

Seismic Modeling with an Earthquake Shake Table

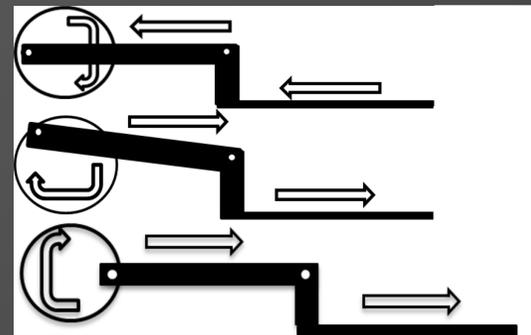
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Abstract

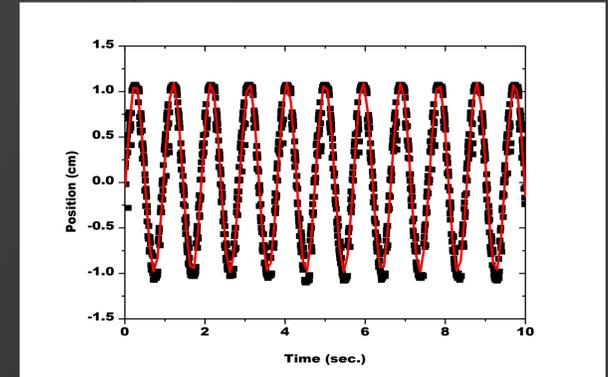
An earthquake shake table was constructed with three orthogonal directions of motion to simulate seismic waves. The peak amplitude and directions of motion are adjustable by the user. The table's acceleration was measured at different amplitude settings for all three directions of motion, and that data was fit to the Peak Ground Acceleration (PGA) scale. This allows the table motion to be calibrated to the proper magnitude of an earthquake. A quake equivalent to 5.0 intensity on the PGA scale was achieved.

Results

Experiment



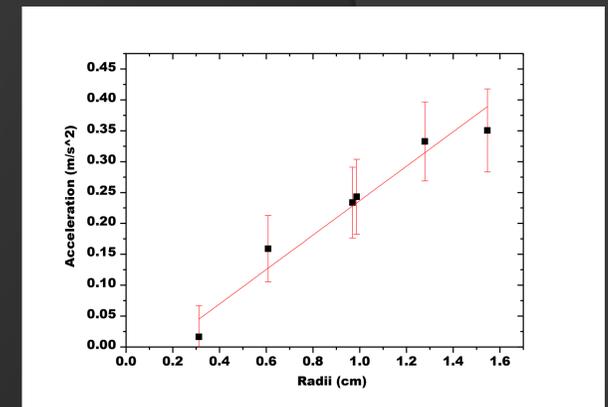
The conversion of rotational motion into linear motion



The sinusoidal oscillation of the table in the X direction shows a period of about one second. The curve fit yields the exact amplitude and period of motion, from which the maximum acceleration can be determined.

Introduction

- The movement of tectonic plates create earthquakes
- The earthquakes are felt as seismic waves are released
- Buildings are designed to survive earthquakes
- Earthquake shake tables simulate earthquakes and test building designs
- Most damage is related to ground motion
- PGA scale measures ground acceleration

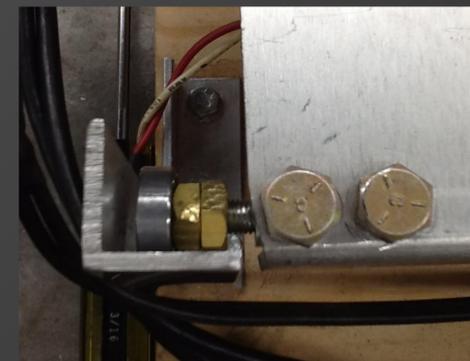


Variation of maximum acceleration in the x-direction as the plate radius is manually adjusted, showing the range of accelerations that can be obtained. The plate radius and maximum acceleration are linearly related, as expected.

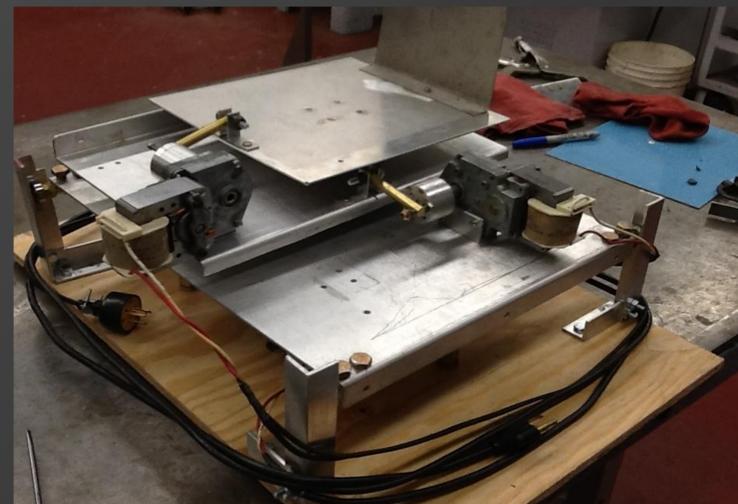
Theory



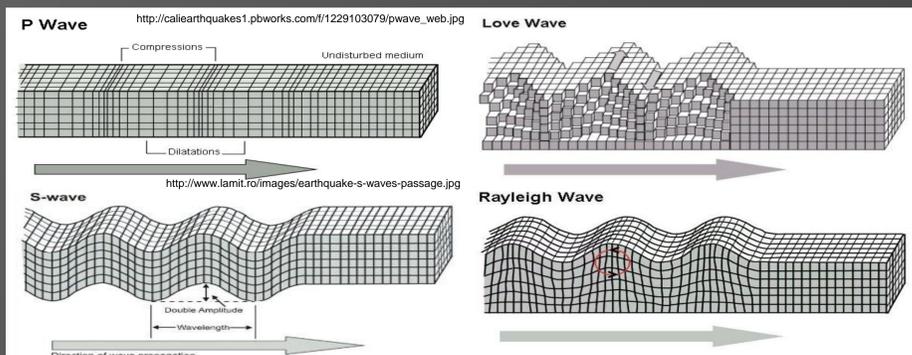
The linear track and block used to guide the directions of motion



Vertical direction guide design



Full picture of the earthquake shake table



Peak Ground Acceleration scale

0.001 g (0.01 m/s ²)	Perceptible by people
0.02 g (0.2 m/s ²)	People lose their balance
0.50 g	Well-designed buildings can survive if the duration is short.
>1.24 g	A 10.0 of intensity on the PGA scale

Conclusion

- Maximum Acceleration reached:
 - X-Direction 0.035g
 - Z-Direction 0.042g
 - Y-Direction 0.025g
- Multiple amplitude settings for each direction
- Three directions of independent motion
- Allows for multiple types of seismic waves to be tested