



## **2021 Model Bridge Rules and Specifications**

The 2021 International Bridge Building Contest has been cancelled, but Brookhaven National Laboratory will still be holding a local competition this year. These rules and specifications have been developed by the 2021 BNL Bridge Building Contest committee. If you have a question that is not answered by this document, email us at [bridgecontest@bnl.gov](mailto:bridgecontest@bnl.gov) or call (631) 344-5461 between 9:00am and 3:00pm EST.

This is a contest for individual high school students, not teams. Your teacher will register your school and your bridge will be submitted to that teacher, who will deliver the bridge to Brookhaven Lab on a specified date (TBD).

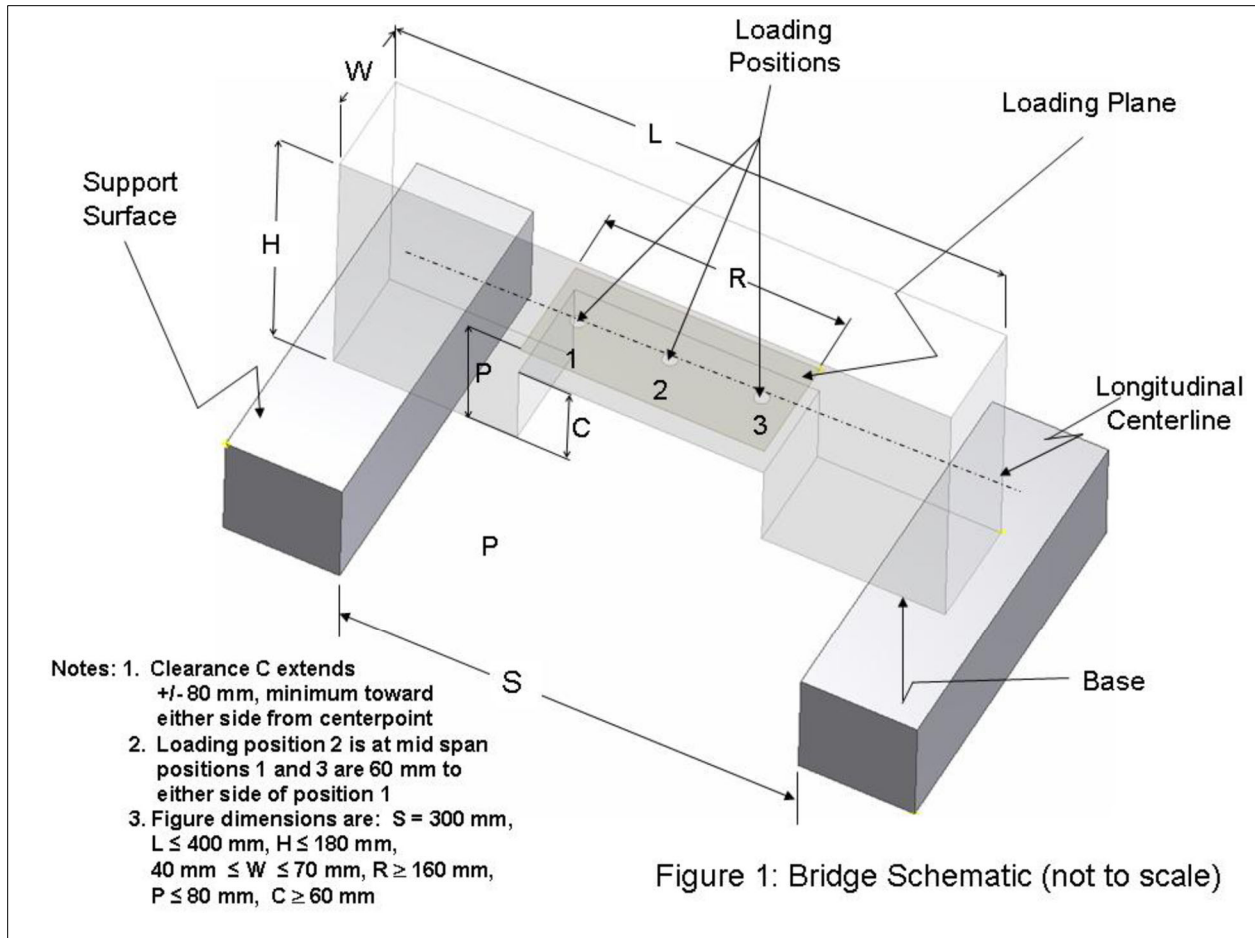
The object of this contest is to design, construct, and test the most efficient bridge built in accordance with the specifications. Model bridges are intended to be simplified versions of real-world bridges, which are designed to accept a load in any position and permit the load to travel across the entire bridge. In order to simplify the model bridge design process, the number of loading positions is reduced, and to allow the contest to proceed in a reasonable amount of time, only one loading position is tested. These simplifications do not negate the requirement that the bridge must be designed to accept a load at any of the specified positions. Bridges determined by the judges to not meet this requirement will be disqualified and test, if possible, as exhibition bridges.

### **1. Materials**

- a. The bridge must be constructed only from 3/32 square cross-section basswood and any commonly available adhesive.
- b. The basswood may be notched, cut, sanded, or laminated in any matter but must still be identifiable as basswood.
- c. No other materials may be used. The bridge may not be stained, painted, or coated in any fashion with any foreign substance.

### **2. Construction**

- a. The bridge mass shall be no greater than 30.00 grams.
- b. The bridge (see Figure 1) must span a gap (**G**) of 300 mm, be no longer (**L**) than 400 mm, be no taller (**H**) than 180 mm above the support surfaces, and have a width (**W**) between 40 mm and 70 mm. It must have a horizontal loading plane that is a maximum height (**P**) of 80. mm above the support surfaces. The bridge structure may not project below the support surfaces.

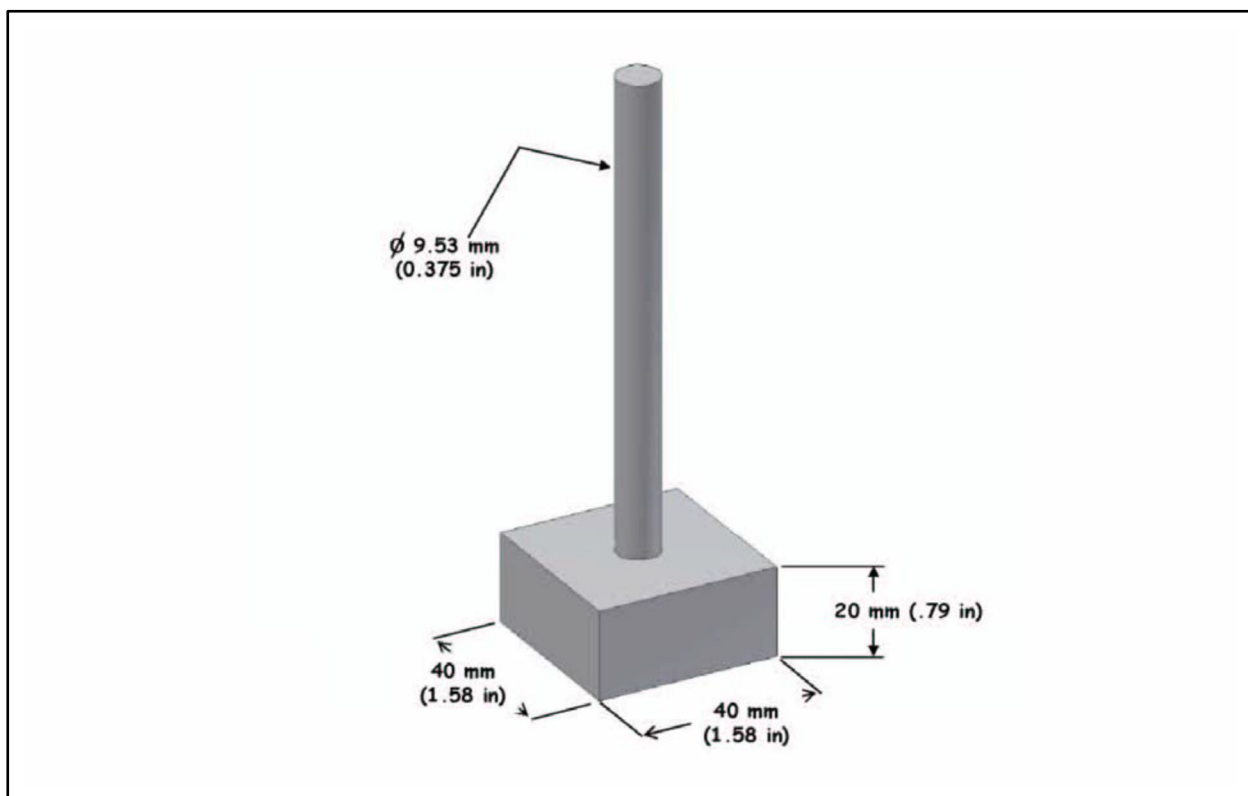


- c. The bridge must be constructed to provide a level, horizontal support for the load at each of the three possible loading locations (see 3d). Any portion of the structure above the loading plane must provide clearance for the loading plate (see 3b).
- d. The bridge structure shall be symmetrical about its longitudinal and transverse centerlines.
- e. The bridge must be constructed to provide a horizontal support surface for the loading plate and rod at each of the three possible loading positions. These three positions, at the mid-span of the bridge and 60 mm to either side of the center, will be clearly and consecutively labeled "1, 2, 3" from either end of the bridge by the participant before submission to the judges (see 3d). The horizontal loading plane must be a minimum length (**R**) of 160. mm and centered on the mid-span of the bridge. The bridge structure must allow the loading rod (see 3b) to be mounted from above or below and allow the loading plate to be placed on the loading plane.
- f. The bridge must have a minimum clearance (**C**) of 60. mm in height above the support surfaces. This clearance also extends 80 mm toward either end of the bridge from the center point of the bridge. It coincides with the horizontal loading plane and lies directly

beneath it. No part of the bridge structure may be built around this clearance area, and a 60 mm high, by 160 mm wide block must pass cleanly under the bridge.

### 3. Loading

- a. 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. Competition loading will stop at 50. kg, loading will continue until bridge failure (see 4d).
- b. The load will be applied downward from above by means of a 40. mm (+/- 1 mm) square plate with a thickness of 6.35 mm (1/4 inch). The plate will have a 9.53 mm (3/8 inch) diameter rod threaded into its center (see Figure 2) loaded from the top using an INSTRON testing machine.



**Figure 2: Loading Plate (not to scale)**

- c. The plate will be horizontal; it will not pivot on the loading rod, and during testing the sides of the plate will be placed parallel to and centered laterally on the longitudinal axis of the bridge. During the contest the loading plate will remain attached to the rod.
- d. The load will be applied with the center of the plate at one of three (3) possible loading locations on the longitudinal axis of the bridge. The center loading position (numbered "2") will be located at the center point of the bridge. The other two loading positions (numbered "1" and "3") will be located 60. mm toward either end of the bridge from the center.

#### 4. Testing

- a. On the day of the contest, judges will center the bridges on the loading surfaces.
- b. The loading plate will be lowered from above on the bridge at the selected loading location with two edges of the plate parallel to the longitudinal axis of the bridge.
- c. The load will be applied from above, as described in section 3, above. Competition loading will stop at 50 kg (~110 lbs). However, loading will continue until bridge failure occurs.
- d. Bridge failure is defined as the inability of the structure to carry additional load or a bridge deflection of 25 mm under the loading location, whichever occurs first. If a bridge has leg(s) which fail, the bridge will have failed regardless of deflection.
- e. The bridge with the highest structural efficiency,  $E$ , will be declared the winner. Bridges failing above 50 kg will be considered to have held 50 kg for efficiency calculation.

$$E = \text{Load supported in grams (50,000 g maximum)} / \text{Mass of bridge in grams}$$

The three bridges with the highest structural efficiencies will be awarded prizes.

#### 5. Qualification

- a. All construction and material requirements will be checked prior to testing by the judges. Bridges that fail to meet these specifications will be disqualified. Bridges disqualified prior to the start of the contest may be tested as exhibition bridges. The results will be reported to the contestants.
- b. If, during testing, a condition becomes apparent (i.e., use of ineligible materials, inability to support the loading plate, bridge optimized for a single loading point, etc.) which is a violation of the rules or prevents testing as described above in Section 4, that bridge shall be disqualified. If the disqualified bridge can accommodate loading, it may still be tested as an exhibition bridge, as stated above.
- c. The builder's name must be legibly written on the side of the bridge toward the bottom.
- d. These rules may be revised as experience shows the need. It is your responsibility to check for rule updates. Periodically check the BNL web site:  
<https://www.bnl.gov/bridgebuilding/>
- e. All decisions of the judges are final.