

TOOTHPICK BRIDGE BUILDING CONTEST RULES

To all Toothpick Bridge Building Contest Entrants: PLEASE read all instructions before starting construction of your bridge. This will help you avoid any cause for disqualification.

GENERAL RULES:

- 1 Each student can enter only one Bridge for this school year. You may CRUSH more than one bridge. However, you must choose one Bridge as the official entry before CRUSHING.
- 2 Bridge construction and materials must conform to the rules of this contest.
- 3 Students may enter individually or as a team of two students. No more than two students per team will be accepted. If any prize is earned by a bridge, we will attempt to distribute the prize evenly between teammates.

MATERIALS RULES:

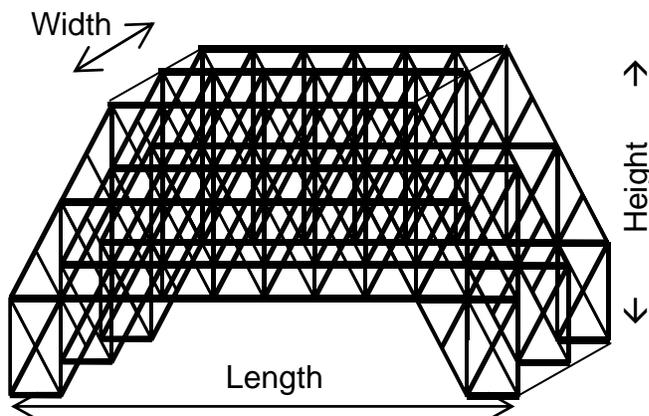
The materials you will need are available at your local super market, hardware or discount store.

- 1 Only standard length round, square, or flat wood toothpicks are acceptable for use in the construction of your Bridge. You will need about two (2) 250 count boxes. You can contact the Contest Officials for examples or questions about toothpicks.
- 2 The only glues approved for use are **regular** "Carpenter's Wood Glue" (**NO POLYMER GLUES ALLOWED**) and "Toothpick Bridge Building Glue". One small bottle will do. The use of contact cement, rubber cement, super glue, multi-part mix, hot melt, or any other adhesive is cause for disqualification. We suggest you bring the used container of glue to the contest site in case a question should arise.
- 3 Toothpicks used must be in their purchased condition. You may not modify toothpicks used in the construction of your Bridge. Cutting, Slicing, notching, drilling, fraying or other alterations will result in disqualification.
- 4 Do not paint, coat, spray, or dip any part of your bridge with any substance. Glue only where toothpicks touch or where one toothpick crosses another. Toothpicks can be glued side by side; however, you cannot fully encase one toothpick inside others. **Complete glue coverage of even one toothpick is cause for disqualification.** Besides, excess glue leads to extra weight.

CONSTRUCTION RULES:

- 1 Bridge weight shall not exceed 125 grams (4.4 ounces).
- 2 Bridge dimensions must meet the following requirements.
- 3 Height: Must be no more than 45.5 cm (18.0 in.) high
- 4 Width: Must be no more than 18.0 cm (7.0 in.) wide
- 5 Length: Must be between 51.0 cm (20.0 in.) and 64.5 cm (25.5 in.) long. It is recommended that the bridge is at least 1-inch longer than the minimum so that it will have enough contact with the support plates to support a load.
- 6 UNSTABLE Bridge Structures will result in disqualification. Bridge must stand by itself.
- 7 Bridge must be constructed to allow a 20.5 cm x 20.5 cm (8 in. x 8 in.) square LOADING BLOCK to rest on the top center section of the Bridge. This plate weighs 2.25 kg. (5 lbs).
- 8 No part of the bridge can extend above the bottom of the loading block.

** It is not a requirement that the Bridge be constructed with a roadway or deck.*



TESTING AND JUDGING

(Decisions of the Judges are Final)

- A. Student will register with the Bridge Building Judges upon arrival.
- B. Judges will examine each Entrant's Bridge to ensure that the Bridge conforms to the MATERIALS RULES (See previous page).
- C. Judges will examine each Entrant's Bridge for conformance to the CONSTRUCTION RULES (See previous page).
- D. Each qualifying Bridge and the Entrant (or team of Entrants) is photographed before Bridge testing, since this is the last time the structure will be in one piece. Photos will be available following the event.
- E. At the request of an Official, each Entrant will bring their bridge to the tester for **LOADING** and **CRUSHING**.
- F. An Official will load the Bridge into "THE CRUSHER". The Load Block is lowered onto the bridge and applies an initial weight to the Bridge.
Your bridge must hold this 2.25 kg (5 lbs.) weight for testing to continue.
The Official slowly increases air pressure to the load cylinder of "THE CRUSHER", increasing the load on the Bridge. This process continues until failure occurs. The Official records the air pressure at failure.
NOTE: Definition of Failure: The point at which the structure can no longer support additional load.
- G. After crushing, an Official calculates the Force on the Bridge, using the air pressure reading recorded at failure.
- H. The **STRUCTURE RATIO** is then calculated by dividing the Force, calculated in 'G' above, by the weight of the Bridge. This value establishes the relative strength of each Bridge and the contest winners. To put it simply, the most bridge that can hold the most weight and weigh the least, will be the best.

EXAMPLE:

Bridge #1 weighs 96 grams and holds a 9870 grams weight (21.8 lbs.)

$$\text{Structure ratio} = 9870/96 = 102.8 \text{ (102.8 times its own weight)}$$

Bridge #2 weighs 85 grams and holds 9000 grams (19.8 pounds)

$$\text{Structure ratio} = 9000/85 = 105.9 \text{ Ratio (105.9 times its own weight)}$$

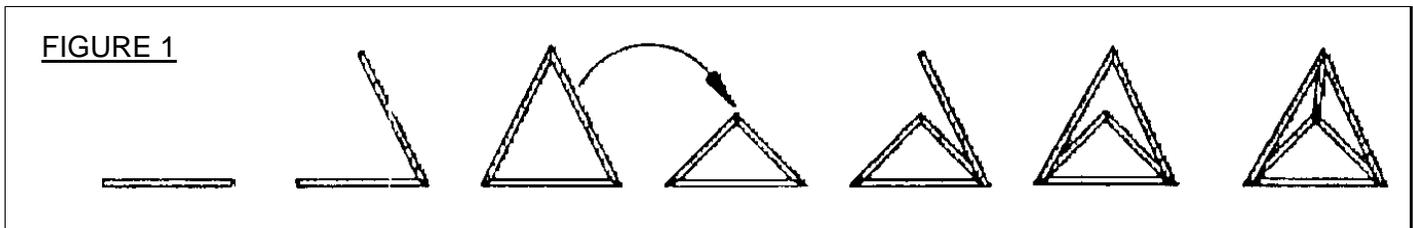
As one can see, although Bridge #2 held less weight, it had a higher "STRUCTURE RATIO". Bridge #2 attained a higher "Structure Ratio" and would be the winner between these two. Bridge #2 was better because it was a more efficient design - it used less material (weight of the bridge) per pound of weight it held up. In the real world of bridge engineering, this would be the more cost effective bridge.

TOOTHPICK ENGINEERING

GLUING TOOTHPICKS:

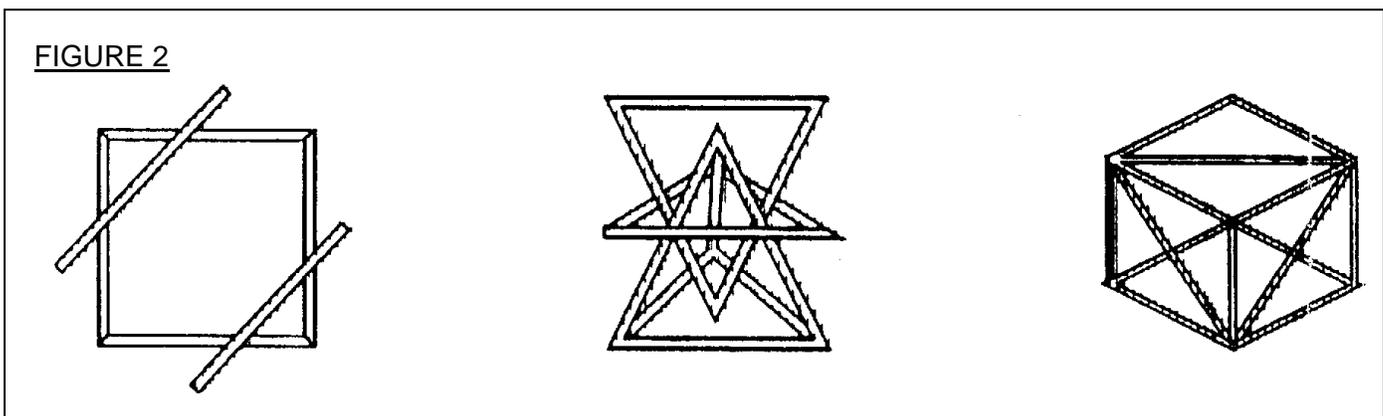
This is the most difficult part of Bridge construction. The glue takes time to set. An excellent way to begin is to lay toothpicks on waxed paper and glue them together into triangles. When the glue has set, prop other toothpicks into the position you want. Then glue these toothpicks to the original triangle. When the glue dries, it will shrink. Where you have used too much glue, (it is difficult to use just the right amount) you will find the excess forms a mass. Removal of this mass, by cutting it away, is allowed. **DO NOT CUT TOOTHPICKS.** Refer to MATERIALS RULE #3.

It is best to wait until the next day to test your substructures. Waiting will insure the glue is completely dry. You will find toothpicks are extremely strong when used carefully. Construction of a Bridge you can **STAND ON** is possible.



CONSTRUCTION:

One of the methods you can use to build your Bridge is to construct triangles, as shown in Figure 1. Figure 1 shows the construction of a tetrahedron (a polyhedron with four sides). Begin by constructing a triangle by gluing three toothpicks together. Then build a pyramid of toothpicks from each of the triangle's corners. You will find that this is a very rigid and very strong structure. If you continue to use this method, you will get the maximum strength from the toothpicks. When you depart from the use of triangles to construct a square, it may not be as stable as a triangle. When this happens, you can glue toothpicks across the corners of the square to strengthen it, as shown in Figure 2. (It is not a requirement to use triangles.)



The Crusher!

