

3D PRINT TOWER

Objectives: The objective of the 3D Printed Bridge competition is to design, fabricate, and assemble a non-metallic, 3D printed bridge capable of withstanding vertical forces applied at the top. Students are to provide a bridge that achieves the highest loading efficiency, quantified as the ratio of vertical resistance to the structure's own weight.

Background: ASCE is initiating a nationwide competition centered around 3D printing, focusing primarily on bridges. This competition, to be held at UNC Charlotte, follows the established guidelines of the national contest but with notable changes in terms of bridge geometry and loading requirements.

Eligibility: Only one team per school will be allowed to compete. This competition is for undergraduate students only. General guidance from other sources is encouraged but all the work is completed by undergraduate students.

Materials: Each team has the flexibility to design their own combinations of strut, chord, and diagonal bracing members. If necessary, they can splice the 3D printed sections at a location of their choosing based on the printing equipment's capacity. The manner joining sections cannot be achieved through metallic connections. No paint, tape, or external coatings of any kind are permitted; the printed sections are to be fabricated with Polylactic Acid (PLA) materials only. Magic markers are allowed, only for identification.

Geometry: Each bridge shall be a truss-style bridge. The bridge must span an open length of 19.5 inches (495 mm). The total bridge length can be no longer than 30 inches (762 mm). The maximum height and width of the bridge is 9 inches (229 mm) and 5 inches (127 mm) respectively.

Testing: The bridge will be placed onto two cylindrical abutments that are 4.5" (114 mm) diameter and 5.5" (140 mm) wide set 24 inches (610 mm) apart. No part of the bridge may extend more than 4.25 inches (108 mm) below the abutments. A bridge exceeding any listed dimension will be penalized.

A steel load plate 5" wide by 16.5" long will be placed on top of the bridge. A vertical load will then be placed upon the steel plate from above. The load on the bridge will increase steadily.

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Scoring: Four metrics will be incorporated and totaled to determine the teams' overall scores. Each metric has a maximum value of 100 points (400 total possible if a team were to finish 1st in every category) and is proportionally disbursed based on the number of teams competing:

For example, if four teams competed, then for each metric:

- 1st = 100 pts
- 2nd = 75 pts
- 3rd = 50 pts
- 4th = 25 pts

Similarly, if five teams competed, for each category:

- 1st = 100 pts
- 2nd = 80 pts
- 3rd = 60 pts
- 4th = 40 pts
- 5th = 20 pts

The four metrics utilized for judging are as follows:

1) Vertical Strength:

- a. The load will be applied and increased steadily until failure or deflection exceeds 4.25" clearance provided by the abutment.
- b. The performance will be calculated by normalizing the load supported by the weight of the bridge.
- c. Maximum points will be awarded to the bridge with the highest load-to-weight ratio.

2) Vertical Stiffness:

- a. Stiffness will be judged at the same load for all bridges (25 lb.) by measuring the change in vertical deflection at center span.
- b. The performance will be calculated by normalizing the stiffness (25 lb. force divided by deflection) by the weight of the bridge.
- c. The bridge with the highest stiffness-to-weight ratio will receive the maximum points

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3) Best Display:

- a. Based on the attention of detail towards printing and connection detail.

4) Closest Prediction:

- a. Teams will be required to predict the ultimate load based on structural calculations provided the estimation is less than the actual tested force.
- b. For any team(s) whose prediction was greater than the actual load, points are distributed based on the deviance.

Additional Information: Questions regarding this competition should be directed towards the Committee Chair. Clarifications will be addressed in forthcoming mailers. Teams are strongly encouraged to submit questions to avoid misinterpretation of the rules. All teams are responsible for all information provided in the Rules and Regulations and clarification responses posted.

** Additional figures and illustrations along with any clarifications will be forthcoming**