Foundation Recommendations To Provide Bearing Capacity For Additional Floors In The East Jakarta PPKPPL Building

Kerlima Hutagaol[1], Ancient Betman Dasuha[2], Hendra Ali Gunawan[3], Muriya[4]
Student Technique Civil, University Mpu Tantular
kerlimahutagaol@gmail.com1 bdpstudy@gmail.com2 muriya4@gmail.com[4]

ABSTRACT

This study aims to provide recommendations regarding foundations capable of supporting additional floors in the PPKPPL building in East Jakarta. The focus of this study is to assess the feasibility of the existing structure, especially the foundation elements, in line with the planned floor addition. A survey was conducted through visual and technical observations to determine the current condition of the structural elements. Data obtained from the survey were then analyzed using structural calculation methods to determine the foundation's capacity to accommodate gravity and earthquake loads in accordance with applicable standards. The analysis results indicate that the existing foundation's bearing capacity is insufficient to support the planned loads after the floor addition. If there is a mismatch between the foundation capacity and the new loads, recommendations for foundation repair or reinforcement will be provided so that the building can meet safety and comfort standards. It is hoped that this study can provide a basis for making technical decisions regarding additional floors and appropriate foundation reinforcement.

Keywords: structural analysis, foundations, building evaluation, additional floors, structural reinforcement

I. INTRODUCTION

The East Jakarta PPKKPL building, located on Jalan Raya Condet, Batu Ampar, Kramat Jati, plans to add one floor, expanding from its previous two to three. This additional floor requires a thorough evaluation of the existing structure's ability to support the additional load. Therefore, a visual inspection and special analysis of the building structure were conducted, along with an assessment of its resistance to additional loads, including potential earthquake risks. This inspection aims to ensure that the building remains safe and stable despite significant changes in load.

The focus of this study is to analyze the strength of the building's foundations, with the aim of determining whether the existing foundations can support additional floors. One of the issues addressed in this study is the evaluation of the bearing capacity of the soil that forms the foundation's current base. Furthermore, this study will assess the foundation's ability to withstand the additional loads caused by the additional floors. This includes technical calculations regarding the extent of the additional load the existing foundations can support and whether they require repair or reinforcement.

The primary objective of this study is to analyze the influence of soil bearing capacity on the type and design of foundations used in the building. This study will calculate the strength of the existing foundations to support additional loads and assess various methods that can be applied to determine the appropriate foundation to support additional floors. The results of this study are expected to provide a deeper understanding of the condition of the existing foundations and the potential impact of changes in load on the overall structural stability of the building.

The benefits of this research are significant, especially for those involved in the planning and decision-making process related to strengthening or repairing building structures. This research will offer deeper insight into the current condition of foundations, assist in determining the most appropriate type of foundation to increase the soil's bearing capacity, and provide useful advice for decisions related to structural changes, such as additional floors. Therefore, this research serves as an important resource for decision-making related to the safety and strength of future buildings.

II. RESEARCH METHODOLOGY

The research method applied in this study includes several steps designed to evaluate the structural feasibility of the East Jakarta PPKKPL Building after the addition of a floor. Initial steps include an Institutional Survey, Coordination, and Document Review, which involves collaborating with relevant parties to determine the direction of activities and align plans related to permits and inspection areas. This process also includes a review of technical documents held by the building owner, which need to be verified through field inspections if deemed necessary. Data not contained in these documents will be taken from the field inspection to ensure the information obtained is accurate.

Next, a visual inspection is conducted to gather data on the condition of the structural elements and the surrounding environment. This inspection aims to identify damage or conditions requiring further attention. The data obtained from the visual inspection will form the basis for the next step, the Special Inspection. This special inspection is carried out using more sophisticated techniques and tools, such as Non-Destructive Testing (NDT) with Ultrasonic Wave Velocity (UPV) and Hammer Testing, which allows the discovery of hidden damage that cannot be detected by visual inspection alone.

More detailed inspection methods, such as UPV and the Hammer Test, provide a better understanding of the condition of concrete and steel materials within structural elements. The UPV test, for example, measures the speed of ultrasonic waves passing through concrete to assess its quality and integrity. The Hammer Test is used to assess concrete hardness, which provides an indication of the material's strength. Both tests provide critical information for determining whether repairs or reinforcements are needed in existing structures.

The final inspection includes destructive testing, such as Steel Quality Testing and Foundation Excavation, to obtain more in-depth information about the material strength and condition of the foundation. The results of this series of tests will be used to develop recommendations for repairs or reinforcements necessary to ensure the building can safely support the additional loads and meet applicable standards. This method provides a comprehensive approach to identifying and resolving potential structural issues in the building, while ensuring the continued and safe operation of the building after the addition of a floor.

III. RESULT AND DISCUSSION

1. Existing Foundation Inspection Results Data

The results of the foundation excavations conducted at 10 locations indicate that the foundation type is a footplate foundation. The dimensions of the footplate foundation are 900 x 280 mm. The condition of the existing foundation is good, as can be seen in the following image:

Figure 1. Existing Foundation Condition

Based on the results of visual observations of the foundation, it was found that the condition of the foundation was still quite good.

Table 1 Foot Plate Foundation Data

LAND DATA			
Foundation depth,	Df =	1.65	m
Soil volume weight,	ɣ =	18.00	kN/m3
Internal friction angle,	Φ =	19.00	°
Cohesion,	c =	0.12	kPa
Average cone resistance (sondir test results),	qc =	11	Kg/cm2
FOUNDATION DIMENSIONS			
Foundation width in y direction,	Bx =	0.90	m
Foundation thickness,	By =	0.30	m
Foundation width in x direction,	h =	0.40	m
x-direction column width,	bx =	0.50	m
Width of the y-direction column,	by =	0.30	m

Column position (depth = 40, edge = 30, angle = 20)	α s =	40.00	
CONSTRUCTION MATERIALS			
Concrete compressive strength,	fc' =	23.00	MPa
Yield strength of reinforcing steel,	fy =	393.00	MPa
Weight of reinforced concrete,	ɣc =	24.00	kN/m3

2. **Sondir Test Results**

From the results of the sounding carried out at a depth of 0 meters to 5 meters, the average cone resistance value of the sounding results at the base of the foundation (11.00 kg / cm2) in each soil layer shows significant variations, which indicates differences in soil strength and density at that location. At depths between 0 and 4 meters, a decrease in the Friction Ratio (FR) value, which indicates a soil layer with a consistency of low to medium FR, while at depths between 4 and 5 meters, the Friction Ratio (FR) value, increases to 0, which indicates the presence of a hard soil layer with better bearing capacity.

3. **Ultrasonic Pulse Velocity Test (UPV Test) Results**

Results Indirect pulse velocity need processed so that produce mark direct pulse velocity. Based on Guidebook on Non-destructive testing of concrete structures, Ch.11.1.4.4 based on ASTM C215 Test Method for Fundamental Transverse, Longitudinal, and Torsional Resonant Frequencies of Concrete Specimens conversion Indirect factor to direct factor with increase results velocity as big as 5% - 30%. In case time This taken mark indirect factor as big as 10%.

Table Calculation Direct or Indirect Pulse Velocity. Following is results pulse velocity the Then classified in accordance criteria speed to quality concrete based on BS 1881: Part 203: 1986 Concrete Quality Based On Pulse Velocity

Table 2 Direct or Indirect Pulse Velocity Calculation

No	Sample ID	Loecatio Test		Velocity (m/s)	Distance (m)	Indirect/Direct Factor **	Direct Flow	Average Direct
		Location	Type					

							(m/s)	Velocity (m/s)
1	U1	Foundation	Pedestal	3115	0.34	1.0	3115	3141
2				3209	0.34	1.0	3209	
3				3189	0.34	1.0	3189	
4				3098	0.34	1.0	3098	
5				3095	0.34	1.0	3095	

Table 3. Assessment Criteria for Ultrasonic Wave Testing

Ultrasonic Wave Speed (m/s)	**Concrete Condition**	**Information**
> 4000	Very good concrete	Very good quality concrete, almost no defects.
3500 - 4000	Good concrete	Homogeneous concrete, little porosity, few small cracks.
3000 - 3500	Medium concrete	The concrete is quite homogeneous, with few defects or cracks.

2000 - 3000	Bad concrete	Concrete with high porosity, has internal defects or cracks.
< 2000	Concrete is very bad	Concrete with many internal defects (voids, large cracks), is very unsuitable for construction.

From results in on Then narrowed down each element structure so that can concluded criteria And mark pulse velocity each element structure. Results from pulse velocity on Then correlated to quality concrete in accordance formula based on ASTM C597 - 16 Standard Test Method for Pulse Velocity Through Concrete.

4. **Results Testing Hammer (Hammer Test)**

Inspection done based on mark Which produced Schmidt hammer.
Then we get:

- Average column concrete quality = 27.22 MPa
- Average quality of slab concrete = 27.63 MPa
- Average quality of concrete blocks = 27.46 MPa
- These results have met the minimum requirements for concrete compressive strength of 21 MPa for special structural concrete quality based on SNI-2847-2019.

I.1. General Material Specifications

The material specifications used in the analysis are as follows:

- Concrete Quality

The quality of concrete used is based on the following test results:

Structural Elements	Yield (MPa)	Testing
Column	23.24	UPV Test
Beam	23.03	UPV Test
Plate	23.53	UPV Test

- Reinforcing Steel Quality

The quality of reinforcing steel is taken from the results of the Brainell test as follows:

Structural Elements	Tensile Strength Fu(MPa)
Tul. Plain	393

I.2. Loading

- **Dead Load**

Dead load details are as follows:

Typical Floor

Type	Burden	Unit
- Speci (2 cm)	0.44	kN/m2
- Floortile	0.3	kN/m2
- Ceiling	0.2	kN/m2
- M/E	0.3	kN/m2
Total	**1.24**	**kN/m2**

Roof

Type	Burden	Unit
- Speci (2 cm)	0.44	kN/m2
- ceiling	0.2	kN/m2
- M/E	0.3	kN/m2
Total	**0.94**	**kN/m2**

The additional dead load due to the wall load is 1.1 kN/m2 with an average wall height of 4 m, resulting in a wall weight of 4.4 kN/m above the structural beam.

- **Burden Life**

Burden life Which used on analysis This referring to on regulation SNI Loading For Building Building 1727:2020 that is :

Roof Concrete = 0.96 kN/m2

Room Office = 2.4 kN/m2

- **Burden Wind**

Determine Speed Wind Base, V Speed wind base must determined by agency Which authorized, However in inspection speed wind must in plan minimum as big as 32 m/s.

Determine Parameter Burden Wind Category Exposure For building Which planned use Exposure type C due to Exposure C valid For all case in where Exposure B or D No applies.

- **Burden Earthquake**

For Analysis Burden Earthquake determined in accordance with Which required by Tata Method Planning Resilience Earthquake For Structure Building Building And Non Building, SNI 1726:2019. Level earthquake use Earthquake 2500 year Where 2% possibility earthquake plan exceeded in 50 year age building.

Results Parameter Response spectrum, acceleration response spectrum And variety response spectrum as following:

SMS: 1,034 □Sds : 0.689 T0 : 0.186 seconds

Sm1 : 0.964 □Sd1: 0.642Ts : 0.931 seconds

I.3. Soil Bearing Capacity

Kd = 1 + 0.33 * Df / B = 2.82 > 1.33

⇨ Kd > 1.33

Average cone resistance from sounding results at the base of the foundation,
qc = 11.00 kg/cm2
qa = qc / 33 * [(B + 0.3) / B]2 * Kd = 1.77 kg/cm
qa= 177.33 kN/m2

I.4. Foundation Reinforcement Recommendations

Therefore, it is recommended to add a D300 strouss pile with a depth of 5. The results of the foundation reinforcement calculations are as follows:

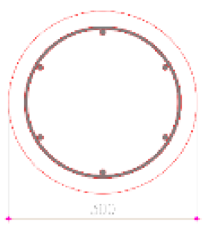
Bore Pile Strength Design Based on Material

Data on Materials Used
Bore Pile Diameter = 300mm
Concrete Quality = K-300 = 300 kg/cm ^{2}
Reinforcement Diameter = 16 mm
Reinforcement Quality = 420 Mpa = 4200 kg/cm ^{2}
$A_{brutto\ borpile}$ = 70650 mm2 = 706.5 cm2
AtulanganD16= 200.96 mm ^{2}=2.01 cm2

$$Jumlah\ Tulangan = \frac{Luas\ Bore\ Pile\ x\ 1\%}{Luas\ Tulangan}$$

= 3,516 pieces

Tried to be taken = 6.0 pieces (minimum requirement)
Total area of reinforcement = 12.0576 cm ^{2}



Diameter = 300 mm
Reinforcement = 6-D16
Concrete Quality = K-300

$A_{netto\ borepile} = A_{brutto\ borepile} - Luas\ Total\ Tulangan$

= 694.4 cm2

Axial force that can be carried

$$P_{izin} = \frac{(0{,}33\ x\ \sigma bk\ x\ A_c) + (0{,}54\ x\ fy\ xA_s)}{safety\ factor\ (2{,}5)}$$

$$P_{izin} = \frac{(0{,}33\ x\ 300\ x\ 698.5) + (0{,}54\ x\ 4200\ x12.05)}{2{,}5}$$

$$P_{izin} = \frac{96096.4344}{2{,}5} = 38438.6\ kg$$

$$P_{izin} = 38.44\ Ton$$

Information :

obk = Concrete Quality (kg/cm2)
Ac = Concrete Area on Bore Pile cm2
fy = Quality of Reinforcement Used (kg/cm2)
As = Area of Reinforcement in Bore Pile cm^2
Bore Pile Reinforcement Area Requirements Must not be less than 1% of the gross cross-section

Bore Pile Strength Design Based on Supporting Soil
-Based on Sondir Data
Area taken based on the data provided:
Table 4. Results of the Soil Test

Depth (m)	Conus Penetration(kg/cm2)	Total Resistance(kg/cm2)
0.6	9	0.25
1	8	0.33
1.6	10	0.25
2	12	0.17
2.6	15	0.25
3	17	0.17
3.6	22	0.17
4	22	0.17
4.6	90	0.17
5	150	2.5
5.6	240	3.33

Qu = (qc x Ab) + (qf x As)
Information :
Qu = Pole Capacity (kg)
qc = static cone penetration resistance (kg/cm^2)
Ab = area of the lower end of the pole cm^2
qf = total static cone friction resistance (kg/cm^2)
As = area of the pillar wall cm^2
Tried at a depth of 5 m with a pole diameter of 30 cm.
qc = 150.0 kg/cm^2
Ab= 706.5 cm^2
qf = 0.2 kg/cm^2
Axle = pole circumference x pole height

= 94.2cm x 500cm
= 47100.0 cm2
Qu = (20 x 706.5) + (0.17 x 47100)
= 113,982kg

$$Qa\ (beban\ yang\ di\ izinkan) = \frac{Qu}{3} = \frac{113.982}{3.0}$$

$$Qa = 37.994\ kg$$

$$Qa = 37.99\ Ton$$

P permit (material) = 38.44 Tons
P permit (supporting land) = 37.99 Tons
The smallest one is taken because it is the first failure condition to occur.
P permit = 37.99 Tons

IV. CONCLUSION

Based on the results of the assessment, testing, and structural analysis of the East Jakarta PPKKPL Building, the following conclusions were obtained:

Assessment and Testing

a) The foundation excavation results at one location revealed a footplate foundation. The footplate dimensions are 900 x 280 mm, and visual inspection of the foundation indicated that the foundation is in good condition.
b) However, the existing foundation is technically not capable of supporting the combined load of the planned additional floor (1 floor) because it has a ratio > 1.

REFERENCES

SNI 8460:2017. (2017). Geotechnical Design Requirements.
SNI 8561:2017. (2017). Brinell Hardness Testing on Steel.
ASTM A956. (2017). Leeb Hardness Test for Metal Materials.
ASTM E 140-97. (1997). Hardness Conversion Table for Metals.
ASTM C597:2012. (2012). Standard Test Method for Pulse Velocity Through Concrete.
BS 1881 Part 203:1986. (1986). Testing of Concrete: Methods for the Determination of Concrete Strength.
ASTM G80S-89. (1989). Standard Guide for Impact Testing of Concrete.
BS 1881 Part 202:1986. (1986). Testing Concrete: Methods for Testing Concrete for Strength.
ACI, 2002. Standard Deviation Criteria for Concrete.
ASTM C805:2012. (2012). Standard Test Method for Rebound Hammer Testing of Concrete.
Ghaly, MA,et al. (2025). Testing the density of concrete quality with the UPV test.