Application Of Geoelectrical Measurements For Identify The Liquefaction Potential Area In Lobu Tua Village

Application Of Geoelectrical Measurements For Identify The Liquefaction Potential Area In Lobu Tua Village

Ricky Syandi[1], **Togi Tampubolon**[2*],

[1,2]Department of Physics, State University of Medan, Indonesia
Jln. William Iskandar, Ps. V, Medan, 20221, Sumatera Utara, Indonesia
Email : topartam@gmail.com

Abstract. Active subduction off the Indian Ocean coast of Sumatra, Sumatra Subduction Zone, admits the responsibility of triggering earthquake along the boundary region on Sumatra Island. Lobu Tua Village is located near to coast Sumatra that has an underground layer in the form of Alluvium which is considered in the vulverable subsurface layer. The aim of this research is investigating the characteristics of stratification and soil properties in Lobu Tua village by using geoelectrical Data is collected from resistivity meter of ARES-G4 v4.7 SN: 0609135. Schlumberger Geoelectrical method is applied to do groundwater mapping by resistivity value at some path. The first path shows the results of electrode measurements are 6.38 meters of the base layer from the lateral surface with the area of silt soil 155 meters, may lead to land subsidence (liquefaction). The second path shows the groundwater-surface in the sounding layer is 21 meters with the potential landslides. The 2-dimensional cross-sectional model image was performed to display the cross-sectional resistivity of the rock coating method by using the Res2Dinv.

Keyword : Liquefaction, Schlumberger Geoelectrical Method, Lobu Tua Village

1. Introduction

Currently, the evaluation of liquefaction potential is done by field tests (Youd et al., 2001) as the standard penetration test - SPT (Seed & Idriss, 1971), (Loáiciga H, 2015), earthquake shocks and groundwater variations are factors behind the occurrence of landslides at the same time. their statements and tests are very expensive field testing, so researchers have geoelectrical testing in determining liquefaction potential by identifying groundwater levels with granular soil in the lobu tua village.

Therefore, this methodology is a good alternative to generate hazard maps for this phenomenon. To validate this methodology the liquefaction potential was evaluated in a grounwater level with granular soil. The experimental program was carried out at a distance of 155 m from the electrodes 0 to 31 with a distance of 1.17 km from the Kohana coastline. This research is very important to classify the differences in soil layers and groundwater surface in the potential for liquefaction during earthquake tremors in the lobu tua village, using 2 passes.

1.1. Geoelectric

Geoelectric is one of the geophysical methods to determine changes in resistivity of layer types below the surface of the soil by means of flowing DC (Direct Current) electricity that has high voltage to the ground. Electric current injection uses two current electrodes A and B as shown in ***Figure 1.*** which are

plugged into the ground with a certain distance. The longer distance of AB electrodes will cause the flow of electric current to penetrate deeper layers of soil (Asra, 2012).

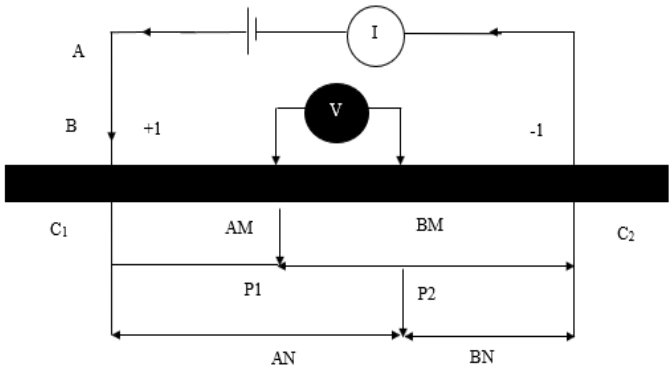

Figure 1. The general form of electrode configuration in resistivity surveys

2. Methodology

This research was conducted in the lobu tua village by using geoelectric with Schlumberger configuration, the data were measured and calculated in the field then interpreted using Res2dinv to show subsurface profiles of the area measured. Res2dinv is used to display 2-dimensional profiles so that the data in the field is a configuration mapping. Each subsurface is calculated using the equation below, which aims to classify the density of the subsoil and groundwater.

Equation :

Resistivity (ρ)

$$\rho = \frac{2\pi\delta V_{MN}}{I}\left\{\left[\frac{1}{AM}-\frac{1}{BM}\right]-\left[\frac{1}{AN}-\frac{1}{BN}\right]\right\}^{-1}$$

Or Apperent Resistivity (ρa) $$\rho a = \frac{\pi\left(s^2\frac{a^2}{4}\right)}{a}\frac{|V_1 - V_2|}{I}$$

Then, the electrode stretch from GPS, is interpreted using the surfer software.

2.1. Study Region

The Lobu Tua Village is located at the electrode coordinates of Track I : 02°2′32,3274″N and Long: 98°21′43,7213″E with an altitude of ± 15 meters above the sea the sea level, and Track II: Lat: 02°2′ 32,7182″ N and Long: 98°21′43,6564″E with an altitude of ± 17 meters above the sea level.

Figure 2. Research Study Region From Google Earth

3. Result and Discussion

By using 155 electrodes and 5 meter electrode distances, data were obtained using a geoelectric meter (Resistivity Meter), which has apparent resistivity values (ρa) with values ranging from 34.8 Ωm to 692 Ωm. The length of the first pass is 155 meters, with the distance of each of the electrodes 5 meters after being converted with Res2Dinv software, the sound contour is obtained as shown in **Figure 3.** below:

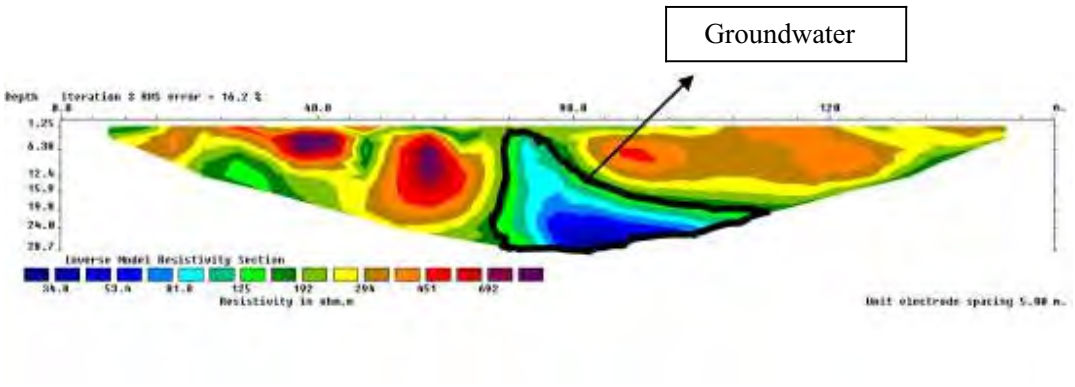

Figure 3. Contour sounding resistivity trajectory I

No.	**Materials**	**Resistivity Ωm**	**Depth meters**	**Electrode distance from 0 to 31**	**Information**
1.	Groundwater	34,8 to 100 Ωm	6 to 28,7 meter	75 meter from electrode 0	Can damage soil density due to the surface of the soil above it is not dense
2.	Sand	125 to 692 Ωm	-	-	Very broad layer

The relation with the liquefaction potential is that the loose or non-dense soil layers including (dry sand and saturated sand), if an earthquake with a strength above 5.0 M and repeated cyclic load on the surface (lateral) then the soil surface will experience subsidence due to soil density laterally it becomes less dense and the distance between lateral part with ground water *(sound test)* is not far about 6 meters from the surface of the earth besides the trajectory is also very close to the water rope or called the community around aek busu. But the area of ground water is far less than saturated sand or dry sand.

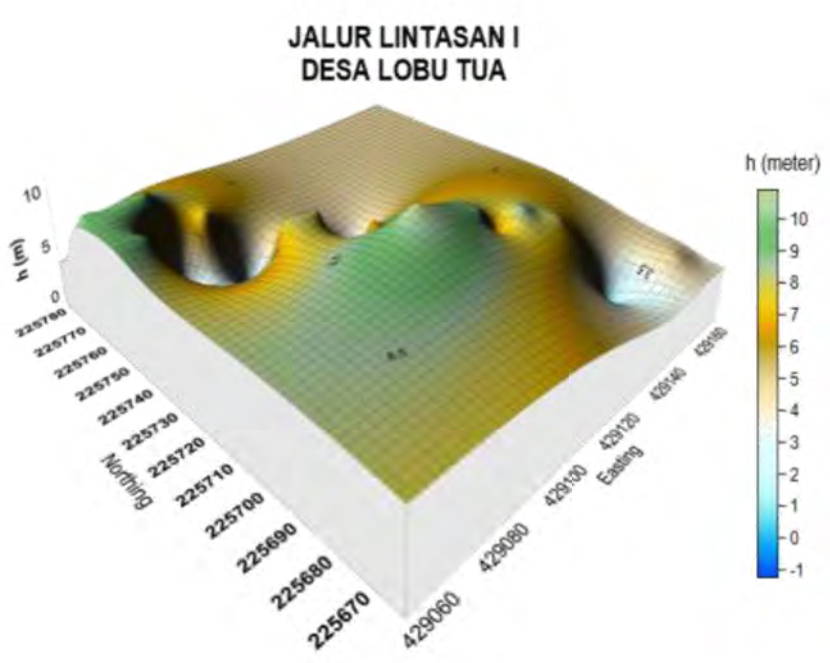

Figure 4. Lateral contour resistivity trajectory I

The data obtained from track II values range from 33.1 Ωm to 691 Ωm with a track length of 155 meters, each electrode spacing of 5 meters after that is converted with Res2Dinv softwares then sounding contours are obtained as shown in Figure 5.below:

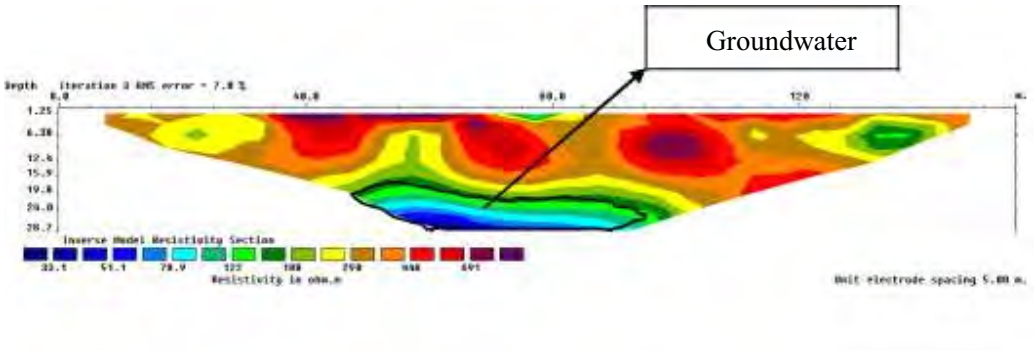

Figure 5. Contour sounding resistivity trajectory I

No	Materials	Resistivity Ωm	Depth meter	Electrode distance from 0 to 31	Information
1.	Groundwater	33,1 to 122 Ωm	21 to 28,7 meters	50 meters from electrode 0	Groundwater is very far from the sand layer
2.	Sand	188 to 691 Ωm	1,25 to 22 meters	-	Has a very broad layer

From the results of the electrode point measured by the lateral surface GPS of track II very far from (groundwater) around 21 meters from the surface (lateral), it can be seen that the 2D cross section of

sandstone is much wider than ground water. In its lithological characteristics, the hypothesis of potential landslide liquefaction remains. The trigger is lane I which has subsidence so that it results in lane II which has lost stability of the slope, this is because the distance between Track I and Track II is ± 8 meters.

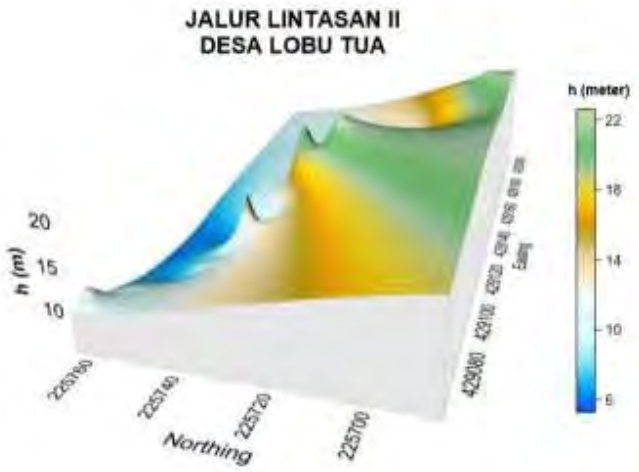

Figure 6. Lateral contour resistivity trajectory II

Conclusions

Based on the distance between lane I and lane II, the potential for ambulance and avalanches remains to be said to exist. The second path shows the groundwater-surface in the sounding layer is 21 meters with the potential landslides. The 2-dimensional cross-sectional model image was performed to display the cross-sectional resistivity of the rock coating method by using the Res2Dinv.

References

[1] Loáiciga Hugo A.., (2015)., *Groundwater and Earthquakes: Screening Analyses for Slope Stability.* Engineering Geology: Hal : 1-3 : University of California.

[2] Seed, H. B., & Idriss, I. M. (1971). *Simplified procedure for evaluating soil liquefaction potential.* Journal of Soil Mechanics & Foundations Division, 97(9), 1249-1273.

[3] Youd, T. L., Idriss, I. M., Andrus, R. D., Arango, I., Castro, G., Christian, J. T., . . . Stokoe II, K. H. (2001). *Liquefaction Resistance of Soils: Summary Report from The 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils.* Journal of Geotechnical and Geoenvironmental Engineering, 817-833.

[4] Asra, A., (2012), *Penentuan Sebaran Akuifer Dengan Metode Tahanan Jenis Di Kota Tangerang Selatan Provinsi Banten*., Skripsi, Fakultas Teknologi Pertanian, IPB, Bogor.