Design Project #1

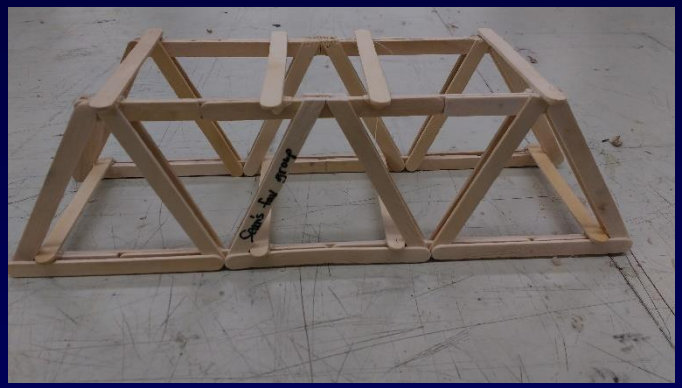
Replacement of Vehicle Bridge over Spring Creek

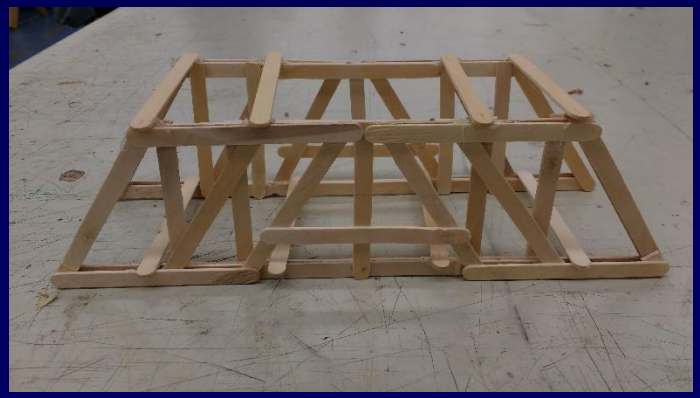
Centre County, PA

Introduction to Engineering Design

EDGSN 100 Section 001

Sean's Favorite Team





06
Tyler
Flynn
Sonny
Stan

Presented to:

Prof. Berezniak

Fall 2015

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1855

Statement of Problem

Local flooding has eventually destroyed a structurally deficient bridge over Spring Creek

The bridge was heavily travelled and a main entrance road to get to the Mount Nittany Medical Center in State College, PA.

All traffic must now be re-routed more than 10 miles around the destroyed bridge, thereby disrupting residential traffic flow, local commerce, and exposing State College residents to considerable risk

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Objective

Quickly design a new bridge

Create an economically efficient bridge that is also structurally efficient

Design Criteria

Standard abutments

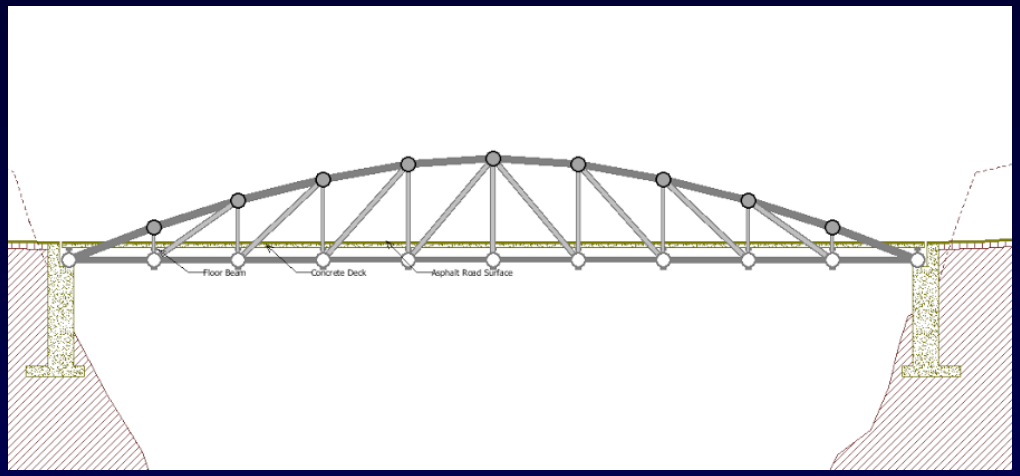
No piers (one span), deck material shall be medium strength concrete (0.23 meters thick)

No cable anchorages

Load of two trucks (225kN) with one in each traffic lane

The deck of the bridge needs to be 20 meters high and the deck will span 40 meters

Technical Approach Phase 1: Economic Efficiency



Technical Approach Phase 2: Structural Efficiency

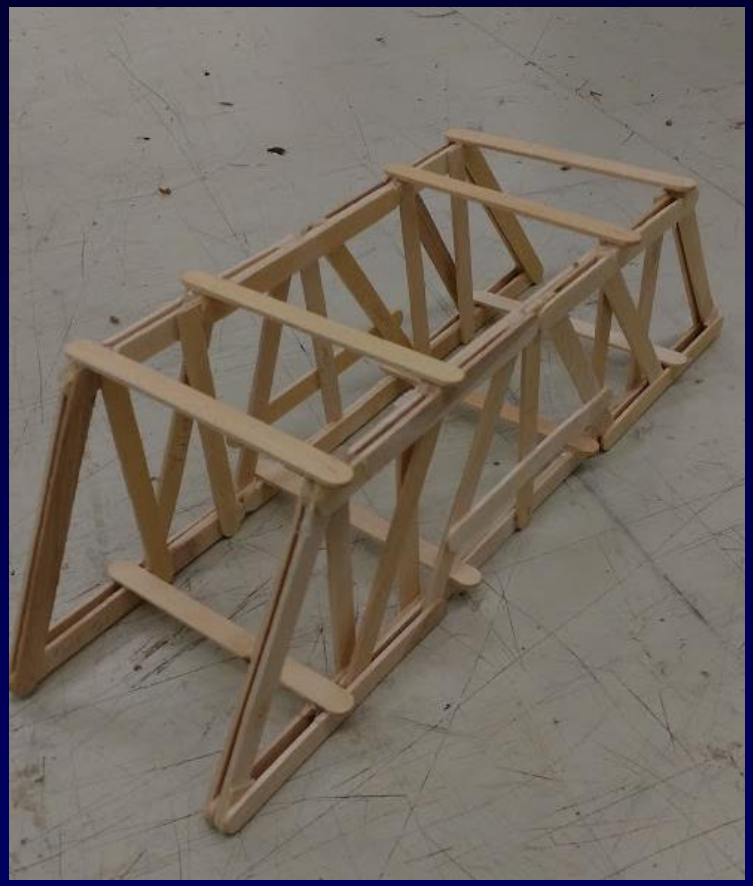
The design criteria that the bridges needed to follow was to hold two 225kN trucks

In the EEBD 2015 program, each bridge was set to hold that weight.

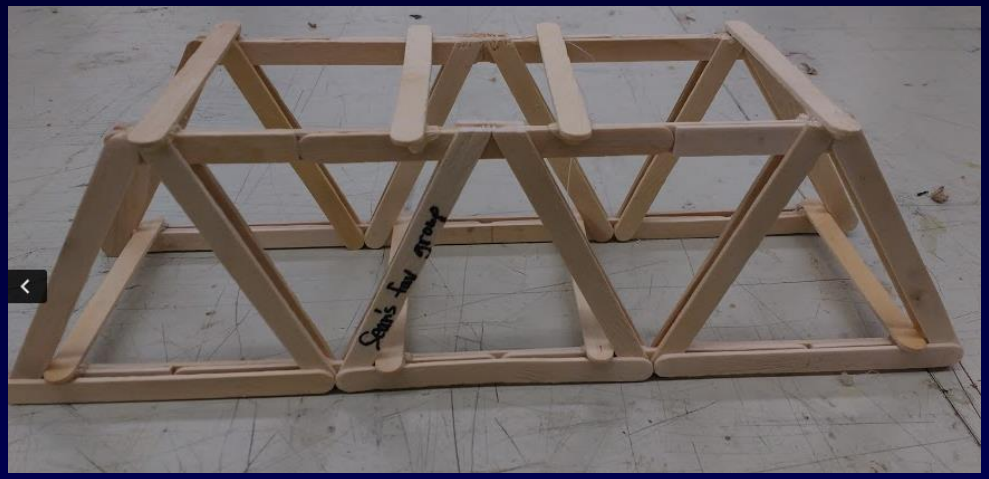
As we limited costs we also kept in mind the weight that needed to be supported

Member type, size, material

Technical Approach Phase 2: Structural Efficiency



Howe



Warren

Results Phase 1: Economic Efficiency

Tested different member materials, types and sizes

Went through member by member limiting costs

The cost of the Warren Bridge $245,317.43

The cost of the Howe Bridge $243,361.04

Howe Truss Bridge Cost Efficiency Report			
Type of Cost	Item	Cost Calculation	Cost
Material Cost (M)	Carbon Steel Solid Bar	(13842.9 kg) x ($4.30 per kg) x (2 Trusses) =	$119,048.86
	Carbon Steel Hollow Tube	(1501.0 kg) x ($6.30 per kg) x (2 Trusses) =	$18,912.18
Connection Cost (C)		(20 Joints) x (500.0 per joint) x (2 Trusses) =	$20,000.00
Product Cost (P)	6 - 90x90x4 mm Carbon Steel Tube	(%s per Product) =	$1,000.00
	2 - 100x100x5 mm Carbon Steel Tube	(%s per Product) =	$1,000.00
	4 - 120x120 mm Carbon Steel Bar	(%s per Product) =	$1,000.00
	6 - 130x130 mm Carbon Steel Bar	(%s per Product) =	$1,000.00
	8 - 130x130x6 mm Carbon Steel Tube	(%s per Product) =	$1,000.00
	1 - 140x140x7 mm Carbon Steel Tube	(%s per Product) =	$1,000.00
	5 - 160x160 mm Carbon Steel Bar	(%s per Product) =	$1,000.00
	5 - 170x170 mm Carbon Steel Bar	(%s per Product) =	$1,000.00
Site Cost (S)	Deck Cost	(10 4-meter panels) x ($4,700.00 per panel) =	$47,000.00
	Excavation Cost	(19,900 cubic meters) x ($1.00 per cubic meter) =	$19,900.00
	Abutment Cost	(2 standard abutments) x ($5,250.00 per abutment) =	$10,500.00
	Pier Cost	No pier =	$0.00
	Cable Anchorage Cost	No anchorages =	$0.00
Total Cost	M + C + P + S	$137,961.04 + $20,000.00 + $8,000.00 + $77,400.00 =	$243,361.04

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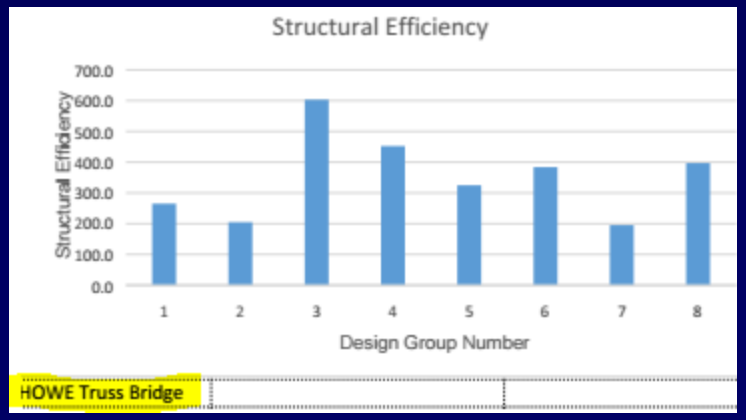
Results Phase 2: Structural Efficiency

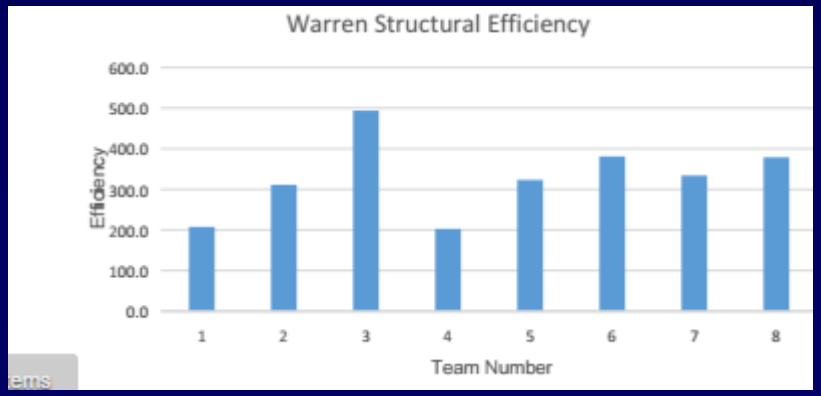
WARREN Truss Bridge				
Design Team No.	Actual Bridge Weight (grams)	Actual Bridge Weight (lbs)	LOAD at Failure (lbs)	Structural Efficiency
1	85.2	0.187833624	39	207.6
2	80.3	0.177030986	55.1	311.2
3	83.4	0.183865308	90.8	493.8
4	73.2	0.161378184	32.7	202.6
5	85.3	0.188054086	60.8	323.3
6	83.8	0.184747156	70.4	381.1
7	75.5	0.16644881	55.6	334.0
8	81.9	0.180558378	68.4	378.8

HOWE Truss Bridge				
Design Team No.	Actual Bridge Weight (grams)	Actual Bridge Weight (lbs)	LOAD at Failure (lbs)	Structural Efficiency
1	84.5	0.18629039	49.4	265.2
2	75.3	0.166007886	34	204.8
3	81.8	0.180337916	108.8	603.3
4	78.1	0.172180822	77.9	452.4
5	81.4	0.179456068	58.3	324.9
6	85.2	0.187833624	72.1	383.9
7	79.7	0.175708214	34.3	195.2
8	80	0.1763696	70	396.9

Warren Structural Efficiency: 381.1

Howe Structural Efficiency: 383.9



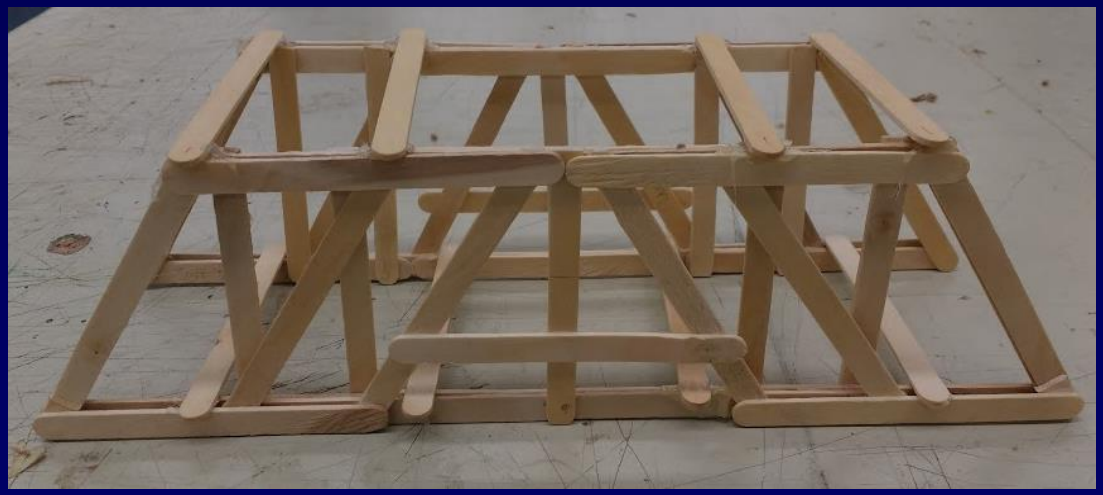


Best Solution

The Howe bridge was the best solution based on structural efficiency and economic efficiency

Warren bridge came in at 381.1 and the Howe at 383.9.

This highlights how the group dedicated equal amounts of time and effort into each bridge.



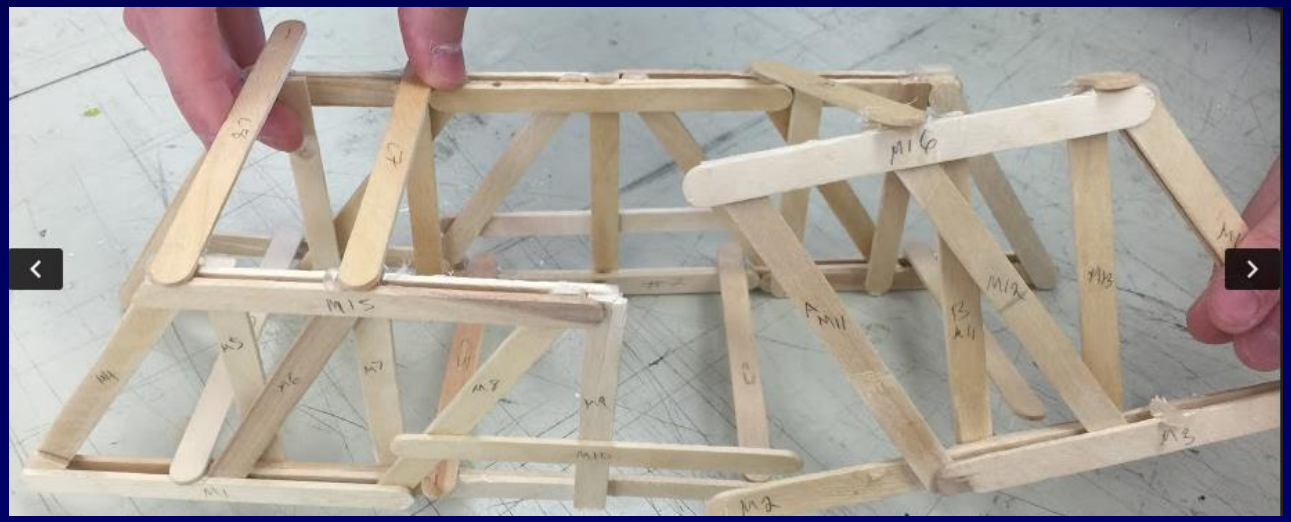
Conclusions

The better bridge out of the two was the Howe

It proved better from the technical approach and also the design

It had a lower cost and had a higher structural efficiency

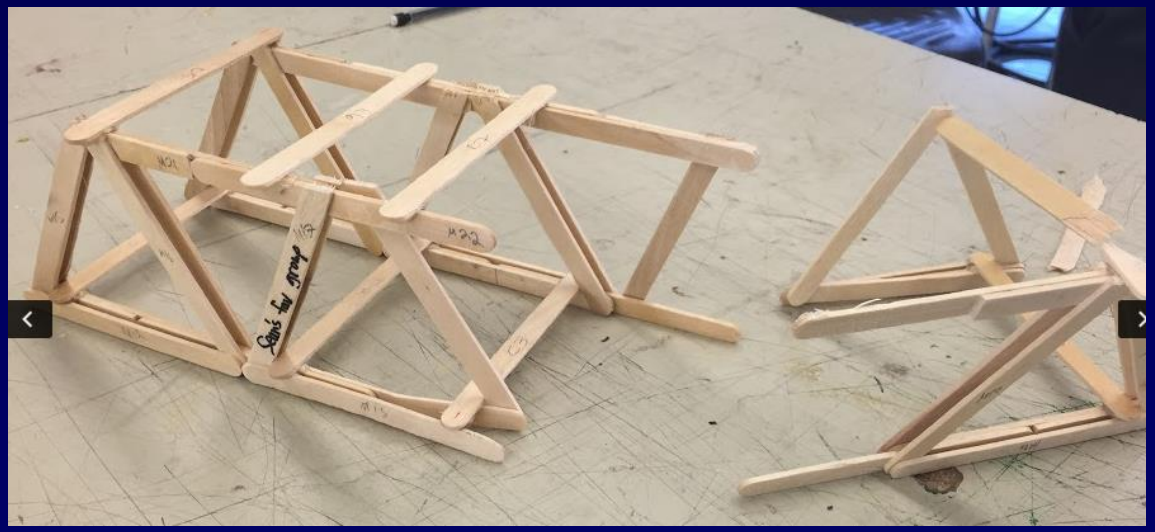
Construction Techniques



Recommendations

When designing the prototype…

Ensure both sides are built the same

Given proper glue time

Parallel to each other