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Analysis of Soil Bearing Capacity Based on Sondir Data for the Construction of the Buti Catholic Church in Merauke

Biatma Syanjayanta

Department of Architecture, Faculty of Engineering, Musamus University, Merauke, Papua, Indonesia 99611

ABSTRACT: Soil bearing capacity studies the ability of the soil to support the foundation load acting on it. To produce an accurate bearing capacity, the soil properties and characteristics must be known. Therefore, a comparison of soil bearing capacity is conducted based on soil sondir and N-SPT calculations. Soil testing was conducted on Jalan Arafura Buti, Merauke, South Papua. The test results report includes a field investigation using a sondir tool in the form of a final report. This work was carried out on October 28, 2025, with the investigation conducted at five sondir points at the planned building site, as shown in the attached test point location plan and coordinates. Soil investigation in the field using a sondir tool is carried out at the sondir point plan according to the predetermined plan as follows: at Point S - 01 with a cone resistance value (qc) == 24.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 55 kg / cm2• For point S- 02 with a cone resistance value (qc) == 19.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 48 kg / cm", point S - 03 with a cone resistance value (qc) == 24.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 55 kg / cm2• point S - 04 with a cone resistance value (qc) == 34.98 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 65 kg/cm2• and point S - 05 with a cone resistance value (qc) == 34.99 kg/cm2 at a depth of 20.00 m, with a friction resistance value of 65 kg/cm^2.

KEYWORDS: Soil; USCS Method; Atterberg Limits; Cikombong Merauke.

INTRODUCTION

Soil investigations (soil tests) using a cone penetration tester were conducted to determine the cone penetration resistance (qc) and soil adhesion resistance (friction). Cone penetration resistance is the soil's resistance to the cone tip, expressed as force per unit area. Cone shear resistance is the soil's resistance to the cone sheath, expressed as force per unit area. The general purpose of a cone penetration test is to determine soil strength at each depth and soil stratification by interpreting cone penetration resistance and adhesion resistance data. No soil samples were taken for laboratory testing in this experiment. This test was conducted to determine the elevation of the "hard" layer and the soil's homogeneity in the lateral direction. The results of the cone penetration test are presented in the form of a cone penetration test diagram that records the cone resistance and sheath friction values. This data is then used to calculate the bearing capacity of the foundation that will rest on the soil layer.

Soil bearing capacity studies the soil's ability to support the foundation load acting on it. To produce an accurate bearing capacity, the soil's properties and characteristics must be known. Therefore, a comparison of soil bearing capacity is conducted based on soil sounding calculations to plan safe and economical building foundations.

Based on the soil sounding data, the soil bearing capacity is calculated, then the results are analyzed and concluded. The soil bearing capacity is analyzed to prevent the foundation from experiencing shear failure and excessive soil bearing capacity. The soil bearing capacity is determined by the type and characteristics of the soil, including layered soil and soil with two or more layers with differences in type or characteristics between the layers. To calculate the bearing capacity of layered soil, an approach can be used based on the theories of Terzaghi and Peck, Schmertman (1978), and Meyerhof. In determining soil bearing capacity, there are several methods to determine the soil's ability to carry loads and to determine its properties. These can be obtained from soil investigations such as standard penetration tests (N-SPT), laboratory tests, and soil sounding tests. The purpose of these tests is to determine soil characteristics and evaluate the condition of the soil to be tested (Hermi Tyahyati 2019). The research objectives are:

1. To determine the method for calculating soil bearing capacity using laboratory data and sounding.
2. To determine the relative strength of the material used as a foundation layer against other materials.

RESEARCH METHODOLOGY

The analysis of the soil bearing capacity at the Arafura Road site in the Samkai District, Merauke Regency, South Papua Province, involved the following steps:

1. The first stage involved conducting a literature review and quoting relevant content to supplement and resolve the issues under review.
2. The second stage involved data collection, including project site images and CPT (sondir) survey data. The final stage involved data analysis, followed by analyzing the calculation results and drawing conclusions.

The research was conducted on Arafura Buti Road, Samkai Village, Merauke District, South Papua Province. Soil samples were tested at the location shown in Figure 1, and the data was then calculated as the soil's bearing capacity.

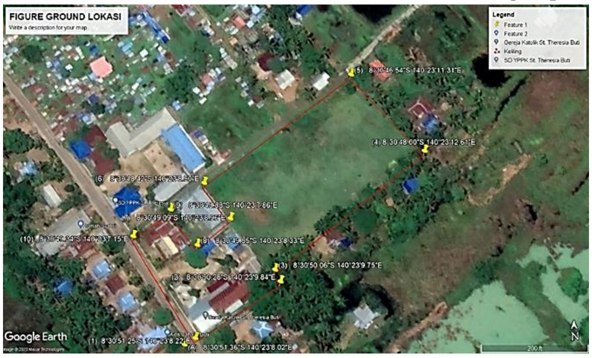

Figure 1. Research location point

1. Research Stages
   a. Initial research preparation was as follows:
      1) References to related research journals.
      2) Problem Definition.
   b. Data Collection
      Data were obtained based on direct field calculations of the research object. This research was conducted at the Buti Catholic Church Building Construction Project, located in Buti Village, Arafura Street, Samkai District, Merauke Regency, South Papua Province.
   c. Data Analysis
      The data analysis used in this study was a comparison of soil calculation results based on standard penetration test (N-SPT) and soil sondir (CPT) data.
   d. Conclusion Drawing
      Conclusions from the data analysis resulted in information containing conclusions regarding the soil bearing capacity, allowing for the construction of the Buti Catholic Church Building, located in Buti Village, Arafura Street, Samkai District, Merauke Regency, South Papua Province.
   e. Data Analysis
      The data analysis used in this study compares the results of soil bearing capacity calculations based on soil penetration test (CPT) and standard penetration test (N-SPT) data with the test results obtained in the form of soil hardness, which are explained in descriptive form. The data analysis process was carried out by collecting data from the soil penetration test and N-SPT in the field. The results of this data analysis will then be compared with the standards used in this study.

RESULTS AND DISCUSSION

RESULTS

1. Sondir Test Implementation Method
   a. Preparation
      Preparation is the initial stage in the soil sounding process. This involves several important steps, as follows:
      1) Install and adjust the soil sounding machine vertically at the location to be inspected using anchors inserted into the soil.
      2) The hydraulic oil filling must be free of air bubbles.
      3) Install the cone and biconus as needed at the end of the first pipe.
      4) Install the first pipe assembly and the cone (b) into the soil sounding machine.
      5) Press the pipe to insert the cone and biconus to a specified depth, generally 20 cm.
      6) If a biconus is used, the initial penetration will move the cone down 4 cm. Read the manometer as the cone penetration resistance (pk).
      7) Subsequent pressure will move the cone and casing down 8 cm. Read the manometer as the sum of the resistances (jp), which is the cone penetration resistance and the adhesive resistance (HL). If a cone is used, the manometer reading is only taken at the first pressure (pk).
      8) Press the pipe with the rod to the next depth to be measured, taking a reading at each 20 cm depth of pressure.
   b. Comparing soil sounding results
      Soil sounding results from various locations within the project area can be compared to obtain a more comprehensive picture of the overall soil conditions. This comparison can be crucial in determining the appropriate construction strategy.
   c. Using soil sounding results to predict future soil conditions
      By understanding current soil conditions and how their properties change over time, we can use soil sounding data to make predictions about future soil conditions.
      This is crucial for long-term planning and risk management in construction projects.
   d. Workplace safety protocols
      Soil sounding involves risks, so it is important to follow workplace safety protocols. This may include using personal protective equipment, preparing a safe work area, and exercising caution when using the soil sounding tool.
2. Sounding Test Equipment
   The following is the sounding equipment used:

a. Light sounding machine (2.5 tons)
b. A set of sounding pipes complete with inner rods, each 1 meter long as needed.
c. Two calibrated manometers with capacities: For light sounding, use 0 to 50 kg/cm2 and 0 to 250 kg/cm2. Cone and bicone.
d. Four anchors with accessories (leaf and spiral anchors).
e. Pipe wrenches, cleaning tools, oil, and hydraulic fluid.

3. Sampling Point Location
The location of the Soil Test (Sondir) point on Arafura Merauke Road, Merauke Regency, South Papua Province, can be seen in the following image;

Figure 2. Location of sampling points

4. Soil Testing
Soil testing was conducted on road Arafura Buti, Merauke, South Papua. The test results report included a field investigation using a sounding device, which was presented in the form of a final report. This work was carried out on October 28, 2025, and the investigation was conducted at five sounding points at the planned building site, as shown in the attached map showing the test point locations and coordinates. Soil investigation in the field using a sondir tool is carried out at the sondir point plan according to the predetermined plan as follows: at Point S - 01 with a cone resistance value (qc) == 24.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 55 kg / cm2• For point S- 02 with a cone resistance value (qc) == 19.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 48 kg / cm", point S - 03 with a cone resistance value (qc) == 24.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 55 kg / cm2• point S - 04 with a cone resistance value (qc) == 34.98 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 65 kg/cm2• and point S - 05 with a cone resistance value (qc) == 34.99 kg/cm2 at a depth of 20.00 m, with a friction resistance value of 65 kg/cm2

5. Results
The following conclusions can be drawn from the sounding test results conducted on Jalan Arafura Buti, Merauke, South Papua.

Table 1. Soil Investigation and Cone Penetration Test (CPT) Results

Point No.	Coordinates	Depth (m)	qc Value (kgf/cm²)	Total Resistance (kgf/cm²)
S-01	8°30'48.438"S, 140°23'11.082"E	20.00	24.99	55
S-02	8°30'48.12"S, 140°23'10.824"E	20.00	19.99	48
S-03	8°30'47.778"S, 140°23'11.094"E	20.00	24.99	55
S-04	8°30'47.736"S, 140°23'10.452"E	20.00	34.98	65
S-05	8°30'48.336"S, 140°23'10.134"E	20.00	34.98	65

1. Soil sounding is an important and useful soil investigation method in various fields, particularly geotechnics and construction. Through soil sounding, we can understand the structure and properties of the soil, which is crucial for the planning and design of construction projects. While soil sounding has significant benefits, it is also important to consider safety and environmental aspects during the process.
2. It is also important to understand that soil testing using a soil probe is not only about collecting data, but also about understanding the meaning of the data, using it in a relevant context and all of this is done in a safe and environmentally friendly manner. With the right approach, soil probes can provide significant benefits for various constructions.
3. Based on the results of the soil probe test for point S - 01, the cone resistance value (qc) = 24.94 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 70 kg / cm2. For point S - 02 with a cone resistance value {qc) = 24.98 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 65 kg / cm2, point S - 03 with a cone resistance value (qc) = 24.99 kg / cm2 at a depth of 20.00 m, with a friction resistance value of 50 kg/cm2• point S - 04 with a cone resistance value (qc) = 34.98 kg/cm2 at a depth of 20.00 rn, with a friction resistance value of 65 kg/cm2• And point S - 05 with a cone resistance value (qc) = 34.98 kg/cm2 at a depth of 20.00 rn, with a friction resistance value of 65 kg/cm2
4. Based on the results of field investigations, the soil conditions in the construction area consist of clay soil with a stiff consistency.

Table 2. Field investigation results

Sondir CPT) Qc(kg/cm2)	SPT(N)	UCS (kg/cm2)	*Consistency*
0-5	0–2	0-0,25	*Very soft*
5 -10	2-5	0,25-0,50	*Soft*

10-20	5-10	0,50-1,00	*Medium Stiff*
20-40	10-20	1,00-2,00	*Stiff*
40-80	20-30	2,00-4,00	*Very Stiff*
80-100	>30	>4	*hard*

For light structures, a shallow foundation in the form of a rectangle can be used. Type: Spread Footing. The depth is 2 meters from the existing ground surface elevation and the width of the foundation is d s B = 1.5 and 2 meters, respectively, with a bearing capacity.

5. For structures that require a large bearing capacity, a deep foundation type can be used, such as a pile foundation or a combined pile and poor plate foundation. The choice of foundation type can be adjusted to the structural load that will be supported by the foundation, as calculated by a structural expert.

CONCLUSION

Construction of the Buti Catholic Church in Merauke Regency, South Papua Province.

While soil sounding offers significant benefits, it's also crucial to consider safety and environmental aspects throughout the process. In conclusion, it's important to understand that soil sounding isn't just about collecting data; it's also about understanding the meaning of that data, using it in a relevant context, and doing all of this in a safe and environmentally friendly manner.

With the right approach, soil sounding can provide significant benefits for a variety of projects, from infrastructure construction to environmental conservation.

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