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ANALYSIS PILE SLAB ON SWAMPLAND KATARAJA TOLL ROAD PROJECT

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ABSTRACT

Kataraja Toll Road has a length of 38.6 km and is a road infrastructure built due to government budget constraints. Because of these limitations, a mechanism for government cooperation with business entities is used. The construction of the Kataraja toll road is considered as one of the means of economic development policy and regional development. However, in its construction there was a problem in the road trase that had to cross the area with swampland. Marshland has a low soil carrying capacity. To solve the problem, roads were created with the Pileslab structure. In the Pileslab structure consists of pile heads, slabs, and pile foundations. The loading standard uses SNI T-02-2005, the bridge's loading standard. Analysis using static methods and using the Allpile program. Based on the analysis conducted, it can be seen that pilelab can withstand vertical loads of 3300.89 kN and horizontal loads of 496.5 kN with eccentricities of up to 3 m. After analysis using the static method and the Allpile program, a decrease of 0.75332 cm and a deviation of 2.5 cm were obtained

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1. INTRODUCTION

Rapid economic growth in the Tangerang area is characterized by the development of industry, settlements, urban expansion, and increasing transportation needs resulting in an unorganized layout causing traffic to accumulate somewhere, an increase in traffic volume and mixing of local and regional traffic that causes traffic jams on main (main) roads. In line with the increasing traffic volume in Tangerang City, the Banten Provincial Government cooperates with private investors and builds transportation infrastructure, namely the Kataraja toll road to facilitate traffic in the developed area. The project will also increase the distribution of goods and services between regions to support the economic growth of the community, attract more workers, and revitalize coastal areas in Tangerang district.

The total length of Kataraja Toll Road is 38.6 km. The construction of the Kataraja Toll Road is planned to be completed in 2023, but in its implementation there are several obstacles, including the existence of swamps at the toll road construction site which causes the construction process The toll road became difficult. Because the swamp is not able to carry the load or in other words the land whose carrying capacity is very low. Several studies were conducted with the aim of finding solutions to the problem of unstable marshlands. This study aimed to design a safe pile slab structure and review the structure's ability to accept the applied load.

2. METHOD

Common

In this case, the author took a case study of Kataraja toll road. In the case of analysis of the design of the Pile slab structure on swampland, the author uses the field data calculation method, namely SPT and uses the Allpile program to analyze the ability of the structure to withstand load on the road.

Analysis and Calculation

When analyzing the pile slab structure on this marshland, the author carried out 7 stages, namely:

- Analyze soil properties and types
- Calculating the load acting on the road
- Calculating vertical carrying capacity
- Calculating horizontal carrying capacity

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- Calculate the decline that occurred at the study site
- Calculates how much deflection occurs
- Controlling safety factors

Soil Data

To determine the capacity of the mast to support the existing load, a thorough structural analysis must be carried out. The bearing capacity of the pole is calculated based on the N-SPT value obtained from the field soil test.

Loading Data

Loading using standardization in the guidelines of the Indonesia Bridge Management System (IBMS, 1992).

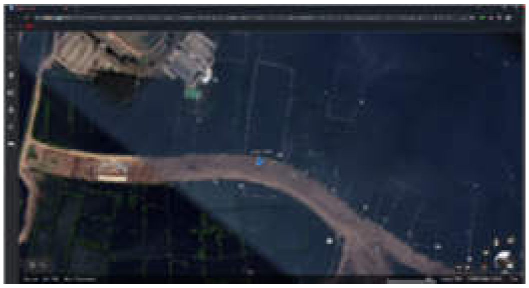

Figure 1. Location of Kataraja *Toll Road*
(Source : Google Earth, 2023)

Analysis and Support

The bearing capacity of pile foundations is calculated by 2 methods, namely by using the static method and using the AllPile program where soil data from SPT test results is used so as to obtain soil parameter data needed to calculate soil carrying capacity.(Encouragement et al. 2018)

Calculating the Decrease

After obtaining the number of foundations and load-bearing dimensions, the next step is to calculate the possible decrease in the soil due to the applied load.

Calculating Deflection

To avoid damage to the structure due to deformation or deflection of the pole, it is necessary to calculate deflection. To calculate it, the author used the equations of Poulus and Davis.

3. RESULTS AND DISCUSSION

Static Calculation of Pile slab

With the following load values:

a. Vertical Load of 3300.89 kN
b. Horizontal Load of 496.5 kN
c. Ultimate moment of 1060.73 kN.m

And the soil used from the SPT test can be seen in Table 1

Calculating axial carrying capacity on Pile slab

- Bearing capacity of pile ends

$Qp = 40 \times Nb \times Ab$ (1)
$= 678.24$ Kn

with :
Qp = End of mast carrying capacity
Nb = Value of N – SPT at the base elevation of the pole
Ab= Cross-sectional area of piles

- Pile friction bearing capacity

$Qs = 0.5 \times N \times As$(2)
$= 1695.60$ kN

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with :
Qs = Pile friction bearing capacity
N = Value N – SPT
As = Perimeter of pile foundation

- Pile bearing capacity

Qw = Qp + Qs (3)
Qw = 678.24 + 1695.60
= 2373.84 kN

- Bearing capacity of pile permits

Qa = Qw/S (4)
Qa = 2373.84/2.5
= 778.62 kN
With pole efficiency of 82%
Qa = 778.62 × 82%
= 949.536 kN
Thus, 949.536 × 5 = 3893.10 kN > 3300.89 kN
by using 5 poles, Qijin group pole > Load (OK)

- Bromsø method

Determine the Long or short criterion based on the T value:

$$T = \sqrt[5]{\frac{El}{nh}} \quad (5)$$

$$T = \sqrt[5]{\frac{2345500 \times 0{,}049}{11779}}$$
= 2,499 m

In determining the criteria for short or long poles, pinch poles are considered rigid short poles when L < 2T, and clasp end poles are considered non-rigid long poles when L > 4T
Then,L > 4T
60 > 4 × 2,499
60 > 9,99 (ok)

Table 1. SPT Testing

Layer	Depth (m)	Soil Type	Nspt	G kN/m^3
1	10	Very Soft	1	15,8
2	20	Soft	3	17,6
3	30	Firm	6	19,2
4	40	Sturdy	11	20,5
5	50	Very Sturdy	23	21,4
6	60	Hard	30	22,2

Table 2. Mmax Results

Depth (m)	M_{max} kN.m
10	10344, 24
20	10875,37
30	11503,35
40	12749,92
50	14692,66
60	16635,83

Weight of reinforced concrete (Wc)= 25 kN/m^3
Cross-sectional area of mast (Ab) = 0.2826 m^2
Piling length (L) = 30 m
Mast Weight (W) = 13.3105 kN

My = 6935.96 kN.m

Because Mmax is larger than the pile, the pile will collapse before the ground so it is estimated that the long end of the pile is free.

- Pile collapse against the maximum bending moment of the pile

Hu $= 60 \times Kp \times D \times \gamma$ (6)
= 3547.17 kN

H = Hu/F (7)
= 3547.17/2.5
= 1418.87 kN

Then 1418.87 × 5 = 7094.34 kN > 496.5 kN (OK)

- Single pile drop

$$S = \frac{(Qp + \alpha Qs)L}{Ap\ Ep} \quad (8)$$

= 0.0021 m
= 2.1 mm

- Group pile drop

$$Eg = 1 - \theta \frac{(n-1)m+(m-1)n}{90mn} \quad (9)$$

= 0.82
= 82%

- Deflection

$$y_0 = \frac{2{,}4\ H}{nh^{3/5}\ El^{2/5}} \frac{1{,}6\ H}{nh^{2/5}\ El^{3/5}} + \quad (10)$$

= 0.1023 + 0.03048
= 0.13278 m

Allpile Program Calculation on Pile Slab

- Vertical single pole analysis

Table 3. Vertical single pole analysis

	Down (kN)	Up (kN)
Ultimate Capacity	11225,368	4607,748
Allowable Capacity	5612,5842	1535,916

Settlement 0.083 cm, Allowable Settlement 2,500 cm then settlement less than *allowable settlement* 0.083 cm < 2,500 cm (OK)

- Vertical pole analysis *group*

Table 4. Vertical pole analysis *group*

	Down (kN)	Up (kN)
Ultimate Capacity	74590,594	19996.50
Allowable Capacity	41530,195	11865,645

Settlement 0.75332 cm, Allowable Settlement 2,500 cm then settlement less than *allowable settlement* 0.75332 cm < 2,500 cm (OK)

4. CONCLUSION

The piles needed in one segment of the Pile Slab to be strong in carrying the load are 5 piles with a pile diameter of 600 mm. Based on calculations by static means and the AllPile program, the Pile Slab structure can withstand the loads acting on the segmen. The decrease and deflection in the structure are still within the safety interval, because it is still below the established safety factor of 0.75332 cm < 2.500 cm

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