Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 001

Design Team 007

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Presented to:

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Statement of Problem

- Bridge over Spring Creek collapsed due to local flood
- Hinder local traffic flow
- Residents of State College are now under several difficulties
- Reduce accessibility to necessities, including Mount Nittany Medical Center

➔ NEED A RELACING BRIDGE

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Objective

- To create an effective replacement for the bridge quickly and efficiently
- To restore normal traffic flow & access to necessities

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Design Criteria

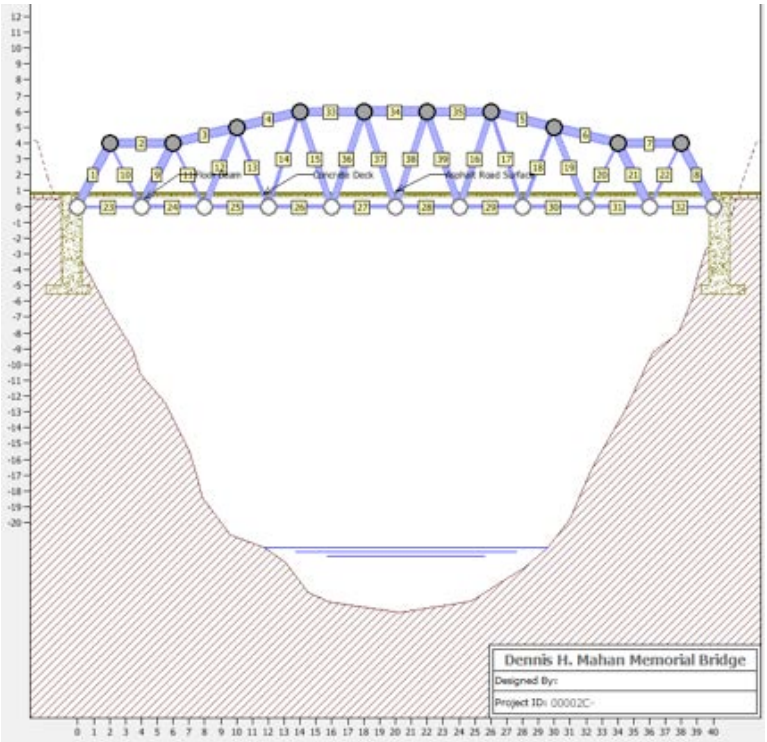
- Both bridges require:
  - Standard abutments
  - No piers, one span
  - Medium strength concrete for deck
  - No cable anchorages
  - Must be able to support two AASHTO H20-44 trucks, one per lane
  - Deck elevation: 20 meters
  - Bridge span: 40 meters.

Technical Approach

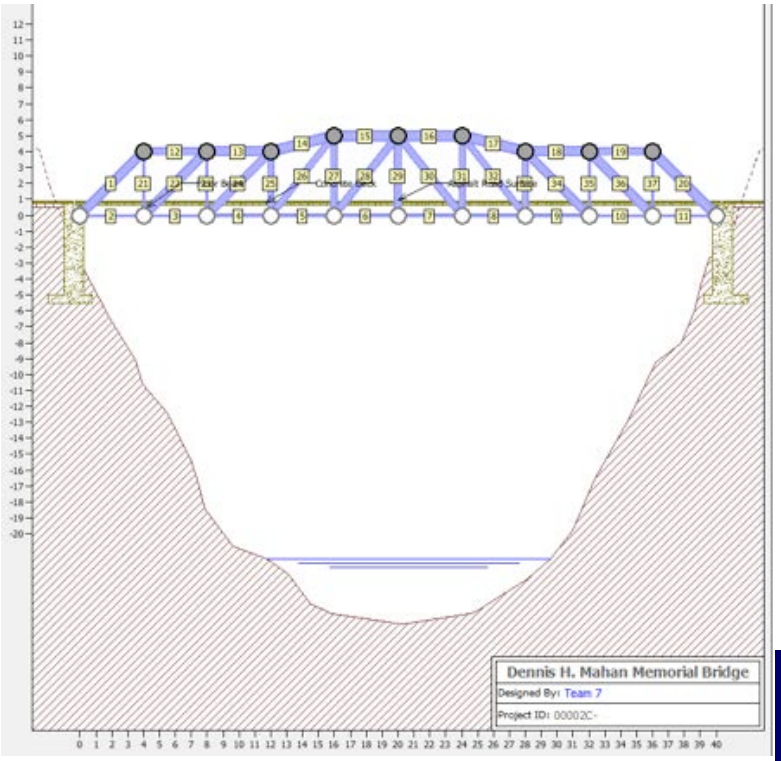
Phase 1: Economic Efficiency

- Determine Cost by Bridge Designer 2016 Software
- Maximize structural integrity + minimize cost

Warren Design



Howe Design



Technical Approach

Phase 2: Structural Efficiency

- Prototype built on:
  - At most 60 Wooden Popsicle Sticks as members
  - Elmer's Glue for joint connection
  - Hot Glue for floor beams and struts

- Load Testing:
  - Loading block hanged on the top center chords
  - Load sand and hammers until failure
  - Failure load measured

- Investigate the failed positions and the causes
  - Photographs before and after testing
  - Thorough analyses
  - Recommendation

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Results

Phase 1: Economic Efficiency

- **Howe Bridge:**
  - Only Quenched and Tempered Steel
  - Higher Production cost (by $1,000) for 8 types of members
  - Higher Material cost (by $7,000)
  - Lower Connection cost (by $800)
  - Same Site cost
  - Total: $214,000

- **Warren Bridge:**
  - Only Quenched and Tempered Steel
  - Lower Production cost (by $1,000) for 7 types of members
  - Lower Material cost (by $7,000)
  - Higher Connection cost (by $800)
  - Same Site cost
  - Total: $207,000

Bridge Cost Analysis

Costs	**Howe**	**Warren**
Material	$108,634	$101,693
Connection	$16,000	$16,800
Product	$8,000	$7,000
Site	$81,400	$81,400
TOTAL	**$214,034**	**$206,893**

➔➔**Warren Bridge is more economically efficient**

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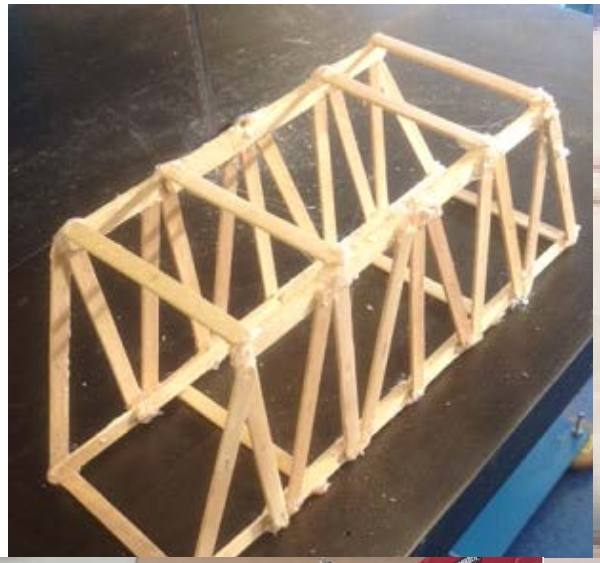
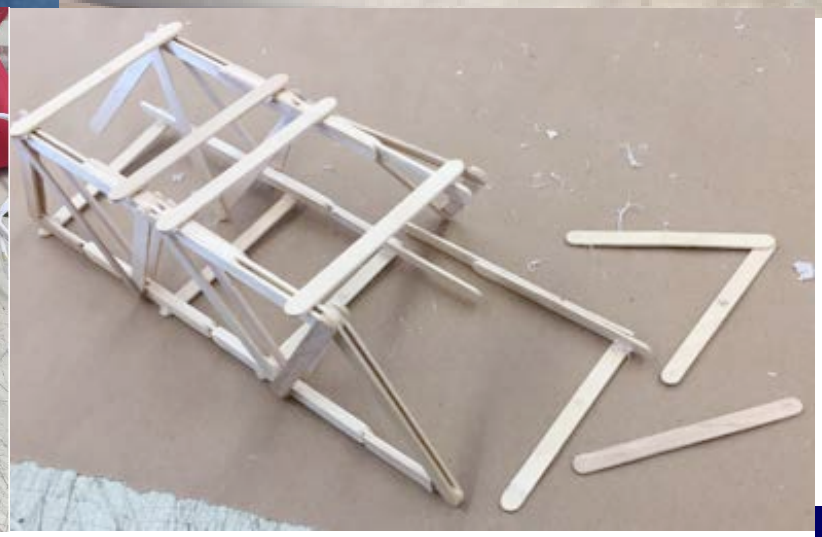
Results

Phase 2: Structural Efficiency

Howe Bridge





Warren Bridge

➔➔ **Warren Bridge is more structurally efficient**

Best Solution

- **Warren Bridge**
  - Lower production cost
  - Structurally more efficient
  - Lower design efficient
  - Higher constructability

Conclusions

- Warren bridge is better than Howe bridge
- The Warren bridge outperforms the Howe bridge in terms of:
  - Economic Efficiency
  - Structural Efficiency
  - Design efficiency
  - Constructability

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Recommendations

- Warren Bridge is highly recommended
- A professional engineer should review and adjust the design