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

1. Identify Problems and Functional Requirements
2. Choose Design
3. Build Model
Constraints

- Cost
- Materials
- Time
- Weight
Calculations and Analysis

\[ \sum F_x = 0 \quad \text{Net forces in x–direction have to equal zero} \]

\[ \sum F_y = 0 \quad \text{Net forces in y–direction have to equal zero} \]

\[ \sum M_z = 0 \quad \text{Net rotation about z–axis has to equal zero} \]
**Calculations and Analysis**

\[
\text{Stress} = \frac{F}{A}
\]

- **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

\[
\frac{C}{A_{\text{tower}}} < \frac{F_{y(\text{tower})}}{SF} \langle 2\text{ksi}
\]

\[
C = \text{Compression on tower}
\]

\[
A_{\text{tower}} = \text{Surface Area of tower}
\]

\[
F_{y(\text{tower})} = \text{Force on tower}
\]

\[
SF = \text{Safety Factor (1.6)}
\]

\[
\text{ksi} = \text{kips/sq.in}
\]
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

<table>
<thead>
<tr>
<th>Decision Criteria</th>
<th>Constructability</th>
<th>Aesthetic Appeal</th>
<th>Cost</th>
<th>Total Weighted Score (Out of 10)</th>
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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
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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)
Desired Bridge

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

<table>
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<tr>
<th>Design Criteria</th>
<th>Aesthetics</th>
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Final Model
Details of Bridge Model
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