

# Stick Together

Spring Challenge 2024, May 10<sup>th</sup> 2024

**LEVEL:** Middle School  
**DIVISION(S):** Grade 6<sup>th</sup> and Grades 7<sup>th</sup>/8<sup>th</sup>  
**COMPOSITION OF TEAM:** 2-3 of Students per team

**OVERVIEW:** Students will use math and science to implement engineering concepts in the design and construction of a model bridge from their own plans that will carry a maximum load while using as few craft sticks as possible; stressing neatness, craftsmanship, and creativity. **Bridges must be turned in to your MESA advisor before May 10th. MESA advisors will bring bridges to Pacific to be tested by the Pacific MESA Center.**

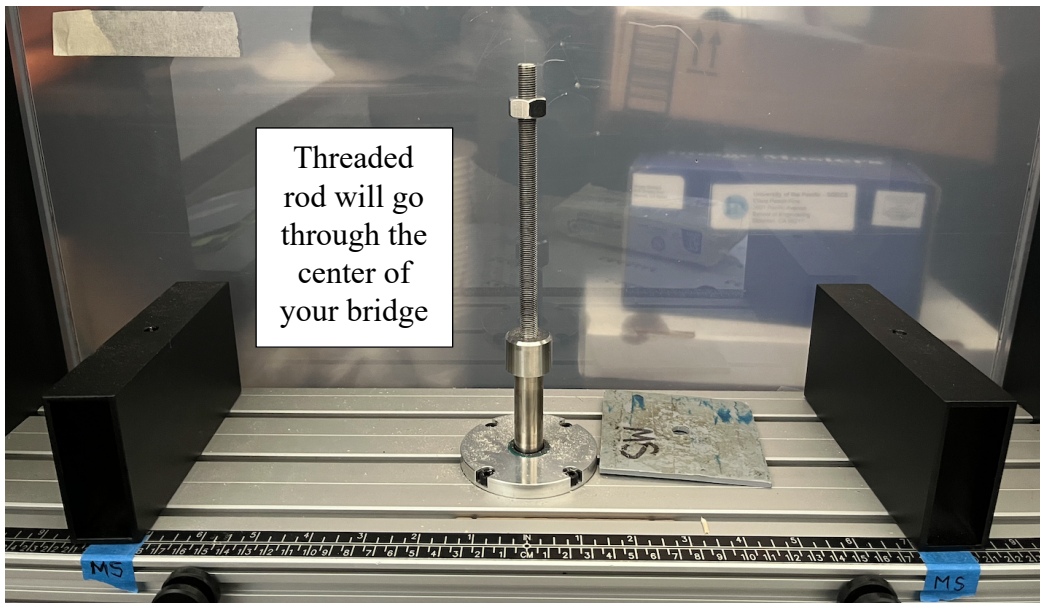
**MATERIALS:**

- Only solid untreated (no manufactured notches or holes), natural wood craftsticks (e.g., popsicle sticks) with the following approximate dimensions may be used:
  - Length= 4 ½ inches (11.4cm)
  - Width = 3/8 inches (0.95cm)
  - Thickness = 1/16 inches (0.2cm)
- Maximum number of sticks allowed, including partial sticks, is 200. Each piece of stick, regardless of size, will be counted as one structural member.
- Only water-soluble Elmer's-type white glue must be used.

## GENERAL RULES:

- 1) Stick Together structures should be labeled with team members' name, grade level, school, and MESA Center. There will be a 10% penalty in the strength to weight score for improper labeling.
- 2) No kits are allowed.
- 3) A maximum of 50% of a craft stick's total wide/flat surface may be glued. Both sides of each stick can be considered in the 50% calculation (e.g., 100% of side 1 and 0% of side 2; 75% of side 1 and 25% of side 2). NOTE: if a whole craft stick is divided into smaller pieces, then this rule also applies to those members. See Appendix B
- 4) Glue (i.e., water soluble Elmer's type white glue) must only be used at joints and must not be used on the surface of the roadway.
- 5) The bridge MUST meet the following dimension restrictions:
  - a. Minimum horizontal length = **15 inches (38.1 cm)**
  - b. Maximum horizontal length = **17 inches (43.2 cm)**
  - c. Minimum width at every point, not including roadway = **4 inches (10.16 cm)**
  - d. Maximum width = **5 inches (12.7 cm)**
  - e. Maximum height above the top of the roadway = **7 inches (17.78 cm)**
  - f. Maximum depth below the top of the roadway = **3.5 inches (8.89 cm)**
  - g. Minimum width of open roadway across entire bridge length = **3.5 inches (8.89 cm)**
- 6) The bridge must have a clear and unobstructed roadway at least 3 ½ inches wide, running the full length of the bridge, as if automobile traffic were going to cross it. The roadway shall be considered a roadway if a toy model car or truck freely rolls from one end to the other.

- 7) The bridge may not have a roof, covering or any other object that will interfere with the 3½ x 3½ inch test plate that is placed directly on roadway at mid span to apply the force for load bearing capacity.
- 8) I-beams are illegal.
- 9) T-sections and longitudinal lamination may be used on the roadway only.
- 10) The bridge must rest on the tester support blocks in a stable manner (i.e., bridge substructure may NOT interfere with testing apparatus).
- 11) Project must be the original work of student(s).
- 12) Please remember that the purpose of this contest is to use creativity to build the best structure within the framework of the rules.
- 13) **Important: There must be a 3/8 inch hole or space in the center of the bridge's roadway to allow for the bridge to fit onto the testing apparatus.** The best way to do this is to not put any popsicle sticks in the center of the roadway. If there is no hole or space here, we will drill a hole into the center of the bridge.



### JUDGING:

- 1) The bridge is examined and measured by the judges to check whether it conforms to contest rules and specifications.
- 2) Any bridge that does not meet the requirements will be disqualified.
- 3) The bridge is weighed, and its weight recorded.
- 4) The bridges are judged for neatness, craftsmanship, and creativity by a team selected by the Host Center prior to testing.
- 5) The bridge will be supported by two wide blocks (each >1 inch) 14 inches apart (see Testing Setup & Apparatus).
- 6) A 3½ x 3½ inch test plate is screwed onto the bridge at mid span so that it rests on the roadway. **A hole must be present in the roadway mid-way to attach the test plate. The hole can be created with a missing stick or drilled.**
- 7) The test plate is loaded until a point of maximum load is reached as determined by judges. The maximum load recorded by the load testing machine will be used as the load capacity of the bridge, regardless of when failure begins.
- 8) Individuals' bridges are not limited in the number of categories they may win.

- 9) Disqualified bridges are not eligible for awards in any category; however, they may be tested, time permitting.
- 10) Strength-to-Weight Ratio: Determined by dividing maximum load at failure by weight of bridge. Bridge with greatest load bearing capacity compared to its weight wins.

Example:       Maximum load = 220.0 pounds  
                  Bridge weight = 50.0 grams  
                  Ratio =  $[220 \text{ pounds} \times 454\text{g/pound}]/50\text{g}] = 1997.6$

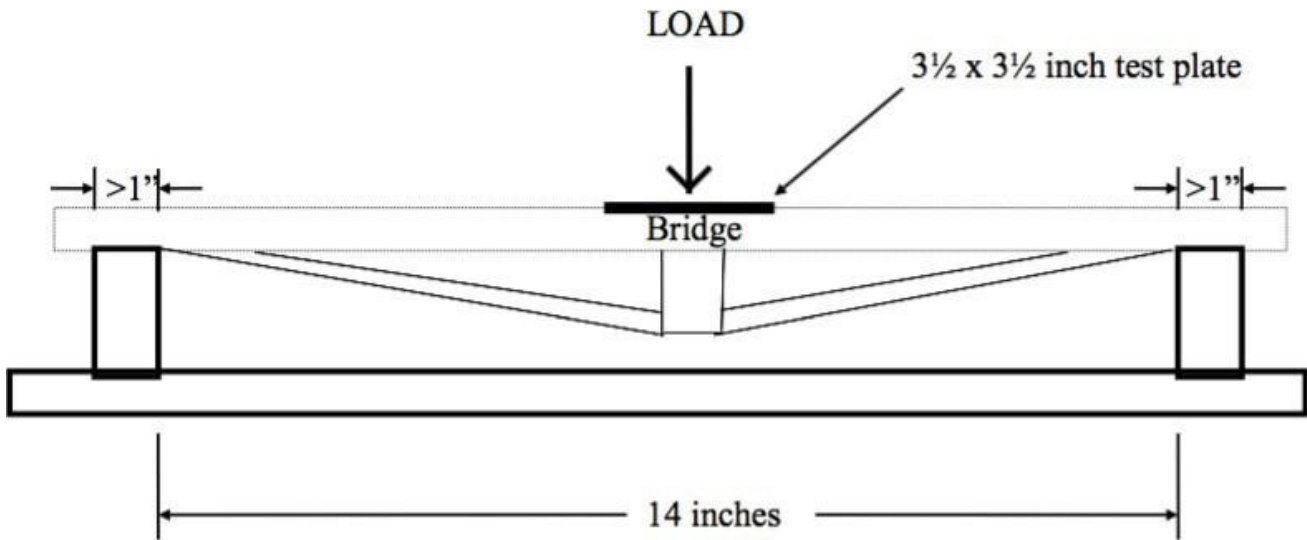
**AWARDS:**

- Awards will be given per division: Grade 6<sup>th</sup> and Grades 7<sup>th</sup>/8<sup>th</sup>.
- Medals will be awarded for 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> place based on the best Strength-to-Weight Ratio.
- Medals will be awarded at the MESA Spring Challenge and Scavenger Hunt on May 25<sup>th</sup> at Pacific from 1:45-2:15pm. Students may invite their families to attend.

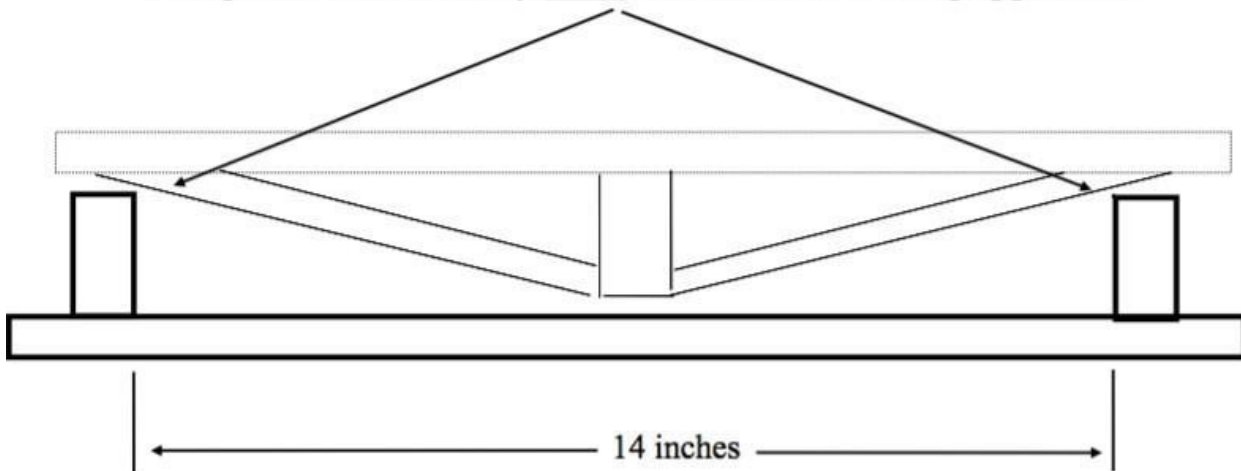
**ATTACHMENTS/APPENDIX:**

- A – Testing Setup & Apparatus
- B – Definitions and Samples
- C – Specification Checklist

**Appendix A – TESTING SETUP & APPARATUS**

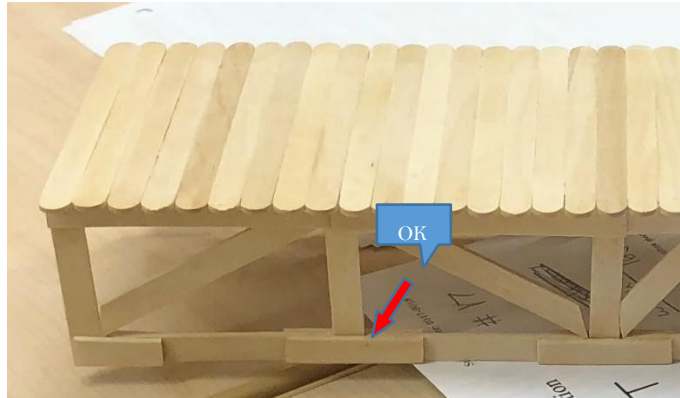


Bridge **MUST** rest on tester support blocks;  
Bridge substructure may **NOT** interfere with testing apparatus



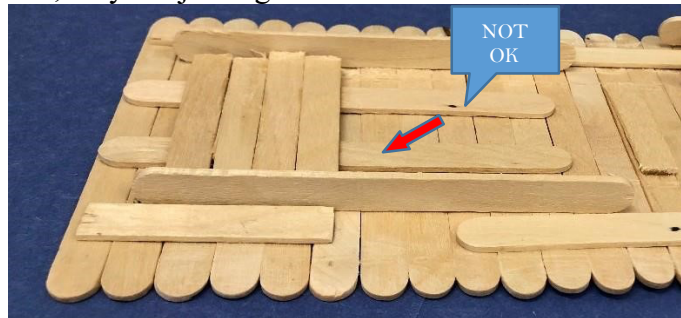
**Appendix B – DEFINITIONS AND SAMPLES**

**Per General Rule #3**

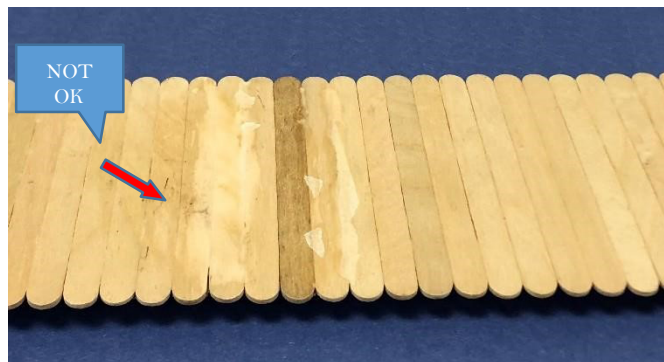


Top: Because the member that is covering 50% of its area are not in contact with any other member, it is considered legal.

Bottom: The members are already 50% in contact with the roadway and are also in contact with other members. Therefore, they are joining with member at more than 50% of its area.



**Per General Rules #4 & 5**



Glue is visible on areas other than the joints and the remains of wax paper left on the roadway are considered coating. Easy way to fix this is to sand off the excess glue or wax paper.



**Per General Rules #7, 8 & 9**



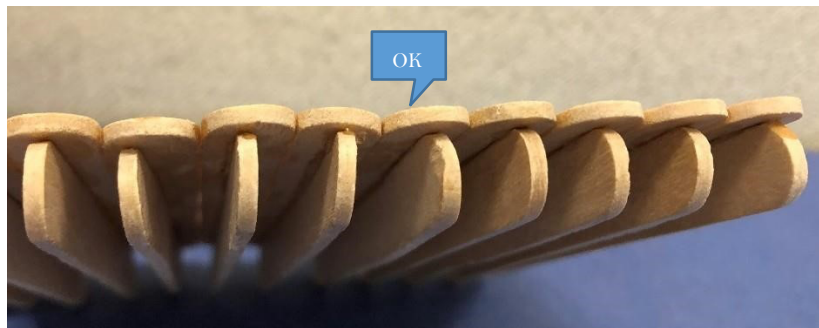
The bridge is open and allows testing apparatus to be placed, the roadway created is clear, gapless and unobstructed, and lastly it does not have a roof.

**Per Rule #10**



**I-Beams are illegal in the bridge's structure.**

**Per Rule #11**



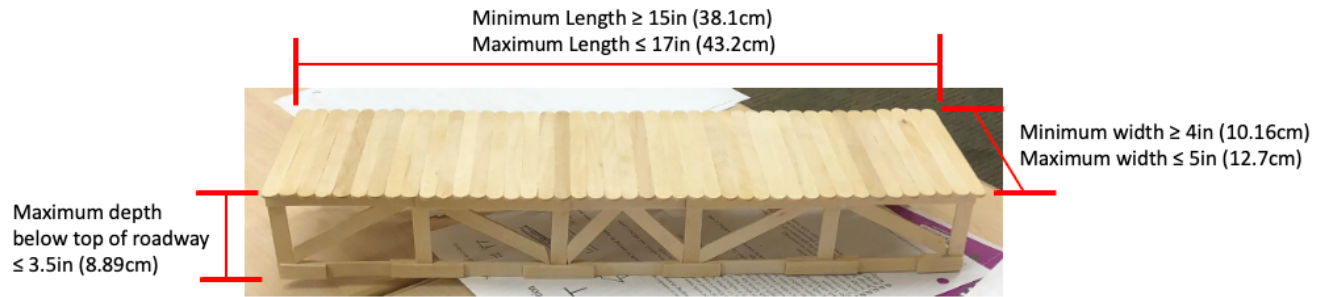
Top: T-Beam are only allowed to be elements of the roadway.

Bottom: Longitudinal lamination may be used on the roadway only.



**Appendix C– SPECIFICATION CHECKLIST**

*\*Note: As the name above implies, this list is intended simply as a guide for meeting the required competition specs. It should not be treated as an official judging document.*



- Bridge is properly labeled with team members names, school, and MESA Center
- Material is solid, natural wood craft sticks (popsicle sticks)
- Glue is water soluble Elmer's-type white glue
- Minimum length  $\geq 15$  inches (38.1 cm)
- Maximum length of bridge  $\leq 17$  inches (43.2 cm)
- Minimum width of entire bridge  $\geq 4$  inches (10.16 cm) – note: roadway is the only part of the bridge that can be 3.5 inches
- Maximum width of entire bridge  $\leq 5$  inches (12.7 cm)
- Maximum height above top of roadway  $\leq 7$  inches (17.78 cm)
- Maximum depth below top of roadway  $\leq 3.5$  inches (8.89 cm)
- Minimum width of roadway  $\geq 3.5$  inches (8.89 cm)
- Roadway runs entire length of bridge
- Maximum number of members (sticks and/or partial sticks)  $\leq 200$
- Glue only at the joints
- Each stick glued  $\leq 50\%$
- No I-beams
- T-sections on roadway only
- Sticks are not painted or treated

- Bridge open at the top (no roof or covering)
- Bridge has open 3½ inch area for placement of the test plate on roadway
- Bridge has supports suitable for placement on testing fixture
- Bridge substructure does not interfere with testing fixture