

2019 Rules and Format of the Balsawood Bridge Competition

Hosted by the
Kansas State University Student Chapter
of the
American Society of Civil Engineers

April 6, 2019

I. Awards

A. Individual Categories

- 1) First-, second-, and third-place structural engineering awards will be given to teams having the highest sustained applied load to bridge weight ratio.
- 2) First-, second-, and third-place craftsmanship awards will be given to teams having the highest ratings in craftsmanship. Factors that will be considered include general appearance, joint construction, conformance with specifications, and elegance of design.

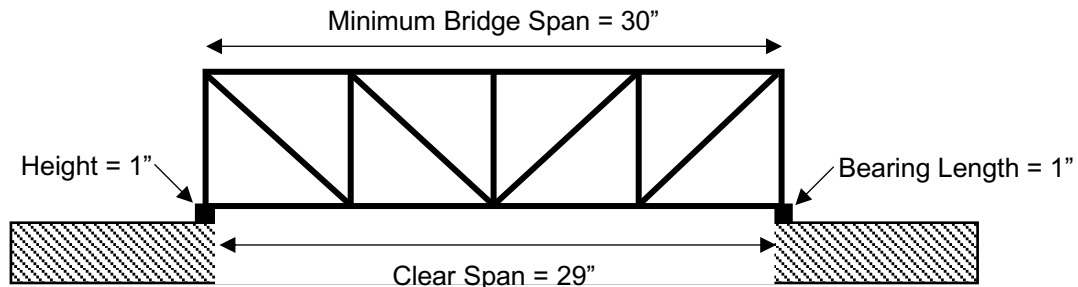
B. Overall Performance

First-, second-, and third-place overall performance plaques will be given to the teams with the highest overall performance ratings. Performance rating will be calculated using the following equation: **Overall Score = 1.5 x Structural Score + 1.0 x Craftsmanship Score**

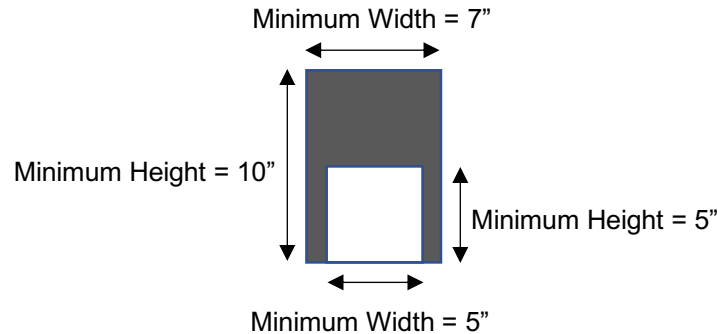
II. Bridge Specifications

A. Overall Bridge Geometry:

- 1) The clear span between the bridge supports will be exactly 29 inches and the center-to-center distance between bearing supports will be 30 inches. Each bearing support will be 1" in length to accommodate some movement and some tolerance. The model bridge must be at least 30 inches in length and rest on the two bearing supports. The bridge must not be longer than 36 inches in length. Regardless of the length of the bridge, the positions of the bearing supports are not adjusted. The bridge must be simply supported - the bridge must rest on the provided supports without any physical attachment to these bearing supports. (See figure given below.)



- 2) The bridge must be at least 5 inches in width, but not more than 7 inches in width. Width is considered to be the distance between the outermost edges of the bridge. The bridge must be at least 5 inches in height, but no more than 10 inches in height. Height is the vertical distance from the lowest point to the highest point on the bridge. (See figure given below.)



B. Weight:

The overall weight of the bridge must not exceed 2.5 oz (mass of no more than 70.9 g).

C. Materials:

- 1) Wood: The bridge members will be composed of balsawood, with no member having cross sectional dimensions greater than $\frac{1}{4}$ " by $\frac{1}{4}$ ", and length greater than 24 inches in length. Exceptions are made at the joints (See below for details). A member is defined as a single piece of balsawood.
- 2) Aliphatic Resin Glue: Elmer's Carpenter's Wood Glue (#E7010), Titebond Original Wood Glue (#5063), and Weldwood Carpenter's Wood Glue (#491) are acceptable glues.
- 3) No other materials (e.g., plastic, tape, string, wire, paint, varnish, etc.) may be used as a member or applied to a balsawood member to strengthen the member or bridge.

D. Laminating:

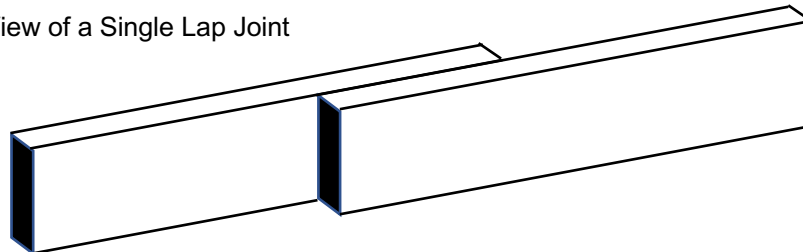
Layering (laminating) members on top of one another to create a larger section is not allowed.

E. Joints:

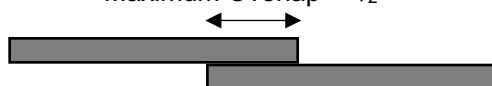
The following are acceptable for the construction of joints to connect member together:

- 1) Overlapping of members as long as overlap does not exceed $\frac{1}{2}$ ". (See figures given below.)

Isometric View of a Single Lap Joint

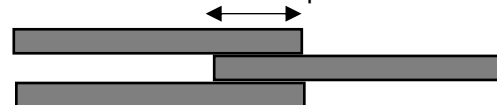


Maximum Overlap = $\frac{1}{2}$ "



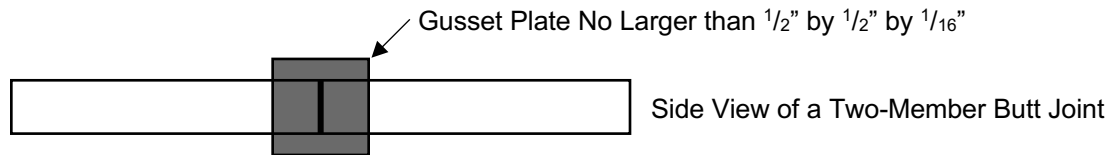
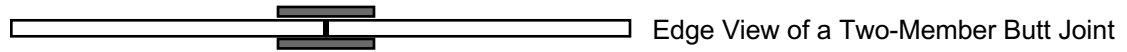
Edge View of a Single Lap Joint

Maximum Overlap = $\frac{1}{2}$ "

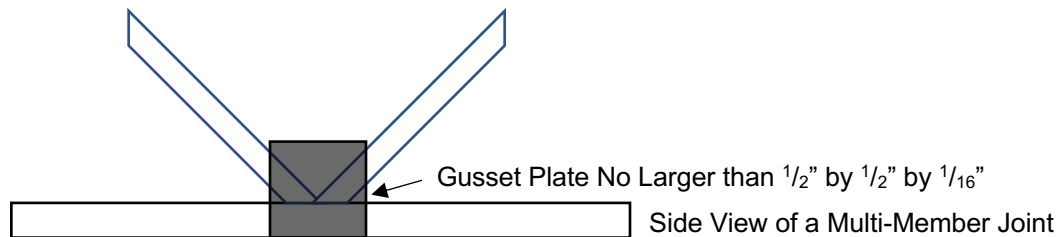
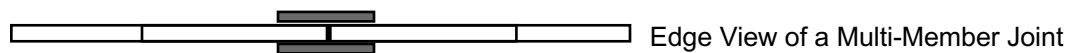


Edge View of a Double Lap Joint

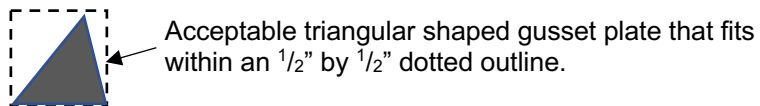
- 2) Use of balsawood gusset plates are allowed as long as each gusset plate does not exceed the dimensions of $\frac{1}{2}$ " x $\frac{1}{2}$ " x $\frac{1}{16}$ " in thickness. Gusset plates need not be rectangular in shape. (See figures given below.)



Butt Joint of Two Members Sandwiched
Between Two Gusset Plates



Joint of Two Diagonals to a Main Member
Sandwiched Between Two Gusset Plates



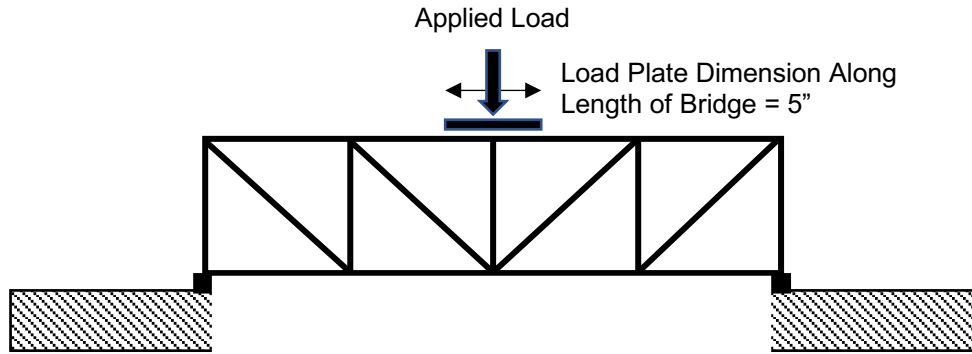
III. Bridge Testing

A. Definition of Failure

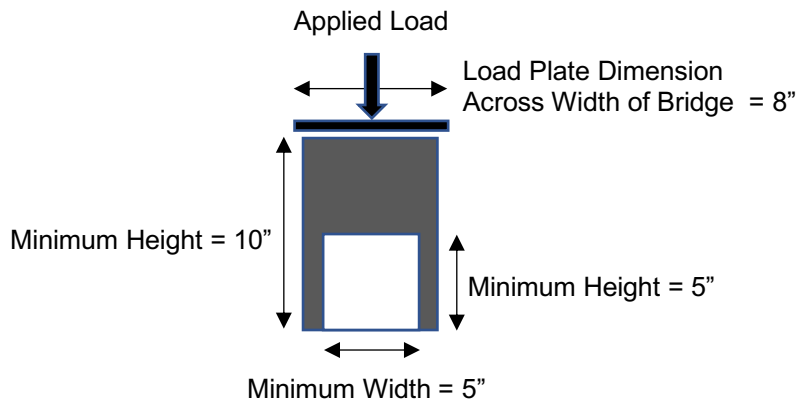
Failure of the bridge will be defined as the point at which the bridge can no longer support additional load. The failure of an individual member does not constitute failure of the bridge as long as the bridge can continue to take additional load. No repairs can be made to the bridge once load has been applied.

B. Method of Loading

The load will be applied through a steel 5" by 8" plate resting on top of the bridge at centerspan. (See figures given below.) If top of bridge at centerspan is not flat, spacers below the load plate will be used to stabilize and level the load plate.



Elevation View of Bridge Showing Load Plate
Sitting on Top of Bridge



End View of Bridge Showing Load Plate
Resting on Top of Bridge

IV. Eligibility and Rules

- A. Each team can be composed of no more than three students and at least one student must attend the competition. Students can either be attending a public or private middle or high school or be home schooled.
- B. All teams must be registered by March 15, 2019.
- C. Each bridge must be ready to be weighed in by 9:00 a.m. on Saturday, April 6, 2019.

- D. Bridges will be loaded in random order beginning shortly after 11:00 a.m.
- E. Craftsmanship will be judged by students and faculty of the Civil Engineering Department. The judges will have final say on any conflicts which may arise during competition.
- F. Presentation of awards will take place shortly after the loading of the last bridge and scoring is completed.
- G. Bridges that do not conform to all specifications will be disqualified. An attempt will be made to test all bridges, even if disqualified from receiving an award.
- H. Specifications include construction material, glue, maximum weight, overall geometry, construction (i.e., no laminations and proper joint design), and loading requirements.

V. Hints

- A. Joints are critical parts of any bridge design. Poor joint construction can greatly reduce the load carrying capacity of your bridge.
- B. For a truss design some members will be in tension (pulled), and some will be in compression (squeezed). Decide which members are going to be in tension, and which are going to be in compression. Design these members accordingly.
- C. Don't be afraid to ask someone knowledgeable in bridge design for some tips. Be sure however, that the design and construction is completely by students.
- D. This is a team project, so be sure to get input from all members of the design team.
- E. Reinforce the deck beams at the loading points so as to prevent premature local failure of the bridge.
- F. Do not build your bridges much longer than 30 inches because the bridges will be sitting on simple supports and not on tables. If your bridge is too long the joints will not be resting over the supports and the bridge will probably break rather quickly.
- G. Most I-beams or truss failures result from twisting of the member or the truss, so provide adequate bracing to prevent twisting of members.

VI. Warning

Please read these rules carefully and follow the required specifications so the bridge is in compliance with these rules. Registering as soon as possible is recommended to allow for clarification of rules and any changes in competition. If you are uncertain of the provided rules or have general questions, please contact Scott D. Schiff, Faculty Advisor to the KSU Student Chapter of ASCE using the email address scottdschiff@ksu.edu.

Good luck on the construction of your bridges and we look forward to seeing you at the competition in April during the Engineering Open House!