FEASIBILITY OF SEGREGATED SAMPLE PREPARATION USING WATER SEDIMENTATION

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1. INTRODUCTION

There are lots of evidences of liquefaction in reclaimed lands constructed by dredging and pumping method. Definition of dredging in this paper is removal of materials from the bottom of rivers or sea. The materials removed during dredging were pumped in to form reclaimed land. In this condition, there is no soil densification performed and soil particles sediment due to gravity. This paper demonstrates the results of soil specimen preparation investigation using water sedimentation on Katori sandy soil. Numerous researches (Tatsuoka et al. 1986; Miura and Toki, 1982; Wood et.al., 2008; among others) have reported that the strength and deformation of sands can be remarkably influenced by methods of specimen preparation. Most prior studies have focused their efforts to establish a standard method of specimen preparation by which homogenous specimens can be formed in order to obtain reliable and repeatable results. However, these techniques may not be valid in all situations, especially when dealing with sandy soil that is deposited in-situ using the dredging and pumping method. These sandy soil deposits are not uniform where the sands and fines are segregated with beddings of millimeters to centimeters in thickness. Yoshimine and Koike (2005) have examined the effect of micro-layer on silty sand behavior by stratified soil of five layers of clean sand and kaolin silt. Their test results indicate that the liquefaction resistance of layered soil is greater than that of uniform sand. In view of the above, the objective of this study is to develop the method for reconstituted soil specimen that is representative of reclaimed soil condition.

2. PROPERTIES OF KATORI SAND

The sample for experiment is selected from reclaimed area in Katori city, Chiba prefecture, which is located near Tone River. All tests in this experimental program were performed on Katori sand with cut-off diameter of 4.75 mm, mean grain size (D_{50}) = 0.16 mm, coefficient of uniformity = 1.81, coefficient of gradation = 0.97, Gs = 2.65, maximum void ratio = 1.35, minimum void ratio = 0.92, and fines content of about 5%. The grain size distribution curve is shown in Figure 1.

3. APPARATUS

Apparatus used in this experiment are (1) acrylic pipe length with inner diameter 6 cm and outer diameter 7 cm; two types of length 55 cm and 105 cm were used, (2) soil funnel, (3) water container, (4) soil container, (5) level, (6) filter paper, (7) drainage, (8) engineering scale, (9) drive samplers. The acrylic pipe was placed vertically by level. In the bottom of the pipe, bottom cap with drainage was placed, and filter papers were put in between. To extract soil sample after water sedimentation, bottom cap was removed manually, and drive samplers was used to retrieve the sample by pushing it from the top of acrylic pipe.

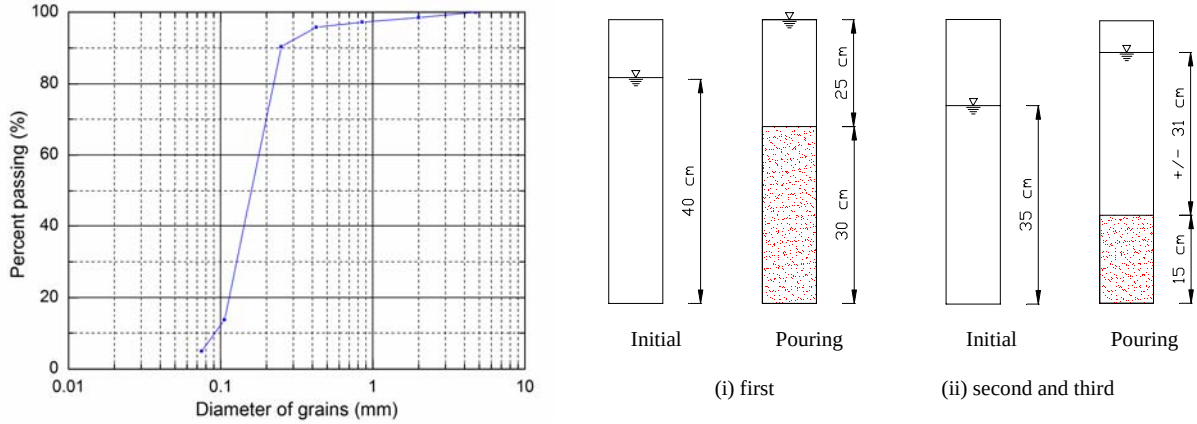

Fig. 1 Grain size distribution curves of Katori sand and illustration of pouring method

4. EXPERIMENT METHOD

The specimen was prepared initially by filling the acrylic pipe with distilled water. The height of initial water was 40 cm from the bottom. This first trial in this study was planed to prepare a soil specimen with height of 30 cm. Air-dried sandy soil was poured into the acrylic pipe using the funnel. The position of the funnel was set at the center or symmetry axis of the acrylic pipe. After sedimentation finished and the water became clear, water released through drainage under the bottom cap. For second and third trials, the height of sample was reduced to 15 cm, and the height of initial water was set at 35 cm. In pouring soil particles, we tried to pour soil particles slowly by fingers. The same sample was used as first

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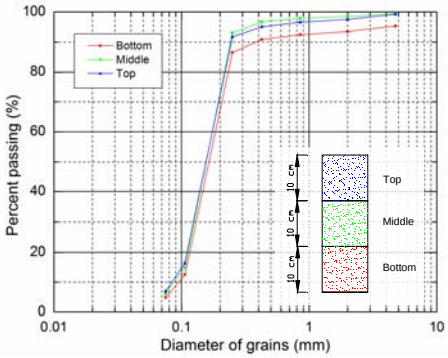
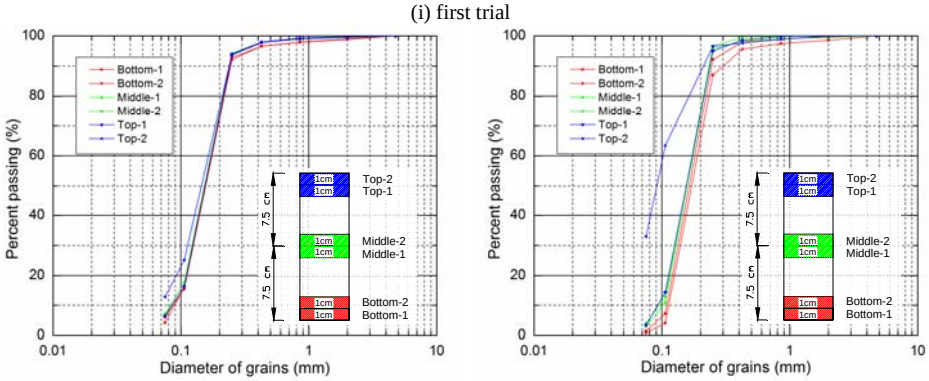
trial after it was air dried. In the third trial, we poured more quickly, the sand particles using soil container. We installed the rubber membrane on the top of the acrylic pipe and rotated the acrylic pipe by 180 degrees in order to shake the acrylic pipe for mixing the soil particles very well in the water. After that, the pipe was rotated back to its initial condition, and the soil particles deposited due to gravity. Illustration for the first, second, and third trials can be seen in Figure 1.

5. RESULTS AND DISCUSSION

In the first trial, grain sieve analyses were conducted every 10 cm using large grain sieve apparatus. The result is shown in Figure 2, where the particle size distribution for the bottom, middle, and top parts was similar to each other. During this experiment, it was observed that there was silt layer at top of specimen about 7 mm of thickness. Based on first trial, because of no significant difference in the grain size distribution, a modification was applied in the second and third trials. The height of soil specimen was reduced to 15 cm, and sieve analyses were conducted at 2 locations at 1 cm interval in the bottom, middle, and top parts. In the second trial, air dried soil was poured very slowly by using fingers. It took about 40 minutes to pour the soil particles. As a result, the surface of silt layer was not flat because it was not easy to control the position of pouring in the center by fingers. On the other hand, in the third trial, the soil surface was flat. During the second and the third trials, they were observed that there was silt layer about 5 mm of thickness. The grain size distributions of the second and third trials showed the same trend; the top zone exhibited higher silt content than the middle zone; and the middle zone exhibited higher silt content than the bottom zone, except for 1 cm thick layer on the top of soil sample, the third trial showed higher silt content. This was because the second trial took longer pouring time than the third trial so that silt particles might not been accumulated in the top parts.



(i) first trial



(ii) second trial (iii) third trial

Fig. 2 Grain size distribution of water sedimentation

5. CONCLUSION

This paper introduces a new specimen preparation procedure by which sandy soil segregates with beddings of millimeters to centimeters in thickness. The procedure will be used for reproducing reclaimed soil in laboratory tests. The test results showed that Katori sand was classified as poorly graded sand with fines content less than 5%. The soil specimen were reconstituted by depositing Katori sand particles in the acrylic pipe through water sedimentation, resulting into segregation where a silt layer was formed at the top of specimen with a thickness of 5 to 7 mm.

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