

## Pre-Construction

1. The judges should use the wood box for member check to determine if each member meets the requirement of the Rules.

The member should fit completely in the box.



Figure 1a. Wood box for member check.

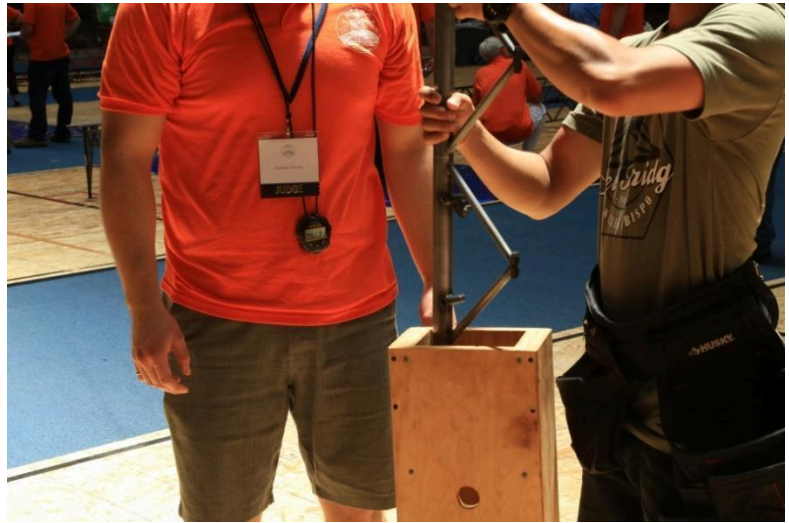


Figure 1b. Judge has competitor perform member check.

2. Use the magnet to determine material compliance with the Rules.

## Post-Construction

1. The judge should use the plywood template for ground clearance to determine if the bridge complies with Rules.

*Note: Check the current year's Rules for the required template dimensions, which can vary from year to year.*

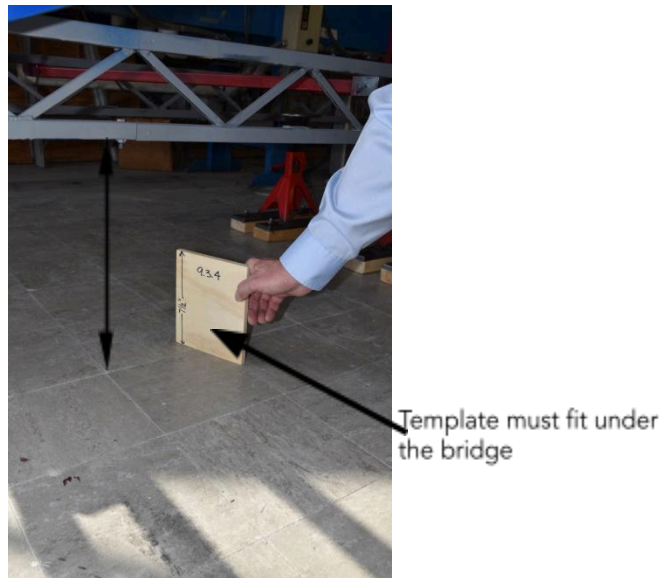


Figure 1. Plywood template for ground clearance.

2. The judge should use the plywood template for passageway to determine if the bridge complies with Rules.

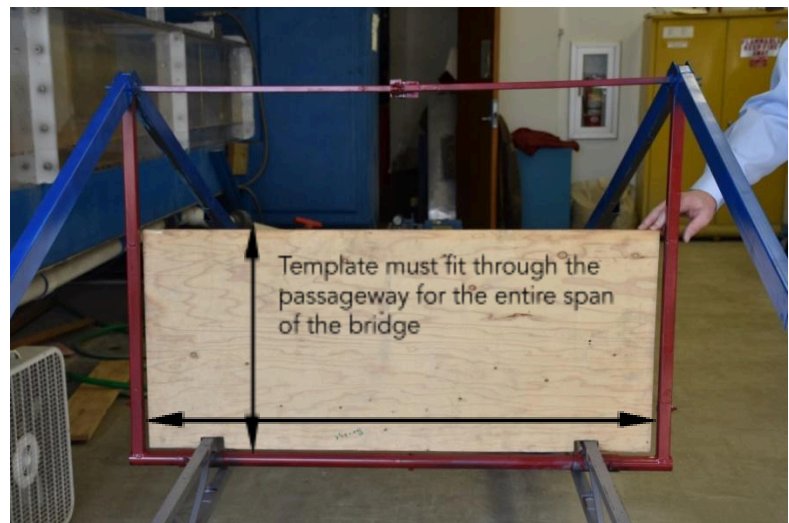


Figure 2. Plywood template for ground clearance.

3. The judges should complete post construction checks including verification of other dimensional requirements using provided equipment such as tape measures and steel bars.

## Lateral Load Test

1. The judge may allow the competitors to preload the bridge. Place grating (no tabs) on the bridge at the location along the span indicated by the Rules and the Lateral Load Test Plan of the Competition Rules.

Set three angles (75 lbs. total) over the stringer indicated in the Lateral Load Test Plan of the Competition Rules. Center the stack of angles on the grating.

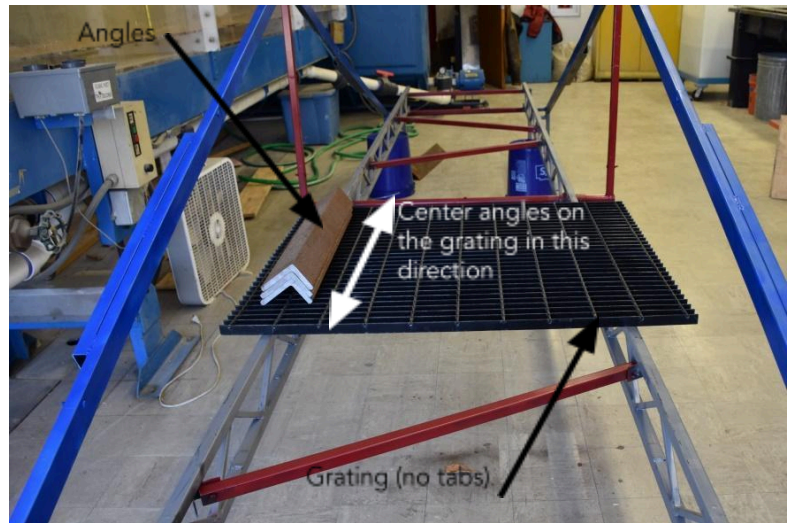


Figure 1. Lateral load test preload.

2. The judge should attach the laser plumb-bob to the bridge stringer at the location labeled as “sway point” in the Lateral Load Test Plan of the Competition Rules.

The bottom of the laser plumb-bob should be positioned about one to two inches above the floor surface. Loop any extra chain length around the stringer and attach the hooked end so that the plumb-bob is securely positioned at the appropriate height.

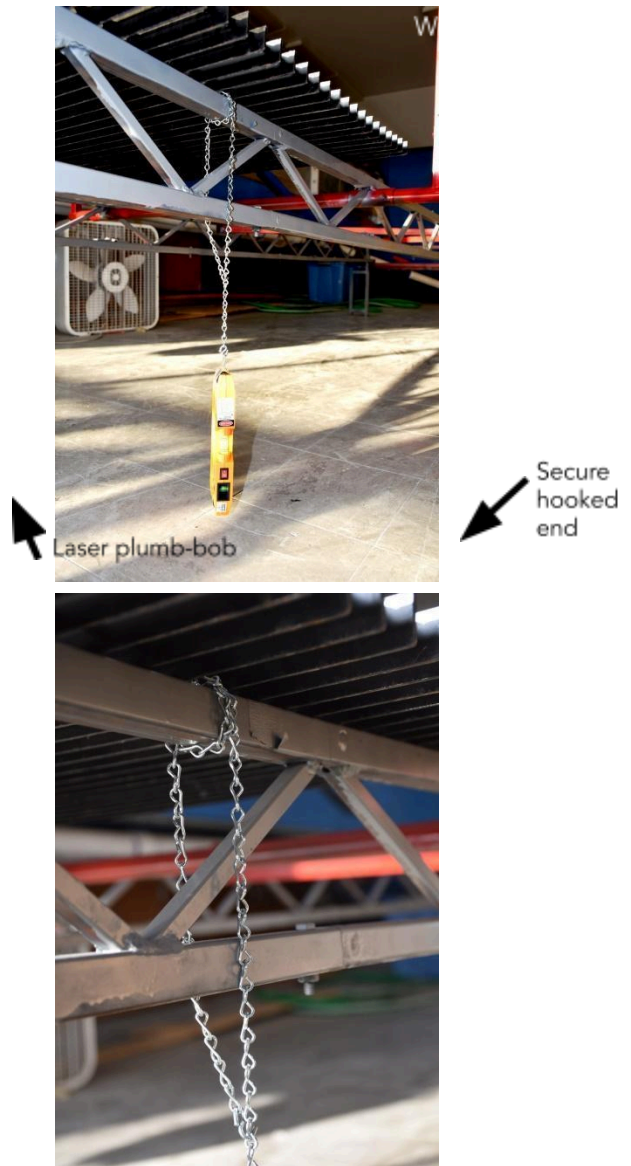


Figure 2a. Laser plumb-bob.

Figure 2b. Chain secured.



3. The judge should set up the lateral load stand. The final setup before loading is shown here.

Position the lateral load stand so that rope runs perpendicular to the bridge stringer. The rope should run parallel to the floor. See Step 5 for how to adjust stand height. The rope should be taught before loading begins.

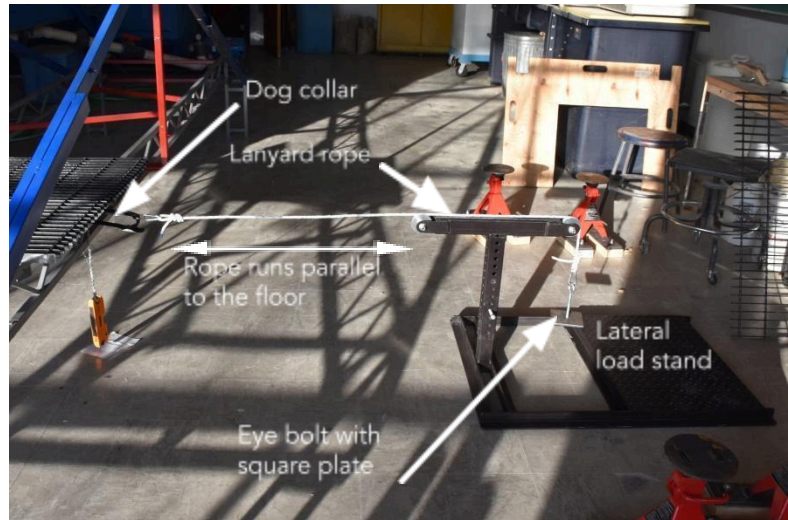


Figure 3. Lateral load stand setup

4. At the bridge end of the rope, connect the carabiner clip to the D-ring of the dog collar. Attach the dog collar to the bridge stringer as close to the laser plumb-bob as possible but at least one grating bar away from the laser plumb-bob so that the two items do not touch. The position of the dog collar and laser plumb-bob should be the same for each bridge.

At the load stand end of the rope, connect the carabiner clip to the eye bolt with small plate.

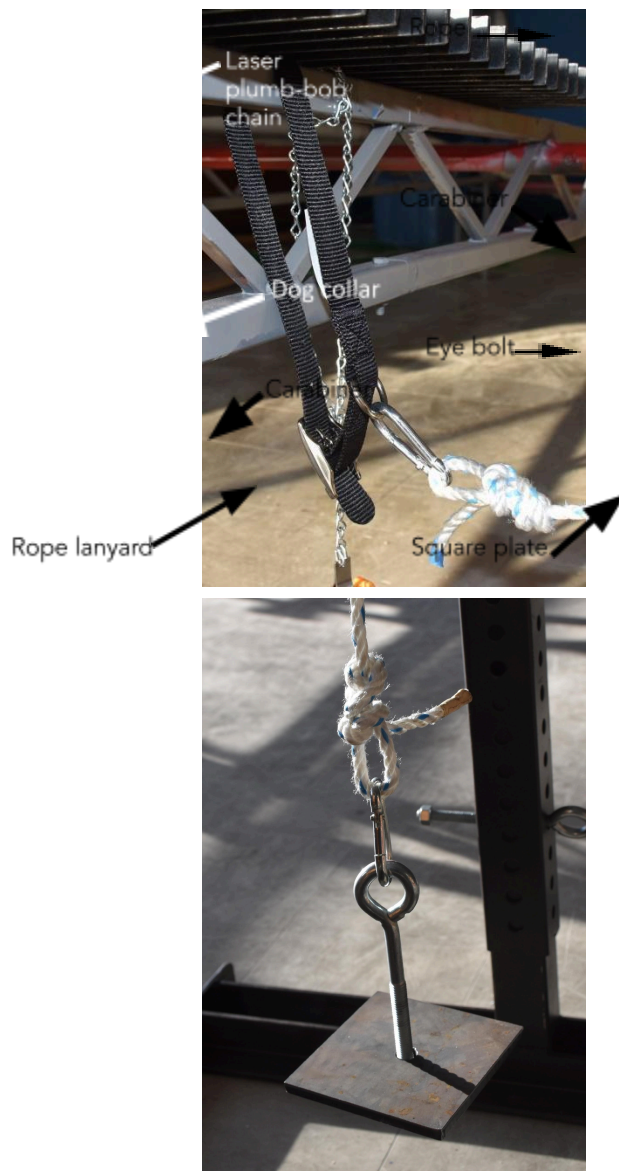


Figure 4a. Rope to bridge.

Figure 4b. Rope to eye bolt.

5. The height of the lateral load stand should be adjusted so that the rope is parallel to the floor. To do this, remove the bolt and slide the outer tube sleeve up or down. Reinsert the bolt and secure once the optimal height is found.

Ensure a minimum of two inches between the bottom of the plate and eyebolt and the floor surface.

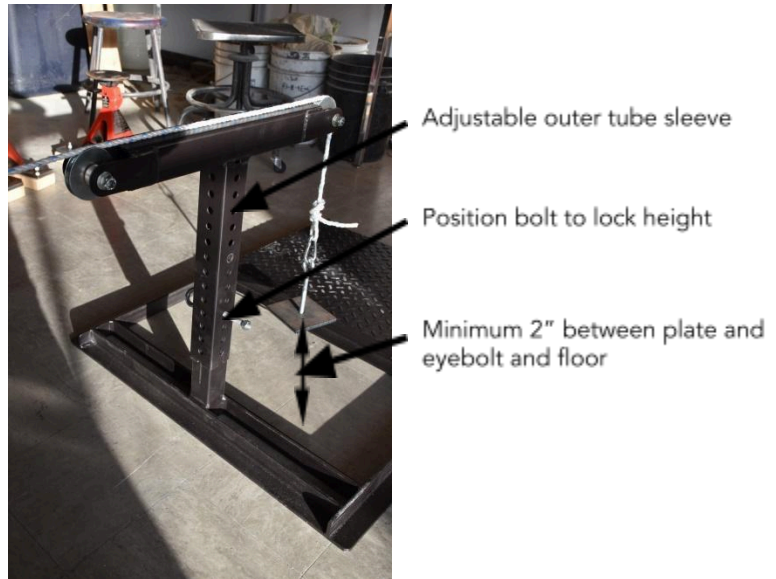


Figure 5. Lateral load stand height.

6. The judge should turn on the laser plumb-bob and position a paper target on the floor so that the laser points to the center of the target. Secure the target to the floor surface with tape.

*Note: Check the current year's Rules for the required paper target dimensions, which can vary from year to year.*

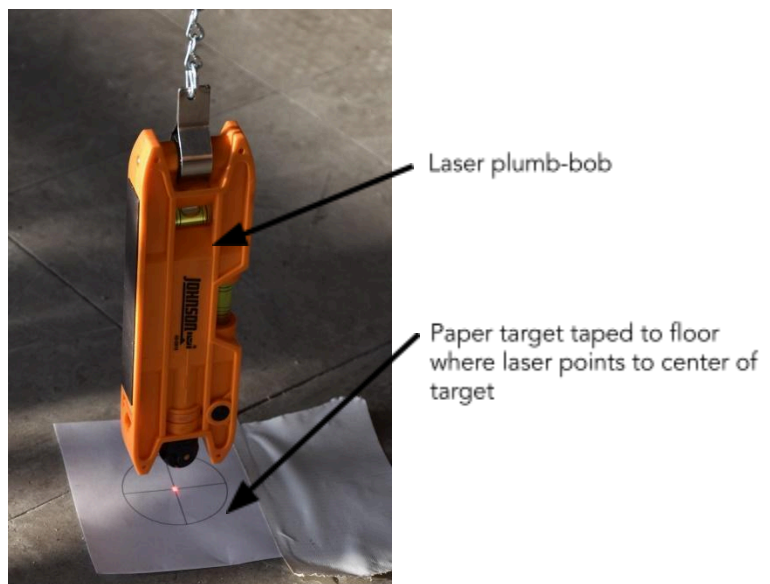


Figure 6. Paper target start position.

7. To prevent slip at the foundation during the lateral load test, competitors may provide lateral restraint at the base of the structure at the floor level per the Rules.

Competitors may use a foot at each support or an object such as an angle.

Do not apply restraint above the floor level. Do not push down on the bridge.

OK



OK



Figure 7a. Acceptable restraint.

Figure 7b. Acceptable restraint.

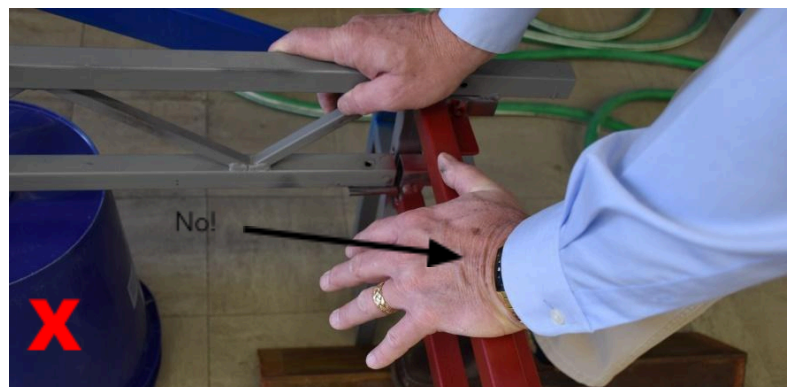


Figure 7c. Unacceptable restraint.



8. A competitor must stand on the lateral load stand to prevent slip. The competitor should load the pulley with the two slotted steel plates.

*Note: Did you spot the rule violation shown in this photo? The participant should be wearing work boots.*



Figure 8. Load applied to lateral load stand.

9. Once the load sequence is complete, the judge should check the location of the laser on the paper target.

If the laser falls outside of the circle, the bridge fails the lateral load test per the Rules.

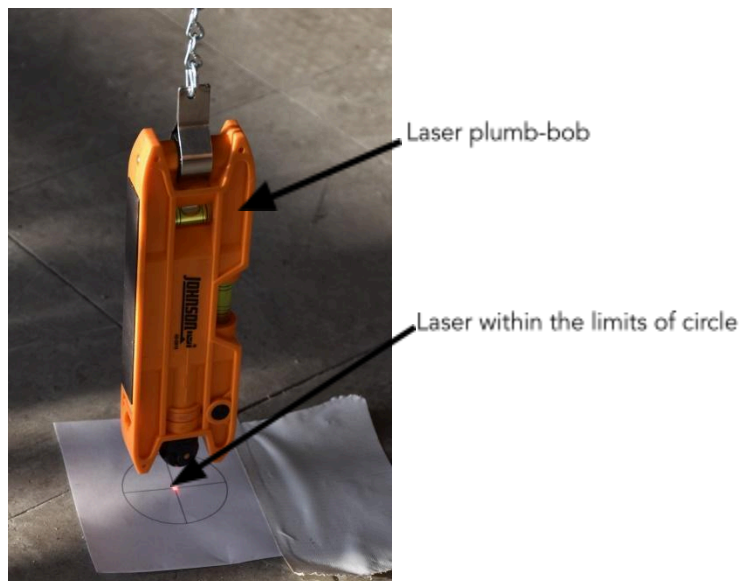


Figure 9. Laser on paper target.

10. Unload the bridge. Once the slotted plates are removed from the pulley, the competitor may step off from the stand. Disconnect the rope from bridge and remove preload grating and angles.

## Vertical Load Test

1. Figure 1 shows a bridge under vertical load.

To begin setup, the bridge should be positioned over the steel bearing plates.

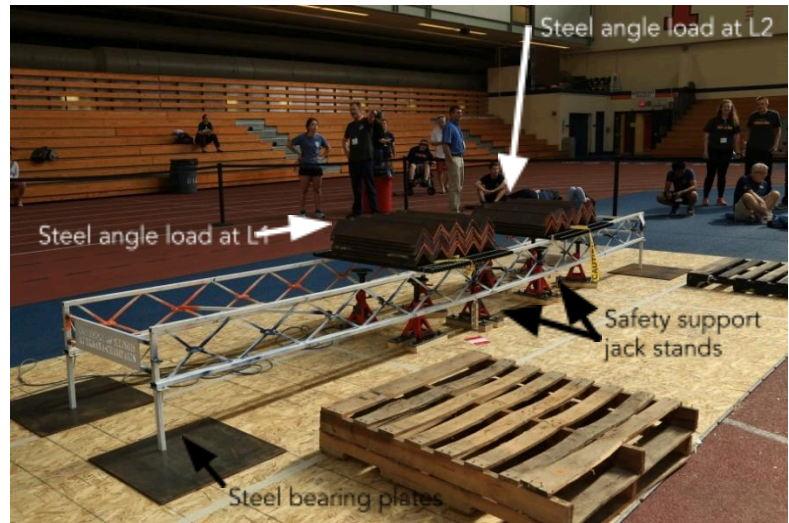


Figure 1. Bridge at vertical load station.

2. The judge should position four jack stands beneath the bridge in each of the two load areas where decking is shown in the Vertical Load Test Plan as indicated in the Competition Rules.

There should be a total of eight jack stands.

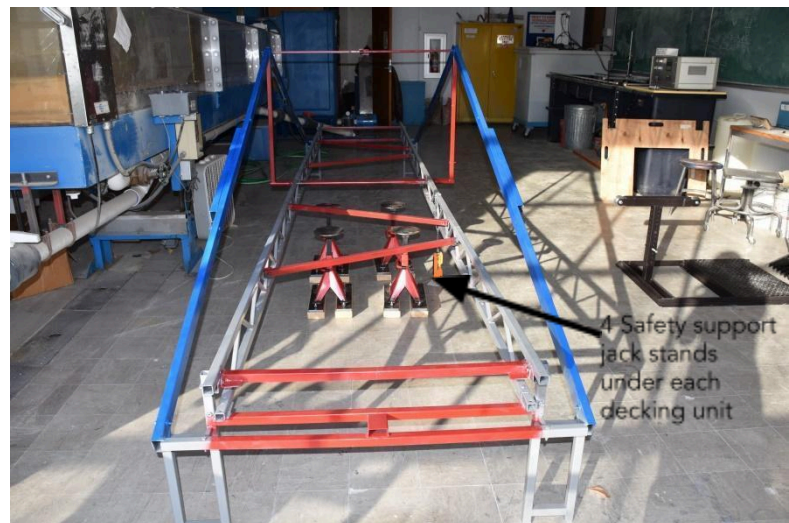


Figure 2. Jack stands under bridge at load location.

3. The judge should lay the 2x4 (2" x 4" x 3'-6" wood piece) across the tops of the two bridge stringers.

Place the 4" block on the jack stand. Raise the height of the jack stand until the top of the 4" block touches the 2x4 and set the jack stand height. Note: there may be about 1/2" between the block and the 2x4.

*If the gap is greater than 1/2", provide 4x4 wood cribbing below the jack stands, as shown in Appendix A.*

Do this for each of the eight jack stands.

5. Judges should direct the competitors to place the grating (with tabs) on top of the bridge stringers in the two load locations along the span of the bridge.



Figure 3. Jack stand height adjustment.



Figure 4. Grating in position.



5. Judges should direct the competitors to position the grating so that the tabs face upward and the bars span from stringer to stringer.

Position the grating at locations L1 and L2 determined by the Rules and the Vertical Load Test Plan and Elevation of the Competition Rules.



Figure 5. Orientation of grating.



6. If necessary, reposition jack stands so that they sit directly beneath the grating.

Do not place the jack stands under any obstructions such as horizontal bracing running between stringers.



Figure 6a. Correct position.

Figure 6b. Incorrect position.

7. Judges may allow competitors to preload the bridge at locations L1 and L2 per the Rules.

Position the angles so that the outer angles touch the grating tabs. The inner angles should touch the outer angles

Angles should be oriented in the same direction (for example, long leg of angles all facing north.)

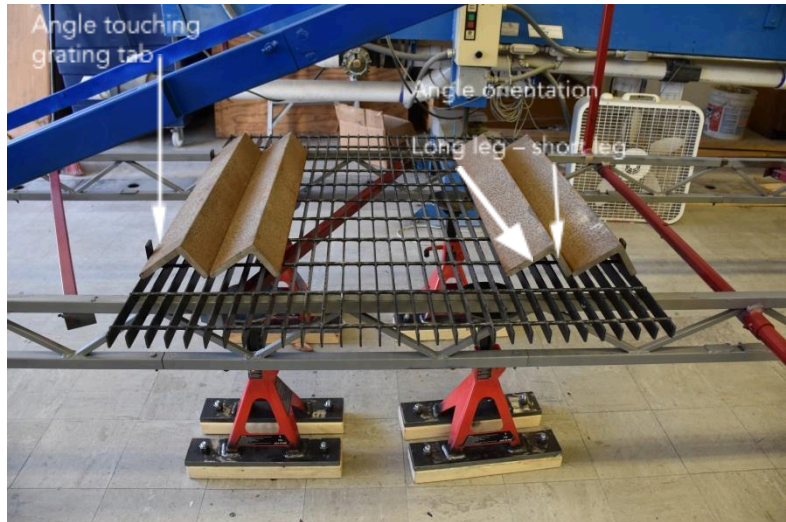


Figure 7. Position of vertical preload.

8. The judge should use the C-clamp to ensure that the bottom of the decking touches the top of the stringer per the Rules. The C-clamp should be removed when no longer needed.

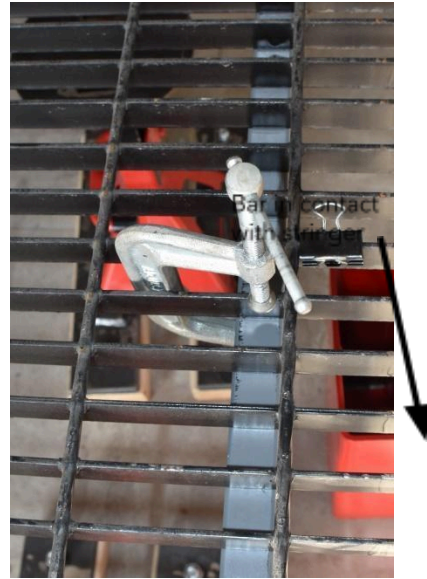


Figure 8a. C-clamp

Figure 8b. C-clamp

9. The judge should attach the laser plumb-bob to the bridge stringer at the location indicated in the Vertical Load Test Plan. Use the 2"x4"x6" wood block as a spacer in order to set the height of the laser bob.

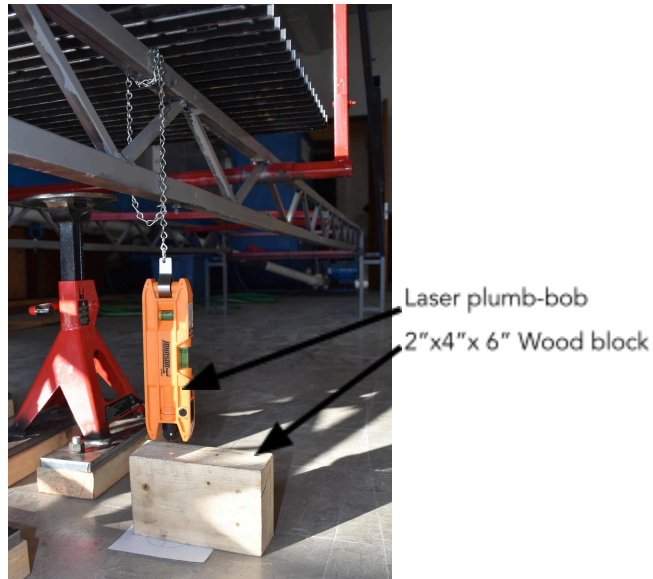


Figure 9. Laser plumb-bob position.

10. Turn on the laser plumb-bob and position a paper target on the floor so that the laser points to the center of the target. Secure the target to the floor surface with tape.

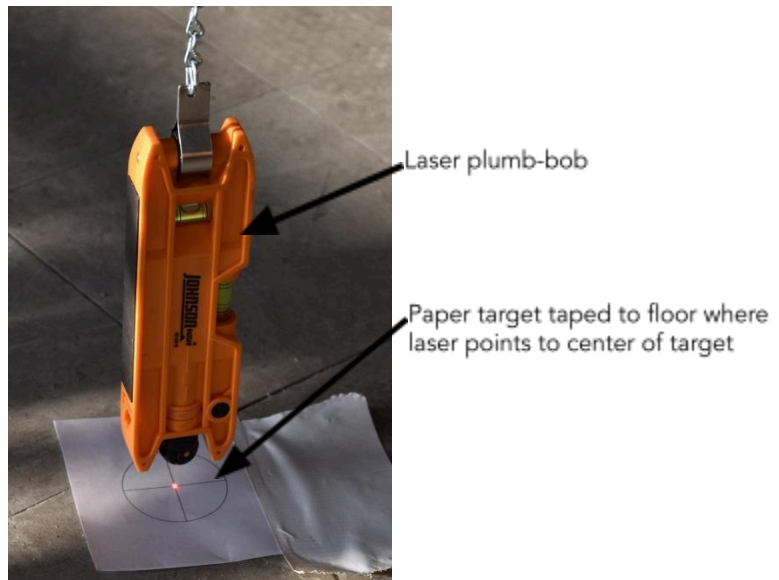


Figure 10. Paper target start position.



11. Locate the two vertical deflection measurement devices. Each device consists of three parts:
- (1) plate with hook
  - (2) caliper stand
  - (3) protective cover

Set the display unit to decimal inches.

Place the gage under the bridge such that the viewing window is visible from the exterior side of the bridge.

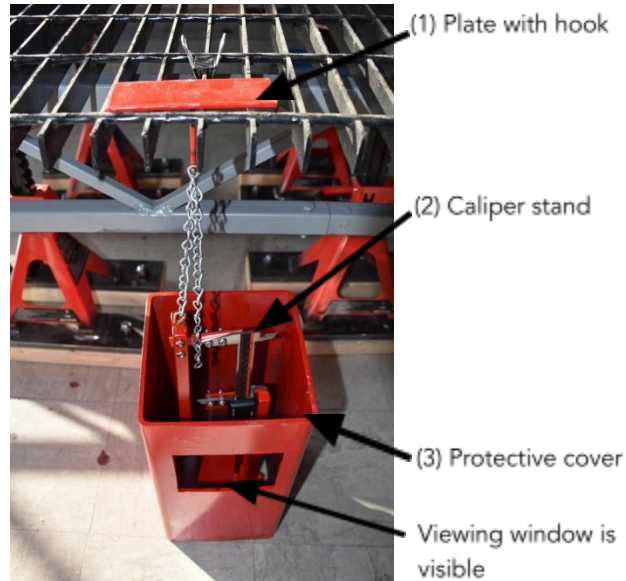


Figure 11. Vertical deflection measurement device.

12. The bar weights attached to the chain and upper jaw should be vertical.

Place the steel protective sleeve over the gage with the display showing. Not shown here for clarity.

Press the 'zero' button.

Pull the chain to open the caliper so that it can measure the maximum deflection allowed by competition rules plus a minimum of 0.5 inches.

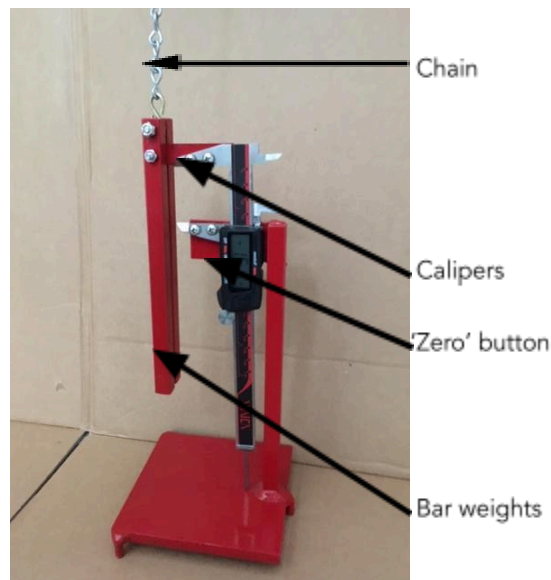


Figure 12. Caliper stand.

13. Use the provided hook to connect the chain to the decking at the location specified by the Rules.

Move the gage and sleeve so that the chain is vertical. It should not have kinks.

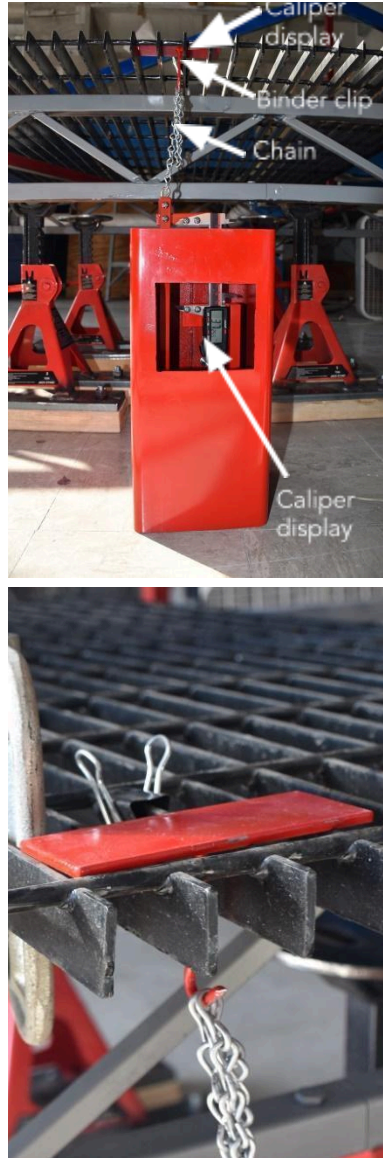


Figure 13a. Device setup.

Figure 13b. Chain to hook.

14. Initial values should be recorded rather than using the 'zero' button.



Figure 14. Record initial values.

15. The competitors can commence load placement starting at L1.

Stack angles in layers. Layer one should have angle legs faced down. Layer two should have angle legs faced up in a nested position. Alternate each layer.

When stacking, a short offset of about  $\frac{1}{2}$ " to 1" may be used to facilitate safe and easy stacking and unstacking.

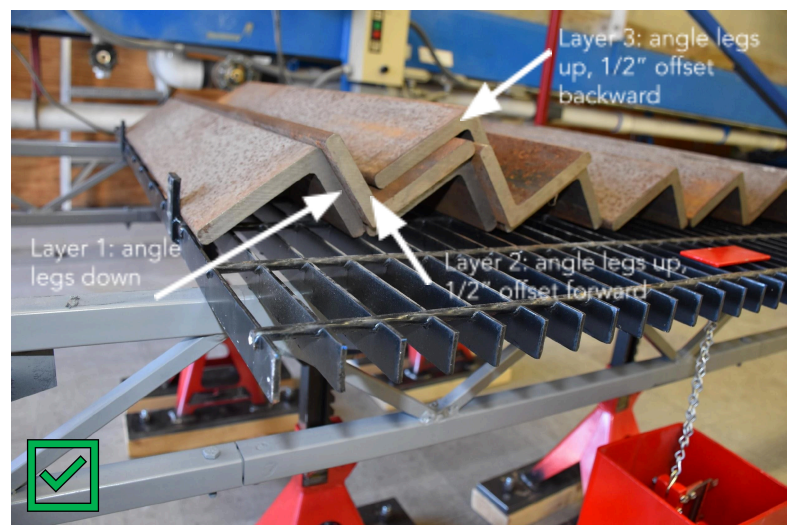


Figure 15a. Proper stacking of loading angles.

Do not stack angles using a large offset. Do not stack angles with the offset in one direction only.

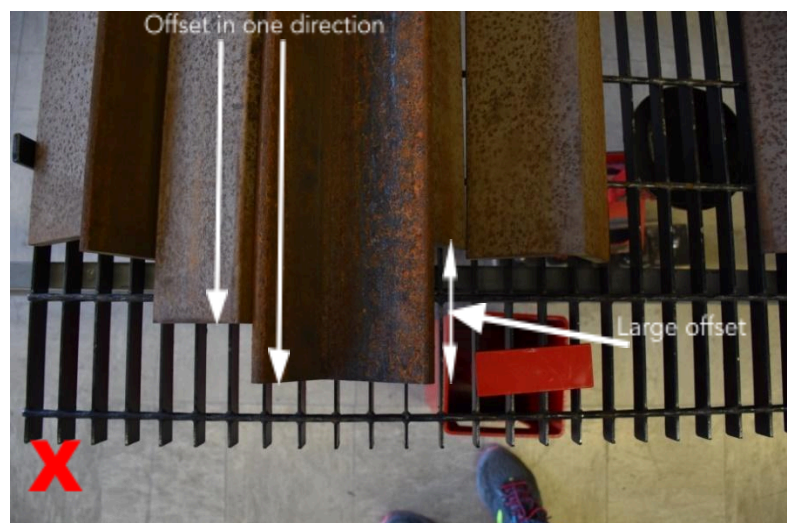


Figure 15b. Improper stacking of loading angles.

16. Loading should be accomplished in a safe, smooth, and continuous manner. Judges should monitor the sway and deflection measurements per the Rules. The judge should record the deflection readings at the end of the load stage and allow the team captain to verify them.

Competitors should then remove all loading angles.



# Vertical Deflection Measurement Device Instructions

(Revised 01.19.2022)

## Preparation for Competition

1. The scoring spreadsheet should round deflection values to  $\pm 0.01$  inch.
2. Check that the screws on the jaws are tight.
3. Replace the battery with a new 357 cell. The installed battery runs down during storage, and if it fails during the deflection measurement is lost. The battery is under a sliding cover just below the display. Be careful not to lose or damage the cover.
4. Have extra 357 button cells available.
5. Assure smooth operation. With the device on a firm surface, the top jaw should slide without the base lifting and should move down with only gravitational force. Values should display when the upper jaw is moved. If the action is not smooth, pull the upper jaw to full extension and clean the groove in the sliding part and the depth probe from the bottom of the caliper. Liquid and liquid lubricant are not recommended.



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upper jaw  
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protruding  
cleaner

## Operation

1. Set the display unit to decimal inches.
2. Place the gauge under the bridge.
3. The bar weights attached to the chain and upper jaw should be vertical.
4. Place the steel protective sleeve over the gauge with the display showing. The viewing window should be on the exterior side of the bridge.
5. Pull the chain to open the caliper so that it can measure the maximum deflections allowed by competition rules plus a little more. For example, if the limits for downward and upward deflections are the same, open the caliper halfway (three inches).
6. Use the provided hook to connect the chain to the decking at the location specified by competition rules.
7. Move the gauge and sleeve so that the chain is vertical. It should not have kinks.
8. The initial value, including sign, should be recorded rather than using the zero button, which is very sensitive.
9. If there is no deflection for several minutes, the display will sleep. However, the last value displayed is retained and the display will wake when deflection resumes. NOTE: The display may be awakened by lightly tapping the chain.

10. If the upper jaw does not slide smoothly (see item 5 above in "Preparation..."), push it down before reading each measurement, using no more force than necessary.
11. Record the final value including sign. The scoring spreadsheet will compute deflection.