

BSA TROOP 401
2009 TOOTHPICK BRIDGE BUILDING COMPETITION
COMPETITION RULES AND SPECIFICATIONS
Revised 10/26/2009

DESCRIPTION: The objective of this event is for each patrol to design and build a structure with the highest load to weight capacity ratio (Failure Load/Weight), over a predetermined span using toothpicks and glue. This is an engineering event; therefore, failure to adhere to the rules and regulations herein may result in disqualification from the competition.

COMPETITION DATE: Monday, November 2, 2009 at the Troop Meeting

Materials:

1. Round toothpicks (1000 handed out to each patrol) (250 toothpicks weigh 1.2 ounces)
2. One sheet of 8.5 x 11 inch notebook paper.
3. Bridges shall be bonded using Elmer's white glue or wood glue (bring container of glue used to competition). No other type of glue is allowed (no contact cement, polymer glues, etc.).
4. Some suggested tools for construction are as follows:
 - a. Glue
 - b. Hair Dryer for drying glue
 - c. Ruler / Scale
 - d. Exacto Knife Kit / Razor
 - e. Clamps
 - f. Construction plans
5. Design plan or drawing is optional but highly recommended and should be provided by the patrol.
6. You may consult with others/adults about your designs but no help may be given during construction.

Construction:

1. Any type of bridge may be constructed as long as it meets the following specifications.
2. Do not coat the bridge with any material (i.e., paint, stain or glue).
3. All glue shall be removed from surfaces that are not bonded together.
4. The bridge must be constructed to meet the following specifications:
 - a. The bridge will span an opening of twenty (20) inches on the loading table. Note that the bridge will need to be longer than twenty inches to allow for bearing on the table.
 - b. Bridge will only be allowed to rest on the loading table provided by the Troop. No glue or physical attachments may be made to the top or sides of the loading table.
 - c. Bridge width: Minimum = 1.5 inches, Maximum = 2.5 inches
 - d. Bridge height: Minimum = None, Maximum = 8 inches
 - e. **The bridge may extend a maximum of 2.5 inches below the loading table.**
 - f. **The bridge may be built to apply vertical and horizontal forces to the loading table.**
 - g. The completed bridge shall weigh no more than 4.0 ounces

5. The bridge must be able to accommodate the loading block (1"x3") at application point. The loading block application point is at the midway point in the bridge. The loading block will be placed on top of the bridge or on the roadbed depending on the design of the bridge.
6. **START EARLY, PLAN THOROUGHLY, AND WORK STEADILY.** Do not put your work off to the night before it is due. Toothpick bridges need time to dry properly.
7. Try different constructions. Build as many versions of your prototype bridge as possible.
8. **TEST** each toothpick before you use it. Test round toothpicks by applying a little pressure to bend it.
9. Good glue joints make for good strength.
10. Consider the strengths and weaknesses of a single toothpick under these four forces: **COMPRESSION, TENSION, TORSION and SHEER.** Design your toothpick bridge to use the strengths of each toothpick as much as possible.
11. Watch out for "stress risers". Before falling, your bridge will give and bend under the load of your test weight. If you have made some parts of your toothpick bridge so strong and hard that it will not give, your toothpick bridge will fail in another area sooner than if the whole bridge were able to adjust.
12. To reduce drying time, do initial gluing with **SMALL** drops of glue (applied with a toothpick). You can go back later and reinforce these small drops with more glue after everything dries.

Testing:

Testing your completed bridge is very exciting! By slowly adding weight to the bridge, you determine how much weight it will support before actually breaking. Of course, you don't need to break your bridge. However, how will you know what the true strength is unless you break the bridge?

1. All bridges will first go to the Check Station where they will be weighed and measured for compliance with the construction specifications. Bridges that are completed but do not meet the construction guidelines will be given a chance to make any necessary alterations.
2. No alterations will be allowed unless deemed necessary by the Judges. If such alterations are required, the team will be allowed ten (10) minutes to complete them.
3. The Troop will provide the loading block and testing apparatus.
4. During the test phase, the bridge will be placed in the center of the testing apparatus containing a span of twenty (20) inches.
5. The load will be applied to a 3"L x 1"W x 3/4"H loading block resting at the midpoint of the span. A standard five-gallon plastic bucket will be attached to the loading block. The roadbed must be constructed to accommodate the 1"-wide loading block at mid-span.
6. Loading the bridges will be accomplished by adding sand to a five-gallon bucket until the structure fails. For this contest, structural failure is defined as obvious structural collapse.
7. The total load incorporates the total mass of the loading apparatus, bucket and sand.

Scoring:

1. Overall ranking will be based on the structural efficiency score.
2. The structural efficiency (SE) score will be determined by the equation:

$$SE = [\text{maximum load supported (pounds)} / \text{weight of bridge (ounces)}]$$