

Golden Valley High School Bridge Building Competition

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 possible loading positions is reduced to three, and to allow the contest to proceed in a reasonable amount of time only one loading position is actually tested. These simplifications do not negate the requirement that the bridge must be designed to accept a load at any of the three positions. Bridges determined by the judges not to meet this requirement will be disqualified and tested as unofficial bridges. This year's bridge is a model railroad bridge that will allow an HO gauge rail car - of the size specified by the clearance envelope shown in Figure 1, cross section - to be rolled completely across the bridge.

1. Materials/Design

- The bridge must be constructed only from 1/8 inch square cross-section balsa wood and any commonly available adhesive.
- Bridges must have design approval from the teacher. The design could be on paper or using the West Point program.
- The balsa wood rails and cross ties **may not** be notched, cut, sanded or laminated in any manner except as noted. Other elements of the bridge may be notched, cut, sanded or laminated in any manner but must still be identifiable as the original official wood. The rails may not touch any part of the structure, other than the cross ties to which they must be attached. Gluing the rails to the cross ties is required and is not considered to be laminating.
- No other materials may be used. The bridge may not be stained, painted or coated in any fashion with any foreign substance.

2. Construction

- The bridge (see Figure 1) must span a gap (S) of 300 mm, be no longer (L) than 400 mm and be no taller (H) than 80 mm above the support surface. The bridge structure may project a maximum (B) of 30 mm below the support surfaces (see Figure 1).
- The bridge must be constructed to provide support for the load (see section 3b) at each of the three loading points described. Any portion of the structure below the loading points must provide clearance for the threaded rod of the eyebolt which extends below the loading plate (see Figure 2).
- The bridge will be a railroad type bridge and shall be able to accept loads in the three (3) loading positions, one at the center of the span and two others, located at 50 mm on each side of center, along the longitudinal axis of the bridge.
- The load will be applied on top of the 1/8" x 1/8" 'rails' at the loading point selected. The 'rails', separated by exactly 16 mm, must be continuous over the entire span and must be firmly attached to the 1/8" x 1/8" cross ties. The cross ties must be a minimum of 40 mm long with a maximum separation of 25 mm. The "rails" and cross ties will transmit the load from the loading plate to your structure. A 45 x 45 mm clear space for top access to the loading points must exist. No materials other than the 'rails' will be permitted within a cylinder of 10 mm radius directly below the loading points.
- The top of the rails must not be more than 15 mm above the support surface.
- The clearances as detailed in the clearance envelope shown in the cross section must be maintained for the full length of the structure.

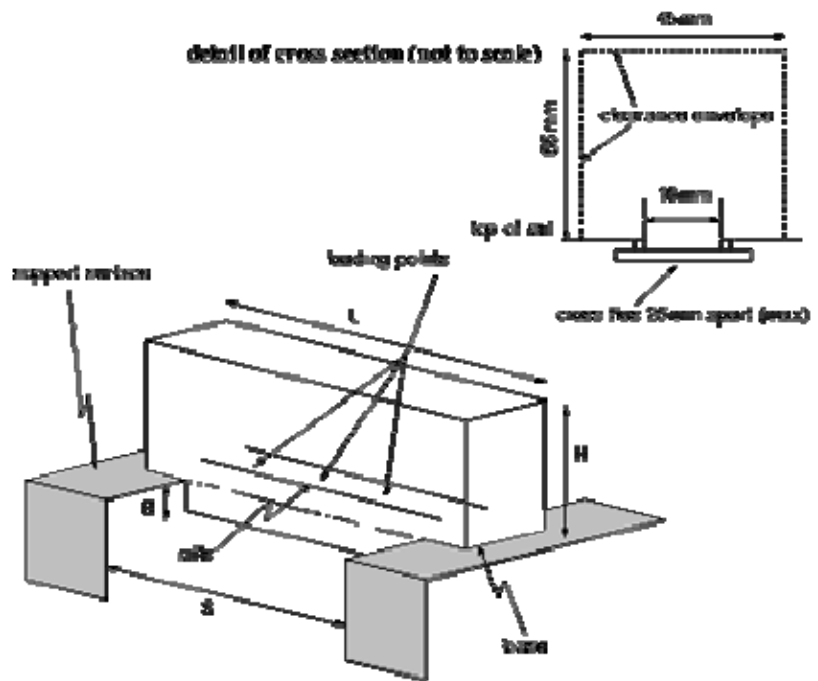


Figure 1. Bridge schematic (not to scale).

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3. Loading

- On the day of the contest, a random drawing will decide which one of the three loading points will be used. The same loading point will be used for all bridges that period. Loading will continue until bridge failure (see 4d).
- The load will be applied by means of a 40 x 60 mm plate that is at least 4 mm but less than 13 mm thick. **This plate will rest solely upon the rails.** A 9.53 mm (3/8 inch) diameter eyebolt is attached from below to the center of the plate (see Figure 2). During loading, the edges of the loading plate will be parallel to the longitudinal axis of the bridge. The load will be applied by means of a loading rod hanging from the eyebolt described above.

4. Testing

- The bridge will be placed on the support surfaces which will provide both vertical and horizontal bracing.
- The loading plate will be placed and centered at the specified loading point as determined on the day of the contest.
- The load will be applied from below, as described in section 3 above. Bridges must be able to support the testing equipment.
- Bridge failure is defined as the inability of the bridge to carry additional load, or a load 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.
- The bridge with the highest structural efficiency, E , will be declared the winner.

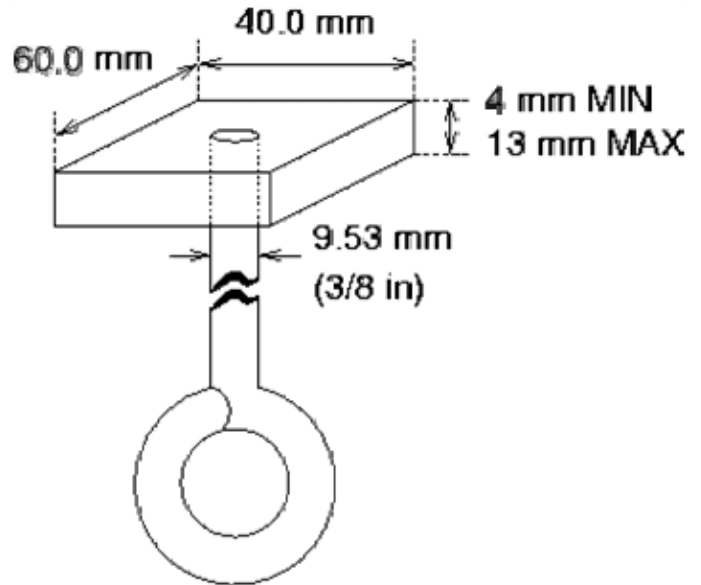


Figure 2. Loading plate detail (not to scale)

$$E = \text{Load supported in grams} / \text{Mass of bridge in grams}$$

5. Qualification/Testing

- All construction and material requirements will be checked both prior to and after testing. Bridges failing to meet these requirements, at the conclusion of the time allowed for checking, will be disqualified. Bridges disqualified prior to the start of the contest will be tested as unofficial bridges at the discretion of the teacher.
- If, during testing of a bridge, an illegal condition becomes apparent (i.e. use of ineligible materials, etc.) that bridge will be disqualified.
- Decisions of the teacher are final; these rules may be revised as experience shows the need.
- Only teams of two or three are allowed. Teams may be of students from any of the Physics or AP Physics classes. *Team members must be the same grade (junior or senior), unless it is impossible for the senior(s) to fail if they receive a zero on the project.*
- The testing date is the first final exam day of the team members. *Senior only groups must be ready to be tested the Wednesday before Final Exams, unless it is impossible for all members to fail if they receive a zero on the project.*
- The bridge competition is the **Final Exam**. The grade counts as **2 Chapter Tests**.