STRUCTURE STABILITY AND ITS INFLUENCE ON SOIL PERMEABILITY

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Abstract

The coefficient of permeability is an important parameter in soil mechanics and it is influenced mostly by soil structure, soil particle distribution, soil porosity and soil water content. Permeability is primarily an indicator of the capacity of soil to store water.In the technical and engineering the knowledge of permeability coefficient is required for irrigation, flow modeling, soil compaction, contaminant migration, forecast landslides etc.Several general functions were used to describe empirical measurements of permeability function. Theoretical developments have provided support for numerous empirical relationships. The objective of this paper is to establish a connection between structural stability and soil permeability. Knowledge of soil pore size is important for infiltration rate (soil water movement), and rate of percolation (water movement through the soil). Size and number of pores influences soil texture and structure, which in their turn affects soil permeability. To evaluate the effect of soil structure on permeability were determined pore size distribution, aggregate stability and suction curve. Coefficient of permeability can be measured either directly (using Darcy's law) or through empirical formulas. Permeability coefficient of saturated soil is determined by the number of pores (pore volume / volume solid part). Incompressible unsaturated soil permeability coefficient is determined by the degree of saturation. Soil permeability in natural setting is extremly variable and difficult to measure, so measurements are performed in the laboratory. Permeability changes can provide early warning of soil degradation, risk of flooding and erosion. It also is an indicator of water potential and nutrient availability to plants.

Key words: structural stability,

Permeability is the measure of the soils ability to permit water to flow through its pores or voids. The coefficient of permeability is an important parameter in soil mechanics and it is influenced mostly by soil structure, soil particle distribution, soil porosity and soil water content. Soil permeability is affected by environmental conditions and is primarily an indicator of the capacity of soil to store water. In the technical and engineering the knowledge of permeability coefficient is required for irrigation, drainage, flow modeling, soil compaction, contaminant migration, forecast landslides. The coefficient of permeability varies with the type of soil and conditions and some of factors that influence it are:

- Size and shape of the soil particles
- Structure stability
- Texture
- Root and animal activity
- Degree of saturation

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MATERIAL AND METHOD

Henry Darcy (1803-1858) described the results of an experiment designed to study the flow of water through a porous medium. Darcy's experiment resulted in the formulation of a mathematical law that describes fluid motion in porous media.

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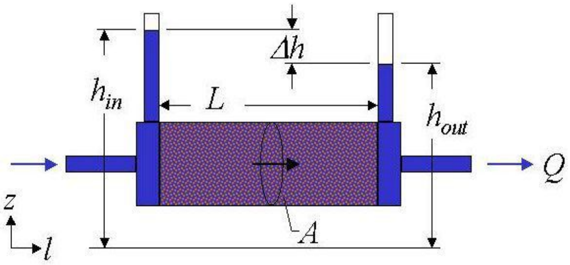

Figure **1. Simple column**

Darcy found that Q is proportional to $\Delta h/L$ or the hydraulic gradient, *i*, that is

$$Q = k\frac{h_{in}-h_{out}}{L}A = k\frac{\Delta h}{L}A \qquad (1)$$

$$Q = kiA \qquad (2)$$

The hydraulic gradient defined as loss of head per unit length of flow

$$i = \frac{\Delta h}{L} \qquad (3)$$

Where:

Q is the value of the rate of flow,

k is coefficient of permeability,

h_{in}, h_{out} are pressure of water at top and bottom the sample

L is the length of the sample

Infiltration in porous media theory is based on a generalization of Darcy's Law, "Velocity of Flow in Porous Media soil is proportional to the hydraulic gradient" where the flow is assumed to be laminar.

$$v = k\,i \qquad (4)$$

Where:

k is coefficient of permeability,

v is velocity of flow

i is the hydraulic gradient.

Table1

Permeability coefficient values for different soil types

Soil type	Coefficient of permeability (mm/s)
Coarse	$10 - 10^3$
Medium sand	$10^{-2} - 10$
Fine sand	$10^{-4} - 10^{-2}$
Dense silt	$10^{-5} - 10^{-4}$
Clay	$10^{-8} - 10^{-5}$

Knowledge of soil pore size is important for infiltration rate (soil water movement), and rate of percolation (water movement through the soil).

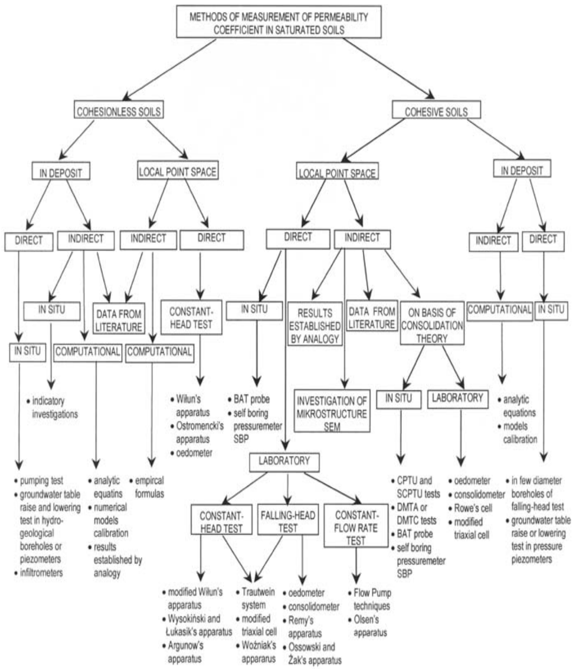

Figure **2. Methods of measurment of permeability coefficient in saturated soils**

Size and number of pores influences soil texture and structure, which in their turn affects soil permeability. To evaluate the effect of soil structure on permeability were made a series of tests of pore size distribution, aggregate stability and suction curve in Soil Science Laboratory of the Faculty of Hydrotechnics, Geodesy and Environmental Engineering of Iasi with the devices shown in *Figure 3*:

Figure **3. Sieving device and pipetting device . Device for determination the aggregates stability and sand box for drying**

The obtained data of texture composition and bulk density were introduced in SOILPARA program, which was generated soil-water characteristic curve (Figure 4).

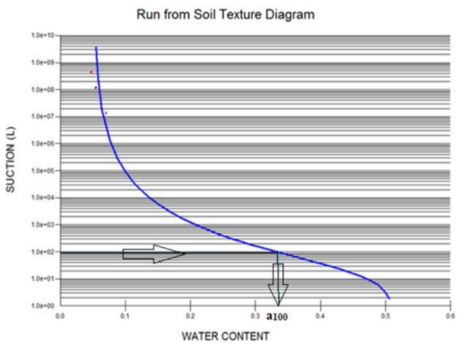

Figure **4. Soil-water characteristic curve**

RESULTS AND DISCUSSION

The data obtained in the laboratory who followed aggregate stability, structure, texture, bulk density (Da) and porosity (PT) are presented in Table 2.

Table 2

Soil characterization

Texture			Da
Clay (%)	Silt (%)	Sand (%)	g/cm^3
24.13	62.07	13.80	1.30

The soil-water characteristic curve is broadly defined as the relationship between the amount of water in the soil and the soil suction, which has repeatedly been identified as the key soil information required for the analysis of seepage, shear strength and volume change behavior involving unsaturated soil.

The results show that there has been a decrease in the permeability of the soil sample. This disturbance may be associated with the crushing of the pore spaces. Permeability varies with the square of particle diameter. A relationship between permeability and grain-size is more appropriate in case of sands and silts. Fine-grained soils with a flocculated structure have a higher coefficient of permeability than those with a dispersed structure.

The shape of the suction curve indicates that the coefficient of permeability is sharply decreasing when is a small reducion in water saturation.

CONCLUSIONS

The coefficient of permeability for a deformable unsaturated soil can be estimated using the soil-water characteristic curve. Permeability function for different pore numbers can be calculates using the soil-water characteristic curve. The study of the soil structure showed that this is a porous medium containing various pore sizes.

Water that enters into the soil remains trapped in pores or leaks to large depths. How are placed spaces between pores determines the type infiltration of water into the soil, which depends on the speed of its absorption, per unit area analyzed.

Permeability changes can provide early warning of soil degradation, risk of flooding and erosion. It also is an indicator of water potential and nutrient availability to plants.

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