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Hydraulic Conductivity Prediction of Fine-Grained Soils based on Grain Size Index

Enes Zengin, Zeynal Abiddin Erguler, and Huseyin Karakus
Dumlupinar University, Geological Engineering Department, KÜTAHYA, Turkey (enes.zengin@dpu.edu.tr)

Hydraulic conductivity is key parameter to define the ability of soils to transitions of water between soil particles in geotechnical projects. To measure the hydraulic conductivity values of soils, the constant or falling-head test should be performed by considering grain size distribution of soil samples. For these tests, undisturbed soils samples are required. The undisturbed sampling efforts during field investigations are time-consuming and exhausting processes especially in cold climate and unsuitable terrain conditions. In addition to these challenges, falling-head test takes rather long time in laboratory conditions due to being done on fine-grained soils samples having low hydraulic conductivity characteristics. To overcome with these unfavorable conditions, many researchers suggested various empirical equations containing physical properties of soils such as grain size distribution based parameters and Atterberg limits which can be easily determined from simple laboratory tests. Many of these equations are not applicable to estimate hydraulic conductivity of fine-grained soils because of the limitations related accurately representing physical properties of soil samples. In this study, a new empirical approach, grain size index (I_{GS}) value which is a single parameter for defining the grain size distribution curve of a soil was utilized to find the relationship between grain size of fine-grained soils and their hydraulic conductivity values. To determine such relationship, grain size distribution analyses, Atterberg limit tests and eventually falling head tests were performed on 15 disturbed and undisturbed soil samples collected from different locations. According to direct measurements of falling head tests, the hydraulic conductivity values of collected fine-grained soil varies between 5.97x10^{-6} m/s and 1.12 x 10^{-10} m/s. The I_{GS} values of collected soils changes between 0.38 and 0.81. Considering the results of laboratory tests, it was found that there is a statistically significant correlation (K=4$\times$10-5(I_{GS})$^{9.3494}$ with a R^2 value of 0.94) between hydraulic conductivity and I_{GS} values of soils whose gravel content is lower than %10. Based on this relationship, by using further database including measurements obtained from fine-grained soils and falling head tests, more accurate, acceptable and applicable equation can be derived for such soils in future studies.