2.3 Tall Towers

Summary

Students translate their understanding of the importance of trusses to the ways in which civil engineers create tall structures.

Learning Objectives

After this class, students will be able to:

- Explain why trusses are important in the construction of structures.
- Construct a structure that uses trusses to support a weight.

Materials

Four plastic rulers with holes in each end
Four metal paper fasteners
Each student team will need:

- 50 drinking straws.
- 50 pipe cleaners.
- 25 paperclips.

Time

80 minutes

Procedure/Pacing

Truss Review

1. Help students connect what they have learned about trusses to how they are used in structures. Ask students why there are triangles in trusses. (Triangles are a stable shape, they cannot deform when loaded unless the length of their sides were to change.)
2. To help students visualize why triangles are more stable than squares in construction, construct a square using the four rulers and four metal fasteners. With the square on its side, have a student push on the square, simulating a load. Watch as the square collapses into a parallelogram.
3. Remove one of the rulers from the square and connect the remaining three to make a triangle. Repeat the loading experiment and notice that the triangle will not deform.
4. Help students visualize how triangles might be used in 3 dimensions to stabilize structures

Tall Tower Challenge

1. Divide students into teams of 2-3 students each. Explain that they will be using what they have learned about trusses to build a tall structure using only the provided drinking straws, pipe cleaners, and paperclips.
2. The challenge is to build the tallest tower, using these materials, that can hold a golf ball within the top 20% of the tower. The tower must be able to hold the golf ball for 30 seconds without collapsing and without any external support (no helping the tower with hands, etc.).
3. Students should record the Problem and Design Statement from Assignment 2.3i in their notebook. This is a good time to help them understand that as a practicing engineer, a supervisor or client will often provide your Problem and Design Statements.
4. Students should meet as teams to discuss their strategy for building. Their research to understand trusses and tall structures has already been done with the preceding class and homework. Have students draw an initial conceptual sketch of how they plan to build the tower. This step should be short, leaving plenty of time for students to experiment with building.
5. After teams have made their sketches, give them their building materials and allow them to start building. Students may assemble or cut any of their materials in any way they would like, but may not use anything beyond what they have been given. Encourage experimentation as students are building. Successful teams experiment and adjust as they build. Limit the time students are building to allow time at the end of the challenge to reflect on their designs.
6. At the end of the challenge, measure height of the tower, and the height at which the golf ball was held. (Have students calculate to make sure that the golf ball was at least 80% of the total height.)
7. As a class, compare the towers. Have students write in their notebooks what worked with their tower and what did not. Ask them to compare their tower to the best and worst performing tower and record what changes they would make if they were to do this challenge again.

In-Class Assignment

Assignment 2.3i: Tower Building Challenge

Resources

The Strength of Triangles http://www.mathsinthecity.com/sites/strength-triangles-bloomsbury-tour

Shapes Lab http://www.pbs.org/wgbh/buildingbig/lab/shapes.html

Homework

Assignment 2.4h: Presentation on Civil Engineering Technology