



Specifications

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DESCRIPTION:

The objective of this event is to design and build a structure with the highest load-to-weight capacity ratio ($\frac{\text{Failure Load}}{\text{Weight}}$), over a predetermined span using supplied materials. The bridge must have an unobstructed flat roadway capable of allowing a wheeled car to pass over its entire length. Each team may consist of 2-3 students and one supervisor, and may enter only one bridge that must be built at the competition within a 3-hour time limit. Each school may enter up to two teams. This is an engineering event; therefore, failure to adhere to the rules and regulations herein will incur penalties against the final score.

MATERIALS:

1. One (1) set of practice building materials to construct a bridge will be provided prior to the competition for each participating school. This set will include the same materials that will be included in the kit provided at the competition and contains the following:
 - Twenty (20) - balsa wood sticks, three (3) feet long and one-eighth (1/8) inch square
 - One (1) - balsa wood plank, eighteen (18) inches long by two (2) inches wide by three-thirty seconds- (3/32) inch thick. This plank **MUST** be used for the Bridge Roadway - any leftover may be used as each team desires.
 - One (1) copy of MVBBC Rules & Guidelines
2. The bridge is to be a single structure constructed of balsa wood. All wood materials will be provided by the Mahoning Valley Miniature Bridge Building Competition (MVBBC) committee at the start of the competition.
3. Bridges shall be bonded using a cyanoacrylate medium density super glue, provided by the competition. This is a fast-setting, gap-filling 5-15 second curing glue that can be found at Boardman Hobby Center.
4. All tools used for construction are to be provided by the building team. Some suggested tools are as follows:
 - Exacto Knife Kit / Razor
 - Jig or Form for Bridge
 - Ruler / Scale
 - Cutting Board
 - Clamps
 - Protective Eyewear
 - Hair Dryer for drying glue
 - Latex/rubber gloves
 - Extension cord / Power Strip
5. Protective eyewear for participating students must be worn during testing (provided by the building team).
6. The design team must allow for a Matchbox or Hot Wheels type car to roll along the bridge deck prior to testing. A car will be provided at the competition.

7. Design plan or drawing is optional, but highly recommended and should be provided by the building team.

Note: More than one student should have a copy of the plan in the event that another team member forgets the plan or is unable to attend.

CONSTRUCTION:

1. Team supervisors may not in any way participate in assisting students during actual building of the structure. Any questions related to construction will be directed to the Rules Committee.
2. Any type of bridge may be constructed as long as it meets the following specifications.
3. All construction on the competing structure will be completed on competition day within the allotted 3-hour time limit.
4. Do not coat the bridge with any material (i.e., paint, stain or glue).
5. All excess glue should be removed from surfaces that are not bonded together.
6. **A bridge must have a minimum of three (3) structural members. Bridges not having a minimum of three (3) structural members will be disqualified and not tested. Laminating to create one thick bridge deck is not permitted (i.e. no slab-type bridges are permitted, see Figure 4.).** For the purposes of this competition, lamination means the gluing together of pieces of balsa wood parallel along the length of the piece to form thicker, stronger members.

While you may not glue all of your wood together to form a slab-type bridge, you may glue up to six pieces together to **form beams or truss-type members**, in order to help strengthen your deck and the rest of the bridge. **Be creative!** (See Figures 4 and 5.) The laminated member cannot exceed 3 parallel pieces in height or width to form larger members. Having more than six pieces laminated or more than 3 parallel pieces laminated together in any direction will result in a weight penalty. Also, a laminated member cannot be spaced closer than 1/4" perpendicular to another parallel laminated member. Having a spacing less than 1/4" will result in a weight penalty. (See Figure 6.) The balsa wood plank used for the roadbed will not be counted as a laminated piece. It will be as if the wood plank is not there creating a space of 3/32 inch.

The determination of whether or not a bridge has been laminated incorrectly is up to the discretion of the judges. If you feel that your design may be questionable, please contact a member of the Rules Committee as early as possible.

7. Construction of a practice prototype bridge prior to competition is strongly encouraged. ***Prototype and/or previous year's bridge are absolutely not permitted at competition – Drawings and/or plans only.***
8. The bridge must be constructed to meet the following specifications:
 - a. The bridge will span a clear opening of twelve (12) inches on the load table. Note that the bridge will need to be longer than twelve inches to allow for bearing on the table. The bridge will be required to have a minimum bearing to bearing distance of twelve and one half (12 ½) inches. The overall length of the structure cannot exceed fourteen (14) inches. The building kit will provide a sufficient amount of materials. Additional materials will be provided during the competition only when there is an accidental break or when the materials are judged to be structurally deficient. Program administrators should be consulted.
 - b. For truss or beam type bridges, there should be no bearing against the vertical sides of the load table. Arch type bridges can bear against the sides of the table (opening). However, caution is urged in constructing an arch type structure because a very tight fit is necessary to develop its strength.

- c. Bridge will only be allowed to rest on the loading table, provided by the MV-MBBC. No glue or physical attachments may be made to the top or sides of the loading table.
 - d. Bridge width:
 - Minimum = 2 inches to accommodate roadbed width
 - Maximum = None
 - e. Bridge height:
 - Minimum = None: check that overhead members are high enough to accommodate loading block & bolt (see Fig. 1)
 - Maximum = None
 - f. The bridge must contain an attached roadbed (See Note 7 under Testing) with a minimum width of two (2) inches and a length greater than twelve (12) inches.
 - g. Roadbed height is not to exceed half-inch (0.5") above the top surface of the loading table (base of bridge) at the supports.
9. A roadbed is defined as a surface that allows free passage of a rolling Matchbox or Hot Wheels car. The car must have an axle width appropriate for successful travel from one end of the bridge to the other.
10. The roadbed must be able to accommodate the loading block and bolt at application point (see Note 7 under Testing). The loading block application point is at the midway point in the bridge (See Figure 2).

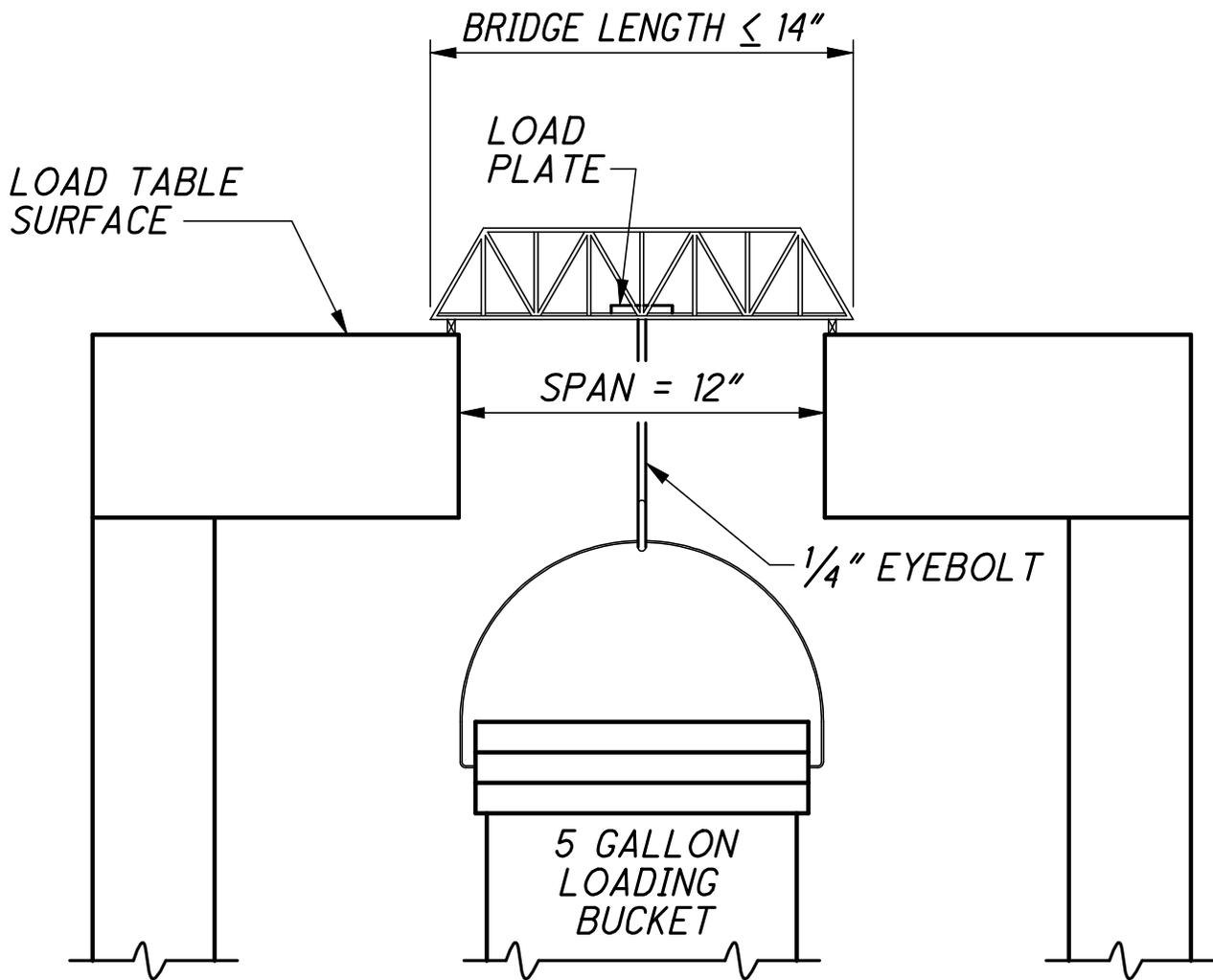
TESTING:

1. At the conclusion of the 3-hour construction period, all bridges will go to the Check Station where they will be weighed and scored based on compliance with the construction requirements (See Figure 5). Bridges that are completed but do not meet the construction guidelines will have points deducted from the bridge score as noted on Figure 6.
2. No alterations will be allowed after the allotted 3-hour construction period unless deemed necessary by the Rules Committee. The Rules Committee reserves the right to assess a penalty depending on the nature of the change.
3. Also at the Check Station, the bridge will be checked for "drivability." One end of the bridge will be placed on a wooden block approximately 2-1/4 inches in height to incline the bridge. A model car (Matchbox or Hotwheels) will be placed on the elevated end of the bridge and allowed to roll the length of the roadbed (minimum of twelve (12) inches). If the car fails to roll the whole length, the student may restart the roll from that point. Students will be allowed two (2) restarts. If, on the second restart, the model car cannot freely roll along the surface of the roadbed from beginning to end, points will be deducted from the bridge scoring as noted on Figure 6.
4. Students must wear protective eyewear during loading and testing. No exceptions.
5. The event sponsor will provide the loading block and testing apparatus.
6. During the test phase, the bridge will be placed in the center of the testing apparatus containing a span of twelve (12) inches.
7. The load will be applied to a 2"L x 1-3/4"W x 1/4"H loading plate resting at the midpoint of the span on the deck. Structural members must be clear of the eyebolt. A standard five-gallon plastic bucket will be attached to the loading block by a one-fourth (0.25) inch diameter eyebolt, which will be pass up **through the bridge from below**. The roadbed must be constructed to accommodate the 1-3/4"-wide loading plate and the one-fourth (0.25) inch eyebolt at the midpoint of the span.

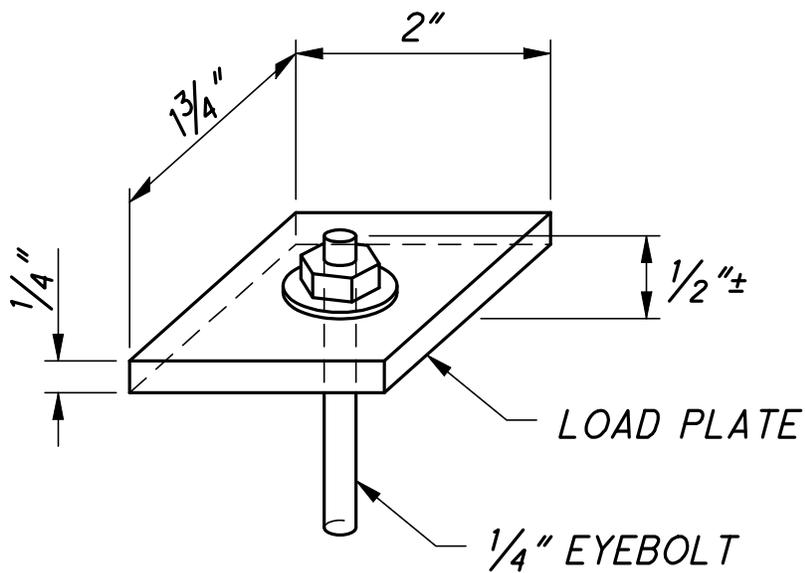
8. At this point, the bridge will be pre-loaded with ten (10) pounds, placed into the loading bucket. The student(s) will then add loading material to the five-gallon bucket until the structure fails. For this contest, structural failure is defined as obvious structural collapse.
9. The total load incorporates the total mass of the loading apparatus, bucket and loading material.

SCORING (see Figure 6):

1. Overall ranking will be based on the combined construction requirements and structural stability scores.
2. The structural stability will be determined by the equation:
[Maximum load supported (grams) / mass of bridge (grams) including any weight penalty assessments]
3. When a bridge has passed through the Check Station, it will remain at the Waiting Station until the time of load testing.
4. Event sponsors may take pictures of all bridges that are entered in the tournament for future assessment and instructional purposes.
5. Engineering ethics are an important factor in today's engineering design. If it is determined by the judging committee that a deliberate violation of the competition rules has occurred, it may result in the disqualification of the offending team.
6. **Aesthetics** by definition means “a pleasing appearance or effect.” Bridge aesthetics will be judged prior to bridge loading. Because aesthetics are highly subjective by nature, there are no “rules” for this portion of the competition.



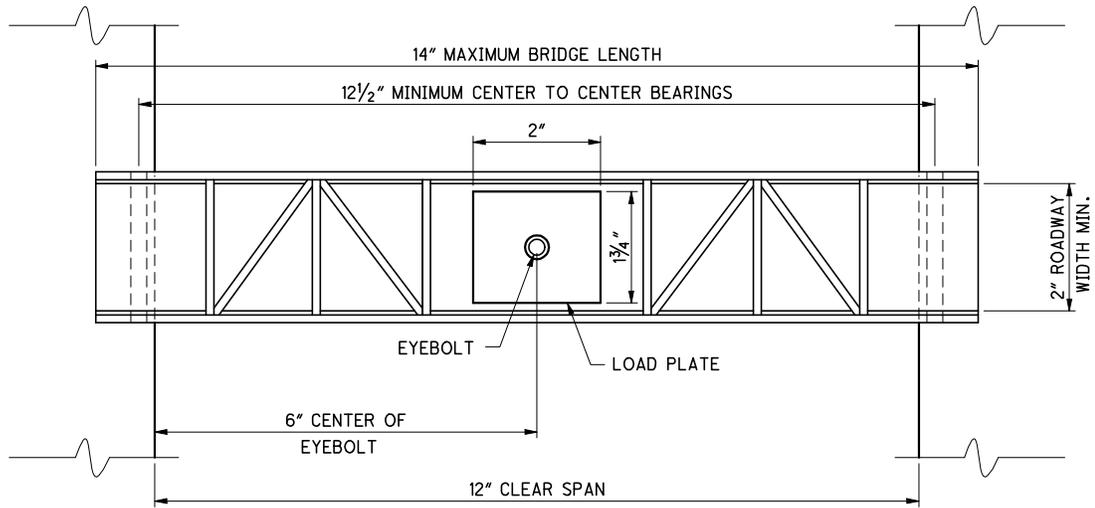
LOADING TABLE SETUP



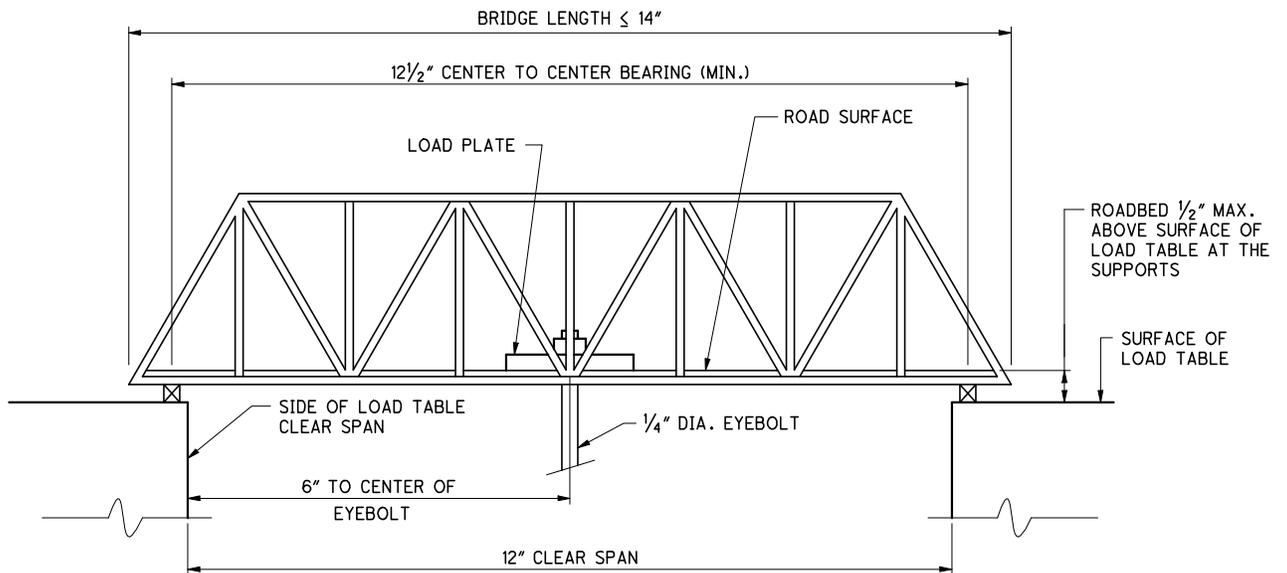
LOAD PLATE DETAIL

FIGURE 1

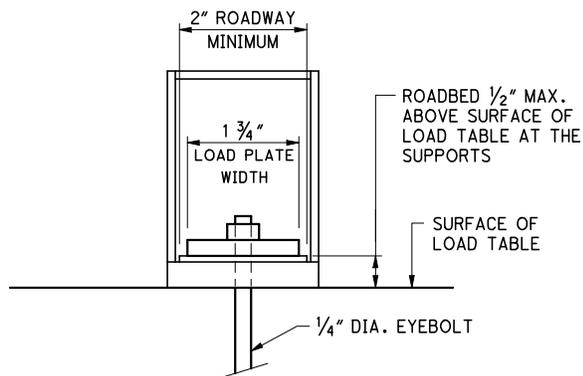
(NOT TO SCALE)



STRUCTURE PLAN



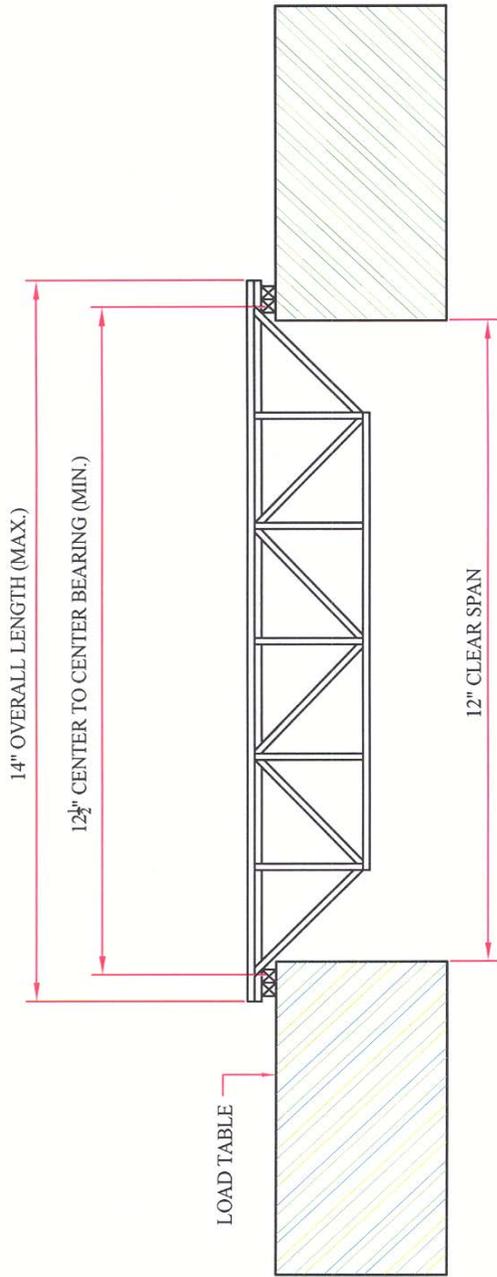
STRUCTURE ELEVATION



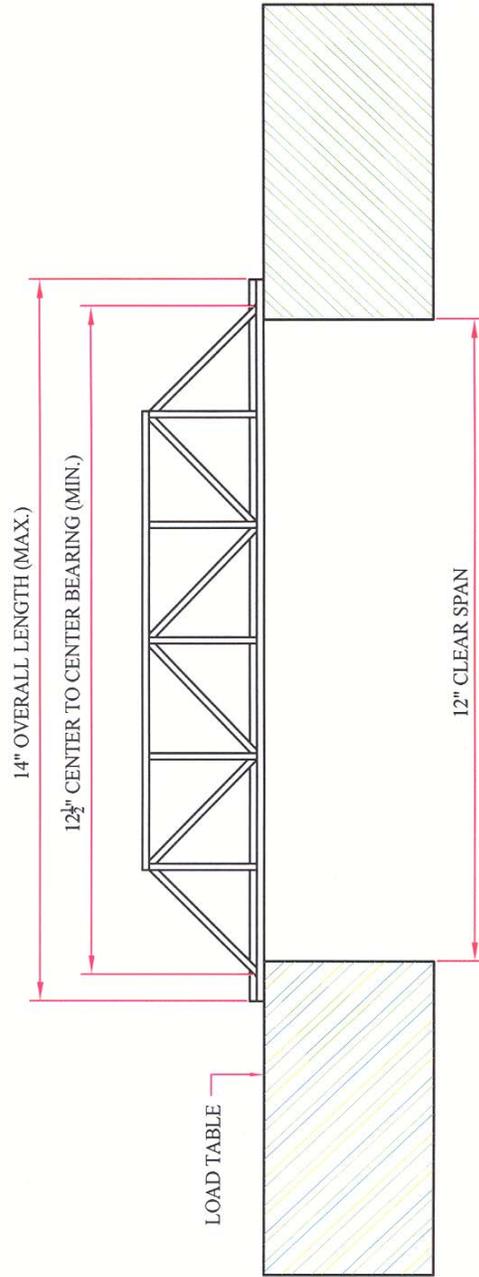
STRUCTURE SECTION

FIGURE 2

(NOT TO SCALE)



STRUCTURE BELOW TABLE



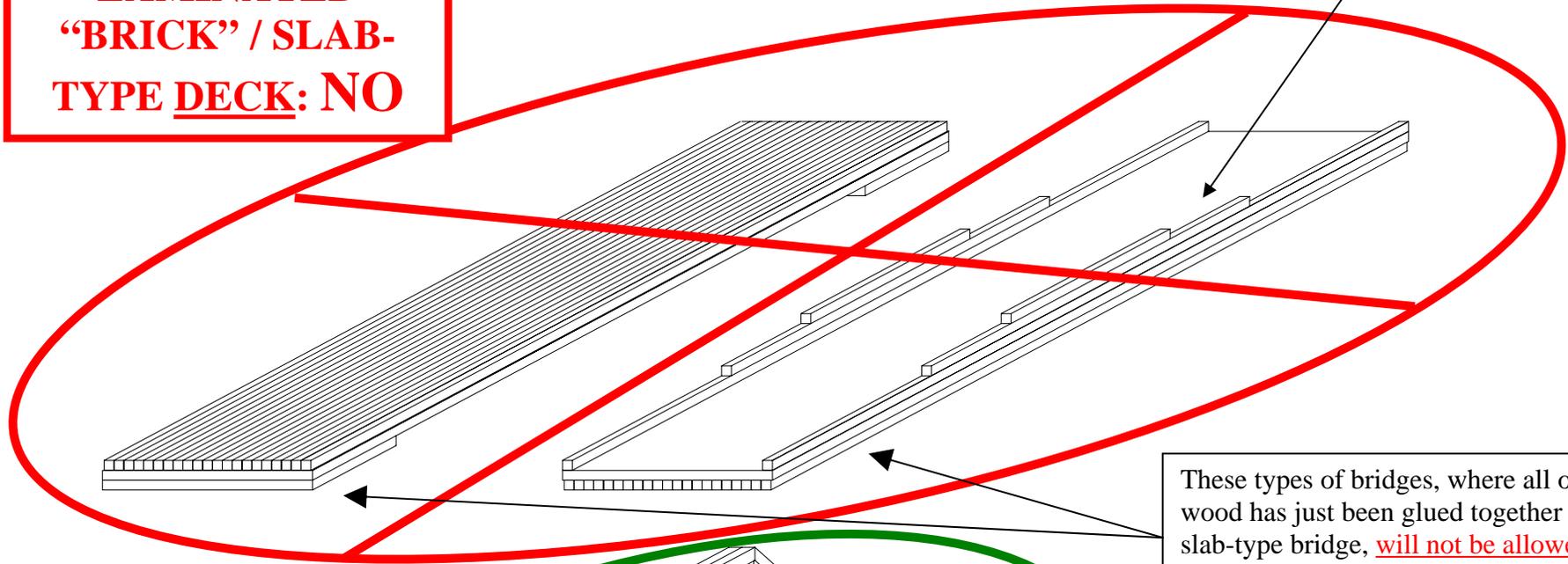
STRUCTURE ABOVE TABLE

FIGURE 3
(NOT TO SCALE)

LAMINATION

**LAMINATED
"BRICK" / SLAB-
TYPE DECK: NO**

Bridge Deck



These types of bridges, where all of the wood has just been glued together to form a slab-type bridge, will not be allowed.

The purpose of this competition is to encourage **creative thinking** in your bridge design!

Your bridge deck WILL need to be braced! It is a thin piece of wood and if you do not brace it, the loading plate will pull right through the wood. You may brace it in several ways, some of which might include truss members, cross-bracing, or pieces of wood glued together to form beams to support the deck.

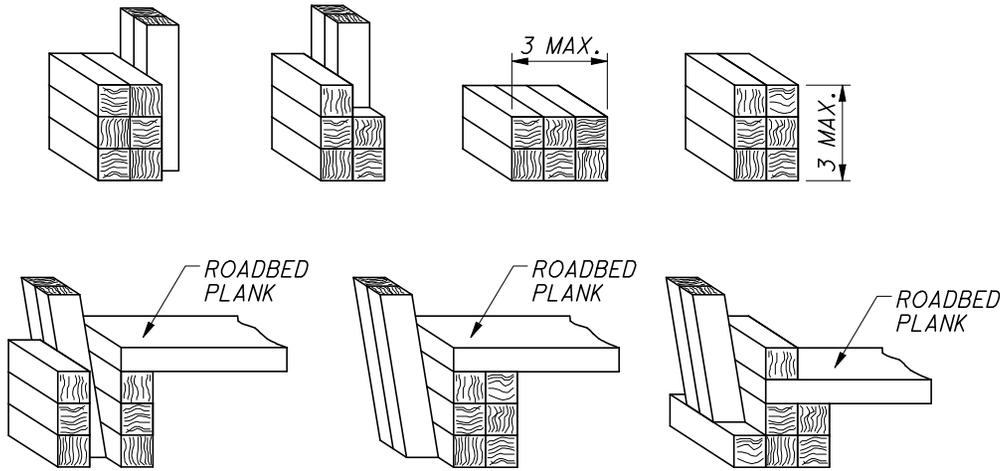
Truss Members

Beams

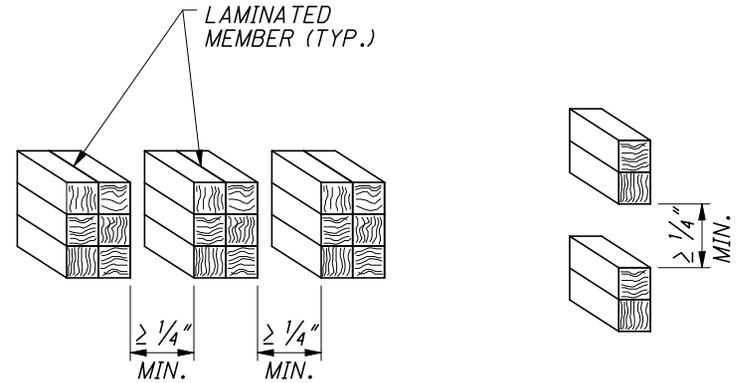
Cross-Bracing

**LAMINATED
MEMBERS: YES**

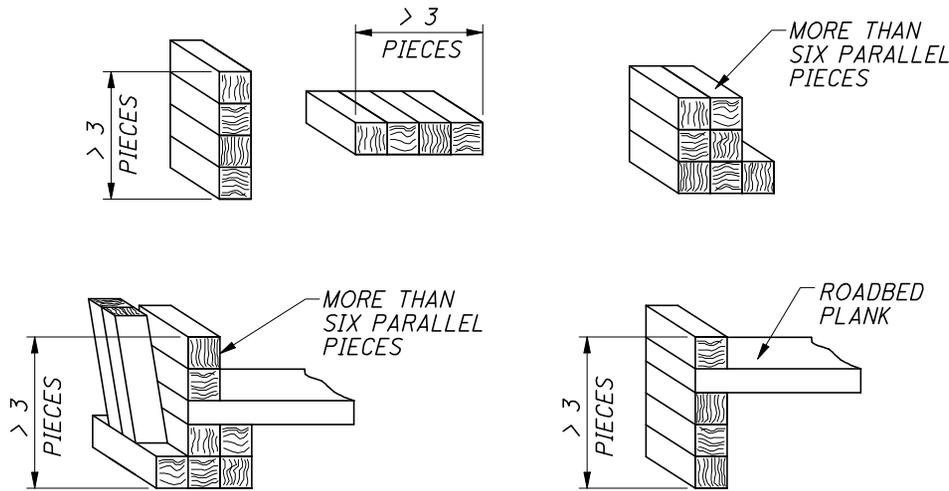
FIGURE 4



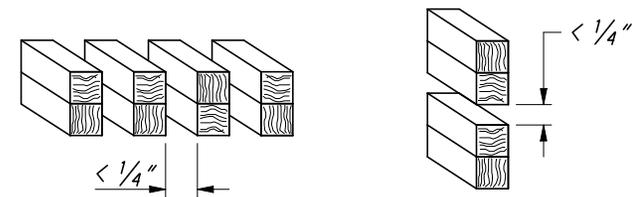
ALLOWABLE LAMINATED MEMBERS
(MAXIMUM OF SIX PARALLEL PIECES LAMINATED)



ALLOWABLE LAMINATED MEMBER SPACING



LAMINATED VIOLATIONS



LAMINATED SPACING VIOLATIONS

NOTE:

THE ROADBED PLANK WILL NOT BE CONSIDERED CREATING A $\frac{3}{32}$ " SPACING.

FIGURE 5

(NOT TO SCALE)

Mahoning Valley Miniature Bridge Building Competition
February 23, 2016

BRIDGE SCORE for: High School Name - Team Number

Construction Requirements			
Item	Penalty / Weight Increase	Weight	Notes
Structure Weight, Grams		32	Actual Structure Weight
Structure Length < 12" but >14"	100%		Does Not meet design specifications
Roadbed Length < 12" but >14"	10%	3.2	Does Not meet design specifications
Roadbed Height above Table > 0.5"	10%		Does Not meet design specifications
Clear Roadbed Width < 2"	20%		Does Not meet design specifications
Car does not roll freely along roadbed	5%	1.6	Does Not meet design specifications
Greater than 3 laminated pieces parallel or greater a total of 6 pieces	30%		Inefficient use of materials
Laminated members spacing	30%		Inefficient use of materials
Penalty Total	15%	<u>4.8</u>	
Revised Structural Weight		36.8	

Structural Stability		Ranking
Failure Load, Pounds		60
Failure Load, Grams		27,216
Efficiency (Failure Load/Weight)	<u>740</u>	

Structure Ranking	<u>0</u>
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Figure 6