CIVIL AND STRUCTURAL ENGINEERING WITH THE NHERI TALLWOOD PROJECT

TALKING POINTS

KNOWLEDGE & COMPREHENSION

1. What is Cross Laminated Timber (CLT), and why is it more suitable for the construction of tall buildings than traditional wood frame construction?

2. How does the rocking wall system work?

ANALYSIS

3. What is the difference between resilience and performance, and why might one be better for tall buildings in earthquake-prone areas?

4. Shake table testing is a very expensive method of engineering investigation. Why do you think the team doesn't just stick to computer models?

5. The first skyscraper was built in 1885, followed by many more over the next few decades. What do you think changed that made these sorts of buildings possible?

APPLICATION

6. Elevators are an example of a non-structural component. How might they be designed so they can be incorporated into a rocking wall system?

7. Hurricanes are an example of a lateral force exerted on a building. Do you think the measures taken for buildings to survive earthquakes are applicable for hurricanes? What other factors might need to be taken into account?

EVALUATION

8. Why is it important that construction companies are advocates for sustainable sourcing?

ACTIVITIES YOU CAN DO AT HOME OR IN THE CLASSROOM

To do individually or in teams

Imagine you are a civil engineer based in a coastal city. Due to the effects of climate change and gradual subsidence, scientists predict that storm surges are going to become more common in the area. You are responsible for designing a type of tall office building that is resilient to this form of natural disaster.

1. Design your building. You may wish to sketch out your design and annotate it. Think about the following things:

- A storm surge is an example of a lateral force. How does the force it exerts differ from earthquakes?
- Is a rocking wall system appropriate? What about a second rocking joint?
- What would be appropriate building materials? Consider durability, cost and sustainability in your choices.
- Is bidirectional loading a concern?
- What about non-structural components? In particular, think about electrics, plumbing and ventilation. How could these be adapted?
- The article mentions 'community resilience'. How can this be incorporated into your design?

2. Now, consider how you would simulate the effects of a storm surge through computer modelling. What parameters would you need to account for? Think about:

- Force
- Directionality
- Resistance and resilience
- Non-structural components
- Insight from real tidal waves in the past

3. Next, consider how you would test this through a physical simulation, equivalent to the shake table. How would you design a 'storm surge simulator'? Think about:

- Underlying mechanics
- Likely challenges
- Cost and feasibility
- The possibility of using natural features to your advantage

4. All the results are in and they suggest your building design performs well when experiencing storm surges, suffering minimal damage from strong waves. Now, you have to convince councillors, town planners and contractors that your design is suitable. Not all of these people will know much about engineering. Design a short presentation to achieve this. Think about:

- The importance of imagery
- The right level of facts and statistics
- Use of technical language
- Key take-home messages

Once you are done, you can present to the class, and ask for feedback on your design and your presentation. Is there a winning design in your class?

BUILD YOUR OWN TOWER USING TOOTHPICKS AND GUMDROPS!

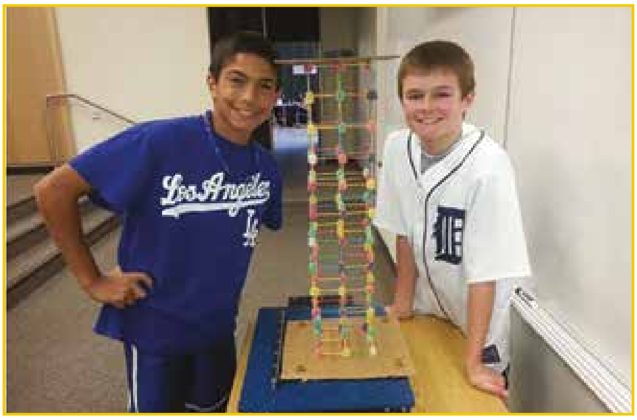
Per team, you will need:
250 toothpicks
A large bag of gumdrops
Two cardboard bases (one for the tower and one for the 1 kg weight)
A slim 1 kg weight
A glue gun

In teams of two to four, build a tall tower using toothpicks and gumdrops (see image) in 30 mins. You don't need to use all of the toothpicks or gumdrops, but think carefully about how different shapes will make the tower more or less stable. For extra stability, glue the tower to a cardboard base. When you have finished building your tower, measure it and record the height.

For the load test, glue a 1 kg weight to a cardboard base (see image). A 20 cm x 20 cm base might be a good option for this. Lay the weight (on the cardboard base) flat across the top of the tower. Which team's tower held the load for the longest/least length of time? What makes these towers strong/weak?

For the seismic test, research online for instructions on how to make a shake table. We like the National Science and Technology Centre's Questacon: https://www.questacon.edu.au/resources/teacher-resources/shake-table

Glue the cardboard weight to the gumdrops at the top of the building. Attach it to the shake table and discover just how resilient your tower really is! Again, think about how many toothpicks and gumdrops you used, and the height and shape of your tower. What factors might have influenced its resilience to the seismic test?



FURTHER RESOURCES

- In this TED talk, architect Michael Green talks about why he believes wood is the construction material of the future: https://www.ted.com/talks/michael_green_why_we_should_build_wooden_skyscrapers?language=en
- This video shows a shake table in action: https://www.youtube.com/watch?v=Y7kKcIsBKDo
- This article explores the engineering techniques behind the world's five most earthquake-resistant structures: https://interestingengineering.com/top-5-earthquake-resistant-structures-around-world