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Determination of hardwear layer for feasibility building development building using geoelectric method resistivity in Coastal Kahona Beach Central Tapanuly Regency

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Abstract. This study aims to determine the value of soil layer resistivity and then relate to the feasibilityof the construction of high rise buildings in the coastal area of Kahona, Central Tapanuli Regency. Based on resistivity value analysis this research using Geoelectric Method of Schlumberger Configuration. Variations of the type resistivity values will be obtained if the distance of each electrode is changed, then obtained the value of resistivity types that are not real values but in the form of apparent resistivity. The data obtained using the resistivity meter ARES-G4 v4.7 SN: 0609135 of apparentresistivity, then converted to resistivity value. The data obtained is made into two dimensional cross section model image using Res2Dinv software.The results showed that the coastal area of Kahona has a low resistivity value of about 4.84 Ωm to 105 Ωm on the first track and 0.865 Ωm to 165 Ωm on the second track. Based on the resistivity value obtained, the area contains clay at depths of 1.25 - 28.7 meters. Based on the results of this study the coastal areas of Kahona can not be recommended for the construction of high-rise buildings because therehard layers in the structure of subsurface rocks. Measurement of the resistivity value of each path has an error percentage of 23.6 - 24.2%.

I. Introduction

Indonesia geographically extends from $6°4' 20''$ LU to $11°1' 23''$LS and $95°6' 30''$ 'BT up to $141°1' 54''$ BT, consists of islands large and small which number approximately 17,504 islands. Three quarters of its territory is the sea (5.9 million km^2), with a long coastline of 95,161 Km, the second longest after Canada. With an island of approximately 17,504 islands, this issue of coastal land use is a topic that should be discussed for the development of coastal in Indonesia.

In this regard, the utilization of resources in Indonesia itself is still focused on the utilization of existing resources in the mainland, while the resources of the oceans in Indonesia are still little to be noticed. When viewed in depth, ocean resources have greater potential than relatively limited land resources.

Coastal areas have very specific potential because the coastal areas are transitional areas between the land and the oceans. So the resources that exist in coastal areas are an interaction

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of both. Such as weather conditions, land, and the availability of mineral water resources that have its own characteristics.

The beach is a the way of meeting between the land and the sea. The coastal areas are specifically emeralds, particularly in the direction of the sea and the sea, while the land is limited by natural influences and human activities on the land environment [1].

The row of the west coast in Sumatera island has a very strategic natural potential because the coastal area directly encounters the Indian Ocean that has great waves and nice sand beaches. So the development of tourism sector become one way to exploit coastal area resources. Central Tapanuli regency is one of the areas that need to be improved its area development due to the potential of nature that is very large and has not been touched by the central government. But recently the district of Central Tapanuli began to be touched by the central government and it is of course a concern for the public to know the potential in the district of Central Tapanuli [2].

Tourism sector in Central Tapanuli regency, especially in Andam Dewi subdistrict of Lobu Tua village become public spotlight due to having good sea tourism potential that is location of Kahona beach tourism. But development in the area hasn't met yet the standards for entry into national tourism due to facilities and facilities such as road access, lodging, hotels, restaurants, and others are still lacking in the area. Development Infrastructure such as buildings is one of the goals to improve the tourism sector in this area. So factors such as hardness, stability, and soil texture need to be considered feasibility in the development process, especially in coastal areas.

The foundation of a building is declared feasible if there are layers of dry rock filled with dry soil with resistivity value more than 300 Ωm then done soil compaction to get a strong texture of soil layer for the foundation of a building [3].

Research on previous hard layers has been done by Selawati [4] by using geoelectric method of Schlumberger configuration in coastal area of Sialang Buah Serdang Bedagai Regency shows that coastal areas of Sialang Buah have very low resistivity value that is average 1,11 Ωm to 5 , 23 Ωm on three tracks. Based on the resistivity value obtained, the area contains clay / silt and silt soil at a depth of 1.25 - 12.4 m. Based on the results of research in this area, then this area can not be recommended for the construction of high-rise buildings because of the absence of hard layers and rock structures on the subsurface.

The application of geoelectrics has been done forcyclical engineering practices by using the methodology oftheSchool configuration as part of the study of the building activity of the second building [3].

Generation method is one of the methods for investigators this method has good advantages in the case of cheaper, faster and faster. This method has a fairly good development so that its use is not limited to exploration but the task is mostly used in environmental problems and geotechnics. The principle is to observe the layering of rocks based on differences in the properties of the pharmaceutical or to observe anomalies ie the physical magnitude difference of the objects sought by the land that covered it. The quantum of analysis for geo-electrical methods of type resistance is electrical properties [5].

Schlumberger configuration has a weakness in the voltage readout on the smaller potential electekes especially when the distance is relatively far away. While the advantages of the Schlumberger configuration have the ability to detect the non-homogeneity of layers of rock on the surface, that is by comparing the apparent resistivity value when there is a change in the distance of the current electrode . The Schlumberger configuration geoelectric method is

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the most commonly used method for knowing the thickness and resistance values of subsurface rock types.

Judging from the development of tourism sector in Kahona Beach, Lobu Tua Village, Andam Dewi Subdistrict, Central Tapanuli Regency should be further improved on the development of facilities and infrastructure. Especially the construction of lodging locations such as hotels, resorts and others. In relation to this problem, research on soil layers in the area is needed so that the development in the area can be seen the comparison between the mass of the building with the condition of the ground surface.

2. Method

From some geoelectric configurations of existing resistivity methods, the Schlumberger configuration will be used. Where in the Schlumberger configuration these potential electrodes are stationary at a place on the central line AB while the current electrodes are moved symmetrically out in certain steps and are equal. The selection of this configuration is based on the principle of convenience both in data retrieval and in its analysis. The way of data collection is as follows:

1. Download data from Ares.
2. Exporting data to Res2Dinv.
3. Processing data using Res2Dinv.

The measurement data and field calculations are then interpreted using Res2Dinv software to show the subsurface profile of the measured area. Res2Dinv software (2D) is used to display 2-dimensional profiles so that the measurement data in the field uses the mapping configuration.

The steps are as follows:

1. Before we run Res2Dinv software first the data we will interpretation written into notepad with the composition of writing as follows:
   - Line 1 is the Survey Name. >>> (Early Sounding Mapping Data)
   - Line 2 is the space between the two potential electrodes (C1 and C2). >>> (10,0).
   - Line 3 is the configuration type used (Wenner = 1, Pole-Pole = 2, Dipole-dipole = 3, Pole-Dipole = 6, Schlumberger = 7) >>> (7).
   - Line 4 is the total number of measurement data (Datum Points)
   - Line 5 data location for measurement data (Datum Points)
   - Line 6 type 0 >>> (0).
   - Line 7 is to enter the measurement data and calculate the distance of the current electrode (s) [distance between the center point and the current electrode], the distance between the two potential electrodes C1 and C2, the measurement path (n1, n2, n3 and n4) false resistivity obtained from calculations (written sequentially) as well as for subsequent data.
2. Run the Res2Din Program
3. Select the file >> Read Data File and Click, then when there is a statement Click OK.
4. Then select Display >> Least Squares Inversion, then the screen will display the profile of the subsurface layer.
5. Done. [6]

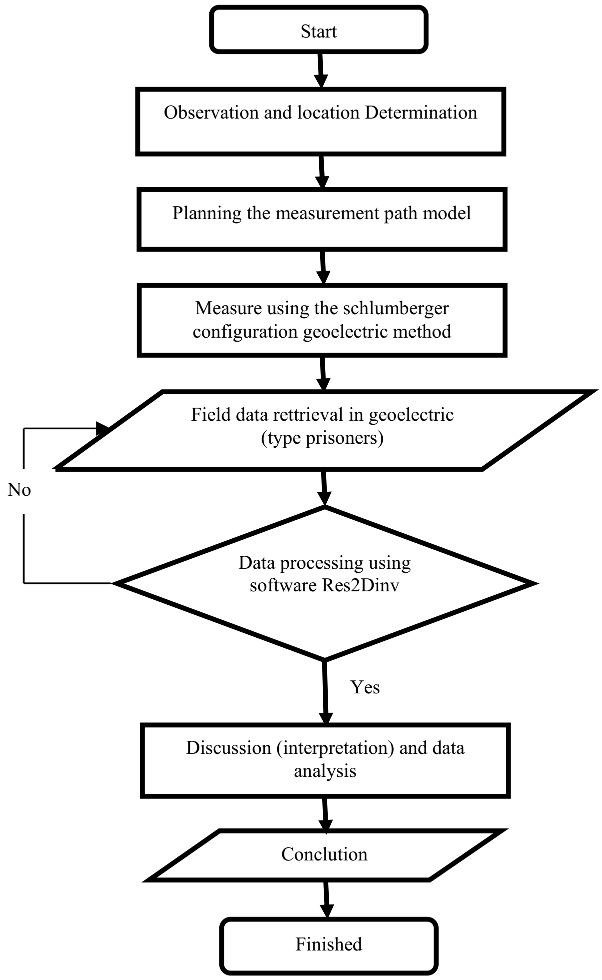

Figure 1. Flow chart in the implementation of research

Figure 1 is a flow chart in the implementation of research starting from the determination of a predetermined location and then using Geoelectric with Schlumberger configuration in order to obtain the data in the form of pseudo resistor values then interpret the data by using Res2Dinv software in order to obtain resistivity value and compare it with specified rock resistivity value, then make a conclusion from the data obtained.

In the formulation of measurement of the quantity V in the potential formula by measurement can be expressed as the potential difference δV between potential at currentless condition (V_0) and at condition with current (V_1), that is by measuring potential between electrode P_1 and P_2 (potential electrode) strong currents flowing between the C1 and C2 electrodes (current electrode). The configuration used in this research is Schlumberger method using equation 1

$$\delta V = \frac{\rho_a}{k} I \quad (1)$$

$$|V_1 - V_0| = \frac{\rho}{k} I \quad (2)$$

Then the apparent resistivity at the point of measurement can be estimated through the formula:

$$\rho_a = \pi n(n+1)a \frac{|V_1 - V_2|}{I} \quad (3)$$

explanation :

K = $\pi n(n+1)a$ is geometry factor for configuration of Wenner-Schlumberger
a = the distance between electrodes P_1 and P_2
a = (P_1 - P_2**)** the smallest space electrodes
n = integers (n=1,2,3,…)
n = (C_1 - P_1) / (P_1 - P_2**)**

The data obtained previously entered into the table data retrieval table in the form of the following table on the path before it is processed with software Res2Dinv. Results resistivity value can be seen in table 1.

Measurement Path

- Distance of electrode: 5 meters
- Track Coordinates:
- Schumberger Method:

Table 1. Input data result of the apparent resistivity value obtained

C1 [el]	C2 [el]	P1 [el]	P2 [el]	Aray	I[mA]	V [mV]	EP [mV]	AppRes [Ohmm]	St-dev [%]
0	3	1	2						
1	4	2	3						
2	5	3	4						
3	6	4	5						
Ext	Ext	Ext	Ext						

3. Results and Discussion

After data retrieval by using geoelectric device (Resistivity Meter), ARES-G4 v4,7 SN: 0609135 (Authentic Resistivity System), GPS (Global Position System), in both predetermined trajectory then do the data downloading then got result data about resistivity of each point, then the data is multiplied by the geometry factor (Schumberger configuration) to obtain the apparent resistivity value (ρ_a) to be used in making contours by connecting each of the apparent resistivity values (ρ_a)then obtained the data as follows:

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Table 2. The value of each track coordinate

Trajectory 1	Time (WIB)	Depth	Position	Resistivity Apparent (Ωm)
Geoelectric location	08.56	18 m dpl	N 02° 2' 27.30" E 98° 21' 3.16"	4,84 - 105 Ωm
Electrode 1	08.53	18 m dpl	N 02° 2' 28.50" E 98° 21' 0.61"	
Electrode 32	08.58	16 m dpl	N 02° 2' 25.51" E 98° 21' 5.24"	
Trajectory 2	Time (WIB)	Depth	Position	Resistivity Apparent (Ωm)
Geoelectric location	11.11	14 m dpl	N 02° 2' 23.65" E 98° 21' 7.81"	0,865 - 165 Ωm
Electrode 1	11.09	20 m dpl	N 02° 2' 28.51" E 98° 21' 5.24"	
Electrode 32	11.16	16 m dpl	N 02° 2' 22.02" E 98° 21' 9.32"	

The 2-D view of the data processing with Res2Dinv consists of three isoresistivity contours on the pseudo-depth section (pseudodepth section). The first section shows the measured apparent resistivity contour, the calculated apparent resistivity, and the third section is the actual resistivity contour obtained after the inversion model resistivity section.

In the first path the data obtained by using the geoelectric (restivity meter) tool is the value of pseudo resistivity varies because the underground structure varies greatly, its value ranges from 4.84 Ωm to 105 Ωm. At the length of the path of 155 meters with a distance of each electrode of 5 meters after being converted with Res2Dinv software obtained image cross section as figure 2 below:

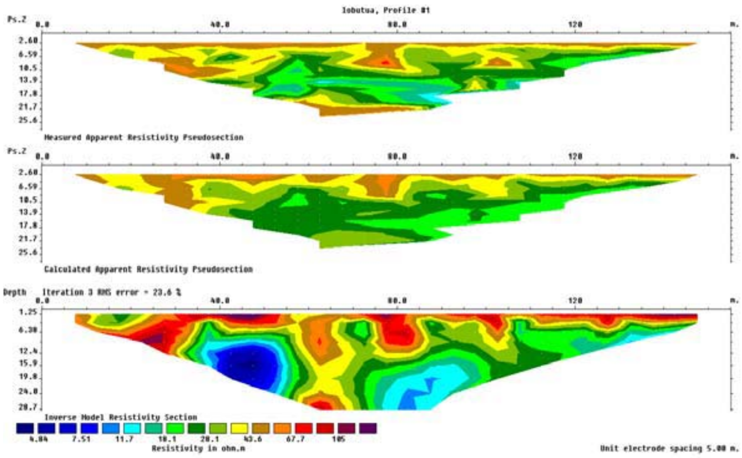

Figure 2. First resistivity contour section

Based on the cross-sectional contours of resistivity on the first trajectory, each color has a different resistivity value. The blue color at the depth of 9.39 meters to 24.0 meters indicates a low resistivity value that is between 4.84 - 11.7 Ωm, while the green and yellow in the depth of about 3.81 meters to 28.7 meters, the resistivity value is higher from the previous value of 18.1 - 43.6 μm, and the red and purple colors indicate the highest resistivity value in each cross-sectional image ranging from 67.7 to 105 Ωm. So the type of soil / rock layers can be interpreted as in table 3.

Table 3. First trajectory interpretation

No	Depth (m)	Resistivity (Ωm)	Interpretation
1.	1,25 - 9,39	67,7 - 105	Clay
2.	9,39 - 24,0	4,84 - 11,7	Soft silt
3.	3,81 - 28,7	18,1 - 43,6	Clay

Based on table 3 at a depth of 1.25 meters to 28.7 meters has not been detected hard layers and rock structures on the subsurface. As indicated by the red and purple in the upper surface layer at depths of 1.25 meters to 9.39 meters having a resistivity value of 67.7 to 105 Ωm is clay mixed with sand (based on table 3) which is the result of solidification of the foundation of the surrounding community. While the foundation of a building is declared feasible if there is a layer of dry rock filled with dry ground with a resistivity value of more than 300 Ωm then done soil compaction to get a strong texture of the soil layer for the foundation of a building (Syamsurizal et al, 2013). This research area has very low resistivity value, because research area is coastal area and pores of rock filled with sea water which is conductive solution.

In second path the data obtained by using the Geoelectric tool (restivity meter) is the value of quasi resistivity varies because underground structure is very varied, the value ranges from 0.856 Ωm to 165 Ωm. At the length of the path of 155 meters with a distance of each electrode of 5 meters after being converted with Res2Dinv Software obtained a cross-sectional image as shown in figure 3 below.

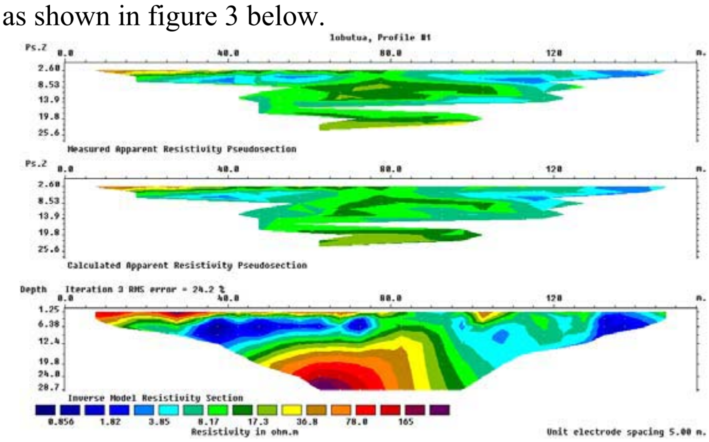

Figure 3. Second resistivity contour section

Based on the cross-sectional contours of resistivity on the first trajectory, each color has a different resistivity value. The blue color at depths of 1.25 meters to 16.1 meters indicates a low resistivity value between 0.856 - 3.85 μm, whereas green and yellow in depths of about 6.38 meters to 19.8 meters, the resistivity value is higher of the previous value ranging from 17.3 - 36.8 Ωm, and the red and purple colors indicate the highest resistivity value for each

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cross-sectional image ranging from 78.0 - 165 Ωm. So the type of soil / rock layers can be interpreted as in table 4.

Table 4. Interpetration of the second trajectory

No	Depth (m)	Resistivity (Ωm)	Interpretation
1.	1,25 - 16,1	0,856 - 3,85	Soft silt
2.	6,38 - 19,8	17,3 - 36,8	Clay
3.	19,8 - 28,7	78,0 - 165	Sanostone/Clay

Based on table 4, at depth of 1.25 meters to 16.1 meters has not been detected hard layer and rock structure on subsurface. While the foundation of a building is declared feasible if there is a layer of dry rock filled with dry ground with a resistivity value of more than 300 Ωm then done soil compaction to get a strong texture of the soil layer for the foundation of a building (Syamsurizal et al, 2013). As has been shown with red and purple on the lower layers at depths of 19.8 meters to 28.7 meters having a resistivity value of 78.0 - 165 Ωm is a bedrock containing soft soil (based on table 2.3). This research area has very low resistivity value, because research area is coastal area and pores of rock filled with sea water which is conductive solution.

4. Conclusions

Coastal area of Kahona coast has a type of sand rock at a depth of more than 28.7 meters in the second track and low resistivity value of clay / clay which has a resistivity value ranging between 67.7 - 105 Ωm at a depth of 1, 25 - 28.7 meters in the first trajectory and for the second trajectory has a resistivity value ranging from 0.856 - 3.85 μm at a depth of 1.25 - 28.7 meters. Based on the results of research in the coastal area of Kahona Beach can not be recommended for the construction of high-rise buildings because of the hard layer detection and rock structure on the subsurface. Based on the interpretation value of the first trajectory and the second trajectory no undetectable hard layers were found on the subsurface due to the low measured resistivity value in the study area.

It can be seen from the research location in the coastal area, it is necessary to do further research by making the path of each other diverging or diagonal for the accuracy of data obtained can be maximized. Then on the second track in the depth of 19.8 - 28.7 meters has been obtained in the form of layers of bedrock. So, it can be done to make the structure of the foundation of the building is deep and strong so that can be done construction of high-rise buildings in the area. Bedic subsurface modeling can also be developed in three dimensions by using Res3Dinv software so obtained a better layer of hard layers.

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