

## **The Fall 2017 South Warren Bridge Building Competition! <http://www.mrbryant.net>**

Your task is to construct a bridge that can hold as much weight as possible while using the least amount of material. That is to say, your bridge should be lightweight *and* strong. Each bridge team will be given 5 balsa wood sticks (61cm long each) and a small bottle of brightly colored glue from which to construct a bridge. The bridge must be constructed using *only these materials*-nothing else. On competition day, the fully constructed bridge must not weigh any more than 12 grams and certainly no more than the total weight of the 5 balsa wood sticks and glue. (If it does, judges will be immediately aware that the team used illicit materials.)

### *Objectives:*

#### I. Structurally-build a bridge with the greatest calculated efficiency

$$\text{Efficiency} = (\text{maximum weight supported}) / (\text{weight of bridge})$$

1. The bridge will be tested for MAXIMUM weight supported (when the bridge breaks, no more weight is added)
2. The bridge must hold the minimum weight of the empty load apparatus (Typically Beam style bridges perform more successfully in this category, but if properly designed, a Truss style bridge can perform as well or better than a Beam style bridge...both have “won” in the past.)

#### II. Aesthetics--build the most visually pleasing structural form

1. Scores will be given only by rank.
2. Judges will be looking for neat workmanship, clean lines, and overall structural creativity. (Typically, truss style bridges perform more successfully in this category, however if properly designed, Beam style bridges may perform as well or better than Truss style bridges.)

### *General Bridge Specifications:*

The bridge design must provide a means of passage for vehicles across the gap. This clear passage through the bridge (in a Truss style) or on top of the bridge (Beam style) shall be a minimum of 5 cm in width and be maintained throughout the entire bridge length. A simulated road surface (decking) in the form of a square wooden block will need to be able to slide along the length of the decking support surface. The bridge must therefore accommodate a 5cm wide decking surface throughout the bridge's length. A load will be hung from the wooden block using a small metal hook which will pass between decking support surfaces on the bridge. Note: your design does not need to include decking, however it must provide a support surface throughout the bridge's length. This should consist of at least two separate lengths of balsa wood continuing the entire length of the bridge. The elevation of the decking support surface should not vary by more than 3cm. Bridges may not have more than four (4) main girder type beams, regardless of structure type (truss or beam). This means that there may be no more than four (4) main members parallel to each other below the decking elevation, lengthwise along the structure. These may not be laminated to each other for any length. The design ideas may be of any structural type (girder beams, trusses, arches, etc.)

### *Bridge Dimensions:*

- 1) Refer to Figures 1 and 1A for bridge dimensions. Figure 1 is the dimensional envelope and Figure 1 A is a side and front view with bridge dimensions. Figure 1 A contains a table of the bridge dimensions as well. Be sure and to check this for clarification. (Special note: Beam style bridges can be no more than 3 cm tall.)

- 2) Remember, as allowed for in the dimensions, a *5cm* wide x *5cm* tall object, representing vehicle traffic, must be able to pass freely above the decking support. Builders do not need to provide decking, only an accessible decking support surface.
- 3) A *5cm* by *5cm* decking wooden block, which is used to load your bridge, must fit into (Truss style) or on top of (Beam style) your bridge and rest on the girders and/or floor beams. Your bridge must have an opening between the girders and/or floor beams big enough to pass the metal loading hood through its bottom.
- 4) Main girder members must be single linear beams, no overlapping is allowed. Please refer to the allowed jointing methods shown in Figure 3. A maximum of 4 main girder type beams will be permitted along the length of any bridge. This means that only 4 main lengths of beam can be used in the decking support surface. (A truss style beam with multiple members can be designed to act as a girder.)
- 5) Only the glue provided may be used to bond the pieces of wood together. Bonding is only permitted at the joints and the glue cannot be "globbed" to increase strength. Figure 3 illustrates "allowed" and "not allowed" joints. Lamination is not allowed, which means the judges must be able to pass another piece of balsa wood between two or more pieces of wood placed parallel to each other.
- 6) DO NOT paint or apply any other chemicals to coat the wood surface; non-compliance will result in immediate disqualification.
- 7) Any bridge not conforming to these dimensions will be required to be altered or be disqualified.

Important Project Dates:

Fri., Oct. 20 <sup>th</sup> , 2017	Project Assigned
Thurs., Oct. 26 <sup>th</sup> , 2017	Class time for questions, practice building techniques, etc.
Thurs., Nov. 2 <sup>nd</sup> , 2017	<b>Design Plan Due!</b>
Mon., Nov. 20 <sup>th</sup> , 2017	<b>Bridges &amp; Final Design Drawings Due!</b>
Tues., Nov. 21 <sup>st</sup> , 2017	Bridge Testing!
Nov. 22 <sup>nd</sup> - 24 <sup>th</sup> , 2017	Thanksgiving Break

## *Design Plan*

About halfway through the bridge project your team will be required to submit a design plan for your bridge. It should include scale drawings of your bridge design showing 3 views of the bridge: a *top view* (as if you were looking down from space on top of the bridge), a *side view* (as if you were standing outside the bridge so that a line connecting you and the length of the bridge would be perpendicular), and an *end view* (as if you were actually going to travel across the bridge and the entire length of the bridge is directly in front of you). These scale drawings should be 2 dimensional (flat, *not* 3D/perspective). Somewhere on your design, state the scale you are using for your drawings. Additionally it should include measurements and a calculation of the total length of wood necessary to construct this particular design. (It should of course be less than the total length of wood given you!) Your final bridge design may change from this preliminary design, but it would wise and time saving if you have a solid design at this stage. (Get it? "solid!?!")

Use the following checklist to help you make sure you have completed necessary steps for your design plan:

My team's design plan has a scaled top view drawing with important measurements indicated \_\_\_\_\_

My team's design plan has a scaled side view drawing with important measurements indicated \_\_\_\_\_

My team's design plan has a scaled end view drawing with important measurements indicated \_\_\_\_\_

My team's design plan has the scale listed that we used to make our drawings \_\_\_\_\_

My team's design plan has a calculation showing the total amount (in linear centimeters) of balsa wood required for our design \_\_\_\_\_

My team's design plan incorporates the required bridge dimension parameters: \_\_\_\_\_

The Design Plan in total will be worth 20 points.

## *Bridge Project Grades*

Bridge projects will be graded via the attached rubric (see additional files on website). You will have to submit final scale drawings of your bridge design and meet all dimensional requirements of the project. Additionally you will grade your own and your teammate's contribution to the project. As long as the bridge holds the testing apparatus, and you have met all other requirements, your team will earn at least an "A." Additional points will be awarded on a sliding scale based on efficiency with the most efficient bridges earning more points. Judging will also take place on aesthetics-with the most aesthetically pleasing bridges winning special awards (no points).

## *Building and Testing Materials*

Your science lab fee covers the cost of building and testing materials.