Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 001

Team Flying Wombat

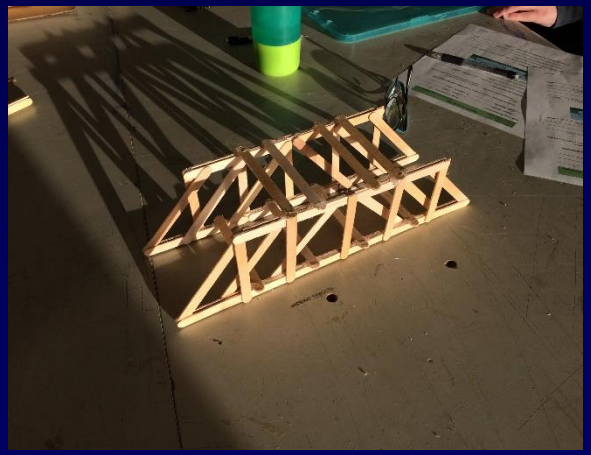
Design Team 4

Laura Cook

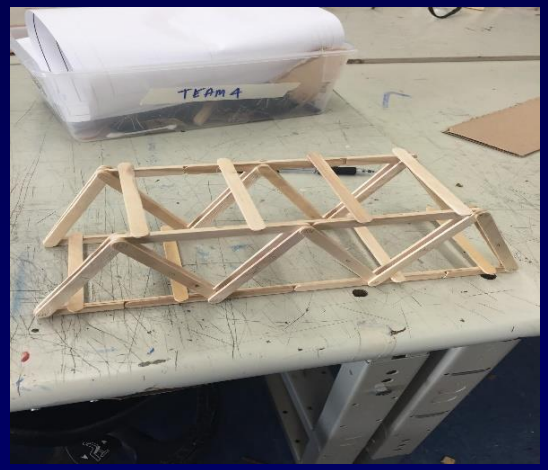
Cody Heaton

Denis Pasic

Connor Hoover



Howe



Warren

Presented to:

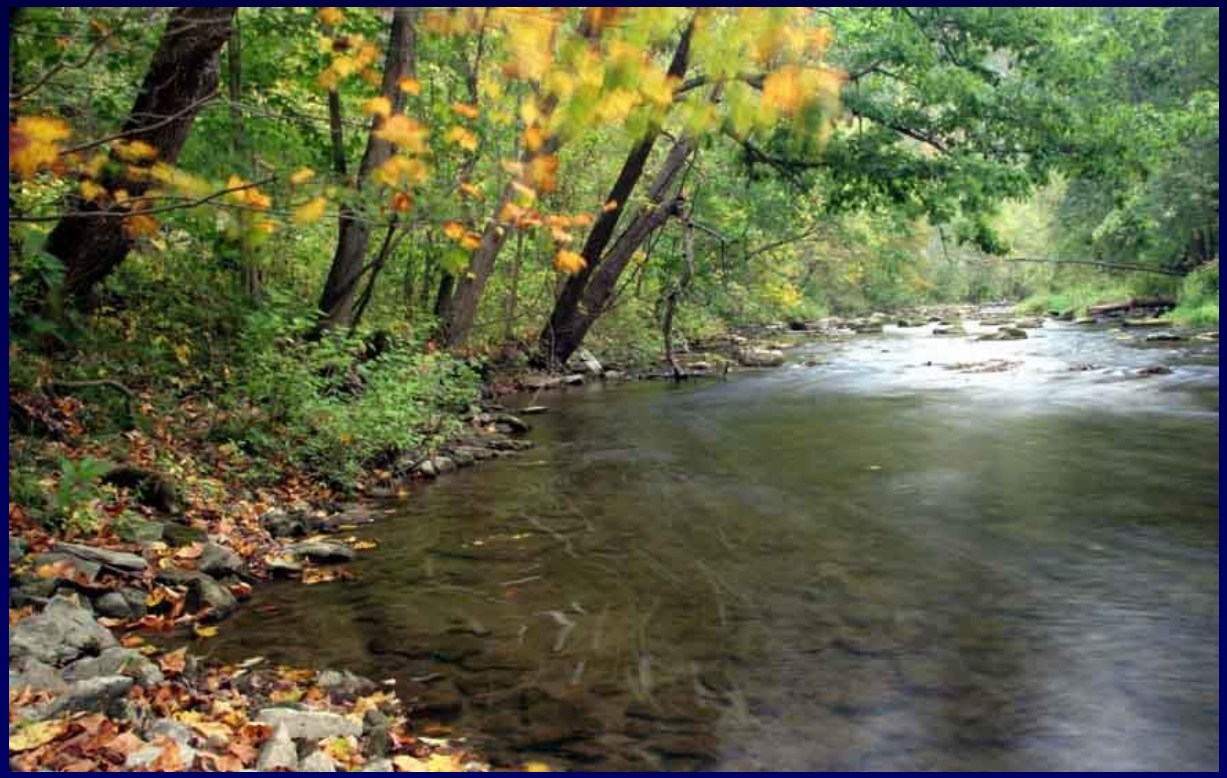
Prof. Berezniak

Fall 2015

PENNSTATE

Statement of Problem

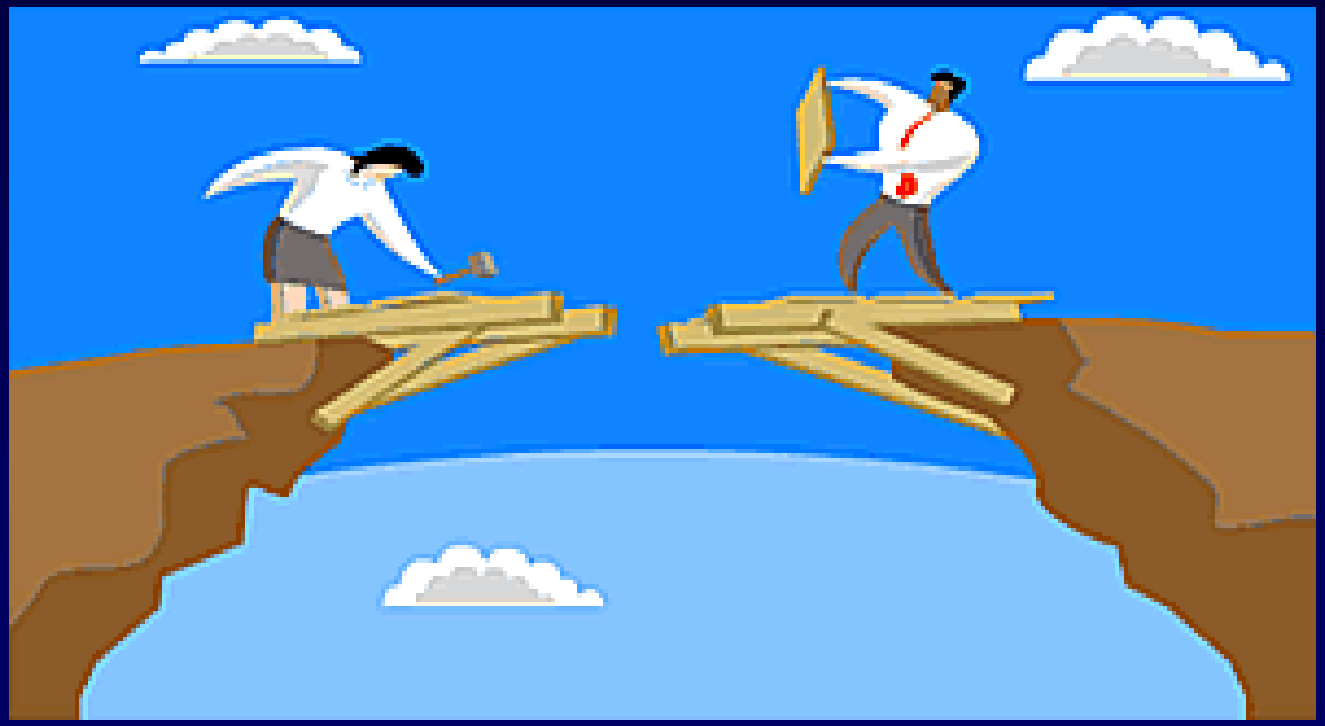
- Local flooding completely destroyed a structurally deficient vehicle bridge
- Located over Spring Creek along Puddintown Road in College Township, Centre County, PA
- Disrupting residential traffic flow



PENNSTATE

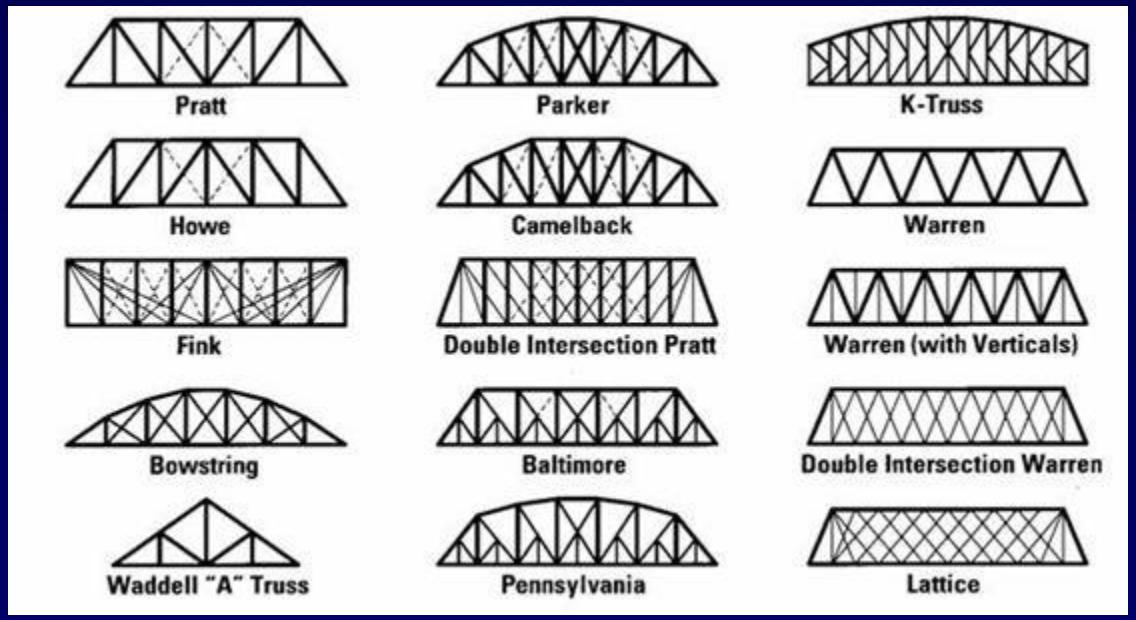
Objective

- Pennsylvania Department of Transportation (PennDOT) of Engineering District 2-0 has initiated an emergency
- Fast-track project: design a new vehicle bridge over Spring Creek



Design Criteria

- Truss bridge for financial and structural reasons
- Requirements:
  - Standard abutments
  - no piers (one span)
  - deck material of medium strength concrete (0.23 meters thick)
  - no cable anchorages
  - load of two AASHTO H20-44 trucks (225kN) with one in each traffic lane
  - The bridge deck elevation was set at 20 meters and the deck span at 40 meters

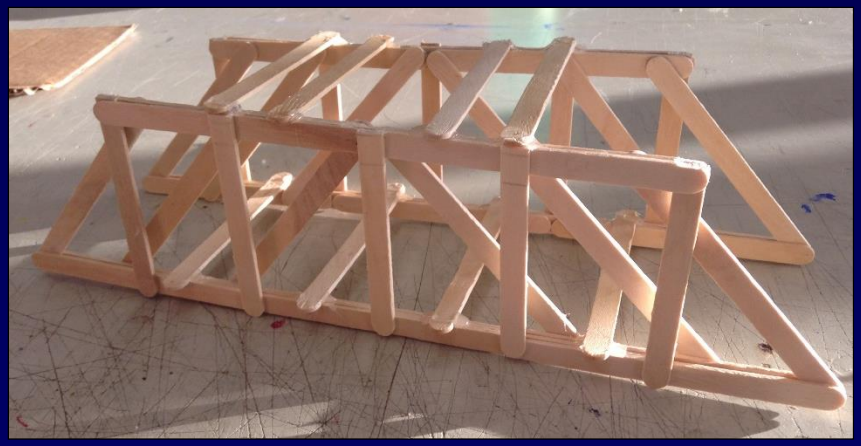


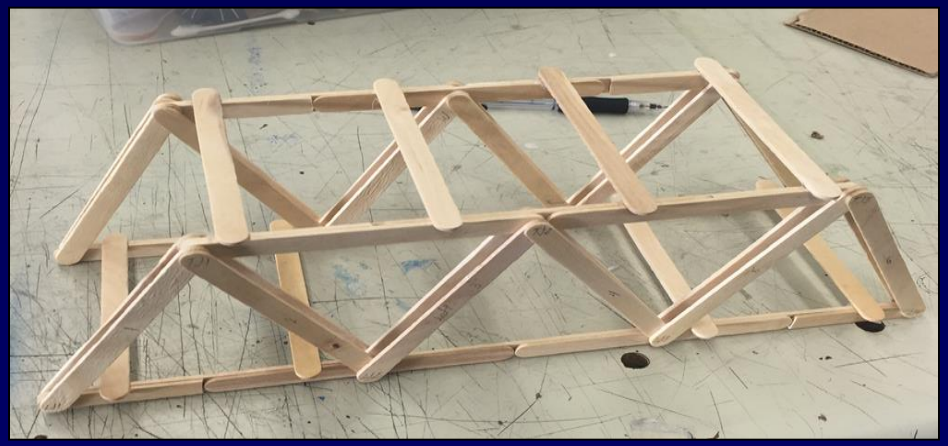
Technical Approach Phase 1: Economic Efficiency

- Economic efficiency (cost) determined using the Engineering Encounters Bridge Design 2015 (EEBD 2015) software
- Objective: to use EEBD to analyze both Warren and Howe truss bridges
- Bridges optimized to keep the cost of the replacement bridge as low as possible
- Must support its own weight (dead load), plus the weight of a standard truck loading (live load)

Technical Approach Phase 2: Structural Efficiency

- Prototypes designed and built for both
- Tested in the lab to catastrophic failure
- Determined which had the best structural efficiency
- The prototypes were built from:
    - Standard Popsicle sticks
    - Elmer's white glue
    - Hot glue



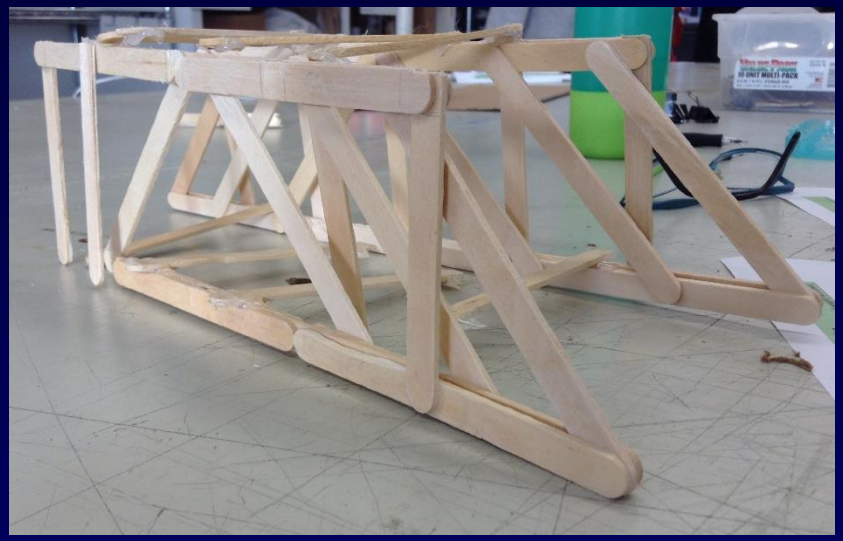


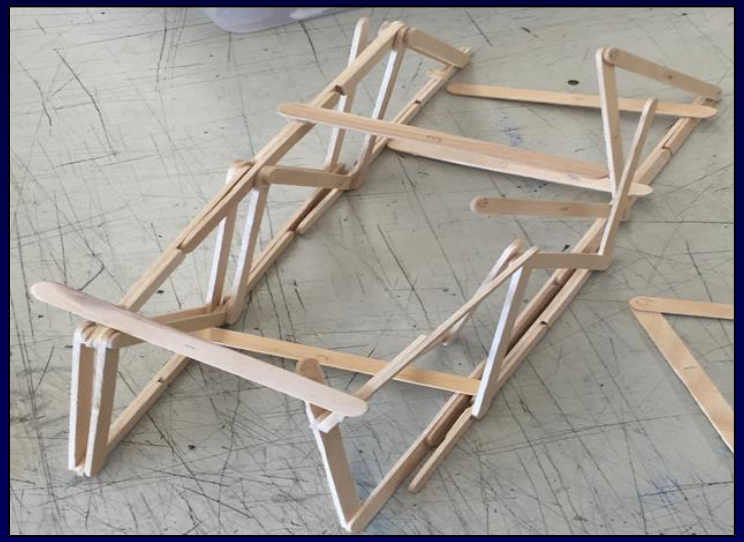
Results Phase 1: Economic Efficiency

- Howe truss: $228,595.39
- Warren truss: $213,282.00
- The designs used one only type of steel to minimize cost
- Also used smaller members and hollow tubes to balance structural integrity and cost
- Total price of the Warren truss was lower than Howe by $15,313.39
- Warren = clear choice from an economic perspective

Results Phase 2: Structural Efficiency

- The Howe design held 77.9 lbs with a structural efficiency of 452.4
    - Above average
- The Warren design held 32.7 lbs, for a structural efficiency of 202.6





- Considering only the structural efficiency data, the Howe truss seemed to be stronger and more durable
- But the Warren truss performed more reliably, with a smaller range of efficiencies

Best Solution

- Took into account both cost and structural efficiency
- Financially,
  - The Warren would be cheaper to build by $15,313.39
- Structurally,
  - This specific Warren design was weaker than the Howe
  - The class Howe efficiencies had a large range and seemed less reliable
  - The Warren average, while slightly lower, represented a smaller range of values

Best Solution

- It is recommended, based on these factors, that the Spring Creek bridge be built as a Warren truss
- Less expensive to build and dependably structurally efficient with an average not much different than that of the Howe

PENNSTATE

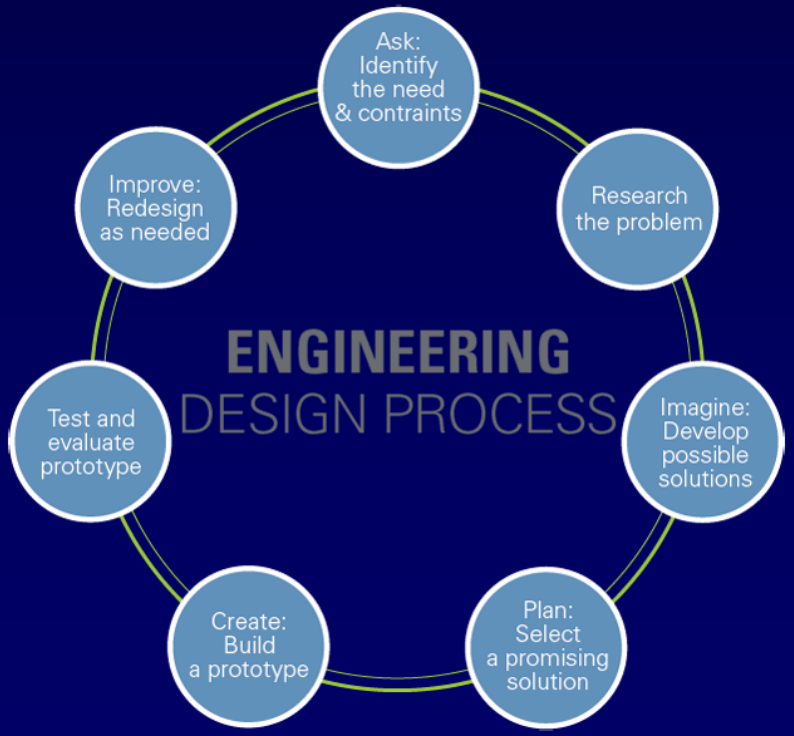
Conclusions

Warren

Howe

Recommendations

- The final recommendation was that the Spring Creek bridge be a Warren truss, due to financial and structural factors
- More economically efficient and more reliably structurally efficient
- Next steps:
  - The physical site of the bridge should be examined
  - If any problems arise between the current design and the realities of its implementing it, revise design according to engineering design process



PENNSTATE