Jurnal Fokus Elektroda : Energi Listrik, Telekomunikasi, Komputer, Elektronika dan Kendali)
Volume 08 No 04, Tahun 2023: Hal. 213-217.
e-ISSN: 2502-5562. Open Access at: https://elektroda.uho.ac.id/
Penerbit : Jurusan Teknik Elektro Universitas Halu Oleo Kendari Sulawesi Tenggara,

Determining Bedrock Quality by Geoelectric Method: A Soil Investigation Study in Moramo District, South Konawe Regency, Indonesia

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***Abstract* — : In comparison to the findings of deep drilling, this study tries to describe the depth of bedrock and soil layers. Wawatu Village, North Moramo District, South Konawe Regency, Southeast Sulawesi Province, Indonesia, served as the location for data collection. Kendari City is 30 kilometers away from the settlement. The community has three borders: the Sea to the east, Wawatu community to the south, and Tanjung Tiram Village to the north. Additionally, it shares a boundary with Abeli Village to the west. The settlement of Wawatu is located at 40 3' 35" S, 1220 38" 52" T, and 0 m above sea level. Res2dinv software uses data processing and interprets it to produce the 2D Pseudo section. based on modeling of 2D resistivity, It is evident that there are three underground rock layers in Wawatu Village, North Moramo District, and South Konawe District. The resistivity measurement is greater than 10 m, indicating bedrock at a depth of 10–18 m. the category of sandy loam layer for soil quality. This implies that the pile foundation's depth is based on the depth of such soil.**

***Keyword* : bedrock, geoelectric method, resistance, resistivity value, soil quality.**

I. INTRODUCTION

One of the most important elements in supporting a nation's development agenda is its infrastructure. Additionally crucial to society's survival, development, and functionality [1] In order to meet the demand for housing in large cities, there is an increased need for suitable infrastructure across Latin America and the Caribbean [2]. A valuable indicator of border permeability worldwide [3], The UK's civil infrastructure sector is expanding and serves as an important global measure of border permeability. [4].

Because infrastructure maintenance performance and planning are improving, it is critical to assess its viability on an ongoing basis. [5]

The Indonesian government's infrastructure development agenda is vast. [6] Development is accelerating in a variety of economic, commerce, industrial, and other social spheres. As a result, infrastructure in Indonesia must be created rapidly so that the dynamics of society in all parts of the country improve. Infrastructure development in Indonesia is currently accelerating and spans the Southeast Sulawesi region. In Indonesia, disaster mitigation initiatives and the preliminary design of earthquake-resistant infrastructure facilities are underway. In terms of road infrastructure sustainability, Indonesia ranks 64th out of 137 countries in terms of road infrastructure quality. For this reason, infrastructure in Indonesia must be built immediately so that the dynamics of the society in all corners of the country are increasing [7]. Infrastructure development in Indonesia is currently accelerating and spans the Southeast Sulawesi region. In Indonesia, disaster mitigation initiatives and the preliminary design of earthquake-resistant infrastructure facilities are underway. In terms of road infrastructure sustainability, Indonesia ranks 64th out of 137 countries in terms of road infrastructure quality[8]. The indicator of road infrastructure sustainability in Indonesia road infrastructure quality is ranked 64th out of 137 countries. [9] [10].

Infrastructure such as highways, ports, docks, dams, and industrial structures necessitate extensive research. Detailed investigations, such as soil layer and cross-section examination. Soil study is required in development planning to determine the quality and kind of soil layer at a site. Hard soil is a type of soil that has distinct properties that set it apart from other soils. Bedrock is essential for development since it has a high bearing capacity and can be used as a construction foundation. As a result, determining the quality of bedrock before it is used for development is critical. The key factor is the investigation of differences in the post-transfer of building projects, recognizing and comprehending probable construction inconsistencies [11]. Unpredictable soil data contribute significantly to construction expenses. The successful deployment of geotechnical building information has been shown to promote soil data, which is an important component in sustainable construction (Lee et al., 2021). One way for determining bedrock quality is the geoelectric method. This method is quite effective and accurate in determining the quality of problematic soils and has advantages over other methods, such as penetration and sonder.

However, infrastructure development is not entirely based on soil investigation research. Determining soil classification requires adequate resources, such as tools and experts, but many regions in Indonesia still lack them. Soil investigation has been carried out conventionally using deep boring. The downsides of deep boring are expensive and the work time is long. in the presence of unstable vibrations.

One of the boring bars processes the presence of unstable vibrations [13].
The use of deep boring can have several negative consequences for soil conditions, including damage to the surrounding environment, such can affect soil stability and change soil structure permanently, soil can affect soil stability and after the deep boring digging process can cause a risk of avalanches, primarily if used for development. The mathematical bar model's discrete point and idealization are dull [14]. Therefore, it is essential to conduct a careful assessment and consider the potential consequences of using deep boring before it is carried out to avoid damaging the environment and soil quality. Here are some of the weaknesses in determining soil classification in Indonesia: the absence of national standards that regulate the determination of soil classification, causing variations in the determination of soil classification between regions, environmental safety, and sustainability often go unnoticed in the process of determining soil classification, so that it can cause environmental damage, lack of data and information about soil conditions in Indonesia makes it difficult in the determination process soil classification and requires more time and effort. Therefore, this study aims to determine the quality of bedrock by geoelectric methods. Abundant sources of andesite rocks can be used as building materials and for other infrastructure and researched using resistivity meter tools [15]. This research is vital because soil quality supports infrastructure planners in designing a structural building. Where information about the subsurface obtained by conventional exploration approaches is generally limited to sparse data; an alternative is the electrical resistivity tomography (ERT) method with Wenner configuration [16][17]. One of the methods that can be used is to determine the quality of bedrock easily, quickly, and without harming the environment. Therefore, this study aims to determine the quality of hard soils by geoelectric methods. [18], [19]. This research is necessary because soil quality supports infrastructure planners in designing a structural building. [17] One of the methods that can be used is to determine the quality of hard soil easily, quickly, and not harm the environment

II. RESEARCH METHODS

This method is intended to produce the value of the subsurface cross-section. Analysis of geoelectric data using the Wenner configuration method (Fig.1) (Khanna, Bagchi, Kannaujiya, & Sarkar, 2022; Mohammed, Mohd Muztaza, & Saad, 2021), namely: voltage sources and analog batteries are checked correctly; electrodes are installed at a certain distance and adapted to Wenner's configuration; [21] a potential electrode connecting cable connected to a resistivity gauge; galvanometer needles on resistivity are well considered; the voltage of the digital counter (volts) is always viewed correctly, and the course compensator is adjusted so that the voltage value is close to zero; [22].

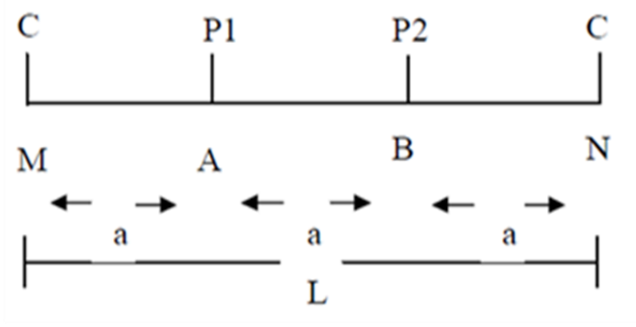

Figure 1. Wenner configuration settings (Andrias S W 2015).

The start button is pressed, and no one is certainly holding the electrode. To analyze the soil layer, the geoelectric was measured to obtain measurements of the difference in current and potential. Differences in the resistance of each soil layer (Oktaviana et al., 2021) exist.

Figure 2. Geoelectric trajectory

Figure 3. Geoelectric Tools

The button begins to be pressed until a constant current (I) value (mA) and a potential difference (V) are recorded is obtained, and after that, the hold button is pressed; the value of the geoelectric device is obtained, and synthetic data is prepared in the form of Microsoft Excel;

Data processing results are entered into notepad and saved in format dat. It is elementary to read in res2dinv software [19].

III. RESULTS AND DISCUSSION

The results of the line configuration are seen in the graphical cross-section [21] (Figure 2 and Figure 3) as follows:

2D Cross Section resistivity is the result of processing from Res2Dilv software. [18], [23]. This cross-section is a display of the distribution of subsurface resistivity values. Results on the effectiveness of electrical resistivity tomography (ERT) for the exploration of Ag-Pb-Zn, fluorite, and barite can illustrate the mineralization of the surface of the underground cross-section. [24]. This cross-section is a research area. Data processing with Res2Dinv software using the inversion process. Processing is carried out in 2 stages. The first stage is to display three contours of torpidity, and This contour consists of the measured real Resistivity, the calculated real Resistivity, and the reverse model resistivity part. The second stage is to bring up the topography of the research, Figure 4. (a), (b), dan (C).

The results of data processing using Res2Dinv software in the form of data input of Res2dinv 2D software are carried out with the following steps: The Res2dinv program is activated, and the main menu appears. After the main menu appears, the process of reading the data file and the inversion process is carried out; the input window of the 2D resistivity data file is displayed in the file name column. File inserted and executable cross-section. The result was obtained by an inversion process and ten iterations with Abs—error of 3.8%.

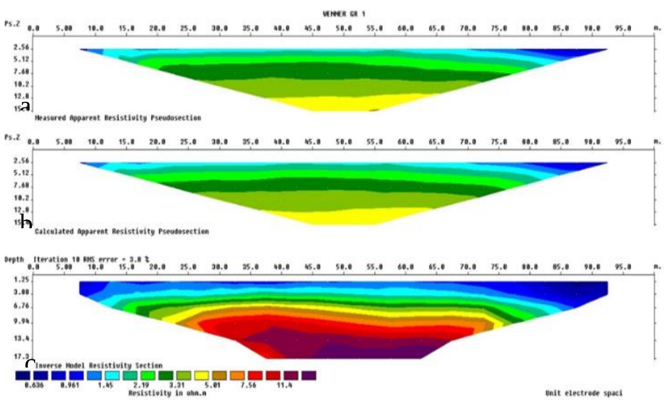

Figure 4. (a) cross-section of the results of pseudo-resistivity measurements, (b) cross-section of the results of pseudo-resistivity calculations, (c) cross-section of inversion results

Based on geoelectric 2D resistivity modeling, it can be concluded that there are three layers of soil below the surface in Wawatu Village, North Moramo District, and South Konawe District. [18], [21]

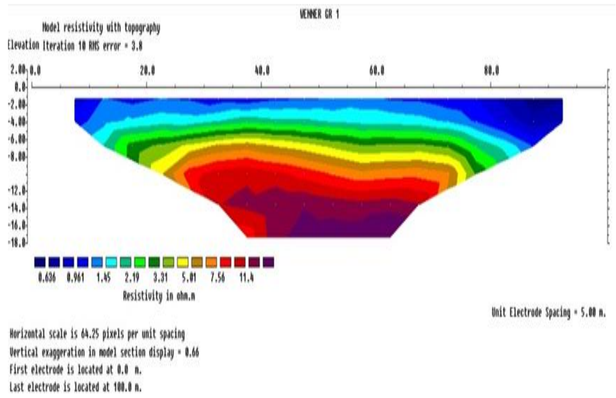

Figure 5. Cross-sectional Resistivity Result 2D

Table 1. Measurement Results with the winner method

No	Resistivity	Depth (m)	Soil layer
1	< 1 Ωm	0 – 4	Wet, very loose clay soil
2	1 – 10 Ωm	4 – 8	Clay, silt, medium rigidity,
3	> 10 Ωm	10 – 18	Sandy clay soil, very rigidity

The value of actual resistivity can be determined based on the electrodes' configuration. This value reflects different subsurface rock layers covering three layers—the resistivity of bedrock, ranging from 84.2 to 1572 Ωm at depths between 20 and 70 meters [25]. Analysis of potential damage caused by earthquake hazards is estimated at a depth of about 291.33 – 735.87 meters from ground level. [26].

IV. CONCLUSION

The bedrock quality in Figure 5 is a category of expansion of sandy clay layers, and it is concluded that the bedrock is at a depth of between 10-18 meters. This complex soil data can be used for development design, bedrock elevation, and dynamic soil profile is the data used for the calculation of surface spectral acceleration (SA)[27], [28], especially the type of foundation, used to determine structural damage in the event of an earthquake, namely the position of engineered bedrock and seismic bedrock/foundation layers, which are known to search for alluvial thickness [29].

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