

1

What is soil liquefaction ?

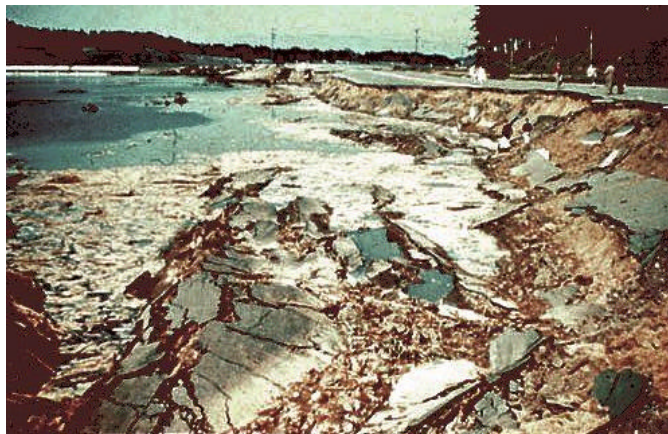
- Phenomenon that occurs in loose to medium dense saturated sand triggered by an earthquake or other rapid loading
- Loosely-packed soil particles attempt to move into a denser configuration.
- In an earthquake, not enough time for the water to escape.
- Water is "trapped" and prevents the soil particles from moving closer together.
- Increase in water pressure which reduces the effective stress and soil strength.
- Responsible for tremendous amounts of damage in historical earthquakes
- Liquefaction can be divided into two main categories: flow liquefaction and cyclic mobility



2

Where does liquefaction commonly occur ?

Liquefaction may include major sliding of soil toward the water.



3

Where does liquefaction commonly occur ?

Most ports have major retaining structures. When the soil behind such a wall liquefies, the pressure it exerts on the wall can cause the wall to slide and/or tilt toward the water.



4

Where does liquefaction commonly occur ?

Liquefaction also frequently causes damage to bridges that cross rivers and other bodies of water.



5

How can liquefaction hazard be reduced ?

Avoid Liquefaction Susceptible Soils

There are different ways to evaluate the liquefaction susceptibility of a soil deposit.

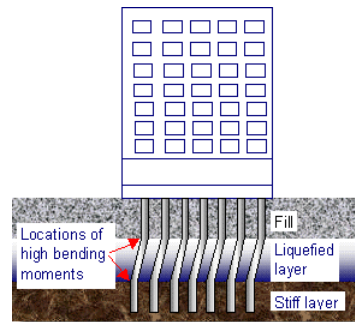
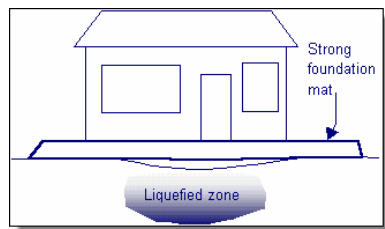
- **Historical Criteria**
Observations from earlier earthquakes provide a great deal of information about the liquefaction susceptibility of certain types of soils and sites.
- **Geological Criteria**
The type of geologic process that created a soil deposit has a strong influence on its liquefaction susceptibility
- **Compositional Criteria**
Liquefaction susceptibility depends on the soil type.
- **State Criteria**
The initial "state" of a soil is defined by its density and effective stress at the time it is subjected to rapid loading.

6

How can liquefaction hazard be reduced ?

Build Liquefaction Resistant Structures

Piles driven through a weak, potentially liquefiable, soil layer to a stronger layer



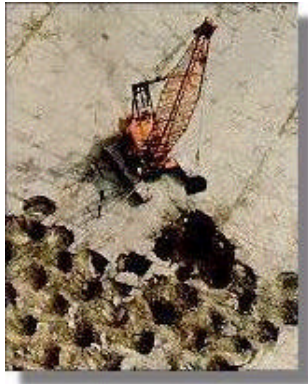
A stiff foundation mat is a good type of shallow foundation

7

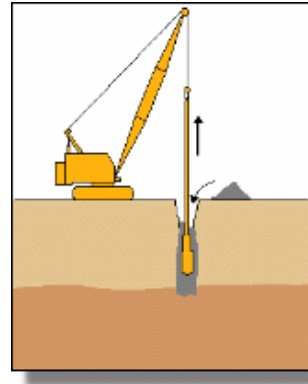
How can liquefaction hazard be reduced ?

Improve the Soil

Mitigation of the liquefaction hazards by improving the strength, density, and/or drainage characteristics of the soil.



Dynamic Compaction



Vibroflotation

8

Niigata, 1964: Sand boils



9

Niigata, 1964: Tilted building



10

Niigata, 1964: Tilted buildings



11

Niigata, 1964: Floated structure



12

Kobe, 1995: Settlements



13

Niigata, 1964: Lateral spreading

