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Earthquake Resistant Structures

Why is Engineering Important?

Engineering plays a vital role in ensuring the safety and stability of structures, especially in regions prone to earthquakes. The "Earthquake Resistant Structures - Jello Shake" experiment is a hands-on illustration of how engineering principles are crucial in designing buildings that can withstand the forces of nature.

Safety First: Engineers are like safety experts. They design buildings to be strong and safe,.

Understanding Forces: In our experiment, we're learning how forces, like earthquake shakes, affect buildings. Engineers understand these forces to keep us safe.

Problem-Solving Skills: Engineers are great at solving problems. They use their creativity to make buildings stronger. In our experiment, we're doing the same - making our structures super strong!

Collaboration: Engineers are great at teamwork. In our experiment, we're working together to make our structures stand strong.

Fun Fact:

Completed in 2004, **Taipei 101** held the title of the world's tallest building until 2010. Taiwan is located in a seismically active region, and engineers took this into account during the design and construction of Taipei 101.

One of the key features that enhances its earthquake resistance is a tuned mass damper. Suspended between the 87th and 92nd floors, this massive pendulum-like device sways in the opposite direction of building movement during an earthquake, helping to counteract and reduce the swaying motion. This innovative engineering solution plays a crucial role in stabilizing the building and ensuring the safety of its occupants during seismic events.

What is a "Tuned Mass Damper"?

Also known as a harmonic absorber, is a device designed to reduce or control vibrations in a structure, particularly in tall buildings, bridges, or other large structures. The primary purpose of a mass damper is to counteract the effects of external forces, such as wind or seismic activity, and enhance the stability of the structure.

The mass damper is tuned to a specific frequency, which allows it to counteract the natural frequency of the building's vibrations.

https://youtu.be/mGe9zjwK2gQ?si=iUZlnPVsSfkPJ1y4

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Activity

Basic Shapes

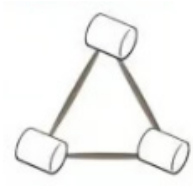
Activity Overview:

To understand the principles of 2D shapes like squares, triangles, and rectangles, or venture into the world of 3D shapes with pyramids, cubes, and prisms.

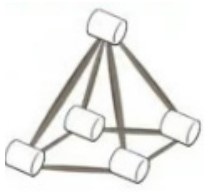
What you need:

- Toothpicks
- Mini marshmallows

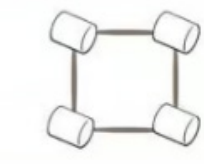
☐ Create a Triangle



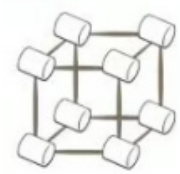
☐ Create a Pyramid



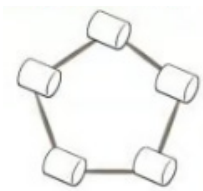
☐ Create a Square



☐ Create a Cube

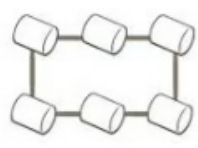


☐ Create a Pentagon

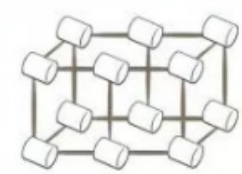


☐ Create a Pentagonal Prism

☐ Create a Rectangle



☐ Create a Rectangular Prism



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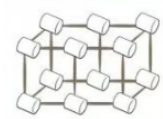
Activity

Earthquake Resistant Structures - Jello Shake

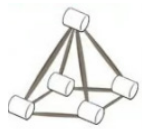
Activity Overview:

To understand the principles of earthquake-resistant building design and its impact on structures by constructing a toothpick and marshmallow building on top of jello.

What you need:



- Toothpicks
- Mini marshmallows
- Jell-O
- Mixing bowl
- Rectangular or square shallow containers
- Marker
- Ruler
- Tape
- Small weights (optional)



Instructions:

1. Prepare the Jello Base:

2. Construct the Building:
   a. Using toothpicks and mini marshmallows, build a simple structure that can stand on its own.
   b. Consider creating walls, columns, and a roof using the toothpicks and marshmallows. Ensure that the structure is not too heavy for the jello to support.

3. Place the Building on the Jello:
   a. Gently place your toothpick and marshmallow building on top of the partially set jello.
   b. Ensure that the building stands steadily on the jello surface.

4. Simulate an Earthquake:
   a. Use your hands to gently shake the container holding the jello. This simulates an earthquake.
   b. Observe the behaviour of the toothpick and marshmallow building during the simulated earthquake.
   c. Record any movement, shaking, or collapse of the structure.

5. Adjust and Reinforce:
   a. Make modifications to your building design to make it more earthquake-resistant. You can add diagonal braces or extra support to the structure.
   b. Re-test the structure on the jello by simulating another earthquake.

6. Data Collection and Analysis:
   a. Record observations of the building's stability before and after modifications.
   b. Measure any movement or deflection in the building during the simulated earthquake.
   c. Reflect on how the modifications influenced the building's resistance to the earthquake.

7. Discussion:
   a. Discuss the importance of earthquake-resistant building design.
   b. Explore real-world examples of earthquake-resistant structures and engineering techniques.
   c. Encourage students to brainstorm and propose additional modifications for enhanced earthquake resistance.