

# **2024 BRIDGE COMPETITION GUIDELINES**

Designed for grades 6-12.

Middle school teams (Grades 6-8) will not compete against high school teams (Grades 9-12).

Entries will be accepted until **March 1, 2024**.

**\*\* Entries that do not meet all construction specifications will not receive a load carrying score. NO EXCEPTIONS! \*\***

The object of this competition is to design, construct and test the most structurally efficient model truss bridge using the specifications. **Important** information for this year's competition includes:

- Minimum clear span of 20". Maximum bridge length of 24".
- Laminated members are not allowed.
- The bridge must not weigh more than 30g.
- Members may not be wider than 1/8" or deeper than 1/8".
- The bridge deck must extend the entire length of the bridge and maintain a "vehicular roadway" without any obstruction (2" wide x 2" high). The bridge deck shall be level (or flat) and shall not be curved (or arched). The bridge deck shall be constructed using a single, solid, balsa wood sheet. The balsa wood sheet used for the deck must be 1/16" thick. The bridge deck should be the full width of the "vehicular roadway" and extend the entire length of the bridge's longest dimension.
- To allow for testing, there must be a 1/2" hole at mid-span in the bridge deck. There must be no obstructions below the hole that would prevent the passage of the testing rod.
- The model bridges will be loaded initially with only the bucket and testing apparatus. Dry sand will be added after the initial loading until the bridge collapses.
- Submit one PDF file of your design drawing and original written report.
- PowerPoint presentations are not permitted at the regional competitions.

**\*\*Regional Competitions: Due to space limitations at the facilities where the regional competitions are held, please notify Mrs. Sterling Johnson with NCDOT if your group, including students, teachers and chaperones, is larger than 20 people.**

## **Construction Specifications**

1. The materials used in the construction of the bridge shall consist only of commercially available balsa wood and glue.
2. Any type of bonding material (glue) may be used.
3. A bridge may not be coated with any material (i.e. paint, stain, or glue).
4. The bridge shall contain no member wider than 1/8" nor deeper than 1/8". This member size requirement does not apply at the intersection of members. Gussets, dowels and mitered joint connections are allowed, but only at the joint areas. They can be no thicker than 1/8" and no larger than **1/2 square inch in area**. Individual members shall be constructed of a single piece of balsa wood. Laminated members are not allowed.
5. The bridge shall be a minimum of 2" wide and must allow a 2"x 2" cube to be passed along the length of the bridge ("vehicular roadway" with no obstructions, referenced above). The maximum length of the bridge shall be 24".
6. The bridge must have a minimum clear span of 20" between supports. Your bridge must allow a 3"x 3" cube to be passed beneath it at mid-span, measured while the end supports are resting on a flat surface. The bridge shall be freestanding.
7. The bridge deck shall be the full width of the "vehicular roadway" and extend the entire length of the bridge's longest dimension. There must be a 1/2" hole at mid-span in the bridge deck to allow for testing. There must be no obstructions below the hole that would prevent the passage of the testing rod.

## **TESTING**

A 1-1/2" wide x 3" long x 1/2" thick loading plate will be positioned over the hole in the deck at midspan, and placed directly on the balsa wood deck. There will be no use of steel bars to elevate the plate above the deck. A testing rod will fit through the 1/2" hole in the balsa wood deck and attach to the loading plate. An initial load will consist of an empty container suspended from the testing apparatus. Sand will be added to the container at a slow, steady rate until the bridge collapses.

## **ADDITIONAL REQUIREMENTS**

1. Draw a diagram of your bridge to scale. This can be done by hand or by using a computer program. Submit a PDF file of your bridge design.
2. Using your diagram, create a model of your bridge from your materials.
3. Write an original, 12 font sized, doubled spaced, three (3) page essay with 1" margins that includes:
  - Research on bridge building history and construction.
  - Identification of career areas used in the design and construction of bridges.
  - Describe the process used to finalize bridge design and incorporate but not limit to the following terminology:

<b>Compression</b>	<b>Joint</b>	<b>Engineer</b>	<b>Live Load</b>	<b>Span</b>
<b>Tension</b>	<b>Truss</b>	<b>Top Chord</b>	<b>Bottom Chord</b>	<b>Dead Load</b>

Students also may incorporate information about the following questions:

- Why do we need bridges? What purpose do they serve?
- How are bridges able to hold the tremendous amount of weight they hold?
- Why is it important to know whether parts of a bridge will be subjected to tension or compression?
- What is a polygon?
- Why is a triangle the strongest polygon?
- Why is it important to first create a scale drawing and model of a bridge before the actual construction begins?
- What materials are essential to design a scale drawing?
- What geometric shapes did you use in the bridge model? Why?
- How does the strength of the bridge compare to the weight of the bridge?
- What should you do to design a bridge for the future?
- How can computers help design bridges?

For information about bridges, we recommend the following web site - [Building Big Bridges](#). You can learn general information about bridges by viewing the "Bridge Basics" section and learn more about the forces that act on a bridge by viewing the "Forces Lab" section. The web site also includes information about significant bridges throughout history.

## **JUDGING CRITERIA**

A panel of judges will evaluate the bridge model using the following criteria:

**Teams can receive a maximum score of 30 for the following three categories.**

### **Oral Presentation (Score 1-10)**

You are promoting the bridge you designed and built for your client -- the judges. Demonstrate knowledge of bridge design and construction. In the oral presentation, describe the chosen design and explain the rationale behind the bridge design. Presentations at both regionals and finals may not exceed seven (7) minutes including set up and break down. Content is critical and will be the main consideration in judging your presentation.

**\*\*Remember, PowerPoint Presentations are not permitted at the regional competitions.\*\***

### **Written Report (Score 1-10)**

An original report must be written according to the guidelines outlined in the bridge model requirements. It must also include your research information.

### **Design Drawing (Score 1-10)**

All bridge models must be accompanied by a scale drawing of the bridge according to the guidelines in the bridge model requirements.

## **LOAD CARRYING SCORE**

**The load carrying score is determined independently from the three categories above.**

Load carrying score is two (2) times the weight in pounds carried.

**The calculated load carrying score will then be added to the numbers from the oral, written, and design drawing scores to create a total score.**

**The winning bridge will be the model with the highest combined score from the four categories. In the event there is a tie, the model with the lowest weight to load carried ratio will be the winner.**

**\*\*Decisions made by competition judges and testers are final. There is no dispute resolution process; however, input for process improvement is encouraged.**