STUDY OF THE SCALE EFFECT IN HYDRAULIC CONDUCTIVITY FOR UNDISTURBED SOIL COLUMNS

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The study of the soil hydraulic conductivity (K) is useful for a wide range of research areas as mining, geotechnical engineering, solute migration, groundwater remediation and others. Its determination can be made by indirect methods as the correlation with porosity values and granulometric curve, but also directly in the field by means of double ring infiltrometer, Guelph permeameter, slug test, among others, that although allowing measurement in a wide variety of volume of soil, can be expensive and difficult to control the influential factors like precipitation, evapotranspiration and temperature. In laboratory, K can be determined using fixed or flexible-wall permeameter, depending on the soil characteristics, with permanent or variable head. The advantage of the laboratory tests is the greater control over the boundary conditions. On the other hand, the main drawback of these tests is that due to logistical difficulties, they are usually performed with no variation of the sample volume, and usually this volume is smaller than those in which K values will be applied, for example, in numerical models. However, K values can change according to the scale at which measurements are taken, configuring the existence of the scale effect, and justifying the need for test on different scales. The scale effect in hydraulic conductivity has been widely reported and the researchers highlighted the importance of experimental studies in the definition of the upscaling rules. In this context, the main objective of this paper is study the scale effect in hydraulic conductivity by laboratory tests performed in undisturbed soil columns with volumes ranging from 1.2 E-03 m3 to 1.46 E-02m3. The columns were collected manual and carefully in slopes and trench walls in the study area located in Sao Carlos City, Sao Paulo State, Brazil. The study area is a soil volume of 30 m x 30 m x 5 m and the columns were randomically sampled. The laboratory conditions as hydraulic head, temperature and type of test (fixed-well permeameter with permanent head) were the same for all columns. First the soil was characterized (mineralogy, texture and physical indices) and the saturated hydraulic conductivities were then measured in the laboratory. The studied soil can be described as a clayey sand, with macropores and double porosity. The results suggest the existence of scale effect in K, with evidence of strong trends in mean and variance. As expected reductions in the variance of ln K are observed with increasing sample volume and this occurs because larger samples can incorporate more heterogeneity than smaller samples. Therefore, it is possible to conclude that there is scale effect in the K of the studied soil and the variance of de ln K tends to diminish with increasing of the sample volume.