

Bridge Design Challenge

PROBLEM STATEMENT

Design a truss bridge using Spaghetti satisfying the stated constraints.



Fig.1-Malviya Bridge, inaugurated in 1887 (originally called The Dufferin Bridge) is a double decker bridge over the Ganges at Varanasi. It carries rail track on lower deck and road on the upper deck. It is one of the major bridges on the Ganges and carries Grand Trunk Road across the river.

1. Event Structure

- No. of participants in a team can be 4-6
- **Round 1:** The teams shall mail a zip file containing the abstract of their design to bridgedesign@techkriti.org The abstract should contain the following:
 - Drawings of the design (isometric and orthographic views) with proper dimensioning on AutoCAD or clear pictures of handmade sketches. Clearly state the specifications and advantages of your design and any innovative idea that you have.
 - Analysis of the design according to the loading specified in the problem statement on a simulation software (preferably SAP2000).
 - The analysis is optional but recommended.
 - The teams will be shortlisted for Round 2 on the basis of their abstracts.
- **Round 2:** The shortlisted teams shall construct their bridge under the surveillance of the organising team at IIT Kanpur.
- **Round 3:** The model built by each team will be tested till failure (yielding) by applying an incremental static load.

2. Materials

- Use Spaghetti sticks provided by the Techkriti Team.
- Sticks can be altered physically by cutting or notching at any angle.
- Only Araldite and Feviquick can be used as adhesive, use of other adhesives will lead to disqualifications.
- Threads can be used during construction, however should not be present in the final structure.

3. Dimensions and Weight Specification

- The Spaghetti Bridge dimensions should be within the specified limits of:
 - Length = 56-60 cm
 - Width = 10-11 cm
 - Height = 12-16 cm
- The members of the bridge can be built by grouping a maximum of 8 sticks together.
- **Clear distance:** An 8cm high by 10cm wide clearance must be provided along the entire length of the bridge.
- The bridge must weigh 300 grams or less.
- **In case of any discrepancies, the decision taken by the judges and the council will be the final verdict**

4. Arena Specification

- 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.
- The arena is as shown below:-

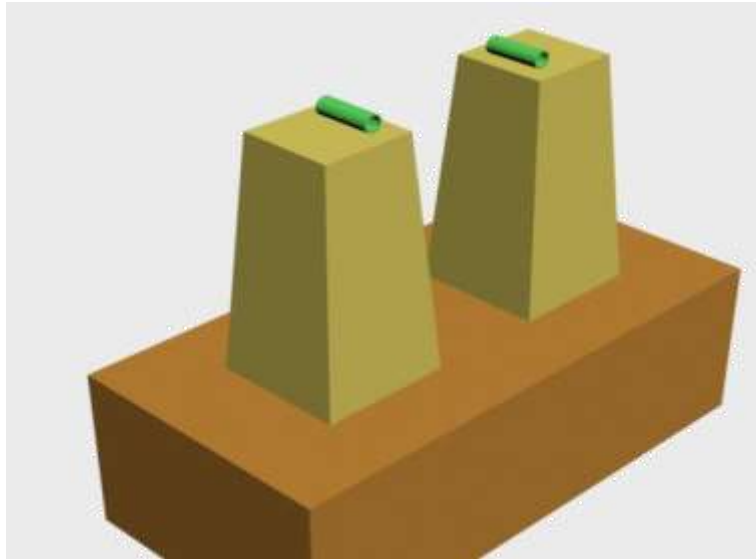


Fig 2: 3D View

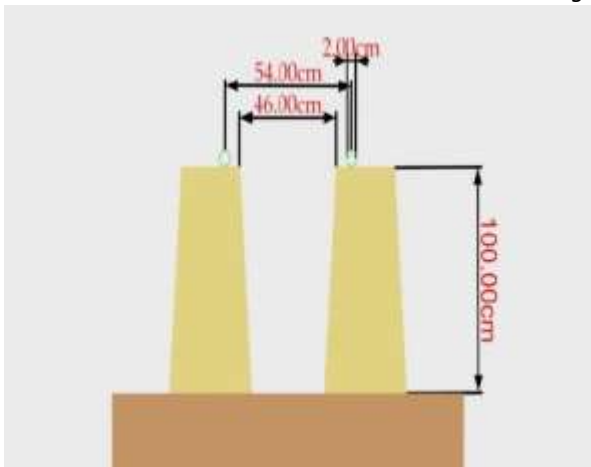


Fig3: Front View

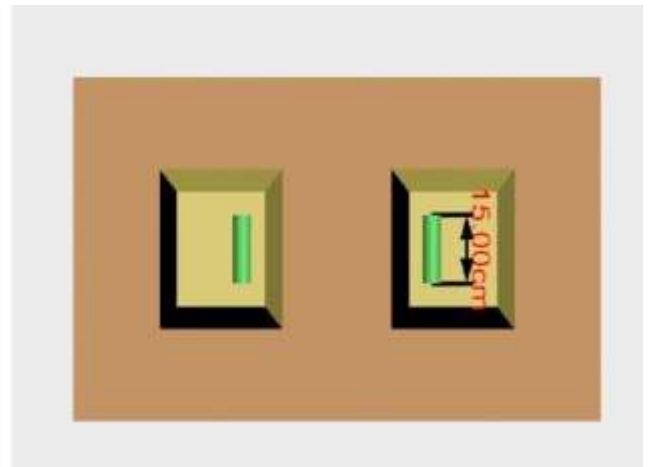


Fig3: Upper View

5. Testing the bridge

- The load will be applied through a hook that connects a steel platform that will be laid upon the span of the bridge.
- The platform will be stretched from each ends and will be connected through the hooks which will be continuously increased through the manual jack.
- The platform will be same for every team and will be placed at the middle of the structure.
- The bridge model will be loaded till failure. The maximum deflection at the point of yielding and the load at that moment will be used to evaluate the structure.
- If it happens that the structure reaches the threshold deflection of 1.0 cms then the jack will be stopped and the evaluation will be made on the same load. At this case the structure will not be tested further.



Fig3: Testing of bridge

6. Examples of kinds of trusses

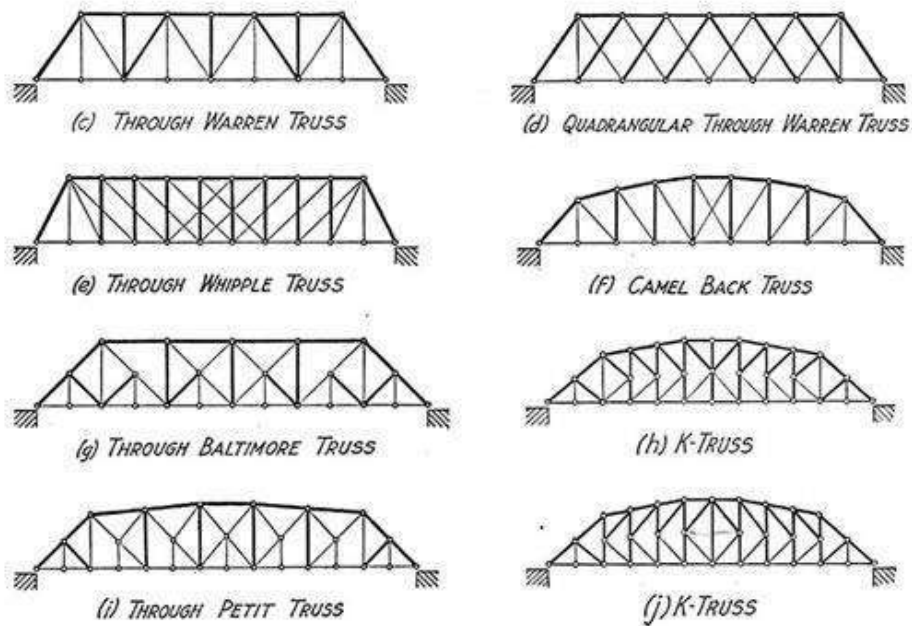


Fig3: Example of truss bridge

7. Judging and Scoring

First the structure will be reviewed to check if it violates any rules mentioned above. The scoring of the structure will be based on performance as well as aesthetics:

- The bridge will be scored on how well the material has been used to support the load. The efficiency will be calculated as the ratio of ultimate load capacity and the bridge weight

In engineering, the best solution may not always be the biggest or strongest bridge.

- The bridge will also be scored on aesthetics. The judges will judge the bridge based on the detail to connections and members, the uniqueness of the design and its overall look.
- The deflection of the bridge at yielding will be noted. If the deflection increases more than 10 mm, then the load at that deflection will be taken as the ultimate load.
- Scoring Criteria
 - Deflection at yield (d) = 20%
 - Efficiency (e) = 50%
 - Aesthetics (a) = 30%

Total Score (S) = d + e + a

Violating any of the conditions mentioned underneath, penalty will be imposed according to the judges and may lead to disqualification:

- Weight exceeds the limit
 - (Till 5% (15gm) weight exceed 5% penalty of the total score
 - But above 5% weight exceed 15% penalty of the total score)
- Dimensional specifications are not met
 - (Penalty of 10% of the total score)
- Use of material, except the ones stated in rules
 - (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 council will be the final verdict.

8. Contact Details

Namrata Choubey, 7752894462

Ajay Choudhary, 7754916071