The Mission

The purpose of this IPRO is to simulate a real world design project by producing a scaled steel bridge. This IPRO showcases the actual process required to erect a structure. Students examine the designing aspect as well as the business aspect of such an operation.
The Cause

This IPRO is a contribution to our school’s own ASCE chapter. The bridge designed will be fabricated and assembled in the following semester and entered into the ASCE/AISC Student Steel Bridge Competition.
A century-old highway bridge that spans a scenic river must be replaced. The bridge carries traffic serving residences and resorts that are the foundation of the economy for this rural region. A quick replacement is necessary because no other crossing is available for miles. The state Department of Transportation (DOT) has requested design/build proposals for replacing the existing bridge.
Motivation for Design

- A deck bridge
- Clearance under the bridge
- Material used is steel
Steel Bridge Crew

Students involved with IPRO 326 are aspiring:
- Civil Engineers
- Architects
- Construction Managers
- Mechanical Engineers
- Architectural Engineers
- & Business majors
Brings the aspiring professionals together

Replicates real world workplace

People interaction
IPRO 326

Team 1

Team 2

- Read the rules of the ASCE Steel Bridge Competition
- Discussed and interpreted the rules to begin designing regulations
- Teams each came up with a preliminary design for the bridge and members, along with timeline and project plan.
Rules for the ASCE competition regulate certain areas such as:

- Building envelope
- Member sizes
- Connection design
- Assembly of the bridge
- Loading requirements
Bridge must exist inside within given dimensions
This excludes many design options
All members must fit into a 6”x6”x42” box
A member must retain its shape, dimensions, and rigidity during timed construction and load testing.
Hinged, jointed, articulated, and telescoping members are prohibited
Each connection must have one fastener.
Loading the Bridge

- Initial vertically load tested
- Loading positions are randomly selected
Loading the Bridge

- Also, laterally load tested
- Load position is known
Initial Project Plan
<table>
<thead>
<tr>
<th><strong>Project Budget</strong></th>
<th><strong>Specifications</strong></th>
<th><strong>Cost</strong></th>
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<tbody>
<tr>
<td><strong>Items name</strong></td>
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<tr>
<td><strong>Registration:</strong></td>
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<td></td>
<td>Individuals</td>
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<td><strong>Hotel:</strong></td>
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<td>Taxes @ 10.75%</td>
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<td><strong>Grand Total:</strong></td>
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IPRO 326

Team 1

Team 2
- Created Budget
- Marketing for the project
- Contacted possible sponsors

- Discussed potential bridge layouts
- Ideas for member shapes and sizes
- Preliminary connection design
- Considered likely dilemmas and possible critical spots
Design Approach

- Find critical loading points
- Simple load analysis
- Moment diagrams
Moment Diagrams

Loading

Bending Moment Diagram

\[ M_{\text{max}} = 3331 \text{ ft-lbs} \]
Several bridge designs were proposed

Constructability was key
Preliminary Bridge Designs

- Web members were carefully considered
IPRO 326

Team 1
- Business Team
  - SAP 2000 Team
  - Pier Design / Oversight
- Design Team 2
  - Connection Design

Team 2
- Design Team 1
  - Shop Drawing
  - Construction Planning
SAP 2000 Team

- Conducted load analysis

Finalize geometry

- Length of overall bridge
- Final shape
- Number and length of members
- Lateral bracing
Determining structural integrity using SAP2000

Difficulties included determining the proper way in which to model connections and releases

Determines best weight to deflection ratio
Analysis of varies load possibilities was done on the proposed bridge design until the correct sized members and connections were perfected.
The final selected bridge consists of simple truss with both the upper chord and lower chord connecting to the pier.
Pier Design/Oversight

- Proposed connection/design for the piers.
- Made a simple model to show the slipping of the feet on the pier.
- Placed an overview of the rules on Igroups that can be viewed should there be any questions.
The pier was a simple design. This inevitably cut down on weight.

Needs to support bridge while building.
Connection Design

- Plan the position of connecting members
- Decide location of bolts
Connection Design
Shop Drawings

- Detailed drawings of individual members
- All dimensions are clearly marked so fabricators can put the members through production
- Each drawing is assembled in a title block to label where it belongs on the bridge
Construction Planning

- Develops a plan to assemble the bridge
- Reviewed ASCE competition rules to see how it will allow us to function
- Develop a time frame of construction
- Plan the purchase of tools and materials
Proposed Assemblage of the Bridge
Ethical Issues

- Quebec Bridge Collapse
- Minnesota Bridge
- Kansas City Hyatt
The progression of this operation has advanced well beyond last years by this time.

- Giving ASCE plenty of time for preparation for the competition
- This allotted time will ensure our success at the ASCE/AISC Steel Bridge Competition
THANK YOU

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