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Assessment and risk reduction measurement of liquefaction of soil

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Abstract : *Aim of project is to analyze the liquefaction possibilities of some selected sites. The SPT data collected from selected sites and determination of liquefaction susceptibility of selected sites by using noviliq software. From this shear stress due to earthquake or settlements of structure are evaluated using novoliqsoftware."A Phenomenon where by a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake Shaking or other sudden change in stress condition, ca using it to behave like a liquid" is called Soil Liquefaction. By using novoliq software for liquefaction data analysis, test values graphs are collected for determination of liquefaction susceptibility of these sites using Novoliq soil software. Finally we can analyse the liquefied zone or sites with the help software, for this liquefied sites prevention methods are to be given to promote anti liquefaction and risk measures. Additionally, phenomena related to damage in soils and foundations induced by liquefaction are investigated and discussed..*

Keywords *– Earthquake , Liquefaction , factor of safety, novoliq software, soil*

I. Introduction

During earthquakes the shaking of ground may cause a loss of strength or stiffness that results in the settlement of buildings, landslides, the failure of earth dams, or other hazards. The process leading to such loss of strength or stiffness is called soil liquefaction. It is a phenomenon associated primarily, but not exclusively, with saturated cohesionless soils. Soil liquefaction has been observed in almost all large earthquake, and in some cases it has caused much damage. The destructive effects of soil liquefaction were forcibly brought to the attention of engineers by the disastrous 1964 earthquake in Niigata, Japan. This earthquake caused more than $1 billion in damages, due mostly to widespread soil liquefaction. For critical structures, such as nuclear power plants and large earth dams, the possibility of liquefaction presents serious engineering problems. In the two decades since 1964, impressive progress has been made in recognizing liquefaction hazards, understanding liquefaction phenomena, analyzing and evaluating the potential for liquefaction at asite, and developing the technology for mitigating earthquake hazard

II. METHODOLOGY

Earthquakes occur on faults with a recurrence interval that depends on the rate of strain-energy accumulation. Intervals vary from The stress-based approach for evaluating the potential for liquefaction triggering, by Idriss and Boulanger (2004). The basic framework, as adopted compares the earthquake induced cyclic stress ratios (CSR) with the cyclic resistance ratios (CRR) of the soil. The components of this Methodology, as briefly summarized below, were developed to provide a rational treatment of the various factors that affect penetration resistance and cyclic resistance Continue... Evaluation of Cyclic Stress Ratio (CSR) The earthquake-induced CSR, at a given depth, z, within the soil profile, is usually expressed as a representative value (or equivalent uniform value) equal to 65% of the maximum cyclic shear stress ratio.Evaluation of Cyclic Resistance Ratio The cyclic resistance ratio represents the liquefaction resistance of the soil, expressed as CRR. That means cyclic stress required to induce liquefaction for a soil stratum.Magnitude Scaling Factor The magnitude scaling factor (MSF) is used to account for duration effects (i.e., number of loading Cycles) on the triggering of liquefaction. The MSF relationship was derived by combing.Factor of Safety Factor of safety is defined as the ratio of cyclic resistance ratio (CRR) to cyclic stress ratio (CSR). Factor of Safety = Cyclic Resistance Ratio / Cyclic Stresshundreds to tens of thousands of years. There is much uncertainty over the variability of the strain rate over time, the recurrence interval, the time since the last rupture, the activity of a fault, and the location of all active faultsCyclic behaviour of saturated soils during strong earthquakes is characterized by development of excess pore water pressures and consequent reduction in effective stress. In the extreme case, the effective stress may drop to zero or nearly zero (ie the excess pore water pressure reaches the initial effective overburden stress or the total pore water pressure rises to equal the total overburden stress) and the soil will liquefy. In these Guidelines, liquefaction refers to the sudden loss in shear stiffness and strength of soils associated with the reduction in the effective stress due to pore water pressure generation during cyclic loading caused by an earthquake shaking. The mechanism of pore water pressure build-up is governed by a contractive tendency of soils (or tendency to reduce in volume during shearing) under cyclic loading. When saturated soils are subjected to rapid earthquake loading, an immediate volume reduction in the soil skeleton is prevented by the presence of incompressible pore water and insufficient time for drainage to occur. The contractive tendency instead results in a build-up of excess pore water pressure and eventual liquefaction. In this context, loose granular soils are particularly susceptible to liquefaction because they are highly compressible and contractive under cyclic shearing due to the high volume of voids in their soil skeleton particle arrangement/structure.

It is important to emphasize at the outset of the discussion on liquefaction assessment that the rate of excess pore water pressure build-up, severity of liquefaction manifestation, and consequent ground deformation strongly depend on the density of the soil. In this context, one can identify ‘flow liquefaction’ as an extreme behaviour of very loose sandy soils in which a rapid pore water pressure build-up is associated with strain-softening behaviour and undrained instability (flow); flow liquefaction results in practically zero residual strength and extreme ground deformation. In loose to medium dense sands, liquefaction results in a (nearly) complete loss of effective stress and rapid development of strains in subsequent cycles of shear stresses. Finally, dense sands exhibit transient liquefaction in which nearly zero-effective stress only temporarily occurs during cyclic mobility, which is associated with a gradual development of strains and limited deformational potential under cyclic loading. These effects of soil density on the pore water pressure build-up, mechanism of strain development and consequences of liquefaction should be recognised and accounted for in the liquefaction assessment. The effects of density on the potential for liquefactioninduced ground deformation is illustrated in where maximum shear strains associated with various combinations of cyclic stress ratios (CSR) and penetration resistances (q_{c1Ncs}) are shown (Idriss and Boulanger, 2008). Note that some of the maximum shear strain values in this (corresponding to low penetration resistances) are overly conservative since they have been derived assuming presence of driving shear stresses associated with lateral spreading. The plot, however, clearly depicts the significant differences in the consequences of liquefaction (in bterms of maximum shear strains or strain potential) for sand deposits with different densities (ie penetration resistances). Assessment of the liquefaction hazard and its effects on structures involves several steps using either simplified or detailed analysis procedures. These Guidelines outline some of the available procedures and highlight important issues to consider when evaluating liquefaction susceptibility, triggering of liquefaction, liquefaction-induced ground deformation, and effects of liquefaction on structures. In this document, the term simplified (liquefaction evaluation) procedure is used to refer to state-of-the-practice semi -empirical methods for assessment of liquefaction susceptibility, liquefaction triggering, and liquefaction-induced ground deformation. illustrates through flow-charts important factors to consider in the liquefaction assessment

IV. Figures and TABLES

Fig.1 Shows mechanism of liquefaction

Fig.2 unequal settlement due to soil liquefaction

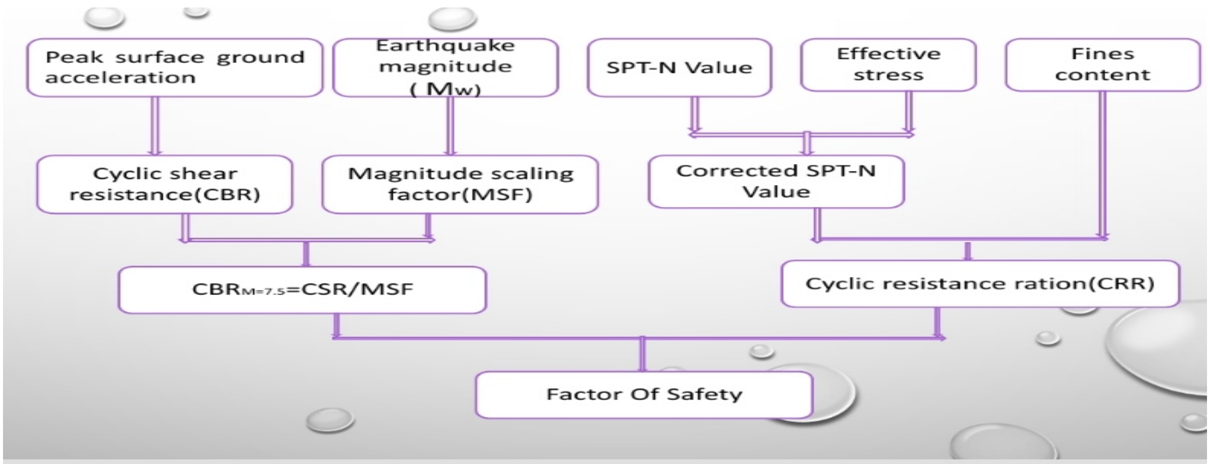
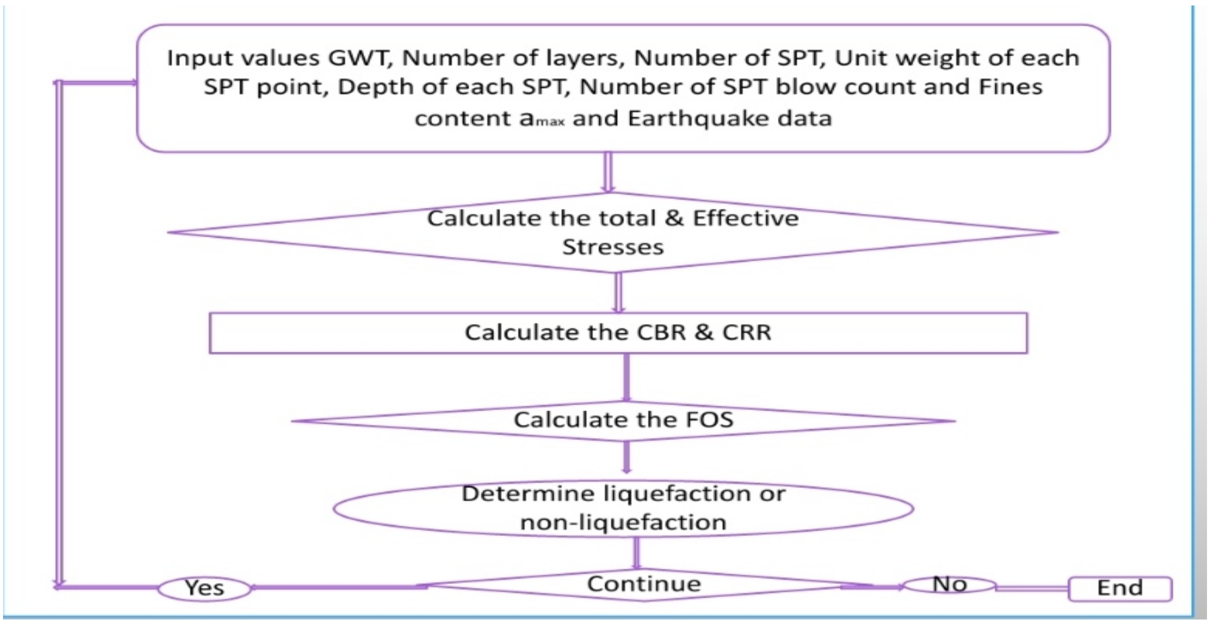


Fig.3 shows how liquefaction process will be done



IV Conclusion

It is now generally recognized that the basic cause of liquefaction of saturated cohesionless soils during earthquakes is the build-up of excess hydrostatic pressures due to the application of cyclic stresses induced by the ground motions. These stresses are generally considered to be due primarily to upward propagation of shear waves in a soil deposit, although other forms of wave motions are also expected to occur. As a consequence of the applied cyclic stresses, the structure of the cohesionless soil tends to become more compact with a resulting transfer of stress to the pore water and a reduction in stress on the soil grains. As a result, the soil grain structure rebounds to the extent required to keep the volume constant, and this interplay of volume reduction and soil-structure rebound deter-mines the magnitude of the increase in pore water pressure in the soil. Thus it can be concluded that the Reliability liquefaction probability analysis model gives us lower error percentage for the SPT case datas (37.5%) and Olsen method gives lower error
percentage for the CPT case datas (35.7%). Hence, from the limited studies done in this paper we may state the above but for more accurate results more earthquake case datas and other methodologies are to be implemented. From the error percentages of SPT and CPT case datas studied in this paper, it can be said that CPT datas gives better results concerning liquefaction potential but for practical purposes the above can‟t be surely concluded. For accurate results, more earthquake case datas and other methodologies are to be implemented.\

References

[1] 1 M. Idriss and R. W. Boulanger, "Semi-empirical Procedures for Evaluating Liquefaction Potential During Earthquakes", Proceedings of the 11th ICSDEE & 3rd ICEGE, pp 32 – 56, January 7 – 9, 2004.

[2] Jin-Hung Hwang and Chin-Wen Yang, "A Practical Reliability-Based Method for Assessing Soil Liquefaction Potential", Department of Civil Engineering, National Central University.

[3] Adel M. Hanna, Derin Ural and Gokhan Saygili, "Evaluation of liquefaction potential of soil deposits using artificial neural networks".

[4] Adel M. Hanna, Derin Ural, Gokhan Saygili, "Neural network model for liquefaction potential in soil deposits using Turkey and Taiwan earthquake data", Soil Dynamics and Earthquake Engineering 27 (2007) 521–540

[5] Chapter 2: soil liquefaction in earthquakes. Sladen, J. A., D‟Hollander, R. D., and Krahn, J. _1985_. „„„The liquefaction of sands, a collapse surface approach.‟‟‟ Can. Geotech. J., 22, 564– 578.

[6] Finn, W. L., Ledbetter, R. H., and Wu, G.: Liquefaction in silty soils: design and analysis, Ground failures under seismic conditions, Geotechnical Special Publication No 44, ASCE, Reston, 51–79, 1994

[7] Castro, G., (1975) Liquefaction and cyclic mobility of saturated sands. Journal of the Geotechnical Engineering Division, ASCE, 101 (GT6), 551-569.

[8] 9. Seed, H. B. 1979. "Soil Liquefaction and Cyclic Mobility Evaluation for Level Ground During Earthquake," Journal of Geotechnical Engineering Division, ASCE, Vol 105, No. GT2, pp 201-225.

[9] 10. Selig, E.T., and Chang C.S.(1981), "soil failure modes in undrained cyclic loading" J. Geotech. Engg. Div.,ASCE, Vol.107, No.GT5, May, pp 539-551

[10] 11. Robertson, P.K.1994, "suggested terminology for liquefaction":An Internal CANLEX Report

[11] 12. Robertson, P.K.and Fear, C.E. (1996), "Soil liquefaction and its evaluation based on SPT and CPT", Liquefaction Workshop, January 1996

[12] 13. National Research Council‟s Committee on Earthquake Engineering (1985)14. Krinitzky et al.1993