

Wood Bridge Competition

Bridge Problem Statement

- A century-old bridge that crosses a river valley in a mountainous region must be replaced.
- The bridge carries heavy truck traffic to and from mines that are the basis for the economy of this rural region, as well as providing access and emergency services to residences.
- A quick replacement is necessary because no other crossing is available for miles.

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Bridge Problem Statement

- The Tennessee State Department of Transportation (TDOT) has requested design/build proposals for replacing the existing bridge.
- Any appropriate type of bridge will be considered, but TDOT has specified wood as the material because of its availability and ease of construction.
- The bridge must carry specified patterns of traffic and wind loads without exceeding deflection limits. In order to expedite environmental approvals, no piers may be used in the river.

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Bridge Problem Statement

- The stone abutments of the existing bridge are in good condition and will serve for the new bridge, provided that no lateral thrust or uplift is applied to the abutments.
- TDOT will not permit modifications of the existing abutments.
- The new bridge, when complete, must be supported only by the existing abutments; for example, stays and anchorage to the riverbanks are prohibitive.

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Bridge Problem Statement

- Your company's design/build proposal is among those that TDOT has deemed responsive.
- TDOT has asked each competing firm to submit a 1:20 scale model to demonstrate its concepts.
- TDOT will evaluate the models by multiple criteria including efficiency and economy.
- The contract will be awarded to the company that submits the best model.

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Safety

- Safety has the highest priority.
- Judges are directed to disqualify bridges that cannot be safely constructed or load tested using the abutments and other equipment provided.
- Collapse or deflection in excess of limits specified in these rules will result in disqualification.

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Scoring

- Categories of competition are efficiency and economy.
- The efficiency of a bridge is measured by the sum of the normalized weight and deflection (*SNWD*).
- The *SNWD* is computed as:

$$\begin{aligned}
 \text{SNWD} = & \text{Total Weight (lbs)} \\
 & + [50 \text{ lbs./in.} \times \text{End-Span Vertical Deflection (in.) Load Case 1}] \\
 & + [50 \text{ lbs./in.} \times \text{End-Span Vertical Deflection (in.) Load Case 2}]
 \end{aligned}$$

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Cost

- The total cost of the model must not exceed \$50.
- If the cost of the bridge exceeds the upper limit, an additional weight penalty will be imposed as follows:

Total Weight = Bridge weight (lbs.) + (Cost - \$50) × 10 (lbs.)

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Bridge Construction Rules

1. Bridges must be constructed using Southern Pine lumber and plywood. Standard shapes may be cut to form any section required by the design team.
2. Any type of fastener or glue is allowable.
3. Members of the bridge cannot be coated or treated in any way.

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Bridge Construction Rules

4. The bridge must be designed to fit on the support. Members must span between the tops of the support to simulate a road surface. Members may brace off only the top surfaces of the support. Members may not brace off the sides or the horizontal bottom of the support.

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Bridge Construction Rules

5. The bridge span is 6 ft. with two 3-ft. cantilever sections. The bridge must be a minimum of 24 in. wide and accommodate the traffic simulator.

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Bridge Construction Rules

5. All bridges must support two load cases.

The first load case is a 1,200-lbs. load, distributed over 2-ft. at the center of the bridge.

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Bridge Construction Rules

5. All bridges must support two load cases.

The second load case consists of an additional 200-lbs. load distributed over the end 2-ft. of the cantilever.

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■ Bridge Construction Rules

6. The traffic deck may be no higher than 4 in. and must span the entire length of the bridge.
7. Each team may submit only one bridge.
8. Bridge performance will be measured by a *SNWD*. The team with the lowest *SNWD* will be awarded the contract.

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■ Bridge Report

- A written report is required for each wood bridge submitted for evaluation.
- The content and quality of the report will account for 70% of the project score.
- The remaining 30% of the project grade will be determined by the strength of the bridge based on the sum of normalized total weight and deflection (*SNWD*).

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■ Bridge Report

- There are two strength criteria for bridges:
 1. All bridges must have a minimum *SNWD* of 75 (20% all-or-nothing - bridges with a *SNWD* < 75 receive 20 points; bridges with a *SNWD* > 75 receive no points)
 2. The bridge with the lowest *SNWD* is awarded full points (10%) and the remaining bridges will be awarded scores commiserate with their performance (first place will be awarded 10 points, the last place no points).

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■ Bridge Report

- If a bridge does not meet the construction rules, listed below, the submitting student will receive no bridge points.

| Date | Event |
|------------------|-------------------------------------|
| October 22, 2009 | Rules and instructions |
| December 1, 2009 | Preliminary Report |
| December 8, 2009 | Final report due and bridge testing |



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Questions?