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A laboratory study on densification of loose sands by disc shearing

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ABSTRACT

This paper presents the results of a laboratory study on using disc shearing method to increase the density of loose sands. Three sands were tested to investigate the relationships among degree of soil improvement, confining pressure, and disc rotation conditions. It is found that degree of soil improvement increases with confining pressure. The effectiveness of density improvement is the highest from the first round of rotation and rapidly decreases with the number of rotation. Reverse rotation is more efficient than one-way rotation. The depth of improvement is found to be one half of the diameter of the disc.

KEY WORDS: Sands, soil improvement, laboratory test.

INTRODUCTION

It has been found in many reclamation projects that the deposited sands are in loose states with relative densities as low as 30%. One of such projects has been completed in Taiwan along the south-west coastal areas. A number of soil improvement methods have been used to increase the relative density of loose sands, such as the dynamic compaction method (Lukas 1980; Feng 2000). A question has been raised as to how to increase the density of the loose sands located within a few meters depth. It is an inevitable problem in dynamic soil improvement methods that vibration induced on the ground surface tends to loosen the cohesionless sand. This is generally recognized as a result of low confining pressure at shallow depths. To overcome such a problem, the development of a new method for increasing the density of loose sands at shallow depth is required. In this regard, a new idea of rotating horizontally a disc on the surface of a sand layer is examined. The rotation of the disc induces a shearing displacement of sand particles that is expected to be very effective in changing the loose sands to dense sands. This paper presents the results of a laboratory study on using a disc with rough base to shear sand specimens. The difference in relative densities of the sand specimen before and after the shearing is presented as functions of the angle of rotation, the type of rotation, and the normal stress. It is highly expected that the results of the study will lead to a field study and a future implementation of the method for application in engineering practice.

TEST PROGRAM

This study is focused on the densification of loose sands by the disc shearing method. A series of laboratory disc shearing tests were carried out on Ottawa sand, Vietnam sand, and Mai-Liao sand. The Vietnam sand is a beach sand and the Mai-Liao sand is an alluvial sand. The grain size distribution curves of these sands are shown in Fig. 1. All three sands tested are considered to be clean sands. The particles of Ottawa sand and Vietnam sand in general are in angular shape, whereas the Mai-Liao sand particles are in general platy.

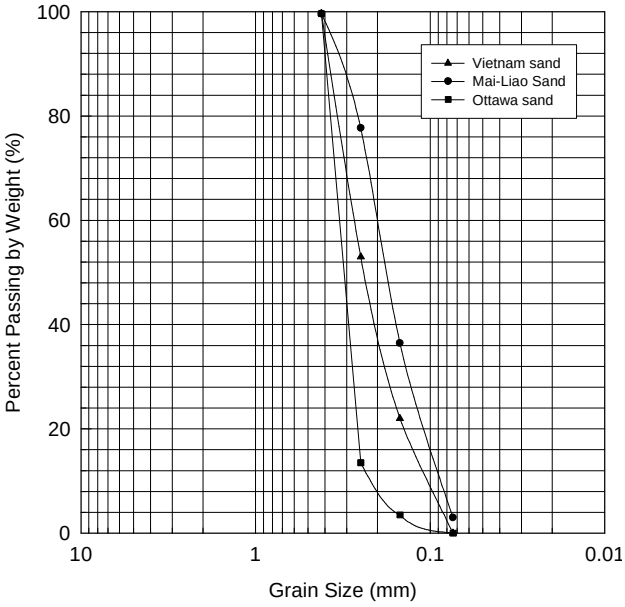

Fig. 1. Grain size distribution curves of the sands tested

The maximum void ratio, minimum void ratio, specific gravity, and d_{50} for the sands tested are listed in Table 1.