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
Objective

• To create an effective replacement for the bridge quickly and efficiently

• To restore normal traffic flow & access to necessities
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
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

> Warren Bridge is more economically efficient
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
Recommendations

• Warren Bridge is highly recommended

• A professional engineer should review and adjust the design