



TEAM ISTE PRESENTS  
**PRODYOGIKI**  
NIT HAMIRPUR

## SPAGHETTI BRIDGE CHALLENGE

### Introduction:

The first bridges built by humans were probably just wooden planks or boulders placed on a flowing stream. But today, engineers have built bridges to cross vast stretches of rivers. Before actually constructing a bridge, we need to model it and test its performance in the lab.

### Objective:

Design and construct a model of a single span truss bridge with the help of **spaghetti noodles** satisfying the constraints stated below.

### Team Size:

Each team should have 4 members.

### Dimension specifications:

- The dimensions of the bridge model must be within the following limits: **Length: 56-60 cm; Width : 10-11 cm; Height: 12-16 cm**
- There should be a proper clearance for a **10cm X 8cm X 8cm** box to pass through the span of the bridge.
- The members of the bridge can be built by grouping a maximum of 8 sticks of spaghetti noodles together.

### Weight specification:

The bridge model should weigh 350 grams or less

### Arena specifications:

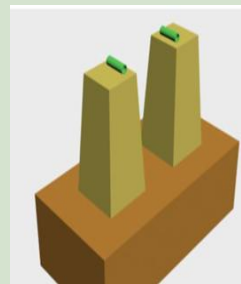
- The arena has two wooden columns representing the landmass on the sides of a river.
- The distance between the inner edges of these columns is **46 cm**.
- One cylindrical support of **diameter 2cm and length 15cm** is placed on each of the wooden column.
- One of the cylindrical support is fixed to the column and the other is free to act as a roller.



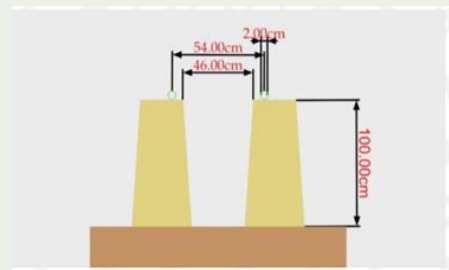
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The arena is as shown below:

Isometric View



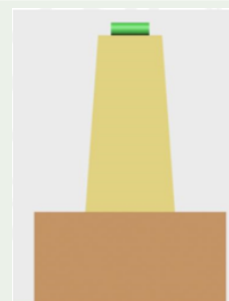
Front View



Top View



Side View





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**Materials:**

The teams shall be provided the construction materials. The teams can bring required tools to build the structure.

The following materials will be provided:

1. Spaghetti noodles
2. Cutter
3. Pencils
4. Ruler
5. A3 size sheet
6. Glue

**Some properties of spaghetti (dry):**

Ultimate tensile strength  $\sim 2000$  psi

Stiffness (Young's modulus)  $E \sim 10,000,000$  psi

**Testing of the structures:**

- The dimensions and weight of each structure will be measured. Structures violating the dimensional and weight specifications will be penalized according to the rules.
- Each structure will be mounted on the arena over the two cylindrical supports shown in the arena.
- A 20 cm X 8 cm wide plate will be placed symmetrically on the base of the structure.
- The centre of the plate will be bolted to a screw-jack which will apply load on the structure. The screw-jack will be connected to a load cell to measure the load being applied.
- An LVDT will be placed on the top of the plate to measure the deflection of the bridge.
- The structure will then be loaded and a continuous monitoring of its deflection and load will be done until it fails. The maximum load taken by the structure will be noted.

**Evaluation of the structures:**

- The structures will be evaluated on the basis of their performance under loading as well as on the basis of aesthetics.
- The efficiency of each structure will be calculated according to the following formula:  
$$e = \frac{\text{Maximum Load}}{\text{Weight of Structure}}$$
- Evaluation on the basis of aesthetics will be done by judges and will include criteria like: Innovation in design, Cleanliness of work and Overall look of the structure



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### Scoring:

The final score of each structure will be calculated according to the following rules:

- **70% weightage** - Efficiency Maximum efficiency by any structure will be taken as the constant 'E' and points will be calculated according to the formula:  $X = eE * 70$
- **30% weightage** - Aesthetics Each structure will be graded by the judges on a scale of 0-30.

### Penalties:

Penalties as mentioned below will be imposed if the structure violates the dimensional or weight specifications.

- |   |   |
|---|---|
| • <b>Weight exceeds the limit</b>                     | -Penalty of 15% of the total score  |
| • <b>Dimensional specifications are not met</b>       | -Penalty of 10% of the total score  |
| • <b>Use of any material other than that provided</b> | -Penalty of 50% of the total score or can lead to disqualification as decided by the judges |

**In case of any discrepancies, the decision taken by the judges and the coordinators will be final and bounding**