# COMPARISON ANALYSIS OF PILE FOUNDATION CAPACITY SINGLE BASED ON PILE LOADING WITH PDA TEST ON SHAKING PORT DEVELOPMENT PROJECTCONTAINERS (APRON SLAB ON PILE) JAYAPURA

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**Abstract**

The foundation is the main structure in a construction which functions as a support for the load or transmits the forces that occur above the construction and is transmitted into the hard soil. Pile foundations are part of the type of deep foundation that is widely used. In designing deep foundations using piles, there are several analytical methods to determine the bearing capacity of deep foundations.The purpose of this study is to calculate and compare the axial bearing capacity of single piles from the Meyerhoff SPT method data, the calendaring data from the Hiley method, ENR, WIKA, Eytelwein Chellis, Navy-Mc, Kay, Gates, Danish, and MSHoC, against the results of the test. PDA test axial bearing capacity. As for the calculation of the lateral bearing capacity using the Broms method.There is a difference in the value of the calculation results of bearing capacity and foundation settlement, both in terms of the calculation method and its location. Based on the calculation results of single pile axial bearing capacity with SPT data = 285,520 tons, calendaring data, Hiley = 336,994 tons, ENR = 50,156 tons, WIKA = 336,994 tons, Eytelwein Chellis = 88,718 tons, Navy-Mc, Kay = 5302,720 tons, Gates = 2802.460 tons, Danish = 9968.484 tons, MSHoC = 62.695 tons, while the results of the single pile axial bearing capacity using the PDA test obtained the results of = 392,000 tons. As for the calculation of the lateral bearing capacity of a single pile using the Broms method for the criteria for the pinned end pile foundation to be considered a long pile or not rigid, and the results obtained that the ultimate lateral force that can be resisted by the long wedged end pile is = 114.463 kg, and for The lateral allowable that can be resisted by the long pinned pile is = 38,154 kg, while the amount of deflection that occurs due to the allowable lateral force on the long wedged end pile foundation is 0.00549 mm. Differences in axial bearing capacity can be caused by differences in soil types, the way the test is carried out which depends on the accuracy of the operator and differences in the parameters used in the calculations.

**Keywords:**Pile foundation capacity; axial pile; lateral pole; PDA test.

## 1. INTRODUCTION

In the Jayapura slab on pile port construction project, the apron slab on pile was built using a pile foundation, the foundation serves to transmit the load of the superstructure to the subgrade layer below it through the end bearing capacity and the interaction of the soil with skin friction (skin friction). The port where the containers are piled up (apron slab on pile) in Jayapura is passed by heavy vehicles, because this port is used as a temporary container stacking place after loading onto the ship or after being unloaded from the ship, then transported and stacked/arranged to the container yard (container yard) while waiting for loading or collection from the importer.

In this study, a review of the carrying capacity of the pile using the static and dynamic formula method was carried out and at the same time carried out a study of the pile loading with the PDA test on the object of the Jayapura port construction project where the container slab (apron slab on pile) piled up.

The formulation of the problem in this study are:

a. How to calculate the axial carrying capacity of piles based on the results of soil investigation (SPT) on the construction project of the Jayapura slab on pile port.
b. How to determine the characteristics of the piles in the construction project.
c. How big is the comparison of the value of the axial bearing capacity of the pile foundation and the corresponding percentage from the results of the calendaring to the results of the PDA test.
d. How to calculate the ultimate lateral resistance due to lateral forces on the pile foundation in the construction project.
e. How to calculate the safe allowable lateral force on the pile foundation in the port construction project.
f. How to calculate the amount of deflection that occurs due to lateral forces on the pile foundation in the port construction project.

The limitations of the problem in this study are:

a. The data used are data from soil investigation (SPT), calendaring, and PDA tests at the Jayapura port construction project site where container slabs (apron slab on pile) are piled up.

b. The piles analyzed are upright piles.
c. The required permit bearing capacity/minimum pile bearing capacity for upright piles is data obtained from the Planning Consultant (PT. Sukma Lestari).
d. Not planning and analyzing the upper structure of the port.
e. Does not analyze or calculate the settlement (consolidation) that occurs in the pile foundation.
f. Does not analyze or calculate the tensile strength of steel, and the compressive strength of concrete piles.
g. To analyze the bearing capacity of piles, both axial and lateral, only the static method, the dynamic method, and the broms method are used.
h. The pile used is of circular cross-section steel with a diameter of 711.2 mm.
i. Do not compare other pile foundations.

Not analyzing the Budget Plan (RAB).

## 2. RESEARCH METHODOLOGY

### a. Research Flowchart

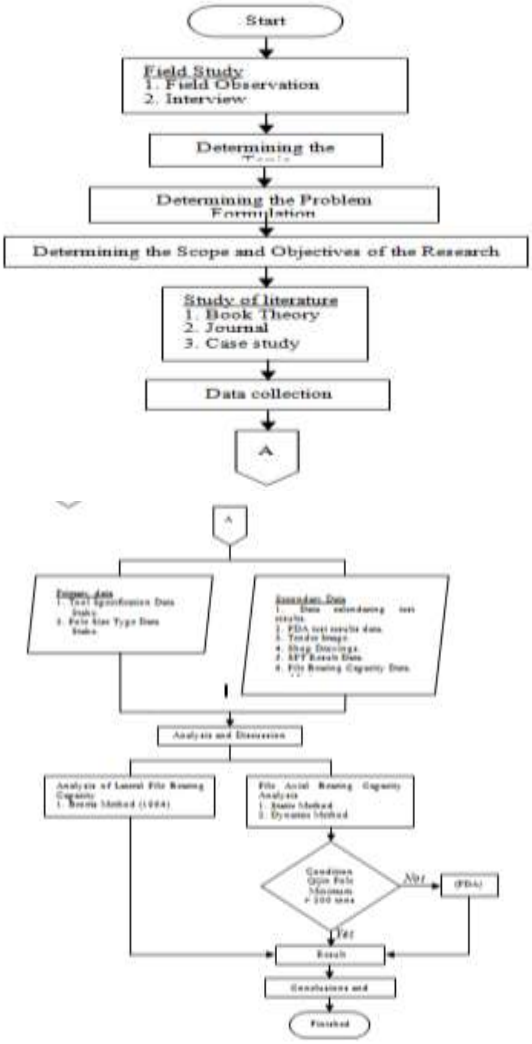



*Figure 3. 1.**Research flowchart***

## 3. RESULTS AND DISCUSSION

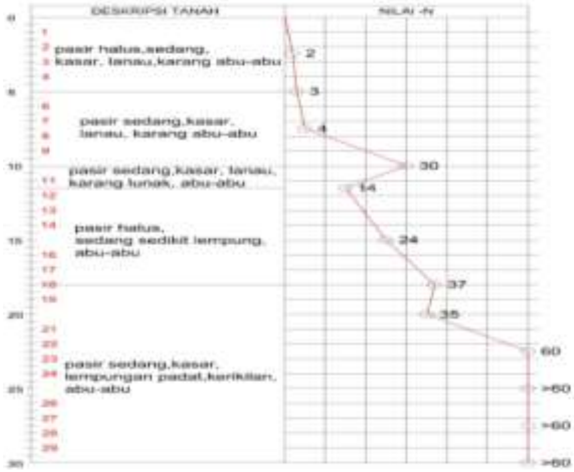
### Calculating Axial Bearing Capacity

### 3.1. Calculating Pile Bearing Capacity Based on SPT Data

Calculating the bearing capacity of the pile using SPT data, soil layering is carried out and the calculation is using the Meyerhoff method. The SPT data used is taken from BH-1. The type of soil in each layer is usually different. For this reason, this calculation uses two types of formulas, namely for non-cohesive soil types (sand) and cohesive soil types (clay).

Pile data:

Pile Diameter (d) = 0,711 m.
Pile area (Ap) = 0,397 m².
Around the pile (P) =2,233m.




*Picture 4.1. **Graph of the results of soil investigations (SPT)***

*Source: Secondary data, 2020*

Non-cohesive soil

As an example of calculation for non-cohesive soil, we take SPT data at a depth of 11.50 meters.

The bearing capacity of the pile tip on non-cohesive soil, based on Equation (2.7) is:

$$Qp = 40 \times Nb \times Ap \times \frac{Li}{D} < 400 \times Nb \times Ap$$

$$Qp = 40 \times 14 \times 0{,}397 \times \frac{1{,}5}{0{,}711} < 400 \times 14 \times 0{,}397$$

Qp = 468,965 kN< 2224 kN

For pile blanket shear resistance in non-cohesive soil with Equation (2.8) is:

Qs = 2× N-SPT × P × Li
Qs = 2× 14 × 2,233 × 1,5 = 93,793 kN

Cohesive soil

Pile bearing capacity (Qp) for cohesive soil with a depth of 30 meters using Equation (2.9) is as follows:

Qp = 9× Cu × Ap
Qp = 9× 400 × 0,397 = 1429,406 kN

For pile blanket shear resistance in cohesive soil with Equation (2.10) is:

Qs = □ × Cu × P × Li
Qs = 0,5 × 400 × 2,233 × 2,5 = 1116,584 kN

Calculating the ultimate bearing capacity at a depth of 30 meters:

Qult= Qp + Qs = 1429,406 + 6968,229
= 8397,635 kN = 856,559 ton
Then the carrying capacity of the permit at a depth of 30 meters is:
Qijin $= \frac{Qult}{SF} = \frac{856,559}{3}$ =285,520 ton

**3.1.2. Calculating Pile Bearing Capacity Based on Calendaring Data**

As an example of a calculation based on calendaring data obtained in the field, we take the calendaring data on pole B 6.86 with the following data:
Hammer or ram weight (W)= 5,5 ton.
Hammer or ram drop height (H)= 300 cm.
*Final set or pole penetration* (S)= 0,03 cm.
Average rebound for last 10 strokes (K) = 1,50 cm.
Hammer efficiency (ef)
= 1,00 (Tabel 2.4).
Restitution coefficient (N)
= 0,5 (Tabel 2.5).
Pile weight (P) = 13,359 ton.
Steel pipe pile length (L) = 61,00 m.
Cross-sectional area of steel pipe pile base (A)
= 3970,573 cm².

a. *Hiley's formula uses* SF = 3.
Ruse $= \frac{2 \times ef \times W \times H}{S + K} \times \frac{W + (N^2 \times P)}{W + P} \times \frac{1}{Sf}$ = 336,994 ton

b. *Formula* ENR use SF = 6
Ruse $= \frac{ef \times W \times H}{S + C} \times \frac{W + (N^2 \times P)}{W + P} \times \frac{1}{Sf}$ = 50,156 ton

c. *WIKA formula uses* SF = 3
Rpakai$= \frac{2 \times ef \times W \times H}{S + K} \times \frac{W + (N^2 \times P)}{W + P} \times \frac{1}{Sf}$ = 336,994 ton

d. *Eytelwein formula with* SF = 6
Ruse $= \frac{2 \times ef \times W \times H}{S + C \times \left(\frac{P}{W}\right)} \times \frac{1}{Sf}$ = 88,718 ton

Information:
Constant value (C) =2,540cm for diesel *hammer*.= 0,254cm for double *acting hammer*.

e. *Navy-Mc,Kay formula with* SF = 6
Ruse $= \frac{ef \times W \times H}{S \times \left(1 + 0,3 \times \frac{P}{W}\right)} \times \frac{1}{Sf}$ = 5302,720 ton

f. *Gates formula with* SF = 3
Ruse
$= a \times \sqrt{ef \times W \times H \times (b - \text{Log } S)} \times \frac{1}{Sf}$
= 2802,460 ton
Information: a = 27 fps; 104,5 Si.
b = 1,0 fps; 2,4 Si.

g. *Danish formula wears* SF = 3
Ruse $= \frac{ef \times W \times H}{S + \left(\frac{ef \times W \times H \times L}{2 \times A \times E}\right)^{0,5}} \times \frac{1}{Sf}$ = 9968,484 ton

Information:
L = Steel pipe pile length (m).
A = Cross-sectional area of steel pipe pile base ($m^2$).$A = \frac{1}{4} \times \pi \times d^2$ , atau $A = \pi \times r^2$
E = Steel's modulus of elasticity 200000 MPa (20000 ton/$m^2$).

h. *Michigan State Highway of Commission Formula with* SF = 6
Ruse $= \frac{1,25 \times ef \times W \times H}{S + C} \times \frac{W + (N^2 \times P)}{W + P} \times \frac{1}{Sf}$ = 62,695 ton
Information:
Constant value (C) =2,540 cm untuk*diesel hammer*.= 0,254cm untuk*double acting hammer*.

**3.2. Calculating Carrying Capacity *Lateral***

The lateral (horizontal) bearing capacity is used to determine the stability of whether the soil will collapse or not. To calculate the horizontal bearing capacity, we must first calculate the pile stiffness factor for the non-cohesive soil type. From the SPT data obtained undisturbed soil samples (Undisturbed Sample) with ground water level (Ground Water Level).

As an example of calculating the lateral bearing capacity, we take the data on pile B 6.86 with the following data:
Pile Dimension (d) = 71,12 cm.
Pile length (L) = 5660,00 cm.
Pile steel quality (fy) = 2447,280 kg/cm².
Modulus of elasticity of pile steel (Ep)
= 2039400 kg/cm².
The moment of inertia of the pile (Ip)= 170000 $cm^4$.
Terzaghi . subgrade modulus (k1)= 5,40 kg/cm³ (Tabel 2.7).

**3.2.1. Characteristics of Piles with Ultimate Lateral Load Resistance**

1. Calculating the horizontal subgrade modulus (kh)
kh $= \frac{k1}{1,5} = \frac{5,40}{1,5}$ = 3,6 kg/cm³
2. Calculating average undrained cohesion (Cu)

*Table 4.1. Cohesion value **(Cu)***

| No. | Tebal Li (m) | Cu (kN/m²) | Cu × Li |
|---|---|---|---|
| 1 | 2,50 | 13 | 33,333 |
| 2 | 2,50 | 20 | 50,000 |
| 3 | 2,50 | 27 | 66,667 |
| 4 | 2,50 | 200 | 500,000 |
| 5 | 1,50 | 93 | 140,000 |
| 6 | 3,50 | 160 | 560,000 |
| 7 | 3,00 | 247 | 740,000 |
| 8 | 2,00 | 233 | 466,667 |
| 9 | 2,50 | 400 | 1000,000 |
| 10 | 2,50 | 400 | 1000,000 |
| 11 | 2,50 | 400 | 1000,000 |
| 12 | 2,50 | 400 | 1000,000 |
| Σ | 30,000 | 2593 | 6556,667 |

*Source: Results of data analysis*, 2020
Cu $= \frac{\Sigma\, Cu \times Li}{\Sigma\, Li} = \frac{6556,667}{30,000}$ = 219 kN/cm²= 2,229 kg/cm²

**3.2.2. Criteria for Rigid and Not Rigid Poles**

According to Broms (1964), for piles in cohesive soils, the connection of pile types and pile clamps is based on the dimensionless factor × L, namely:
$\beta = \left(\frac{kh \times d}{4 \times Ep \times Ip}\right)^{\frac{1}{4}} = \left(\frac{3,6 \times 71,12}{4 \times 2039400 \times 170000}\right)^{\frac{1}{4}}$
= 0,004 cm

a. short poleFree end pole (*free end pile*) behaves like a short pole when $\beta \times L \leq 1{,}5$ cm.
$\beta \times L \leq 1{,}5$ cm
$\beta \times L = 20{,}863$ cm > 1,5 cm
(Tidakmemenuhisyarat)

b. Fixed end piles behave like short piles when $\beta \times L \leq 0{,}5$ cm.
$\beta \times L \leq 1{,}5$ cm
$\beta \times L = 20{,}863$ cm > 0,5 cm
(Not eligible)
   a. long pole
   b. Free end piles are considered as long (not rigid) piles) when $\beta \times L \geq 2{,}5$ cm.
$\beta \times L \geq 2{,}5$ cm
$\beta \times L = 20{,}863$ cm > 2,5 cm
(Qualify)

c. Tiangujungjepit (*fixed end pile*) sebagaitiangpanjang (tidakkaku) bila
$\beta \times L \geq 1{,}5$ cm.
$\beta \times L \geq 1{,}5$ cm
$\beta \times L = 20{,}863$ cm > 1,5 cm
(Qualify)

According to Broms (1964), the characteristics of the pile foundation used are of 2 types, namely the free end piles are considered as long poles (not rigid), and the fixed end piles are long poles (not rigid).

**3.2.3. Calculating the Magnitude of Lateral Force and Deflection**

1. Calculating the strength of the pile load in resisting the moment (My)

The flexural strength of the pile load
fb = 0,40 ×fy = 0,40 × 2447,280 = 978,912 kg/cm²
Moment resistance

$$W = \frac{Ip}{d/2} = \frac{170000}{71{,}12/2} = 4780{,}652 \text{ cm}^3$$

Maximum moment of pole
My = fb × W = 978,912 × 4780,652
= 4679838,020 kg.cm
Lateral force on clamp end posts
f = Hu / (9 × Cu × d)
f = Hu / (9 × 2,229 × 71,12)
f = 1426,909 Hu
Assuming the maximum moment is the moment of the pile cross section (My), the value of Hu can be determined from the following equation:

$$Hu = \frac{2 \times My}{(1{,}5 \times d + \frac{1}{2} \times f)}$$

$$Hu = \frac{2 \times 4679838{,}020}{(1{,}5 \times 71{,}12 + \frac{1}{2} \times 1426{,}909\ Hu)}$$

$$Hu = \frac{9359676{,}040}{(106{,}68 + 713{,}455\ Hu)}$$

Hu (106,68 + 713,455 Hu) = 9359676,040
106,680 Hu + 713,455 Hu² = 9359676,040
106,680 Hu + 713,455 Hu² − 9359676,040 = 0

$$\frac{713{,}455\ Hu^2 + 106{,}680\ Hu - 9359676{,}040}{713{,}455} = 0$$

Hu² + 0,150 Hu − 13118,813 = 0

$$X = \frac{-b \pm \sqrt{b^2 - 4 \times a \times c}}{2 \times a}$$

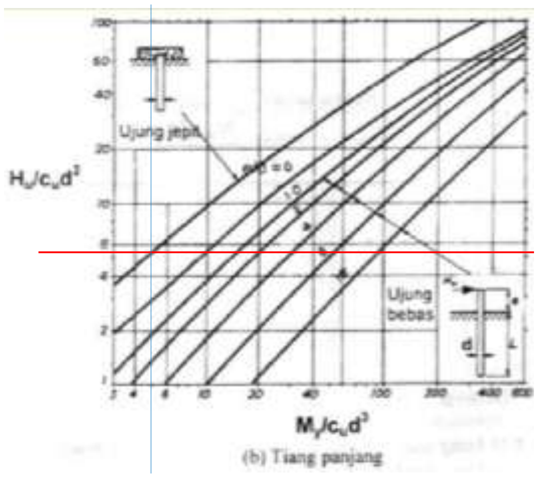
$$Hu = \frac{-0{,}150 \pm \sqrt{0{,}023 - (-52475{,}251)}}{2}$$

$$Hu1 = \frac{-0{,}150 + \sqrt{0{,}023 - (-52475{,}251)}}{2}$$

Hu1 = 114,463 kg
(Hu value used)

$$Hu2 = \frac{-0{,}150 - \sqrt{0{,}023 - (-52475{,}251)}}{2}$$

Hu2 = -114,612 kg
Then the value of f can be calculated:
f = Hu / (9 × Cu × d)
f = 114,463 / (9 × 2,229 × 71,12)
f = 0,080 cm
From the value of Hu = 114,463 kg and Hu = -114,612 kg, then Hu = 114.463 kg is used. The value of Hu can also be found using the following graph:




*Picture 3.1.* ***The ultimate lateral resistance of the pile in cohesive soil***
*Source: Data analysis results, 2020*

Max moment (My) = 4679838,020 kg.cm

$$\frac{My}{Cu \times d^3} = \frac{4679838{,}020}{2{,}229 \times 71{,}12^3} = 5{,}836$$

$$\frac{Hu}{Cu \times d^2} = \frac{114{,}463}{2{,}229 \times 71{,}12^2} = 0{,}010$$

$$\frac{Hu}{Cu \times d^2} = 5{,}5 \text{ (Result of graph)}$$

Hu = 5,5 × (Cu × d²)
Hu = 5,5 × (2,229 × 71,12²) = 62016,636 kg

There is a difference in ultimate lateral resistance (Hu) by the Broms method, the usual calculation method, which is 114,463 kg using a graph, which is 62016,636 kg. This is due to the lack of accuracy in determining the value of the graph. Then the value of the ultimate lateral resistance (Hu) used is the ultimate lateral resistance of the Broms method with the usual calculation, namely Hu = 114.463 kg. Using the value of the factor of safety Sf = 3, the permissible lateral forces that are safe against soil and pile failure are:

$$Hijin = \frac{Hu}{SF} = \frac{114{,}463}{3} = 38{,}154 \text{ kg}$$

Then the value of the allowable lateral force of the clamped end pile is Hijin = 38,154 kg.

Clamp end pole deflection

In accordance with the results of the calculation using the dimensionless factor × L > 1.5, the pile is included in the type of long, non-rigid pile with clamped ends, the deflection of the pile can be calculated using the formula:

$y0 = \frac{Hijin \times \beta}{kh \times d}$

$y0 = \frac{38,154 \times 0,004}{3,6 \times 71,12} = 0,000549 \text{ cm} = 0,00549 \text{ mm}$

$\beta \times L = 0,004 \times 5660,000 = 20,863 \text{ cm} = 0,209 \text{ m}$

### 3.3. Comparison of Axial Bearing Capacity Calculation Results

#### 3.3.1. Comparison of Axial Bearing Capacity

*Table 3.2. Calculation of axial bearing capacity of piles on pile B 6.86*

| Pengujian | Metode | Daya Dukung (ton) |
|---|---|---|
| SPT | Meyerhoff | 285,520 |
| Kalendering | Hiley, 1930 | 336,994 |
| | ENR | 50,156 |
| | WIKA | 336,994 |
| | Eytelwein Chellis, 1941 | 88,718 |
| | Navy-Mc, Kay | 5302,720 |
| | Gates, 1957 | 2802,460 |
| | Danish, 1957 | 9968,484 |
| | MSHoC, 1965 | 62,695 |
| PDA | | 392,000 |

*Source: Data analysis results, 2020*

Based on table 4.2, the pile with code B 6.86 shows a comparison of the results of the analysis of the axial bearing capacity, based on soil investigation (SPT) data, calendaring, and PDA test.

#### 3.3.2. Comparison of Results of Axial Bearing Capacity and Percentage Table 4.3. Comparison of pile axial bearing capacity and percentage of fit between Hiley dynamic method, 1930 against PDA. test

Table 3.3. Comparison of the axial bearing capacity of piles and the percentage of fit between the dynamic Hiley method, 1930 against the PDA test . test

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | Hiley,1930 | PDA | |
| F 2.18 | 251,966 | 462,000 | 55 |
| I 3.36 | 485,137 | 416,000 | 83 |
| **B 6.86** | **336,994** | **392,000** | **86** |
| A 7.99 | 219,168 | 424,000 | 52 |
| J 7.111 | 215,681 | 320,000 | 67 |
| B 8.115 | 226,563 | 438,000 | 52 |
| C 10.134 | 268,461 | 494,000 | 54 |
| B 11.139 | 282,817 | 456,000 | 62 |

*Source: Data analysis results, 2020*

Based on table 4.3 on the pile with code B 6.86 using Hiley's dynamic formula, 1930 shows the comparison value of the axial bearing capacity of 336,994 tons, and the percentage of conformity is 86% against the results of the PDA test.

*Table 3. 4. Comparison of the axial bearing capacity of piles and the percentage of conformity between the dynamic ENR method and the PDA test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | ENR | PDA | |
| F 2.18 | 62,026 | 462,000 | 13 |
| I 3.36 | 58,776 | 416,000 | 14 |
| **B 6.86** | **50,156** | **392,000** | **13** |
| A 7.99 | 49,715 | 424,000 | 12 |
| J 7.111 | 53,097 | 320,000 | 17 |
| B 8.115 | 49,177 | 438,000 | 11 |
| C 10.134 | 50,658 | 494,000 | 10 |
| B 11.139 | 50,658 | 456,000 | 11 |

*Source: Data analysis results, 2020*

Based on table 4.4 on the pile with code B 6.86 using the dynamic engineering news record (ENR) formula, it shows the comparison value of the axial carrying capacity of 50,156 tons, and the percentage of conformity is 13% against the results of the PDA test.

*Table 3.5. Comparison of the axial bearing capacity of piles and the percentage of conformity between the WIKA dynamic method and the PDA test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | WIKA | PDA | |
| F 2.18 | 251,966 | 462,000 | 55 |
| I 3.36 | 485,137 | 416,000 | 83 |
| **B 6.86** | **336,994** | **392,000** | **86** |
| A 7.99 | 219,168 | 424,000 | 52 |
| J 7.111 | 215,681 | 320,000 | 67 |
| B 8.115 | 226,563 | 438,000 | 52 |
| C 10.134 | 268,461 | 494,000 | 54 |
| B 11.139 | 282,817 | 456,000 | 62 |

*Source: Data analysis results, 2020*

Based on table 4.5 on the pole with code B 6.86 using the dynamic formula WIKA shows the power capacity comparison valueaxial support is 336,994 tons, and the percentage of conformity is 86% to the results of the PDA test.

*Table 3.6. Comparison of the axial bearing capacity of piles and the percentage of fit between the dynamic method EytelweinChellis, 1941 against the PDA test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | Eytelwein Chellis, 1941 | PDA | |
| F 2.18 | 174,342 | 462,000 | 38 |
| I 3.36 | 146,606 | 416,000 | 35 |
| **B 6.86** | **88,718** | **392,000** | **23** |
| A 7.99 | 88,146 | 424,000 | 21 |
| J 7.111 | 110,327 | 320,000 | 34 |
| B 8.115 | 84,449 | 438,000 | 19 |
| C 10.134 | 95,085 | 494,000 | 19 |
| B 11.139 | 95,085 | 456,000 | 21 |

*Source: Data analysis results, 2020*

Based on table 4.6 on the pile with code B 6.86 using the dynamic formula EytelweinChellis, 1941 shows the comparison value of the axial bearing capacity of 88.718 tons, and the percentage of conformity is 23% to the results of the PDA test..

*Table 3.7. Comparison of axial pile bearing capacity and percentage of fit between the Navy-Mc, Kay dynamic method against the PDA test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | Navy-Mc, Kay | PDA | |
| F 2.18 | 2879,474 | 462,000 | 423 |
| I 3.36 | 3191,716 | 416,000 | 567 |
| **B 6.86** | **5302,720** | **392,000** | **1153** |
| A 7.99 | 3177,241 | 424,000 | 549 |
| J 7.111 | 2176,522 | 320,000 | 480 |
| B 8.115 | 3896,268 | 438,000 | 690 |
| C 10.134 | 2345,530 | 494,000 | 275 |
| B 11.139 | 2345,530 | 456,000 | 314 |

*Source: Data analysis results, 2020*

Based on table 4.7 on the pile with code B 6.86 using the Navy-Mc dynamic formula, Kay shows the comparison value of axial carrying capacity of 5302,720 tons, and the percentage of conformity is 1153% against the results of the PDA test.

*Table 4.8. Comparison of the axial bearing capacity of piles and the percentage of conformity between the Gates dynamic method, 1957 and the PDA . test*

*Source: Data analysis results, 2020*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | Gates, 1957 | PDA | |
| F 2.18 | 2667,785 | 462,000 | 377 |
| I 3.36 | 2692,788 | 416,000 | 447 |
| **B 6.86** | **2802,460** | **392,000** | **515** |
| A 7.99 | 2722,064 | 424,000 | 442 |
| J 7.111 | 2645,935 | 320,000 | 627 |
| B 8.115 | 2757,472 | 438,000 | 430 |
| C 10.134 | 2667,785 | 494,000 | 340 |
| B 11.139 | 2667,785 | 456,000 | 385 |

Based on table 4.8 on the pile with code B 6.86 using Gates' dynamic formula, 1957 shows the comparison value of axial bearing capacity of 2802.460 tons, and the percentage of conformity is 515% to the results of the PDA test.

*Table 3.9. Comparison of the axial bearing capacity of piles and the percentage of conformity between the Danish dynamic method, 1957 against the PDA . test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | Danish, 1957 | PDA | |
| F 2.18 | 6264,192 | 462,000 | 1156 |
| I 3.36 | 6920,593 | 416,000 | 1464 |
| **B 6.86** | **9968,484** | **392,000** | **2343** |
| A 7.99 | 7312,359 | 424,000 | 1525 |
| J 7.111 | 5368,635 | 320,000 | 1478 |
| B 8.115 | 8360,506 | 438,000 | 1709 |
| C 10.134 | 5836,934 | 494,000 | 982 |
| B 11.139 | 5836,934 | 456,000 | 1080 |

*Source: Data analysis results, 2020*

Based on table 4.9 on the pile with code B 6.86 using the Danish dynamic formula, 1957 shows the comparison value of the axial bearing capacity of 9968.484 tons, and the percentage of conformity is 2343% against the results of the PDA test.

*Table 3.10. Comparison of the axial bearing capacity of piles and the percentage of conformity between the dynamic method MSHoC, 1965 against the PDA . test*

| Kode Tiang | Daya Dukung Tiang Pancang (ton) | | Persentase Kesesuaian (%) |
|---|---|---|---|
| | MSHoC, 1965 | PDA | |
| F 2.18 | 77,533 | 462,000 | 17 |
| I 3.36 | 73,470 | 416,000 | 18 |
| **B 6.86** | **62,695** | **392,000** | **16** |
| A 7.99 | 62,143 | 424,000 | 15 |
| J 7.111 | 66,371 | 320,000 | 21 |
| B 8.115 | 61,471 | 438,000 | 14 |
| C 10.134 | 63,322 | 494,000 | 13 |
| B 11.139 | 63,322 | 456,000 | 14 |

*Source: Data analysis results, 2020*

Based on table 4.10 on the pile with code B 6.86 using the dynamic formula MSHoC, 1965 shows the comparison value of the axial bearing capacity of 62,695 tons, and the percentage of conformity is 16% against the results of the PDA test.

## 4. CONCLUSIONS AND SUGGESTIONS

### 1. Conclusion

Based on the results of the calculation of the bearing capacity of the pile foundation in the construction project of the Jayapura Slab On Pile Port, the following results were obtained:

1. From the calculation of the pile bearing capacity based on data from soil investigation (SPT) using the Meyerhoff method at a depth of 30 meters, it is obtained that Qult = 856,559 tons and Qijin = 285,520 tons.

From the results of calculations using the Broms method, 1964 for the criteria for the pin-tip pile foundation it is considered a long or non-rigid pile ($\beta \times L > 1.5$).

2. From the results of the calculation of the axial bearing capacity of the piles and the percentage of conformity based on the calendaring data for the PDA test using eight dynamic formulas, which were tested on the eight piles, the axial bearing capacity of the piles is obtained which is almost close to the results of the PDA test. is the Hilley formula, 1930 with the axial bearing capacity of the pile and the percentage fit as follows:

a. F 2.18 = 251,966 ton = 55 %
b. I 3.36 = 485,137 ton = 83 %
c. B 6.86 = 336,994 ton = 86 %
d. A 7.99 = 219,168 ton = 52 %
e. J 7.111 = 215,681 ton = 67 %
f. B 8.115 = 226,563 ton = 52 %
g. C 10.134 = 268,461 ton = 54 %
h. B 11.139 = 282,817 ton = 62 %

3. The ultimate lateral force that can be resisted by long pinned piles is Hu = 114.463 kg. So in this case the pinned end pile is only able to withstand the ultimate lateral force of < 114.463 kg.
4. The amount of deflection that occurs due to the allowable lateral force on the long wedged end pile foundation is 0.00549 mm.

**2. Suggestion**

The suggestions that the author can convey after conducting this research are as follows:

1. We recommend that during testing, you should be more careful in the use of equipment and reading the results listed on the test equipment, as well as correct data processing, because this is very important because a little error can cause the results obtained to be inaccurate and not according to the standards that have been set.
2. Before carrying out calculations, you should obtain complete data, because the data is very supportive in making a calculation analysis plan in accordance with the standards and requirements.
3. In calculating the analysis of the axial and lateral bearing capacity of the pile foundation, there are still many methods used to be more focused in analyzing so that more accurate comparisons are obtained.
4. In choosing the method used, more attention should be paid to the data owned whether it is in accordance with the method or not. When the data obtained is incomplete, it is better to do the calculations yourself.
5. In calculating the axial bearing capacity, it would be nice to obtain PDA test data because this data is very good for comparing the axial bearing capacity calculations we analyzed with the PDA test in order to analyze the extent of the differences.

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