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Study on landslide management at SMPN 18 Balikpapan city

Maraden Panjaitan
Lecturer of Civil Engineering Study Program, University of 17 August 1945 Samarinda, Indonesia

Abstract
Field survey activities are data collection/collection in which nature is the source of data, nature is the source of data, besides requiring personal experience, it is also required to prepare appropriate materials, equipment and work methods and meet standard requirements. The Geoelectrical Study provides an overview of the subsoil structure of SMPN 18 Sepinggan Balikpapan. The research was carried out for 3 months located in the SMPN 18 area in the city of Balikpapan. The research activities carried out included direct observation in the field and examination of soil properties in the field and laboratory which included: consistency, soil type, color, estimated percentage of coarse grains/ smooth according to the USCS Method as well as geoelectric, sondir test, and boring test. From the results of the analysis, it is found that the structure of the soil layer consists of groundwater where the resistivity value is relatively small. The layer containing groundwater is at a depth of 0.00 to 1.25 m with a resistivity of 297-323 Ωm. In addition, there is also a layer of sand mixed with clay, and alluvium and gravel on track three. Sand is a rock material that can pass water, but with the insertion of clay, this layer can store water and drain it in limited quantities. Stratigraphy or lithology of the hills of SMPN 18 Sepinggan Balikpapan is composed of overburden which is clay to a depth of 0-1.25 meters, tuffaceous sand and weathered breccia. The slip plane is the boundary of tuffaceous sand with weathered breccia rock with a depth ranging from 5-7 meters, and shale at a depth of 15-20 meters. The slip plane is included in rocks with a weathering level of 4 meters.

Keywords: geoelectric; resistivity; topography; contour

Introduction

The foundation is the lowest structure of the building that transmits the load from the upper and lower structures of the bridge to the ground below. The building foundation plays a major role in the stability of the building when it receives dead loads, live loads and environmental actions. Therefore, the bridge foundation must not be lowered, shifted or overturned. To keep the foundation from sinking, sliding or rolling over, the foundation should be placed on hard soil, or clamped on solid soil. The condition of the building foundation can vary from one location to another and this will certainly affect the overall cost of the building. Once the location of the bridge has been determined, a complete program of soil investigation and testing should be carried out. If there is doubt about the condition of the subgrade while at the building site, a preliminary soil investigation can be carried out at each questionable building location.

Groundwater Condition

Groundwater comes from the surface such as rainwater, lakes, rivers and so on, which seeps into the soil, fills the pore spaces in soil and rocks and accumulates in a groundwater basin. The amount of water that seeps into the ground depends on space and time, the steepness of the slopes, soil surface conditions, vegetation and rainfall and the capacity of the basin. An aquifer is a rock body or regolith where groundwater is stored, which has high porosity and permeability and is located in a saturation zone. The rock body can be in the form of sediments or rocks such as clay, sand, sandstone and alluvial deposits. Sediment or rock that is impermeable and able to hold a lot of water is called aquiclude, for example clay. An aquifer whose upper surface coincides with the water surface and is under the direct influence of atmospheric pressure is called an unconfined aquiver. While the aquifer that is limited by the aquiclude layer is called a confined aquiver (Ludman, 1990).

Resistant Type of Rock Containing Water

The resistance of rock types is directly related to the porosity and texture of the rock. The relationship between ρ rock resistivity and φ porosity, expressed as a fraction per unit volume of rock. According to Archie's law: $\rho = a\rho_w \varphi^{-m}$, where ρ is the measured resistivity of the rock, ρ w is the resistivity of pore-filling water, a is a constant that characterizes the type of rock character, m is a constant that characterizes the cementation character. The relationship between the resistivity values in equation (1) is reflected by the magnitude of the formation factor $F=\rho/\rho w = a / \varphi^{-m}$. The formation factor can be used for estimating the aquifer zone, because it reflects the porosity of sedimentary and igneous rocks that have fractured. In hydrogeological exploration, measurements of subsurface ρ resistivity can be carried out directly in the field. The resistivity of pore-filling water ρ w can not only be measured directly, but can also be calculated using the equation: ρ w = 1000/ DHL, DHL is the electrical conductivity expressed in microsiemens (μs). Some conclusions of the value of formation factors from various hydrological studies obtained by Boehmer (Taib, 2000), can be seen in Table (1).

Table 1: Classification of Formation Factor Estimation for Sedimentary Rocks

F	Formation	Aquiver/ Aquiclude
≤ 1	Clay	Aquiclude
1 – 1,5	Peat, clayey sand atau silt	Aquiclude
2	Silt – find sand	Poor to medium aquiver
3	Medium sand	Medium to produktive aquiver
4	Coarse and	Produktive aquiver
5	Gravel	Higly produktive aquiver

Geoelectric

Geoelectric is a geophysical method that aims to determine the electrical properties of rock layers below the soil surface by injecting electric current into the soil. Geoelectric is one of the active geophysical methods, because the electric current comes from outside the system. The main purpose of this method is to find the resistivity or resistivity of the rock. Resistivity or resistivity is a quantity or parameter that indicates the level of resistance to electric current. Rocks that have greater resistivity indicate that they are difficult to flow with electric currents. There are 3 methods of collecting geoelectrical data, namely:

a. Resistivity Geoelectric Method (Resistivity Method)
b. Self Potential (SP)
c. Induce Polarization (IP)

Table 2: Resistivity Value of Earth Materials

Material	Resistivity (Ohm-Meter)
Pyrite (Pirit)	0.01 – 100
Quartz (Kwarsa)	500 - 800.000
Calcite (Kalsit)	1×10^{12} - 1×10^{13}
Rock Salt (Garam Batu)	30 - 1×10^{13}
Granite (Granit)	200 - 100.000
Andesite (Andesit)	1.7×10^{2} - 45×10^{4}
Basalt (Basal)	200 - 100.000
Limestone (Gamping)	500 - 10.000
Sandstone (Batu Pasir)	200 - 8.000
Shales (Batu Tulis)	20 - 2.000
Sand (Pasir)	1 - 1.000
Clay (Lempung)	1 – 100
Ground Water (Air Tanah)	0.5 – 300
Sea Water (Air Asin)	0.2
Magnetite (Magnetit)	0.01- 1.000
Dry Gravel (Kerikil Kering)	600 - 10.000
Alluvium (Aluvium)	10 – 800
Gravel (Kerikil)	– 600

Research Methods

The research was carried out for 3 months located in the SMPN 18 area in the city of Balikpapan. The research activities carried out included direct observation in the field and examination of soil properties in the field and laboratory which included: consistency, soil type, color, estimated percentage of coarse grains / smooth according to the USCS Method as well as geoelectric, sondir test, and boring test.

Results and Discussion

Topographical Conditions

Balikpapan's astronomical location is between 1.0 South Latitude - 1.5 South Latitude and 116.5 East Longitude - 117.5 East Longitude. Balikpapan City has an area of 85% hilly and 12% in the form of a narrow flat area, especially in the Watershed (DAS) and small rivers and the coast. With acidic soil conditions (peat) and dominant red soil that is less fertile. Like other regions in Indonesia, this city also has a tropical climate. This city is located on the east coast of Kalimantan, which is directly adjacent to the Makassar Strait, has a bay that can be used as a commercial sea port and an oil port. In this coastal area, there are many flat areas that are relatively low from the highest sea level, so they are very prone to natural disasters. flood. Slope is a natural surface feature caused by the difference in height.

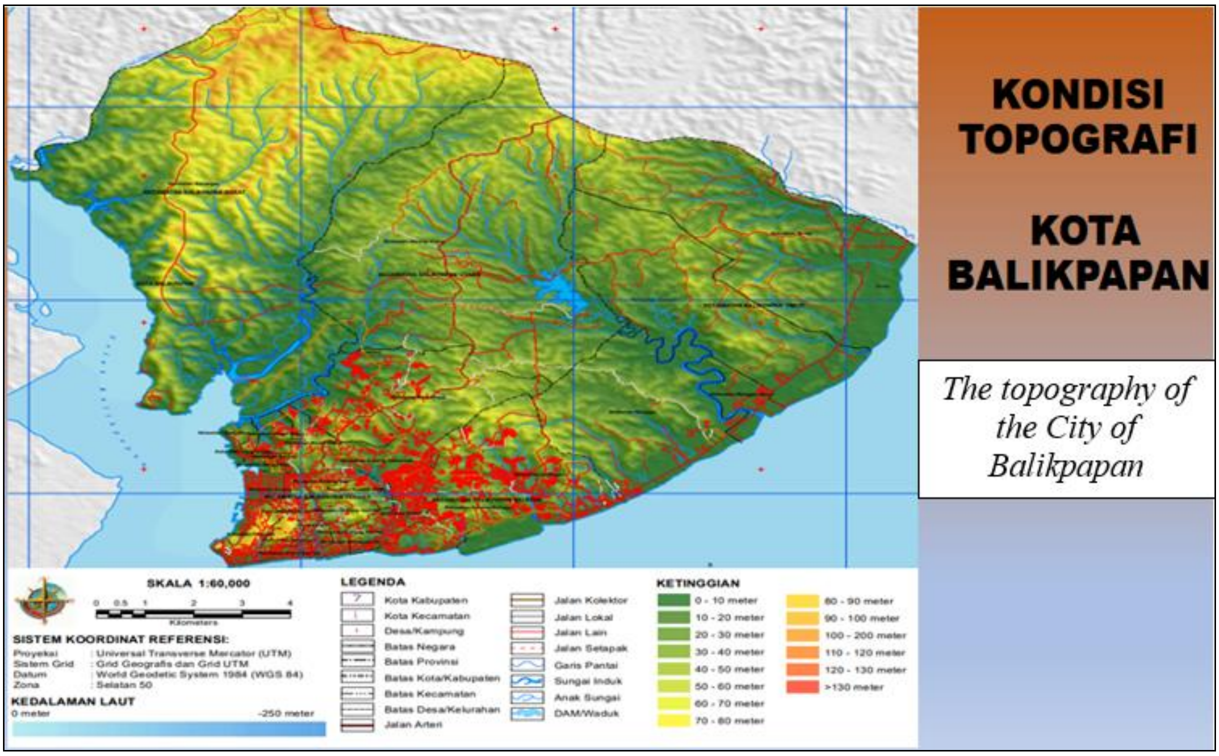


Fig 1: Map of Balikpapan City Topographic Conditions

The slope of the slope is the ratio between the straight horizontal distance and the difference in height of a place. Slope Slope Classes include: Class I = < 8%; Class II = 8 – 15%; Class III = 15 – 25%; Class IV = 25 – 45%; and Class V = >45%

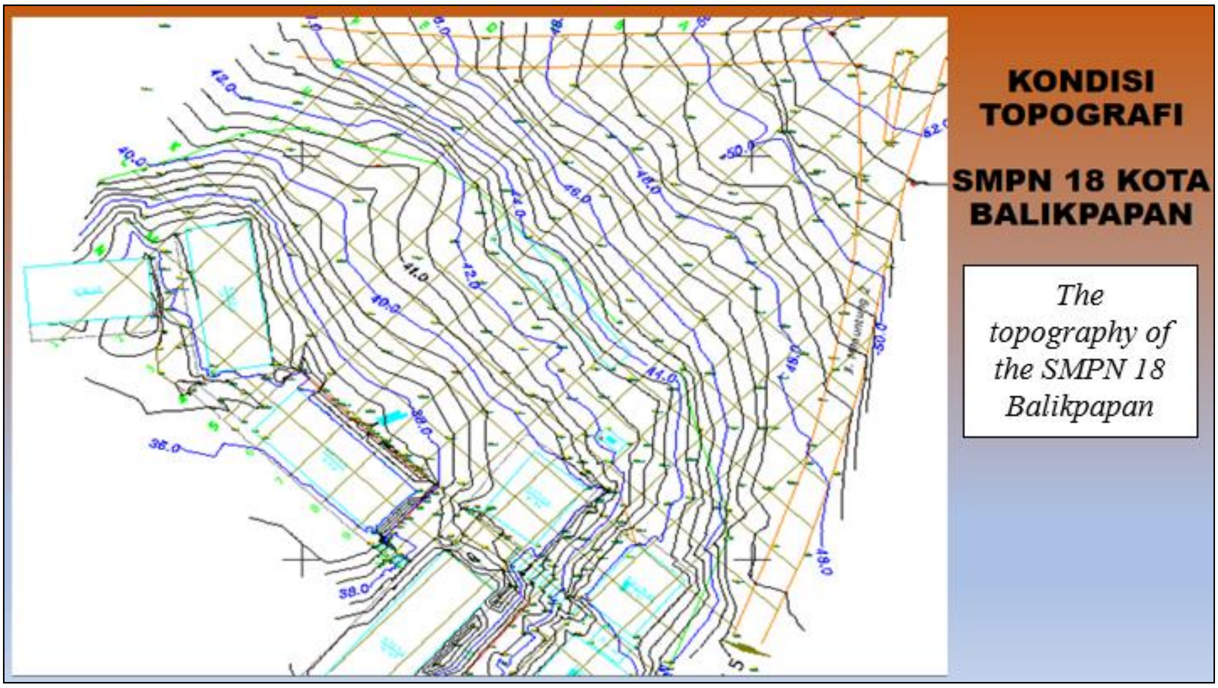


Fig 2: Map of the Topographical Contours of SMPN 18 Balikpapan

Study of Geoelectrical Conditions for SMPN 18 Balikpapan City

Geoelectrical mapping has been carried out as many as 2 tracks and magnetic coring to identify the hard layer contained in the location of SMPN 18 Balikpapan City. The configuration used in mapping measurements is the Wenner-Sclumberger configuration. This geoelectric measurement has a maximum and minimum value of AB/2 which is 2 and 100 meters, respectively. Magnetic coring measurement consists of 2 tracks with each track taking 20 samples. The results of processing geoelectrical mapping data are correlated with secondary data in the form of machine drill data and N-SPT. The hard layer at SMPN 18 Balikpapan City is suspected to be tuffaan sandstone with high resistivity values (>135 Ωm), susceptibility 2.7-81.4 (x10-8m3 /kg), and SPT >50 blow/foot found at a depth of 9 meters continuously up to 12 meters from the surface. Correlation geophysical methods can be used in dry soil conditions and the geoelectric method can not be a substitute for geotechnical in determining the hard layer. Based on the magnetic coring stratigraphy in Figure 3.1 and the susceptibility plot in Figure 3.2, there are 2 tracks with almost the same lithology from each track, the difference lies in the rock layers and the depth of each track. The following is the result of the interpretation of each path, among others:

1. The first track has 3 layers with a depth of up to 12 meters and has a magnetic susceptibility value of 1.5-81.4(x10-8m3 /kg) with top soil lithology, fine-coarse grain tuff, tuffaan sand, white tuff, gray tuff and tuffan clay.
2. The second track has 3 layers with a depth of up to 14 meters and has a magnetic susceptibility value of 1.7-79(x10-8m3 /kg) with top soil lithology, fine-coarse grain tuff, yellow tuff, white tuff, colored tuff ash and tuffan clay.

In general, the subsurface lithology of the magnetic coring sampling area has similarities seen from the stratigraphy of the three paths, so it can be said to be well correlated.

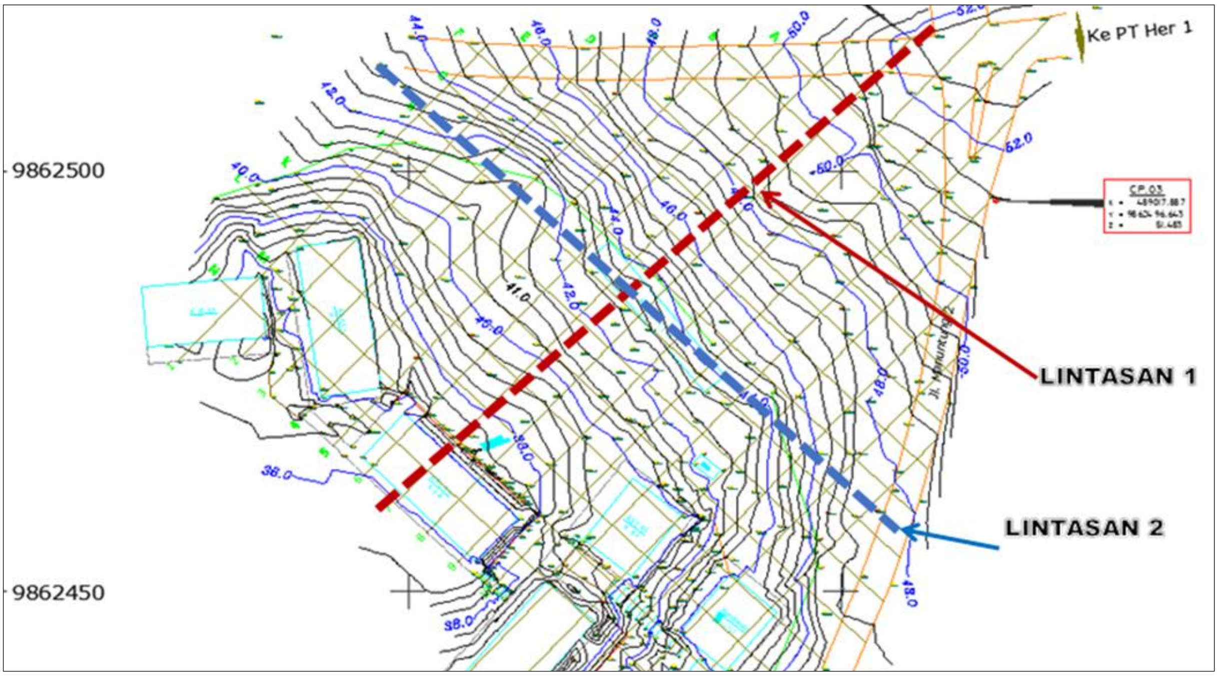


Fig 3: Lay Out Geoelectric Condition

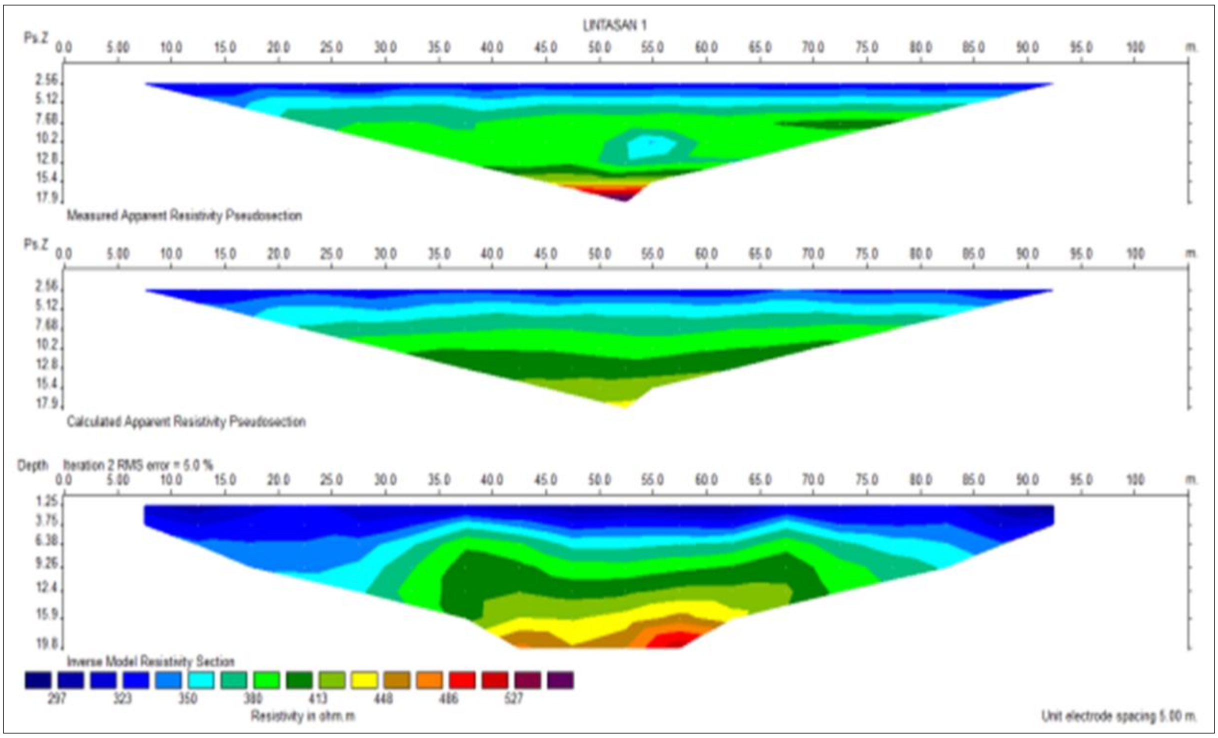


Fig 4: Condition of Magnetic Coring Stratigraphy Results of Path 1

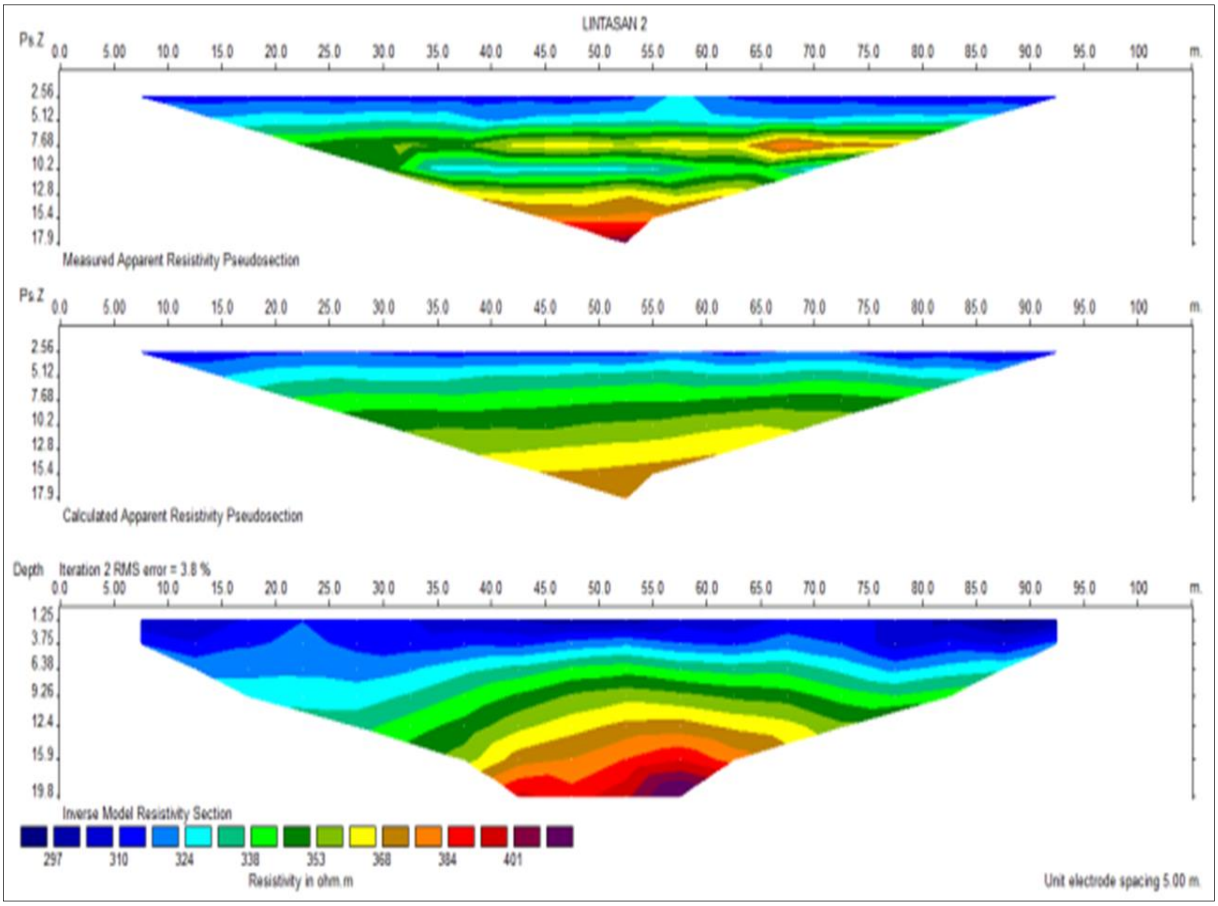


Fig 5: Condition of Magnetic Coring Stratigraphy Results of Path 2

Table 3: Stratigraphic Interpretation Results of Soil Types from Magnetic Coring

Layer	Depth	Scatter	Resistivity	Lithology Forecast
Lapisan	**Kedalaman (m)**	**Sebaran (m)**	**Resistivitas (Ωm)**	**Perkiraan Lithologi**
I	0-1,25	7,5-9,25	297-232	Clay
II	1,25-9,26	15-85	350-380	Alluvium
III	9,26-15,9	30-75	380-413	Sandstone
IV	15,9-19,8	40-60	448-527	Shale

Study of Geological and Morphological Conditionsx

1. Regional Stratigraphy Sheet Balikpapan

The stratigraphic order of the Balikpapan sheets, ordered from young to old, is as follows: Alluvial (Qa): gravel, gravel, sand, clay and silt. It is the sediment of rivers, swamps, beaches and deltas. Spread along the east coast of Tanah Grogot, Adang Bay and Balikpapan Bay. The Kampungbaru Formation (Tpkb): sandy claystone, quartz sand, siltstone, coal inserts, marl, limestone and lignite. The thickness of the coal and lignite inserts is less than 3 meters. The bottom is marked by coal seams. Limestone contains fossils of Miogypsina sp., Lepidocyclina sp., Ammonia Yabei and Pseudorotalia cattiliformis. Late Miocene to Pliocene, deposited in deltaic and shallow marine environments. The thickness of this formation is 700-800 meters and is located unconformably above the Balikpapan formation.

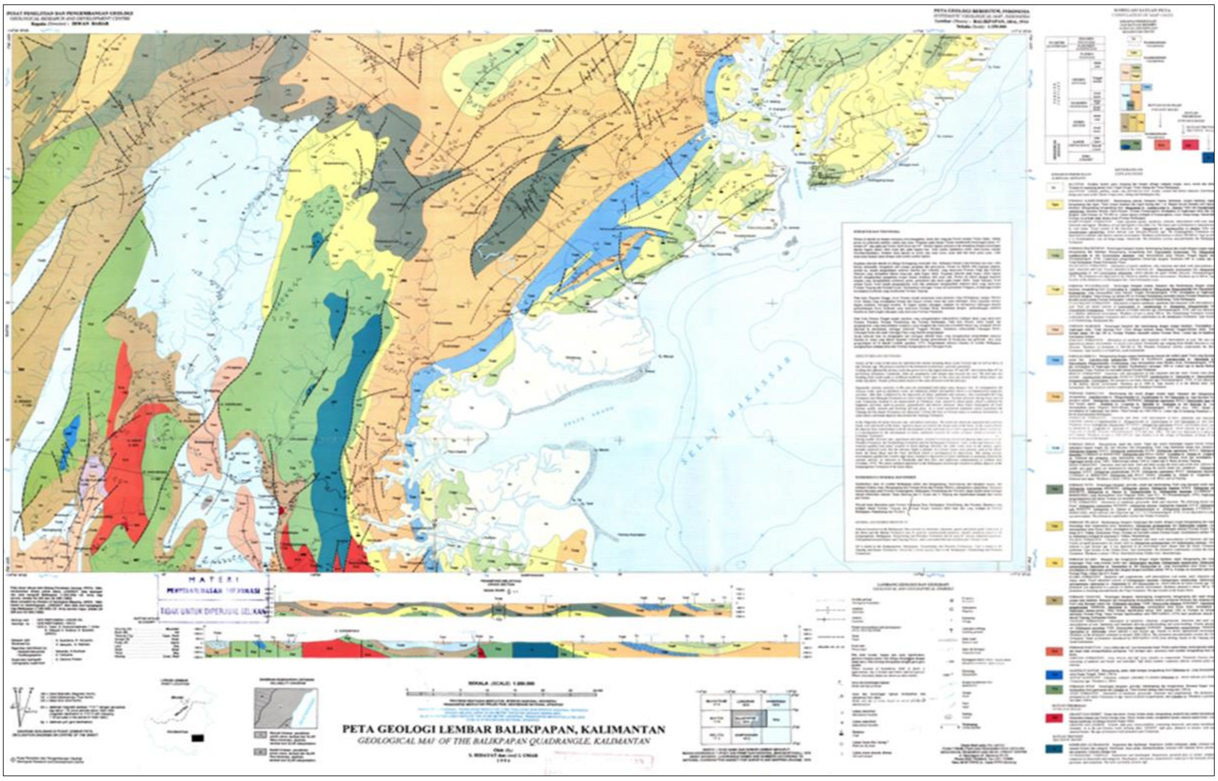
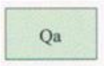


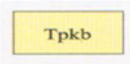
Fig 6: Geological Map of Balikpapan, East Kalimantan

2. Geological Structure

The Geological and Tectonic Structures of the Balikpapan Sheet in this area are almost all deformed, starting from the pre-Tertiary to the Late Tertiary. As a result of this process, anticline, syncline and fault are formed. Folds in Tertiary rocks form a slope between 10-60 degrees and in pre-Tertiary rocks it is greater than 40 degrees. The shape of the folds is generally not symmetrical with the slope of the inner layer being steeper than the outer. The direction of the fold axis is from north-south to northeast-southwest. The fault structure in this area consists of a descending fault, an ascending fault and a strike shear fault. The direction of the faults is almost the same as the direction of the fold axes. The tectonic activity of this area is thought to have been going on since the Jurassic. As a result, pre-Jurassic rocks, namely ultramafic rocks, experienced displacement, folding and faulting. This process is followed by magmatic activity after which the deposition of clastic and volcanic sediments that compose the Pitap formation and the Haruyan formation which is a rock of fixed origin in the Late Cretaceous. Tectonic activity in the lower Late Cretaceous resulted in the displacement of ultramafic rocks by upswing faults. This process was followed by magmatic activity which resulted in the breakthrough of granite, granodiorite and diorite in the Late Cretaceous. From the Early Paleocene to the Early Eocene, uplift, erosion and flattening resulted in land sediments that compose the Tanjung formation and the Kuaro formation. Based on the Tertiary basin in Southeast Kalimantan, carbonates were deposited in several places to form the Tanjung Formation. During the Oligocene to Early Miocene there was a continuous decline that lasted until the Early Miocene. The deposited material comes from the southern, western and northern parts of the basin. Marine shrinkage facies are formed in the deepest part of the basin. In the southern part of the basin, this deposit is related to the development of the carbonate facies that compose the Berai formation along with the development of clastic sediments towards the center of the basin that composes the Pamaluan formation. During the Middle Miocene, there was a decrease in the sea which resulted in the formation of land deposits that compose the Warukin formation, Balang Island and Balikpapan. At the time of the Late Miocene there was another uplift that caused the occurrence of lump faults and the reappearance of old rock including replacement rock so that Tinggian Meratus was formed. As a result, the Barito, Kutai and Sand basins were formed which were accompanied by deposition. This strong tectonic movement lifted the western edge of the basin which resulted in the deposition of clastic sediments to the east, followed by volcanic activity in the form of a breakthrough in Purukcahu and melting of lava and tuff deposition in the Lembak area. The deposition of clastic sediments on the Balikpapan sheet resulted in deltaic deposits from the Kampung Baru formation. Mineral Resources and Energy Sheet Balikpapan. Mineral resources in the Balikpapan sheet consist of limestone, claystone and quartz sandstone as well as placer gold. Limestone from the Berai Formation and the Bebulu Formation is quite large. Quartz sandstone found in the Kampungbaru, Balikpapan, Pulaubalang and Warukin formations can be processed for various industrial needs. Gold is panned from the Kuaro and Panjang rivers and is thought to have come from pre-Tertiary rocks. Petroleum is found in the Kampung Baru, Balikpapan, Balang and Warukin formations. Coal occurs as an insert in the Tanjung, Kuaro, Balikpapan, Pulaubalang and Warukin formations. The quality of the coal varies according to the depositional environment. Judging from the calorific value and sulfur content of coal in the Tanjung formation and the Kuaro formation, the quality is better than that found in the Balikpapan, Balang Island and Warukin formations..



JM: Gravel, gravel, sand, clay and silt as sediment in rivers, swamps, beaches and deltas.
long the east coast of Tanah Grogot, Adang Bay and Balikpapan Bay.



KAMPUNGBARU FORMATION: Sandy claystone, quartz sand, siltstone, coal inserts, marl, limestone and lignite. The thickness of the coal and lignite inserts is less than 3 m. the bottom is marked by coal seams. Limestone contains fossils: Miogypsina sp., Lepidocyclina sp., Ammonia Yabei and Pseudorotalia cattiliformis, aged Late Miocene-Pliocene. The kampungbaru formation was deposited in a deltaic and shallow marine environment. The thickness of this formation is 700-800 m. The location of the type is in Kampungbaru, east of Sanga-Sanga, Samarinda. This formation is not aligned above the Balikpapan Formation.

Fig 7: Description of Sepinggan Geological Map of Balikpapan City

Conclusions and Suggestions

A. Conclusion

Based on the results of research, analysis and discussion, conclusions can be drawn, as follows:

1. The Geoelectrical Study provides an overview of the subsoil structure of SMPN 18 Sepinggan Balikpapan. From the results of the analysis, it is found that the structure of the soil layer consists of groundwater where the resistivity value is relatively small. The layer containing groundwater is at a depth of 0.00 to 1.25 m with a resistivity of 297-323 Ωm. In addition, there is also a layer of sand mixed with clay, and alluvium and gravel on track three. Sand is a rock material that can pass water, but with the insertion of clay, this layer can store water and drain it but in limited quantities.
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B. Suggestion

1. It is necessary to study the borlog test to obtain property and mechanical values as a comparison of geoelectrical resistivity.
2. It is necessary to study sondir test to compare the value of conus and friction.

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