



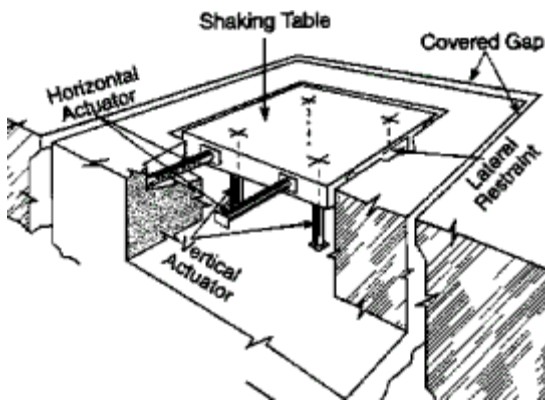
just in case arizona

Build A Shake Table

Do you want to see how the structures you've designed will stand up in an earthquake? One way you can do this is by testing them on a shake table or seismic simulator.

What is a shake table?

To study the effects of earthquakes on structures, researchers at the Multidisciplinary Center for Earthquake Engineering Research (MCEER) mechanically recreate these natural disasters in their laboratory at the State University of New York at Buffalo (UB) using an earthquake simulator or shake table.



The shake table is a 12 feet by 12 feet square platform made of concrete poured around a steel frame, with a ferrocement exterior (concrete and wire reinforcement). It has five degrees of freedom, meaning it can move in five separate directions. The table can move horizontally and vertically, as well as roll back and forth, rock from side to side, and twist on a central axis.

A computer system is used to control the motion of the table. The system enables researchers to input any one of more than one thousand earthquake records into the table and simulate vibrations of actual past earthquakes. In addition, researchers can create their own earthquake as well as test anything beyond existing recordings on the Richter scale.

What should I consider when I design my own shake table?

- Cost of table and materials for models
- Feasibility of construction
- Ability of the table to take the weight of the different materials
- Directions of motion -- the more the better
- Scale -- the larger the better

What can you test on a shake table?

- Building models
- Bridge models
- Soil, sand, and water combinations
- Components of buildings and bridges, such as beam and column connections, walls, and foundations

What are some things you can learn?

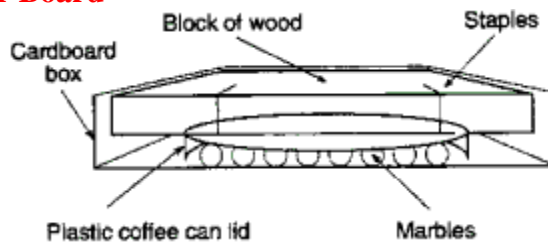
- Not all structures perform alike during the same ground motion
- Size, shape, and materials used in structures make a difference
- Structures have a natural period of vibration
- Structures have a certain level of flexibility

Buildings' contents are affected by:

- the ground shaking
- the building's earthquake resistance

Two different styles of shake tables that you can build

Shaker Board



Materials:

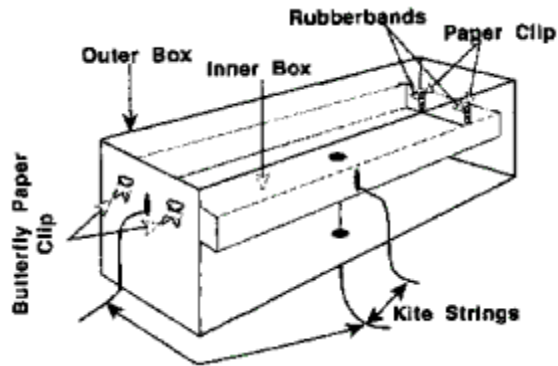
- marbles
- coffee can lid
- piece of wood (or wooden platform)
- box lid (about 1/2" depth)

Procedure:

- Staple plastic lid to wooden block
- Put marbles under the lid. Experiment with varying amounts and sizes.
- Place marbles, plastic lid, block of wood in card board box lid to contain amount of movement.
- Place structures on the wooden block and simulate an earthquake.

- First do back and forth motion to imitate P waves (more accurate if very rapid)
- Next do vertical or side to side motions to imitate S waves (more accurate if very rapid)
- Surface waves, with a gentle rolling motion, will arrive later

Shake Table



Materials:

- box insert
- box with top flaps cut off
- kite string or twine
- marker
- paper clips (4 large size, 6 butterfly)
- popsicle sticks (5)
- rubber bands (4 heavy size)
- ruler
- scissor
- washer

Procedure:

The shake table consists of a box (with flaps cut off) and an inner box insert that will be the floor of the shake table. The movement of the shake table is done by pulling on the kite string from each end and underneath the box. The rubberbands also help simulate movement and shaking.

Final Considerations:

Whichever shake table you build, observe the motions of each of your structures on it. Attach all of your structures to a single base so motions can be better observed.

Which part of the structure moves the most? The least? How could you improve your structure?

Additional Resources:

- Black, B. (1990, March 9). Quake-proof building. Scholastic News, Explorer Edition 4, Hands-on Science Supplement
- Bracing for the big one. (1990, October). Superscience Blue, pp.15-17.
- Chayet, B. (1990, March 9). Bending without breaking. Scholastic News, Citizen Edition 5, Hands-on Science Supplement.
- Northwest Earthquake Workshop for Teachers (N.E.W.T) (1990). Pacific Science Center.
- Salvadori, M. (1990). The art of construction: Projects and principles for beginning engineers and architects. Chicago: Chicago Review Press.
- Santilli, C. (1993). Kids for architecture. Construction Specifier, 7691.
- Shake Board developed by Dr. Joyce R. Blueford, Plate Tectonic Cycle of the Integrating Science, Math, and Technology.
- Shake Table developed by Walter Kutschke from the Northwest Earthquake Workshop for teachers.

(Source: Multidisciplinary Center for Earthquake Engineering Research (MCEER), <http://mceer.buffalo.edu>)

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