A Study on Soil Liquefaction

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Abstract: Liquefaction is a phenomenon that turns solid ground into liquidstate.soil liquefaction was understood to be the result of an increase in "pore water" pressure associated with a decrease in soil frictional resistance during earthquake shakings. Liquefaction is more likely to occur in loose to moderately saturated granular soils with poor drainage, such as silty sands, sandy silts, clayey sands. it is required to recognize the conditions that exist in a soil deposit before an earthquake in order to identify liquefaction. soil profile shaken by a scenario earthquake is presented, through which consistent estimations of representative SPT blow-(Standard penetration test) counts along with fines content are discussed. The presence of silt and clay particles has long been thought to affect the behavior of sand under cyclic loading. the liquefaction potential index(LPI) is proposed by luna and frost method (1998) to predict the potential of liquefaction at sites. Although pore pressure remains well below lithostatic values, the soil liquefies, as identified macroscopically by intruder sinking to its isostatic position.

KEYWORDS: Standard penetration test (spt), liquefaction potential index (lpi)

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INTRODUCTION

Soil liquefaction has caused major damage during past earthquakes. Soil is basically an assemblage of many soil particles which stay in contact with many neighboring soil. The simplified procedure by seeding at all (1971)was widely used for evaluation of safety factor of soil liquefaction.

SOIL PROPERTIES DURING LIQUEFACTION

SHRINKAGE LIMIT

The moisture content at which a fine-grained soil does not change the volume on drying; the moisture loss is compensated by air that enters its pores.

PLASTIC LIMIT

The plastic limit (PL) is determined by rolling out a thread of the fine portion of a soil on a flat, non-porous surface.

LIQUID LIMIT

The plastic limit (PL) is determined by rolling out a thread of the fine portion of a soil on a flat, non-porous surface.

DEFINITION

Soil liquefaction, also called earthquake liquefaction, ground failure or loss of strength that causes otherwise solid soil to behave temporarily as a viscous liquid. The phenomenon occurs in water-saturated unconsolidated soils affected by seismic *S* waves (secondary waves), which cause ground vibrations during earthquakes.

CASUES OF SOIL LIQUEFACTION

Bridges and large buildings constructed on pile foundations may lose support from the adjacent soil and buckle or come to rest at a tilt after the earthquake induced shaking.

Fig:1 Nishinomia Bridge 1995 Kobe earthquake, Japan

Soil liquefaction occurs most frequently in sandy, silt-laden, gravel-based, loose or poorly drained soils. Quicksand is an example of this phenomenon. The water-saturated sandy soil cannot bear the weight of items, causing them to sink.

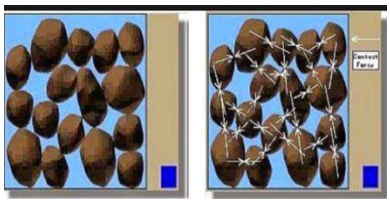

Fig:2 Quick Sand

The contact forces produced by the weight of the overlying particles holds individual soil particle in its place and provide strength.

SOIL LIQUEFACTION DISASTER

Fig:3 Soil liquefaction leaves Indonesian island in ruins

Fig:4 An aerial view of liquefaction, Indonesian

Fig:5 The 1989 Loma Prieta earthquake occurred on California's Central Coast on October 17 at 5:04 p.m. local time

Fig:6 the 1964 Niigata earthquake

Fig:7 Canterbury Earth Quake

SAND PHENOMENONS

Quick Sand

Quick Clay

Quick sand

Quicksand is a mixture of two phases of matter that pack together to produce a surface that looks solid but collapses from weight or vibration. It can be a mixture of sand and water, silt and water, clay and water, sediment and water, or even sand and air.

Fig:8 Quick sand

Quick Clay

Quick clay behavior is primarily characterized by a material property known as sensitivity, a term utilized in soil mechanics to define the ratio between the undisturbed and the remolded shear strength of a soil material.

Fig:9 Quick Clay

METHODS OF REDUCTION

Vibro Stone Columns

Vibro Compaction

Dynamic Compaction

Vibro Stone Columns

Vibro stone columns or aggregate piers are an array of crushed stone pillars placed with a vibrating tool into the soil below a proposed structure. This method of ground improvement is also called vibro replacement. Such techniques increase the load bearing capacity and drainage of the soil while reducing settlement and liquefaction potential.

Fig:10Vibro Stone Columns

Vibro Compaction

The method of soil improvement whereby granular soils are compacted using depth vibrators is known as Vibro Compaction or Vibroflotation. Naturally deposited soils as well as artificially reclaimed sands can be compacted to great depths.

Fig:11 Vibro Compaction

Dynamic Compaction

Dynamic compaction (DDC, heavy tamping, dynamic consolidation, etc.) is a cost-effective method of soil compaction whereby a heavy weight is repeatedly lifted and dropped from a height, impacting the ground surface with a readily calculated impact energy.

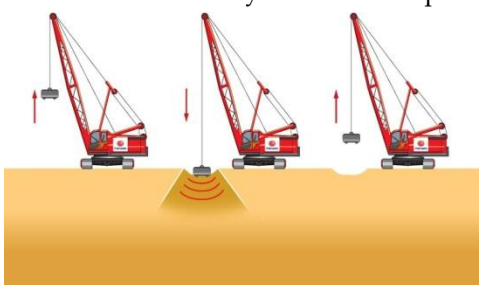

Fig:12 Dynamic Compaction

CONCLUSION

We study mechanisms for liquefaction. The preliminary modeling results show that liquefaction, as testified by the intruder sinking towards its isostatic position, occurs under specific shaking conditions in saturated soils. Liquefaction does not require loose sediments. It is established that the underlying sands and gravels are liquefiable and many of the surrounding reclaimed areas of Manila Bay will be affected.

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