

Evaluation of liquefaction potential in Bandar Imam Khomeini Quaternary deposits

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Extended Abstract

Introduction

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. This phenomenon is the result remolds sand particles. Soil liquefaction occurs in loose, saturated cohesionless soil units (sands and silts) and sensitive clays when a sudden loss of strength and loss of stiffness is experienced. Sometimes it is resulting of large, permanent displacements of the ground. Even thin lenses of loose saturated silts and sands may cause an overlying sloping soil mass to slide laterally along the Liquefied layer during earthquakes. Liquefaction and related phenomena have been responsible for tremendous amounts of damage in historical earthquakes around the world. Destruction of buildings, roads, land subsidence, and even loss of life is one of the dangers of liquefaction.

Materials and Methods

Liquefaction hazard evaluations generally deal with three issues: liquefaction susceptibility, initiation of liquefaction, and effects of liquefaction. The issues are generally addressed in the order listed, since the latter issues are dependent on the former. Assuming a soil is judged to be susceptible to liquefaction. Its potential for initiation under the anticipated earthquake loading conditions is then judged. This process is usually described as an evaluation of the soil's liquefaction potential.

There are various methods to evaluate the liquefaction potential of the soils. Using the Soil Penetration Test results is the one of the important method to investigate of the liquefaction potential in uncemented deposits. Seed and Idriss are the pioneers of the using SPT to investigation of liquefaction potential (Seed & Idriss, 1971). In recent decades, evaluation of the liquefaction potential by shear wave velocity has also been recommended by National Institute of Standards and Technology (NIST, 1998). Cone penetration test (CPT) results have also been used to evaluation of soil liquefaction potential by Robertson and Wride (1998).

Results and Discussion

In this research, the liquefaction potential of the Imam Khomeini Port has been investigated. The

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port is situated at South-West of Iran at the North of Persian Gulf. In recent decades, numerous numbers of infrastructures and oil & gas facilities have been developed in this area. According to geological investigation the studied area is in the folded Zagros structural zone. No volcanic activities have been reported since Mesozoic. The sedimentary rocks are the main geological formation in this region. The large part of the port has been constructed on low level quaternary deposits without any rock outcrops in the studied area. The quaternary deposits are mainly loose and uncemented. The ground water level of the region normally is high due to penetration of the saline water from Persian Gulf. Considering to high level of groundwater table at sea coastline, the site could be vulnerable to liquefaction during possible earthquakes. It should be mentioned, Zagros folded zone is one the most active part of the Iranian structural zones.

Conclusion

In this study, Standard Penetration Test (SPT) and shear wave velocity (V_s) measurements have been used to evaluate the liquefaction potential of the alluvial. Simplified procedure of Seed and Idriss (1971) has been used to evaluate the liquefaction potential based on SPT method. The cyclic stress ratio (CSR) and the cyclic resistance ratio (CRR) were evaluated in 160 borehole data and the safety factor was given in each borehole. The correction factors for depth and cementation of the soils have been applied based on Seed & Idriss (1982) and EPA (1995).

The site area is evaluated high liquefaction potential based on this analysis. On the other hand, the liquefaction potential assessed using the V_s measurements based on the method proposed by National Institute of Standards and Technology (NIST) in 1998. In this study, 160 borehole data were studied considering the soil type and ground water level. The safety factor at different depths and liquefaction Potential Index at different boreholes were compared. Generally, results of the two methods are in agreement, especially in shallow depth for SPT method and in lower deep for shear wave velocity method. Based on the analysis results and considering to seismicity of the region, the liquefaction potential is high in some part of the studied area. The result of liquefaction potential evaluation of the studied site has been presented based on different peak ground acceleration. The results showing the most of area are highly vulnerable to liquefaction even by 0.3 PGA. Therefore, we recommend the soil of the area should be treated before any construction in the site. Since the thickness of the loose deposits considerably is high, dynamic soil treatment method specially suggested.

Keywords: cyclic resistance ratio(CSR), Imam Khomeini Port, liquefaction potential, NIST, quaternary deposits, Seed-Idriss procedure, Standard Penetration Test (SPT).