Critical Load Activity

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Question

How do civil engineers design structures to deal with critical load?

Grade/Subject

Grade Six Science, Physical Science.
Virginia Standards of Learning: (2010) 6.1, PS.1, PS.10

21st Century Curriculum

Engineering: Design and Build 2.22, 2.23; Civil Engineering 4.41, 4.43.

Background

Civil engineers are problem solvers who must meet the challenges of pollution, traffic congestion, drinking water and energy needs, urban redevelopment, and community planning. Structural engineers must design structures that support their weight and the loads they carry, as well as be able to resist forces such as wind, temperature, and earthquake.

If something is built that is large and complicated, such as a skyscraper, you can be sure that the skills of civil and structural engineers are at work. When structures are built, engineers must be able to measure the critical load or the maximum weight a structure can bear.

In this activity, students will learn about basic structures, how to reinforce these structures, how to select suitable materials, and how to work in a team to design and build a structure that is able to hold increasingly greater weights.

Safety

Remember to follow your regular classroom rules for labs and activities.

Materials

- 12 unused playing cards
- 1 roll of Scotch tape
- 1 two quart cardboard juice or milk container
- 4 – 9 lbs of marbles or coins

- Graph paper and ruler

Procedure

1. On notebook or graph paper, design a structure that will support the most weight without collapsing. (You may not physically alter the cards!)
2. Below your sketch, predict how many marbles your card structure will support.
3. Build a prototype of your design. (You will only have 10 minutes so be efficient!)
4. Using the scissors, cut the juice/milk carton in half and use the bottom of the carton as a base to support the weights to be added to the card structure.
5. Place the base of the carton on top of the card structure and slowly add one marble at a time until the card structure collapses. Record how many marbles the structure could support until its collapse. This is your structure's critical load.

Data Analysis/ Results

Teams share their designs and maximum loads with the class and present possible explanations for the success or failure of their card structures.

Conclusion / Questions

1. What was your structure's critical load?
2. How close were you to your prediction?
3. What aspects of your design do you think helped it to hold more weight than other designs?
4. What aspects of your design do you think hindered its ability to hold more weight?
5. What was the highest critical load in the class?
6. What was the difference in the winner's design and yours? Or…if your team had the winning structure, what do you think set your structure apart from the rest?
7. If you could do your design over, what would you change and explain why?

8. What human factors do you think a civil/structural engineer needs to take into consideration when planning an office building?

References:

Lesson activity adapted from "Critical Load," TryEngineering, IEEE.
www.tryengineering.org

MathScience Innovation Center
Information on educational programs available to students, teachers and school divisions and procedures for registering for programs.
http://msinnovation.info

Other web sites with activities for concepts of critical load:
http://greatstructures.info
www.cardstacker.com

