GEOTCHNICAL INTERPRETARION OF THE INTERLAYERED STRUCTURE OF FINE-GRAINED AND COARSE-GRAINED SOIL ADOPTED IN JAPANESE OLD TUMULI 'KOFUN'

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1. INSTRCUTION

Kofun tumuli, one of Japan's representative historical heritages, are massive tomb mounds built around 3~7 century, using Japanese ancient civil engineering techniques. One of the methods used in the construction of kofun tumuli is interlayered structure of soil with different grain sizes, such as clay and sandy soil [1]. In this study, the reason for adoption of the interlayered structure of fine-grained and coarse-grained soil is interpreted from a modern geotechnical engineering perspective. Based on archaeological and geotechnical engineering research methods, the interlayered structure soil was reproduced using silica sand No. 3 to No. 9 and silica sand powder, based on the grain size accumulation curves for clay and sandy soils in the excavation report for the Miyakozuka Kofun, Nara Prefecture [2]. Triaxial compression tests and sand box tests were conducted to determine its shear and seepage characteristics.

2. METHODOLOGY

Triaxial compression tests were conducted to investigate the compressive strength of the interlayered structure of fine-grained and coarse-grained soil. The cylindrical specimen (Figure 1, left) was 50mm diameter and 100mm length, under a confining pressure of 50 kPa.

Sand box test was conducted to investigate infiltration characteristics of the interlayered structure of fine-grained and coarse-grained soil. The interlayered structure was placed with a thickness of 10cm, and inclined at a 10° angle. Rainfall was applied from the top of the sand box. The flow rate through the surface, the amount of water drained per layer and the time when the outflow was confirmed were measured. (Figure 1, right)

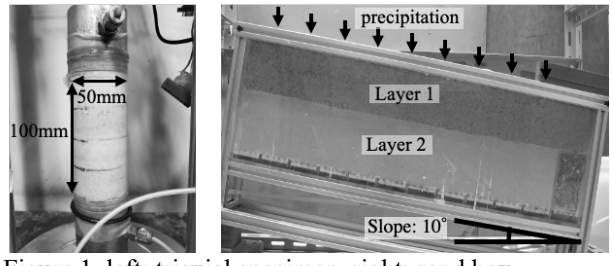

Figure 1. left: triaxial specimen, right: sand box

3. RESULT

Triaxial compression test showed that the strength of the interlayered structure was about the same as that of the single-layered fine-grained soil.(Figure 2). This is because the fine-grained soil layer preceded the coarse-grained soil layer in strain.

Sand box test showed that the infiltration flow preferred the coarse-grained soil layer (Figure 3).

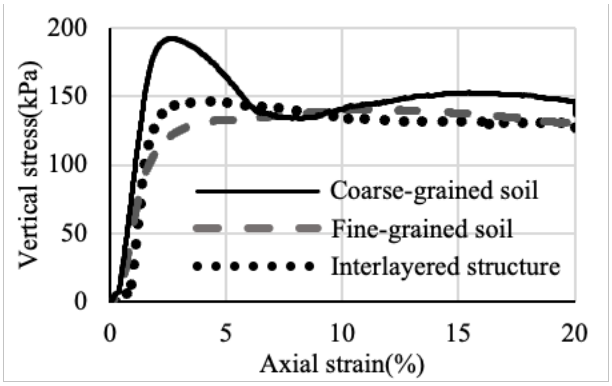

Figure 2. The result of triaxial compression tests

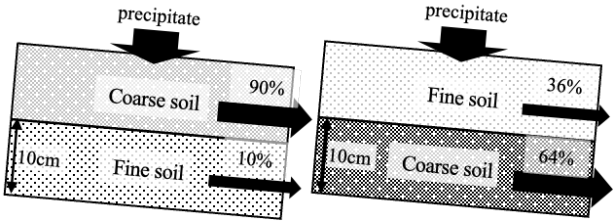

Figure 3. The result of sand box infiltration tests

4. CONCLUSION

The result of triaxial tests suggests that the interlayered structure was not used for the purpose of increasing the strength of the mound.

Sand box test showed that rainwater infiltrating into the mound might flow outward along the slope, mainly through the coarse-grained soil layer, preventing the deterioration of the fill due to rainwater infiltration.

The interlayered structure of fine-grained and coarse-grained soil adopted in Kofun was found to combine the permeability of the coarse-grained soil layer with the impermeability of the fine-grained soil to prevent rainwater from penetrating into the center of the mound.

REFERENCES

[1] K. Nishida, T. Nishigata.(2002) Geotechnical Properties of Ancient Burial Mounds

[2] 都塚古墳発掘調査報告書 −飛鳥の多段築墳の調査− 飛鳥村教育委員会 関西大学文学部考古学研究室