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INITIAL SHEAR MODULUS OF AUCKLAND RESIDUAL SOIL FROM FIELD AND LABORATORY TESTS

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Abstract: This paper describes the experiments performed to investigate the initial shear modulus of Auckland residual soil. Firstly, WAK (wave-activated stiffness) tests and spectral analysis of surface waves (SASW) tests were conducted at a residual soil site by applying impact and harmonic loads on a circular steel plate in vertical direction. A sledgehammer equipped with a dynamic force transducer was used to produce the impact load while harmonic loading was applied using an eccentric mass shaker to generate steady-state excitations. The initial shear modulus of soil was obtained by considering the soil to be vibrating as a single degree of freedom (SDOF) system. Next, undisturbed soil samples from the site were subjected to consolidated undrained tests with three submersible miniature linear variable differential transducers (LVDTs) mounted on the sides of the specimen to measure the small strain stiffness. The LVDTs were capable of resolving displacements of less than 1 μm and measuring axial strains ranging from less then 0.001% to 2.5%. The small strain stiffness obtained from laboratory tests compared very well with those determined from geophysical tests.

1. INTRODUCTION

The initial shear modulus is an important parameter used in solving dynamic problems, such as ground response analysis and soil-structure interaction problems. Several researchers have investigated the initial shear modulus of sand and clay and proposed relationships based on void ratio and confining pressure (e.g., Hardin and Richart, 1963; Hardin and Black, 1966; Kokusho, 1980) However, these relationships were developed and calibrated based on normally consolidated Northern Hemisphere sedimentary soils. As a result, their applicability for analyses in residually weathered soils in sub-tropical climates is unclear.

Most of the present Auckland region is underlain by Waitemata sandstones and siltstones. The in-situ chemical weathering of Waitemata sediment group produced a highly variable material referred to as Auckland residual soil. The depth of the weathering profile ranges from a few metres to a few tens of metres at the very maximum. In designing structures to be built over this formation, characterisation of the foundation ground is very important. Toward this end, research efforts are currently underway to investigate the properties of Auckland residual soil, including its initial shear modulus.

This paper focused on the results of both field and laboratory testing which were conducted to investigate the initial shear modulus of Auckland residual soil. For field testing, WAK (wave-activated stiffness [K]) test and spectral analysis of surface waves (SASW) method were employed to investigate the small-strain stiffness of the ground consisting of residual soils. Next, undisturbed samples were obtained from the same site, and the samples were subjected to undrained triaxial tests with three linear variable displacement transducers (LVDTs) attached to the specimen to measure the axial strain. The results of the field and laboratory tests were then compared.

2. SITE DESCRIPTION

The selected site is located in a sloping ground in Orewa, north of Auckland City, within an area being developed for residential purposes. The site consists of residual clay of yellow reddish in colour and was excavated to about 1.3 m depth from the actual ground surface. WAK test and SASW method were then performed at the leveled site.

Next, undisturbed samples were obtained from the