Evaluation on the permeability and behavior of geosynthetic clay liner which are overlapped subjected to differential settlement

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1. BACKGROUNDS AND OBJECTIVES

On March 11th, 2011, a mega-thrust earthquake occurred in offshore North East Japan and some geo environment problems were generated by the Fukushima No.1 nuclear power plant accidents. A large quantity of radioactive polluted soil and waste is one of the geo environment problems and it is necessary to dispose them safety and appropriately. In case of Japan, installing soil layers to function as hydraulic barriers and for sorption against radioactive caesium is therefore required. Geosynthetic clay liners (GCLs) are expected as the hydraulic barrier in final covers because of their low hydraulic conductivity and adsorptive performance. GCL is one of the water shielding bentonite liners and it has a low hydraulic conductivity because its inner bentonite swells as it absorbs water. Since GCLs are overlapped without mechanical welding on waste layer, the ability of hydraulic barriers to withstand differential settlement is an important issue when used in final covers. Ogawa (2013) conducted trapdoor test and constant head permeability tests tank. From the trapdoor test, although behaviour of overlapped GCLs subjected to differential settlement was investigated, tensile and friction force in GCLs were not considered. In this study, friction force in GCLs has been investigated by box shear tests. From permeability tests, it can be said that the tests is not accuracy due to small amount of passing water. In this study, the hydraulic barrier performances have been investigated by falling head permeability tests.

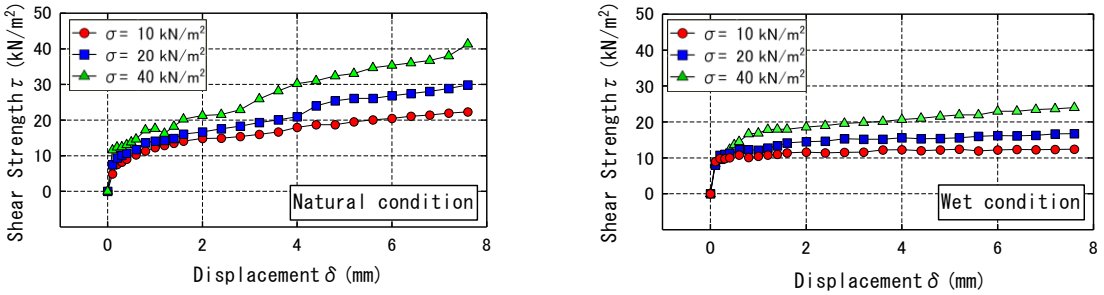
2. METHOD

In GCL box shear tests, two GCL specimens are placed into shear boxes. In shear box, GCL woven side and GCL non-woven side are contacted on the shear plane. The specimens in shear boxes are consolidated for 30 minutes and sheared at the shearing velocity of 0.2 mm/min for 38 minutes. In the falling head permeability tests, two GCLs were placed at the bottom of the tank with 50 mm or 150 mm overlap. A 300 mm thick silica sand layer with a moisture content of 13% was placed above GCLs. Hydraulic gradient about from 65 to 75 are maintained during the tests.

3. MAIN ACHIVEMT

Figure 1 shows relation of shear strengths and displacement in the overlap GCLs. In case of using the natural GCLs, shearing strengths increased with increasing shear displacement. However, in case of using the wet GCLs, shearing strengths has not increased with increasing shear displacement. This can be attributed that the water which is from the GCLs is resident on shear plane and decreased friction resistance. Therefore, it can be said that the overlap GCLs section in wet condition are decreased significantly although the length of GCLs in natural condition are increased since friction resistance in the natural GCLs are bigger than friction resistance in the wet GCLs.

Hydraulic conduct value of overlap width 50 mm and 150 mm are $3 \sim 4 \times 10^{-11}$ m/s. It can be seen that decreasing of overlap width had little effect on hydraulic barrier performance of the GCL overlap section. These values were low enough to act as hydraulic barrier because test is conducted under hydraulic gradient



(a) Natural condition (b) Dry condition

Figure1. Relation of shear strength and displacement