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Study Planning of The Dwi Indah Building Pile Foundation in Selodono Village, Kediri Regency

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A B S T R A C T

Foundation is a structure that functions to withstand loads above it and the load itself. These loads are transferred to the ground directly. The case study in this plan is the construction of the Dwi Indah Building in Selodono Village, Kediri Regency. The building has a building area of 308 m2 and a height of 16 m, with the function of the building as an inn. In this planning, the type of pile foundation is used. A Pile foundation is a type of deep foundation that divides the gravity load evenly on the ground and makes the structure of the building strong and strong. The purpose of this planning is to plan a strong pile foundation that can withstand the load of the Dwi Indah Building. The method used in this planning is the Meyerhoff method, with a pile diameter of 30 cm and a foundation depth of 800 cm. From the calculation results obtained (single pile bearing capacity) Pall= 42.62 tonnes greater than (maximum pile load) Pmax= 26.00 tonnes (SAFE). For the control of the yield of the buckling factor, the result is (buckling) ω= 178.61 kg/cm2 <(base stress) σ = 2400 kg/cm2 (SAFE).

INTRODUCTION

Construction cannot be separated from building structural planning. Planning the structure of a building needs to be considered because it ensures building users' safety and comfort [1]. The building structure itself is divided into two types, namely the upper structure and the lower structure. The upper structure is a structure above the ground, such as column, beam, and plate construction. While the lower structure is a structure under the ground, one of which is the foundation [2]. The foundation is a substructure that functions to support the load

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on it as well as the foundation load itself which is then continued to the ground directly [3][4]. The function of the foundation itself is what makes these elements very necessary to plan [5].

Foundation planning includes various aspects, such as dimensional calculations to choosing the type of foundation [6]. Selection of the type of foundation is selected based on the required requirements. Two types of foundations are commonly known, namely shallow foundations and deep foundations[7]. Shallow foundations are used to build construction with shallow hard soil locations, while deep foundations are used for soils with deep hard soils above 3 meters [8]. One type of deep foundation is a pile foundation. The pile foundation is part of a building structure that divides the gravity load evenly on the ground. Some of the common types of pile foundations are steel, concrete, wood, and composite piles. Of the various types of piles, the most frequently used are concrete type piles because they are more economical in terms of price and can also be applied in various existing field conditions [9].

Several studies on pile foundation planning have been carried out in several case studies[10]. Referring to the previous problems and research, a Dwi Indah building plan will be carried out in Selodono Village, Kediri Regency. The Dwi Indah building has a building area of 308 m2 and a height of 16 meters which functions as lodging. Based on the results sondir test that was carried out, the hard soil's location is at a depth of 8 meters; because the location of the hard soil is at a depth of more than 3 meters, the foundation in the type of pile is used. This research's main objective is to plan a safe and able foundation to withstand the structural load of the Dwi Indah building, Kediri Regency.

METHODS

The method used in this research is a method of collecting data from the research location and reviewing the literature from previous studies. The planning includes the calculation of the bearing capacity of the pile, the bending factor, and the pile cap. This research was conducted at Dwi Indah Building, located in Selodono Village, Kediri Regency. The building functions as an accommodation and has 4 floors with a building area of 24 m x 15 m and a total height of 16 m.

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Research Flow

The stages of this research are described in the following flow chart:

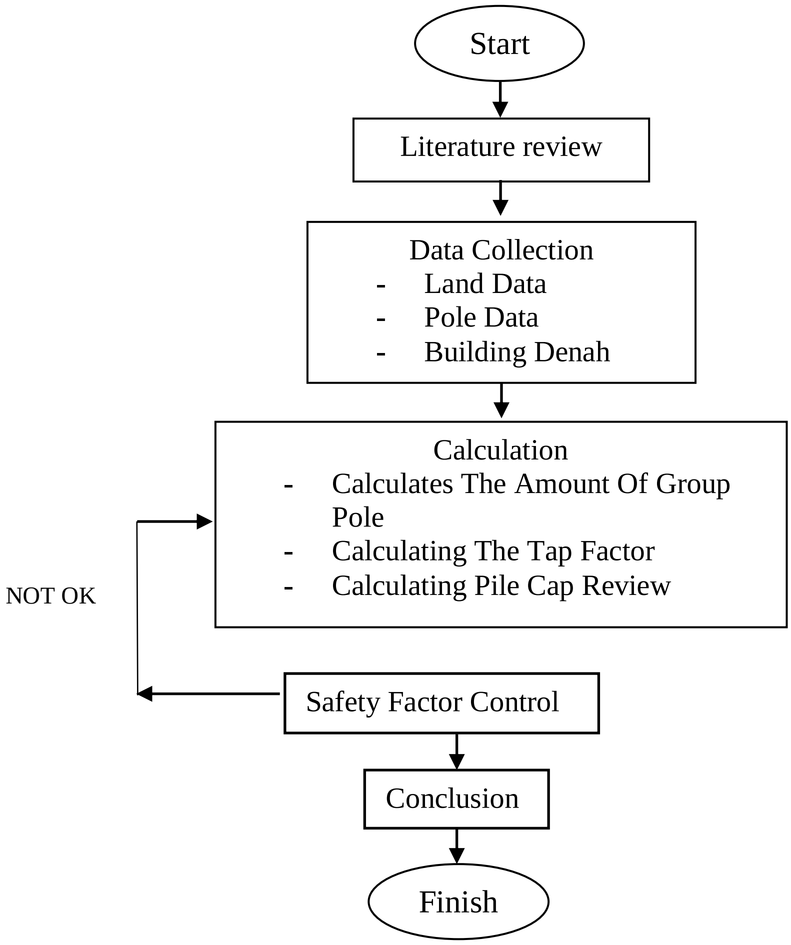

Figure 1. Research Flowchart

Planning begins with studying literature related to pile foundations, followed by planning data collection in the form of soil data from the sondir test results (to determine the location of hard soil), pile data, and building plans. The number of pile groups, bending factor, and pile cap reinforcement will be calculated from these data. Finally, security controls and conclusions are made.

RESULTS AND DISCUSSIONS

Value of Conus and Amount of Sticky Resistance (JHP)

Investigating the soil in the field using the Vone Penetration Test (CPT) method. From these investigations, the value of Conus and Amount of adhesive resistance was obtained as follows:

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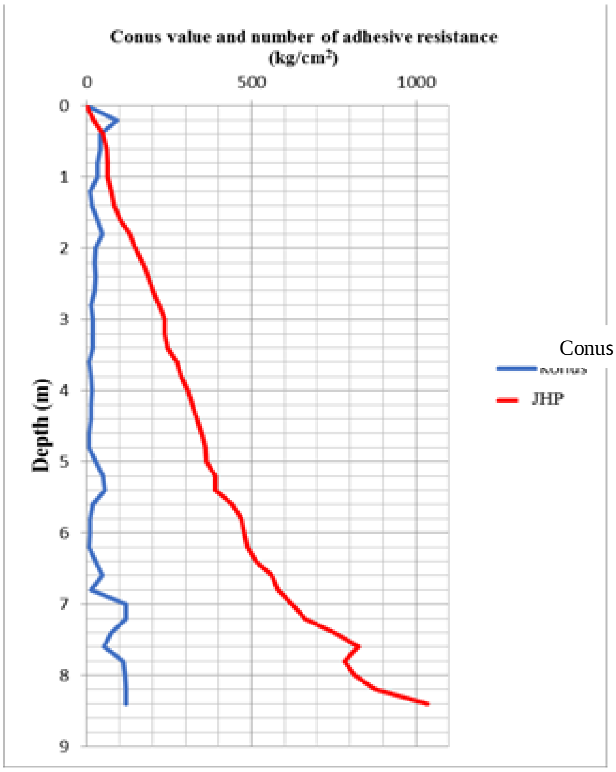


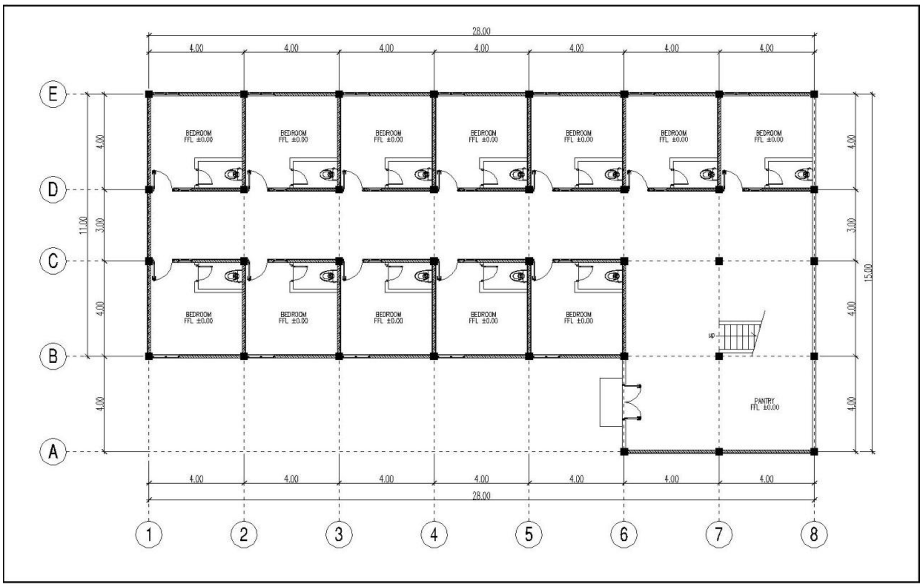
Source: Research Data

Figure 2. Graph of conus and JHP values

From **Figure 2** it can be seen that the cone value (qc) = 110 kg/cm^2 and the value of the amount of adhesive resistance (JHP) = 814 kg/cm^2.

Floor Plan

Floor plan is a part that needs attention in order to determine the existing foundation point



Source: Research Data

Figure 3. Floor Plan

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From Figure 3 it can be seen that the number of columns is 35 which will later become the foundation points.

Result of Loading Calculation

The loading calculation in SAP2000 software is used to find the axial load value at each column point. SAP2000 output results can be seen in **Table 1**

Table 1. The results of the calculation of loading

Type Coloum	Frame	Station	OutputCase	Case Type	P	M2	M3
	Text	M	Text	Text	Tonf	Tonf-m	Tonf-m
K1	337	0	COMB2	Combination	-100,00	0,54666	0,06814
K2	289	0	COMB2	Combination	-88,1759	-0,25422	-0,19091
K3	401	0	COMB2	Combination	-67,655	0,94766	0,02122

Source: Processed Data

From **table 1** it can be seen that the maximum axial load value (P), K1 = 100 tons, K2 = 88.17 tons, and K3 = 67.65 tons. From these results, the ability of the pile to carry the load received must exceed the maximum axial load value (P).

Pile products

Piles have been manufactured by factory. One of the factories that produces piles is PT Wijaya Karya. The following are some of the specifications used in this plan according to PT Wijaya Karya's standards:

Table 2. Size of Piles and Permissible Axial Loads

Outside Diameter (mm)	Concrete Thickness (T=mm)	Classification	Cross-sectional Area of Concrete (cm^2)	Weight (kg/m')	Long (L=m)	Allowable Axial Load (ton)
300	60	A2	452	113	6-13	72,60
		A3				70,75
		B				67,50
		C				65,40
350	65	A1	582	145	6-15	93,10
		A3				89,50
		B				86,40
		C				85
400	75	A2	766	191	6-16	121,10
		A3				117,60
		B				114,50
		C				111,50

Source: Calculation data of PT. Wijaya Karya

In this plan, piles with a diameter of 300 mm / 30 cm are used with axial loads that can be held at 72.60 tons.

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Results of the calculation of the carrying capacity of the soil

The bearing capacity of the pile is a measure of the pile's ability or capacity to support the load. The calculation of the bearing capacity of piles using sondir data uses the Meyerhoff method. The results of the calculation of the bearing capacity of the pile are described in **table 3** below:

Table 3. Recapitulation of the calculation results of the bearing capacity of the pile

Type Coloum	Pole Diameter	P_{all} (ton)	P_{max} (ton)	$P_{all}>P_{max}$	Number of Pole	P_g (ton)	ΣVu (ton)	$P_g >$ P_{max}
K1	30	42,62	26,00	SAFE	4	129,19	103,86	SAFE
K2	30	42,62	23,03	SAFE	4	129,19	92,04	SAFE
K3	30	42,62	35,81	SAFE	2	74,92	71,51	SAFE

Source: Processed Data

From **table 3** it can be seen that the value of the group pile bearing capacity (Pg) in column K1 = 129.19 tons, K2 = 129.19 tons, and K3 = 74.92 tons. These results are said to be safe because they have exceeded the maximum axial load value (ΣVu) in the existing column.

Result of the buckling factor calculation

Buckling failure can occur when the soil is very soft where the pole only rests on hard ground, and the ground around the pole does not provide a clamp so that the mast behaves like a column with supports joints

Table 4. Recapitulation of buckling factor calculations

Buckling Factor (kg/cm^2)	Base Stress (σ) (kg/cm^2)	Bending Factor < σ
178,61	2400	AMAN

Source: Processed Data

From **table 4** it can be seen that the value of the bending factor = 178.61 kg/cm^2 is still smaller than the basic stress = 2400 kg/cm^2, so that the pile is safe from the danger of buckling.

Result of pile cap reinforcement calculations

The pile cap is composed of steel reinforcement with varying diameters which forms a plane with different thickness and width depending on the number of piles embedded. The results of the pile cap reinforcement calculation are described as follows:

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Table 5. Recapitulation of pile cap reinforcement calculations

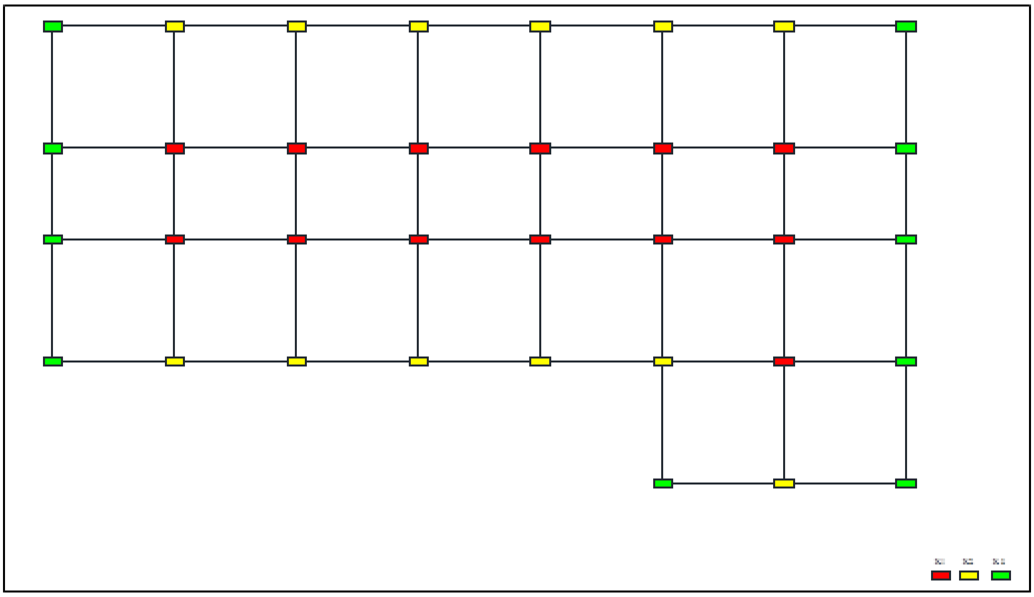
Type Kolom	Type Reinforcement	Diameter (mm)	As_{perlu} (mm)	As_{ada} (mm)	$As_{ada} > As_{perlu}$	Reinforcement Distance (s) (mm)
K1	Press	10	291	314	Ok	250
	Pull	16	1459	1608	Ok	125
K2	Press	10	291	314	Ok	250
	Pull	16	1459	1608	Ok	125
K3	Press	10	291	314	Ok	250
	Pull	16	1459	1608	Ok	125

Sumber : Data diolah

From table 5 it can be seen that the Asada value is greater than the Asperlu value, therefore the reinforcement has met the safety requirements. Meanwhile, for the distance between reinforcement used (s) = 125 mm for compressive reinforcement, and (s) = 250 mm for tensile reinforcement.

Visual

From the calculations that have been done, it can be proposed that the laying point of the foundation based on the column type (Figure 4) is a side view of the planned foundation (Figure 5)



Source: Processed Data

Figure 4. The foundation plan

From Figure 4 it can be seen that the foundation points for K1 = 13 units, K2 = 12 units, and K3 = 10 units.

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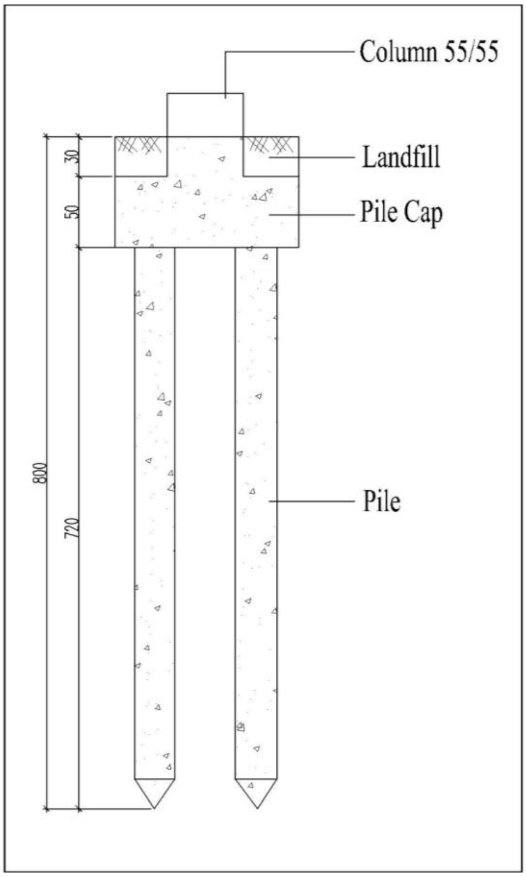

Source: Processed Data

Figure 5. The foundation plan side view

From Figure 5 it can be seen that the side view of the foundation with a depth of 800 cm / 8 m and a thickness of the pile cap = 50 cm.

CONCLUSION

From the calculation results of the pile foundation planning above, it can be concluded as follows:

1) Pile bearing capacity at a depth of 8 m with a diameter of 30 piles and using the Mayerhoff method get the results:

   qc = 115 kg/cm^2 , with a single pole carrying capacity Pall = 42.62 tons greater than Pmax = 26.00 tonnes (SAFE)

   For the pile bearing capacity of groups K1, K2 and K3 will be produced as follows:

   a. K1 with the yield of Pg = 129.19 tonnes> ΣVu = 103.86 tonnes (SAFE), using 4 poles.
   b. K2 with the yield of Pg = 129.19 tonnes> Σvu = 92.04 tonnes (SAFE), using 4 poles.

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c. K3 with the yield of Pg = 74.92 tonnes> Σvu = 71.51 tonnes (SAFE), using 2 poles.

d.

2) For yield control the buckling factor gets the results

$\omega = 178.61$ kg/cm^2 $< \sigma = 2400$ kg/cm^2 (SAFE).

3) Pile cap reinforcement with the results:

a. Pile cap K1 uses tensile reinforcement with direction X = D16 - 125 and compression reinforcement = D10 - 250. For tensile reinforcement direction Y = D16 - 125 and compression reinforcement = D10 - 250.

b. Pile cap K2 uses tensile reinforcement with direction X = D16 - 125 and compression bone = D10 - 250. For tensile load direction Y = D16 - 125 and compressive load = D10 - 250.

c. Pile cap K3 uses tensile reinforcement with direction X = D16 - 125 and compression reinforcement = D10 - 250. For tensile reinforcement direction Y = D16 - 125. and compression reinforcement = D10 - 250.

Suggestion

In planning the pile foundation stake, should pay attention to soil conditions in which it will be performed erection, because of soil conditions greatly affects the amount of power supports the poles stake can carry that.

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