Can Music Cause Earthquakes?

Background

The analysis by which a building's susceptibility to an earthquake is determined is based on the response of a SDOF (single degree of freedom) oscillator to the excitation. Suspending or supporting the mass on a spring as shown in Figure 1 is the easiest way to construct a SDOF oscillator. The spring and mass represent a building, and the base represents the ground.

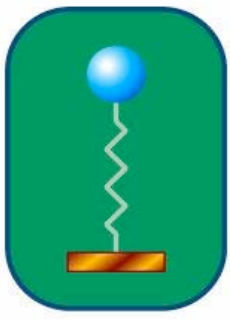

Figure 1

If we take such a "building" and subject the "ground" to the motion of an earthquake, we can determine if the building will survive. For this project, we can use vibration of the base to stimulate an earthquake. Different kinds of music can be used as the base or ground vibration.

Equipment Needed

1. Steel ball bearings of various diameters, ranging from 0.1” to 0.5” diameter
2. Springs from ball point pens
3. A circular speaker such as from a car or old hi-fi
4. Wires for connecting the speaker to a radio

Discussion

Figure 2 is a diagram of an experimental setup to demonstrate the susceptibility of buildings to the music. The foam-board disk represents the town. This town is populated with buildings of different sizes. We can model the different sizes by varying the spring size, the ball size, or both.

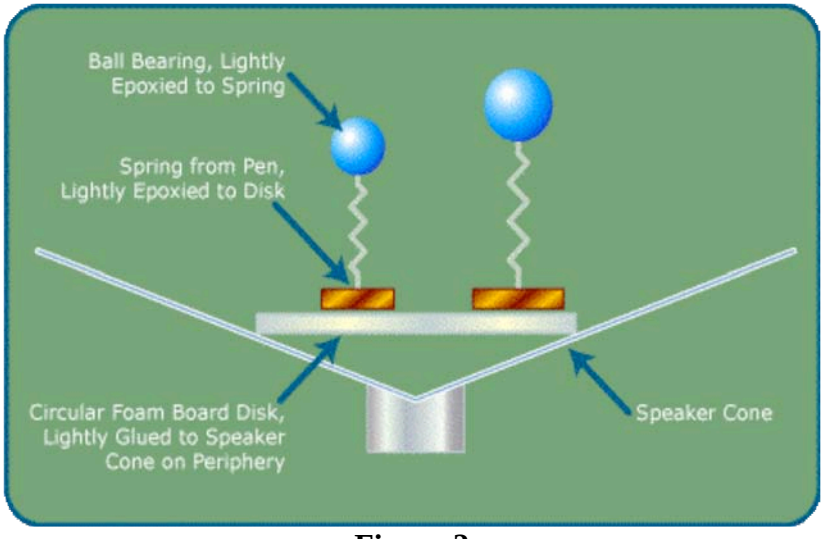

Figure 2

For simplicity, the same spring size will be used, and the ball diameter will be variable. When the speaker is connected to the hi-fi amplifier, the cone will vibrate. This will in turn cause the foam board disk to vibrate, thereby causing the ball-spring combination to vibrate. Each ball-spring combination will have a different natural frequency. If the music (the earthquake ground motion) has a frequency that coincides with the natural frequency of a building, that building will oscillate quite a lot. All others will be caused to vibrate at a much lower level.

Figure 3 below shows how we can relate the ball and spring to the frequency of oscillation:

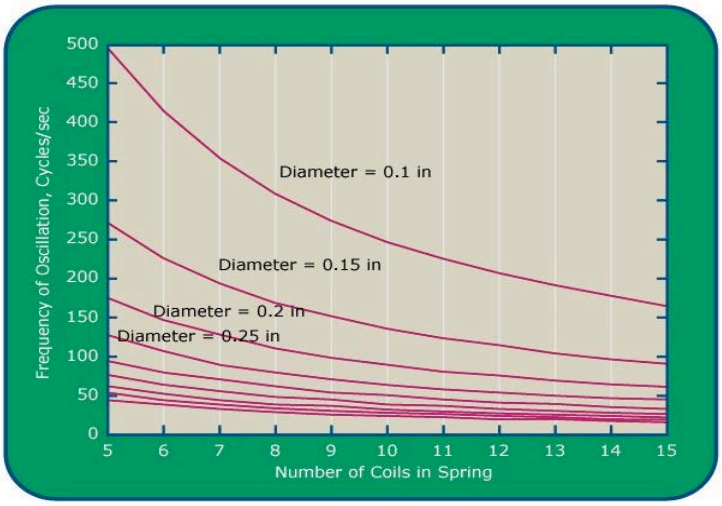

Figure 3

Once having determined the frequency of each building the next step is to find music that contains the same frequency content. Do this by turning the radio to different stations to find the music that causes a “building” to resonate (vibrate with large amplitude). Also, adjust the bass and treble settings to see the effect on building vibration. If you have trouble creating resonance, try different weights on the springs.