LIQUEFACTION

What happens to sandy or fine-grained soils when an earthquake shakes them up? Try this simple activity to find out.

What do I need?
• Metal or heavy plastic pan—full-sized loaf pans work fine
• Sand
• Water
• A smooth brick
• A rubber mallet

What do I do?
1. Fill the pan with sand—the deeper the better.

2. Put the pan on a table. Then pour in water to just below the surface of the sand.

3. Wiggle the skinny end of the brick down into the wet sand so it stands up like a building would.

4. Now, very gently, repeatedly tap the side of the pan with a mallet and notice what happens to the sand and the brick.
What's Going On?
Did the sand get all squishy? Did the brick fall over?

If a mixture of sand and water sits for a while, the sand particles will settle until they touch each other. There will be water in spaces between the particles, but the mixture will behave as a solid.

When you squeeze the sand (essentially what you’re doing by striking the container with the mallet) you’re trying to push the sand particles closer together. To get closer to each other, the particles would have to push the water between them out of the way. That’s what happens when you squeeze saturated sand in your hand, and what happens to the wet sand under your feet when you walk along a beach.

But that’s not what happens during an earthquake. During a quake, the squeezing done by the seismic waves happens very quickly, and the water doesn’t have time to flow out of the way of the sand particles. So as the particles try to move into a denser configuration, they push on the water, causing an increase in water pressure.

This increased pressure causes the forces at the contact points between the sand particles to decrease. If the water pressure is high enough, it can reduce the interparticle forces to zero, which means that the sand particles “float” away from each other. For a brief time, the sand particles are suspended in the water. This is liquefaction. The soil’s loss of strength occurs because there’s no contact between the particles of sand.

So What?
Many buildings in the San Francisco Bay Area are built on landfill, sand, or mud that can liquefy. Liquefaction caused much of the damage during the 1989 Loma Prieta earthquake. It has also been responsible for major destruction in other quakes, including Kobe, Japan, in 1995 and Mexico City in 1985.