IPRO 315
Design of a Large-Scale Bridge Structure

Project Plan

Advisor: Jeffrey Budiman
1.0. Objectives

The objectives of this IPRO are to design and build a steel bridge to the specifications given by AISC and, using teamwork, to win this year’s ASCE/AISC Regional Steel Bridge Competition.

2.0. Background

A. The ASCE Steel Bridge Competition is co-sponsored by ASCE (American Society of Civil Engineers) and AISC (American Institute of Steel Construction). ASCE is an organization that is over 150 years old with a history in engineering and problem solving. The rules for the steel bridge competition are written by AISC and updated yearly.

B. The students are to design, fabricate and construct a scaled down steel bridge. The rules are based on real life build scenarios. Examples of said problems include: cost of the project, management, design, analysis, fabrication techniques, methods, and construction time, efficiency and safety.

C. Various technologies are used. SAP (Structural Analysis Program) is used to analyze the integrity and strength of the structure, AutoCAD is used to draw out the design, Strength of Materials is used in the choice of steel used, and fabrication using wood and metals is used in building templates and building the bridge. The use of tools is found throughout the entire project from fabrication to actual construction.

D. IIT has participated in this competition for many years. Our greatest success is the 2004 competition where the team went to nationals and placed in several events. The group last year was seriously hampered by bad fabrication and slow construction time.
E. Some scientific issues that can be investigated are different design methods and use of analysis to find the best overall design. Cultural problems arise in communication between the group members who come from different cultures. Ethical problems may arise in scoring of the competition.

F. All costs are absorbed by organization involved in solving the problem. There are no costs on society. Any costs arising to businesses are by their own choice through sponsorship.

G. The solution will be implemented by splitting off tasks into sub groups. There is a group for designing the bridge, another to fundraise for expenses, a group to help fabricate the bridge, the construction team for building the bridge at competition, a group to make posters and any presentation material, and any other tasks for individuals.

H. There is no research involved other than historical information that will be used from past years experiences.

I. Attached are the bridge layout rules set by AISC and the introduction and summary of the competition provided by AISC.

3.0. **Methodology/Brainstorm/Work Breakdown Structure**

To make the project more successful the team needs to first make sure the rules of the competition and specifications of design are understood. The team will then assign tasks to sub-teams to make everyone work more efficiently toward finalization of the project. A conceptual design will be produced by the design team using software such as AutoCAD and SAP2000. The design team will draw on past experiences and the knowledge of team members for the design, as well as the support of academic advisors. Concurrently, funding will be raised for materials and fabrication and a website will be
designed for the project by the other sub-teams. After selection of the design and a fabricator, the design process will begin. Wooden templates will be made to hold the steel sections in place for welding. Templates will also be made for connections and other parts of the bridge as needed. After fabrication, assembly of the bridge will be practiced and load testing will be done with the bridge. Final modifications of the bridge will be made as needed to facilitate assembly and satisfy loading requirements.

4.0. Expected Results

For this Inter-professional project, our objective is to design and build a steel bridge that can compete in the ASCE/AISC Regional Steel Bridge Competition. The overall performance of the bridge is based on two categories, and as expected, the goal is to obtain the highest score through a combination of the two scores. Construction Economy is based essentially on the amount of “person-minutes” needed to correctly assemble the bridge. Succeeding in this area requires a bridge designed with simplicity in mind. A huge bridge with complicated trusses could be incredibly strong; if it takes an outrageous time period to build, then failure could result on that basis alone. The next category, Structural Efficiency, is based on a rather simple calculation—weight times 5000$/lb added to the deflection times 500,000$/inch. The project team aspires to design and construct a bridge that is light, stiff, and simple.

If those criteria are met, then we will have a steel bridge that can easily vie for first place in the regional competition.
5.0. Estimated Project Budget

**Registration:**
- School: $125
- Individuals: $30/pp x 27 ppl = $810

**Hotel:**
- 7 Rooms @ $80/night * 3 nights + tax is approx. = $2,500

**Travel:**
- Gas Reimbursement for driving: National pay = $.485/mi @ 240mi x 10 cars = $1,250

**Fabrication:**
- Total Estimated: $4,000
  - Welding
  - Bolts
  - Tools
  - Wooden forms
  - Hard Hats

**Presentation:**
- Total Estimated: $50
  - Posters
  - Printing

**Bridge Aesthetics:**
- Total Estimated: $200
  - Paint
  - Decals

Grand Total: $8,935
## 6.0. Schedule of Tasks and Milestone Events

<table>
<thead>
<tr>
<th>Date</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20-07</td>
<td>IPRO Olympics</td>
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<tr>
<td>1-30-07</td>
<td>Conceptual Design</td>
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<tr>
<td>2-3/4-07</td>
<td>Project Management Workshop, 10-2pm SH 237</td>
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<tr>
<td>2-06-07</td>
<td>Preliminary to final Design</td>
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<tr>
<td>2-13-07</td>
<td>Detailed design and Drawing, Selection of size and shape of bridge</td>
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<td>members. Order the steel materials.</td>
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<tr>
<td>2-16-07</td>
<td>Project Plan due to the IPRO office</td>
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<tr>
<td>2-20-07</td>
<td>AutoCAD Drawings for fabricators, Construct template</td>
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<tr>
<td>2-27-07</td>
<td>Work with Fabricator</td>
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<tr>
<td>3-06-07</td>
<td>T-shirts Design and order, Develop Website</td>
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<tr>
<td>3-20-07</td>
<td>Working with Fabricator</td>
</tr>
<tr>
<td>3-23-07</td>
<td>Midterm Report due to the IPRO office</td>
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<tr>
<td>2-27-07</td>
<td>Receive bridge from fabricator.</td>
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<tr>
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<td>Bridge refinement and adjustments.</td>
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<tr>
<td>4-3/16-07</td>
<td>Bridge Assembling Practice, Load testing, Develop posters</td>
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<tr>
<td>4-06-07</td>
<td>Team Minutes due to the IPRO office</td>
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<tr>
<td>4-14-07</td>
<td>Bridge painting</td>
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<tr>
<td>4-16-07</td>
<td>IPRO Hints and Tricks meeting</td>
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<tr>
<td>4-20-07</td>
<td>IPRO website link, poster and abstract are due to IPRO office</td>
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<td>4-25-07</td>
<td>IPRO presentation due to IPRO office</td>
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<tr>
<td>4-26-07</td>
<td>Team leaders Register at Purdue University</td>
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<tr>
<td>4-27-07</td>
<td>IPRO Presentation. Leave for Purdue University</td>
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<tr>
<td>4-28-07</td>
<td>Bridge Competition</td>
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7.0. Individual Team Member Assignments

Gbadebo Atewologun
Major: Civil Engineering
Skills: SAP, MathCAD, and proficient with hand and mechanized tools.
Strengths: Problem-solving ability and aptitude with structural analysis and design. Meticulous and organized work ethic.
Experiences: Steel analysis and design courses. Has been apart of a design sub-team in an internship, the project was a success and was presented to the project sponsors.
Sub-Teams: Design

Christina Barrett
Major: Computer Science
Skills: Microsoft Office and anything Adobe
Strengths: Working with computers and following rules.
Experience: Has created an IPRO website during Fall 06 semester. Helped build a trebuchet, two catapults, and a loft.
Sub-Teams: Leader of Website
Representative to the IPRO office
Bridge Construction

John Brilla
Major: Architecture
Skills: AutoCAD, CAModeling/Manufacturing, Photoshop/Illustrator, Web Design, some coding, and public speaking
Experiences: Presentations, Construction Documents, Model Building, and Personal Websites.
Sub-Teams: Website
Presentation
Posters/CAD
Template Fabrication

David Fahs
Major: Civil Engineering
Sub-Teams: Design

Patrick Fong
Major: Architecture
Skills: AutoCAD, Adobe Photoshop, and Adobe Illustrator
Strengths: How to get drawings to print for AutoCAD, Adobe Photoshop, and Adobe Illustrator.
Sub-Teams: Template Fabrication
Posters/CAD
Bernard Froehlich
Major: Civil Engineering
Skills: Has worked in construction.
Strengths: Tall
Experiences: AFROTC
Sub-Teams: Design
Bridge Fabrication
Bridge Construction

Emiliano Giana
Major: Civil Engineering
Skills: Has worked in construction.
Strengths: Tall
Experiences: AFROTC
Sub-Teams: Design
Bridge Fabrication
Bridge Construction

Naomi Heler
Major: Civil Engineering
Skills: Design and Analysis, Management
Strengths: Organized, Technical
Experiences: Has done this IPRO before and was the project leader then. Has been to the conference before and is fairly knowledgeable in what is expected and of problems that may arise.
Sub-Teams: Leader of Fundraising
Design
ASCE competition Representative

Daniel Hernandez
Major: Civil Engineering
Skills: Design
Strengths: Structural engineering
Sub-Teams: Design
Bridge Fabrication
Bridge Construction

Ei Hong
Major: Civil Engineering
Skills: Design, AutoCAD, and SAP2000
Strengths: Structural analysis
Sub-Teams: Design
Template Fabrication
Bridge Fabrication
Thomas Huang
Major: Architecture
Skills: AutoCAD, 3D modeling, and model making
Sub-Teams: Posters/CAD, Template Fabrication

Mohamad Khudeira
Major: Civil Engineering
Skills: Planning, construction, and management
Strengths: Team-work and communication
Experiences: Is working in an office doing drawing, and has worked in the field as an inspector of the jobsite.
Sub-Teams: Fundraising, Design

Yong-Wan Kim
Major: Civil Engineering
Skills: AutoCAD, MathCAD, MS Word, MS Excel, SAP2000
Strengths: Fast, diligent, and team-work
Experiences: Learned bridge designing from CAE 408 and structural analysis.
Sub-Teams: Design, Posters/CAD, Bridge Construction, Bridge Fabrication

Linda Lee
Major: Architecture
Skills: AutoCAD
Strengths: Teamwork
Experiences: Has learned about steel structures and has studied steel buildings
Sub-Teams: Posters/CAD

Man Leung
Major: Civil engineering
Strength: theoretical, frame, and structure analysis
Experience: Official and unofficial participation in both regional and international high school bridge building competitions at IIT from 1999- current. Student bridge judge in both regional and International competitions in 2003
Sub-Teams: Design, Bridge Construction
**Heather Mahoney**
Major: Civil engineering  
Skills: Construction experience  
Sub-Teams: Fundraising  
Leader of Bridge Fabrication

**Jinit Patel**
Major: Civil Engineering  
Skills: Cutting steal  
Experiences: Working with cars and metal cutting.  
Sub-Teams: T-Shirts  
Design  
Bridge Fabrication  
Bridge Construction

**Robert Pershey**
Major: Political Science  
Skills: Construction experience and editing  
Strengths: Negotiation/compromise  
Experiences: NROTC and helped build a trebuchet, a catapult, and a loft.  
Sub-Teams: Fundraising  
Bridge Construction

**Sotiel Polena**
Major: Civil Engineering and Construction Management  
Skills: Project Management and Structural Design  
Experiences: Has been in construction related work for five years and is currently working in construction management.  
Sub-Teams: Design  
Presentation

**Fuzel Shethwala**
Major: Architecture  
Skills: AutoCAD, 3D Max, Model Making, and working with related tools.  
Sub-Teams: Posters/CAD

**Lucas Shorette**
Major: Civil Engineering  
Experiences: Has done this IPRO before.  
Sub-Teams: T-Shirts  
Presentation  
Minute Taker of Design
Milena Stopic
Major: Architecture
Skills: Spatial and Urban Planning, Material Modelling, 3D Modelling, Animation, Presentations, and Visualizations
Sub-Teams: Leader of Posters/CAD

Melissa Swinderski
Major: Civil Engineering
Skills: AutoCAD
Experiences: Has done this IPRO before.
Sub-Teams: Fundraising
Template Fabrication
Bridge Fabrication

Chintan Thakkar
Major: Mechanical Engineering
Skills: Design and management
Strengths: Team-work
Sub-Teams: Design

Lee Welsh
Major: Civil Engineering
Skills: Design and construction management
Experiences: Seven years in US Army and an internship with F. H. Paschen.
Sub-Teams: Leader of Design
Template Fabrication
Bridge Fabrication
Presentation

Sub-Teams

Design
This sub-team is responsible for completing the bridge design that will be built, as well as running virtual structural tests.

Fundraising
This sub-team will create a list of possible sponsors and send personalized donation requests to each.

Posters/CAD
This sub-team will create and print the IPRO Day and ASCE Competition posters. This team will also help make the AutoCAD drawings.

Presentation
This sub-team will be in charge of the IPRO Day presentation.
T-Shirts
This sub-team will design and get competition t-shirts made.

Website
This sub-team will create and maintain the IPRO 315’s website.

Template Fabrication
This sub-team will be building the templates for us to use for cutting the sections as well as the templates to send to the fabricators to weld the pieces. Passing the safety test at Crown Hall is a requirement.

Bridge Fabrication
This sub-team will be used to track and manage the fabrication of the bridge. It will include visits to the fabricator as well as any design changes.

Bridge Construction
This sub-team will be the competition team. Being a member of ASCE is a requirement as well as the trip to Purdue for the assembly at the regional competition.

8.0. Designation of Roles

Sub-Team Leaders:
Leader of Design               Lee Welsh
Leader of Fundraising          Naomi Heler
Leader of Posters/CAD          Milena Stopic
Leader of Presentation        unassigned
Leader of T-Shirts             Lucas Shorette
Leader of Website             Christina Barrett
Leader of Template Fabrication unassigned
Leader of Bridge Fabrication  Heather Mahoney
Leader of Bridge Construction unassigned

Other Roles:
ASCE competition Representative Naomi Heler
Representative to the IPRO office Christina Barrett
Minute Taker of Design Sub-Team Lucas Shorette