Design Project #1

# Replacement of Vehicle Bridge over Spring Creek

## Centre County, PA

### Introduction to Engineering Design

### EDGSN 100 Section 002


"Good Enough" Design Team

Design Team Number Three

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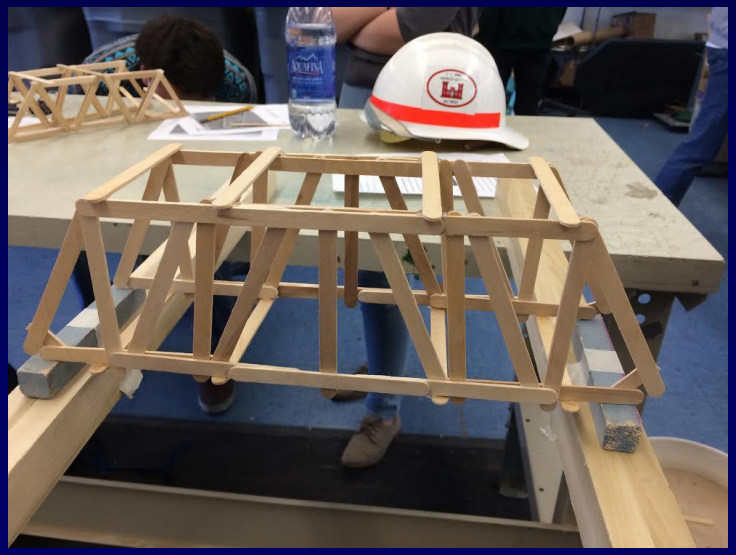

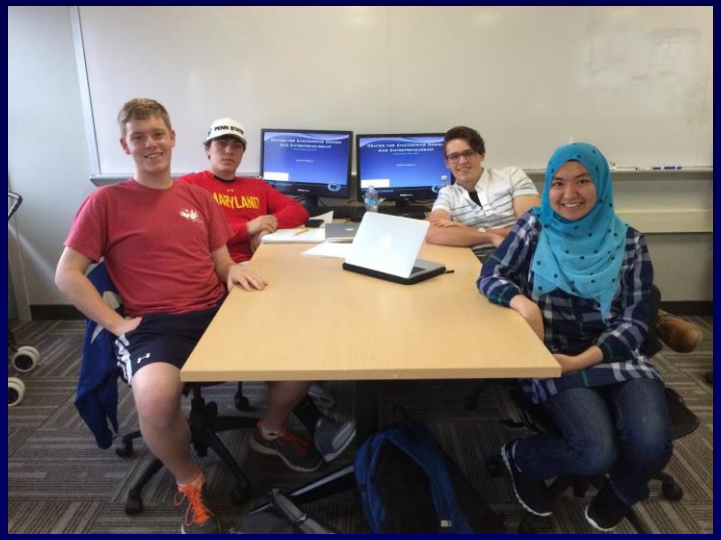

**Presented to:**

**Prof. Berezniak**

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# Statement of Problem

- The bridge over Spring Creek along Puddintown Road has collapsed as a result of flooding
- Major route to Mount Nittany Medical Center
  - Speedy and sturdy solution needed

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# Objective

- A new bridge needs to be designed
- Structurally sound bridge so that future flooding will not destroy the bridge again.

# Design Criteria

- The bridge will be a continuous span of 40 meters with no piers
- Deck will be made of medium strength concrete (0.23 m thick)
- The deck shall have an elevation of 20 meters
    - wide enough for two lanes of traffic.

# Technical Approach Phase 1: Economic Efficiency

The economic efficiency of the bridge was determined by the EEBD software

- Included:
  - Material cost
  - Connection Cost
  - Product Cost
  - Site Cost – identical in all bridge designs



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# Technical Approach Phase 2: Structural Efficiency

- Determined by dividing the load the bridge supports at catastrophic failure by the weight of the prototype bridge
  - $W_{failure}/W_{bridge}$=Structural Efficiency

# Results Phase 1: Economic Efficiency

**Howe:**

Carbon Steel Tube: $6.30/kg x 2,601.8kg = $16,391.34

Tempered Steel Bar: $6.00/kg x 3,077.2kg = $18,463.20

Tempered Steel Tube: $7.70/kg x 6,460kg = $49,742.00

Connection Cost: $16,000.00

Product Cost: $9,000.00

Site Cost: $77,400.00

Total: $186,996.14

**Warren:**

Carbon Steel Bar: $4.30/kg x 6,054.0kg = $26,032.20

Carbon Steel Tube: $6.30/kg x 1,049.8kg = $6,613.74

Tempered Steel Tube: $7.70/kg x 9,303kg = $71,633.10

Connection Cost: $16,800.00

Product Cost: $12,000.00

Site Cost: $77,400.00

Total: $210,478.29



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# Results Phase 2: Structural Efficiency

**Weight of Bridge/Load at Failure**

**Howe:**

**0.147lbs / 32.6lbs = 222**

**Warren:**

**0.161lbs / 48.2lbs = 299**

**Howe**

**Warren**

# Best Solution

- **Howe is $23,482.15 cheaper than Warren**
- **Warren is over 1.3x more structurally efficient**
- **Bridge must withstand floodwaters**
  - Bridge chosen should be most structurally efficient
- **A Warren truss bridge is the best solution**

# Conclusions

- **Warren truss bridge is more structurally efficient**
  - Slightly more expensive
- **Total Cost/Structural Efficiency**
  - Howe: $186,996.14/222 = 842
  - Warren: $210,478.29/299 = 704
    - Warren costs less per unit of S.E.
- **Tubular members are strong in compression**
- **Bars are strong in tension**



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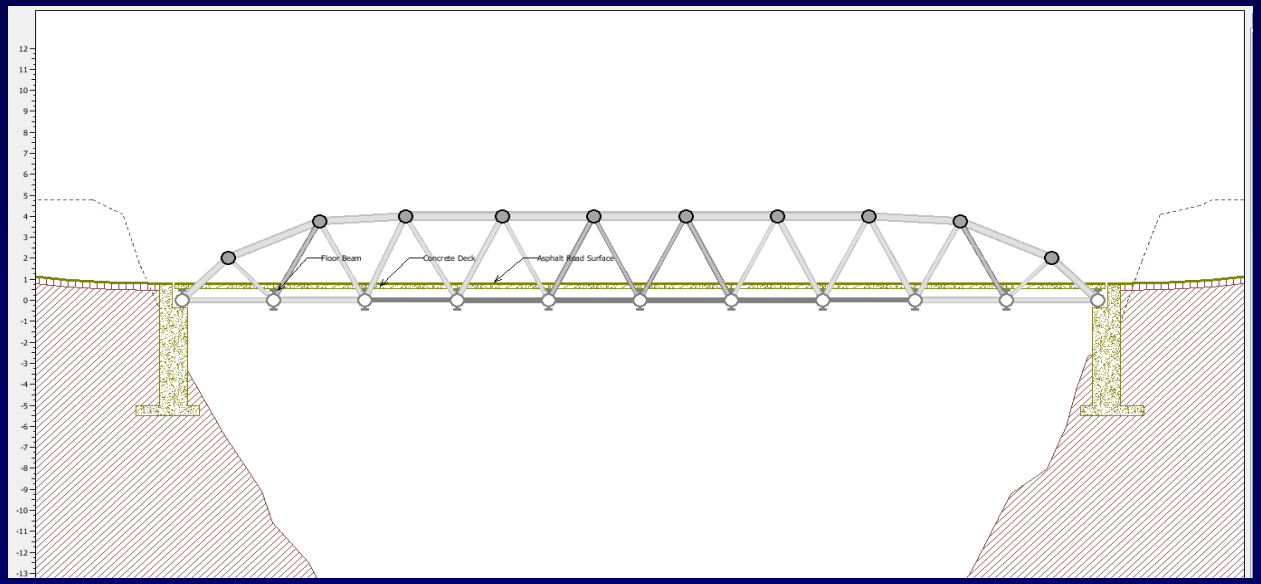
# Recommendations

- A Warren through truss bridge should be built to span Spring Creek

- Quenched and tempered steel tubes are best material for members in compression