

# THE EFFECT OF EARTHQUAKES ON BUILDINGS

## *Purpose*

*To simulate the response of buildings to the shaking caused by earthquakes and to find out which shapes vibrate least.*

## *Activity*

*It is the Love and Raleigh waves, which only travel along the earth's surface, which do all the damage to buildings.*

- 2 Record the sizes of all the buildings if this data it is not provided.*
- 3 Trial run: increase the speed of vibration slowly and watch what happens to the buildings.*
- 4 Return the frequency of vibration to 1 hertz and then slowly increase the frequency incrementally. For each increment record the amplitude of the vibration of each building as none, slight, moderate or large. Record the frequency at which each building shows the greatest amplitude of vibration (resonance).*
- 5 Move the board through 90° and repeat your recordings.*
- 6 Plot your data as you think best.*
- 7 Draw your conclusions.*

## *Question*

*Explain why in the Kobe earthquake in Japan many of the 20 story buildings were undamaged but the 10 storey ones were badly damaged?*

## Teacher's Section

### Requirements

Signal generator

Vibration generator.

Cradle for vibration generator

Block 45cm by 10cm by 5cm

Block 30cm by 10cm by 5cm

Plywood or hardboard 30cm by 30cm

Sponge shapes

*Making the equipment (2.5 hours including cutting the sponge)*

*The vibration generator should be placed in a cradle so that it vibrates in a horizontal plane and this attached to a piece of wood 45cm by 10cm by 5cm. The generator itself is attached to a piece of wood about 30cm by 10cm by 5cm with a cup hook screwed into the end (see diagram).*

*Rectangular pieces of sponge of different widths, heights and thicknesses are glued by their smallest ends to a piece of plywood 30cm by 30cm.*

*The plywood has small holes drilled in the centre of each edge. These fit onto headless nails on the wooden block so that the plywood can be turned through 90°. I have the following sizes in centimetres of sponge shapes.*

*They can be cut from sponge using a hot wire.*

*15 x 2 x 2            10 x 2 x 2            5 x 2 x 2*

*15 x 2 x 3            10 x 2 x 3            5 x 2 x 3*

*15 x 2 x 5            10 x 2 x 5            5 x 2 x 5*

*15 x 2 x 7            10 x 2 x 7            5 x 2 x 7*

*15 x 2 x 10          10 x 2 x 10          5 x 2 x 10*

*It would be quite satisfactory to have half this number or by just using those sizes in bold one can demonstrate that at certain vibration speeds the smaller building vibrates more than the taller one.*

### Notes

*A shake table which would replace the signal generator and vibration generator can be bought from Middlesex University Teaching Resources f*

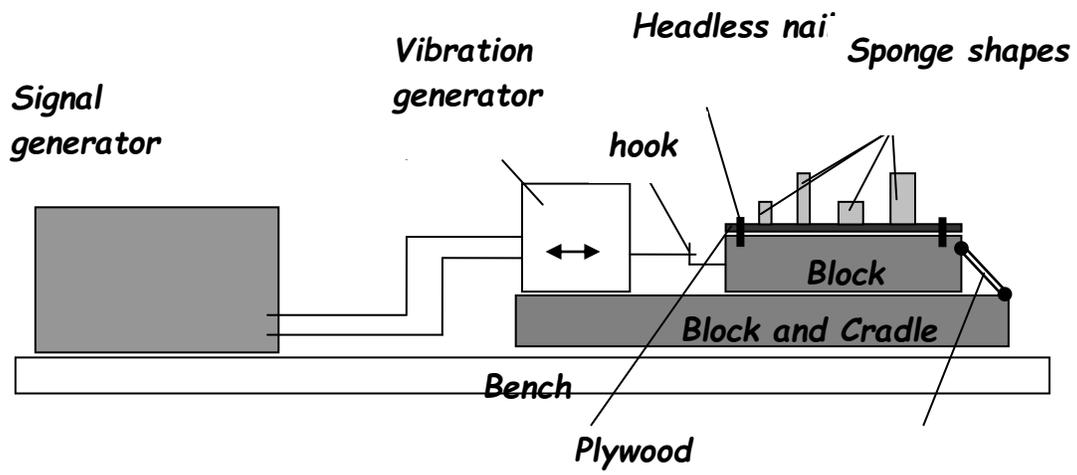
### Results

*Tall thin buildings generally vibrate the most and short squat ones the least. However at certain speeds of vibration the tallest do not vibrate and the moderate height buildings do. This explains why in some*

*earthquakes e.g. Kobe the tallest buildings were not damaged but shorter ones were.*

*Time*

*30 minutes*



Signal generator, vibration generator and sponge shape