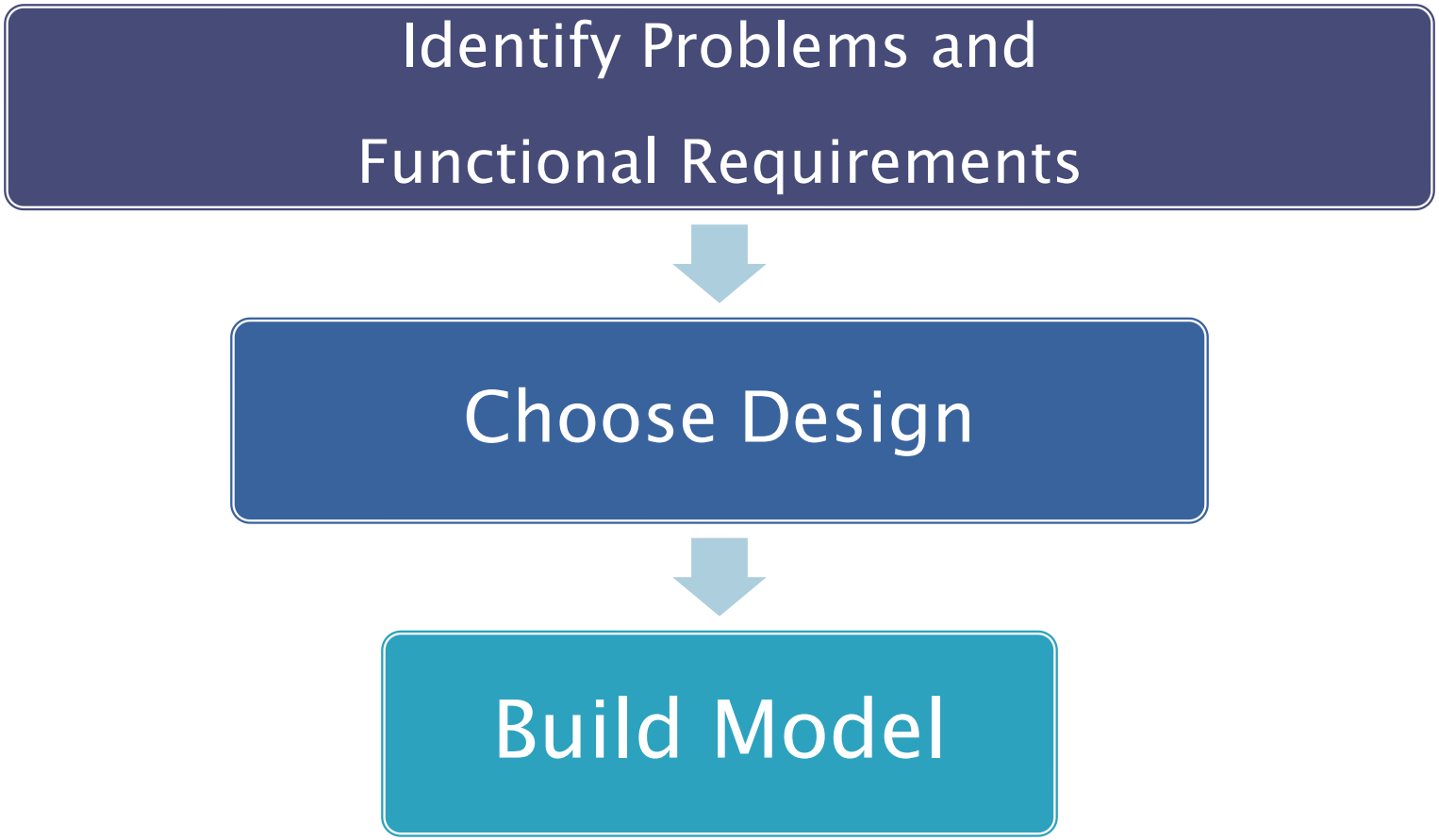
The Bridge of the Future EID101D

Professor Tzavelis
Fall 2011

What is the Bridge of the Future?

- Durable
- Cost-Effective
- Aesthetically Pleasing
- Energy Producing

Goals


Identify Problems and
Functional Requirements
Choose Design
Build Model

Constraints

- Cost
- Materials
- Time
- Weight

Calculations and Analysis

$\sum F_x = 0$ Net forces in x-direction have to equal zero

$\sum F_y = 0$ Net forces in y-direction have to equal zero

$\sum M_z = 0$ Net rotation about z-axis has to equal zero

Calculations and Analysis

$$Stress = \frac{F}{A}$$

F = Force (weight on bridge)

A = Cross-section of the cable

$$\frac{F}{A} < \frac{F_y}{SF}$$

F_y = Force on individual cable

SF = Safety Factor (1.6)

Calculations and Analysis

$$\frac{C}{A_{tower}} < \frac{F_{y(tower)}}{SF} < 2ksi$$

C = Compression on tower

A_{tower} = Surface Area of tower

$F_{y(tower)}$ = Force on tower

SF = Safety Factor (1.6)

ksi = kips/sq.in

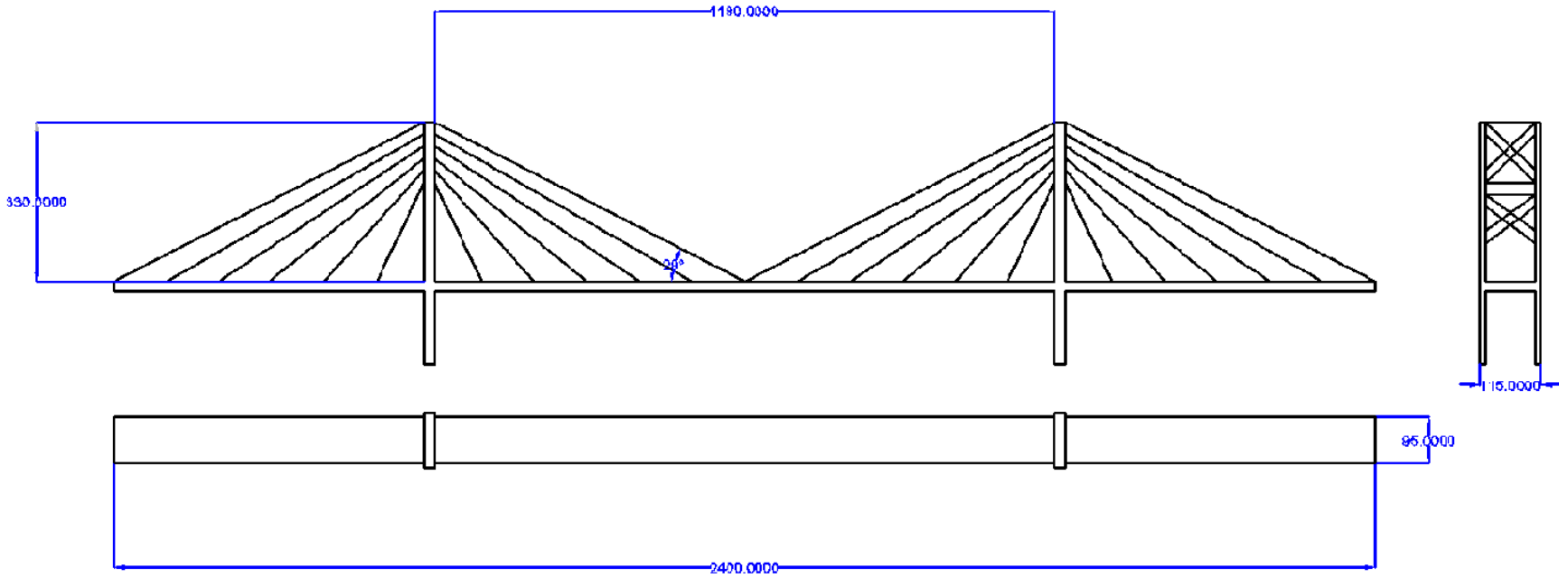
Group 1

Karmen Chong, Austin Joa, Kelvin Lin,
Eitan Selter, Ezra Sultan

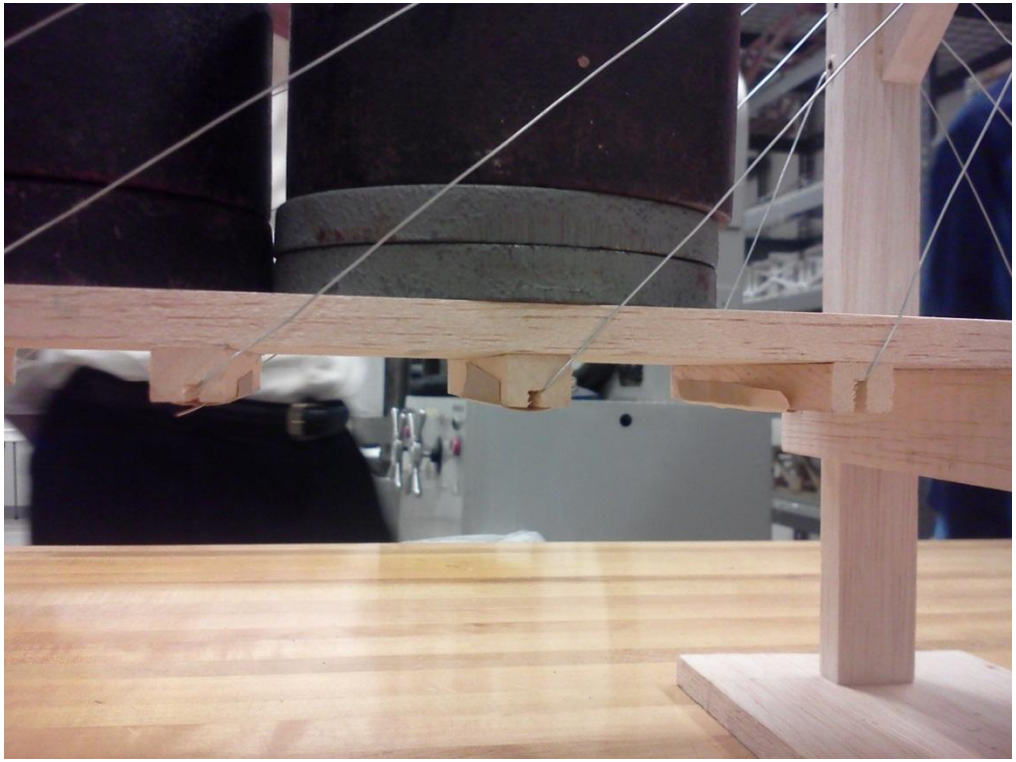
Design Criteria

- Reliability/Durability
- Maintenance
- Constructability
- Cost
- Usability
- Aesthetics
- Energy Production

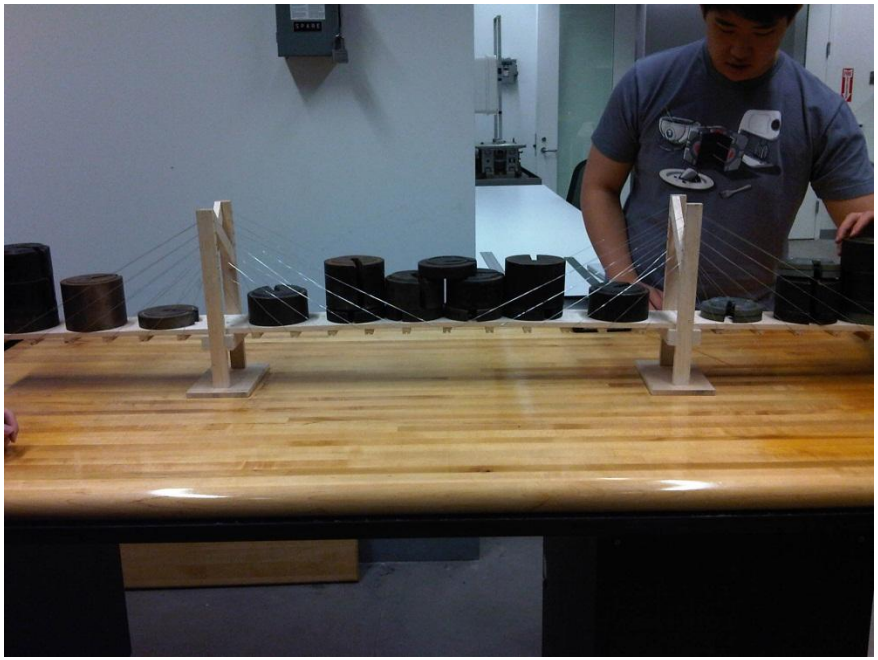
Final Design



Construction

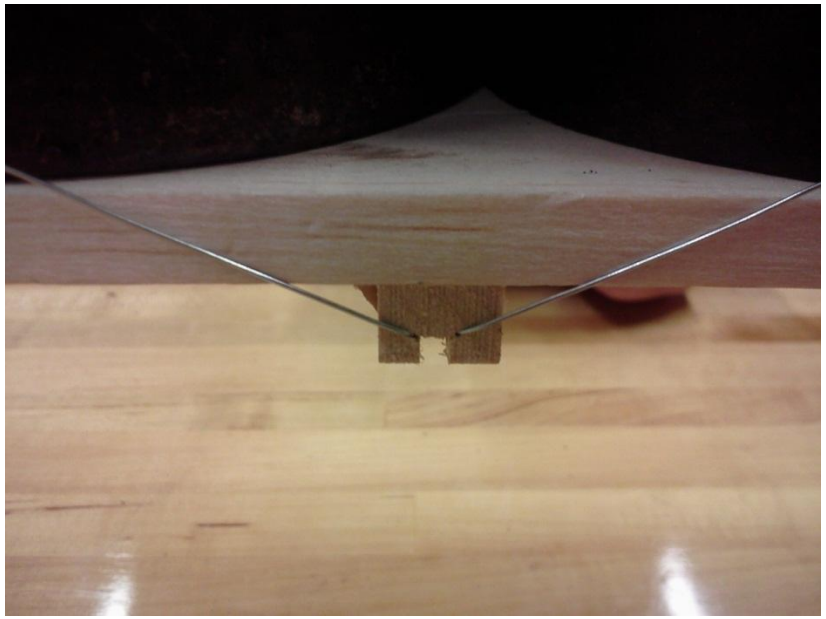


Testing Phase



Thoughts

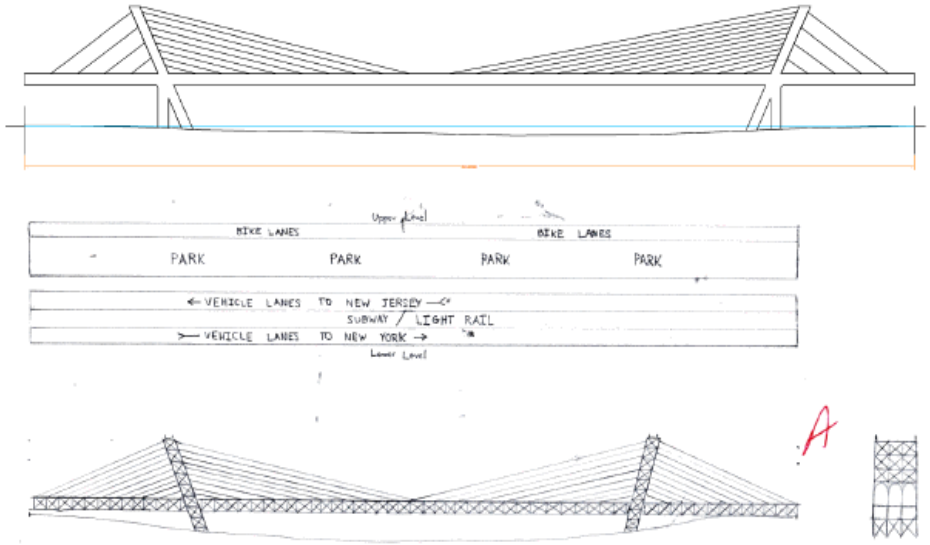
- No failure at any point in the bridge
- Basswood cross beams could be replaced with a more durable material

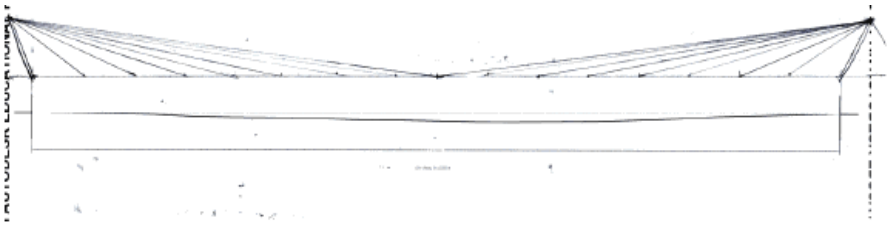


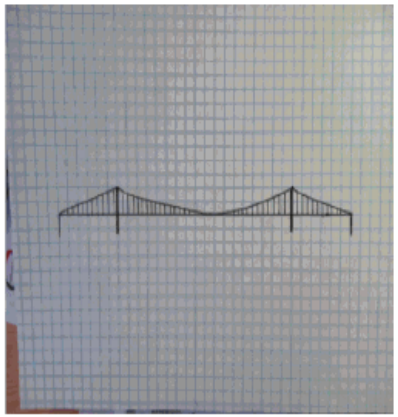
Group 2

Miles Blue Spruce, Charles Greenstein,
Michael Hirschberger, Daniel Schwartz, Bin Wu

The Proposed Designs





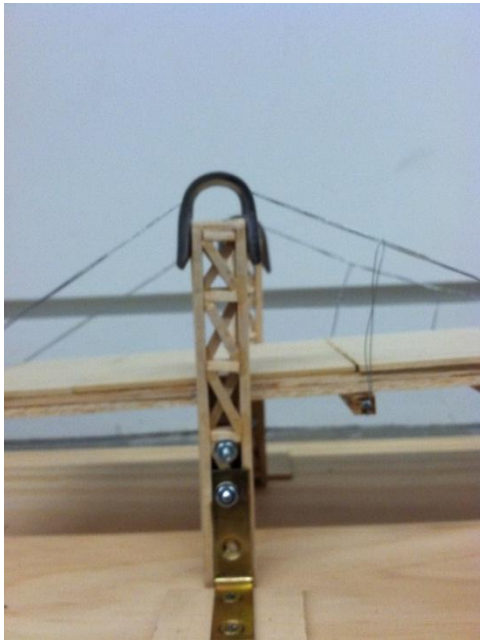


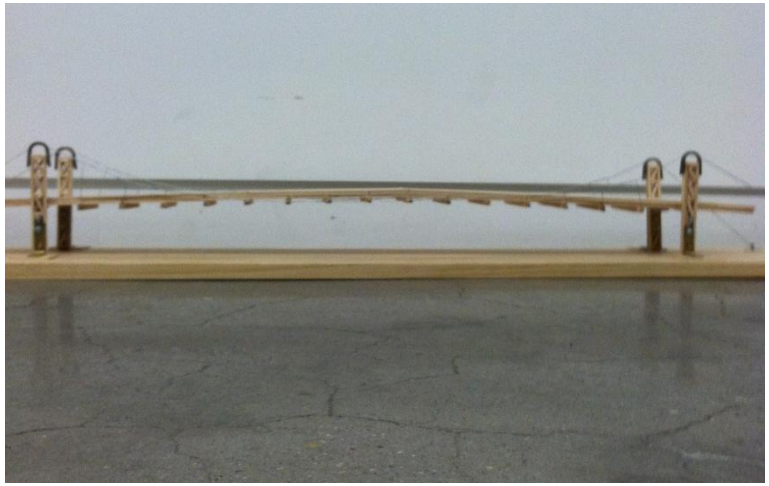
The Decision Matrix

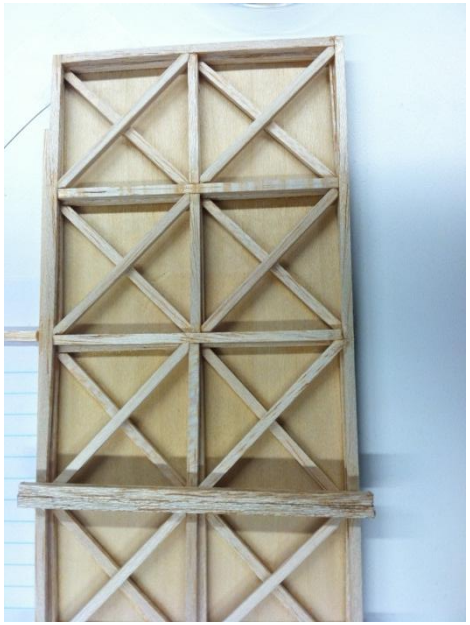
Decision Criteria	Constructability	Aesthetic Appeal	Cost	Total Weighted Score (Out of 10)
Weighting Factor	0.35	0.35	0.3	
Daniel S. (Cable Stayed)	9	9	9	
Criteria Weighted Scores	3.15	3.15	2.7	9
Miles B. (Cable Stayed)	8	8	9	
Criteria Weighted Scores	2.8	2.8	2.7	8.3
Mike H. (Cable Stayed)	8	8	9	
Criteria Weighted Scores	2.8	2.8	2.7	8.3
Bin W. (Arc with Suspension)	7	10	8	
Criteria Weighted Scores	2.45	3.5	2.4	8.35
Chuck G. (Suspension)	9	10	8	
Criteria Weighted Scores	3.15	3.5	2.4	9.05

The Winning Design

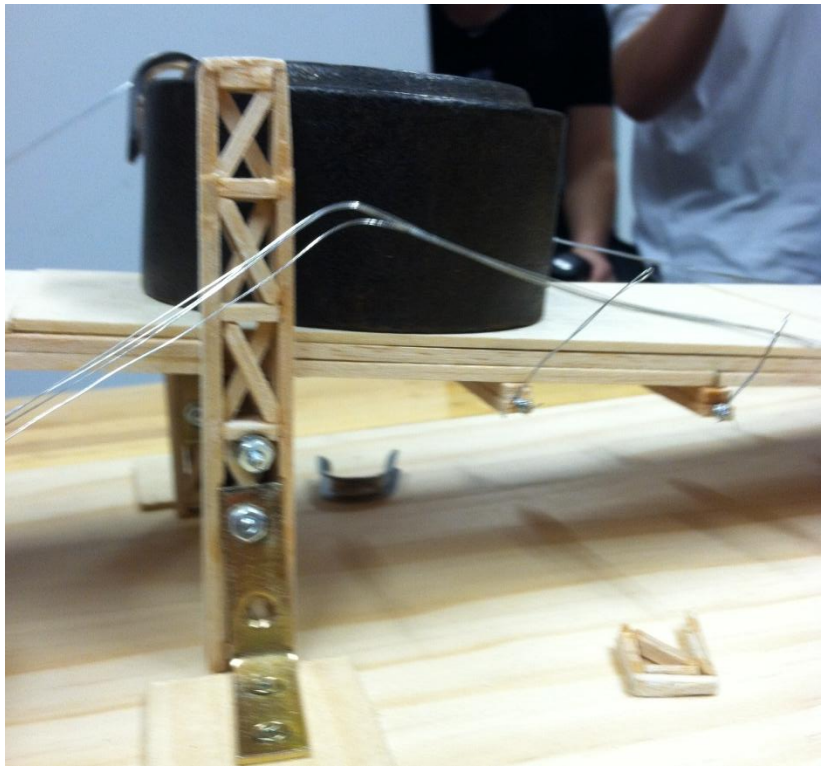
The Model

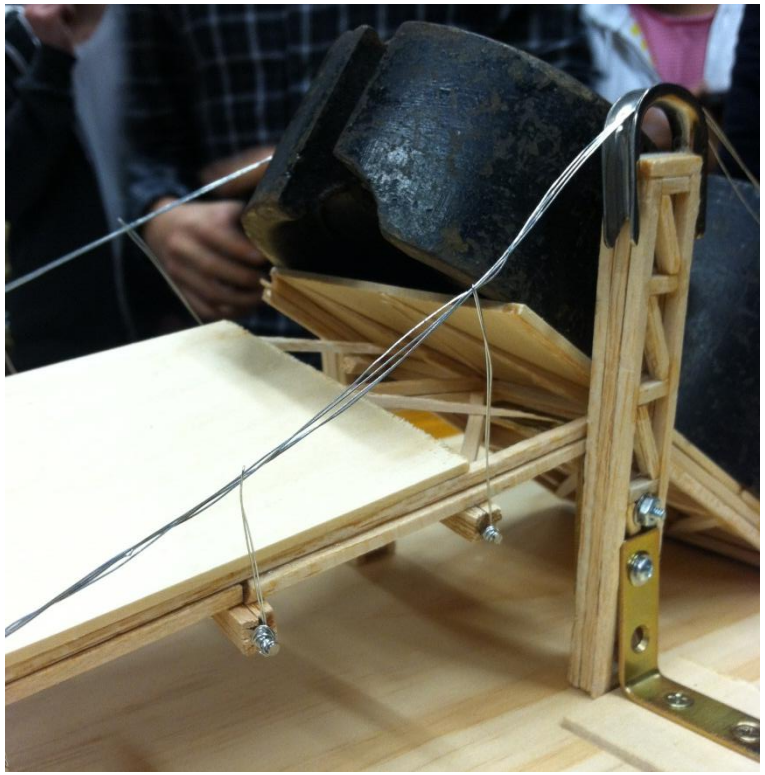


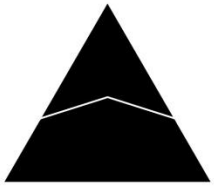




The Test







Group 3
Castle Point To Chelsea Pier

Anthony Colangeli, Elizabeth Juette
Min J. Kang, Peter Morfe, Laura Quan

Decision Matrix

Weights	Components
0.1	Constructability
0.15	Maintenance
0.1	Durability/Reliability
0.05	Sustainability
0.2	Usability
0.1	Cost
0.15	Aesthetics
0.15	Energy Production

Unique Features for the Bridge

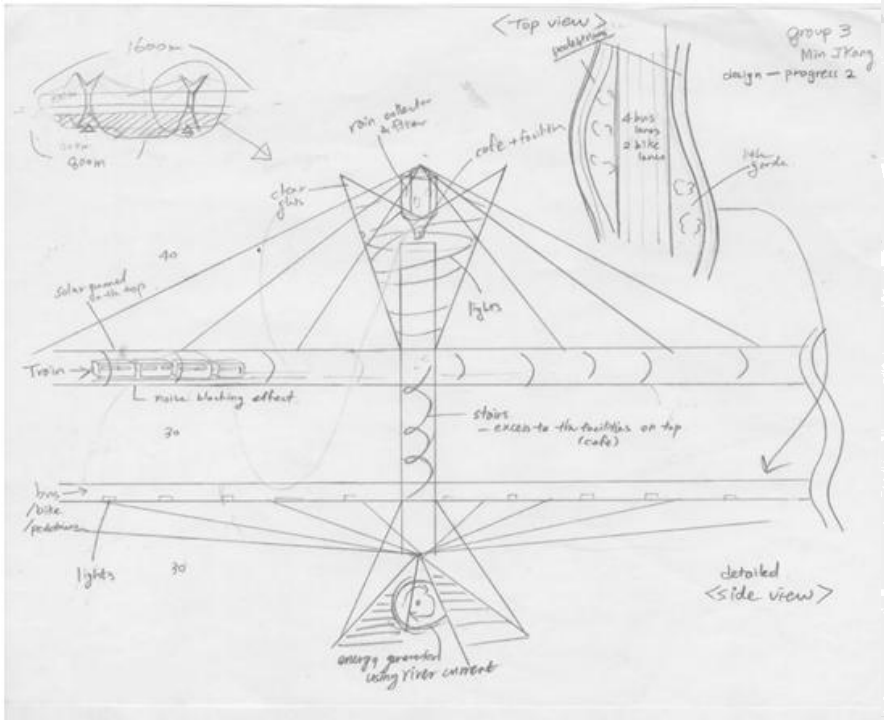
Usability

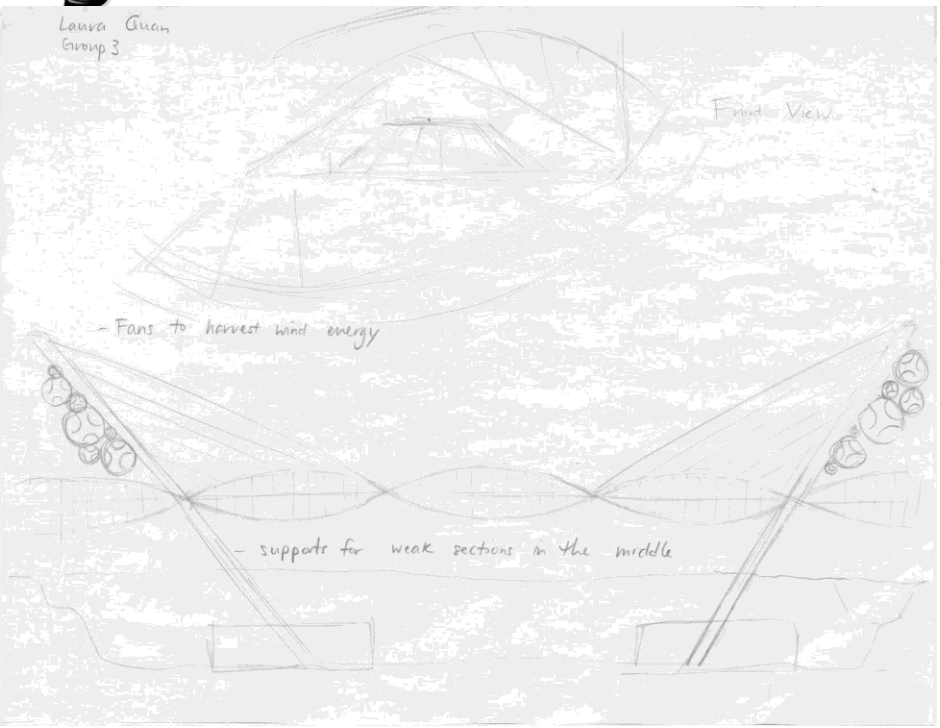
- Bus lanes
- Park
- Facilities inside of the Towers

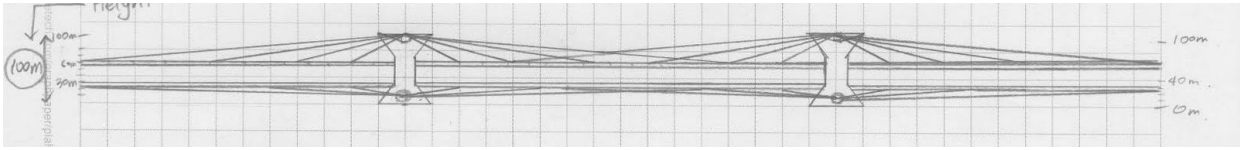
Energy Production

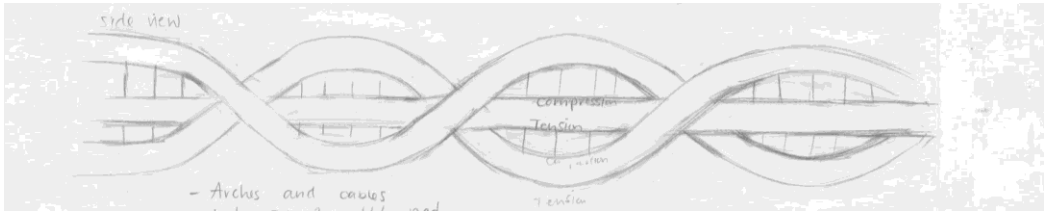
- Wind Turbines
- River Current

Basis of the Design

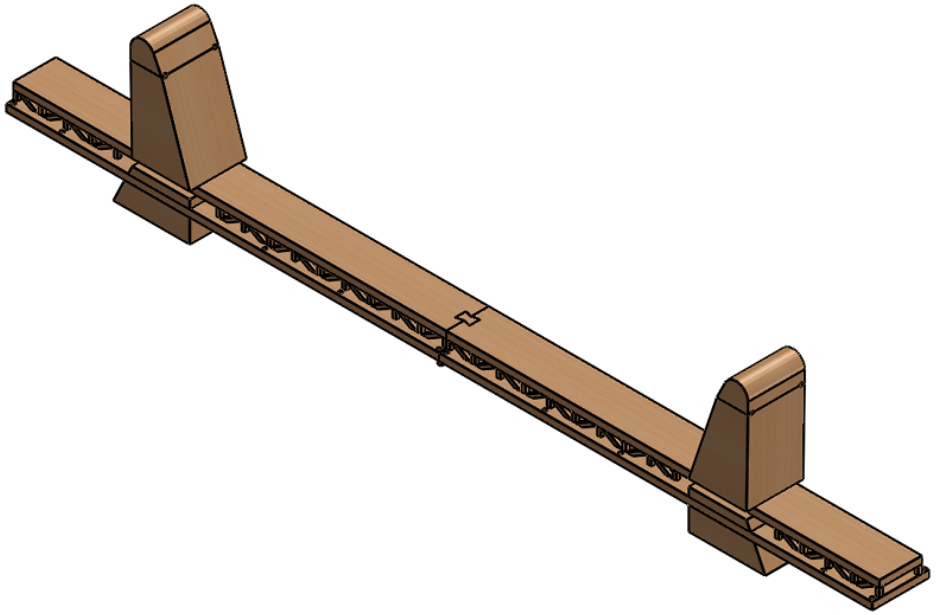


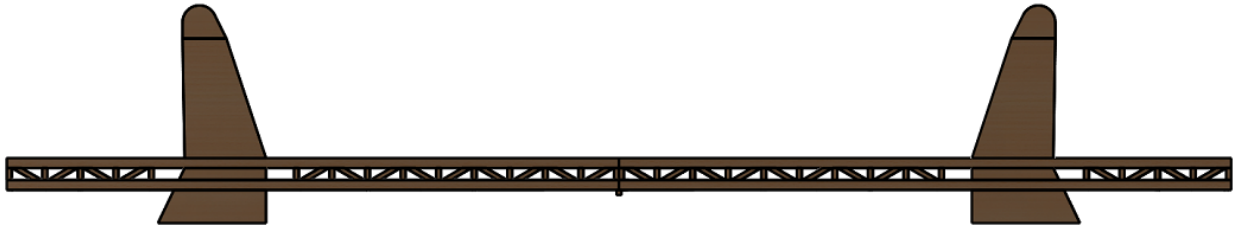


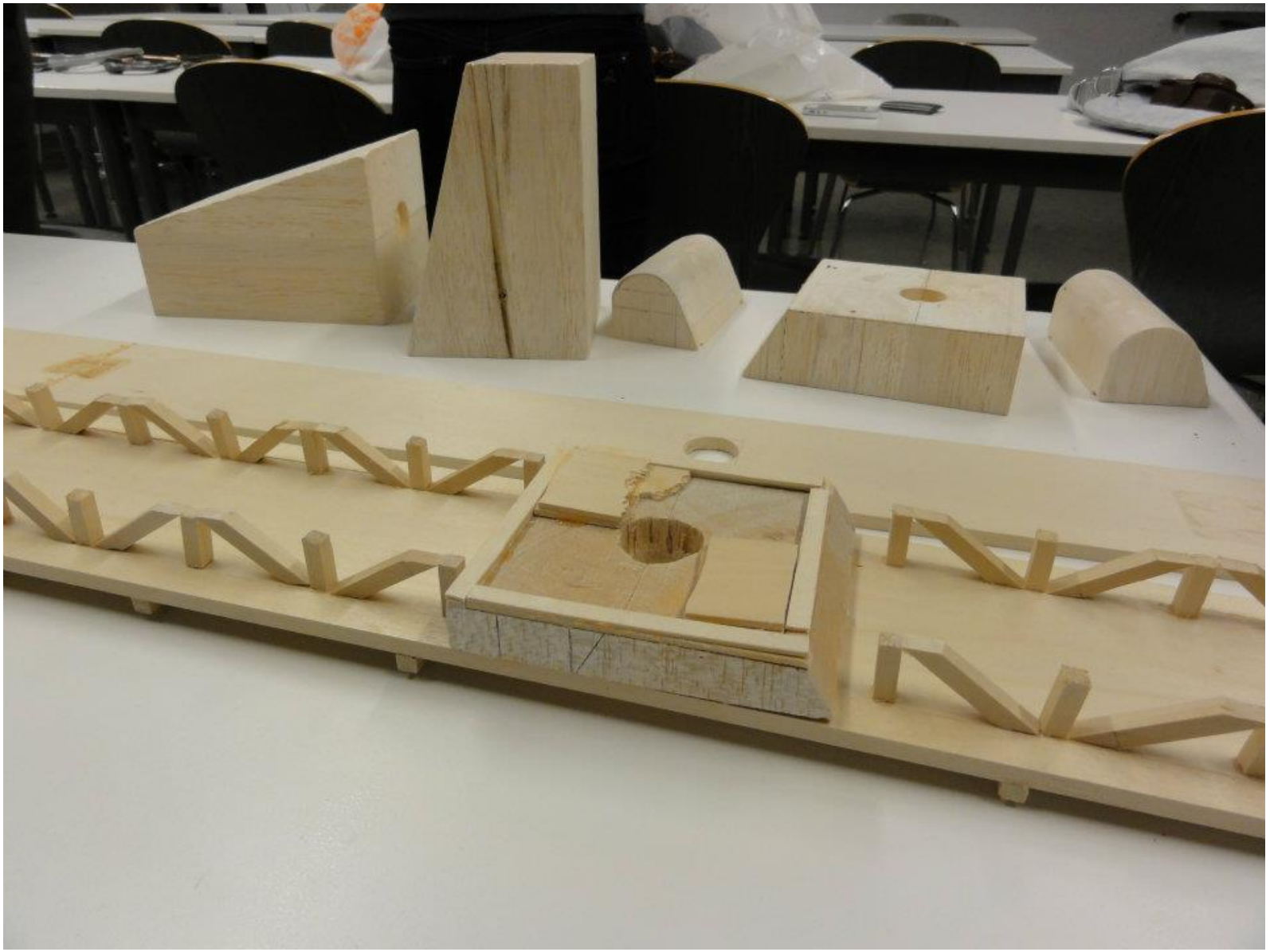




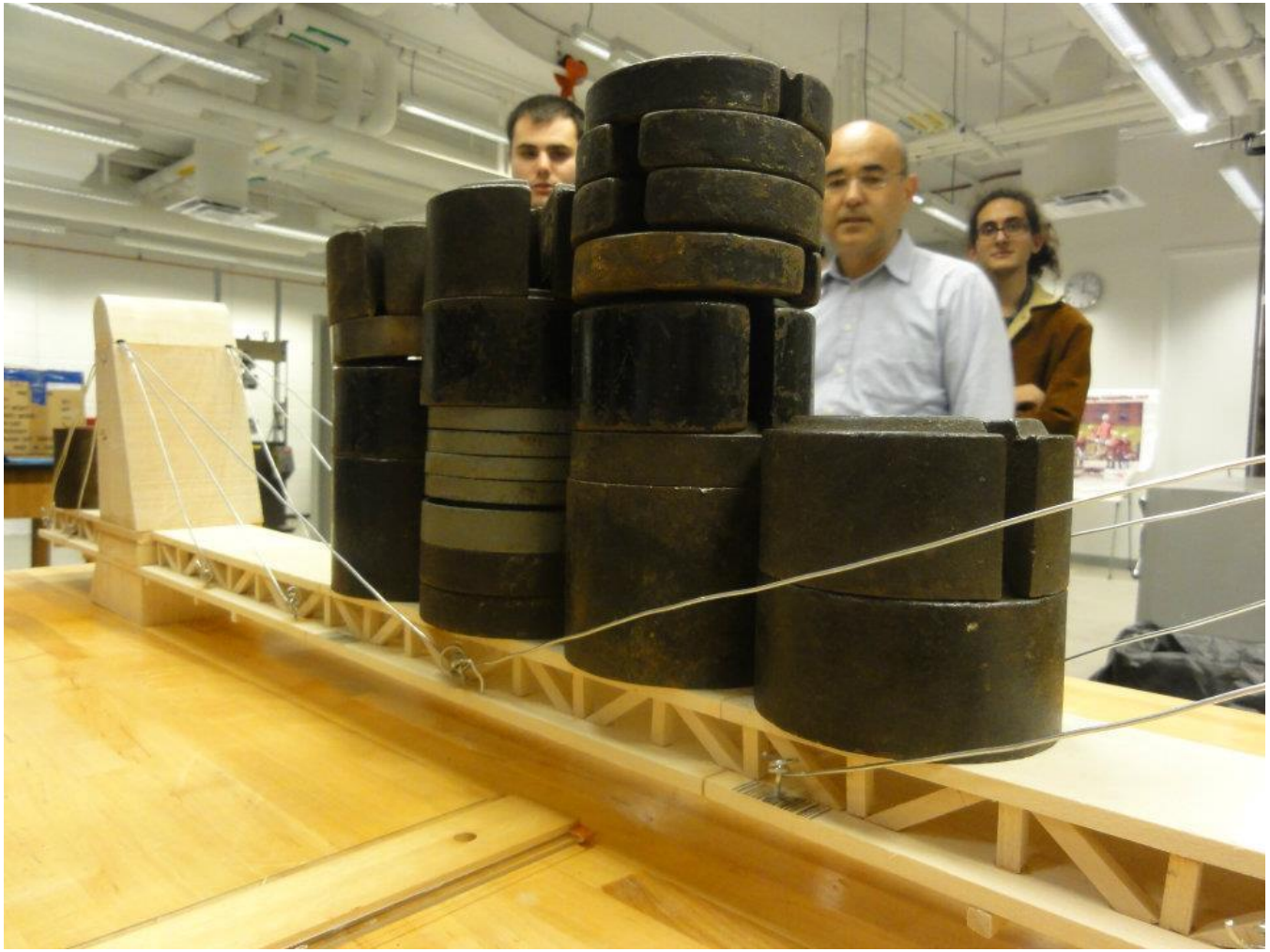
The Final Design

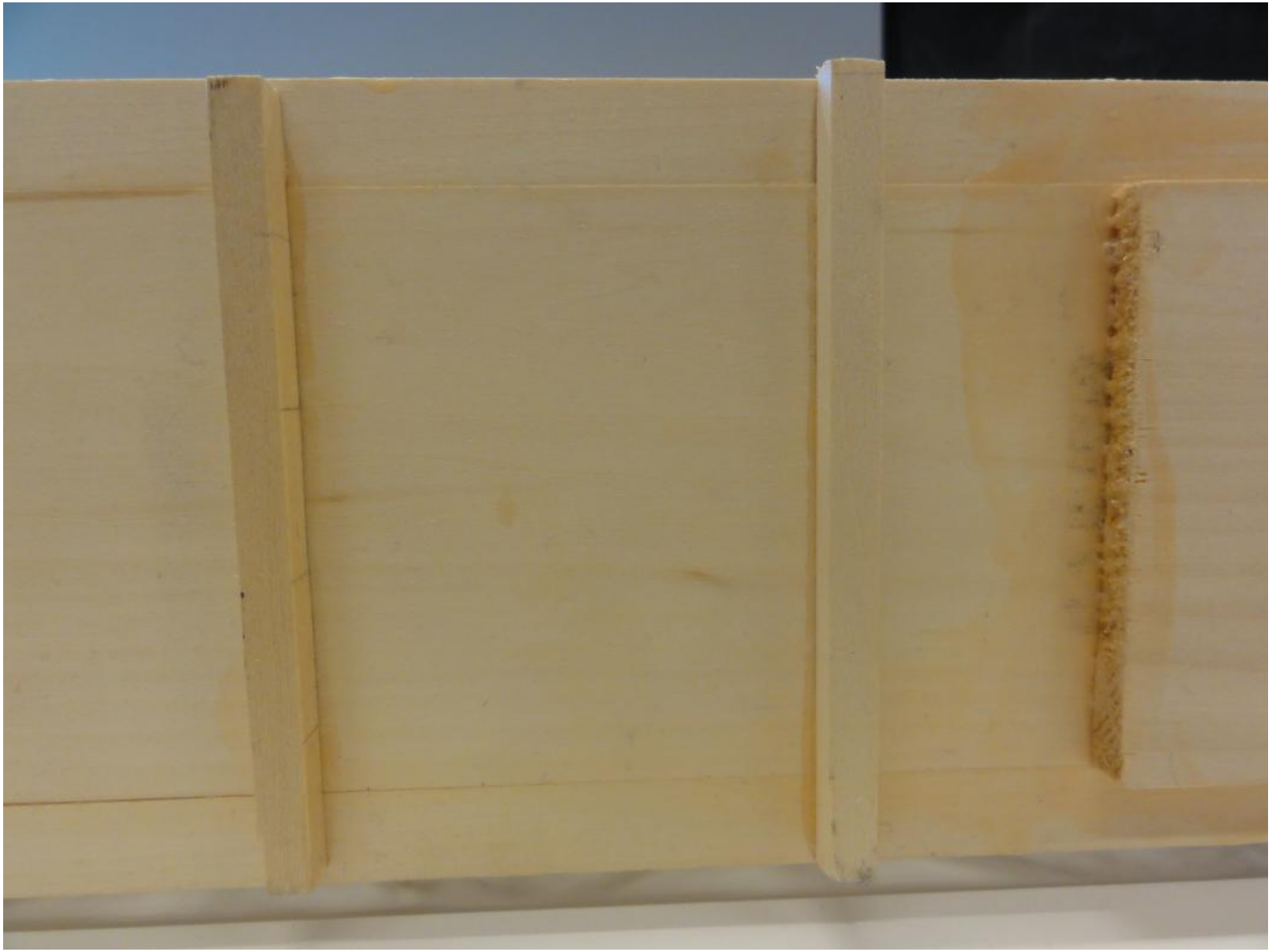


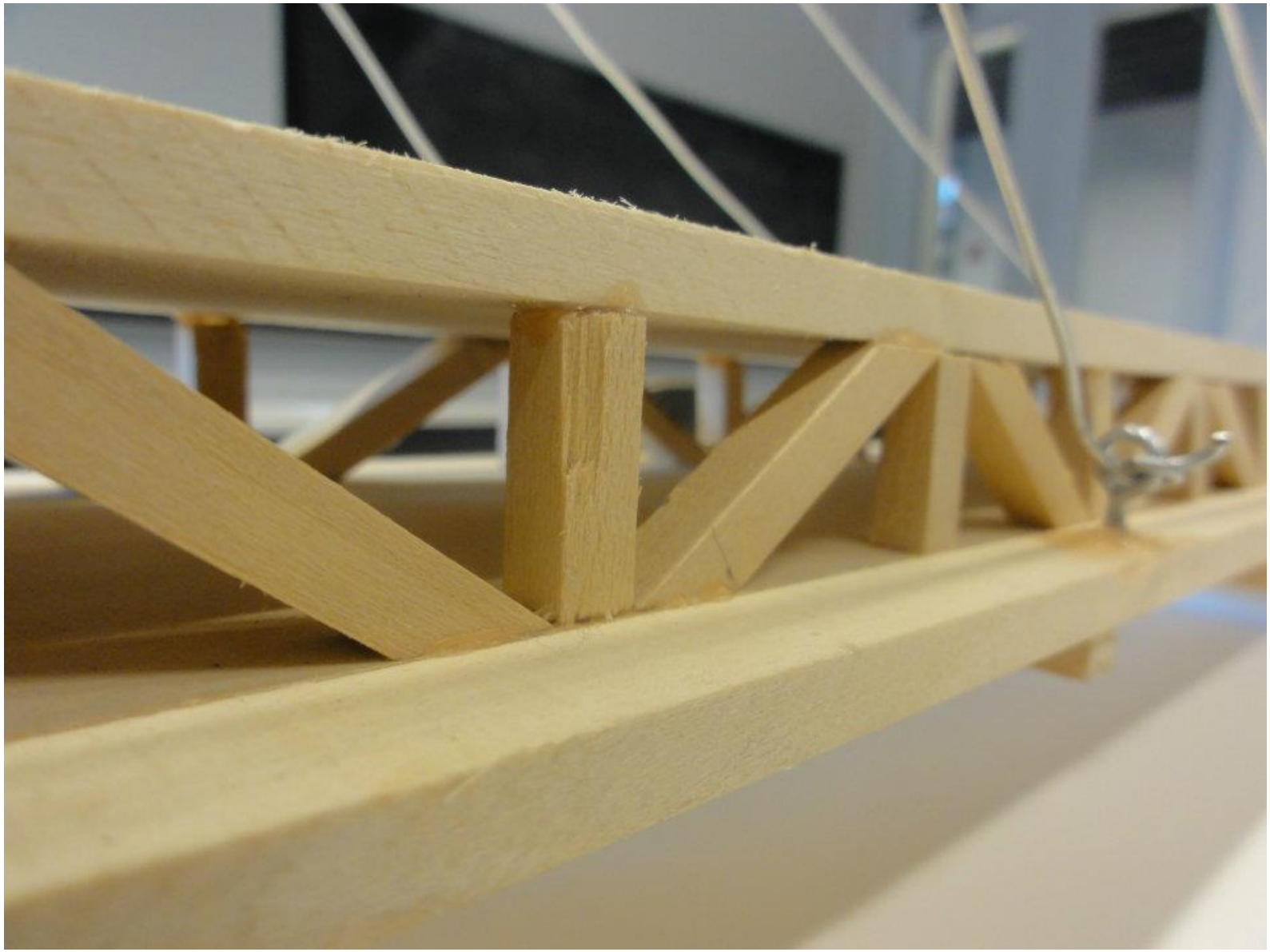


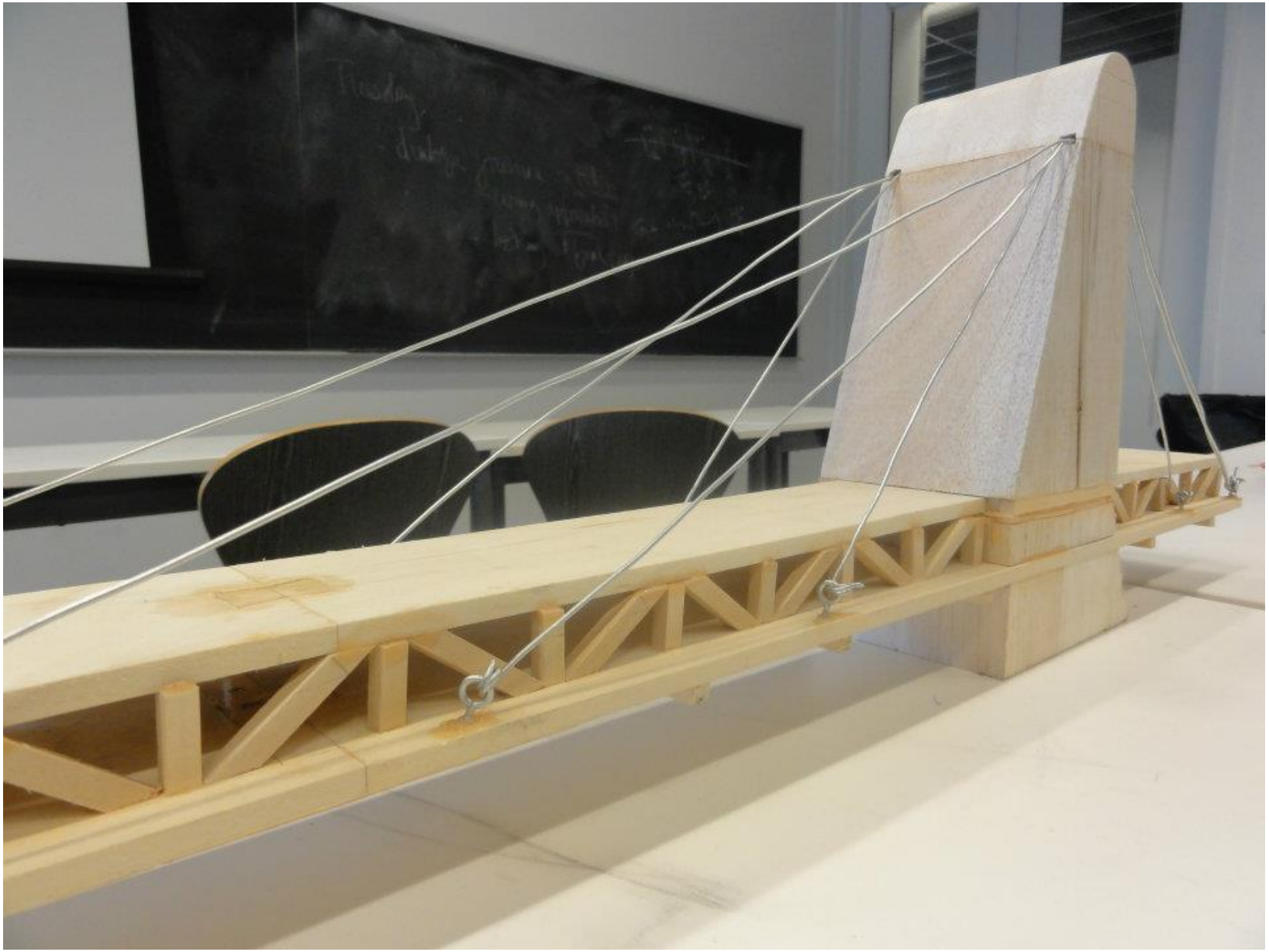


Testing

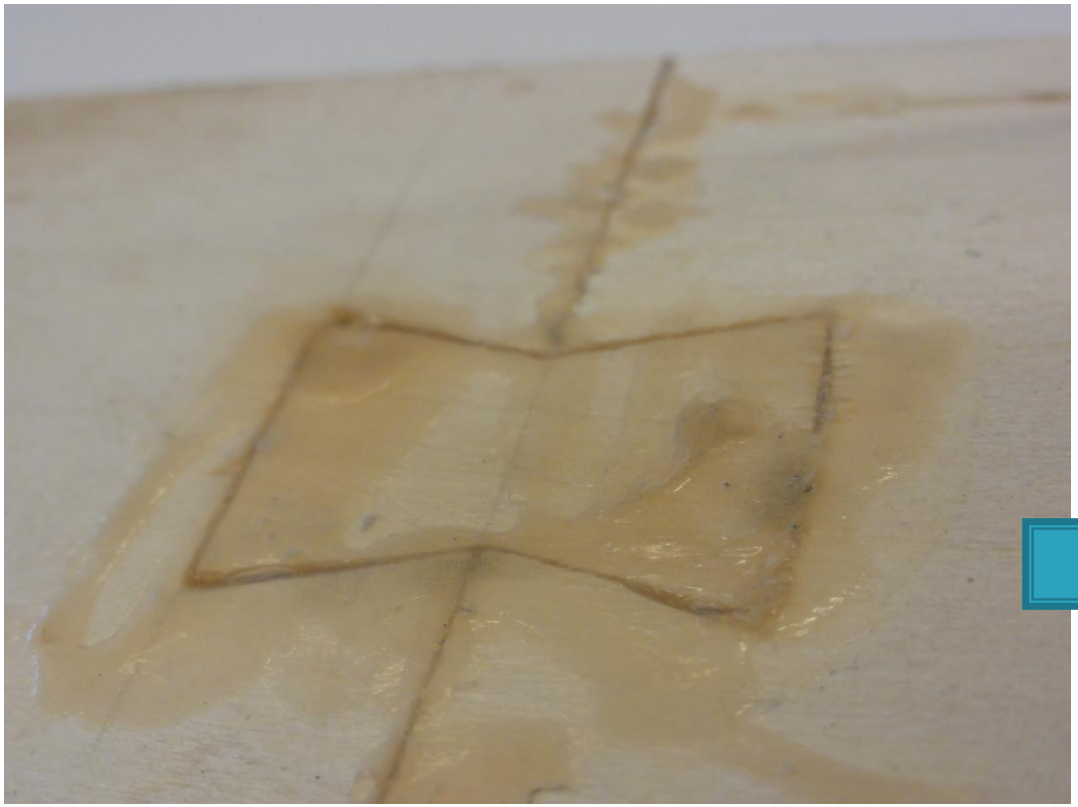


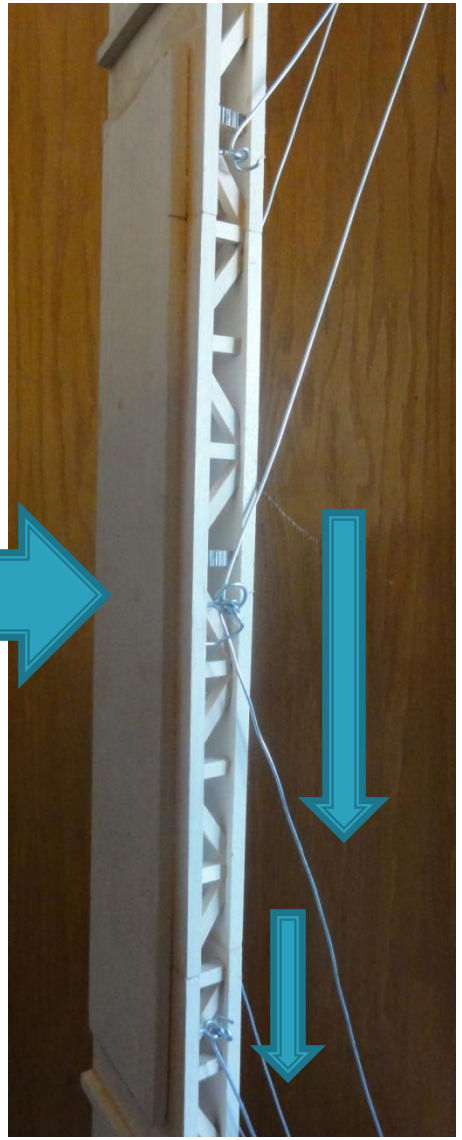






Lessons Learned



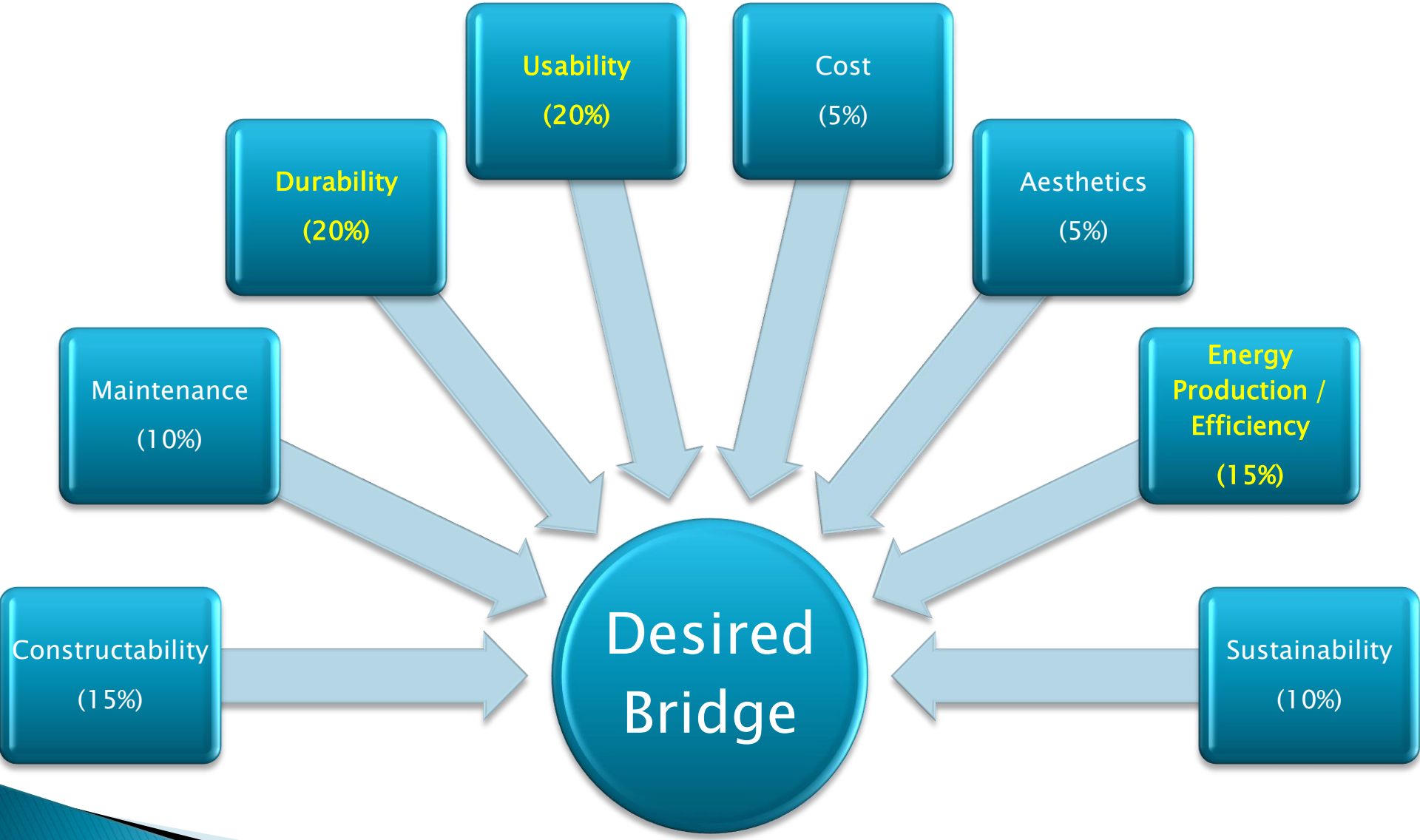


Group 4

Raymond Fu, Tyler DiStefano,
James Lastihenos, Piotr Michalik,
Gerard O'Donnell

Final Design

- Decision matrix tool
- Weighted average of five possibilities
- All design possibilities limited to a cable stayed bridge (most cost efficient for the amount of weight needed to be held)


Usability
(20%)
Cost
(5%)
Durability
(20%)
Aesthetics
(5%)
Maintenance
(10%)
Energy
Production /
Efficiency
(15%)
Constructability
(15%)
Desired
Bridge
Sustainability
(10%)


Stress


Stress

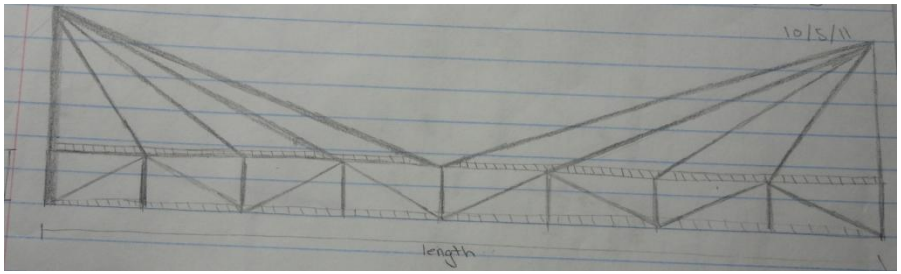
Group 5

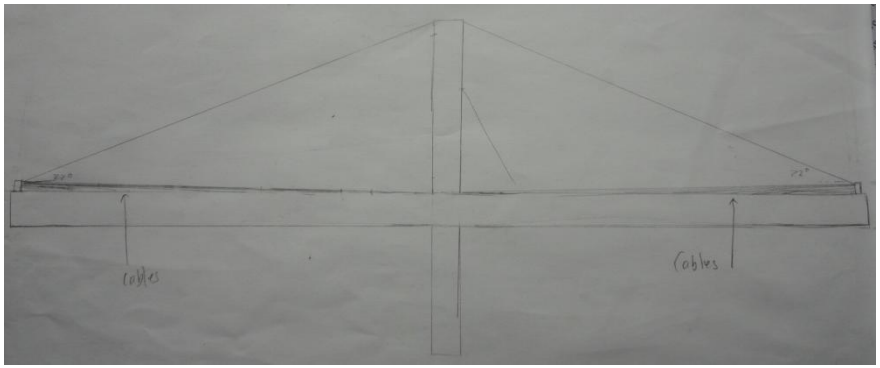
John Biswakarma, Emily George,
Ratan Rai Sur, Sivan Shemesh, Caroline Yu

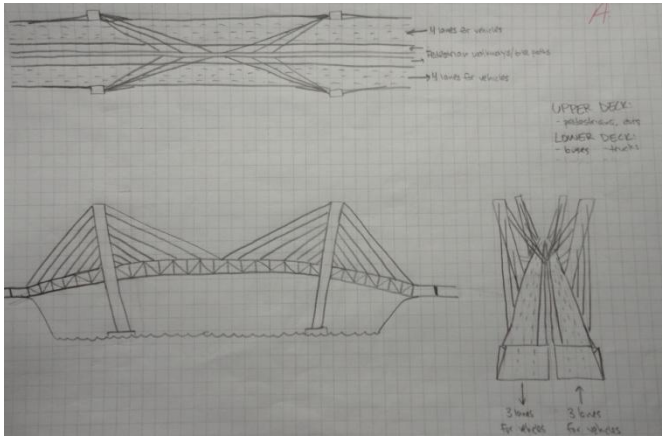
Design/Philosophy

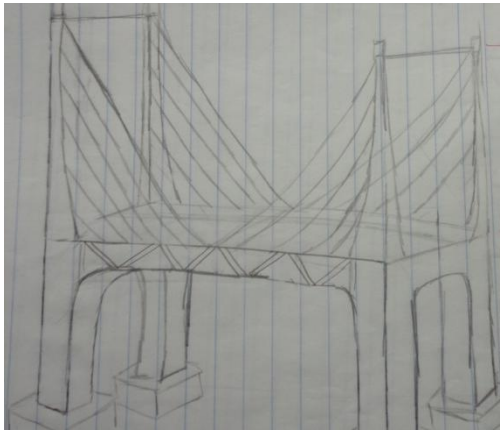
- Cable-stayed bridge
- AASHTO guidelines and NJ and NY Building Codes → Specifications table
- Replacement of Tappan Zee Bridge
- Need to alleviate traffic → increase in carrying capacity by adding more lanes
- Convert vibrational motion to electrical energy

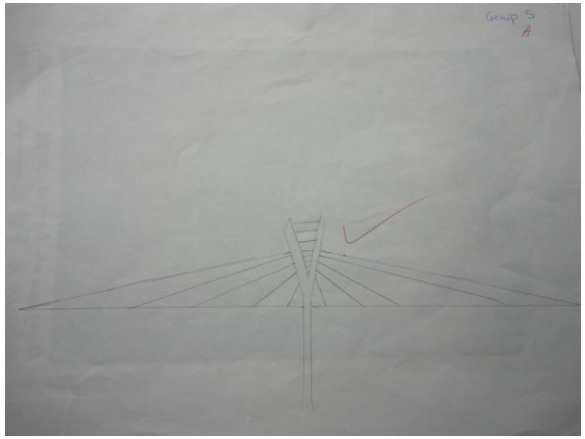
Proposed Solutions



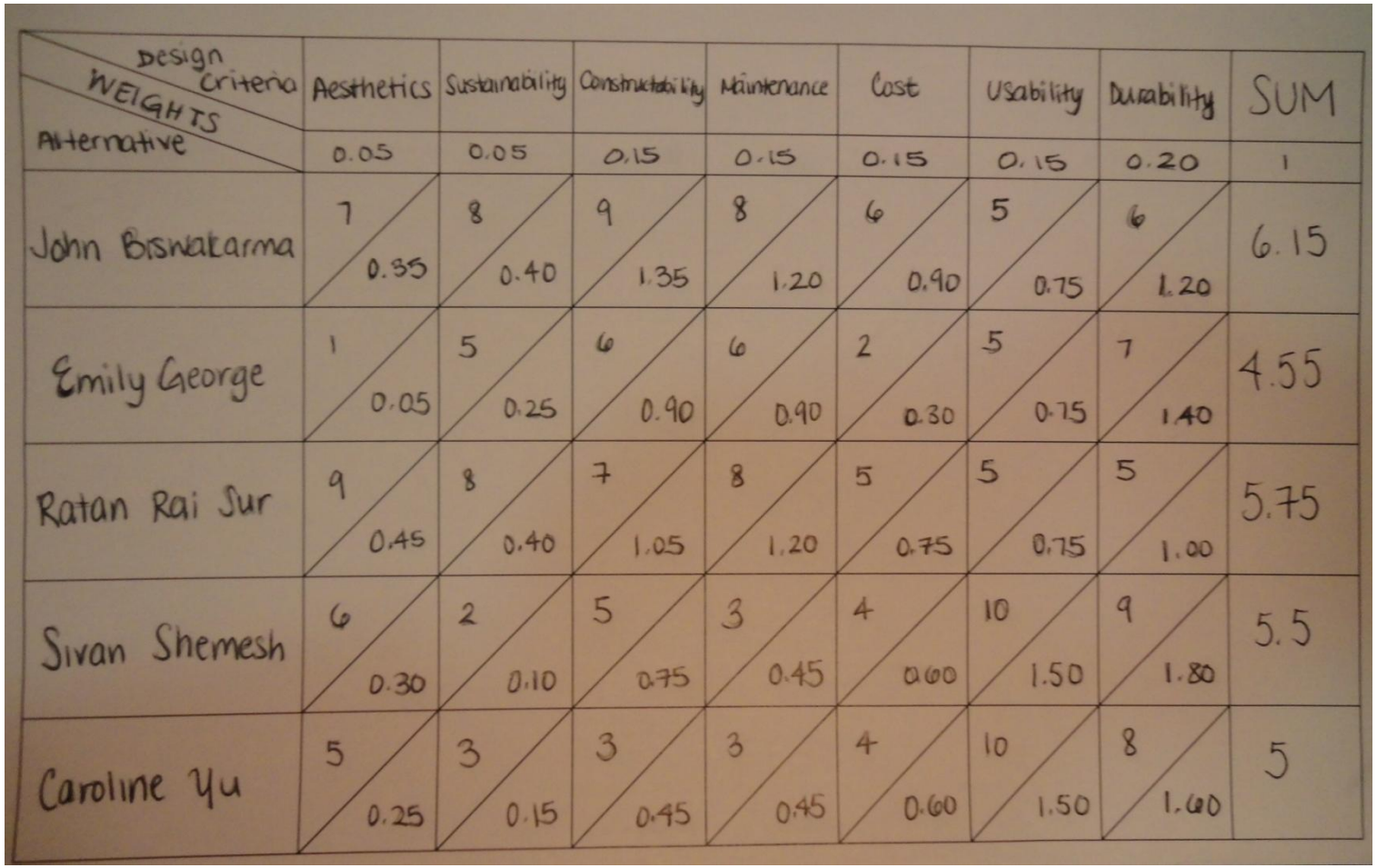






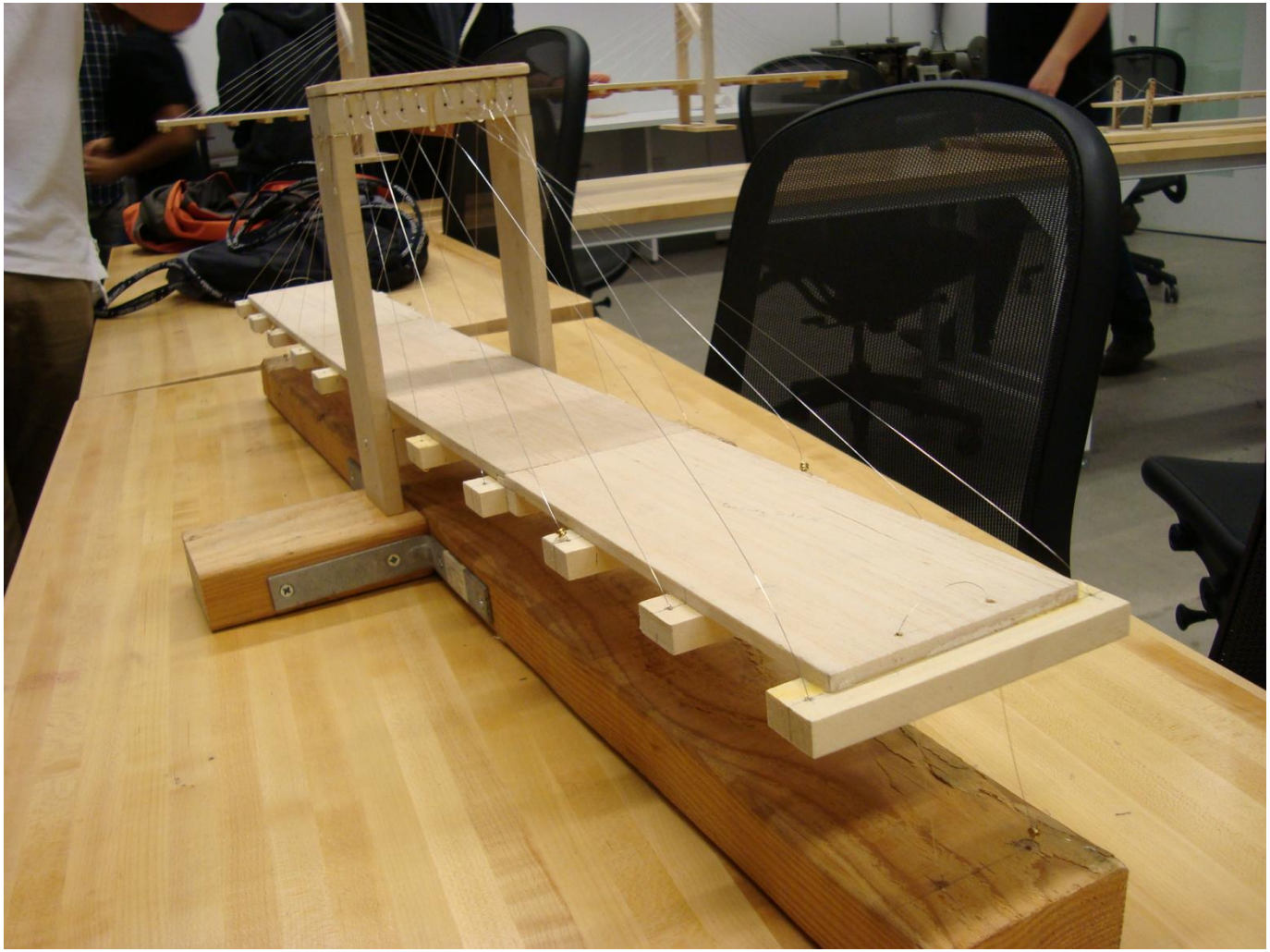


Decision Matrix

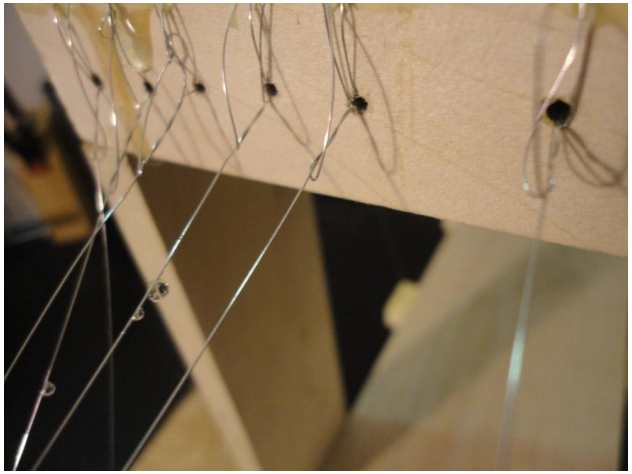


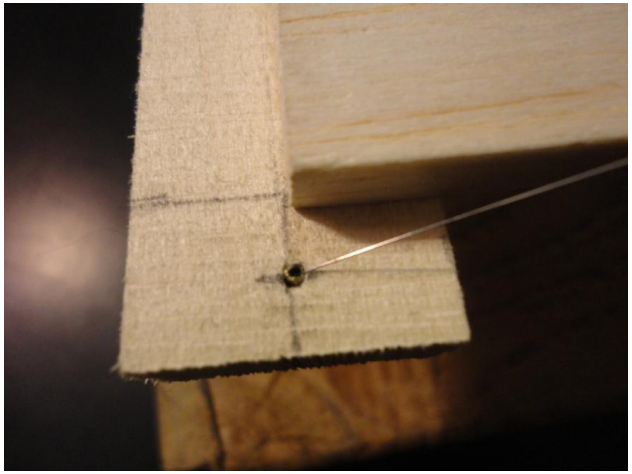
Design Criteria / WEIGHTS / Alternative	Aesthetics	Sustainability	Constructability	Maintenance	Cost	Usability	Durability	SUM
	0.05	0.05	0.15	0.15	0.15	0.15	0.20	1
John Biswakarma	7 / 0.35	8 / 0.40	9 / 1.35	8 / 1.20	6 / 0.90	5 / 0.75	6 / 1.20	6.15
Emily George	1 / 0.05	5 / 0.25	6 / 0.90	6 / 0.90	2 / 0.30	5 / 0.75	7 / 1.40	4.55
Ratan Rai Sur	9 / 0.45	8 / 0.40	7 / 1.05	8 / 1.20	5 / 0.75	5 / 0.75	5 / 1.00	5.75
Sivan Shemesh	6 / 0.30	2 / 0.10	5 / 0.75	3 / 0.45	4 / 0.60	10 / 1.50	9 / 1.80	5.5
Caroline Yu	5 / 0.25	3 / 0.15	3 / 0.45	3 / 0.45	4 / 0.60	10 / 1.50	8 / 1.60	5

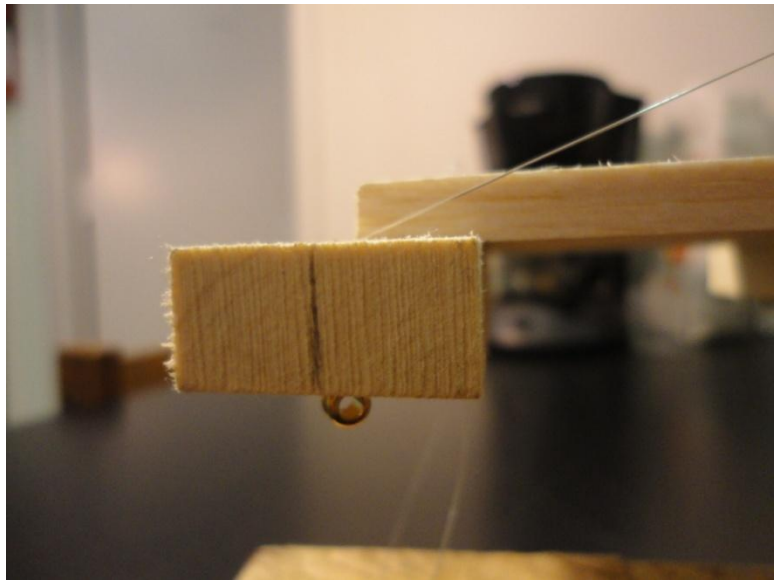
Final Model

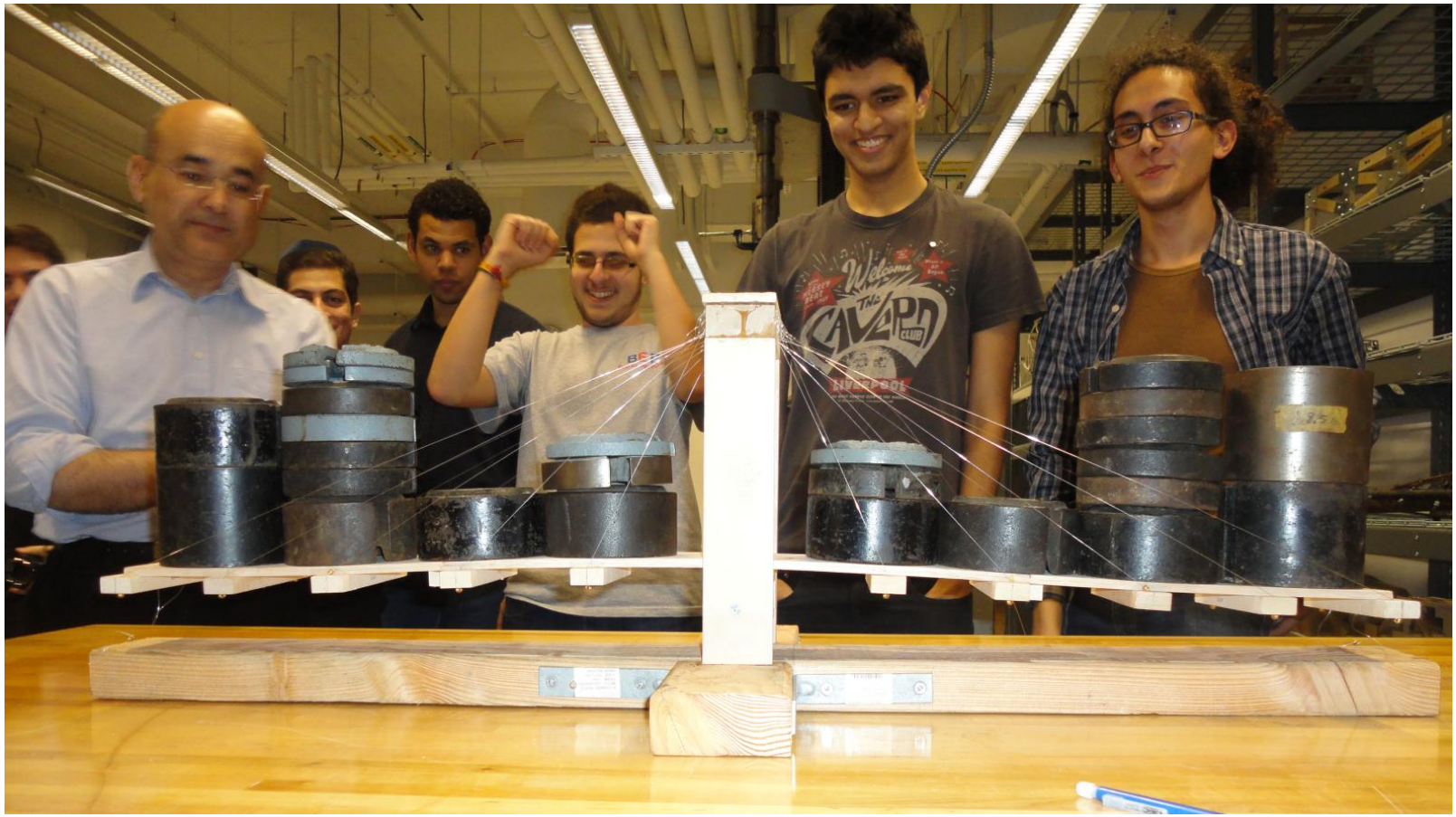


Details of Bridge Model








Welcome
This
LIVERPOOL

Key Lessons Learned

- **Schedule ample amount of time** needed for design process
- **Research** past solutions
- **Stay up to date** with similar current projects
- **Be careful** of overbuilding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