Study on the Permeable Property of Modified layer arrangement of Soil of Unnao District

Hashir Abdullah[1] Anuj Verma[2]

[1]M. Tech Student, [2]Assistant Professor
[1,2]Department of Civil Engineering, Rajshree Institute of Management and Technology, Bareilly

Abstract: According to the experiment, for deposits of stratified soil, the permeability coefficient during the flow normal to the bedding plane orientation is seen to get deviated from the value in the theory. We calculate the permeability coefficient with the help of Darcy's law. This technical analysis has been made with the help f outcomes from the permeability behavior study of a couple of layers of a system of soil and a trio of soil layer systems. For a system of two later, the permeability coefficient of the exit layer could be known as the factor that controls the trio-layer system and this permeability coefficient relies on the relative position of the soil system. While flow becomes normal in accordance with the bedding planes, it relies on the relative position of layers that have a distinct value of permeability coefficient in system.

Index Terms—Permeability, Soil, Darcy's law, Black soil, Sand, Clay.

I. INTRODUCTION

The belonging of soils to permit the pass of the fluids against the voids it has is an essential engineering property. In order to examine the porosity of the soils, we study the soil mechanics, and it becomes imperative to calculate the amount of seepage underground in varied hydraulic conditions. In normal conditions, the coefficient of permeability is normally gotten through the help of a permeability test of constant head and is used in drainage settlement and calculation of stability. The issues are quite essential in accordance with the environment like the management of wastewater, control of slow stability, structural failure in accordance with ground settlement and erosion etc. The movement of water and drainage in soils with fine grains is quite imperative for the science of soils, geotechnical engineering and even hydrology. For geotechnical engineering, the value of permeability has a lot of effect on the features of consolidation in the soil & as a result of the drainage, over the shear of strength and the mobility of the soil. Besides this, the study related to the seepage of the soil in the body of dams, problems with slope stability, the flow of groundwater and other similar topics need reliable info and features of permeability of the soils with fine grains. For a soil system with layers, the layers and their bedding plane could be vertical or horizontal and even inclined. Every layer would have a single value of permeability coefficient that is k. The similar permeability coefficient or average value of the deposits in strata will rely on the flow direction according to the bedding plane orientation.

The permeability characteristics of homogeneous soil deposits are known to be functions of void ratio and the soil type. The permeability characteristics of stratified deposits (i.e., layered systems), predominantly when the flow is normal to the bedding plane, can further be complicated by the possible mutual interaction among the soils of different layers and their relative position in the deposit. Hence, in the present experimental investigation, it is proposed to study the permeability characteristics of stratified deposits when the flow is normal to the bedding planes, the factors affecting them, and the possible mechanisms controlling such flows. For the sake of simplicity, the simple cases of a two layer system and three layer system are considered. The required permeability coefficient in these cases could be evaluated while presuming that the law of Darcy is valid. If L1 and L2 and, ..., Ln denote these individual level thickness and k1, and k2 and,....., kn are adjacent permeability coefficients while then the resulting coefficients for normal permeability for bedding plane which is (keq)n or which is parallel to bedding plane, (keq)p can be calculated with the help of (keq)n

Water will never flow between 2 given points in one straight line with a similar velocity but it will rater be in a winding path on different pores. According to equation from Bernoulli's, all sum of heads at one place in water that stays moving could be offered by sums of pressure heads, velocity heads, and elevation heads.

II. LITERATURE REVIEW

One of these sections deals with art with respect to soil permeability with a few work-related to permeability could be as follows:

Uppot (in 1989): A couple of clays can face inorganic and organic permeants to examine the alterations in permeability that led due to a connection between permeants and clays.

Haug et al (in 1990): They conducted permeability tests in labs on a specimen lined created from Ottawa sand with sodium bentonite. They mixed the material and conditioned it with moisture to compact it and make it reinforced frames of wood. This test result was inside lab and was tested with back pressure and low gradient parameter tests that were done on cores of an undisturbed besides remolded specimen.

Sridharan & Prakash (in 2002): When we examine the dual-layering system of soil in detail, it denotes that the interaction between distinct soil layers and types that forms a strata deposit will affect the similar permeability of the strata deposit that will not be calculated simply with the help of some equation in the same permeability coefficient for a strata deposited while the following tends to be normal against the bed plane orientation according to Darcy's Law. Permeability in the controls of the exit layer even if the permeability that is measured is more or less than the values in theory for the strata deposit. The permeability coefficient of soils tends to be a kind of interaction function between soils and their surroundings that are in contact with them, apart from the thickness, void ratio, and the type for soil in a layered approach. In this aspect, the permeability coefficient in the soil in a system of later

could be considered to depend on the way the layers of distinct k can be placed, the flow direction, and the thickness. While this examination is completely an experiment, it tends to deliver a further work scope according to the validity of results and hypotheses that can be mathematically calculated.

Galvaeo et al (in 2004): The permeability coefficient of the saprolitic soil gets enhanced about 5 times in number when 2% of lime was mixed and then it got decremented on adding more lime. This is in accordance with the chemical bond creation and even the aggregation. According to the laterite soil, the permeability coefficient got lessened with the addition of more lime. This could also be similar to the similar process unless the bonds tend to be weaker than that in developed soil.

Nikraz et al (in 2004): A lot of tests for permeability that was carried out in the lab to know the effect of fiber on behavior related to the hydraulic of conductivity of the composite sand and Sand with clay was taken as the ground aspect of natural and composite fibers that got the reinforcement.

Prakash and Sridharan (2013): Performed a study of comparison for the permeability coefficient of a measured value of triple-layer sediments of the soil with the value that was obtained in theory. According to the outcomes of this, the permeability coefficient of the controls of the bottom layer in accordance with the value that we get for the permeability coefficient is more or less against the theoretical worth. The result for this study is the outcome that the obtained permeability coefficient of any layer of soil deposits will not only rely on the worth of k of the single coatings that contain the deposit besides and it will also rely on the comparative position for the system of coatings.

III. Materials and Methods

a) Materials

- Clay: This project consists of clay that we got from Sector 5 in Rourkela. Clay is actually quite plastic according to its water content and tends to turn hard and brittle. Minerals of clay normally get formed over certain periods of time when the rocks get weathered continuously.
- Black Soil: Black soil in India is commonly used for agricultural uses, but in civil engineering, the black earth are offered risky issues to the creators. In this study, we get black earth from a place near Ambazari Nagpur, and it could be employed to know the porosity of the ground layers.
- Sand: The kind of sand that is utilized in the test in lad was brought from the kind of riverbed of the Koel. It should be devoid of any organic elements and roots etc. The sample was then taken to an oven for drying and was sieved in an IS Sieve of 710 microns where the retention was at 300 microns to get the desired grading.

b) Methodology

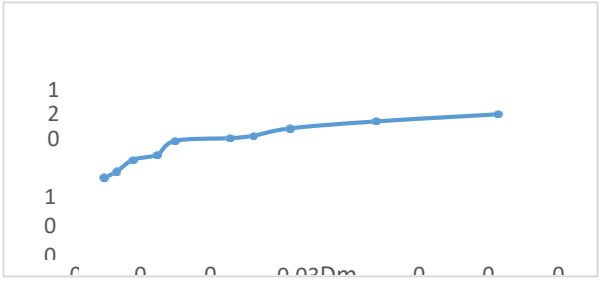
- Preparation of Sample: - the collected sample i,e clay, black soil and sand were prepare for the characterization
- Geotechnical Characterization of sampled material: - the prepared sample were subjected for geotechnical analysis. The tests that were performed to fulfill the purpose are as below: -
    1. Liquid Limit
    2. Optimum moisture content
    3. Specific gravity
    4. Maximum dry density
    5. Sieve Analysis
    6. Standard Proctor test
    7. Constant head permeability test
    8. Variable head permeability test
- Mixing of soil: - three types of mix were prepared in the combination of black soil and sand, sand and clay, black soil and sand and clay
- Preparation of Permeable layer: - A total eighteen sample, six samples in different ratio from each mix were prepared for analysis
- Permeability analysis of soil: - Falling head permeability test were conducted on each sample in permeability system and then result is obtained.

IV. Results

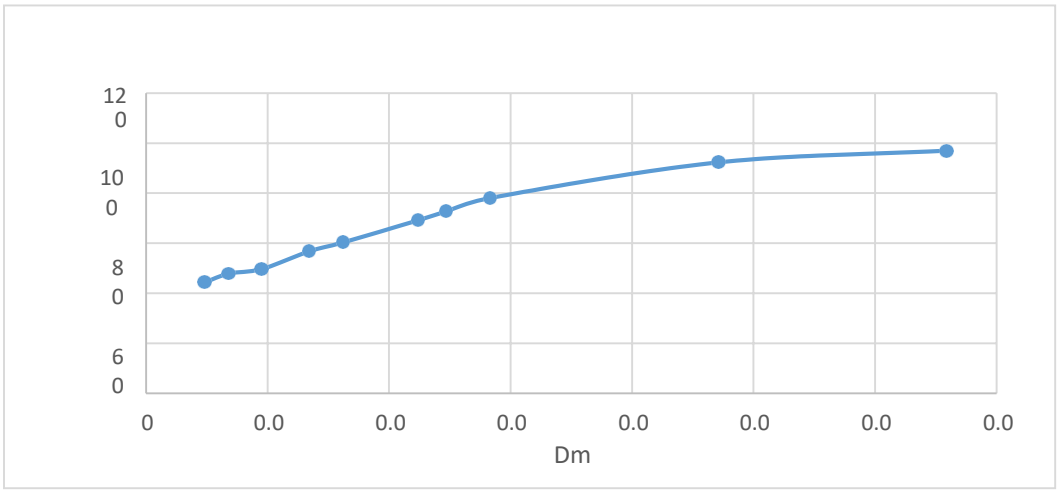
- Results for specific gravity of soils

Clay	2.46
Black soil	2.29
Sand`	2.65

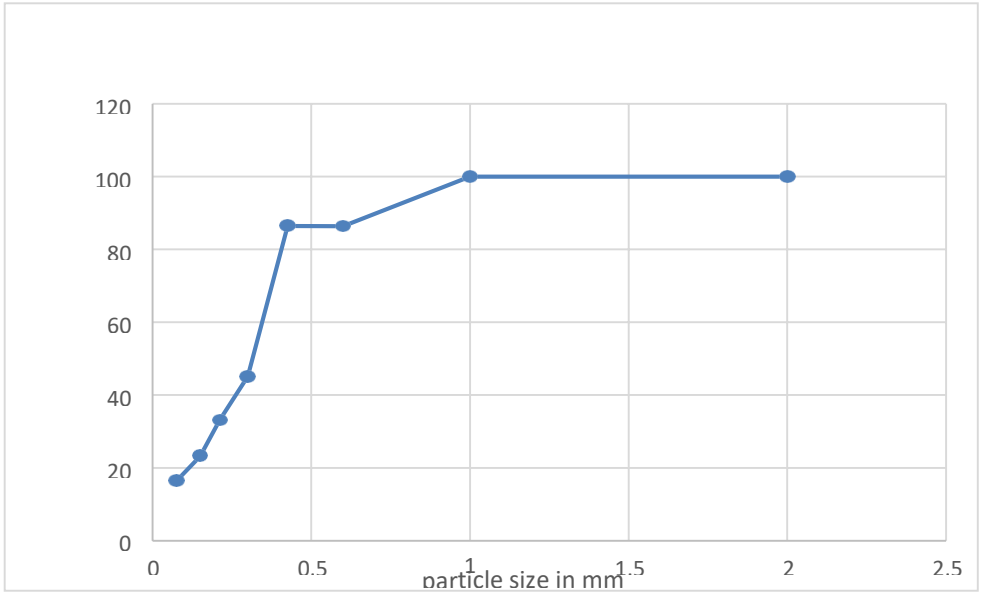
- Result for Grain size analysis
    1. Clay



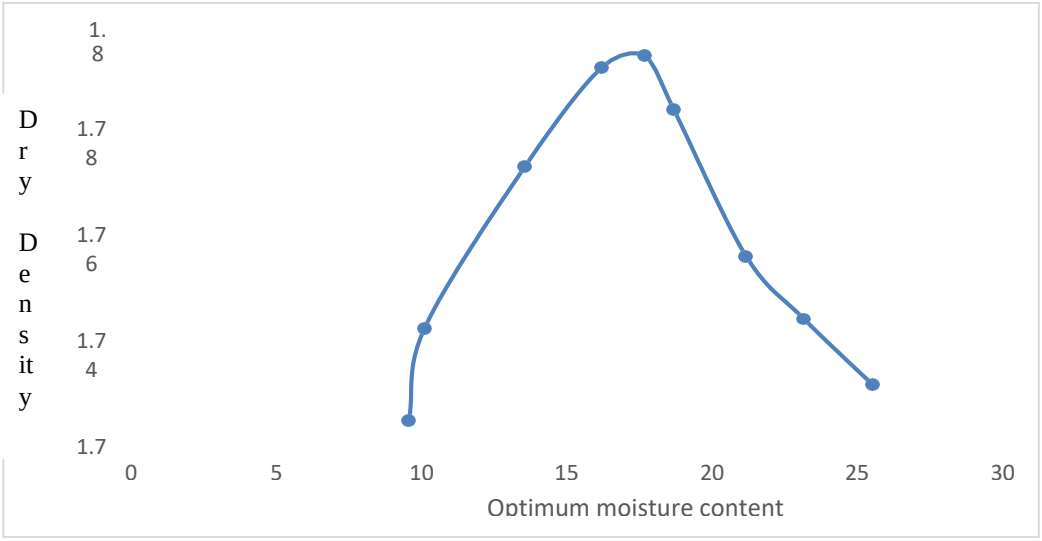
    2. Black soil



3. Sand

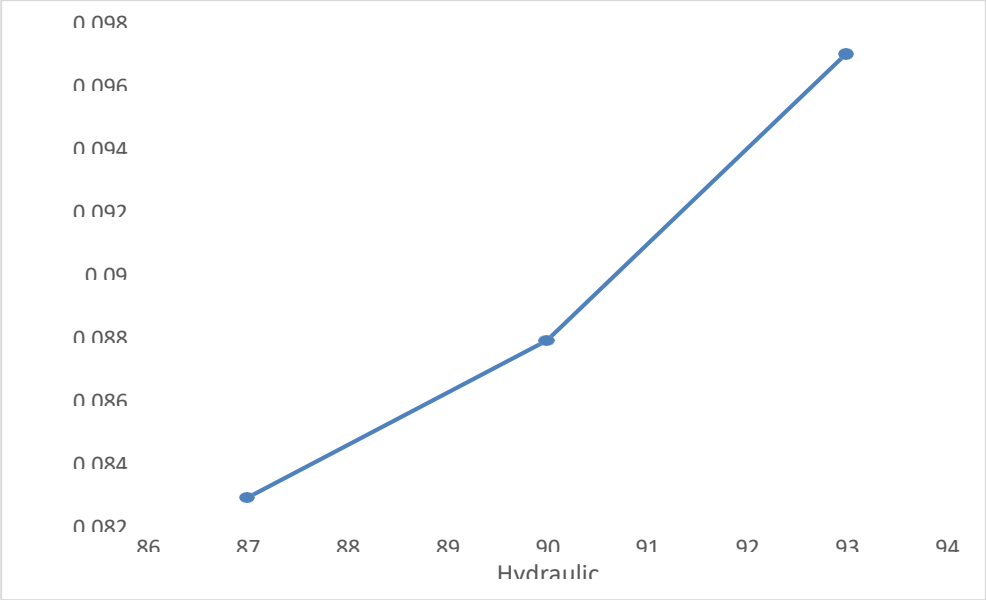


- Relationship between maximum dry density and optimum moisture content for clay



- Relationship between maximum dry density and optimum moisture content for black soil

- Relationship between hydraulic gradient and velocity of flow for sand



- Result for permeability analysis

S. No.	Clay and Sand	Black soil and Sand	Clay and Sand and Clay and Sand
1	4.06×10^{-4}	3.94×10^{-4}	3.0529×10^{-4}
2	4.06×10^{-4}	3.94×10^{-4}	3.0529×10^{-4}
3	6.06×10^{-4}	5.88×10^{-4}	3.0529×10^{-4}
4	6.06×10^{-4}	5.88×10^{-4}	3.0529×10^{-4}
5	3.05×10^{-4}	2.972×10^{-4}	3.0529×10^{-4}
6	3.05×10^{-4}	2.972×10^{-4}	3.0529×10^{-4}

V. CONCLUSION

A laboratory study was done for two layer and three-layer soil system having different types of soil, type of layer, varying proportion and position for clay, sand and black soil .and it is found that equivalent coefficient of permeability differs from the value calculated from Darcy's law. The permeability of the exit layer controls

whether the measured permeability is greater or lesser than the theoretical values for a stratified deposit. The coefficient of permeability of a soil appears to be also a function of the interaction between the soil and the surrounding soil(s) with which it is in contact, in addition to the void ratio, thickness, and the soil type in the case of layered system. And hence the coefficient of permeability of a soil in a layered system has to be considered as dependent upon flow direction, relative position and thickness of layer also this study is purely experimental and it opens up the scope for further work and hence to obtain a mathematical equation for layered soils.

REFERENCES

1. Boroumand, A., & Baziar, M. H. (2005). Determination of compacted clay permeability by artificial neural networks. In *Ninth International Water Technology Conference, IWTC9, Sharm El-Sheikh, Egypt*.
2. Chegenizadeh, A., &Nikraz, H. (2011). Permeability test on reinforced clayey sand. World Academy of Science, Engineering and Technology, 2011, 130-133.
3. Fernando, J. (2008, October). Determination of coefficient of permeability from soil percolation test. In Proceedings of the 12th lnternational Conference of lACl\/lACr (pp. 1824- 1881).
4. Fernuik, N., &Haug, M. (1990). Evaluation of in situ permeability testing methods. Journal of geotechnical engineering, 116(2), 297-311.
5. Li, X., Li, J. H., & Zhang, L. M. (2014). Predicting bimodal soil–water characteristic curves and permeability functions using physically based parameters. Computers and Geotechnics, 57, 85-96.
6. Lafhaj, Z., &Shahrour, I. (2002). Influence of the presence of partially saturated layer on the interpretation of field water tests. In Unsaturated Soils: Proceedings of the Third International Conference on Unsaturated Soils, UNSAT 2002, 10-13 March 2002, Recife, Brazil (Vol. 1, p. 33). Taylor & Francis US
7. Osinubi, K. J. (1998). Permeability of lime-treated lateritic soil. Journal of Transportation Engineering, 124(5), 465-469.
8. Raisinghani, D. V., &Viswanadham, B. V. S. (2010). Evaluation of permeability characteristics of a geosynthetic-reinforced soil through laboratory tests. Geotextiles and Geomembranes, 28(6), 579-588.
9. Rajapakse A. (1993), SHORT-TERM AND LONG-TERM PERMEABILITIES OF CONTAMINATED CLAYS,ASCE, ISSN, 1993.119:725-743.
10. Sathananthan, I., &Indraratna, B. (2006). Laboratory evaluation of smear zone and correlation between permeability and moisture content. Journal of Geotechnical and Geoenvironmental Engineering, 132(7), 942-945.
11. Sezer, A., Göktepe, A. B., &Altun, S. (2009). Estimation of the Permeability of Granular Soils Using Neuro-fuzzy System. In AIAI Workshops (pp. 333-342).
12. Sridharan, A., & Prakash, K. (2002). Permeability of two-layer soils. Geotechnical Testing Journal, 25(4), 443-448.
13. Swartzendruber, D. (1962). MODIFICATION OF DARCY'S LAW FOR THE FLOW OF WATER IN SOILS. Soil Science, 93(1), 22-29.
14. Uppot, J. O., & Stephenson, R. W. (1989). Permeability of clays under organic permeants. Journal of Geotechnical Engineering, 115(1), 115-131.
15. De Brito Galvão, T. C., Elsharief, A., &Simões, G. F. (2004). Effects of lime on permeability and compressibility of two tropical residual soils. Journal of environmental engineering, 130(8), 881-885.