

SUMMER INSTITUTE FOR ENGINEERING AND TECHNOLOGY EDUCATION

CIVIL ENGINEERING - TEACHER MODULE 3

DEMONSTRATION OF LIQUEFACTION OF SAND

CONCEPT

This experiment introduces the student to the ideas of material science.

OBJECTIVES

Demonstrate the effect of ground vibration on the bearing capacity of saturated sand (illustrates the effects of earthquake forces on structures built on sandy soils).

SCIENCE AND MATH PROCESS SKILLS

- Predicting
- Observing
- Experimenting
- Calculating
- Investigating

AAAS SCIENCE BENCHMARKS

- 1B Scientific Inquiry
- 2B Mathematics, Science, and Technology
- 3B Design and System
- 8E Information Process
- 11B Models
- 12C Manipulation and Observation

SCIENCE EDUCATION CONTENT STANDARDS (NRC)

- Scientific Inquiry
- Use appropriate tools, techniques, and analyze data
- Scientific explanations.
- Recognize and analyze alternative explanations and models.

STATE SCIENCE CURRICULUM FRAMEWORKS

Grades 5-8: 1.1.9, 1.1.10, 1.1.11, 1.1.13, 1.1.14, 1.1.15, 1.1.16, 3.1.2, 3.1.7

Grades 9-12: 1.1.20, 1.1.21, 1.1.22, 1.1.24, 2.1.14, 2.1.15, 2.1.16, 3.1.34

MATERIALS

- Small (5 gal) aquarium or container with capability for draining water from the bottom (see *Figure 1*).

- Block of solid wood, approx. 8" long by 4" wide by 8" high, preferably painted to look like a building.
- Sand (approximately 4 gallons)
- Rubber mallet or other small striking instrument.

PROCEDURES

- 1) Close off drainage valve. Fill the aquarium with dry sand. Place "building" block in center of sand as shown in *Figure 1*.
- 2) Demonstrate by pushing down on block that the sand "foundation" is solid enough to hold up the building (let students push on block if possible).
- 3) Fill the aquarium with water to the top of the sand (do not let water stand on the sand). Ensure the sand is completely saturated. *Be extremely careful to avoid bumping the aquarium while saturating the sand!*
- 4) Tap the side of the aquarium 4-5 times with the rubber mallet. The building block should slump down into the saturated sand.

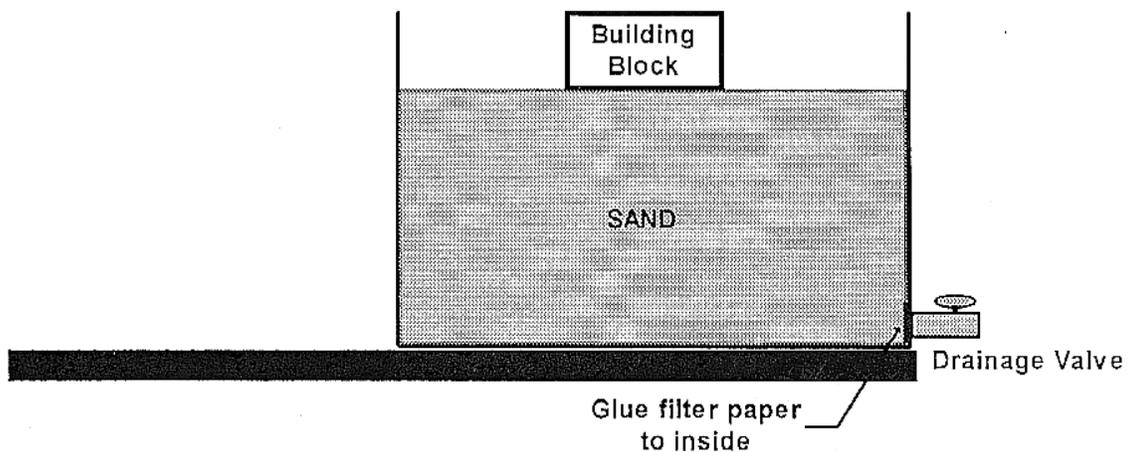


Figure 1

- 5) Remove the block. Open the drainage valve to drain the aquarium (this will take some time).

ASSESSMENT

1. Determine the shape with the greatest stability on each of the surfaces.
2. Figure the area of the side of the shape that was on the sand and discuss the relationship between the surface area resting on the sand and the stability of the blocks.
3. Draw a histogram to compare different weights and shapes.
4. Determine how fast different amounts of solidarity occur.