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*by* Dr Irianto

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## Soil Characteristics in the Yetni Yahukimo River Area

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**Abstract.** Rivers have a significant role in life and economic activity in Papua. The river not only acts as a source of raw water or irrigation water but is also rich in biodiversity. Uncontrolled logging and methods of clearing land for various purposes, including agricultural use by burning, have resulted in land damage. The land investigation aims to determine the characteristics of the soil in the Yetni River, Yahukimo Regency, Papua, which is used as a basis for deciding infrastructure development. The methods used with geotechnical investigations (soil mechanics) are boring, sondir, and laboratory tests. From the laboratory test results, it is known that the soil in that location is dominated by clay soil with an average value of Gs 2.5, the water content of 27.7%,  $\gamma_m = 1.67 \text{ Mg / m}^3$  and Sr = 74.01%.

### 1. Introduction

Yahukimo Regency is located between 138045' - 140014' East Longitude and 3039' - 5002' South Latitude, and is at an altitude of 100 - 3 000 M above sea level, has an area of 17,152 Km<sup>2</sup>, Morphologically Yahukimo Regency is a lowland, highland, mountainous and hilly areas. The site with a 0-1 percent slope is 1,621,900 square meters; the slope rate of 15-40 percent is 96,875 square meters, while the slope level above 40 percent is the largest, namely 3,572,825 square meters of the total area of Yahukimo Regency.

One of the essential aspects of organizing and improving infrastructure development in the Yahukimo Regency is to secure historical sites located right in the Yetni River watershed. Therefore, it is necessary to maintain the stability of river morphology both on the slopes and river cliffs against the dangers of scouring, cliff landslides so that the surrounding environment is not disturbed (be it settlements, roads, and other buildings). Rivers have a vital role in life and economic activity in Papua. The river not only acts as a source of raw water or irrigation water but is also rich in biodiversity. Uncontrolled logging and methods of clearing land for various purposes, including agricultural use by burning, have resulted in land damage.

Thus, it is necessary to research the land's conditions and characteristics in the Yetni River area to support government policies in infrastructure development in the Yahukimo Regency. The methods used with geotechnical investigations (soil mechanics) are boring, sondir, and laboratory tests.

### 2. Methods

Soil investigations are carried out to determine the data on the characteristics of the soil layer characteristics (rock lithology) and the allowable carrying capacity to aim that the foundation planning is well planned, both from a technical and economic point of view. These data are obtained from the research results both directly in the field and in the laboratory on samples of drilling results. The



equipment used is; Drilling Machine Brand YBM - 05 with a depth capacity of 100 meters; Core barrel single dan double 73 mm; 89 mm protective case and other accessories [1,2]

2.1. Field Work

Fieldwork consists of 2 (two) drilling points with a depth of 0.00 - 10.00 meters, each accompanied by testing the Penetration Standard Test (SPT) and taking Undisturbed Sample (UDS) and Disturbed Sample (DS).

Drilling is carried out with a rotary drilling system. The core tube used is a single core barrel Ø 73 mm with a length of 1.50 meters. The bits used are tungsten carbide bits and available diamonds. To transport drill cuttings during drilling, a Suncin 45 pump with a pressure capacity of 34 kg / cm2 is used. However, in this drilling system, dry and wet drilling systems are generally carried out because they are usually hard and easily crushed rocks.

Soil sampling can only be done with samples undisturbed and samples disturbed through leaching. Soil sampling is intended for investigation in the soil mechanics laboratory (Mectane) to determine the identifying properties and the technical properties of the soil. Soil samples taken are placed in a Core Box, each core box consisting of 5.00 meters to make it easier to identify each soil layer. The results of the drilling are described and presented in the form of a drill log [3,4].

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2.2. Laboratory Test

Laboratory testing is carried out on both disturbed and undisturbed soil samples from soil sampling results at the worksite. Laboratory tests include Moisture content, Specific gravity, Grain size analysis, Atterberg Limit, Compaction test, Triaxial C, Permeability test, Water sample test.

3. Results

In general, the investigation's location, in terms of geology, is a unit of clay rock with fresh gray color, while the weathered color is blackish gray. The characteristics of clay rock are generally easy to break, especially when touched by water and air. These rocks usually are loose because they have experienced weathering. The weathering of these rocks is still ongoing. It is proven that when drilling takes place, a protective casing is generally used to prevent landslides in the borehole walls. Examples of weathering can also be seen directly in the presence of material carried by water flows. In the rainy and dry season, the water flows are always cloudy.

FORM SUMMARY OF TESTS																		
Proyek : Rencana Teknis Longsoran Kali Yetni																		
NO	Sample	Location (Lokasi)	Sample no. (nomor contoh)	Depth (Kedalaman) (m)	Water Content (kadar air) W <sub>w</sub> (%)	Unit Weight (Berat isi) γ <sub>u</sub> (gr/cm <sup>3</sup> )	Unit Weight (Berat isi) γ <sub>s</sub> (gr/cm <sup>3</sup> )	Specific Gravity (berat Jenis) G <sub>s</sub> (gr/cm <sup>3</sup> )	Soil Type (Jenis Tanah)	Color (Warna)	Grain Size Analysis (analisis ukuran butir)				Atterberg Limit (batas-batas Atterberg)			
											gravel	sand	silt	clay	W <sub>L</sub>	W <sub>p</sub>	I <sub>p</sub>	Classification (klasifikasi)
											(%)	(%)	(%)	(%)	(%)	(%)	(%)	
1	UDS	Bor mesin	BH - 1	3.50 - 4.00	21.62	1.6960	1.3863	2.5943			0.00	7.53	37.34	55.13	85.95	28.68	54.27	CH
2	UDS	Bor mesin	BH - 2	4.50 - 5.00	32.25	1.6578	1.2535	2.5684			0.00	6.04	34.67	59.29	87.83	30.86	56.97	CH
3	UDS	hand bor	BH - 1	1.50 - 2.00	29.72	1.6426	1.2663	2.5817			0.00	7.18	36.71	56.11	79.28	28.36	50.92	CH
4	UDS	hand bor	BH - 2	1.50 - 2.00	25.98	1.6877	1.3397	2.5727			0.00	7.13	35.26	57.61	80.44	27.04	53.40	CH
5	UDS	hand bor	BH - 3	1.50 - 2.00	26.94	1.6626	1.3097	2.5946			0.00	7.78	33.22	59.00	83.38	28.03	55.35	CH
6	UDS	hand bor	BH - 4	1.50 - 2.00	30.84	1.7083	1.3057	2.5754			0.00	8.95	37.62	53.43	81.01	27.85	53.16	CH
7	UDS	hand bor	BH - 5	1.50 - 2.00	26.65	1.6981	1.3408	2.5681			0.00	5.86	37.98	56.16	84.66	28.93	55.73	CH

Figure 1. Recap of Soil Sample Laboratory Test Results at the Work Site

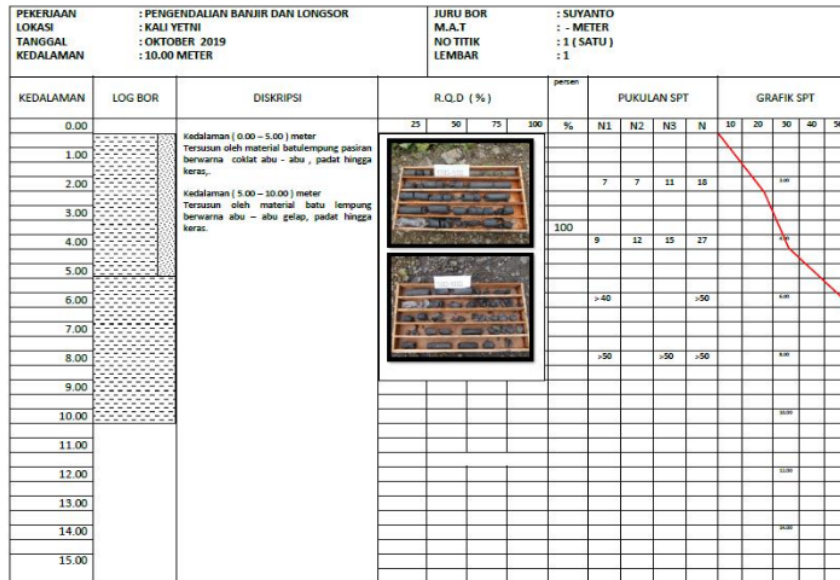


Figure 2. Recap of Soil Sample Laboratory Test Results at the Work Site

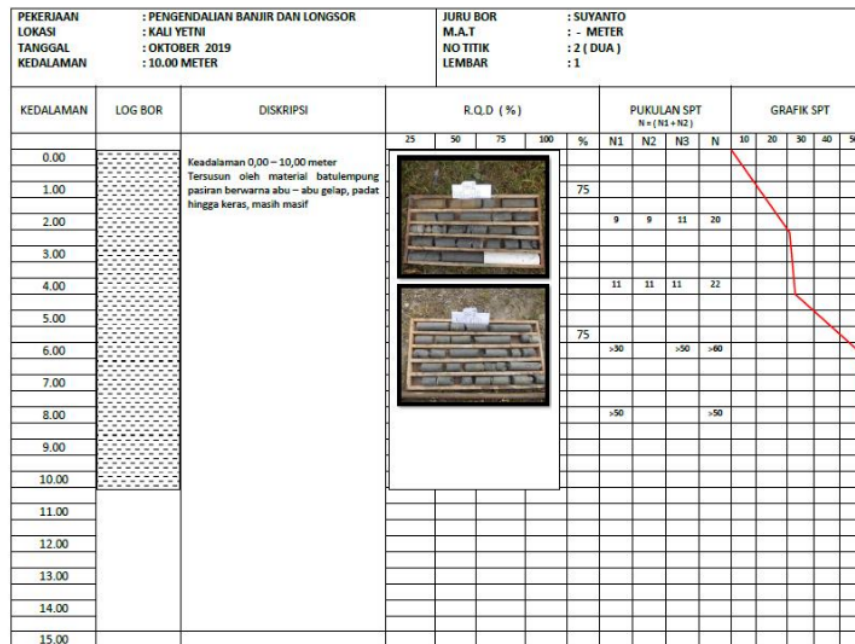


Figure 3. Recap of Soil Sample Laboratory Test Results at the Work Site

NO	Sample	Location (Lokasi)	Sample no. (nomor contoh)	Depth (Kedalaman) (m)	DIRECT SHEAR			Triaxial UU		Triaxial UU		KONSOLIDASI			
					j	C	OMC	j	C	j	C	e0	Cv	pc	cc
					(deg)	(kpa)	(%)	(deg)	(kPa)	(deg)	(kg/cm2)		cm2/sec		
1	UDS	Bor mesin	BH - 1	3.50 - 4.00						20.877	0.207	0.871	5.090E-03	1.064	0.264
2	UDS	Bor mesin	BH - 2	4.50 - 5.00						16.360	0.195	1.055	4.110E-03	1.062	0.291
3	UDS	hand bor	BH - 1	1.50 - 2.00						17.354	0.201	1.042	4.270E-03	1.037	0.260
4	UDS	hand bor	BH - 2	1.50 - 2.00						19.606	0.218	0.925	4.490E-03	1.072	0.284
5	UDS	hand bor	BH - 3	1.50 - 2.00						21.430	0.209	0.975	5.210E-03	1.055	0.288
6	UDS	hand bor	BH - 4	1.50 - 2.00						17.654	0.192	0.978	4.340E-03	1.048	0.269
7	UDS	hand bor	BH - 5	1.50 - 2.00						18.835	0.206	0.918	5.040E-03	1.049	0.294

Figure 4. Recap of Soil Sample Laboratory Test Results at the Work Site

Client	-									
Project	Rencana Teknis Longsoran									
Job No.	-	Date	November 2019							
Tested By	yanto	Checked By	lugiri							
<b>INDEX PROPERTIES</b>										
Location	: Kali yetni		Sample Type	: UDS						
Bore Hole No	BH-1 (Bor mesin)	BH-2 (Bor mesin)	BH-1 (hand bor)	BH-2 (hand bor)	BH-3 (hand bor)					
Sample ID	UDS	UDS	UDS	UDS	UDS					
Depth meter	3.50-4.00	4.50-5.00	1.50-2.00	1.50-2.00	1.50-2.00					
Soil Description	Lempung lanauan abu abu	Lempung lanauan abu abu	Lempung lanauan abu abu	Lempung lanauan abu abu	Lempung lanauan abu abu					
<b>SPECIFIC GRAVITY TEST (ASTM D - 854)</b>										
Pycnometer No.	C	D	I	K	H	F	B	N	J	E
Wt. Of dry Soil (A)	22.04	22.18	22.27	22.11	22.35	22.48	22.28	22.19	22.15	22.25
Temperature (T)	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Wt. Pycnometer + Water + Soil (B)	187.99	185.58	186.10	183.39	199.28	188.43	191.53	189.05	187.19	188.32
Wt. Pycnometer + Water at T °C (C)	174.47	171.96	172.47	169.89	185.56	174.66	177.91	175.46	173.60	174.66
C-B)	8.52	8.56	8.64	8.61	8.63	8.71	8.66	8.60	8.56	8.59
Specific Gravity (Gs)	2.5822	2.5865	2.5744	2.5624	2.5860	2.5773	2.5690	2.5764	2.5840	2.5853
<b>SPECIFIC GRAVITY Average (Gs)</b>	<b>2.5843</b>		<b>2.5684</b>		<b>2.5817</b>		<b>2.5727</b>		<b>2.5846</b>	
<b>MOISTURE CONTENT TEST (BS 1377 : 1975)</b>										
No. Container	29A	28A	8A	11A	17A	13A	68A	50A	30A	37A
Wt. Container + Wet Soil	57.32	59.25	61.85	60.55	59.87	57.65	55.34	58.84	61.35	60.14
Wt. Container + Dry Soil	48.97	50.65	49.28	48.51	48.48	46.97	46.24	48.85	50.65	49.55
Wt. Container	10.62	10.57	10.82	10.68	10.64	10.56	10.83	10.81	10.68	10.52
Wt. Water	8.35	8.60	12.57	12.04	11.39	10.68	9.10	9.99	10.70	10.59
Wt. Dry Soil	38.35	40.08	38.46	37.83	37.84	36.41	35.41	38.04	39.95	39.03
Moisture Content (w)	21.78	21.46	32.68	31.83	30.10	29.33	25.70	26.26	26.78	27.13
<b>MOISTURE CONTENT Average (w)</b>	<b>21.62</b>		<b>32.25</b>		<b>29.72</b>		<b>25.98</b>		<b>26.94</b>	
<b>DENSITY TEST (BS 1377 : 1975)</b>										
No. Ring	8	9	10	11	8					
Wt. Ring + Wet Soil	125.25	130.69	122.97	130.94	124.62					
Wt. Ring	79.83	82.84	78.72	82.23	79.83					
Vol. Wet Soil (= Vol. Ring)	26.94	26.86	26.94	26.86	26.94					
<b>BULK DENSITY (γ<sub>m</sub>)</b>	<b>1.6660</b>		<b>1.6578</b>		<b>1.6426</b>		<b>1.6877</b>		<b>1.6626</b>	
<b>DRY DENSITY (γ<sub>d</sub>)</b>	<b>1.3863</b>		<b>1.2535</b>		<b>1.2663</b>		<b>1.3397</b>		<b>1.3097</b>	
<b>VOID RATIO (e)</b>	<b>0.86</b>		<b>1.05</b>		<b>1.04</b>		<b>0.92</b>		<b>0.97</b>	
<b>POROSITY (n)</b>	<b>0.46</b>		<b>0.51</b>		<b>0.51</b>		<b>0.48</b>		<b>0.49</b>	
<b>DEGREE OF SATURATION (Sr)</b>	<b>64.65</b>		<b>78.98</b>		<b>73.86</b>		<b>72.62</b>		<b>71.55</b>	

Figure 5. Recap of Soil Laboratory Testing Results (Doc. Laboratory)

#### 4. Conclusion

The three drill point locations were investigated using machine drilling in the Detailed Package Project for Flood Control and Landslide Management in Kali Yetni, Yahukimo Regency, Papua Province. It is shown that the area of the investigation location is a clay rock area that has relatively high levels of water. Weathering, as evidenced by the presence of very loose sedimentary material up to a depth of more than 0.00 - 10.00 meters. From the description at two drilling points, it is better if the foundation used is to use a shallow foundation utilizing a well. As for the dimensions and magnitude, and depth, they must adjust the building load they bear. From the laboratory test results, it is known that the soil in

that location is dominated by clay soil with an average value of  $G_s$  2.5, the water content of 27.7%,  $\gamma_m = 1.67 \text{ Mg / m}^3$  and  $S_r = 74.01\%$ .

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