

## A Study on the Strength Anisotropy of the Compacted Materials

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### ABSTRACT

In order to investigate the strength and deformation anisotropy of compacted decomposed granite soils, a series of unsaturated and saturated-drained triaxial compression tests were performed. The specimens used in the study were a decomposed granite soil from Shimonoseki in Yamaguchi prefecture in Japan. The specimens had three different angles of the axial direction to a horizontal plane,  $\delta = 0, 45$  and  $90$  degrees. The compressive strain of the specimens subjected to isotropic consolidation was influenced strongly by the horizontal plane  $\delta$ . In addition, the effect of the horizontal angle on the triaxial compressive strength and deformation was more evident in the unsaturated specimen than in the saturated specimen. Moreover, we proposed a new procedure, which can be applied in the shear strength  $\tau$  of the unsaturated specimen in consideration of the  $\delta$ .

**KEY WORDS:** Compacted decompose granite soils, angles of the axial direction to horizontal plane, anisotropy, degree of saturation, triaxial compression tests

### INTRODUCTION

Artificial soil structures such as riverbanks and embankments built for roads and railways, have a similar stress history of compaction in the process of construction. In this process, the compacted soils become anisotropic in terms of direction of confinement. Most of laboratory tests is conducted to identify the compressibility or mechanical properties of compacted materials. In conventional cylindrical triaxial tests, the direction of the compaction loading corresponds to the direction of the major principle stress. But the stress conditions in a soil structure caused by an additional loading such as an earthquake vary with the direction of the major principal stresses. Therefore, the study of detailed stability and deformability of a structure built by compacted materials requires us to understand the anisotropic properties of compacted materials. Although the studies on the anisotropic property of compacted materials are limited to those of Livneh, M. & Komornik, A., 1967 and Onitsuka, K. & Hayashi, S., 1979, the studies on the anisotropic property of saturated clay and soil have been done by many researcher (i.e., Oda, M., et al., 1978; Tatsuoka, F., et al., 1990), and as a result, there is much knowledge about saturated clay and soil. There

is a need to collect substantial data to understand the mechanical properties of compacted materials.

A series of unsaturated and saturated-drained triaxial compression tests were performed on compacted materials. Test specimens were prepared using granite soil because the material is commonly adopted for construction in Japan and Korea. The test results show show not only the degree of anisotropy for the angles of the axial direction to a horizontal plane of compacted material, but also the influence of the degree of saturation on the anisotropic property.

### MATERIAL PROPERTIES

#### Basic Characteristics

A decomposed granite soil was sampled from Shimonoseki in Yamaguchi prefecture, which is located at the west end of Japan's main island. Table 1 shows the physical properties of the material and Fig 1 does the grain size distribution curve .

The quartz, feldspar and colored mineral contents of specimens were about 23%, 62%, and 15%, respectively. Toyoura sand is mostly composed of quartz and weathered with a small degree. The ignition loss of the specimens was 1.83.

Table 1. Physical properties of soils used.

Sample	Grain size (mm)	$G_s$	Ignition loss (%)	$U_c$	$w_{opt}$	$\rho_{dmax}$ ( $g/cm^3$ )
Shimonoseki	-2	2.68	1.83	7.14	13.24	1.78

#### Sample Preparation

The decomposed granite soil was compacted at the optimum moisture content ( $w=13\%$ ) by hitting with a 2 kg hammer in a container (200 mm  $\times$  100 mm  $\times$  200 mm). The density of the compacted materials was controlled such that the degree of compaction,  $D_c$ , is to be 90%.

The degree of compaction is defined as the percent-density with respect to the maximum dry density obtained from the compaction test. The rectangular sample was frozen under  $-20^\circ C$ . Then, cylindrical