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Behavior of Composite Ground Reinforced by Sand Compaction Piles

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Stress transfer characteristics as well as the settlement reduction factor are the most important elements in design and analysis of the SCP (sand selection pile) method. This study suggests new theoretical equations in order to estimate stress transfer parameters in the laboratory and the field without any instrumentation which can cause some errors in the ground. Laboratory measurement data verify the applicability of these equations. From a series of laboratory tests for single sand pile and multi sand piles, variations of stress transfer parameters according to different influential factors and the test methods are studied. Composite ground shows somewhat different behavior between a single-pile test and a multi-pile test. These differences seem to be caused by the fact that the stiffness of the sand pile in a single-pile test was overestimated, because the ratio of the pile length to the diameter decreased as the replacement increased. Also, this study takes up the point that design based on the stress concentration ratio can cause some mistakes, because the stress reduction factor of clay and the stress increment factor of a sand pile estimated from the replacement ratio and stress concentration ratio cannot have unique trends even if the stress concentration ratio is the same.

INTRODUCTION

Ground improved by compacting a sand pile is called composite ground. When load is applied onto composite ground, a concentration of stresses occurs due to the stress differences between the sand pile and the surrounding clay. This is referred to as stress transfer characteristics in the composite ground and, along with a settlement reduction effect, it is a very important factor in design and analysis of composite ground, especially when a low replacement ratio is considered. While most studies rely on an earth pressure cell to estimate stress transfer characteristics, the results show a very different trend of stress concentration ratio, depending upon influential factors, as shown in Fig. 1. Yamagata and Hukumoto (1982) reported that these disagreements may occur due to a direct measurement of stress actions on sand piles and clay. Direct measurement of stress can cause some individual inaccuracies, depending on the depth of installation, movement and inclination of instruments, which are caused by horizontal displacement and malfunction from the cutting of wiring. For these reasons, estimation of the stress transfer parameter in composite ground without instrumentation is needed.

This study suggests new theoretical equations for the estimation of stress transfer parameters in composite ground. Two types of laboratory tests, a single-pile test and a multi-pile test, are performed to verify the applicability of these equations. Finally, settlement and the stress transfer characteristics of composite ground are investigated according to various influential factors, when a low replacement ratio is applied.

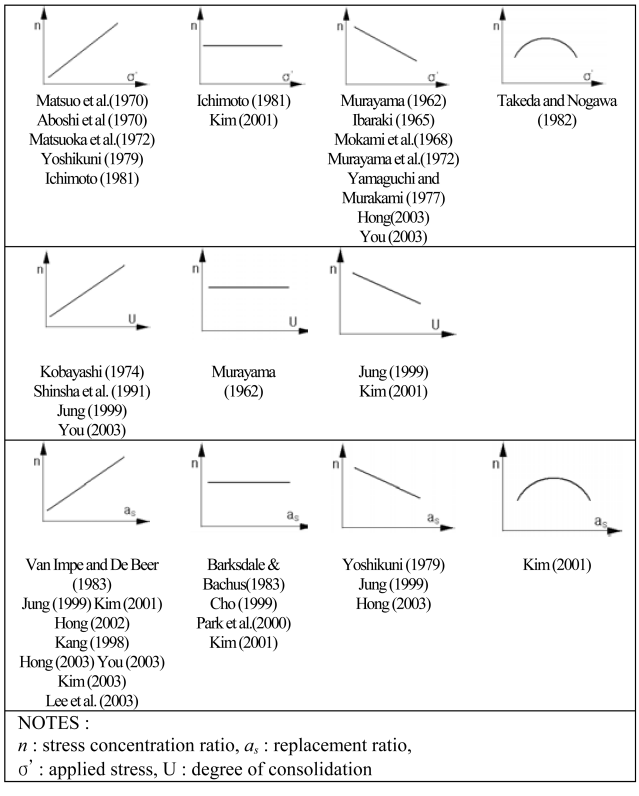

Fig. 1 Examples of differences in stress concentration ratio according to various influential factors and to researcher, Shin (2005)

BASIC PARAMETERS FOR SCP-COMPOSITE GROUND

The replacement ratio is defined as the ratio of the sand pile area to the whole area of the equivalent cylindrical unit within the

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