Design Project #1

Replacement of Vehicle Bridge over Spring Creek

Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 002

Team Steve

#8

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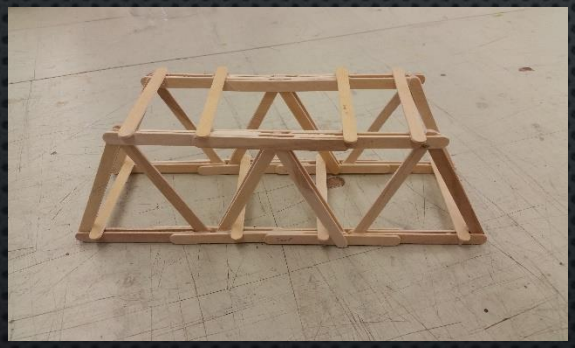
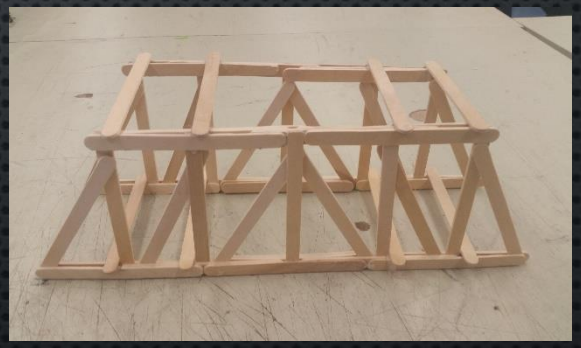


Warren Truss Bridge

Design Team Photo



Howe Truss Bridge

Presented to:

Prof. Berezniak

Fall 2015

STATEMENT OF PROBLEM

- A 100-year flood event caused the complete destruction of a structurally deficient vehicle bridge
- Located over Spring Creek along Puddintown Road in College Township, Centre County, PA
- along a heavily traveled local road and is designated as a vital lifeline for vehicle access to the Mount Nittany Medical Center located in State College, PA.
- traffic must be re-routed 10 miles around the bridge, disrupting traffic flow, commerce, and exposing State College residents to considerable risk

Objective

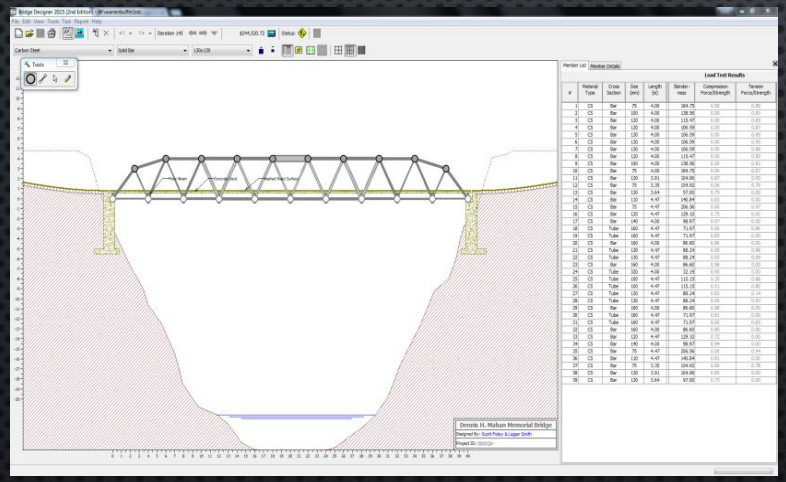
- Design two different potential bridges using Howe and Warren truss types
- Determine the bridge with the lowest total cost through the use of the Bridge Designer 2015 software
- Construct prototypes for each bridge and test them until failure
- Determine the structural efficiency of each bridge

DESIGN CRITERIA

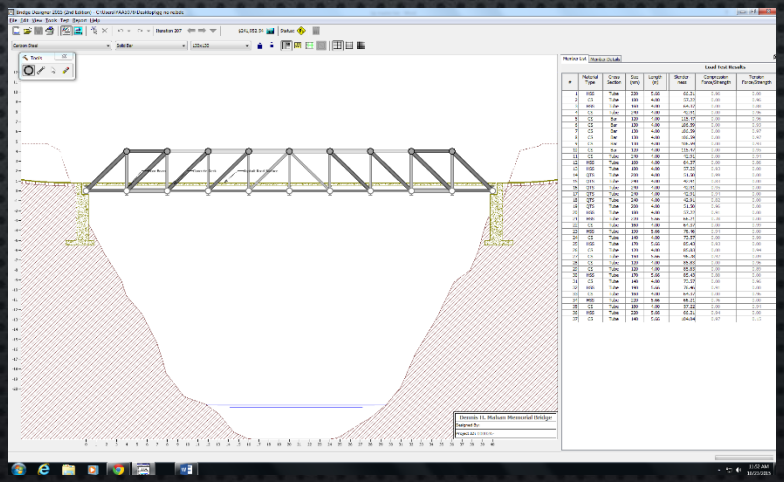
- Standard abutments, no piers (one span)
- Deck-medium strength concrete (0.23 meters thick), no cable anchorages
- Withstand load of two AASHTO H20-44 trucks (225kN), one in each traffic lane.
- Elevation at 20 meters, deck span - 40 meters.

TECHNICAL APPROACH PHASE 1: ECONOMIC EFFICIENCY

- USE BRIDGE DESIGNER 2015 TO DESIGN A STABLE WARREN AND HOWE THROUGH TRUSS BRIDGE
- OPTIMIZE EACH TO KEEP THE COST OF THE REPLACEMENT BRIDGE AS LOW AS POSSIBLE
- REPLACEMENT BRIDGE CAN SUPPORT ITS OWN WEIGHT (DEAD LOAD), PLUS THE WEIGHT OF A STANDARD TRUCK LOADING (LIVE LOAD).



Warren Truss Bridge



Howe Truss Bridge

TECHNICAL APPROACH PHASE 2: STRUCTURAL EFFICIENCY

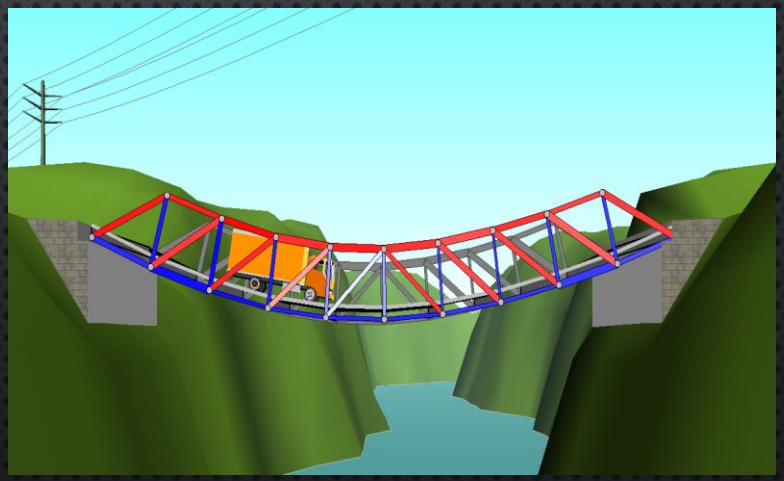
- PROTOTYPE BRIDGE DESIGNED AND BUILT FOR BOTH A WARREN THROUGH TRUSS BRIDGE AND A HOWE THROUGH TRUSS BRIDGE
- EACH PROTOYPE BRIDGE LOAD TESTED UNTIL CATASTROPHIC FAILURE.
- THE TRUSS BRIDGE TYPE THAT EXHIBITS THE BEST STRUCTURAL EFFICIENCY WHEN TESTED TO FAILURE IN PROTOTYPE SHALL BE DETERMINED.
- STRUCTURAL EFFICIENCY - THE ABILITY OF THE TRUSS BRIDGE TO SAFELY DISSIPATE LIVE LOADS.
- STRUCTURAL EFFICIENCY (SE) IS CALCULATED BY DIVIDING THE LOAD THE BRIDGE SUPPORTS AT FAILURE BY THE WEIGHT OF THE PROTOTYPE BRIDGE

RESULTS PHASE 1: ECONOMIC EFFICIENCY

- MAJORITY SOLID BARS
- END POSTS WERE SHORTENED
- CENTER TOP CHORD MADE VERY THICK

Warren Truss Bridge
Total Cost = $244,520.72

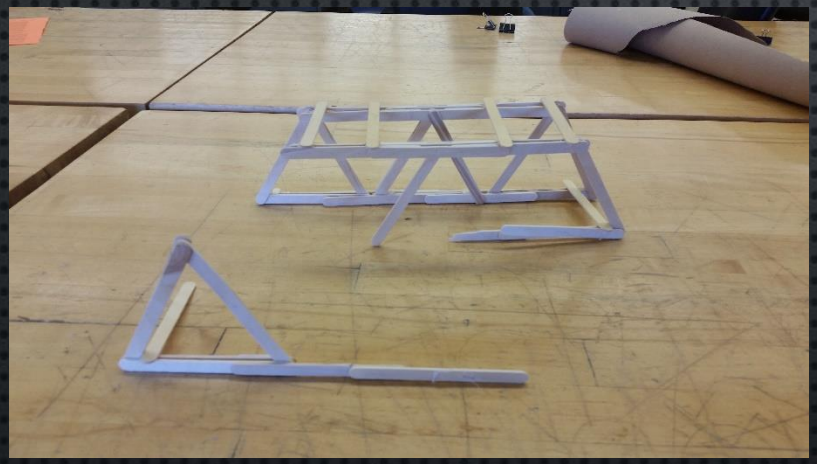
- MAJORITY HOLLOW TUBES
- VERTICALS ARE VERY SMALL COMPARED TO DIAGONALS
- SIX CENTER TOP-CHORD MEMBERS MADE FROM QTS

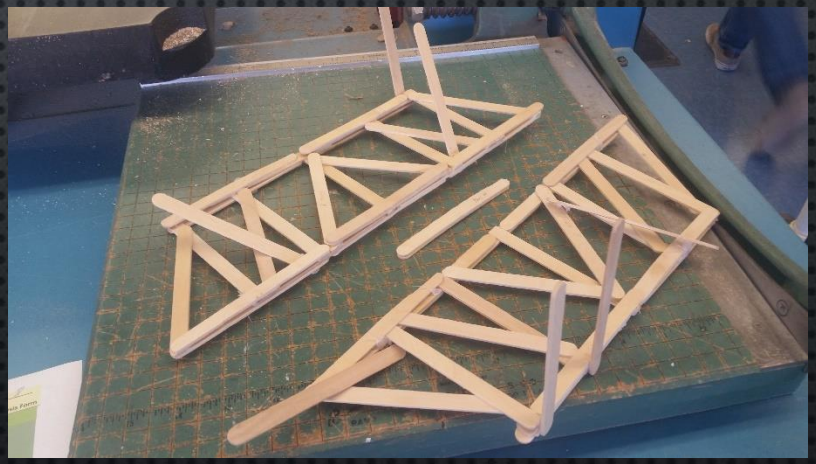


Howe Truss Bridge
Total Cost = $241,952.54

RESULTS PHASE 2: STRUCTURAL EFFICIENCY

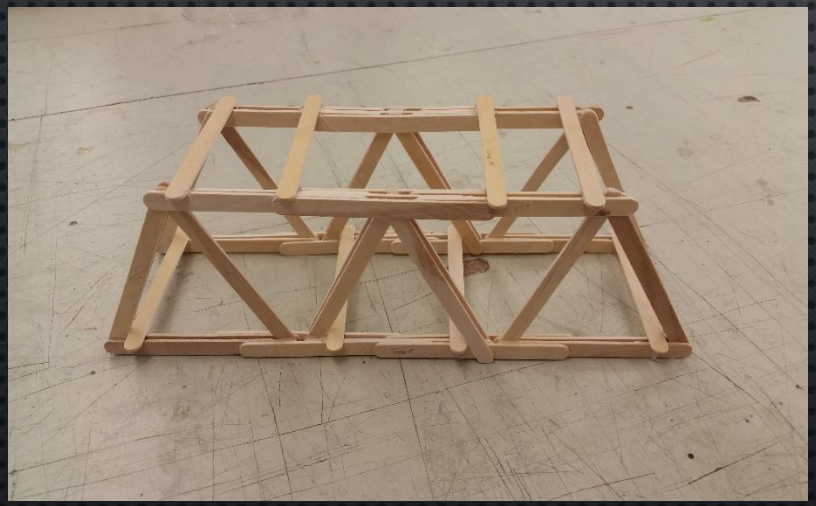
- Warren truss bridge Structural Efficiency: 489.94
- Howe truss bridge Structural Efficiency: 244.66

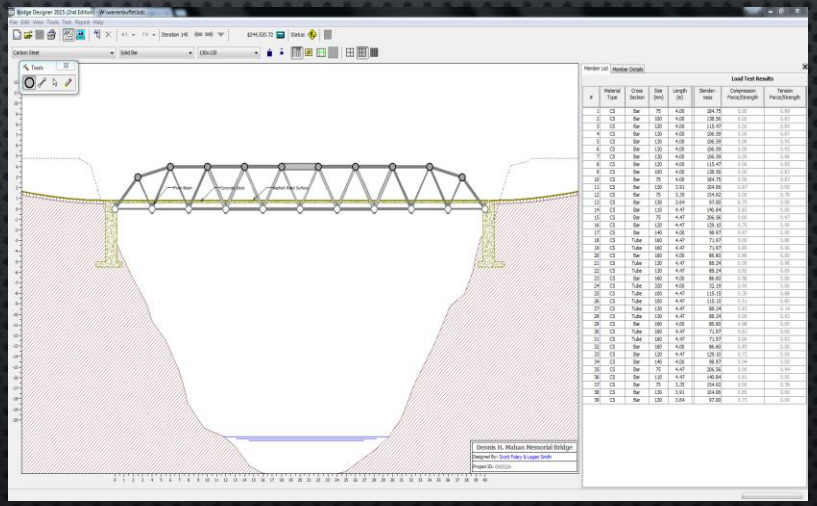




BEST SOLUTION

- WARREN THROUGH TRUSS BRIDGE





CONCLUSIONS

- Warren truss bridge costs: $244,520.72
- Howe truss bridge costs: $241,952.54
- Warren bridge structural efficiency: 489.94
- Howe bridge structural efficiency: 244.66
- Structural efficiency/cost
  - Warren: 0.00200
  - Howe: 0.00101

RECOMMENDATIONS

- Recommend the Warren Through Truss Bridge
- Possess the best structural efficiency among the two
- Best load test results
- Small price leap from Howe Truss Bridge: $2,568.18
- Low cost overall