

# Anchorage Engineers' Week Student Competitions

## 2021 Bridge Strength Competition

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### Introduction

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/2020/international\\_rules](http://bridgecontest.phys.iit.edu/public/international/2020/international_rules)

### Objective

Design and build a bridge which will support the greatest weight (maximum applied load) while meeting all the required specifications.

### Specifications

#### 1. Materials:

- You may use any commercially available Balsa wood or Basswood that does not exceed 5mm x 5mm (3/16"x3/16") in any cross-sectional dimension. There is no limit on the length of the pieces.
- 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 or members may not be used.
- 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:

- 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:  $[(25 \text{ grams} / \text{actual mass})^2]$ .  
Maximum Mass: 25 grams
- Length:** The Bridge (Figure 1) must span (S), a 300 mm (11.8 inch) canyon opening. The bridge must sit on at least 25mm (1.0 in.) at each end, which means the overall length (L) must be at least 350mm (13.8 in.). The overall length (L) of the bridge cannot exceed 400mm (15.8 in.). Bridges that are too short will not be tested.

Minimum Length: 350mm (13.8 in.)

Maximum Length: 400mm (15.8 in.)

- Width:** The bridge must be no wider (W) than 80mm (3.1 in.). The width is measured at the loading surface. There is no minimum width. Bridges which do not meet these criteria will be penalized.

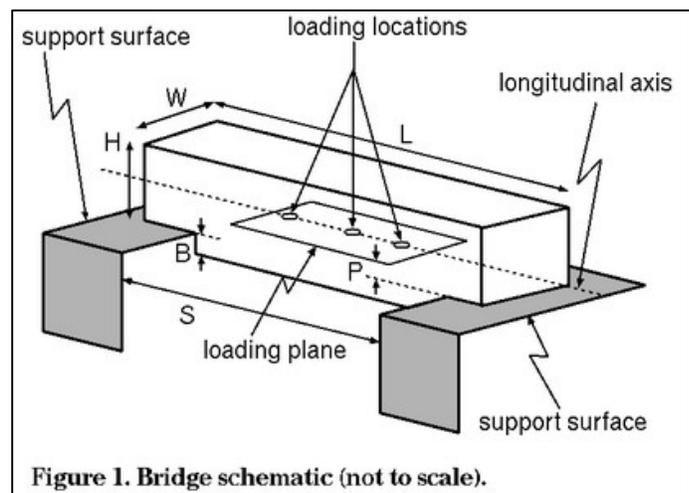
Maximum Width: 80mm (3.1 in.)

- Height:** The bridge may extend no more than 80mm (3.1 in.) above the support surface (H), and not more than 20mm (0.80 in.) below the support surface (B). There is no minimum height.

Maximum Height (H): 80mm (3.1 in.)

Maximum Height (B): 20mm (0.80 in.)

- Load Points:** The bridge must provide a horizontal support for the load at three (3) loading locations. These locations will be at the center and 40mm (1.60 in) to the right



and left of center. Any portion of the structure above the loading plane must provide clearance for the loading plate and for the cylindrical rod below the plate (Figure 2). The loading plane (P) must be between 0 and 20mm (0.80 in) above the support surface.

- f. **Roadway:** The bridge must allow a 48mm diameter (1.9 in.) pipe to be passed horizontally through or across the bridge with the pipe's lower surface on the loading plane (P). This pipe must touch all three loading locations simultaneously. This means that the roadway cannot be arched.
- 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.

### 3. Loading:

- a. **Position:** On the day of the competition, the judges will decide which one of the three loading locations will be used; it will be the same for all bridges.
- b. **Loading Plate:** Load will be applied by means of a 40mm (1.60 in.) square plate (Figure 2). The plate has a thickness (t) between 6mm and 13mm. A 10mm (3/8 inch) diameter eyebolt is attached from below to the center of the plate. Force will be applied to the eyebolt.
- c. **Termination of Loading:** The largest supported load throughout the testing will be taken as the maximum applied load. Loading is terminated 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 (bottom of canyon).

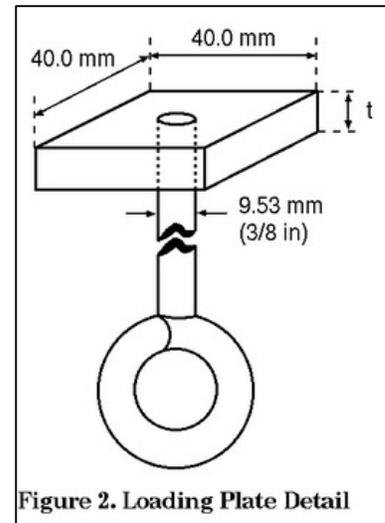


Figure 2. Loading Plate Detail

## Tips and Suggestions

To help keep your bridge under the weight limit, the approximate weights of typical pieces are below. Note that the density of balsa wood has a huge variation and the pieces you use can have a large effect on both the strength and weight of your bridge. It is highly recommended that you use Basswood.

High quality wood glue, such as Titebond III provides a strong and durable joint, but takes up to 24 hours to cure. Fast-dry (3-second) superglues do NOT form strong bonds, but slower (30-second) superglues can be as strong as wood glue. Polyurethane glue, such as Gorilla Glue, has similar strengths and expands to fill cracks, however it requires moisture to cure, so surfaces should be wetted.

Type	Size (inches)	Approximate Weight (g)
Basswood	1/16 x 1/16 x 24	0.7
Basswood	3/32 x 3/32 x 24	1.6
Basswood	1/8 x 1/8 x 24	3.0
Basswood	3/16 x 3/16 x 24	6.6
Balsa	1/16 x 1/16 x 36	0.1 – 0.4
Balsa	3/32 x 3/32 x 36	0.3 – 1.0
Balsa	1/8 x 1/8 x 36	0.6 – 1.8
Balsa	3/16 x 3/16 x 36	1.3 – 4.0