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Soil Permeability Zonation in Rabak Village and Surroundings, Rumpin District, Bogor Regency, West Java

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Abstract**—** *Permeability is the ability of fluids to flow in the soil either through cavities with macro or micro sizes in horizontal and vertical directions. Soil is the result of weathering of a rock where the soil consists of a collection of solid particles with interconnected cavities. It is because of these voids that water can flow in the particles through the voids from one point to another in the direction of lower elevation. The property possessed by the soil is what allows fluids to pass through which is called soil permeability. The purpose of this study was to identify the permeability value of the soil in Rabak Village and its surroundings, Rumpin District, Bogor Regency, West Java. This study uses the constant head permeability method which was carried out at the Geological Engineering Laboratory, Trisakti University, Jakarta. The results of the permeability measurement will be related to the classification of soil type parameters (Department of Soil Science, USU, 2003). Permeability testing using the Constant Head Permeability method used 8 soil samples with the results of 5 samples classified as very fast (>25.4 cm/hour), 2 samples classified as fast (12.7 – 25.3 cm/hour), and 1 sample classified as medium (6.3-12.6 cm/hour) . Based on the results of these measurements can be made a permeability map in the research area.*

Keywords**—** *Constant Head Permeability, Engineering Geology, Rumpin Distric, Soil Permeability*.

I. INTRODUCTION

Water has the ability to flow on pores (cavities) in the soil (Darcy's Law). There are two things used in Darcy's law, the first is stated that the fluid flow in the soil will be laminar, and the second is that the fluid in the soil is in a saturated state. Soil is the result of weathering of a rock where the soil consists of a collection of solid particles with interconnected cavities. It is because of this cavity that water can flow inside the particles through the cavity from one point to another in the direction of lower elevation. It is this property possessed by the soil that allows the fluid to pass the so-called soil permeability. The result of this permeability test is to find out the value of the coefficient of a soil in melting its fluid where the data can be a reference in many ways, for example in disaster mitigation, infrastructure development, and references in regional development designs. This research took a case study in the Rabak Village area and its surroundings, Rumpin District, Bogor Regency, West Java Province.

II. AIMS AND OBJECTIVES

The main purpose of this research is to determine the value of the permeability coefficient of a soil sample in passing its fluid where in this study the sample studied was soil derived from weathering of Andesite Rocks, Sandstones, Tufaan Sandstones, and Claystones.

III. RESEARCH LOCATION

The research area is included in the Rabak Village and its surroundings, Rumpin District, Bogor Regency, West Java Province. It is located approximately 52 km to the southwest of the city of West Jakarta. Geographically the study area is located at 6°28'6.524" - 6°29'43.822" LS and 106°37'44.443", - 106°39'22.226" BT.

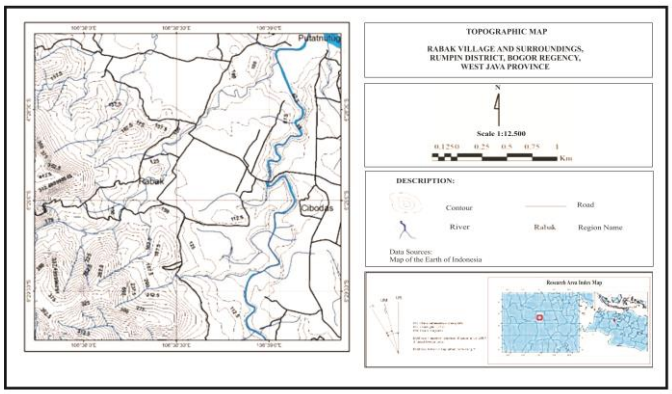

Fig. 1. Topographic Map of the research area with a scale of 1: 12.500. Source: Rupa Bumi Indonesia Map.

IV. REGIONAL GEOLOGY

Regional geology describes the geological conditions of the research area broadly with the regional scope of the research area, where research has been carried out by previous studies such as regional physiography, regional stratigraphy, regional structure. The research area is included in the physiographic Bogor Zone based on the division of the West Java physiographic zone. The Bogor Zone is located in the southern part of the Jakarta Coastal Plain Zone in the form of hills extending from the west-east around the city of Bogor

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which turns to the southeast in the eastern part of Purwakarta and forms an arch around the Duchy City with a width of about 40 km. The Bogor zone is composed of lithologies of tertiary sedimentary rocks and intrusive and extrusive igneous rocks to form the morphology of steep hills (Van Vemmelen, 1949). Regional stratigraphy Based on the research of T. Turkandi, Sidarto, D.A. Agustiyanto, and M.M. Purbo Hadiwidjoyo (1992), the oldest rocks exposed in the study area consist of: The Bojongmanik Formation which is estimated to be of Early Miocene- Middle Miocene age, then at the Pliocene age deposited the Serpong Formation, at the Plistocene age deposited Alluvium Fan, and at this age also deposited Young Volcanic Rocks. In the study area, there are indications of geological structure in the form of anticlines in a northwest-southeast direction that stretches from Mount Gubar to Cisentul based on the research of T. Turkandi, Sidarto, D.A. Agustiyanto, and M.M. Purbo Hadiwidjoyo (1992).

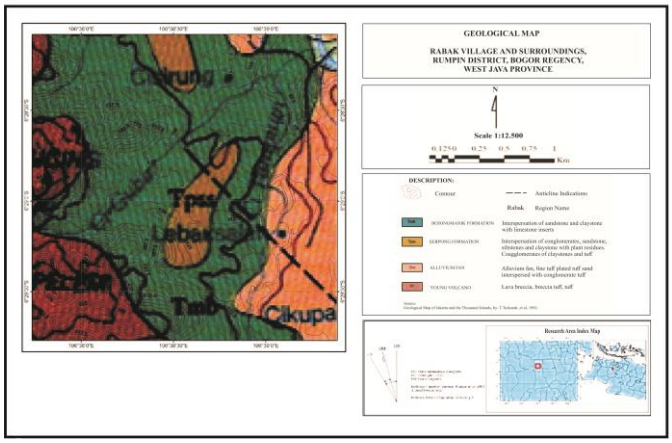

Fig. 2. Geological Map of the research area with a scale of 1: 12,500. Source: Geological Map of Jakarta and the Thousand Islands, by: T.Turkandi, et al, 1992.

V. METHOD

This research requires several stages, the first is a literature study, with the aim of being a reference and basis in conducting this research and the steps that must be considered in data collection. After the literature study, field activities were carried out for soil sampling in the research area. After the collection of soil samples, laboratory activities were carried out to test permeability with the Constant Head Permeability method. The permeability test was carried out at the Engineering Geology Laboratory of Trisakti University Jakarta.

A. Procedure

- Calculate the dimensions and volume of the tube
- Input porosity stones into tubes and soil samples of a certain height
- Cover the ground with porosity stones and spring felt, after which lock the tube with a tube cover
- Calculate the height and area of sand in tubes
- Input 500 ml of water into the tube until all soil samples are submerged by water and the water surface is above the soil
- Measure the difference in the height of the water in the tube
- Open the hole where the water comes out while introducing water into the tube to maintain the water level in both tubes remains constant
- The water coming out of the tube is accommodated in a measuring cylinder. Record the time required until the volume of water collects in a measuring cylinder
- Repeat the experiment until times, then calculate the average time to reach a volume of 500 ml

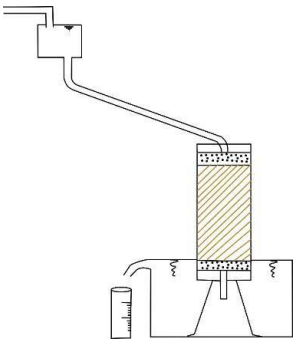

Fig. 3. Permeability test scheme by method Constant head Permeability

B. Calculation Formula

$$k = \frac{Q \times L}{A \times h \times t}$$

D : Tube diameter
L : The height of the sand in the tube
A : Cross-sectional area of Sand
T : Time required for the experiment
V : The volume of water collected
H2 : The height of the water in the tube

VI. RESULTS AND DISCUSSION

Fig. 4. Constant head permeability testing at the Engineering Geology Laboratory, Trisakti University

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A. Very Fast Permeability Soil Unit Analysis

From 8 test samples, there were 5 results with very fast soil permeability with a permeability rate of > 25.4 cm / hour. Where in sample 1 the volume of water collected was 89 ml, the height of the soil in the tube was 10 cm, the area of the base of the tube was 9.884 cm, the time required was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 38.98 cm / hour. Sample 2 volumes of water collected were 65 ml, soil height in the tube was 10 cm, the area of the tube base was 9.884 cm, the required time was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 28.468 cm / hour. Sample 3 volumes of water collected were 112 ml, soil height in the tube 10 cm, the area of the tube base was 9.884 cm, the required time was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 49 cm / hour. The sample of 4 volumes of water collected was 83 ml, the height of the soil in the tube was 10 cm, the area of the base of the tube was 9.884 cm, the time required was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 36.35 cm / hour. The sample of 5 volumes of water collected was 62 ml, the height of the soil in the tube was 10 cm, the area of the base of the tube was 9.884 cm, the required time was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 27.15 cm / hour.

B. Fast Permeability Soil Unit Analysis

From 8 test samples, there were 2 results with fast soil permeability with a permeability rate of 12.7 - 25.4 cm / hour. Where in the sample 6 the volume of water collected was 55 ml, the height of the soil in the tube was 10 cm, the area of the base of the tube was 9.884 cm, the time required was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 24.08 cm / hour. The sample of 7 volumes of water collected was 62 ml, the height of the soil in the tube was 8 cm, the area of the base of the tube was 9.884 cm, the time required was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 21.72 cm / hour.

C. Medium Permeability Soil Units Analysis

From 8 test samples, there was 1 result with moderate soil permeability with a permeability rate of 6.3 – 12.6 cm / hour. Where in the sample 8 the volume of water collected was 18 ml, the height of the soil in the tube was 10 cm, the area of the base of the tube was 9.884 cm, the time required was 2 minutes with a water height of 70 cm, based on the data in this experiment the value of the permeability coefficient was 7.88 cm / hour.

D. Zoning Map of Soil Types by Permeability

Based on the analysis of soil permeability in the study area, there are 3 types of permeability, namely very fast permeability with a permeability rate of >25.4 cm / hour where from 8 samples there are 5 samples that have a > value of 25.4 cm / hour, namely: 38.98 cm / hour, 28.46 cm / hour, 49 cm / hour, 36.35 cm / hour, 27.15 cm / hour. Then in the type of fast permeability with a permeability rate of 12.7 – 25.4 cm / hour where from 8 samples there were 2 samples that had a value of 12.7 - 25.4 cm / hour, namely: 24.08 cm / hour, and 21.72 cm / hour. Medium permeability rate with a value of 6.3 – 12.6 cm / hour there was 1 sample that belonged to this category with a value of 7.88 cm / hour. Of the 8 samples, there were 5 samples of very fast permeability type, 2 samples of fast permeability type, and 1 sample of medium permeability type, because there is only 1 sample of a total of 8 samples and the type of permeability soil is surrounded by soil with very high permeability, so on the permeability distribution map, this type of permeability is not included in the final map because it does not represent.

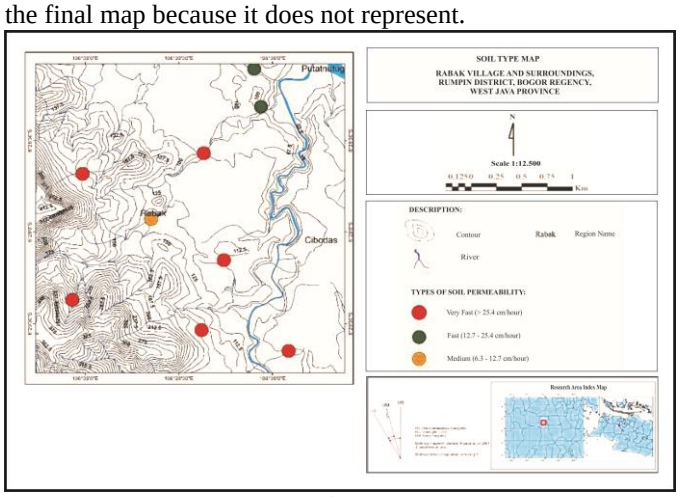

Fig. 5. Map of Research Areas

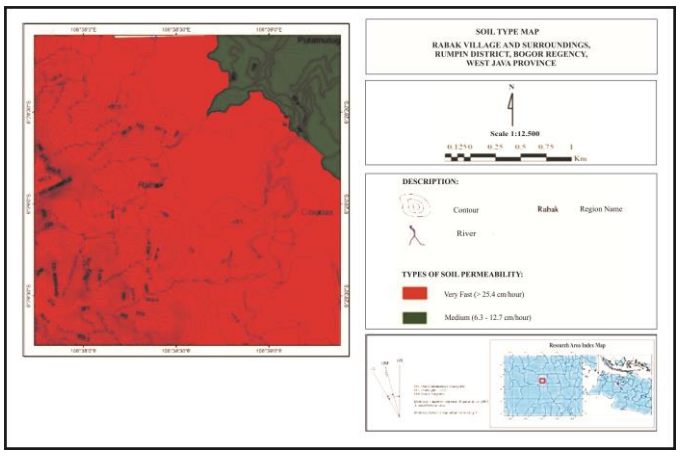

Fig. 6. Soil Type Zoning Map Based on Permeability

VII. CONCLUSION

The research was in the area of Rabak Village and its surroundings, Rumpin District, Bogor Regency. Permeability testing using the Constant Head Permeability method was carried out at the Engineering Geology Laboratory of Trisakti University, Jakarta. Where in the experimental results the research area has 3 units of soil types based on their permeability, namely very fast, fast, and medium. In very fast

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units with a permeability rate of > 25.4 cm / hour the sample that has very fast permeability consists of 5 of a total of 8 samples, where in sample 1 has a permeability coefficient of 38.98 cm / hour, sample 2 has a coefficient value of 28.46 cm / hour, sample 3 has a coefficient value of 49 cm / hour, sample 4 has a coefficient value of 36.35 cm / hour, and sample 5 had a coefficient value of 27.15 cm/hour. In medium units with a permeability rate of 6.3 – 12.6 cm / hour the sample that has medium permeability consists of 1 of a total of 8 samples, where in sample 8 it has a coefficient value of 7.88 cm / hour.

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