How Can We Make Stronger Buildings?

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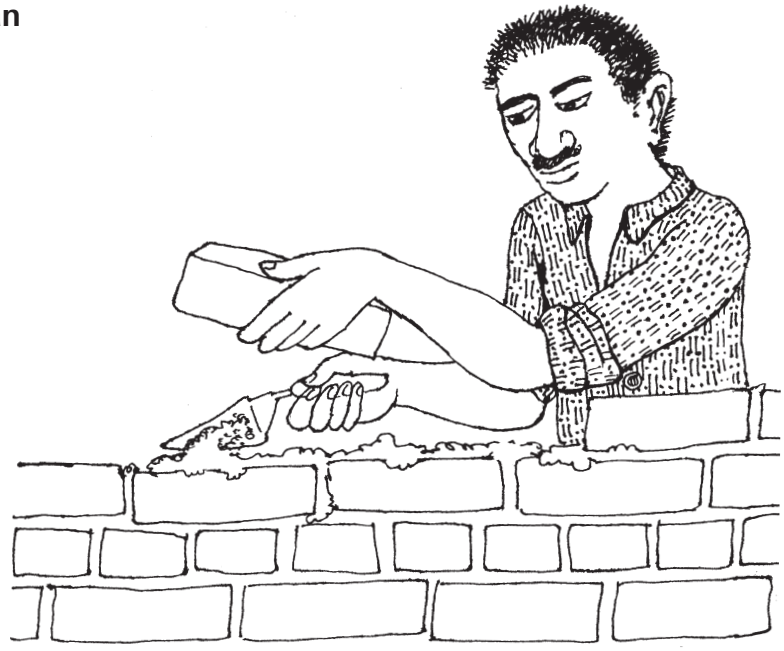
Grade level: Classes V-VII



Introduction

In an earthquake, we find that some buildings fall down or are damaged while others are not. What are some basic building methods that will result in strong structures?

Science concepts

1. Experimenting with building designs
2. Devising experimental methods to test the strengths of structures
3. Comparing the strengths of different construction designs

Previous knowledge

No particular knowledge of construction methods is necessary.

Teaching/learning materials

Building materials such as stones, mud, blocks, paper, cardboard, sticks, pieces of wood, plastic, etc.

String, Glue, tape, etc.

Students' Guide

Scenario

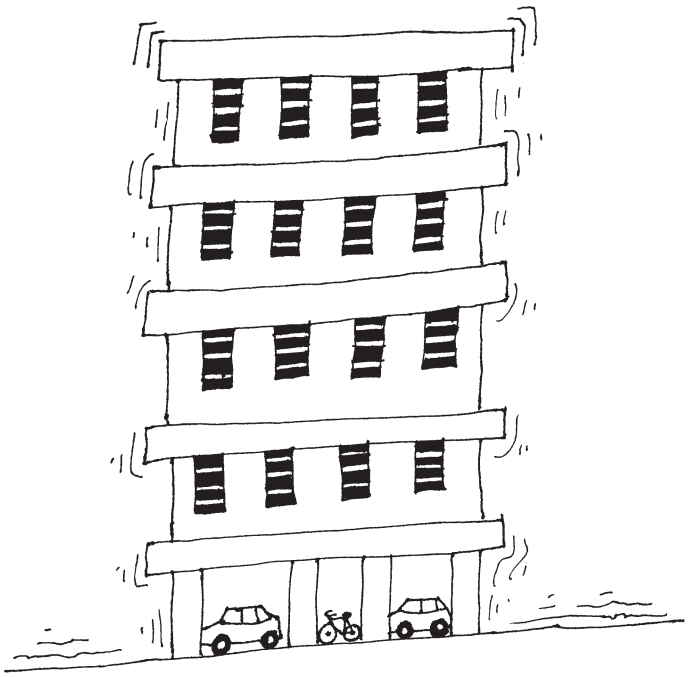
Simran and her mother were going back home to Bhuj after their stay with relatives in Haryana. On the train Simran's mother started talking to the other passengers who were sitting in the same compartment. After finding out that Simran and her mother lived in Bhuj, they started talking about the earthquake that had occurred there a few months before.

Simran said, "Everything started shaking. We ran down the stairs and out into the street. A big house down the street where Bimu lives fell down."

"Aaccha?" another passenger replied.

"Simran has missed so much school. You much finish learning your science, beta," Simran's mother said as she reopened the science book for Simran.

Simran started reading the book and her mother leaned forward and spoke in a low voice to the passenger, "It was very bad - we haven't told her yet what happened to her friend Bimu. The house fell on the whole family. Our house was spared."



In the Gujarat earthquake of 2001 some buildings were damaged and others were not. In some cases one building was completely damaged while another building next to it was completely undamaged. Could this be due to the different designs of the buildings? Can we learn to design buildings that will not be destroyed in earthquakes?

Your Tasks

1. Read the story out loud, with expression and action. What questions does the story raise in your mind?
2. Using the materials your teacher has given you, or using whatever materials you can find around the school grounds, construct some structures and compare which ones are strongest, as shown in the Student Handout. You will have to work with those in your group to design the structures and devise fair tests of their strength. Carefully record your guesses (before you test) and your results (after you test). Then write down the conclusions your group reaches.

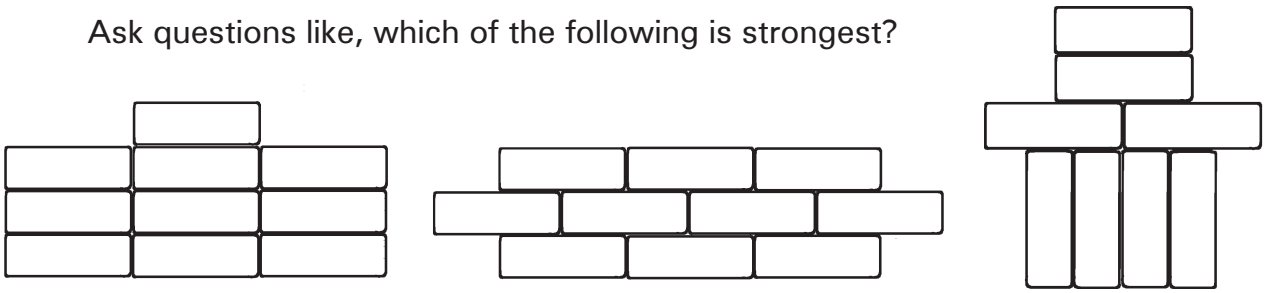
Student Handout

Do one or more of the following:

1. Using just one piece of paper, who can make a bridge or roof that will support the most weight?

2. Use blocks to build two different structures on a board. Compare which ones are best able to withstand jiggling of the board.

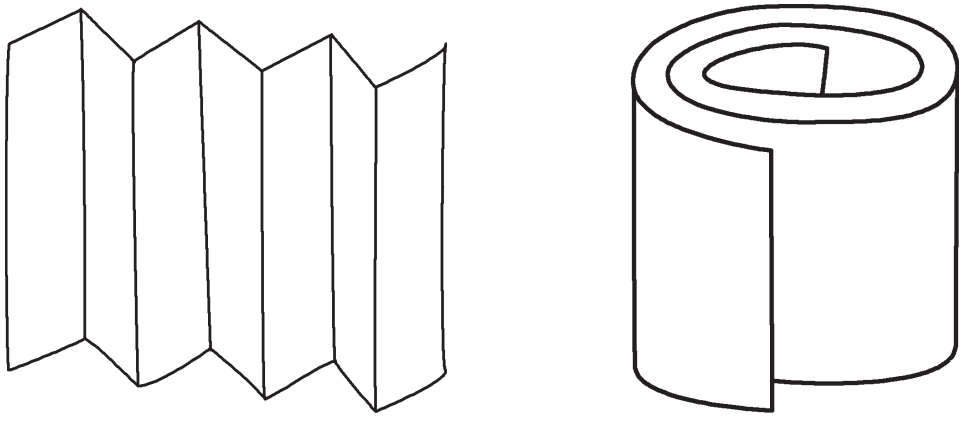
   Ask questions like, which of the following is strongest?



A **B** **C**

3. Using only one piece of paper, who can make a structure that will hold 3 Science textbooks 5 cm off the ground?

4. Which of the following structures can support more weight on top? Devise a way to make a fair test (e.g. (such as by stacking books on top), and find out. Record your results.



5. Consider questions such as:

   - Which are more earthquake proof: rigid buildings or flexible buildings?
   - Should very tall buildings be banned in earthquake prone areas?
   - Are traditional or modern building methods better?

Teachers' Guide

Suggested Teaching Strategy

1. Ask the students to read the story out loud, with expression and action. Ask them what questions arise in their minds after reading the story. Ask whether they think buildings can be built to withstand earthquakes, and if so, how.
2. Divide the class into small groups of about 4 students each. Assign one or more of the activities given in the Student Handout. (All the activities need not be done.) Tell the class that they will have to work together to design structures and to devise fair tests to compare the strengths of the structures. Do not tell them how to do these things – let them find out for themselves. Allow enough time so that they can thoughtfully carry out their work, and repeat and modify their methods if needed.
3. Have a class discussion in which each group explains what they did and what their conclusions were. Compare the work done by different groups and encourage the students to ask each other questions.

The tasks in the Student Handout are given as examples, you can think of other activities using other materials to encourage the students to experiment and find out for themselves which construction methods are best. They need not use expensive materials. Mud, sticks, and stones might be the best materials.

About the script:

When we first thought of the idea for this script (in the Delhi Dec 2001 Workshop), some people were sceptical, saying that children will not be able to design and invent good building methods on their own.

For example, they argued that if a child was asked to use a piece of paper to build a bridge between two piles of books that would be able to support a lot of weight, the child would not be able to invent good designs without help.

So, we found a child (of about 10 years old), gave him 2 pieces of paper and asked him to use it to build a bridge that would hold a lot of stones. We left him alone outside, secretly watching from a window to see what he would do. He tried out a number of ideas. He tried setting the paper in the long direction or in the short direction. He tried putting stones on the ends of the bridge for support. He tried folding the paper in different ways. Finally he made a bridge that had sides folded up several times and he reported that this design was able to hold the maximum weight. We felt that this exercise had been useful – the child had used the scientific method of guessing, designing, testing, observing, reguessing, retesting, etc. He was ready to challenge the guidelines, question his suppositions, and be creative, without needing someone to instruct him.

Later on, this script was tried out by the adult participants in the February Chandigarh Workshop. We gave them the same task that we had given the boy in Delhi: to make a strong bridge using a piece of paper. There happened to be a few teachers in the Workshop who had heard that a paper folded into an accordion shape can support the maximum weight. So they immediately made their bridge like that, then sat back and waited for the others to finish. Gradually the other teachers noticed what they had done and also made accordion bridges. When it was time for them to report on what they had made, everyone showed only the accordion type bridges (even though in the beginning I had noticed a few other designs). Some of the teachers also did not seem to be very creative in trying to figure out whether different accordion designs would give different results.

This shows that this activity may be best for people who are not already familiar with strong building methods. Most probably it will work better for children than for adults, keeping in mind that the objective is to experiment, not just to remember what kind of building is strongest.