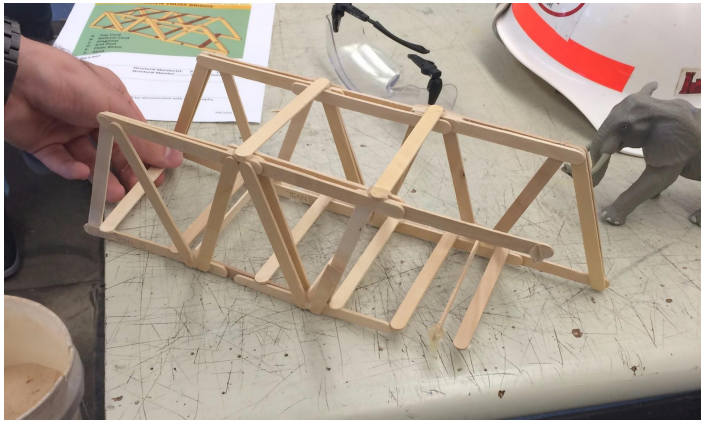
The Warren Truss bridge is more cost effective by $12,266

Results

Phase 2: Structural Efficiency



The howe truss bridges had a mean structural efficiency of .815. Between our bridges the Howe truss held almost twice as much weight.



The warren truss bridges, though more cost efficient, generally held less weight for its mass, with a mean structural efficiency of .790. However, the most efficient warren truss bridge was slightly more so than the most efficient Howe truss bridge.

Howe Truss Bridge Test

Best Solution

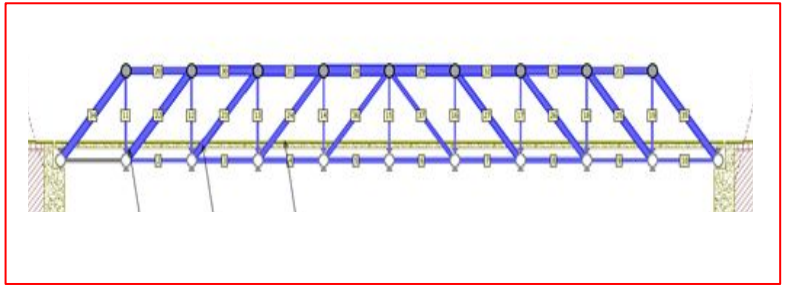
The howe truss bridge was less cost efficient at 105% of the cost of the howe truss, a difference that amounts to over $12,000.

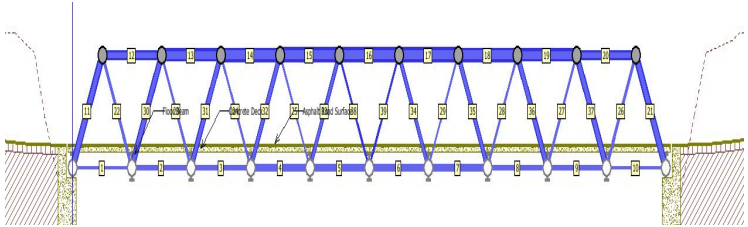
The Howe truss bridges were the most structurally efficient. The mean structural efficiency of the Howe truss bridge was 103.2% of the mean structural efficiency of the Warren truss bridge.

By comparing the percentages of the structural and cost efficiency of both bridge types one can conclude that Howe truss bridges are the optimal solution. Despite being slightly more expensive, the Howe truss is more structurally efficient.

Conclusions

The team recommends replacing the destroyed bridge with a Howe truss bridge. Despite being more expensive in material usage, the Howe truss bridge is more structurally efficient. This should result in a Howe truss bridge requiring less material than a Warren truss to hold the same amount of weight, offsetting the higher cost of materials.





Recommendations

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CEDE/edit
3Fusp%
3Ddrive_w

Both the team’s bridges could be improved with more careful securement of critical structural members.

The team’s Howe truss design could have used extra supports along the joints that lengthened the top and bottom cords as well.

The next step in the development phase should be to analyze and compare various means of assembling a howe truss bridge to minimize resources and cost of production.