

Bridges

2021-2022 Virtual Coaches Clinic MSU

(This presentation will be recorded)

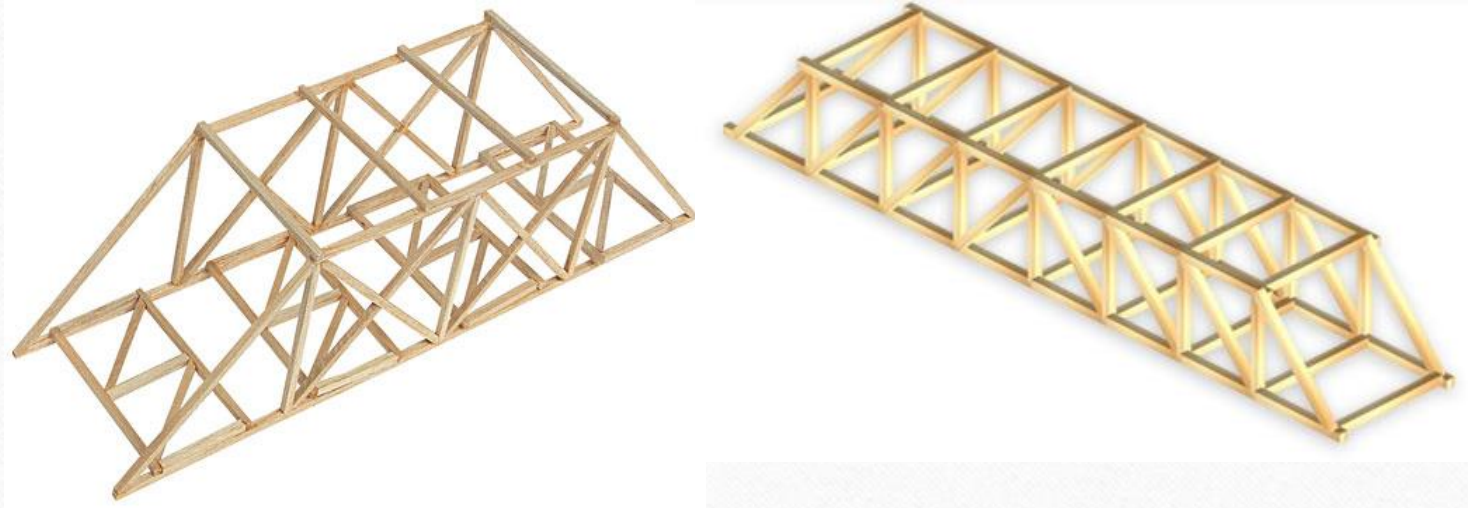
EVENT SUPERVISORS

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DISCLAIMER

- The official rules override other documentation concerning the construction and competition requirements. This document is only used for clarification and explanation and should not be used as a replacement of the rules.

Building Bridges



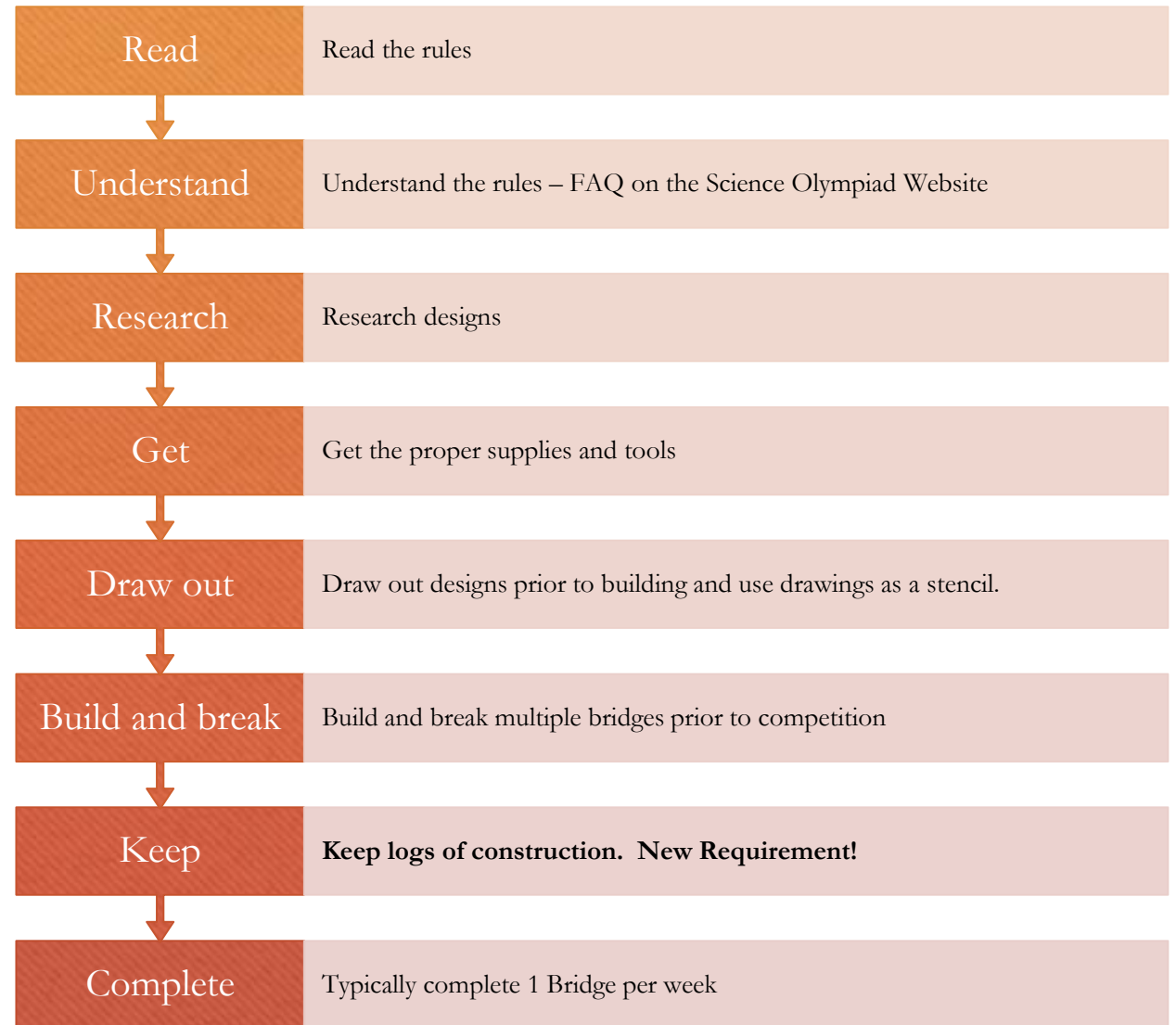
WWW.BALSAWOODHOPPERS.COM



EVENT OBJECTIVES

- Build the most efficient Bridge possible which meets the construction criteria **and holds the entire 15Kg mass.**
- Efficiency is based on weight of Bridge vs. holding capability of Bridge.
- Bonus points for holding the entire available mass.
- Science Olympiad Bridge Information
 - <https://www.soinc.org/bridge-c>
- Rules for all 2021-2022 events can be downloaded for free at the SO store.
 - <https://www.soinc.org/rules-2022>

Building Process



What's new in 2022?

(and notable notes)

- Building Cycle change – Bridges Event
- Students **MUST** submit a detailed design log on the day of the competition. (New Requirement)
- Loading Assembly may not exceed 1.5Kg
- Bonus points for holding entire load (>15Kg)
- Bridge must be designed to allow a block to pass through the center
- Rules have gotten extremely detailed in comparison to prior years (opinion)
Make sure you are extremely familiar with the rules.

Typical Building Materials

- Wood
 - Balsa is the most popular
 - Bass wood common for parts of the bridge requiring higher tensile strength
- Glue
 - CA glue is the most popular
 - Accelerators can be used but can lead to a more brittle joint.
 - Wood glue is more flexible but is also harder to control and is much heavier

CONSTRUCTION PARAMETERS

3.

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.

CONSTRUCTION PARAMETERS

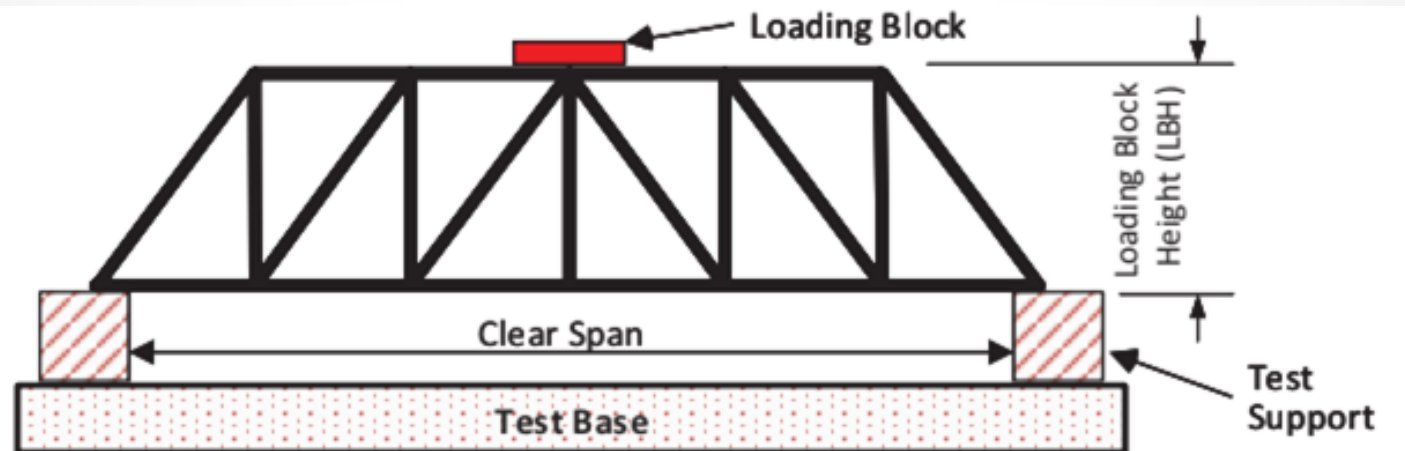
DIVISION

B

CONSTRUCTION
PARAMETERS

Division B Dimensions:

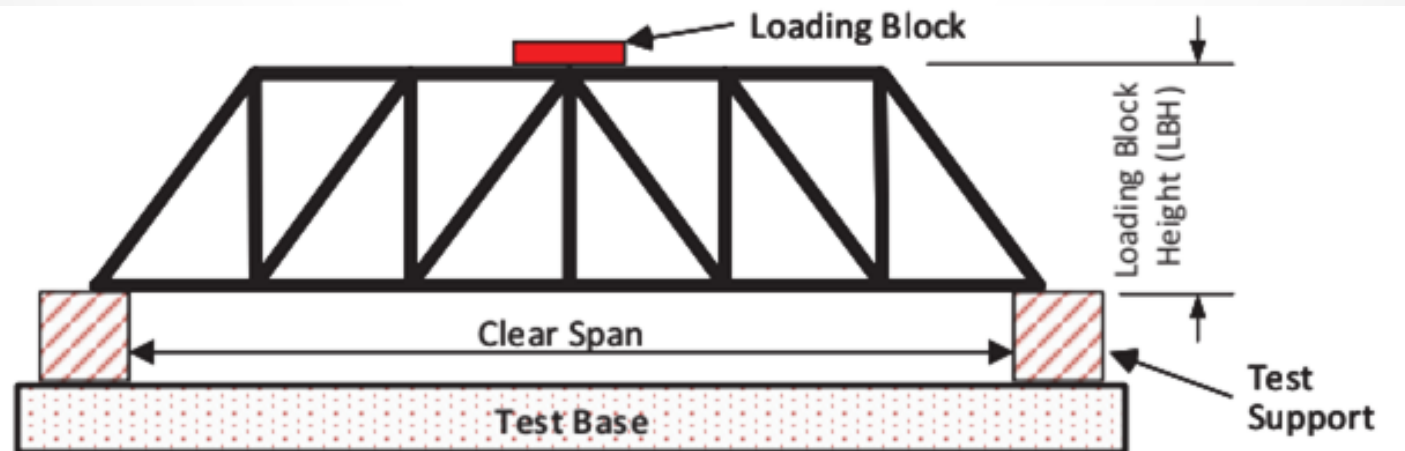
- i. The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 10 cm above the Test Supports.**
- ii. A 7 cm high by 4 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Loading Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.**
- iii. The Clear Span will be 35 cm.**



DIVISION
C
CONSTRUCTION
PARAMETERS

Division C Dimensions:

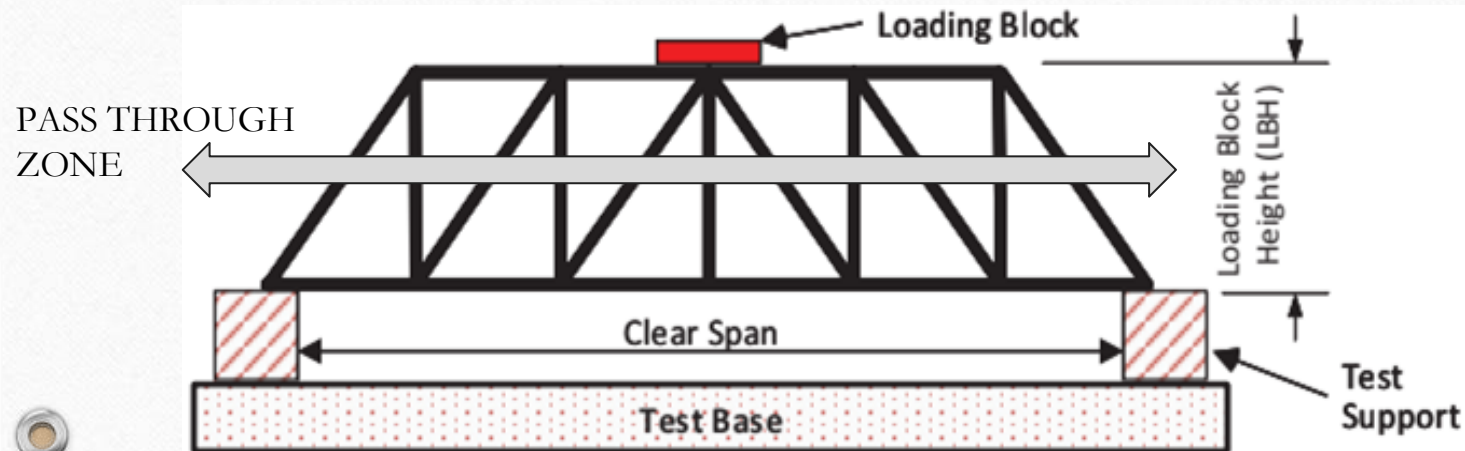
- i. The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 15 cm above the Test Supports.**
- ii. A 12 cm high by 7 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Load Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.**
- iii. The Clear Span will be 45 cm.**



PASS THROUGH BLOCK

(New Bridge Requirement)

- Division B: 7cm High x 4cm Wide
- Division C: 12cm High x 7cm Wide (Taller and Wider!)
- Both will be between 1 and 2 cm thick with a 50cm dowel



DESIGN LOG (NEW THIS YEAR)

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

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.

WHAT IS NEEDED FOR COMPETITION

- YOUR BRIDGE
 - YOUR DESIGN LOG
 - SAFETY GLASSES
-
- THAT'S IT – THE EVENT SUPERVISOR WILL SUPPLY ALL TESTING EQUIPMENT

CHECK IN

COMPETITION –
THE FUN PART

Competition Day Check-in PROCESS

- STUDENTS WILL CONSTRUCT THE BRIDGE PRIOR TO COMPETITION
- STUDENTS ARRIVE WITH THEIR BRIDGE AND DESIGN LOG AT OR BEFORE THEIR SCHEDULED TIMES (NO IMPOUND!!!)
- ADJUSTMENTS OF SCHEDULED TIME MUST BE APPROVED PRIOR TO COMPETITION
- STUDENTS (NO COACHES) WILL BRING THEIR BRIDGE AND DESIGN LOG TO THE CHECK IN TABLE.
- ONLY ONE BRIDGE MAY BE CHECKED IN. SWAPPING BRIDGES, ADJUSTMENTS OR REPAIRS AFTER THE CHECK IN PROCESS WILL BE CONSIDERED A COMPETITION VIOLATION AND PLACE THE TEAM IN TIER 3.
- THE STUDENT WILL WEIGH THE BRIDGE AND PUSH THE PASS THROUGH BLOCK THROUGH THE BRIDGE. EVENT STAFF WILL VERIFY THE BRIDGE MEETS CONSTRUCTION PARAMETERS.
- STUDENTS WILL PROVIDE THEIR ESTIMATED LOAD SUPPORTED (TIE BREAKER)
- EVENT SUPERVISORS AND VOLUNTEER STAFF WILL NOT HANDLE THE BRIDGE

TESTING

COMPETITION –
THE FUN PART

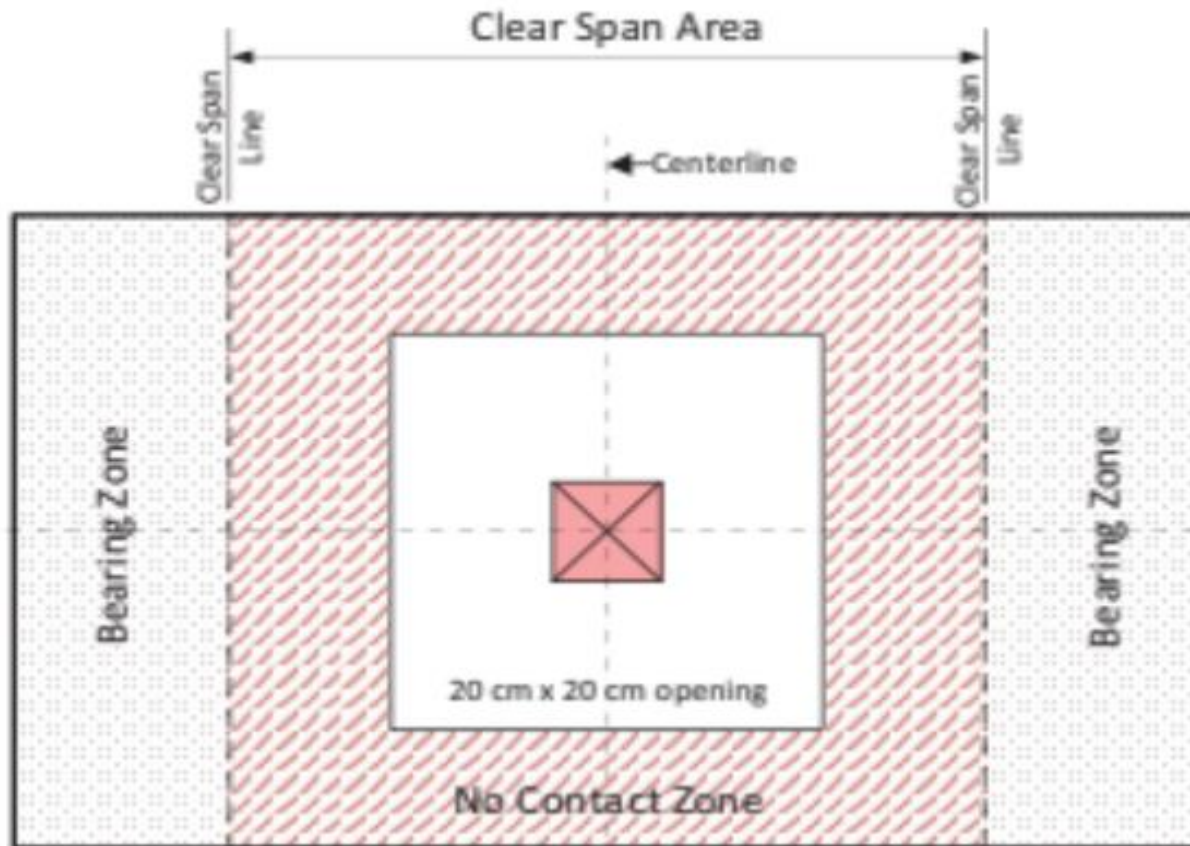
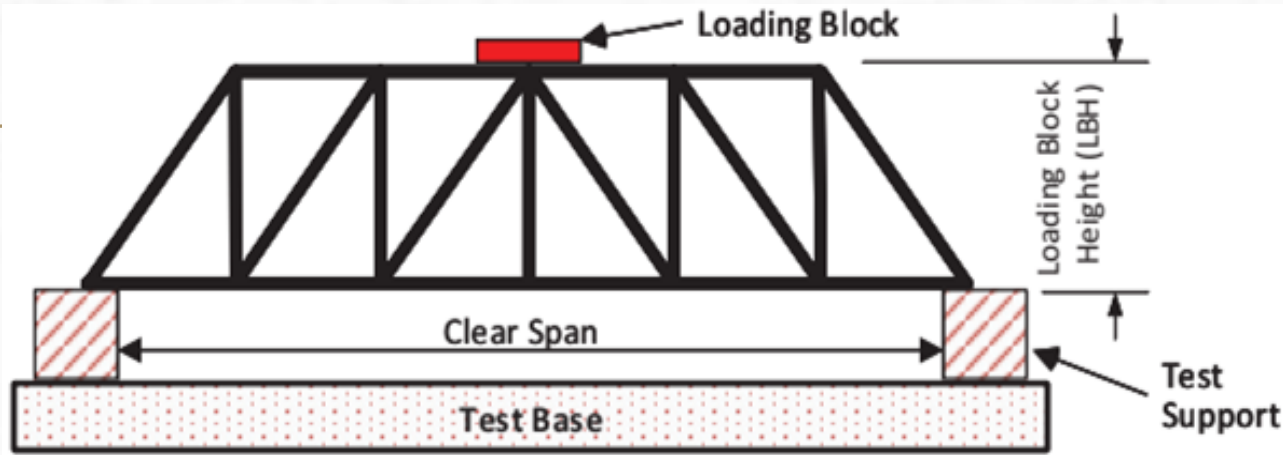
TESTING PROCESS

- No alterations, substitutions, or repairs are made to the structure after check-in.
- Once team enter the event area to compete, it does not leave or receive outside assistance, materials, or communication.
- Participants will have 6 minutes to set up and test their Structure to maximum load or failure
- 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
- Once loading of sand has begun, the Bridge is not adjusted.
- Team members do not directly contact the bucket except by using the tips of the stabilization sticks
- 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.

THE TESTING PROCESS



- STUDENTS WILL SET UP THEIR BRIDGE WITH THE SUPPLIED TESTING APPARATUS, IF AN EXPLANATION OF THE SYSTEM IS REQUIRED THE EVENT STAFF WILL GO OVER THE PROCESS.
- ONCE SETUP IS COMPLETED THE EVENT STAFF WILL INSPECT AND VERIFY THAT PARAMETERS HAVE BEEN MET AND VERIFY THAT THE BRIDGE WILL LOAD CORRECTLY.
- STUDENTS WILL LOAD THE BRIDGE UNTIL THE BRIDGE BREAKS OR THE ENTIRE LOAD IS SUPPORTED.
- THE BUCKET CANNOT BE TOUCHED DURING COMPETITION, STABILIZATION STICKS WILL BE MADE AVAILABLE.
- TOTAL TIME FOR TESTING 6 MINUTES



TESTING APPARATUS

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

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

COMMON VIOLATIONS

- Bridge Built to wrong parameters (B vs C dimensions)
- Bridge Built to EXACT (almost) parameters
 - Make sure you give yourself some freedom. Leave adequate room for the pass through block. Clearly span the clear span line. Be 2mm higher than the minimum load height.
- Incorrect materials (BAMBOO IS NOT WOOD)
- Testing block, eyebolt or chain will not fit (Falls through, only supported on 2 sides, etc)
- No Design Log (Automatic Tier 2)

CONSTRUCTION
PARAMETERS
VERIFICATION

SCORING

SCORING PROCESS

- $$SCORE = \frac{LOAD\ SUPPORTED\ (grams) + BONUS}{MASS\ OF\ THE\ DEVICE\ (grams)}$$

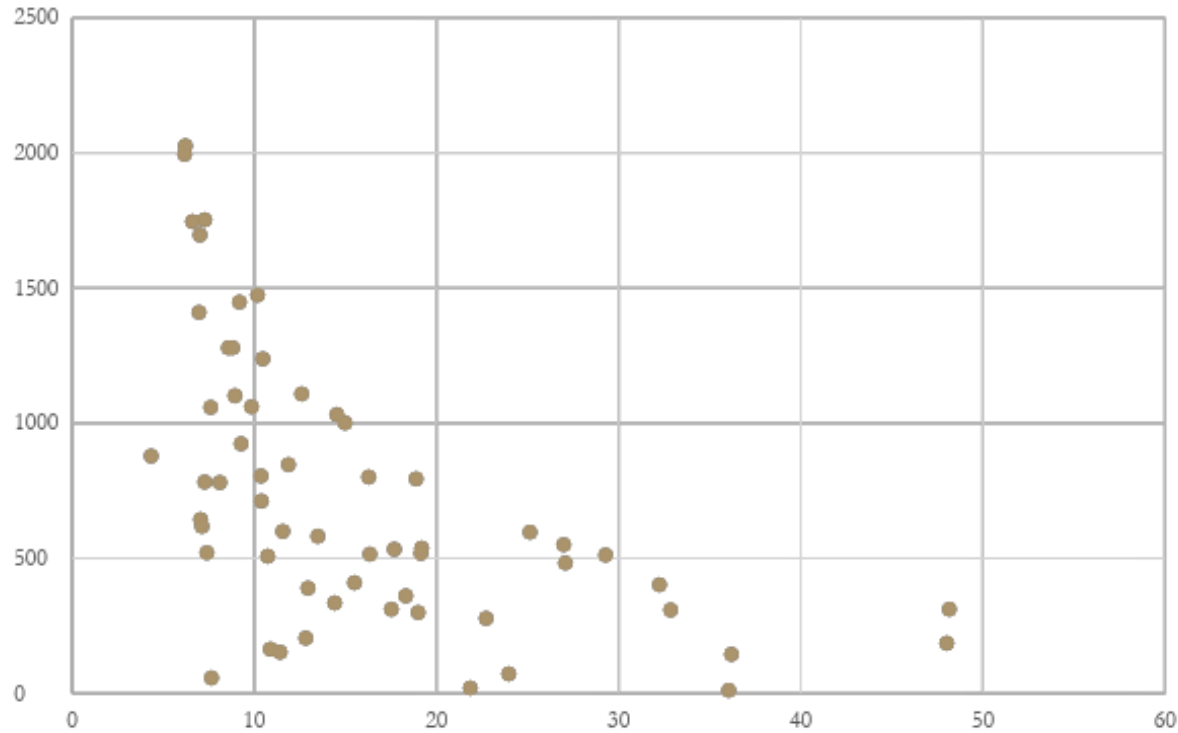
EXAMPLE:
$$\frac{12500g}{9.52g} = 1313$$

EXAMPLE:
$$\frac{15000g + 5000}{15.5g} = 1290$$

5000g BONUS ADDED FOR HOLDING THE ENTIRE 15000G

SCORE

2019 Boomilever



MASS

It's about
efficiency

TIERED SCORING

- TIER 1 – Holding any load and meeting all construction parameters and competition requirements.
- TIER 2 – Holding any load with any violations of the construction parameters and/or competition requirements and or **not submitting the design log**
- TIER 3 – Unable to load for any reason. (ranked by lowest mass)

TIE BREAKERS

- 1) – Load scored Estimate.
- 2) – Lowest Mass.

TIE BREAKERS ARE RARELY UTILIZED