Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 002

007

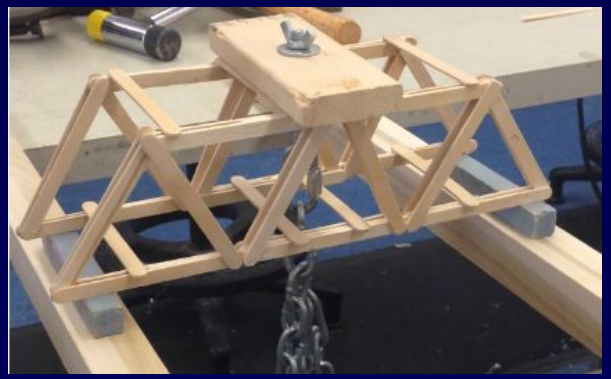
Design Team 7

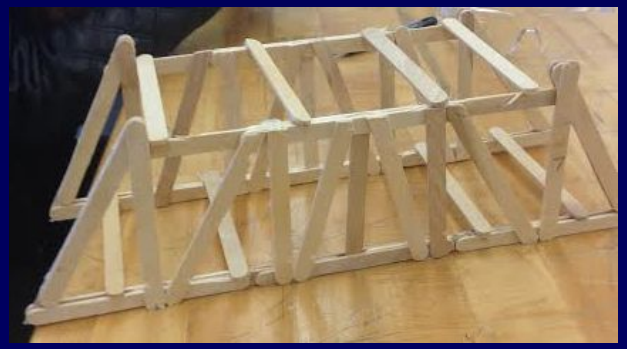
Wing See Michelle Leung

Eric Zimmerer

Katherine Tu

Zeyu Zhang





Presented to:

Prof. Berezniak

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Statement of Problem

Collapse of a local vehicle bridge in College Township, Centre County, PA

Scouring (erosion) from fast moving flood water

Pennsylvania Department of Transportation (PennDOT) Engineering District 2-0

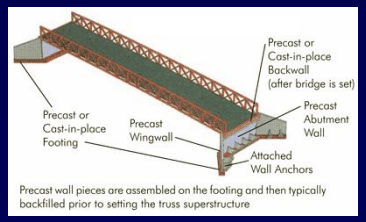
Objective

Design a new vehicle bridge over Spring Creek to replace the failed bridge.

Design Criteria

For Warren and Howe Truss Bridge Design

- Standard abutments -->



- No piers (one span)
- Deck material 0.23 meter thick concrete
- No cable anchorages
- Able to sustain a live load of two 225kN trucks with one in each traffic lane
- The bridge deck elevation is 20 meters, deck span is 40 meters.

Technical Approach Phase 1: Economic Efficiency

Economic efficiency determined using the EEBD 2015 software which uses various materials, cross sections, and sizes of units to construct the most economically beneficial product.

Materials- Carbon Steel
High-Strength Low-Alloy Steel
Quenched & Tempered Steel

Cross Sections- Bar (tension) and tube (compression)

Sizes- minimized

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Technical Approach Phase 2: Structural Efficiency

Prototype bridge of each design built with Popsicle sticks and white glue, as well as hot glue for struts and/or floor beams.

The bridges both have a maximum of sixty (60) Popsicle sticks and dimensions of 13.5 inches in length, 4 inches in height and 4.5 inches in width

The prototype bridges will be tested to catastrophic failure

The failure will be analyzed to find why, where, and how it the bridge failed.

Results Phase 1: Economic Efficiency

According to the data from the bridge design software, both types of bridge can reach the cost around $250,000.
In comparison, the result turns out that the Warren Truss is the more economically efficient design. The costs of the bridge was largely reduced by using the different truss and cross-section material.

Predicted cost of The Howe Truss bridge: $251,347.14

Predicted cost of The Warren Truss Bridge: $240,760.59

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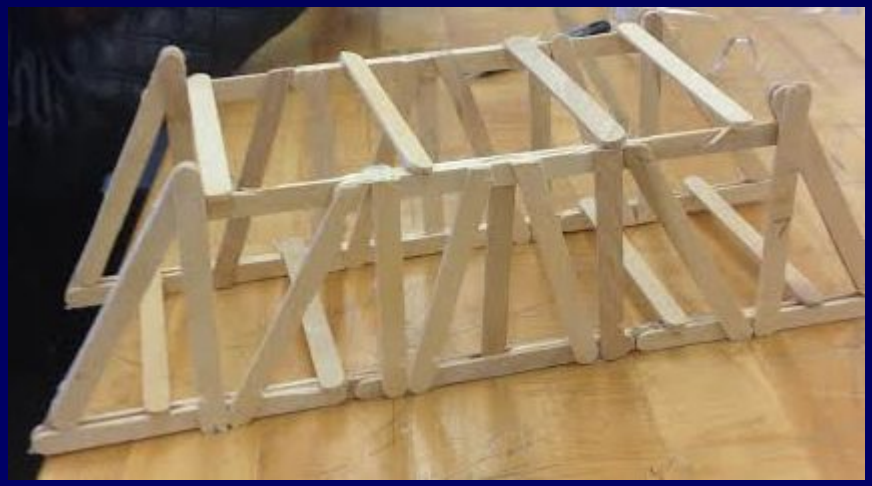
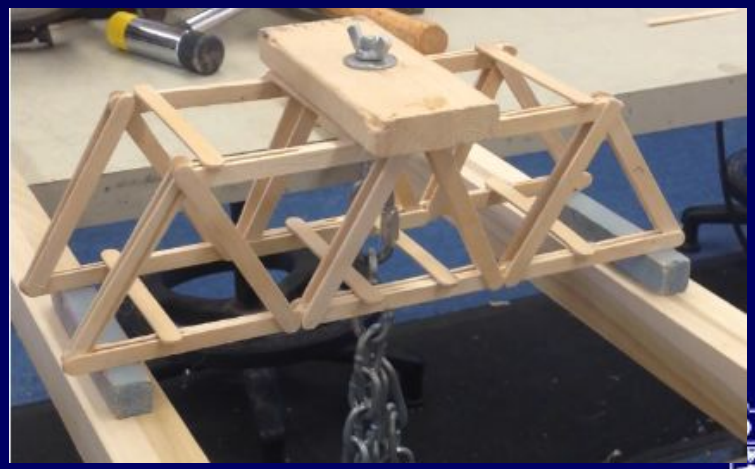
Results Phase 2: Structural Efficiency

The maximum loads of the Howe Truss bridge and the Warren Truss bridge are extremely close.
The Howe Truss bridge failed at 71.0 lbs.
The Warren Truss bridge failed at 70.9 lbs.
They are both structured by 60 popsicle sticks.

The principle causes -
The Howe Truss bridge: The poor quality popsicle sticks used on the top cord.
The Warren Truss bridge: The mistake in the construction. Crooked structure led to the uneven stress on the bridge. Also the glue was given less time to cure





Best Solution

The Warren Truss Bridge.

Advantages:

i) It is more economically efficient. The total cost of the Warren Truss bridge is less than the cost of Howe Bridge.

ii) It has high structural efficiency. Although the Warren Truss bridge costs less, but the result from the load test shows that it takes almost the same loads as the Howe Truss Bridge. The detailed data tables are attached in this report.

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Conclusions

After thoroughly analyzing and a series of testing, the design group 7 recommends the Warren Truss bridge to replace the bridge destroyed by the recent flood event.

Recommendations

The next step that should be accomplished is testing the stability of the bridge under real life situation, for instance: weather, location and temperature.

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