

## Evaluation of The Foundation of The Ambon City Financial Services Authority Office Building, Maluku Based on Field Data

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### Abstract.

*This study aims to evaluate the performance of the inner foundation in the Ambon City Financial Services Authority (OJK) Office Building based on field data in the form of boring logs and Standard Penetration Test (SPT) results. The evaluation focused on axial bearing capacity, lateral resistance, and foundation degradation to assess the level of safety and reliability of the foundation system against working loads. The types of foundations analyzed included drilled pile foundations and piles with variations in diameter of 60 cm and 80 cm and depths of 18 m and 25 m. The bearing capacity analysis of the drill pile was carried out using the Reese & O'Neil and Reese & Wright methods, while the bearing capacity of the pile was calculated using the Coyle & Castello and Schmertmann methods. Lateral resistance was analyzed using the Broms method, and the estimated decline was calculated using a semi-empirical approach. The results showed that there was a difference in carrying capacity, lateral resistance, and the magnitude of the decline between the drill pile and the pile which was influenced by the size of the pile and the characteristics of the local soil. In general, the increase in the diameter and depth of the pile contributes to an increase in bearing capacity and lateral resistance and reduces the potential for degradation. These findings confirm that the selection of foundation types must consider the specific geotechnical conditions of the location in order to be able to provide optimal and safe structural performance.*

**Keywords:** *Drill pile foundation; pile; bearing capacity; lateral resistance; lowering and foundation evaluation.*

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## I. INTRODUCTION

The foundation is the most basic structural element in a building that functions to withstand and transmit the load from the upper structure to the supporting ground so that the stability and safety of the building are maintained. According to Widodo (2025), the foundation acts as the lowest part of the construction that accommodates the entire building load before being channeled to the soil layer that is able to support it. Therefore, every construction erected on the ground must have a properly planned foundation system. The selection of the shape of the foundation is influenced by the size of the building load and the soil condition at the construction site, while the depth of the foundation is determined based on the location of the hard soil layer that is able to provide optimal support. In addition, the determination of the appropriate type of foundation must consider the carrying capacity of the soil and the magnitude of the possible subsidence to avoid structural failure (Suroso and Tjitradi, 2020). In general, foundations are divided into two types, namely shallow foundations and deep foundations. A shallow foundation is a foundation that is only able to accept relatively small loads and receive building loads directly.

In contrast to deep foundations, which are foundations that are able to accept large building loads and pass building loads to hard soil or very deep rocks. The foundation elements should be considered ranging from the interland at a safe level of watering to the limit of subsidence to the acceptable amount. The selection of the type of foundation for a building must take into account many aspects, such as the type of soil, the load to be carried, as well as other factors, such as; wind, earthquake, storm and others. In the research area located in the Amantelu area, it is dominated by very rigid soil at a depth of 5 to 15 m, at a depth of more than 15 m the soil condition has a hard soil location. This soil condition was obtained based on the results of drill data at the research location, namely in the "Construction of the Financial Services Authentication Office". Drilling work is carried out at 3 (three) drilling points using a rotary drilling machine using bentonite or a casing with a diameter of 100 mm. At each drill point, a Standard Penetration Test (SPT) was tested using a Split Spoon Sampler with a diameter of 50 mm and a length of 500 mm for sampling the ground hit using a 140 pound (63 kg) drive weight dropped from a height of 30 inches (75 cm).

Based on the results of the land investigation, the construction of the Financial Services Authentication Office (OJK) with an area of 4,500 m<sup>2</sup> and a total height of 26.8 m located on Jl. RA. Kartini, Amantelu Village, Sirimau District, Ambon City, Maluku Province, used a type of deep foundation in the form of a 60 cm diameter drill pile foundation, and a length of 25 meters. This study aims to assess the performance of the foundation system in the Financial Services Authority (OJK) Office Building in Ambon City, Maluku, by referring to the available field data and considering the local geotechnical characteristics and the influence of vertical loads, lateral loads, and earthquake loads working on the foundation. A number of previous studies have shown that the variation in analysis methods and differences in research locations have a significant influence on the results of the calculation of the carrying capacity and the decline of the foundation, as shown in the research of Trinanda (2021) and Ikhwan et al. (2024) which produce different carrying capacity and subsidence values in different soil conditions and types of foundations.

The findings indicate that the results of foundation planning cannot be applied in general without considering the soil conditions and structural characteristics at the research site. On this basis, this study is directed at a thorough evaluation of the foundation of the Ambon City Financial Services Authority (OJK) Building through a recalculation of carrying capacity, lateral holding capacity, and lowering of poles based on NSPT data and field technical data using appropriate analytical methods. It is hoped that the results of this study can describe the actual condition of foundation performance and become a technical reference in assessing the level of safety and reliability of building foundation systems in areas with geotechnical and seismic conditions such as Ambon City. The research process on the construction of the Financial Services Authentication Office (OJK) was carried out in accordance with the planned research flow and planned recalculation of the bearing capacity of the drill pile foundation with NSPT drill data, pile specification data, and other data using the Reese & O'Neil and Reese & Wright methods and recalculating the bearing capacity using pile foundations with the same dimensions using the Coyle & Castello method and Schmertmann, Broms Method for lateral resistance and mast lowering using Semi-Empirical methods.

## II. METHODS

The research method used in this study is a quantitative method that aims to evaluate the carrying capacity of the foundation in the construction of the Financial Services Authority Office Building on Jalan RA Kartini, Amantelu Village, Sirimau District, Ambon City, Maluku Province. The analysis was carried out using the Reese & O'Neil and Reese & Wright methods to assess the bearing capacity of the pile foundation, and then the results were compared with the pile foundation calculation using the Coyle & Castello and Schmertmann method. This approach is carried out through systematic stages which include preliminary studies, identification and data collection, data processing and analysis, to drawing conclusions related to the feasibility and performance of the foundation at the research site.

## III. RESULT AND DISCUSSION

### Analysis of Drilling Pole Calculation 60 cm Diameter

The analysis of the calculation of drill piles in the reviewed buildings was carried out using piles with a diameter of 60 cm and a depth of 25 m. The geometric parameters of the pole are calculated as the basis of the analysis, where the circumference of the side of the pole is obtained from the result of multiplying  $\pi$  with the diameter of the pole, while the area of the pole blanket is calculated from the circumference of the pole multiplied by the length or depth of the pole. The cross-sectional area of the bottom end of the pole is determined using the formula of a quarter  $\pi$  multiplied by the square of the diameter of the pole. In addition, the weight of the pole is obtained from the result of multiplying the cross-sectional area, the length of the pole, and the specific gravity of the concrete used. In the planning of pole groups, a variation in the number of poles is used, consisting of the first group as many as 2 poles, the second group as many as 3 poles, and the third group as many as 4 poles. The horizontal distance from the survey point to the ground level is set at 100 cm. All of these parameters are used as a basis for analyzing the bearing capacity of the poles, both against pressing, tensiling, and lateral loads, as well as to calculate the amount of settlement that occurs in the foundation.

The calculation of the bearing capacity of a single drill mast is carried out using two approaches, namely the Reese & O'Neill and Reese & Wright methods. Based on the Reese & O'Neill method, the end resistance value was 915.62 kN and the total friction resistance was 5521.69 kN, so that the net ultimate support capacity of the pole reached 6260.7 kN after subtracting the weight of the pole. Meanwhile, the Reese & Wright method yielded a greater value, with an end resistance of 1074.33 kN and a friction resistance of 5859.09 kN, resulting in an ultimate capacity of 6756.80 kN. This difference is due to the different approaches to correlation of NSPT values to soil resistance in each method. For tensile conditions, the ultimate capacity obtained was 4335.96 kN (Reese & O'Neill) and 4570.95 kN (Reese & Wright), indicating that the contribution of blanket friction was very dominant in resisting uplift forces. Taking into account safety factors, the permit bearing capacity for compressive loads was obtained at 3130.35 kN in the Reese & O'Neill method and 3378.40 kN in the Reese & Wright method. As for the towing load, the permit value is 1445.32 kN and 1523.65 kN, respectively. In the pole group analysis, the total capacity increases with the number of poles, where the Reese & O'Neill method ranges from 11043.38 kN to 22086.76 kN, while the Reese & Wright method produces a capacity between 13513.6 kN to 27027.2 kN. This suggests that Reese & Wright's method tends to provide a larger estimate of carrying capacity.

In lateral load analysis, the pole is categorized as a long pole for both free-end and clamp-end conditions, based on the value of the dimensionless factor  $\beta L$  that exceeds the criterion limit. Calculations using the Broms method show that the ultimate lateral resistance for free-end posts is 12966.02 kg, while for clamp ends is 45531 kg. After the implementation of the safety factor, the lateral load of the permit was obtained of 42.38 kN and 148.8 kN, respectively. The deflection that occurs is relatively small, which is about 7.3 mm for the free-end pole and 8.98 mm for the clamp-end pole, so it is still within acceptable limits. Furthermore, the analysis of the decline of the foundation shows that the total settlement that occurred is relatively similar in both methods. With the Reese & O'Neill method, the total decrease reached 7.7 cm, while the Reese & Wright method resulted in a value of 7.8 cm. The largest component of the drop comes from deformation at the end of the pole, while the contribution from the axial deformation of the pole and the distribution of the load along the blanket is relatively smaller. Overall, the results of the analysis show that the drill mast has a fairly good capacity to withstand axial, lateral, and tensile loads, with a drop rate that is still within the design tolerance limit. The analysis of the calculation of drill piles with a diameter of 80 cm was carried out as a comparison with the existing foundation by taking into account geometric parameters and soil conditions at the site. From the results of the calculation of the carrying capacity of a single mast using the Reese & O'Neill and Reese & Wright methods, the same value was obtained, namely the ultimate bearing capacity of 4340.11 kN.

This value comes from the contribution of the end resistance of 1243.44 kN and the friction resistance of the blanket of 3322.75 kN, then subtracted by the weight of the pole by 226.08 kN. For tensile conditions, the ultimate capacity of the pole reaches 2718.19 kN which is dominated by the contribution of friction along the pole blanket. After taking into account the safety factors, the permit support capacity for compressive loads is 2170.05 kN, while for tensile loads is 906.06 kN. In the analysis of the pole group, the carrying capacity increased with the number of poles used, which was 8680.22 kN for 2 poles, 13020.33 kN for 3 poles, and 17360.44 kN for 4 poles. In lateral load analysis, the pole is categorized as a long pole because the value of the  $\beta L$  factor meets the criteria for a long pole for both free-end and clamp-end conditions. The calculation results show that the ultimate lateral resistance for the free-end pole is 26038.45 kg and for the clamped end pole is 76341.19 kg. After dividing by the safety factor, the lateral load of the permit was obtained of 85.12 kN and 249.55 kN, respectively. The deflection value that occurs is relatively small, which is about 8.24 mm at the free end and 9 mm at the pinch end, so it is still within the safe limit. Furthermore, the analysis of the foundation subsidence showed that the total settlement that occurred was relatively small compared to the diameter of 60 cm. The total decrease calculated by both methods is the same, which is 3,726 cm. The largest component comes from the drop at the end of the pole, while axial deformation and load distribution along the pole make a smaller contribution. Overall, the 80 cm diameter drill post shows fairly good performance with adequate bearing capacity, safe lateral stability, and relatively small drop so that it is suitable for use as an alternative to foundation planning.

#### IV. CONCLUSION

Based on the results of the analysis of bearing capacity, lateral resistance, and foundation subsidence on drill piles and piles with variations in diameter of 60 cm and 80 cm, the following conclusions can be drawn: Based on the calculation results, at a diameter of 60 cm, the axial bearing capacity of the pile has a ratio of about 1.18–1.39 times greater than that of drill piles. Meanwhile, at a diameter of 80 cm, the ratio of the bearing capacity of the pile to the drill post increases to about 2.05–2.18 times. This shows that piles generally have a greater axial bearing capacity than drill piles of the same diameter. The lateral resistance obtained indicates that the lateral resistance value is determined by the diameter and soil conditions, not by the type of pole. At 60 cm in diameter, both the drill post and the pile produce a lateral resistance of 446.51 kN, while at 80 cm a diameter of 748.65 kN.

Thus, it can be concluded that the increase in the diameter of the mast provides a significant increase in the lateral resistance capacity. The results of the dip analysis showed that piles generally experienced a smaller decline than drill piles, especially at the same diameter. At 60 cm in diameter, the borehole decline is in the range of 7.7–7.8 cm, while the pile only decreases by 3.04–3.5 cm. At 80 cm in diameter, the borehole drop is 3.73 cm, relatively comparable to the pile which ranges from 3.98–4.68 cm. Based on the calculation value obtained in the evaluation of the carrying capacity of the foundation in the construction of the Financial Services Authentication Office (OJK) and compared with the bearing capacity of the pile foundation, it was found that piles have advantages and advantages compared to drill piles based on carrying capacity parameters

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#### REFERENCES

- [1] Angelis, A. D., Gasco, L., Parisi, G., & Danieli, P. P. (2021). A Multipurpose Leguminous Plant for the Mediterranean Countries: *Leucaena leucocephala* as an Alternative Protein Source: A Review. *Animals (Basel)*, 11(8), 2230. [10.3390/ani11082230](https://doi.org/10.3390/ani11082230)
- [2] AOAC International. (2023). *Official methods of analysis* (22nd ed.). AOAC International.
- [3] Charmley, E., McSweeney, C. S., Bishop-Hurley, G. J., Simington, J., Padmanabha, J., & Giacomantonio, P. (2023). Evaluation of the productivity and feed value of Wondergraze and Redlands *leucaena* cultivars under grazing. *Animal Production Science*, 63(3), 450–462. <https://doi.org/10.1071/AN22260>
- [4] Chanchay, N., & Poosaran, N. (2009). The reduction of mimosine and tannin contents in leaves of *Leucaena leucocephala*. *Asian Journal of food and agro-industry*, 2, 137-144.
- [5] Desta, S.T., Yuan, X., Li, J., & Shao, T. (2016) Ensiling characteristics, structural and nonstructural carbohydrate composition and enzymatic digestibility of Napier grass ensilaged with additives. *Bioresource Technology*, 221, 447-454. doi: 10.1016/j.biortech.2016.09.068. Epub 2016 Sep 17. PMID: 27668877.
- [6] Fayemi, P. O., Onwuka, C. F. I., ISAH, O. A., Jegede, A. V., Arigbede, O. M., & Muchenje, V. (2011). Effects of mimosine and tannin toxicity on rabbits fed processed *Leucaena leucocephala* (Lam) De Wit leaves. *African Journal of Agricultural Research*, 6(17), 4081–4085. [10.5897/AJAR11.327](https://doi.org/10.5897/AJAR11.327)
- [7] Food and Agriculture Organization of the United Nations. (n.d.). Feed storage practices: moisture and safe storage of animal feed. FAO. Retrieved: 2 January 2026, from <https://www.fao.org/4/s4314e/s4314e08.htm>
- [8] Hardiansyah, B., Tafsir, M., Daulay, A. H., Wahyuni, T. H., & Ginting, N. (2017). Effect of processing Lamtoro leaf (*Leucaena leucocephala*) as feed on rex rabbit carcass. *Journal of Integrative Animal Husbandry*, 5(3). <https://doi.org/10.21776/ub.jpi.2017.005.03>
- [9] Honda, M. D. H., & Borthakur, D. (2019). Mimosine concentration in *Leucaena leucocephala* under various environmental conditions. *Tropical Grasslands*, 7(2), 164–172. [https://doi.org/10.17138/tgft\(7\)164-172](https://doi.org/10.17138/tgft(7)164-172)
- [10] Jiang, X., Liu, X., Xu, H., Sun, Y., Zhang, Y., & Wang, Y. (2021). Improvement of the nutritional, antioxidant and bioavailability properties of corn gluten-wheat bran mixture fermented with lactic acid bacteria and acid protease. *LWT*, 144, 111161. <https://doi.org/10.1016/j.lwt.2021.111161>

- [11] Khamseekhiew B, Jansuk J, Puddang S, Nakavirot P, & Pimpa O. (2022). Effect of turmeric (*Curcuma longa* Linn.) powder supplements in diet on milk yield of lactating goats. *Khon Kaen Agriculture Journal (Supplement)*, 1, 284-291.
- [12] Knez, E., Kadac-Czapska, K., & Grembecka, M. (2023). Effect of Fermentation on the Nutritional Quality of the Selected Vegetables and Legumes and Their Health Effects. *Life (Basel)*, 13(3), 655. 10.3390/life13030655
- [13] Kung, L. R. D., Shaver, R. J., Grant, R. J., & Schmidt (2018). Silage review: Interpretation of chemical, microbial, and organoleptic components of silages. *Journal of Dairy Science*, 101 (5), 4020-4033. <https://doi.org/10.3168/jds.2017-13507>
- [14] Li, Y., Niu, L., Guo, Q., Shi, L., Deng, X., Liu, X., & Xiao, C. (2022). Effects of fermentation with lactic bacteria on the structural characteristics and physicochemical and functional properties of soluble dietary fiber from proso millet bran. *LWT*, 154, 112609. <https://doi.org/10.1016/j.lwt.2021.112609>
- [15] Mokoboki, H. K., Sebola, A. N., Ravhuhali, K. E., & Nhlane, L. (2019). Chemical composition, in vitro ruminal dry matter degradability, and dry matter intake of some selected browse plants. *Journal of Food and Agriculture*, 5, 1587811. <https://doi.org/10.3389/fnut.2019.1587811>
- [16] Montoya-Flores. M. D., Botero. I. C., Sigh. J., Romano-Muñoz. J. L., Solorio-Sanchez. F. J., and Aguilar-Perez. C. F., and Ku-Vera. J. C. (2020). Effect of dried leaves of *Leucaena leucocephala* on rumen fermentation. Rumen microbial population, and enteric methane production in crossbred heifers. *Animals*. 10(2). 300. Rabbits and Rodents: Clinical Medicine and Surgery. 4th Edition. 174–187. doi: 10.1016/B978-0-323-48435-0.00014-9.
- [17] Nulik, J., Dahlanuddin, Hau, D. K., Pakereng, C., Edison, R. G., Liubana, D., Ara, S. P., & Giles, H. E. (2013). Establishment of *Leucaena leucocephala* cv. Tarramba in eastern Indonesia. Proceedings of the 22nd International Grassland Congress.
- [18] Oyun, M. B. (2006). Chemical characterization of selected tree legumes as indices for their litter quality. *Journal of Applied Sciences*, 6(10), 2321–2324. <https://doi.org/10.3923/jas.2006.2321.2324>
- [19] Raju, S., Nagalakshmi, D., Kumari, N. N., & Sravanthi, B. (2025). Nutritional Characterisation of *Leucaena Leucocephala* Leaves: Insights for Sustainable Ruminant Production. *Journal of Experimental Agriculture International*, 47(6), 274-80. <https://doi.org/10.9734/jeai/2025/v47i63487>.
- [20] Sakhawat, I. (2011). The effect of silage quality on gross energy losses. Swedish University of Agricultural Sciences.
- [21] Shahidi, F., & Oh, W. Y. (2020). Lipid-derived flavor and off-flavor of traditional and functional foods: an overview. *Journal of Food Bioactives*, 10.
- [22] Thamaga, M., & Mokoboki, T. (2021). Apparent digestibility and nutritional composition of *Leucaena*. *Tropical Animal Health and Production*, 53, 458. <https://doi.org/10.1007/s11250-021-02668-2>
- [23] Wan-Mohd-Nazri, W. A. R., Johari, N. A. N., Sarmin, S. N., Yunus, N. Y. M., Japarudin, Y., Mahmud, J., & Khairuddin, M. N. (2020). *Leucaena leucocephala*: A fast-growing tree for the Malaysian particleboard industry. *BioResources*, 15(4), 7433–7442. <https://doi.org/10.15376/biores.15.4.7433-7442>
- [24] Wang, S. (2025). Silage preparation, processing and efficient utilization. *Agriculture*, 15(2), 128. <https://doi.org/10.3390/agriculture15020128>
- [25] Wang, Y., Wang, H., Wu, Y., Xiang, H., Zhao, Y., Chen, S., Qi, B., & Li, L. (2022). Insights into lipid oxidation and free fatty acid profiles to the development of volatile organic compounds in traditional fermented golden pomfret based on multivariate analysis. *LWT*, 171, 114112. <https://doi.org/10.1016/j.lwt.2022.114112>
- [26] Zhao, G., Wu, H., Li, Y., Huang, Z., He, J., & Xie, X. (2025). Ensiling characteristics, in vitro digestibility and bacterial community structure of mulberry leaf silage with or without the addition of cellulase, protease, and starch. *Frontiers in Plant Science*, 16, 1517529.