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Numerical Analysis for Permeability of Clay on Natural Terrane

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A landslide on natural terrane is mainly occurred by rainfall, snowmelt, earthquakes and construction works. Especially, the role of rainfall or snowmelt in slope stability is very important because it causes decreased in shear strength by reducing the soil cohesion. As water content in soil increases, the shear strength in soil or other unconsolidated material usually decrease.

If clay exists in the weathered soil, the physical characteristics such as viscosity and permeability are generally different from the condition without the clay. In this case, changes of permeability or viscosity due to the rainfall or snowmelt are dependent on the content of clay in soil. In order to calculate the permeability variation according to the content of clay in soil, many researchers already investigated using laboratory experiments or in-situ tests in the field. However, it is difficult to determine the property of the clay such as a viscosity because of its poor crystalline property. In order to solve this problem and to calculate permeability of clay under various dry densities, we used molecular dynamic (MD) simulation to examine the viscosity of micro scale and homogenization analysis (HA) method to expand micro material property to macro scale. In this research, we determined the permeability of clay under various dry densities due to the rainfall or snowmelt conditions by using MD/HA method.

We determined the viscosity of micro scale material using the MD because the viscosity is heavily dependent on the amount of interlayer water and it cannot be calculated by the experimental method. And then, in order to calculate the macro scale permeability of clay under each dry density condition we made a unit model using the result of MD analysis as input data. Finally, macro scale permeability of clay was determined under various dry density conditions using the HA method. we also examined the applicability of the method to the natural terrane including clay.

Keywords: Molecular Dynamics, Homogenization Analysis, Viscosity, Permeability, Clay