Anchorage Engineers' Week Student Competitions

2024 UAA Model Bridge Strength Competition

Introduction and Objective

The objective of the contest is to design and build a bridge that will support the greatest weight (maximum applied load) while meeting all the required specifications.

These rules are a modification of the rules for the International Bridge Building Contest, which can be found at: http://bridgecontest.phys.iit.edu/public/international/2023/international_rules

Categories

The contest is open to students grades 2-12. Participants may enter as individuals, pairs, or small groups. If a school competition has been held, winners may enter to represent a school or organization. Teachers or group leaders who wish to use the contest as a class activity may request a classroom visit and/or mentorship from a Structural Engineer. Email Scott Hamel at sehamel@alaska.edu

Specifications

1. Materials:

   a. You may use any commercially available Basswood that does **not exceed** 3.5mm (1/8 inch) in any orthogonal cross-sectional dimension. There is no limit on the length of the pieces. **Note:** only 3/32x3/32 members are allowed for the International Bridge Building Contest, if you want to compete beyond Anchorage

   b. Glue is to be any commercially available wood glue or super glue. Hardened glue by itself may not be used as a structural member. Non-wood fasteners, such as screws, may not be used.

   c. The bridge may not be stained, painted or completely coated in any fashion. Decorative designs may be applied to the members provided they do not prevent judges from identifying the wood.

2. Construction:

   a. **Mass**: Bridges should be at or below 25 grams. Bridges more than 25 grams will be penalized by multiplying the max applied load by a reduction factor equal to: [(25 grams / actual mass)^2].

   b. **Length:** The Bridge (Figure 1) must span (S) a 305 mm (12.0 inches) canyon opening. The bridge must sit on at least 25mm (1.0 inch) at each end, which means the overall length (L) must be at least 355mm (14.0 inches.) The overall length (L) of the bridge cannot exceed 406 mm (16.0 inches). Bridges that are too short will not be tested.

   c. **Width:** The bridge must be no wider (W) than 70mm (2.75 inches). The width is measured at the loading surface. There is no minimum width. Bridges which do not meet these criteria will be penalized.

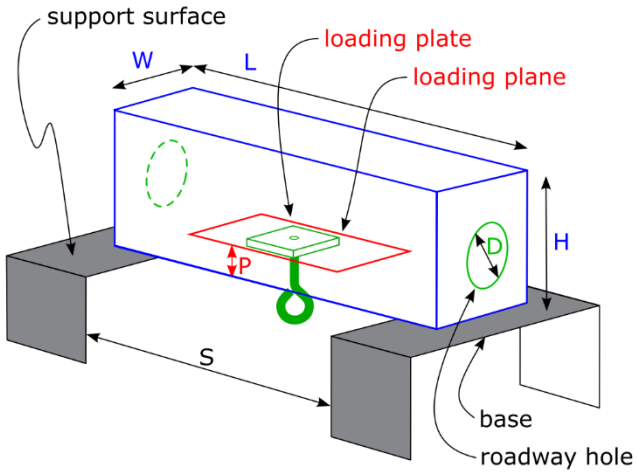

Figure 1. Bridge schematic (not to scale)

d. **Height:** The height of the bridge above the support surface (H) may be no more than 127 mm (5.0 inches). There is no minimum height. The bridge may not extend below the support surface.

e. **Load Point:** The bridge must provide a horizontal loading plane (P) that is between 3.5 mm (1/8 inch) and 25 mm (1.0 inches) above the support surface. The support must accommodate one loading location at the center of the bridge. Any portion of the structure above the loading plane must provide clearance for the "loading plate" and for the rod below the plate (Figure 2).

f. **Roadway:** The bridge must allow a pipe with a diameter (D) that is equal to 48 mm (1.9 inch), (1½" Schedule 40 PVC) to be passed horizontally through the bridge with the pipe's lower surface on the loading plane.

g. **Support:** The bridge shall be supported by the bearing (sitting) on the horizontal support surfaces at each end. The vertical face of the canyon may not be used to provide support for the bridge, nor may supports sit in the water on the surface below the span (bottom of the canyon). Bridges that touch the sidewalls or bottom of the canyon will be disqualified.

In summary:

Maximum Mass: 25 grams

Minimum Length (L): 355mm (14.0 inches)

Maximum Length (L): 406mm (16.0 inches)

Maximum Width (W): 70mm (2.75 inches)

Maximum Height (H): 127mm (5.0 inches)

Roadway Diameter (D): 48mm (1.90 inches)

3. Loading:

a. **Loading Plate:** Load will be applied by means of a 40 mm (1.60 in.) square plate (Figure 2). The plate has a thickness (t) between 6 mm and 8 mm (approximately 1/4 inch). The loading plate will be placed from above on a 3/8" threaded rod with two sides parallel to the longitudinal axis of the bridge. Force will be applied to the rod.

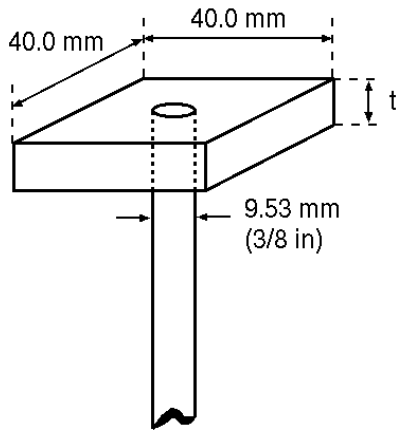

Figure 2. Loading Plate Detail

b. **End of Loading**: The largest supported load throughout the testing will be taken as the maximum applied load. Loading is stopped if the bridge breaks (i.e., an obvious peak is reached in the applied load measurement), or the bridge touches the sides of the load support or bottom of the load frame.

Tips and Suggestions

Triangles! The most efficient bridge designs use trusses, which have "holes" that are triangular. Common trusses are the Warren Truss, the Pratt Truss, and the Howe Truss.

To help you meet the weight limit, the approximate weights of some pieces are shown. Balsa wood is not used because it has a huge variation of density and strength.

Approximate Weight (g) per piece

Size (inches)	Basswood
3/32x3/32x24	**1.6**
1/8x1/8x24	3.0

High quality wood glue, such as Titebond II provides a strong and durable joint, but takes up to 24 hours to cure. A fairly new product: *Titebond Quick & Thick* provides similar strength but dries much faster (though full cure is still 24 hours). Fast-dry (3 second) superglues do NOT form strong bonds, because they only bond to the surface. Slower (30 seconds) superglues can be as strong as wood glue. Polyurethane glue, such as Gorilla Glue, likely has similar strengths (though we have not tested it) and expands to fill cracks, however it requires moisture to cure, so surfaces should be wetted.