



1. **DESCRIPTION:** Teams will design and build a Bridge (Structure) meeting requirements specified in these rules to achieve the highest structural efficiency.

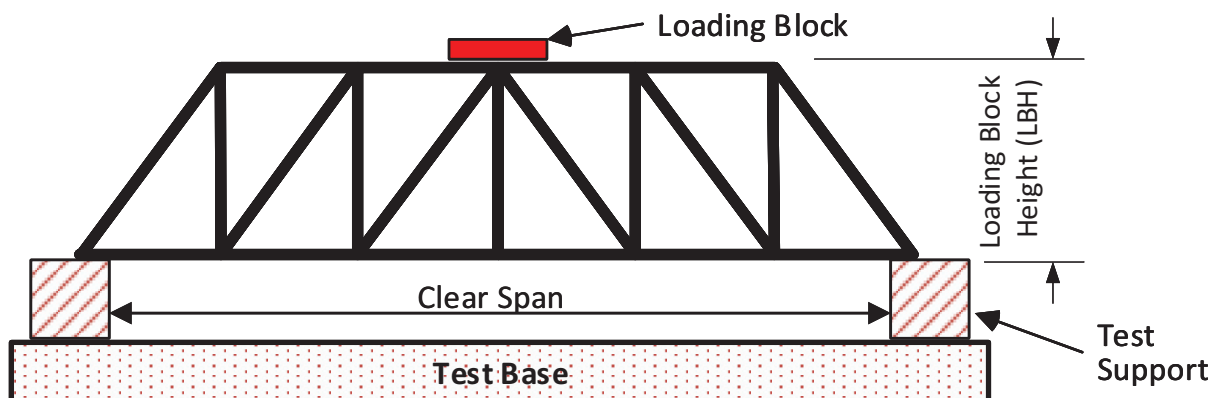
A TEAM OF UP TO: 2 **IMPOUND:** No **EYE PROTECTION:** B **EVENT TIME:** 6 minutes

2. **EVENT PARAMETERS:**

- a. Each team is allowed to enter only one Structure, built prior to the competition.
- b. All participants must properly wear eye protection at all times. Participants not wearing proper eye protection will not be allowed to compete and be placed in Tier 3.
- c. Participants may NOT bring any equipment such as levels or squares.
- d. The Event Supervisor will provide the Test Apparatus (see Section 6) and tools/materials for measurement.

3. **CONSTRUCTION PARAMETERS:**

- a. The Bridge must be a single structure with no separate, loose, sliding, or detachable pieces, constructed of wood, and bonded by adhesive. No other materials are permitted.
 - i. Wood is defined as the hard, fibrous substance making up the greater part of the stems, branches, trunks, and roots of trees beneath the bark. Wood does NOT include bark, particleboard, wood composites, bamboo or grasses, paper, commercially laminated wood (i.e., plywood), or members formed of sawdust, wood shavings, and adhesive. Wood may never be painted, soaked, or coated in glue, color enhanced, or have tape/preprinted/paper labels affixed. Ink barcodes or markings from the construction process may be left on the wood.
 - ii. There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated by the team without restriction.
 - iii. Adhesive is a substance used to join two or more materials together and may be used only for this purpose. Any commercially available adhesive may be used (e.g., glue, cement, cyanoacrylate, epoxy, hot melt, polyurethane, and super glues). Adhesive tapes are not allowed.
- b. The Bridge must be designed to sit on top of the Test Supports and support the Loading Block of the Loading Assembly (6.d.) at the center of the spanned opening.
- c. **Division B Dimensions:**
 - i. The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 10 cm above the Test Supports.
 - ii. A 7 cm high by 4 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Loading Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.
 - iii. The Clear Span will be 35 cm.
- d. **Division C Dimensions:**
 - i. The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 15 cm above the Test Supports.
 - ii. A 12 cm high by 7 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Load Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.
 - iii. The Clear Span will be 45 cm.
- e. Before loading, no portion of the Bridge may be below the plane defined by the top of the Test Supports.
- f. Participants must be able to answer questions regarding the design, construction, and operation of the structure per the Building Policy found on www.soinc.org.





4. DESIGN LOG:

- a. Teams must submit a Design Log with documentation of bridges tested prior to competition. Each bridge documented must include at least:
 - i. Materials used
 - ii. Sketch of the design
 - iii. Weight and other dimensions of the bridge
 - iv. Appropriate metric units for all numerical values
 - v. Predictions: Load held & weak points
 - vi. Test results: Load held & breaking point(s)
 - vii. Observations & recommended design improvements
 - viii. A front cover labelled with the Team Name and the Team Number for the current tournament
- b. If a laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.
 - i. Information about the tool hardware, software, materials, and supplies used
 - ii. Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet
 - iii. Descriptions of how the team constructed the final device from the tool created components
- c. All submitted logs will be returned to teams.

5. THE COMPETITION:

Part I: Check-In

- a. The team must present their Structure for inspection & measurement.
- b. The team must place their Structure on the Structure Scale (6.g.) so the Event Supervisor can determine the mass, in grams to the nearest 0.01 g or best precision available.
- c. The team must submit their estimated Load Supported (5.Part II.g.) to be used as a tiebreaker.
- d. No alterations, substitutions, or repairs may be made to the Structure after the check-in process has started.
- e. Prior to Part II: Testing, the Event Supervisor will verify that the combined mass of the Loading Assembly and sand is at least 15,100 g, but no more than 15,200 g.

Part II: Testing

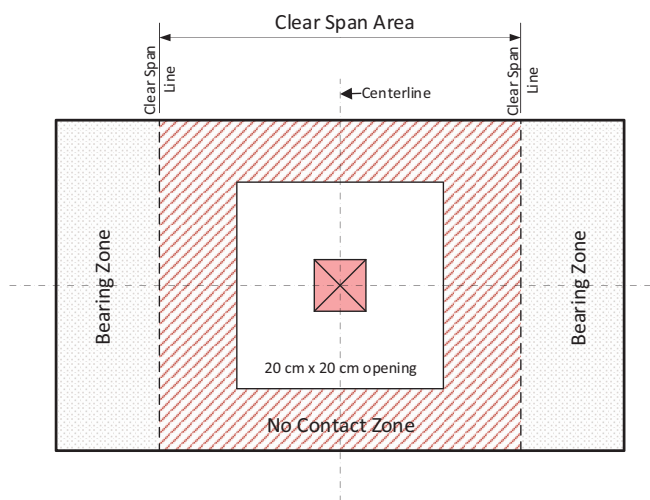
- a. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
- b. Participants will have 6 minutes to set up and test their Structure to maximum load or failure.
- c. The participants must place the Structure on the Test Supports within the Bearing Zone (6.a.iv.) of the Test Apparatus. They will then place the Loading Assembly as required to load the Structure. If necessary, participants may disassemble & reassemble the Loading Assembly. If the Loading Assembly is disassembled & reassembled it must retain the original sequence with no loose pieces and the opposing force must always be on the bottom of the Loading Block. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the structure to deflect.
- d. The participants will be allowed to adjust the Structure until they start loading sand. Once loading of sand has begun, the Structure must not be further adjusted.
- e. Prior to loading, the Event Supervisor will verify that:
 - i. The Test Supports are properly placed on the Test Base
 - ii. The Structure is placed properly on the Test Supports and the loading point must be within 2 cm of the center of the span.
 - iii. No portion of the bridge is below the top of the Test Supports for the entire length of the Bridge.
- f. Participants will load the sand into the bucket and be allowed to safely and effectively stabilize the bucket from movement caused by sand loading. Direct contact with the bucket by participants is NOT allowed. The bucket may only be stabilized by using the tips of the provided Bucket Stabilizing Sticks (6.f.). The bridge may deflect below the top of the Test Supports but may not touch the Test Base.
- g. Loading stops immediately when the Structure Failure occurs, or time expires. Structure Failure is defined as the inability of the Structure to carry any additional load, if any part of the load is supported by anything other than the Structure or the Structure touches the Test Base. Incidental contact of the chain/eyebolt with the structure is not a failure.



- h. Once loading stops, any parts of the Structure in the bucket will be removed. The Load Supported (mass of the Loading Assembly and the sand in the bucket) will be recorded to the nearest gram or best precision available. The minimum Load Supported is the mass of the Loading Assembly. The maximum Load Supported is 15,000 g.
- i. At the Event Supervisor's discretion, more than one Test Apparatus may be used. Teams may be given a choice of which apparatus they will use.
- j. The Event Supervisor will review with the team the data recorded on their scoresheet.
- k. Teams who wish to file an appeal must leave their structure with the Event Supervisor.

6. TEST APPARATUS:

- a. The Test Base shall be a solid, level surface as follows:
 - i. At least 55.0 cm long x 32.0 cm wide, stiff enough that it does not bend noticeably when loaded
 - ii. Shall have a smooth, hard surface (e.g., metal, high-pressure plastic laminate)
 - iii. Shall have an opening at its center approximately 20.0 cm x 20.0 cm
 - iv. A Centerline and parallel Clear Span Lines shall be marked across the width of the surface of the Test Base. The Centerline shall divide the Test Base in half; Clear Span Lines to each side of the center line at 17.5 cm for Division B (35 cm span), or 22.5 cm for Division C (45 cm span) to



- indicate the Bearing Zones.
- b. The Test Supports shall meet the following requirements:
 - i. Two identical, unfixed supports will be supplied
 - ii. Must be at least 1-1/2 inches by 1-1/2 inches by 6 inches but not greater than 2 inches by 2 inches by 6 inches
 - iii. Made of a material that it does not noticeably compress when loaded and have smooth, hard surfaces (e.g., hard wood, metal, high-pressure plastic laminate)
 - iv. Must be able to rest flat on the Test Base
- c. **The Pass Thru Block shall be a solid light weight material (such as wood or plastic) for passing through the bridge with a minimum 50 cm dowel securely attached to the height & width face.**
 - i. **Division B: Block size shall be 7 cm high by 4 cm wide by approximately 1 cm thick but not more than 2 cm thick**
 - ii. **Division C: Block size shall be 12 cm high by 7 cm wide by approximately 1 cm thick but not more than 2 cm thick**
- d. The Loading Assembly will consist of:
 - i. A square Loading Block measuring 5 cm x 5 cm x approximately 2 cm high with a hole no larger than 8 mm drilled in the center of the 5 cm x 5 cm faces for a 1/4" threaded eyebolt
 - ii. 1/4 inch threaded eyebolt (1-inch nominal eye outside diameter), minimum 2 1/4 inch length to a maximum 4 1/2 inch length, and a 1/4 inch wing nut. The loading block must be mounted on the eye bolt and be trapped between the "eye" of the eye bolt and the wing nut. The loading block cannot sit on top of the wing nut or be loose.
 - iii. A chain and S-hook that are suspended from the eyebolt on the Loading Block



- iv. An approximately five-gallon plastic bucket with handle and hook to be suspended from the chain
 - v. The total combined mass of the Loading Assembly may not exceed 1.5 kg
 - e. Sand: sand or other clean, dry free-flowing material.
 - f. Two (2) Bucket Stabilizing Sticks each made from a piece of ½" dowel approximately 18 inches long with a spring-type door stop screwed into one end. Refer to example on www.soinc.org.
 - g. **Structure Scale: Scale shall have minimum resolution of 0.1 grams; recommended resolution is 0.01 grams.**
 - h. **Sand Scale & Load Verification: Scale shall have minimum resolution of 10 grams; recommended resolution is 1 gram.**
7. **SCORING:**
- a. High score wins. Score = Load Score (g)/Mass of Structure (g).
 - b. The Load Score= Load Supported (5.Part II.h)+ Bonus (7.c).
 - c. Structures that have a Load Supported of 15,000 g will earn a Bonus of 5,000 g.
 - d. Structures will be placed in three tiers as follows:
 - i. Tier 1: Holding any load and meeting all construction parameters and competition requirements
 - ii. Tier 2: Holding any load with any violations of the construction parameters and/or competition requirements and/or not submitting a Design Log
 - iii. Tier 3: Unable to be loaded for any reason (e.g., cannot accommodate or hold Loading Assembly, failure to wear eye protection) and will be ranked by lowest mass
 - e. Ties are broken as follows:
 - i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
 - ii. Lowest Structure mass
 - f. Example score calculations:
 - i. Structure 1: mass= 10.12 g, Load Supported= 12,134 g; Score= 1,199
 - ii. Structure 2: mass= 12.32 g, Load Supported= 15,000 g + 5,000 g (Bonus) = 20,000 g; Score= 1,623

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org

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