

Compression Characteristics of Jeju Island Beach Sands

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ABSTRACT

Sands distributed in Jeju island's coastal areas, Korea, can be classified as silicate sand derived from volcanic rock, carbonate sand derived from shells, and mixed sands containing both silicate and carbonate sands. These three types of sands typically exist in Jeju coastal areas. Samples of silicate, carbonate and mixed sands were obtained from Samyang beach, Gimnyeong beach, and Jeju harbor area, respectively. Compression tests were conducted to assess the compression characteristic of these sands. As a result of these tests, each sand showed different behaviors. For Samyang beach sand, it appeared that initial compression is a larger than the other two sands. For Gimnyeong and Jeju harbor sands, however, the additional compression occurred after initial compression. This could result from the crushing, shattering, and rearrangement of sand particles. In addition, settlement behavior of Jeju harbor ground according to the construction stages was analyzed using the measured data. It showed that in addition to the initial elastic compression, a considerable additional compression occurred with time. The settlements of Jeju harbor ground were predicted by using the elastic settlement calculation methods (empirical methods) and the compression test method. The empirical methods, which were not considered the crushing, shattering, and rearrangement of particles could be a smaller than that occurred actually.

KEY WORDS: Jeju island; silicate sand; carbonate sand; settlement; crushing and rearrangement.

INTRODUCTION

The Jeju Island is a typical shield volcano located on the continental margin at the southern part of the Korean peninsula. The volcanic rocks of the Jeju Island were formed in the Pleistocene and Holocene periods (Kim, 2002).

Presently, demand of harbor facility continuously increases due to the increase of utilization of harbors to transport the freights and the passengers in the Jeju Island. In addition, the harbor facility is to be maximized to use it as ocean recreation and tour facilities. Jeju-Do, the

government administrative, makes effort to develop the Jeju Island as a popular tour island. To do this, construction of waterfront infrastructures such as ports and ferry terminals is in progress in coastal areas.

The main geologic composition material of Jeju island's coastal areas is sandy soils. These sandy soils were generated from volcanic rocks consisted of basalt, trachyandesite, tuff, and pyroclastics of adventive volcano or shellfish, horny substance of mollusk and keratose of red algae by weathering process.

In this study, therefore, the sands distributed in the Jeju island coastal areas were sampled and conducted experiments to assess the physical, chemical and engineering properties. Based on these results, Jeju sands were classified.

In addition, to investigate the compression characteristics of Jeju sands, compression tests were conducted on three representative sand samples, Samyang, Gimnyeong, and Jeju harbor sands by using oedometer test. Holtz (1991) and Leonards and Frost (1988) indicated that primary factors that influence the compressibility of sand materials are soil characteristics, state of stress in the ground, state of compaction, and stress history. Especially, in this study, the compressibility of sands related to material characteristics is mainly investigated in detail.

CLASSIFICATION OF JEJU BEACH SANDS

Before conducting the compression tests, Jeju beach sands distributed in Jeju island's coastal areas should be classified. To do this, sands were sampled from 26 coastal areas (Fig. 1) and were analyzed by XRF and XRD (Table 1). In addition, Field Emission Scanning Electron Microscope (FE-SEM) analysis was conducted to assess surface characteristics of sand particles. Based on these results, Jeju beach sands were classified as silicate sand, carbonate sand, and mixed sands containing both silicate and carbonate sands. Silicate sand was formed from the volcanic rocks by weathering process. Carbonate sand was formed from the shellfish, horny substance of mollusk and keratose of red algae. Figure 2 shows the relationship of composition ingredients of Jeju sands, $CaO + LOI$ (Loss of Ignition) versus $SiO_2 + Al_2O_3 + Fe_2O_3$. These two terms are in inversely proportion each other.