**Main Event: Bridge Building**

**Event Description:**
In this event, teams of 2-4 students will design a bridge, virtually test it, and then print it on a 3D printer. Teams will then bring their bridges to the tournament to see which will have the highest structural efficiency. Teams will also submit a Design Document outlining some of the key aspects of the process. Design Documents must be converted to a PDF file before uploading to the 3D Derby Design Document Submission Portal on Teams.

**Common Core Standards and 4 C’s:**
Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently. Creativity, Collaboration, Communication and Critical Thinking.

**Designing and Creating your Project:**

**The process of creating your project should take on the following steps:**

- Research different bridge structures to help design your bridge.
- Use [West Point Bridge Design](#) program to design and virtually test your bridge.
- Use a 3D program such as [SketchupMake](#) to create a 3D model of your bridge.
- Print your bridge on a 3D printer.
- Test your bridge, make adjustments and reprint (may repeat multiple times).
- Bring your bridge to the tournament to see which is the best.

**Technical Requirements and Specifications:**

- The bridge must be completely drafted by the students. Bridges will be designed and printed prior to the competition, using West Point Bridge Design, 3D modeling software and the Makerbot 3D Printers.
- The bridge must weigh no more than 30 grams.
- The bridge must be able to span a distance of 5.75 inches (146mm), from the center of the pier to the center of the next pier. ([See load test diagram here](#))
- The load plate will be 2” x 2” (50.8mm x 50.8mm) and will be placed on the top of the bridge.
- The bridge can be printed in one piece, or in components that may be glued together, but NO other materials may be used.

**Reward Points:**
Teams will test their bridges on the day of the tournament. Each bridge will be loaded with weights until it fails. Its structural efficiency will be calculated by dividing the total load supported by the mass of the bridge. Then the bridges will be ranked by structural efficiency and final points will be as follows:

<table>
<thead>
<tr>
<th>3D Bridge Scoring Breakdown</th>
<th>Max Points</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points from Rank</td>
<td>35</td>
<td>35 – 3(Your Rank -1)</td>
</tr>
<tr>
<td>Points from Structural Efficiency</td>
<td>35</td>
<td>First Place Efficiency / Team's Efficiency x 35 = Team’ Total Efficiency</td>
</tr>
<tr>
<td>Points from Design Document</td>
<td>30</td>
<td>See Design Document Rubric</td>
</tr>
</tbody>
</table>
3D Bridge Design Document

Overview:

Students will create a document outlining the process of designing and testing their bridge. There will be four main sections: Research, Specifications, Testing and Conclusion. The document will be submitted and scored prior to the tournament and will be worth 30 points. Design Documents must be converted to a PDF file before uploading to the 3D Bridge Design Document Submission Portal on Teams no later than 11:59 pm March 3, 2018.

Research:

In this section students will select a question or concept related to the project and use the internet or other sources to search for information and solutions.

**Students may investigate their own question, or choose one from the list below:**

- What are the benefits/limitations of different bridge structures?
- What roles do compression and tension play in a bridge structure?
- What makes a good bridge?

Specifications:

In this section students will list specific measurements of their bridge such as mass and dimensions. They will also include screen shots of their bridge in the West Point Bridge Design Program, the 3D model design stage as well as a picture of their final printed bridge.

Testing:

**Virtual Testing:**

Students will explain how they designed and tested their bridge in the West Point Bridge Design program and what modifications they made to improve its structural efficiency. This could include minor adjustments such as increasing/decreasing the size of individual components; or major changes such as complete redesign or use of a completely different structure.

**Physical Testing:**

Students will describe what modifications they made after testing their bridge past its breaking point. They should include a picture of the broken bridge and explain what changes were made to increase strength and prevent repeated failure.

Conclusion:

In the last section students will write a conclusion which summarizes the modifications to their final bridge. They will explain why they chose certain adjustments and modifications over others citing their testing and research.

Getting Help:

Visit the [Tournament of Technology Teams](#) site see a sample Design Document and our new [YouTube Channel](#) to view tutorials to help prepare and practice.

Contact Anthony Sombat at [Anthony.sombat@fresnounified.org](mailto:Anthony.sombat@fresnounified.org) if you have any further questions further questions or suggestions regarding this future competition event.
# 3D Bridge Design Document Scoring Rubric

Team Name: ____________________________________________

<table>
<thead>
<tr>
<th>Category</th>
<th>Exemplary</th>
<th>Proficient</th>
<th>Partially Proficient</th>
<th>Incomplete</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESEARCH:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>The question/concept is well answered and relevant to increasing the strength of the bridge.</td>
<td>The question/concept is very well answered and relevant to improving the strength of the bridge.</td>
<td>The question/concept is well answered and somewhat relevant.</td>
<td>The question/concept is somewhat answered but not that relevant.</td>
<td>The question/concept is not at all answered and not relevant.</td>
<td></td>
</tr>
<tr>
<td><strong>WORKS CITED:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>Multiple reliable sources have been referenced or cited in the research.</td>
<td>3 or more very reliable sources have been referenced or cited in the research.</td>
<td>2 reliable sources have been referenced or cited in the research.</td>
<td>Just 1 somewhat reliable source was referenced or cited in the research.</td>
<td>There were no sources referenced or cited in the research.</td>
<td></td>
</tr>
<tr>
<td><strong>SPECIFICATIONS:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>The measurements of the bridge are clearly listed with multiple screenshots and pictures.</td>
<td>All measurements are listed and there are 5 or more screenshots/pictures.</td>
<td>All measurements are listed and there are 3 screenshots/pictures.</td>
<td>Some measurements are listed and there is just 1 screenshot/picture.</td>
<td>Most of the measurements are missing and there are no screenshots or pictures.</td>
<td></td>
</tr>
<tr>
<td><strong>TESTING:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>Specific modifications were described as a result of virtual testing in the WPBD program.</td>
<td>3 or more modifications were very clearly described in the virtual testing.</td>
<td>2 modifications were clearly described in the virtual testing.</td>
<td>Only 1 modification was somewhat described in the virtual testing.</td>
<td>There were no modifications described in the virtual testing.</td>
<td></td>
</tr>
<tr>
<td><strong>MODIFICATIONS:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>Specific modifications were described as a result of physical testing, including a picture of the broken bridge.</td>
<td>3 or more modifications were very clearly described after the physical testing.</td>
<td>2 modifications were clearly described after the physical testing.</td>
<td>Only 1 modification was somewhat described after the physical testing.</td>
<td>There were no modifications described after the physical testing.</td>
<td></td>
</tr>
<tr>
<td><strong>CONCLUSION:</strong></td>
<td>5 points</td>
<td>3 points</td>
<td>1 point</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>The conclusion clearly states what was done to improve the structural efficiency of the bridge.</td>
<td>The conclusion is a well written summary of what was done and cites specific evidence from testing and research.</td>
<td>The conclusion is a summary of what was done to the bridge but lacks evidence from testing and research.</td>
<td>The conclusion is a weak summary of what was done and is lacking detail.</td>
<td>There is no conclusion in the design document.</td>
<td></td>
</tr>
</tbody>
</table>

Total Points (30 Max)