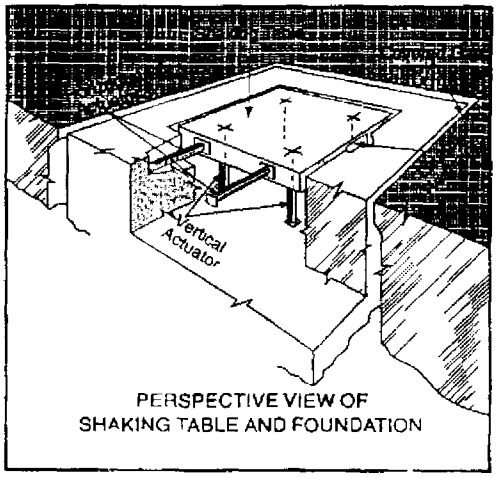
Doc 9086
NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH
Headquartered at the State University of New York at Buffalo

Earthquake Education Series

MAKING 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?



PERSPECTIVE VIEW OF SHAKING TABLE AND FOUNDATION

To study the effects of earthquakes on structures, researchers at the National Center for Earthquake Engineering Research (NCEER) mechanically re-create 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 12 feet by 12 feet square and 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. It is among the most versatile shake tables in North America.

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 DO I WANT TO 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 I TEST ON MY SHAKE TABLE?

- Building models
- Bridge models
- Soil-sand-water combinations

WHAT ARE SOME THINGS I CAN LEARN?

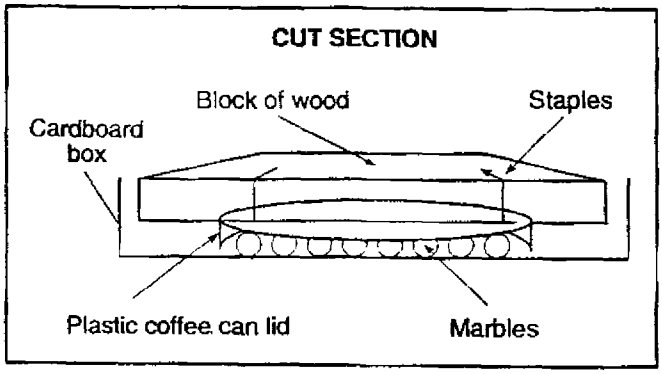
- All structures do not perform the same when subjected to ground shaking
- Size, shape and materials used in structures make a difference
- Structures have a natural period of vibration and a certain level of flexibility
- Contents of a structure are affected not only by table shaking but performance of the structure

WHAT ARE SOME SHAKE TABLES I CAN BUILD?

There are different levels of difficulty in the shake tables you can construct.

1. Shaker Board[1]

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

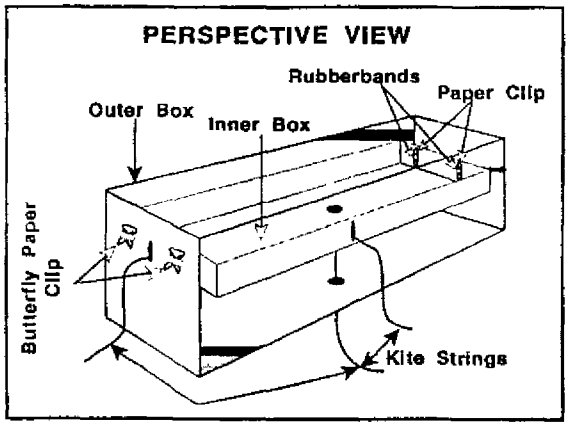


Procedure:

1. Staple plastic lid to wooden block
2. Put marbles under the lid. Experiment with varying amounts and sizes.
3. Place marbles, plastic lid, block of wood in card board box lid to contain amount of movement.
4. Place structures on the wooden block and simulate an earthquake.
   a. First do back and forth motion to imitate P waves - more accurate if very rapid
   b. Next do vertical or side to side motions to imitate S waves - more accurate if very rapid
   c. Surface waves - with a gentle, rolling motion - come after

2. Shake Table[2]

Materials: box insert, box with top flaps cut off, kite string or twine, marker,
paper clips (4 large size, 6 butterfly), popsicle sticks (5),
rubberbands (4) heavy size,
ruler, scissors, washer



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

3. Earth Shaker Shaking Table

An electromechanical shake table can be constructed inexpensively. Materials: foam board top and base, coil springs (4), DC motor, flywheel, mini-binder clips (8), nuts and bolts. This more advanced shake table has higher precision and durability. It is powered by batteries and can be constructed in less than two hours. For detailed instructions or a complete kit, contact the inventor[3].

FINAL GUIDELINES

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?

RESOURCES

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FOR MORE INFORMATION

Katharyn E. K. Ross
Education Specialist
National Center for Earthquake Engineering Research
University at Buffalo
Red Jacket Quadrangle
Buffalo, NY 14261
Phone: 716/645-3391 Fax: 716/645-3399

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[1] Adapted from Shaker Board directions provided in the "Plate Tectonic Cycle" of the Integrating Science, Math, and Technology by Dr. Joyce R. Blueford.

[2] Adapted by Walter Kutschke from the Northwest Earthquake Workshop for Teachers.

[3] Invented by Ken Potter, Heads and Hands Edutainment, Inc., 2209 Odie Blvd., Suite 344, Sparks, NV 89431.