Build Em & Bust Em Rules

A. Bridge Contest Summary:

Teams construct balsa wood bridges to be load tested on the day of the event.

Four awards will be given (1st, 2nd, 3rd, and 4th Place) in each Category to the team with the highest score determined from the **Bridge Efficiency (E)**. Bridge Efficiency (E) is a ratio of how much load the bridge can handle to the mass of the bridge.

Efficiency of your bridge will be determined using the following formula:

$$E = \text{Bridge Efficiency} = \frac{(\text{LOAD IN kg}) \times (1000 \text{ grams/kg})}{(\text{MASS OF BRIDGE IN grams})}$$

The load will be measured in kilograms, while the mass of the bridge will be measured in grams.

Example: If your bridge weighed 22 grams, and supported 42 kilograms of weight during the test, you would calculate efficiency as follows:

$$E = \text{Bridge Efficiency} = \frac{(\text{LOAD IN kg}) \times (1000 \text{ grams/kg})}{(\text{MASS OF BRIDGE IN grams})} = \frac{(42)(1000)}{(22)} = 1909$$

One additional award will be given in each Category for **Bridge Design** based on aesthetics and functionality. Remember form follows function.

B. Dimensional Parameters for Bridges:

- Test Block (50mm x 50mm) must be able to pass through bridge
- *Judges to provide blocks to use on day of event*
- Bridges must have a deck structure to support the test platform (provided)
- Bridges shall be loaded only on the bottom of the truss (deck and lower chord)
- Bridge decks must be accessible to test platforms
- See Diagrams 1 and 2 for a schematic of the testing platforms

C. Wooden Test Platform:

A 5 cm square wooden board will be used during testing to apply stress to the bed of the bridge. Please allow space in your bridge design so that the testing crew can place this in the **CENTER** of your bridge. Teams can create a 5 cm cardboard square while you're constructing your bridge to mimic this board.

For Category I and II bridges, the load will be applied to this board from beneath the bridge. The hook, illustrated in Diagram 1, must be able to pass below the bed where the load device will be connected.

For Category III teams, the load will be applied to the board by a dowel rod placed vertically on top of the bridge deck. Again, make sure your bridge is designed so that

the dowel can be **CENTERED** on the bridge deck from above. See Diagram 2.

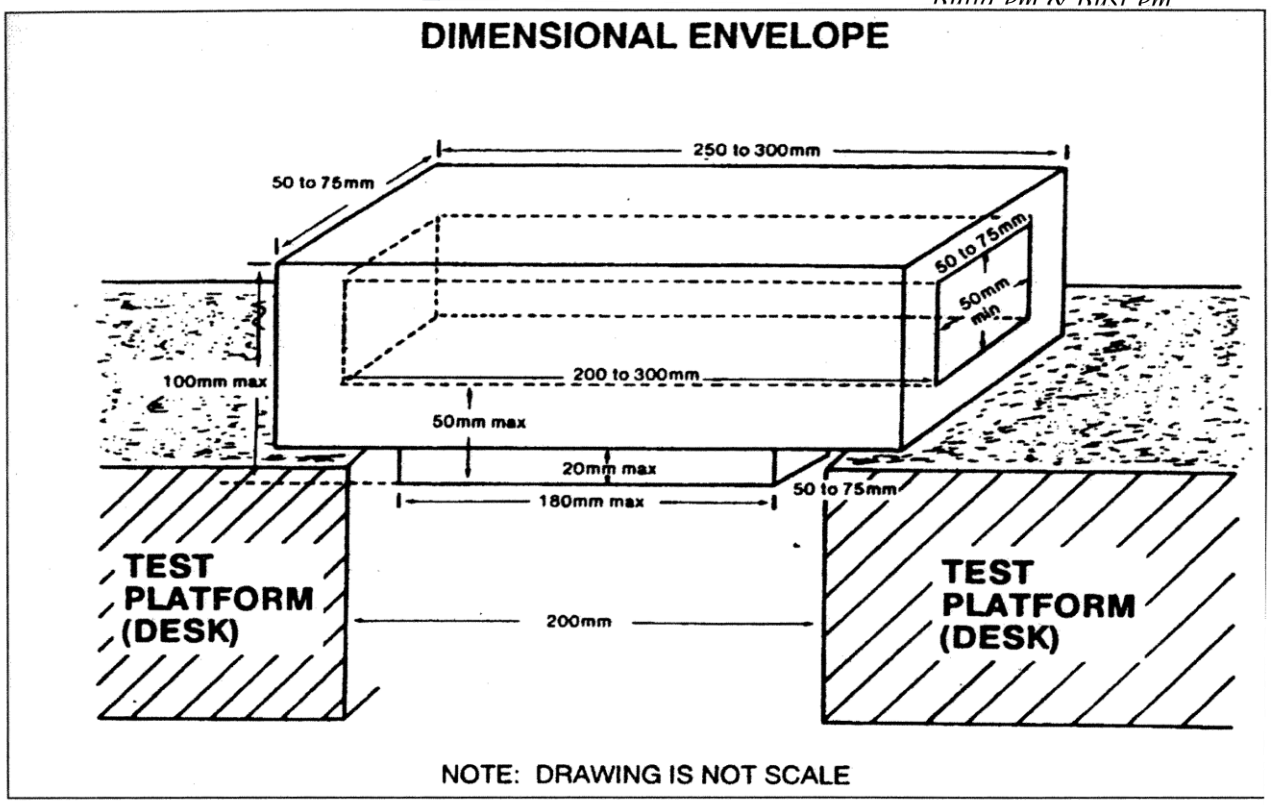
The bridge must be built within these dimensions (See Dimensional Envelope Sketch on Page 3):

	Bridge	Roadbed	Optional Underhang	Testing Platform
Length	250 to 300mm	200 to 300mm	Less than 180mm	50mm
Width	50 to 75mm	50 to 75mm	50 to 75mm	50mm
Height	Less than 100mm	Less than 50mm	Less than 20mm**	7mm

** Included in the overall height of the bridge

Note:
It is imperative that bridges are built to the dimensional envelope shown within these rules. Bridges not meeting the geometric requirements will not be allowed to compete.

- Bridges may undergo repairs prior to testing in order to meet the dimensional specifications. Only the respective team members shall be allowed to make alterations to the structure.



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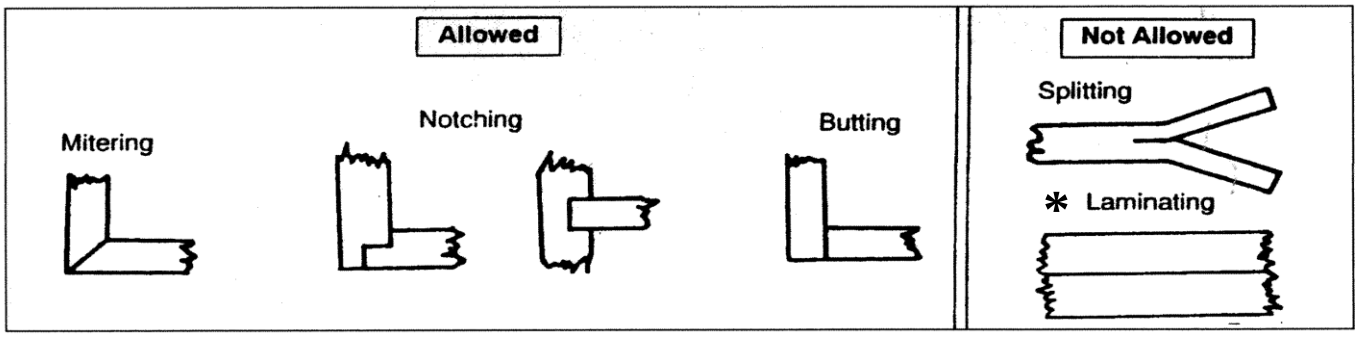
D. Construction Requirements & Techniques:

- Only the provided materials should be used in the construction of the bridge.
- All bridges must contain a truss design element (vertical triangles).
- Splitting of members is not allowed
- Wood pieces may be bonded together with glue only at joints. If two or more strips of wood are placed parallel to each other, they must be at least the thickness of this sheet of paper apart from each other.
- **No laminating of members allowed for Category I and Category II**
- **Laminating is allowed for Category III teams only**
- The term *Laminating* for purposes of this competition is defined as bonding (gluing) together multiple pieces of wood, parallel to one another, to create a larger composite truss member
- See sketch below for allowed types of connections

The Following Types of Connections Must be Considered For Your Bridge:



*** Lamination of wood pieces is allowed for Category III teams only.**

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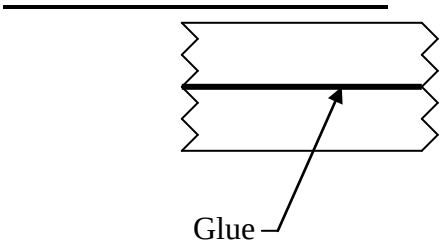
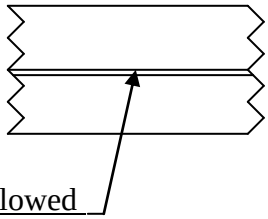
* Laminating:

Category III Teams:



Category I and II Teams:



E. Recommended Tips for Constructing Your Bridge

Blueprints or plans of the bridge drawn to scale will be very helpful prior to final construction of the bridge. Plans are not required for the competition.

Four views should be drawn:

1. END VIEW
2. SIDE VIEW
3. ROADBED
4. TOP VIEW

Recommended Construction Materials & Tools:

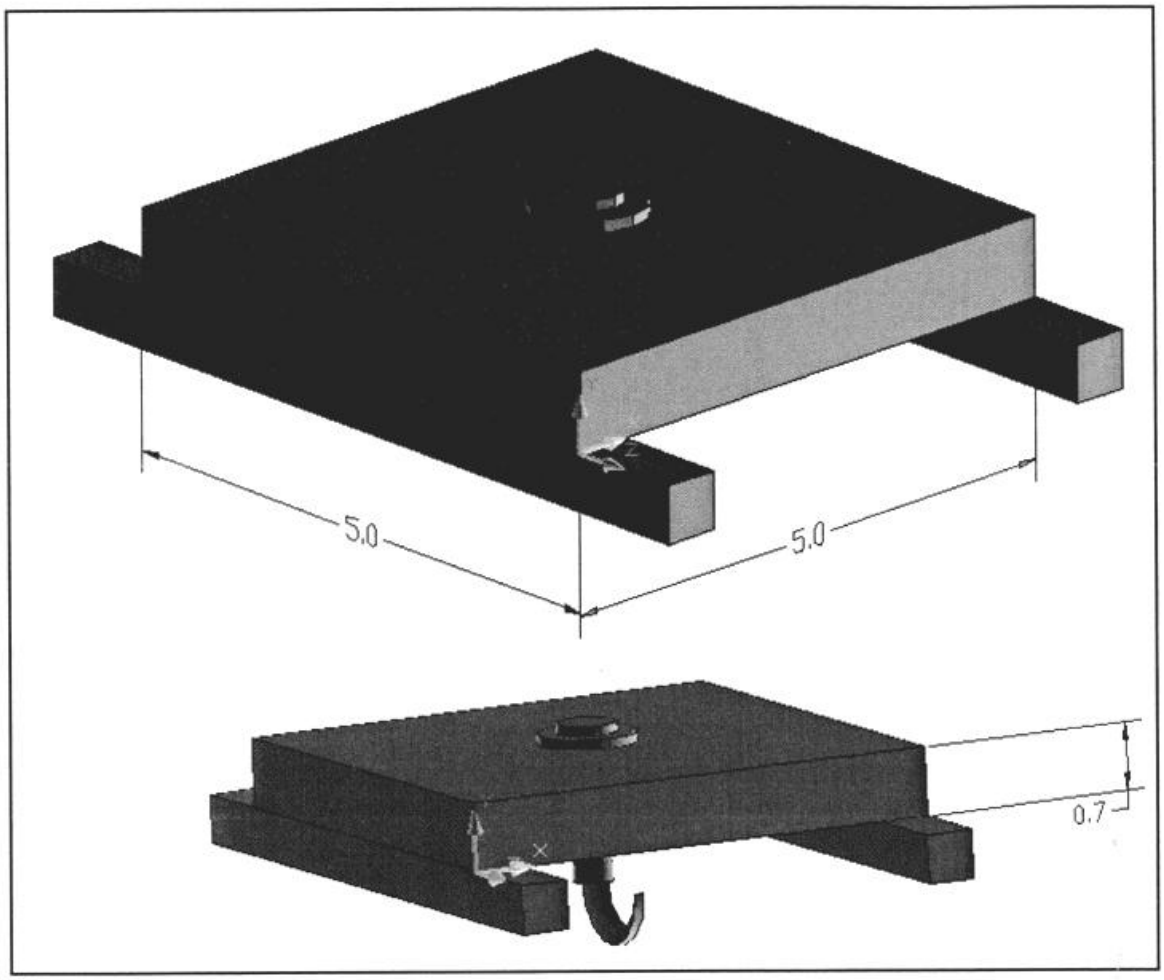
- Cardboard for use as a building board
- Straight Pins to hold pieces in place as glue dries
- Single Edge Razor Blade, or X-Acto® knife, for cutting (**Use Adult Supervision**)
- Waxed Paper, to cover the plan (blueprint) as you build on top of it
- Ruler or other device for measuring
- 15 pieces of balsa wood and a 2/3 oz. bottle of glue (supplied)

Diagram 1 – Category I and II Test Platform

Sketch of the Testing Platform

(All dimensions in cm)

Note: Figure Not Drawn to Scale



Dimensions of the wooden board:

Length = 50 mm
Width = 50 mm
Height = 7 mm

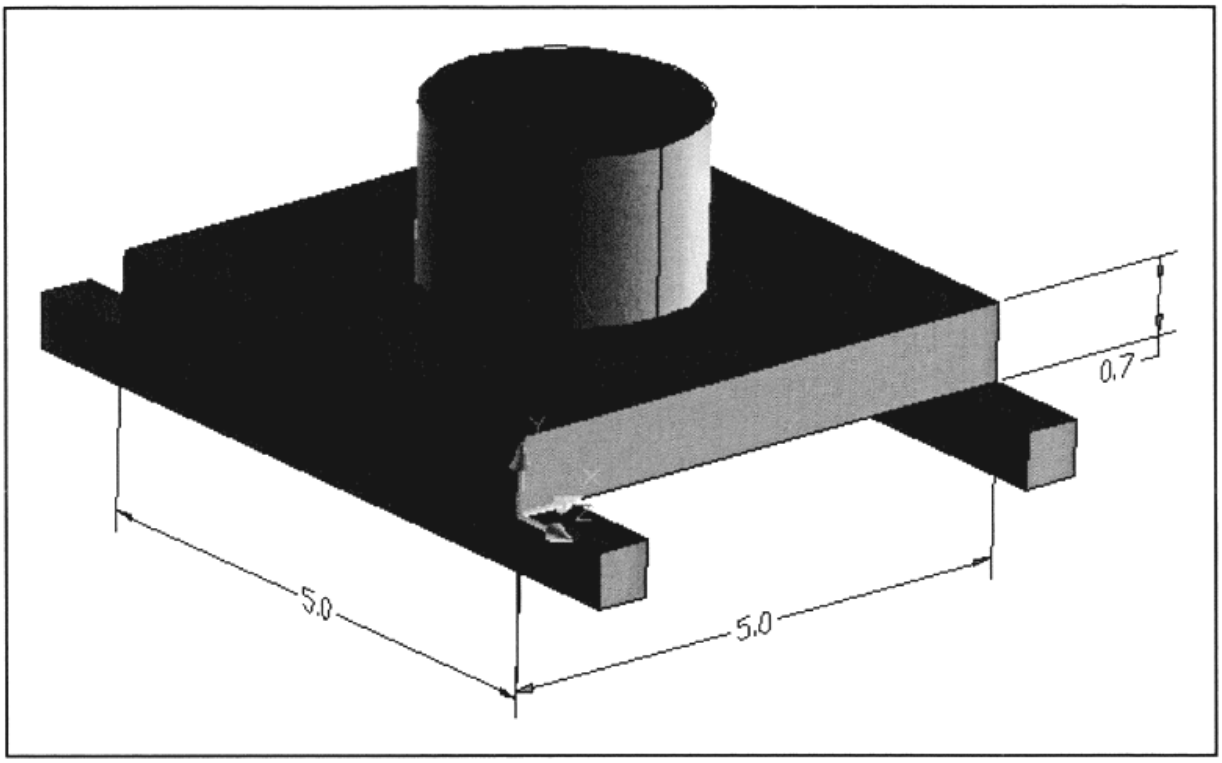
A wooden board has been provided which can be used as a testing platform. The board should be kept at the center of the roadbed on the bridge. The board has been fixed with a hook to which weight will be attached.

Diagram 2 – Category III Test Platform

Sketch of the Testing Platform

(All dimensions in cm)

Note: Figure Not Drawn to Scale



Dimensions of the wooden board:

Length = 50 mm
Width = 50 mm
Height = 7 mm

A wooden board has been provided which can be used as a testing platform. The board should be kept at the center of the roadbed on the bridge. Load will be applied from above the board.

Tips for Building your Balsa Bridge:

The best advice for building winning structures starts with commitment. Your dedication and attention to detail is the winning combination. The list of tips below will help you succeed but only if you are dedicated to the project. Be sure you understand the event rules before designing your prototype.

1) Draw your preliminary design with full wood outlines. This should help you to decide whether to use butt joints or lap joints.

2) ALL joints should have absolutely flush surfaces before applying glue.
Anytime glue is used as a "gap filler", it dooms the structure! Cut the wood precisely and carefully sand the part so that it fits flush. Then, number the part and use it as a template to make numbered duplicates in assembly sequence (i.e.: two for bridges, four for towers).

3) Structures are symmetric. When building a bridge or a tower with two or four sides, build the two primary sides one on top of the other. Once the first side is built, cover it with wax paper and **build the second side directly on top of the** first. This helps insure the structure's symmetric integrity.

4) Most competitions require these structures to be weighed. **Up to 20% of the structure's mass may be from over-gluing.** Adhesives do not work better when they are drooled all over the structure. Use the adhesives sparingly where any more than a translucent, moist surface becomes wasted, excess mass.

5) When building a balsa wood structure, **pre4est all the strips for tensile strength before assembly.** A simple deflection test works best. Anchor half of the strip on a surface and ballast the free end using clay on a bent straight pin. Use a simple gauge to categorize the strips. Group similar tensile strengths together. The strips that deflect the least are the strongest. Use those for the longest pieces. The ones that deflect the most use as the shortest pieces. When the structure is finished, it should have a relatively consistent load carrying capability.

The above tips can also be viewed at the following URL:

http://www.midwestproducts.com/structtips.htm

Bridge Truss Designs