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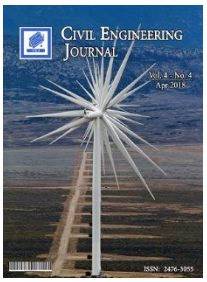

Effect of Variable Confining Pressure on Cyclic Triaxial Behavior of K_0-consolidated Soft Marine Clay

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Abstract

The effect of variable confining pressure (VCP) on the cyclic deformation and cyclic pore water pressure in K_0-consolidated saturated soft marine clay were investigated with the help of the cyclic stress-controlled advanced dynamic triaxial test in undrained condition. The testing program encompassed three cyclic deviator stress ratios, CSR=0.189, 0.284 and 0.379 and three stress path inclinations η^{ampl}=3, 1 and 0.64. All tests with constant confining pressure (CCP) and variable confining pressure (VCP) have identical initial stress and average stress. The results were analyzed in terms of the accumulative normalized excess pore water pressure r^q_u recorded at the end of each stress cycle and permanent axial strain, as well as resilient modulus. Limited data suggest that these behavior are significantly affected by both of the VCP and CSR. For a given value of VCP, both of the pore water pressure r^q_u and permanent axial strains are consistently increase with the increasing values of CSR. However, for a given value of CSR, the extent of the influence of VCP and the trend is substantially depend on the CSR.

Keywords: Soft Marine Clay; K_0-Consolidated; Cyclic Stress Ratio; Stress Paths; Cyclic Deformation; Pore Water Pressure.

1. Introduction

Engineering structures founded on soft marine clay deposits are often designed to withstand cyclic loading such as earthquakes, traffic, or ocean waves etc. during their operational life. Due to the low permeability of soft clays, cyclic loading is essentially undrained. When fully saturated soils are subjected to cyclic loading in undrained conditions involving moderate and large cyclic stress levels, their structure is permanently altered, the generation of excess pore-water pressure and thus to a deterioration of bearing capacity and soil stiffness [1-3]. In undrained conditions, cyclic degradation of stiffness and cyclic pore water pressure changes are among the most important phenomena in soil dynamics [4]. The degradation of soils will then significantly influence the development of the accumulation of plastic strains and resilient stiffness. Both of these can significantly reduce the life of the engineering structures.

A number of investigations have considered the effects of cyclic loading on soil behavior and simulated using the cyclic triaxial or simple shear apparatuses, as widely reported in the literature [5-13]. As these studies only applied a single deviator stress or horizontal shear stress, thus relatively few have addressed the coupling effects of the vertical and horizontal stress changes to which soft clays are subjected. Actually, the in situ stress fields in soil layers induced by earthquakes or traffic loads are combinations of varying normal and shear stresses [14]. Field measurements have also shown that, although vertical stress changes attenuate with depth, horizontal stress changes become more pronounced up to a certain depth below the sleeper base before then reducing with further increases in depth [15].

Cyclic triaxial tests with a simultaneous variation of the deviator stress q^{ampl} and confining pressure $\sigma_3{}^{ampl}$ (VCP) can be used to simulate the coupling effect of cyclic vertical and horizontal stresses induced by earthquakes or traffic loading

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