

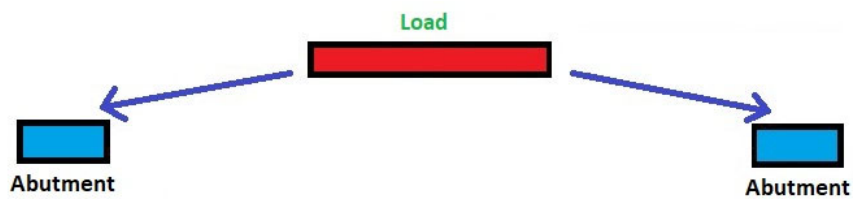


# Structural Design and Engineering

## 2024 High School Problem Statement

### BACKGROUND

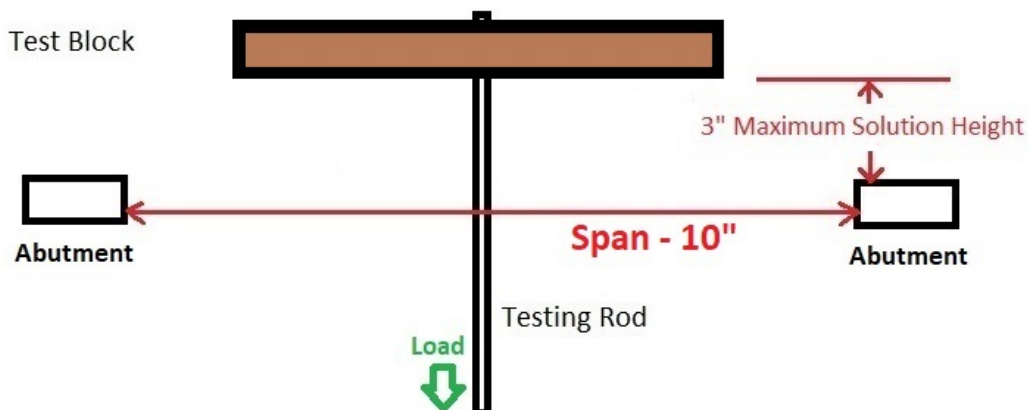
Individual structural members working together to support a load is the challenge for every engineering project. The problem statement for 2024 is to design a balsa structure that will support the greatest load possible (in the center) using the least amount of materials. The solution must transfer the load to the top of the abutments as efficiently as possible.



### DIMENSIONS

The solution must meet the following dimensions:

Length	Minimum <b>10.5"</b>	Maximum <b>12"</b>
Width	Minimum <b>1"</b>	Maximum <b>2.5"</b>
Height	Minimum <b>0"</b>	Maximum <b>3"</b>
Test Block	6" long x 2" wide x 3/4" tall	
Span	The structure tester will have a span of <b>10"</b>	



## BUILDING MATERIALS

Balsa strips (1/8"x1/8" and 1/8"x1/4") are the only building material permitted. A maximum of **16** linear feet of balsa is allowed to construct the solution – a maximum of **12** feet of 1/8"x1/8" and a maximum of **4** feet of 1/8"x1/4". Treated, conditioned, or coated balsa is **not** permitted. No other construction materials are allowed to be used in the construction of your solution.

The participants may choose a **glue** type; however, hot-melt glue is not allowed for the pre-built or on-site structures. Keep the time limit in mind when selecting the glue for semifinals.

## SPECIFICATIONS

1. The solution must be constructed using only a mixture of **1/8" x 1/8" and 1/8" x 1/4"** balsa sticks. The balsa sticks must be wood only – treated, conditioned, or coated balsa is **not** permitted.
2. A maximum of **16** linear feet of balsa sticks can be used in the construction of the solution – a maximum of **12** feet of 1/8"x1/8" and a maximum of **4** feet of 1/8"x1/4".
3. The test block will be **6" long, 2" wide, and 3/4" tall** (placed with length horizontal).
4. The test block will be placed on the solution in the center. There is no minimum measurement from the bottom of the solution to the bottom of the test block. The solution must accommodate the placement of the test block to the center of the solution from the end or from the top.
5. No part of the constructed solution may extend above 3" (the test block may extend above 3").
6. The 1/2" test rod must pass vertically through the center of the solution.
7. The span of the abutments will be **10"**.
8. A tolerance of +/- 1/16" will be applied for the length, width, and height of the solution.
9. The solution may not contact any vertical surface of an abutment below the top of an abutment at any time.
10. No part of the constructed solution can extend below the top surface of the abutments when placed on the abutments for testing.
11. Lamination refers to the combining of two or more pieces of material with the glue grain running in the same direction. **Laminations of any kind are NOT allowed in the construction of the solution.**
12. Lap joints are allowed and involve the gluing of two pieces of Balsa material with the grain pattern normally at right angles; however, lap joints less than 15° or greater than 165° would circumvent the lamination guidelines and would result in a disqualification.
13. Gussets are not allowed to be used in the construction of the solution.
14. The use of glue for coating structural components is not allowed. Excess glue on joints is considered a gusset and will result in disqualification.

## AUTOMATIC DISQUALIFICATIONS

1. Use of any material that is not 1/8" x 1/8" or 1/8" x 1/4" balsa sticks.
2. Use of any laminations or treated, conditioned, or coated balsa.
3. Use of gussets or over-gluing that emulates a gusset.
4. The solution contacts any vertical surface of the abutments at any time.

## DRAWING AND PARTS LIST

In construction, a builder uses a set of drawings along with a list of actual cut parts needed for construction. For this requirement, your drawing must be a three-view drawing that includes a **front**, **top**, and **right-side** view of the solution. If a full-scale drawing is not possible, a scaled drawing is permitted. The drawing must include the **test block** to indicate where the test block will be placed for evaluation. The title block on the drawing must include only the team ID number. The paper size is no larger than 11"x17". One page is allowed for the drawing.

A parts list is required. The parts list needs to be a list of the actual cut pieces used for the final solution. The parts list should include the length, size, and quantity. The parts list should provide the total inches for each size of material (for example, 135 inches of 1/8"x1/8" balsa and 46 inches of 1/8"x1/4" balsa).

*Example of a Parts List:*

All Material Is Balsa Sticks

Part Name	Length	Size	Quantity
Vertical Support	2"	1/8" x 1/8"	6
Horizontal Connectors	9"	1/8" x 1/4"	4
Diagonal Connectors	1.5"	1/8" x 1/8"	16

## RESEARCH AND DEVELOPMENT

Photographic evidence is required for a minimum of three iterations tested to achieve the final solution. Each photo can be of a top or side view, however, the selected view must show as much detail as possible. Each individual photo should include a label and a written description of where the solution failed and what modifications were made for the next iteration. (Three pages maximum)

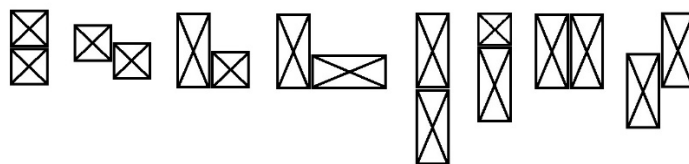
## SPECIAL NOTE

When designing the solution, the solution must allow room above the test block for the coordinator/judges to apply the u-clip and wingnut to the 1/2" testing rod for testing. This applies to any cross members or other structural elements of the solution.

## LAMINATION

Lamination refers to the combining of two or more pieces of material with the glue grain running in the same direction. The figures below are the end view examples of laminations (all possible illegal laminations are not shown below).

**Laminations of any kind are NOT allowed in the construction of the solution.**



## REQUIREMENTS FOR CHECK-IN ON-SITE

1. The completed solution is placed in a single plastic storage box (size limit for the storage box is a maximum of 18" long, 16" wide, and 12" tall). The plastic storage box should have only the **team/chapter ID** on the outside.
2. The documentation materials (comprising a "portfolio") are required and must be secured in a **clear from report cover**, which is placed inside of the plastic storage box:
  - Team Verification Form.
  - Three-view drawing of the solution on one (1) piece of paper no larger than 11"x17" (folded as needed to fit into the documentation portfolio). The drawing includes the test block to indicate where the test block will be placed for evaluation.
  - A parts list of all the structure's cut pieces used in construction.
  - Research and development photos and written descriptions of at least three iterations.

Note: The submitted documentation (drawing, parts list, and research and development photos and written descriptions) will be scored and will contribute to the overall solution score used when judging structures.