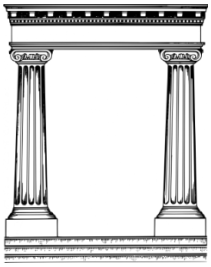
Structural Design and Engineering

2025 High School Problem Statement

BACKGROUND

The Parthenon in Centennial Park (Nashville, Tennessee) is a full-scale replica of the original Parthenon in Athens, Greece. The roof of the Parthenon is supported by a series of columns. The 2025 National TSA Conference will be in Nashville. The design brief for 2025 is to design a pair of two (2) balsa tower structures that will support the greatest load possible using the least materials. The solutions must transfer the load from the architrave to the base as efficiently as possible. *The Parthenon photo below is from istockphoto.com.*

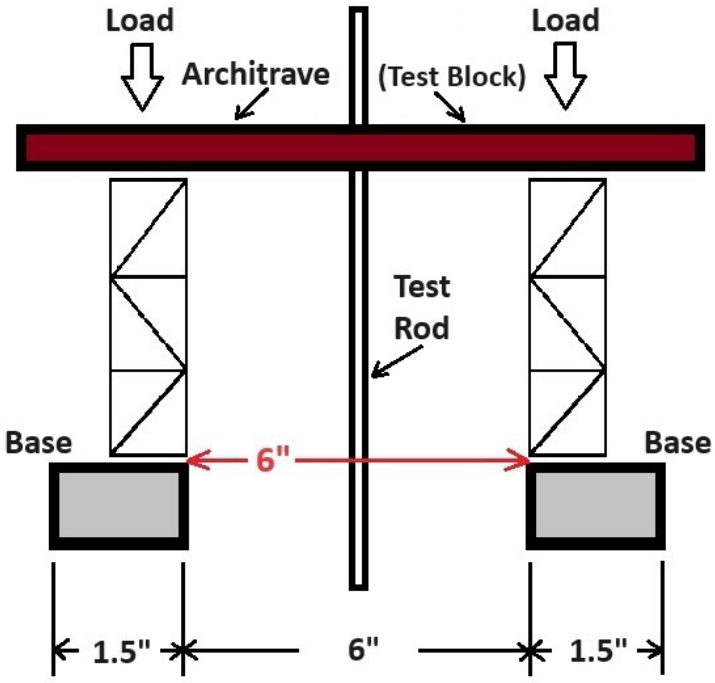


DIMENSIONS

The solution must be **two (2) separate column towers** that meet the following dimensions:

Length	Minimum **1”**	Maximum **1.5”**
Width	Minimum **1”**	Maximum **1.5”**
Height	Minimum **7”**	Maximum **8”**
Architrave (Test Block)	10” long x 2” wide x 3/4" thick	
Base opening	6” opening	

The two column towers will be placed on the bases 6” apart.



BUILDING MATERIALS

Balsa strips (1/8”x1/8”) are the only building material permitted. A maximum of **16** linear feet of balsa is allowed to construct the solution. The solution is two (2) separate balsa tower columns. 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 AND NOTES

1. The solution must be constructed using only **1/8”** x **1/8”** balsa sticks. The balsa sticks must be wood only – treated, conditioned, or coated balsa is **not** permitted.
2. The minimum height is **7”** and the maximum height is **8”**. The minimum width is **1”** and the maximum width is **1.5”**. The minimum length is **1”** and the maximum length is **1.5”**.
3. A maximum of **16** linear feet of balsa sticks can be used in the construction of the solution. The solution is two (2) separate tower columns designed and constructed from 16 linear feet of balsa sticks (not 16 linear feet per tower).
4. The architrave (test block) will be **10” long**, **2” wide**, and **3/4" tall** (placed with length horizontal).
5. The architrave will be placed on the top of the solutions. The testing rod will be centered between the two tower columns.
6. The distance between the two bases will be **6”**. The distance between the two column towers will be **6”** at the base (bottom).
7. Using an ink marker or pen, label the top and bottom on each column. If no notes are present, the event staff will determine the top and bottom.
8. Three-sided structures are permitted, but the 1” minimum and 1.5” maximum width dimension applies to each side.
9. A tolerance of +/- 1/16” will be applied for the length, width, and height of the solution.
10. The solution may not contact any vertical surface of the architrave or the bases at any time.
11. Lamination refers to the combining of two or more pieces of material with the glue grain running in the same direction. **Single lamination is only permitted with two pieces of balsa at a time.** Lamination details are provided in the ‘Lamination’ section on the next page.
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 lamentation guidelines and will result in a disqualification. If three pieces of balsa are laminated, an automatic disqualification will apply.
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.
15. The completed solution (both tower columns) is placed in a single plastic storage box with the documentation materials at check-in. The semifinal round team toolkit is a separate box and is not submitted at check-in.

AUTOMATIC DISQUALIFICATIONS

1. Use of any material that is not 1/8” x 1/8” balsa sticks.
2. Use of any 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 architrave or base 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. If the second tower is an exact duplicate of the first tower, only a drawing of one (1) tower is required. 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. Also, include a total number of inches of material (maximum is 192”).

Example of a Parts List:

All Material Is Balsa Sticks

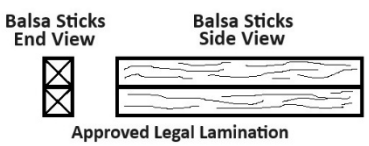
Part Name	Length	Size	Quantity
Vertical Support	7”	1/8” x 1/8”	8
Horizontal Connectors	1.5”	1/8” x 1/8”	24
Diagonal Connectors	3”	1/8” x 1/8”	8
Total Number of Inches	157”		

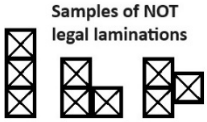
RESEARCH AND DEVELOPMENT

Photographic evidence is required for a minimum of three (3) 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)

LAMINATION

Lamination refers to the combining of two or more pieces of material with the glue grain running in the same direction. Lamination is not required. Be careful that applying glue between the two pieces of balsa doesn’t coat the exposed sides of the wood resulting in coating the wood. The figure on the left below is an end view and side view of single lamination. **Single laminations are allowed in the construction of the solutions.** Three or more pieces of balsa with grain running in the same direction is NOT a single lamination (resulting in an automatic disqualification).





REQUIREMENTS FOR CHECK-IN ON-SITE

1. The completed solution (both tower columns) 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 and the solution along with the documentation materials (portfolio) on the inside. **The toolkit required for the semifinal round is a separate box and not submitted during the preliminary round submission.**

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).
   - 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: If the team qualifies for the semifinal round, 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.