GEOTECHNICAL IDENTIFICATION USING RESISTIVITY METHOD FOR DETERMINING GROUNDING LOCATIONS

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Abstrak. Digunakan metode resistivitas untuk menetukan lokasi grounding dengan memanfaatkan respon batuan terhadap aliran listrik. Berdasarkan nilai resistivitas hasil pengukuran akan diketahui lokasi grounding dengan nilai resistivitas dibawah 5 ohm.m. Dalam penelitian ini menerapkan konfigurasi Wenner-Schlumberger dengan panjang masing-masing lintasan 32 meter untuk 2D dan 40 meter untuk 1D. Hasil yang diperoleh menunjukkan bahwa lokasi grounding berdasarkan penampang 1D terletak pada kedalaman 4 meter dengan nilai tahanan jenis 5,47 ohm.m, pada penampang 2D dapat diketahui lokasi grounding terletak pada kedalaman 2,5-4 meter dengan nilai tahanan jenis 2-7 ohm.m. Berdasarkan interpretasi lithologi, daerah tersebut merupakan lempung.
Kata Kunci: Metode Resisitivitas; Konfigurasi Wenner-Schlumberger; Grounding

Abstract. Resistivity method is used to determine the location of the grounding by utilizing rock response to the flow of electricity. Based on the results of measurement of resistivity values will know the location of the grounding with resistivity values below 5 ohm.m. In this study, applying the WennerSchlumberger configuration with each path length of 32 meters to 40 meters for 2D and 1D. The results obtained showed that the location of the grounding is based on a cross-1D lies at a depth of 4 meters with 5.47 ohm.m resistivity value, at the cross-2D can know the location of grounding lies in the depth of 2.5-4 meters with resistivity of 2-7 ohm value .m. Based on the interpretation of lithology, the area is claypaper purposes.
Keywords: Resistivity Method; Wenner-Schlumberger Configure; Grounding

INTRODUCTION

The soil classification system is used to find out soil structure with general behavior on certain physical conditions. Soil structure in an area could be different from other regions, because of the physical condition. Map of soil classification can be used to determine the grounding location.

There are many physical parameters in the soil can be identified, one of which is the resistivity parameter. Geoelectrical is a geophysical method to determine changes in of soil (rock) resistivity under ground by electric current injection uses with 2 electrodes that are plugged into the ground at a certain distance. The longer the distance of the current electrode will cause the flow of electric current can penetrate the layer of rock more deeply. Two other electrodes measure voltage parameters that occur due to injection of current. The measurement result from Geoelectrical is resistivity value.

Geology of Research Areas

Geology of Research Areas Gresik is located between 112° to 113° East and 7° to 8° south latitude and the lowland with a height of 2 to 12 meters above sea level except the Panceng area which has a height of 25 meters above sea level.

Some areas of Gresik are coastal areas, which extends from Kebomas, Gresik, Manyar, Bungah, Sidayu, Ujungpangkah, Panceng, Sangkapura and Tambak. The last two areas are located at Bawean Island, a small island in north gresik.

Geology of the research area can be determined by interpretation of surabaya and sapulu geology map. Three formation of the research area are Madura Formation, Lidah Formation, Kabuh Formation. In that’s area have a Sekarurung anticlines Sekarurung. The measurement point is in the Lidah Formation. The rocks making up the region, among others, the blue-black mudstone, springy, solid, and hard when dry, and rarely find fossils.

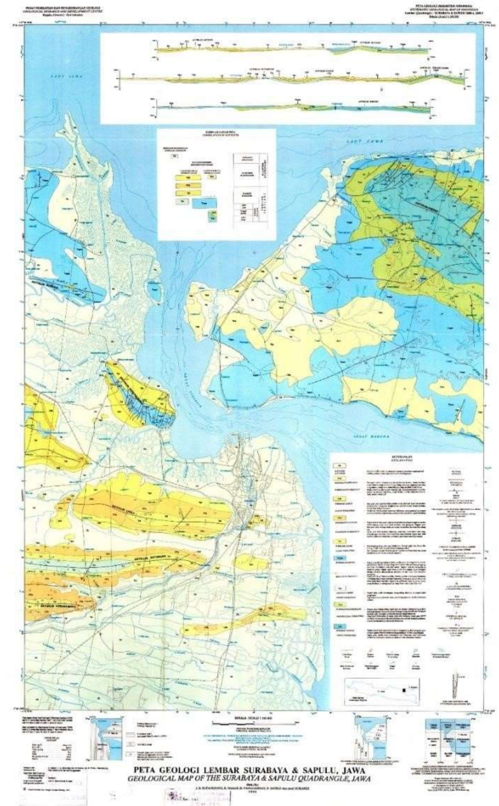

Figure 1. Geological map of Gresik

Geoelectrical Method

Geoelectrical is one of the geophysical methods to find a subsurface layer, this method work by inject DC current (Direct Current) into the soil, the different of resistivity value shown the layers of subsurface. Increasing the ion concentration in the fluid will increase fluid conductivity and decrease the overall rock resistance value (Hasanuddin and Pryambodo, 2009). There are two kinds of geoelectric method that is Vertical sounding 1D method and lateral mapping method.

Vertical geoelectric sounding method (1D) can be an alternative for drilling method with a lower cost and more quickly, using this method then the depth of the material to be detected. The principle of this method is inject electric current (I) into the soil and to measure the different of electrical potential (V) response from the material below the soil surface vertically.

The basic principle of the lateral mapping measurement is inject electric current from the source device with high voltage into the earth by using current electrode configuration, the value of the potential difference (mV) due to the propagation of currents in medium earth that has a value resistivity (Ohm) Will be obtained on the data reading device. In resisitivity measurement it is assumed that the earth has an isotropic homogeneous medium. But in reality the earth is composed of different materials by the layer, so the measured resistivity value is a pseudo-resistivity value that depends on the use of configurations in the measurement.

The wenner-schlumberger configuration is used in this study. This configuration has a ratio of the distance between the C1-P1 electrodes and the space between P1-P2 at n. If the distance P1-P2 is a, so, the distance C1-P1 is na.

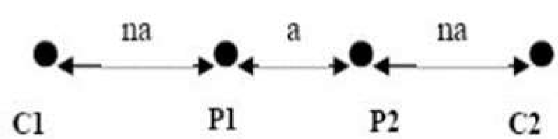

Figure 2. Configuration Form Wenner-Schlumberger

The geometry factor value (k) in this configuration is determined using the equation:

$$k = \pi n(n+1)a \tag{1}$$

Resistivity of Material

Most minerals can not discharge electricity, but some of the original metal and graphite can conduct electricity. The measured resistivity of the earth's material is primarily determined by the movement of the ions in the pores fluid. Here is the variation of earth material resistivity.

Table 1. Earth material resistivity values (Telford et al, 1990)

Material	Resistivity (Ωm)
Air	(Infinity)
Pirit	0.01 - 100
Quartz	500 - 800,000
Calcite	1 × 10 $^{12-1}$ × 10 ^{13}
Rock salt	30-1 × 10 ^{13}
Granite	200 - 100,000
Andesite	1.7 × 10 $^{2-45}$ × 10 ^{4}
Basal	200 - 100,000
Limestone	5000 - 10,000
Sandstone	200 - 8,000
Slate	20 - 2,000
Sand	1 - 1,000
Clay	1 - 100
Groundwater	0.5 - 300
Sea water	0.2
Dry pebbles	600 - 10,000
Alluvium	10 - 800

RESEARCH METHODS

The location of the research area in the three areas of Pertagas GRE operation, Gresik, as shown in Figure 2. In this identification, two methods are used: 2D and 1D Resitivity with the objective of knowing the distribution and classification of vertical and horizontal soil resistivity values, for the grounding point recommendation.

Figure 3. 2D and 1D Measurement Design

In general, the research flow can be described in the flow chart.

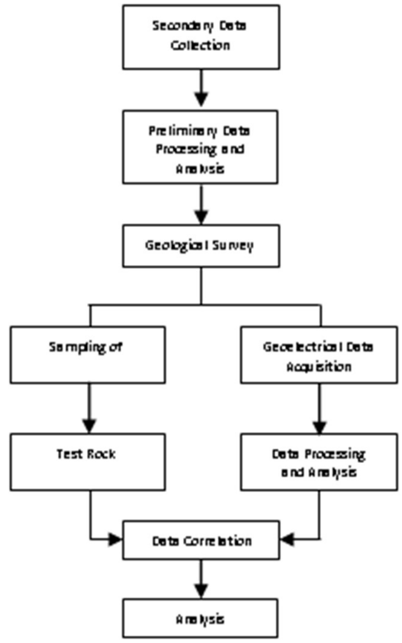

Figure 3. Research Flow Diagram

RESULT AND DISCUSSION

From the secondary data in the form of Geological Map, it is known that the measurement area is composed of Sediment Formation and Holocene Alluvium which is dominated by alluvium and clay. While from visual observation in the field, surface lithology consists of synthetic overburden.

As described in the research methodology, geoelectric data acquisition of the WennerSchlumberger configuration constants is performed at 1 point for VES and one path for 2D in a position coinciding. Processing and interpretation of data is done directly on the inversion.

The result of the processing is a cross-section of one-dimensional and two-dimensional land resistance values. The two-dimensional crosssection will show the distribution of resistance values of the type based on horizontal and vertical while the one-dimensional cross-section will provide the depth of the type of resistance values vertically (based on depth) only. In the identification used trajectory along the 32 meters for two-dimensional cross section and 40 meters to produce a onedimensional cross section.

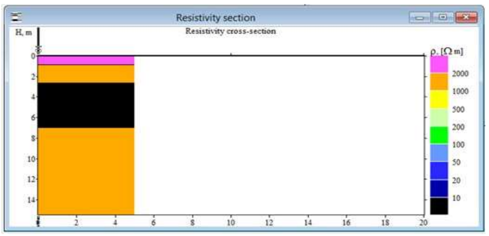

Figure 5. Results of the Layer Model on a 1D Resistivity Section

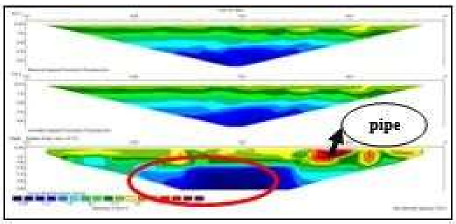

Figure 6. Results of Interpretation of Coating on 2D Resistivity Section

Figure 5 shows the distribution of resistivity value of the location by the increasing the depth. The value of ground type resistance at a depth of less than 1 meter is 4200 ohm-meter with a thickness of about 0.5 meters. At a depth of 1.75 meters shows a type of resistance value of 1012 ohm-meter with a thickness of about 1 meter. And at a depth of 4 meters shows the type of resistance value of 5.47 ohm-meter with a thickness of approximately 2 meters. The error value shown is 7.07%.

Then at the cross-Resistivity cross-section in Figure 6 shows the distribution of lateral resistivity value accompanied depth level. The results show a low resistivity value at a depth of 2.5 meters to 4 meters. The resistivity value shown is 2 ohm-meters up to 7 ohm-meters. Also noticeable high resistivity anomalies are thought to be the effects of underground buried gas pipelines. The error value shown is 9.3%.

Based on the results shown in the cross section of the above is found underground structures that correspond to grounding system condition where the value of a good resistivity is soil that has a maximum value of 5 Ohm resistivity that is at a depth of 2 to 4 meters with grades resistivity 2 ohmmeter and 7 ohm- Meter marked in light blue-dark blue on a two-dimensional cross section and black on a one-dimensional cross section. According to an analysis conducted lithology, were identified as the rock layer clays.

CONCLUSION

Based on the measurement and data processing, it can be concluded the location of grounding with depth up to 4 meters with a value of soil resistivity 2 ohm-meters to 7 ohm-meter. From the literature the value of resistivity, that can be used grounding location had a value of resistivity under 5 ohm-meter. Lithology in research area is identified as a clay with a low resistivity value. Data processing have an error under 10 % for each result.

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