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Original Article

Influence of Consolidation Settlement to the Bearing Capacity of Shallow Foundation in Over-consolidated Organic Soil

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Abstract - *The construction of shallow foundations on soft and over-consolidated organic soil may be challenging. The difficulty arises from the shear strength of the soil, its compressibility, and the ability of the soil to settle. The aspect of soil consolidation is also crucial in the long run. This is because it is associated with soil strengthening and improvement in the bearing capacity of the foundation. This study evaluates the effects of consolidation settlement on the bearing capacity of strip shallow foundations on over-consolidated organic soil through a series of FEM-based calculations in PLAXIS 2D. In this calculation, two factors are considered. The factors include the width of the strip foundation, ranging from 0.5 m to 3.0 m, and the thickness of the over-consolidated organic soil, ranging from 2 m to 12 m. To gain insight into how consolidation can affect the soil behavior during settlement, the calculation was done using a time-dependent loading condition. The results have emphasized that the increase in bearing capacity due to consolidation occurs to a large extent in the first 1000 to 1500 days. For all the test results, wider foundations performed with a higher bearing capacity. The results have emphasized that for high organic soil conditions, higher organic soil thickness resulted in less performance in the initial stages but contributed more to the advancements in strength. These observations emphasize the need for proper consideration of both the time involved for soil consolidation, the dimensions of the foundations, and the soil thickness in designing a shallow foundation.*

Keywords - *Consolidation, Bearing Capacity, Shallow Foundation, Over-Consolidated Organic Soil, Finite Element Analysis.*

1. Introduction

Building on soft organic soils presents significant geotechnical challenges due to their low shear strength, high compressibility, and susceptibility to long-term settlement. These characteristics typically result in differential settlement and inadequate load-bearing performance in shallow foundations. Problematic soils are often met in coastal, deltaic, and lowland areas, where structural integrity is at risk without proper design strategies or ground improvement measures [1–4]. Organic soils are by far the weakest of such soils due to their high content of organic matter that comes from highly decomposed plant and animal materials [5–8].

Organic soils normally have high water content, low bulk density, and high compressibility. Consolidation, defined as time-dependent volume reduction resulting from the dissipation of pore water under sustained loads, is a dominant process that improves shear strength and reduces the deformability of soil with time [9–11]. The time-dependent consolidation behavior of organic soils must, therefore, be understood to properly predict the long-term performance of shallow foundations.

The research evidence produced so far indicates that consolidation is indeed a crucial factor in improving the bearing capacity of shallow foundations. Analytical formulations taking into account the effect of consolidation were presented by Zhu et al. [16], while Elsawy and Ismail [17] provided examples of time-dependent increases in load-carrying capacity. Taylor and Oort [18] identified advantages of preloading, whereas Suzuki and Yasuhara [19] studied the consolidation rate dependence of undrained shear strength.

Unfortunately, in spite of such notable contributions, most studies available to date remain predominantly theoretical or based on small-scale tests conducted in a laboratory. Numerical modelling studies assessing shallow foundations supported by over-consolidated organic soils subjected to realistic, time-dependent loading conditions clearly represent a gaping hole in the available literature. Further, few comparative studies have been conducted into the relative influence of varying foundation width and thickness of organic soil layers on the consolidation-enhanced bearing capacity. Recent studies, such as Nguyen [10] and Hashim et al. [7], confirm once again that organic soil consolidation continues to form a relevant domain of research within the current context of infrastructure resilience and optimization of construction.

The current study attempts to fill these gaps by using FEM-based simulations to investigate the impact of primary consolidation settlement on the bearing capacity of shallow foundations resting on over-consolidated organic soils. The width of the foundation and the thickness of the organic soil layer are systematically varied to investigate their coupled effects on time-dependent soil behaviour and foundation performance. The results further enhance theoretical insight and provide practical guidelines for foundation design in compressible soil conditions, especially for cases where ground improvement is not feasible or not economically viable.

In consideration of the above aim, research questions that this study follows include: (i) How does primary consolidation settlement impact the ultimate bearing capacity of shallow foundations lying over over-consolidated organic soils? (ii) What degree of variation in foundation width imparts changes to consolidation-driven gains in load-carrying capability? (iii) To what extent does the depth of the organic soil layer impact the rate and magnitude of consolidation and, therefore, directly impact the bearing capacity of the foundation? These lead to the hypothesis that larger foundation widths and deeper organic soil layers are associated with measurable changes in consolidation behavior, thus substantially impacting the time-dependent increase in bearing capacity for shallow foundations on organic soils.

The originality in this research is found in the combination of the parametric study on time-dependent consolidation, geometry of the foundation, and the thickness of the organic soil layer in a real loading scenario using the software PLAXIS 2D.

Contrary to recent FEM studies that have generally focused on any of the following: (i) short-term bearing capacity without taking into consideration the time-dependent consolidation, (ii) settlement without relating to the strength development, or (iii) influence of foundation or soil thickness independently, this study brings all parameters together in one study.

The novelty of this study explicitly quantifies for the first time exactly how consolidation-driven strength gain evolves over time and interacts with the dimensions of the foundation, providing a degree of coupled insight that has not been fully addressed in previous works. This integrated approach enables the identification of optimum foundation configurations for over-consolidated organic soils more clearly and underlines possible cost-saving opportunities by allowing design decisions to be commensurate with soil behaviour over varying consolidation stages.

2. Literature Review

Consolidation is the time-dependent process of dissipation of excess pore water pressure in saturated clay due to the application of external loads [22]. When a shallow foundation is placed on cohesive soil, the initial response of the soil is undrained, with an immediate increase in pore water pressure and corresponding decrease in effective stress, and the soil exhibits its lowest undrained shear strength.

However, with time, the dissipation of the excess pore water pressure leads to an increase in the effective vertical stress (σ_v'), which in turn results in an increase in the compaction of the soil, leading to an increase in the effective vertical stress (σ_v'), which will eventually lead to an increase in the settlement of the soil, resulting in the development of an undrained shear strength (s_u), which is required for the functionality of shallow foundations. [23, 24].

The relationship between consolidation and strength gain has been explained through the theoretical framework of Mesri [25]. Undrained shear strength for normally consolidated clay at any stage can be given as

$$s_u = m.\sigma_v' \tag{1}$$

where m is an empirical strength ratio typically ranging from 0.20 to 0.30 [25]. Thus, the increase in undrained shear strength due to consolidation is

$$\Delta s_u = m.U.\Delta\sigma_v' = m.U.\left(\sigma_{v,final}' - \sigma_{v,initial}'\right) \tag{2}$$

showing that the increase of shear strength is proportional to both the degree of consolidation U and the change of effective stress.

For overconsolidated clays, further, Mesri and Ali (1999) showed that the undrained shear strength is dictated by a combined effect of the current effective stress and the soil's stress history, represented by the Overconsolidation Ratio (OCR) [26]. Their well-accepted empirical relationship is

$$s_u = m.\sigma_v'.OCR^n \tag{3}$$

where n is usually in the range from 0.7 to 1.0. Since OCR is defined as OCR = σ_p'/σ_v', where σ_p' is the preconsolidation stress, the increase in effective stress during consolidation tends to increase OCR and thus causes progressive strength gain.

The strengthening effect is due to primary consolidation caused by the dissipation of excess pore pressure, as well as secondary consolidation involving creep and microstructural realignment.

In line with the consolidation progresses, the soil becomes increasingly overconsolidated compared with the in situ state and thus experiences further gain in strength.

These changes in undrained shear strength induced by consolidation have direct implications for the bearing capacity of shallow foundations. The classic Terzaghi bearing capacity equation for a strip footing on clay [22, 27] is

$$q_{ult} = c_u N_c + \gamma D_f \tag{4}$$

Because the bearing capacity in saturated cohesive soils is dominated by cuNc, any increase in undrained shear strength caused by consolidation directly increases the ultimate bearing capacity. Substituting Mesri's strength-stress relationship into the bearing capacity equation yields a time-dependent expression.

$$q_{ult}(t) = N_c . m . \sigma_v'(t) + \gamma . D_f \tag{5}$$

and for overconsolidated clays,

$$q_{ult}(t) = N_c . m . \sigma_v'(t) . OCR(t)^n + \gamma . D_f \tag{6}$$

These formulations make it clear that the bearing capacity of a shallow foundation resting on clay does not remain constant; instead, it increases with time, in accordance with the degree of consolidation, increase in effective stress, and improvement in shear strength. This is particularly important for structures located on soft or lightly overconsolidated clays, where the initial resistance to bearing may be low but long-term performance significantly improves owing to strength gain from consolidation.

Appreciation of this time-dependent relationship between consolidation, gain in strength, and bearing capacity is crucial for a reliable design of foundations, prediction of settlement, and long-term stability of the structures founded on cohesive soils.

3. Methodology

As seen in Figure 1, the numerical model included a shallow strip foundation on top of an organic soil layer. In order to simulate typical operating conditions, the foundation is modeled as an elastic material subjected to a service load of 10 kN/m² [28]. The foundation width was varied to assess its effect on the bearing capacity.

The subsoil consists of overconsolidated organic clay with properties such as low shear strength, high compressibility, and significant consolidation behaviour. Soil parameters such as the Compression Index, Shear Strength, and Consolidation Coefficients were determined from standard laboratory and field data (summarized in Table 1) [20, 21]. The Over-Consolidation Ratio (OCR) was included to consider in affecting the settlement and gain in strength.

These parameters, i.e., Compression index (Cc), Swelling index (Cs), and consolidation coefficients (cv), were obtained from a consolidation test using an oedometer apparatus, while undrained shear strength (c_u) is obtained from Unconsolidated-Undrained (UU) triaxial tests. The initial effective stress and the Overconsolidation Ratio (OCR) of soil were derived from the stress history reconstruction by using laboratory consolidation curves.

The parameters used in the numerical model were confirmed through multi-stage calibration and validation. First, compressibility parameters (Cc, Cs) were calibrated by matching measured oedometer settlement curves to the theoretical response predicted by the model. Adopted values provided a high degree of agreement with laboratory strain-log stress plots, confirming the accurate representation of primary and secondary compression behaviour. Strength parameters (c′,ϕ′) and the OCR were validated against measured shear strength profiles and further cross-checked using Mesri's empirical correlations for overconsolidated organic clays. Bulk unit weights and initial void ratios were verified by comparing them with in situ conditions and typical ranges for organic clay deposits of similar geological origin.

The final suite of calibrated parameters adopted for numerical modelling is summarized in Table 1. These parameters were chosen since they yielded simulated settlement and shear strength responses that closely approximated observed laboratory behaviour and were within the published ranges for overconsolidated organic clays. The validation stage indicated that the numerical model successfully simulated both the deformation pattern and stress-strain characteristics anticipated for this soil type, hence confirming the suitability of the adopted parameters for the subsequent bearing capacity and consolidation analyses.

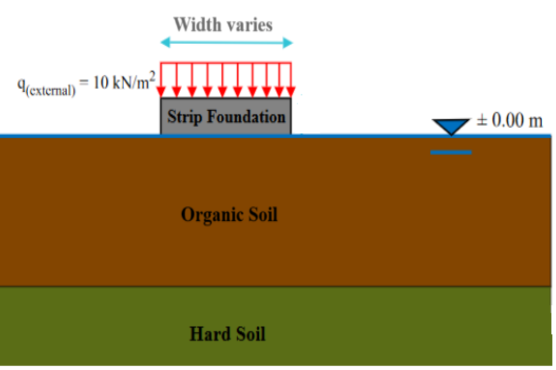

Fig. 1 Cross-section of analysis model

A parametric study was conducted to investigate the behavior of shallow foundations on over-consolidated organic soils. Some key factors that are known to influence consolidation settlement and bearing capacity were varied in the analysis, i.e., foundation width, thickness of the organic soil layer, and period of consolidation. The variables studied are chosen to properly represent realistic field conditions and their impact on the performance of foundations resting on soft soils.

Table 1. The properties of over-consolidated organic soil

Properties	Value
Unsaturated unit weight (γ_{unsat}) – kN/m^3	10.44
Saturated unit weight (γ_{sat}) – kN/m^3	12.00
Initial void ratio (e_0)	9.70
Cohesion (c') – kN/m^2	5.33
Internal friction angle (φ') – deg	10.00
Compressibility index (Cc)	4.71
Swelling index (Cs)	0.94
Over-Consolidated Ratio (OCR)	7.80

The stress–strain response of the soil under loading was simulated, including both elastic and plastic behaviours, using PLAXIS 2D [28]. The consolidation phase was modelled by using time-dependent analysis to determine the settlement and the increase in shear strength. The main results obtained are as follows.

- Settlement profiles: Vertical displacement at different time steps beneath the foundation area.
- Bearing capacity: by calculation of the safety factor ΣMsf.
- Time-dependent behavior: Assessing the effect of different consolidation periods on soil strength and settlement.
- Influence of foundation width: Geometric considerations for performance variation

Also, the important limitations of the model concern the exclusion of secondary compression and possible variability in organic soil heterogeneity, which could play an important role in real situations. Large-scale field phenomena, such as creep or microstructure changes or biochemical degradation, were not modeled explicitly.

The bearing capacity in this research was quantified within the framework of PLAXIS using the strength reduction method. This approach involves the systematic reduction in the shear strength parameters, that is, the internal friction angle and cohesion, and tensile strength, until failure occurs. Thereafter, the FoS would be evaluated as a ratio of the values of original and reduced parameters at the point where failure occurs. In this paper, the bearing capacity is quantified by calculating the safety factor, ΣMsf, through the strength reduction method, which progressively reduces the shear strength parameters (internal friction angle, cohesion, and tensile strength) of the soil until it fails. The safety factor is defined as follows.

$$\sum M_{sf} = \frac{tan(\phi_{input})}{tan(\phi_{output})} = \frac{c_{input}}{c_{input}} = \frac{tensile\ strength_{input}}{tensile\ strength_{output}} \quad (7)$$

The calculated factor of safety can be highly sensitive to the input parameters, especially the soil's shear strength parameters. Small variations in these parameters can lead to significant changes in the calculated factor of safety [28].

4. Results and Discussion

This section describes the results of the numerical simulations and analyzes the influence that two main parameters, related to subsoil thickness and foundation width, have on the time-dependent bearing capacity of shallow foundations resting on over-consolidated organic soils.

The analyses improve the presently existing understanding of ground stability, in terms of the coupled effects of soft-soil behavior and foundation geometry, thus complementing the existing literature.

Figures 2–7 show the development of bearing capacity with time for foundation widths from 0.5 m to 3.0 m and organic soil thicknesses from 2 m to 12 m. For all the configurations, there is a distinctive early-stage bearing capacity increase within the first 1,000-1,500 days, resulting from the rapid dissipation of excess pore water pressure and the concomitant increase in effective stress as described by Terzaghi's consolidation theory [22].

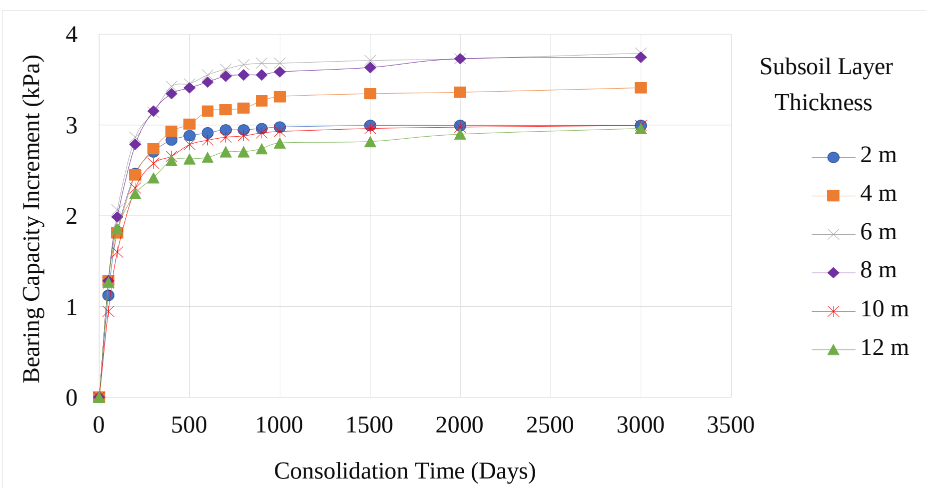

Fig. 2 Bearing capacity increment of the 0.5m foundation width under varying subsoil layer thicknesses

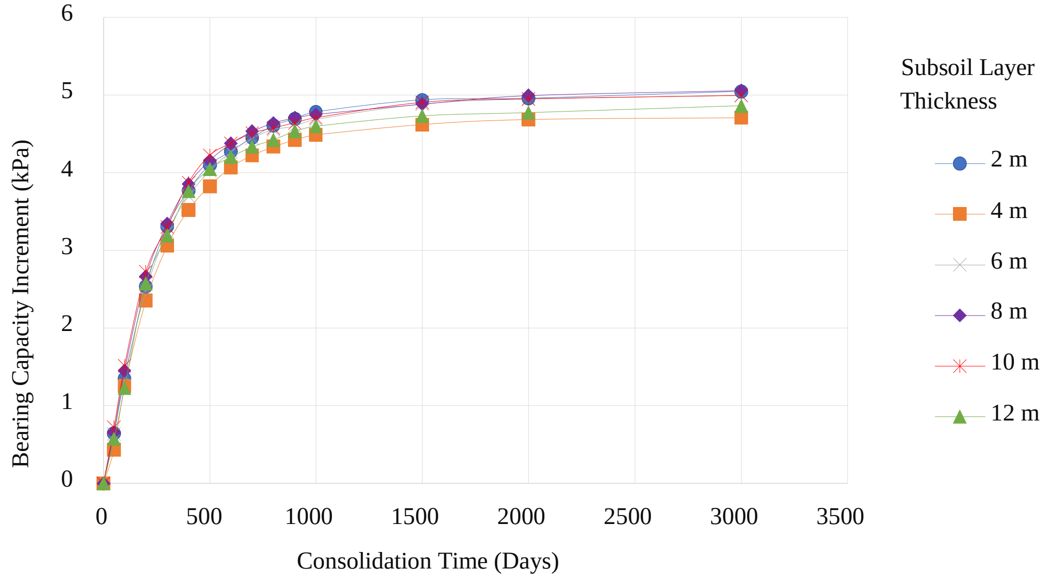

Fig. 3 Bearing capacity increment of 1m foundation width under varying subsoil layer thicknesses

Although the above-mentioned trend is in agreement with previously reported consolidation behavior, the finer temporal and spatial resolution of the finite element modelling in this paper provides a better approximation of both the rate and magnitude of strength gain than those obtained from analytical or semi-empirical studies.

The results have consistently indicated a rapid rise in bearing capacity followed by gradual stabilization, reinforcing the idea that the early consolidation phase has the majority of strength development. A clear dependence on subsoil thickness is also evident, where the thicker organic layers result in lower capacity improvements in their early stages because of longer drainage paths and reduced stiffness. On the other hand, wider foundations (e.g., 3.0 m, Figure 6) systematically yield higher values of bearing capacity compared to narrower ones (e.g., 0.5 m, Figure 2) owing to their larger distribution of stresses and deeper mobilization of consolidation effects. All these findings are in broad agreement with Nguyen [10], though the present study gives an explicit quantification of geometrical influence across a wider range of soil thicknesses.

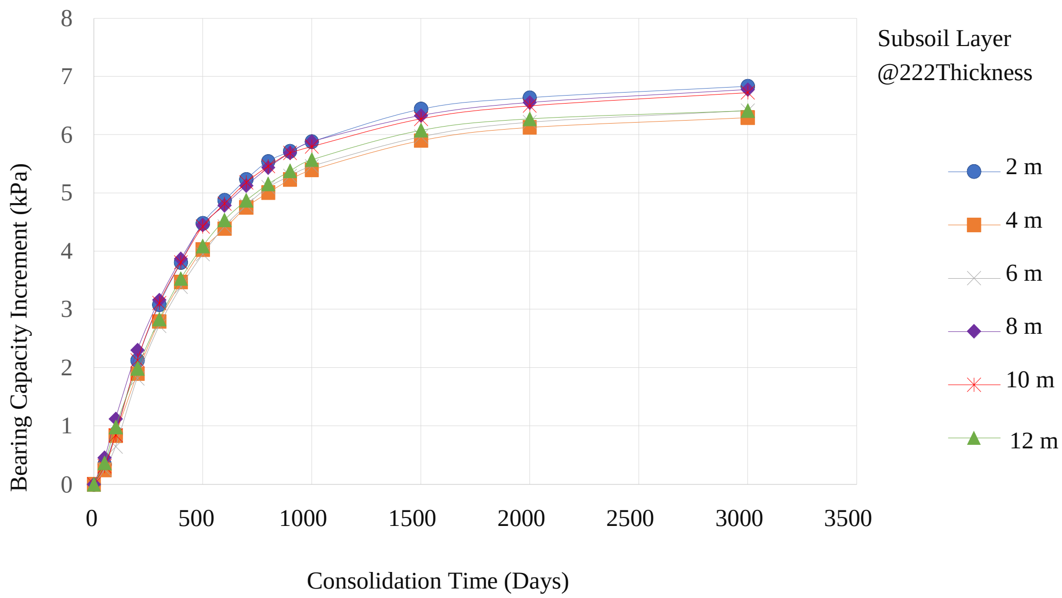

Fig. 4 Bearing capacity increment of 1.5m foundation width under varying subsoil layer thicknesses

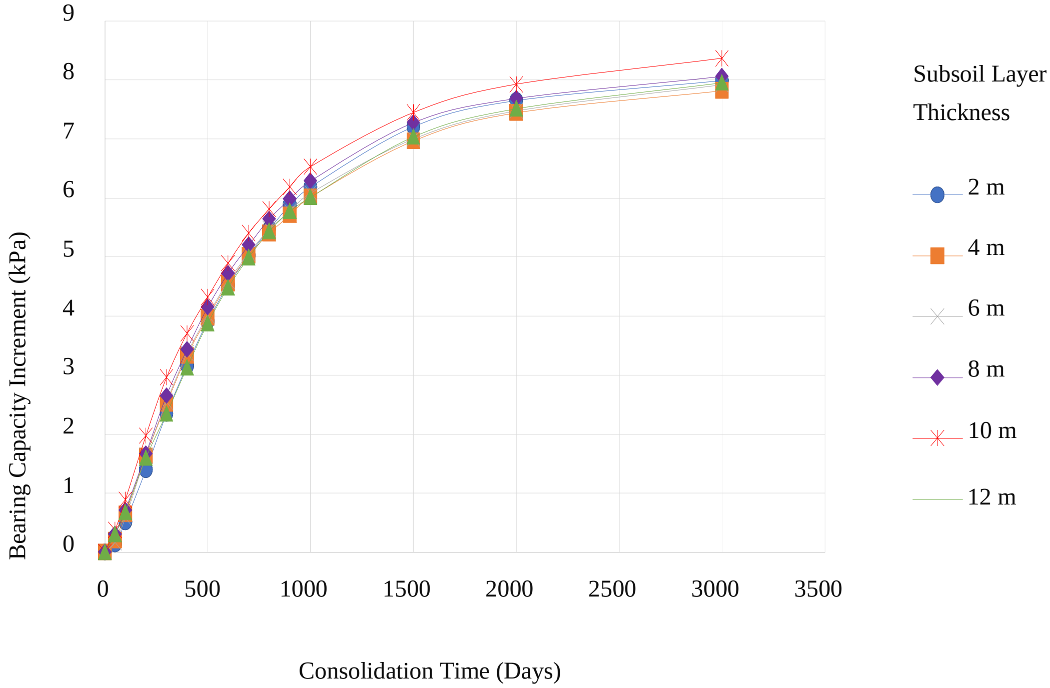

Fig. 5 Bearing capacity increment of 2m foundation width under varying subsoil layer thicknesses

Figures 8–13 further present a comparison of the performance of different widths of foundation for organic layer thicknesses ranging from 2 m to 12 m. The simulations all confirm an early-stage steep rise in bearing capacity, followed by stabilization at around 1,000–1,500 days.

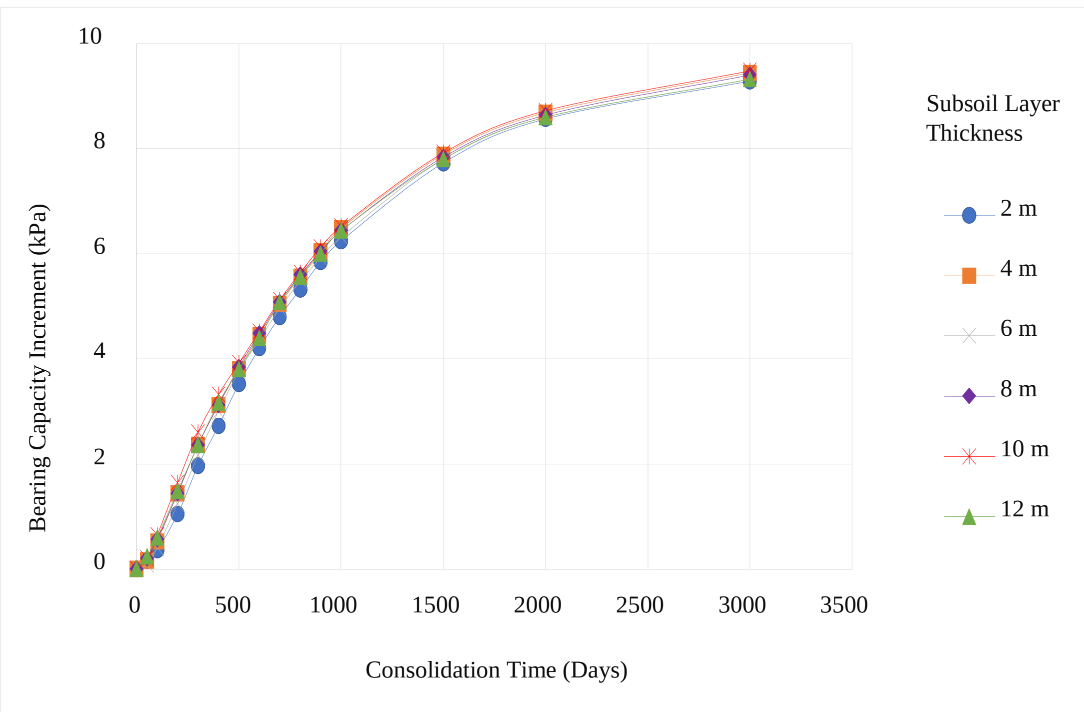

Fig. 6 Bearing capacity increment of the 2.5m foundation width under varying subsoil layer thicknesses

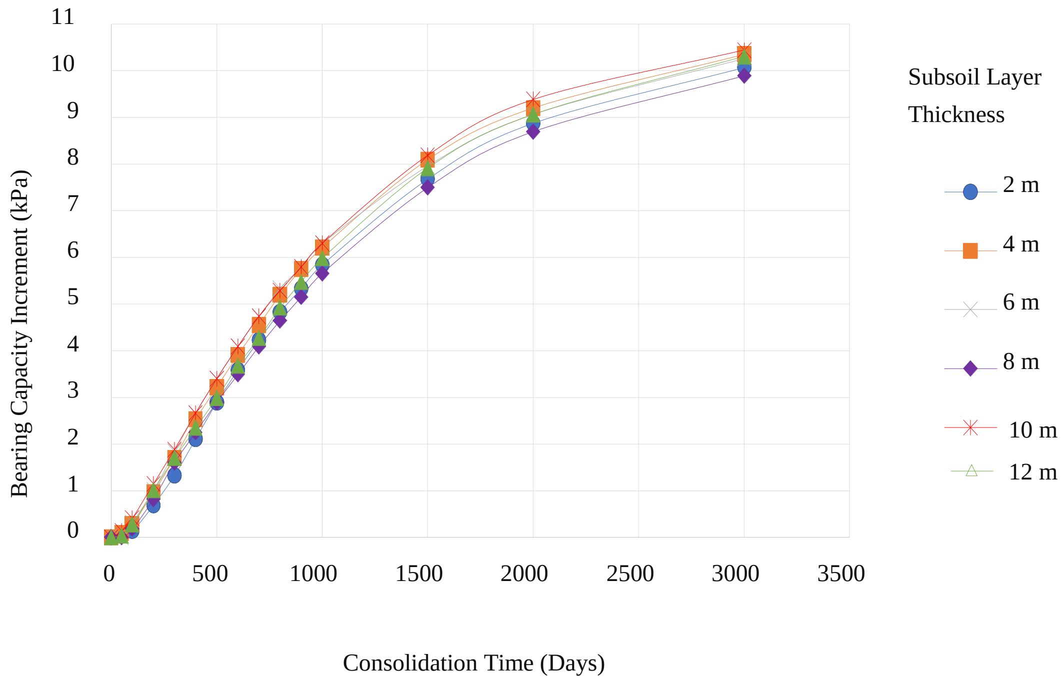

Fig. 7 Bearing capacity increment of the 3m foundation width under varying subsoil layer thicknesses

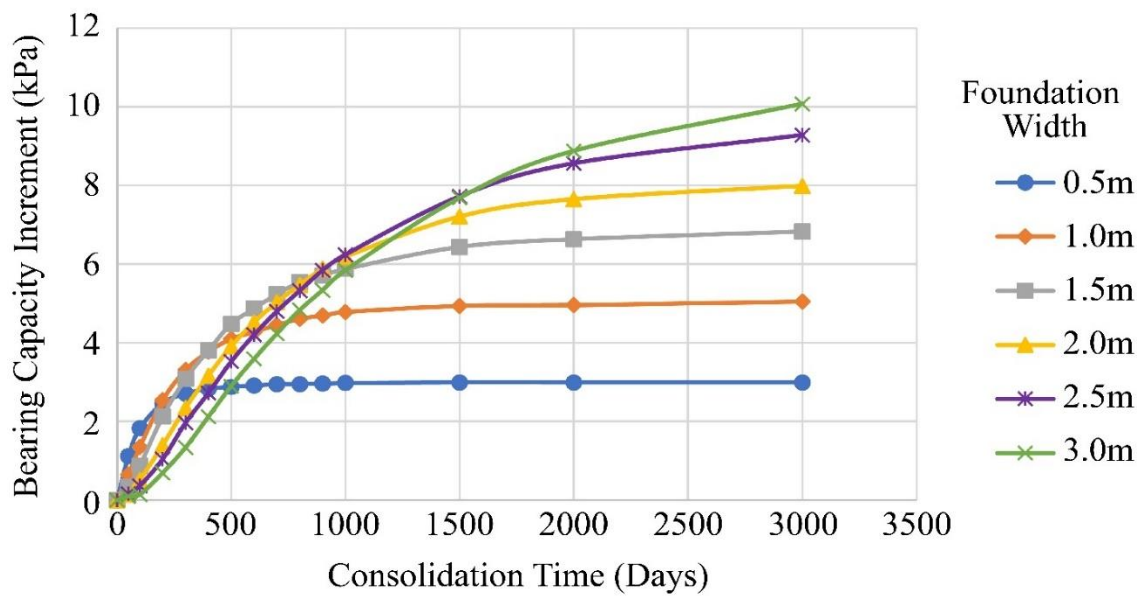

Fig. 8 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 2 m

Although this trend is consistent with observations made by Elsawy and Ismail [17], the results obtained herein show that the time and degree of stabilization depend systematically on both the width of the foundation and the thickness of the soil—issues not adequately explored in earlier studies. That the finite element framework is able to track pore pressure dissipation, stress redistribution, and progressive settlement simultaneously explains why the present results reflect more differentiated and, in many instances, higher long-term capacity values than those predicted by traditional analytical methods.

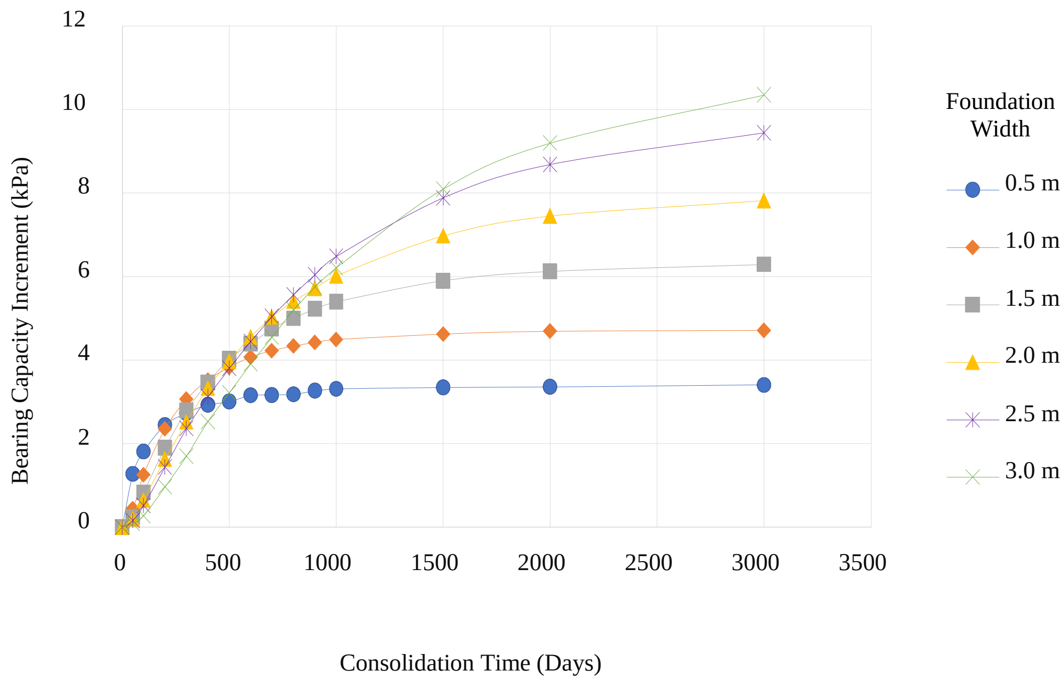

Fig. 9 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 4 m

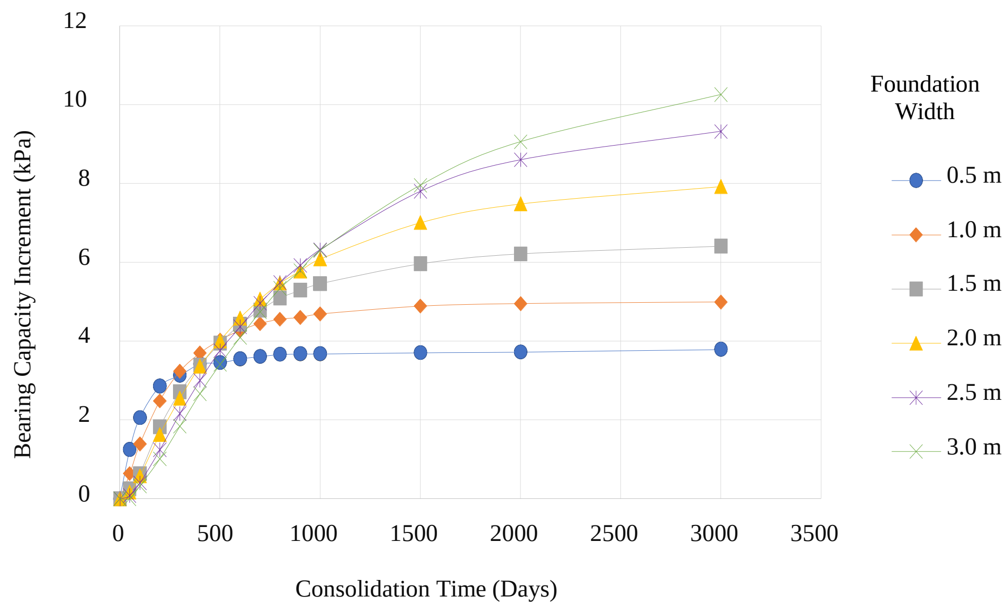

Fig. 10 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 6 m

A trend can be clearly seen regarding the width of the foundations; the wider the foundation, the higher the bearing capacity, irrespective of the thickness of the soil. This is because wider footings provide a wider distribution of stress and a greater contact area, allowing a more effective consolidation response along with better mobilisation of shear strength in the underlying soil. Additionally, thicker organic soil layers (e.g., 12 m in Figure 13) exhibited higher absolute bearing capacity values over time than thinner layers (e.g., 2m in Figure 8), likely because of the increased volume of soil undergoing consolidation and the potential for deeper stress penetration. These results emphasise the importance of foundation geometry in enhancing consolidation-driven strength improvement in soft organic soil.

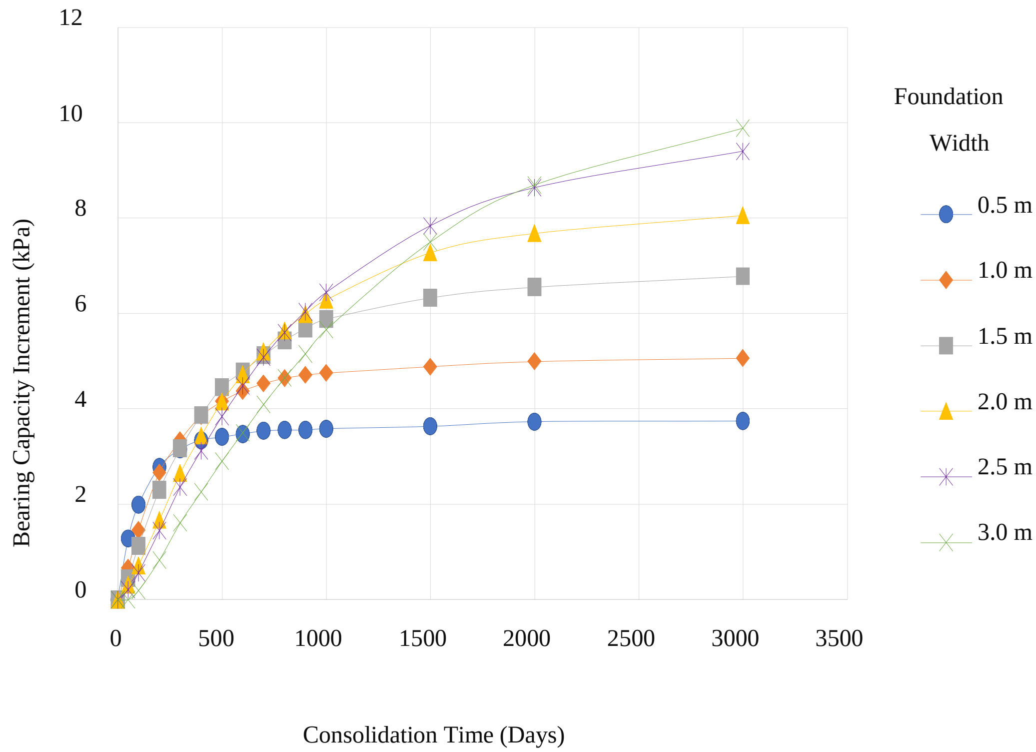

Fig. 11 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 8 m

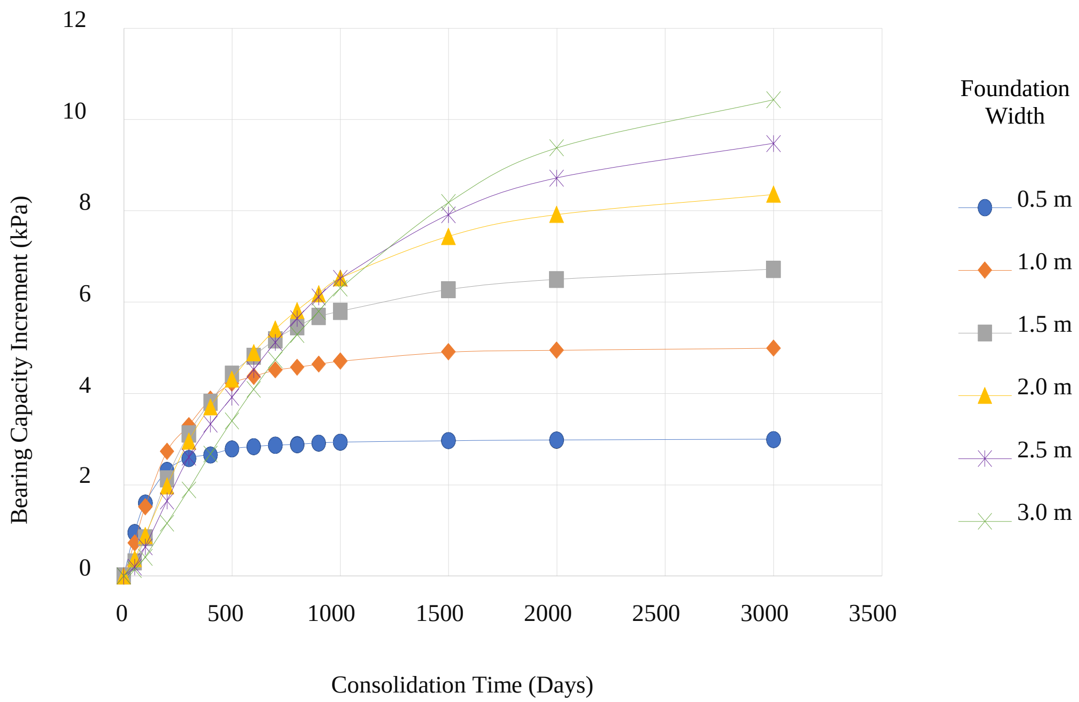

Fig. 12 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 10 m

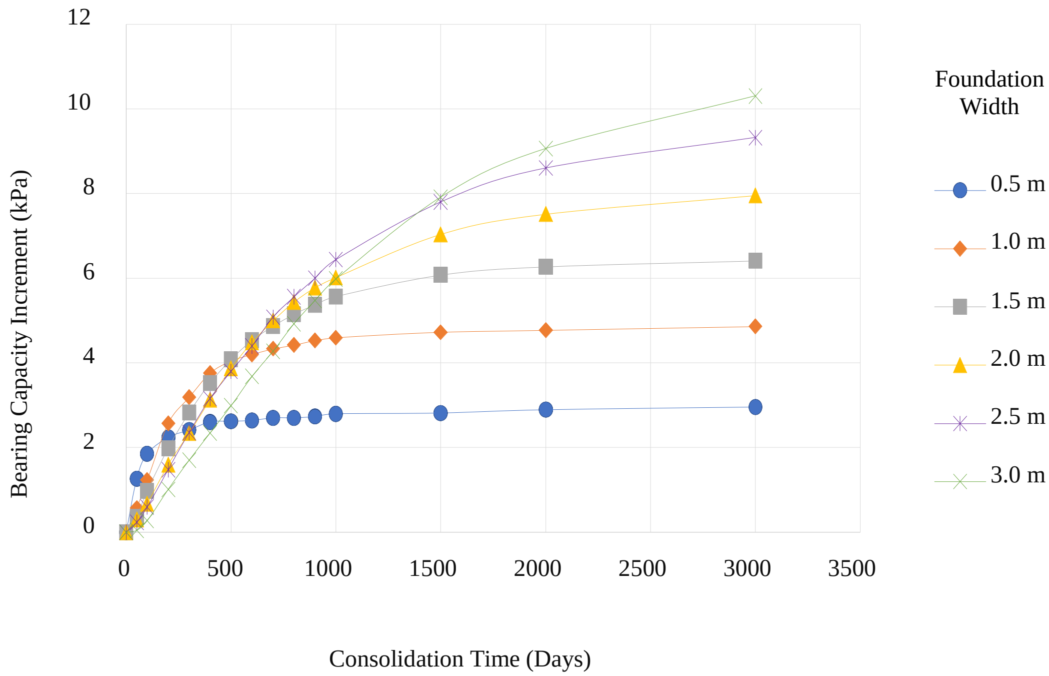

Fig. 13 Bearing capacity increment for different foundation widths under a subsoil layer thickness of 12 m

The results of this study indicate crucial interdependencies in the thickness of subsoil, the width of the foundation, and the consolidation behavior of over-consolidated organic soils. Both of these parameters, independently and in combination, had a significant influence on time-dependent bearing capacity development.

The basic analysis of the obtained results confirms that consolidation is the main mechanism that provides strength gains in soft soils. In detail, the high-increasing rate in bearing capacity at early stages of consolidation reflects excess pore water pressure dissipation according to classical Terzaghi's consolidation theory [22]. However, during subsequent consolidation, the rate of gain in strength diminishes. Hence, when designing foundations in soft soil regions, the duration of consolidation has to be taken into account. In relation to subsoil thickness, thicker organic layers in general would provide lower bearing capacities at early times due to longer drainage paths, with higher compressibility. With time increasing, however, larger settlements and more extensive load redistribution are allowed by the greater volume of compressible soil, leading to higher total gains in strength for these layers under long-term conditions. This condition makes it necessary to have extended consolidation periods and preloading strategies when developing deep organic deposits.

However, with increasing foundation width, the bearing capacities were consistently higher. Wider footings dissipate loads more effectively and develop deeper zones of stress, hence increasing the consolidation effect within a wider zone of soil mass. This would particularly be applicable for structures resting on soft soils, indicating that, where possible, increasing the width of the foundation would lead to better load-carrying capacity rather than relying on improving the ground. The interaction of the combined effects of wider foundations and increased thickness of soil layers presents a complicated picture. Though the overall performance of wider foundations was superior, their effectiveness was somewhat reduced as the thickness of the soil increased beyond an optimum value due to the retardation in the consolidation response. This indicates an optimum range of foundation width in relation to the depth of the soft soil, which could guide the selection of efficient and economical dimensions of the foundation for a particular profile of soil.

These results emphasize that consolidation behaviour and time-dependent soil response should be incorporated into foundation design from the outset. If consolidation effects are ignored, conventional calculations of bearing capacity may substantially underestimate the capacity of soft soils over the long term. Simulations using the finite element method, of the type used in this paper, form a very useful approach to investigate these complex interactions and improve the predictive accuracy of foundation performance in organic soil environments. Whereas classical consolidation theory identifies the dominant mechanisms responsible for strength gain, the present study goes beyond traditional approaches by embedding these mechanisms within a fully coupled finite element framework. This provides a more robust and realistic prediction of long-term foundation performance than that possible from state-of-the-art analytical formulations.

5. Conclusion

In this paper, a finite element simulation using PLAXIS 2D was conducted to model the effects of consolidation settlement on the bearing capacity of shallow strip foundations resting on over-consolidated organic soils. A parametric study was conducted by changing the width of the foundation from 0.5 m to 3.0 m and the thickness of the organic soil layer from 2 m to 12 m under a typical service load of 10 kPa.

The results of the simulation indicated that a significant increase in bearing capacity was recorded within the early duration of consolidation, up to 1,000 to 1,500 days. This is attributed to early and rapid dissipation of excess pore water pressure, which results in increased effective stresses and, consequently, shear strength. Strength gain clearly reduces with time; hence, consolidation time must be factored into foundation design for organic soils.

The presence of the thicker layers of organic materials resulted in reduced consolidation rates and shorter-term bearing capacities, yet their long-term improvements were enhanced. The results further indicated that an increase in the foundation width led to an enhancement in the bearing capacity in all situations, owing to improved load distribution and stress transfer, yet their improvements were reduced as the soil thickness increased. The implication is that, although an increase in foundation width is advantageous, a consideration of the depth of the soil strata and the consolidation time is important.

This paper verifies the dominance of the consolidation process in the strength increase in soft organic soils, as it emphasizes the complexity of the geometric, soil, and time-related interactions. It is significant to note that the paper sheds light on the optimum geometric design for foundations and the optimal stages for construction in soft soil areas, while some restrictions need to be highlighted. The analytical representation neglects the secondary compression, the soil creep, the homogeneous spatial variability of the soil, and the chemical/biological degradation processes.

The assumption of perfect foundation-soil contact and vertical drainage is also an oversimplification from real field conditions. Therefore, these effects should be considered in future studies, and the results need to be validated against field or laboratory data to enhance predictive reliability.

In general, this research develops further insight into time-dependent foundation behavior in over-consolidated organic soils and provides valuable guidance in the design of shallow foundations that are economical, safer, and more reliable under unfavorable ground conditions.

For future research, some aspects may be considered, such as

- Numerical predictions are validated against field monitoring data or large-scale laboratory tests, with a main focus on the dissipation of pore pressure and development of time-dependent shear strength.
- Effects of biodegradation or chemical decomposition of organic matter on long-term stiffness and strength loss.
- A combination of foundation width and depth, with preloading or improvement strategies for organic soil profiles of different types.

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Authors Contribution

AS prepared the manuscript and reviewed the analysis results, IGM prepared and reviewed the manuscript, RS reviewed the manuscript, and MD performed the analysis.

Data Availability

https://zenodo.org/records/15037928

References

[1] Ernesto Cascone, and Orazio Casablanca, “Static and Seismic Bearing Capacity of Shallow Strip Footings,” *Soil Dynamics and Earthquake Engineering*, vol. 84, pp. 204-223, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[2] Xiao-Li Yang, and Dian-Chun Du, “Upper Bound Analysis for Bearing Capacity of Nonhomogeneous and Anisotropic Clay Foundation,” *KSCE Journal of Civil Engineering*, vol. 20, no. 7, pp. 2702-2710, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[3] M.W. Bo, V. Choa, and K.S. Wong, “Reclamation and Soil Improvement on Ultra-Soft Soil,” *Proceedings of the Institution of Civil Engineers - Ground Improvement*, vol. 9. no. 1, pp. 23-31, 2005. [CrossRef] [Google Scholar] [Publisher Link]

[4] Jean Frank Wagner, *Chapter 9 - Mechanical Properties of Clays and Clay Minerals*, Developments in Clay Science, vol. 5, pp. 347-381, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[5] Pao-Tsung Huang et al., "*Classification of Organic Soils*," Technical Reports, Publication FHWA/IN/JTRP-2008/02, Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2009. [CrossRef] [Google Scholar] [Publisher Link]

[6] Joonho Hwang et al., "*Stabilization and Improvement of Organic Soils*," Publication FHWA/IN/JTRP-2004/38, Joint Transportation Research Program Technical Reports, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2005. [CrossRef] [Google Scholar] [Publisher Link]

[7] Sarah Hashim Mohammed, Khitam Abdulhussein Saeed, and Hasan Ibrahim Al Shaikhli, "Evaluation of the Strength and Microstructural Characteristics of Stabilized Organic Clay Soil," *Case Studies in Chemical and Environmental Engineering*, vol. 9, pp. 1-6, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[8] Hanifi Canakci, Waleed Sidik, and Ibrahim Halil Kilic, "Effect of Bacterial Calcium Carbonate Precipitation on Compressibility and Shear Strength of Organic Soil," *Soils and Foundations*, vol. 55, no. 5, pp. 1211-1221, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[9] Kamal Mohamed Hafez Ismail Ibrahim, "Bearing Capacity of Circular Footing Resting on Granular Soil Overlying Soft Clay," *HBRC Journal*, vol. 12, no. 1, pp. 71-77, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[10] Ngoc Thang Nguyen, "Long-Term Settlement Prediction for Over-Consolidated Soft Clay under Low Embankment," *Engineering, Technology and Applied Science Research*, vol. 14, no. 6, pp. 18592-18599, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[11] K. Been, and G.C. Sills, "Self-Weight Consolidation of Soft Soils: An Experimental and Theoretical Study," *Geotechnics*, vol. 31, no. 4, pp. 519-535, 1981. [CrossRef] [Google Scholar] [Publisher Link]

[12] Mohammad Gharehzadeh Shirazi et al., "Sustainable Soil Bearing Capacity Improvement using Natural Limited Life Geotextile Reinforcement-A Review," *Minerals*, vol. 10, no. 5, pp. 1-22, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[13] Shriful Islam, Junaidul Islam, and Nur Md. Robiul Hoque, "Improvement of Consolidation Properties of Clay Soil using Fine-Grained Construction and Demolition Waste," *Heliyon*, vol. 8, no. 10, pp. 1-16, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[14] Chiang C. Mei, "Gravity Effects in Consolidation of Layer of Soft Soil," *Journal of Engineering Mechanics*, vol. 111, no. 8, pp. 1038-1047, 1985. [CrossRef] [Google Scholar] [Publisher Link]

[15] Adityaputera Wirawan, and Cindarto Lie, "Study on Pile Bearing Capacity Improvement in Soft Soil After Vacuum Consolidation," *Indonesian Geotechnical Journal*, vol. 3, no. 1, pp. 49-56, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[16] Fu Zhu et al., "A New Calculation Method for the Bearing Capacity of Soft Soil Foundation," *Advances in Mechanical Engineering*, vol. 9, no. 10, pp. 1-7, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[17] Mohamed B.D. Elsawy, and Kamal M. Hafez Ismail, "Influence of Aging on Bearing Capacity of Circular Footing Resting on Soft Soil," *HBRC Journal*, vol. 9, no. 3, pp. 256-262, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[18] P.W. Taylor, and T.A. Oort, "The Increase in Bearing Capacity Resulting from Consolidation," *Geotechnics*, vol. 21, no. 4, pp. 376-390, 1971. [CrossRef] [Google Scholar] [Publisher Link]

[19] Koji Suzuki, and Kazuya Yasuhara, "Increase in Undrained Shear Strength of Clay with Respect to Rate of Consolidation," *Soils and Foundation*, vol. 47, no. 2, pp. 303-318, 2007. [CrossRef] [Google Scholar] [Publisher Link]

[20] SNI 8460:2017, "*Geotechnical Design Requirements*," National Standardization Agency (BSN), 2017. [Google Scholar] [Publisher Link]

[21] Aviva Stevani, and Chaidir Anwar Makarim, "Comparative Analysis of Shallow Foundation Settlement in Peat Soil with Lime and Rice Husk Ash Stabilization," *JMTS: Journal of Civil Engineering Partners*, vol. 4, no. 1, pp. 233-248, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[22] Karl Terzaghi, *Theory of Consolidation*, Theoretical Soil Mechanics, Wiley, 1943. [CrossRef] [Google Scholar] [Publisher Link]

[23] T. William Lambe, and Robert V. Whitman, *Soil Mechanics*, John Wiley and Sons, 1991. [Google Scholar] [Publisher Link]

[24] Robert F. Craig, *Craig's Soil Mechanics*, 7th ed., CRC Press, 2004. [CrossRef] [Google Scholar] [Publisher Link]

[25] Gholamreza Mesri, "Discussion of New Design Procedure for Stability of Soft Clays," *Journal of the Geotechnical Engineering Division*, vol. 101, no. 4, pp. 409-412, 1975. [CrossRef] [Google Scholar] [Publisher Link]

[26] G. Mesri, and S. Ali, "Undrained Shear Strength of a Glacial Clay Overconsolidated by Desiccation," *Geotechnics*, vol. 49, no. 2, pp. 181-198, 1999. [CrossRef] [Google Scholar] [Publisher Link]

[27] Braja M. Das, and Nagaratnam Sivakugan, *Principles of Foundation Engineering*, 9th ed., Principles of Foundation Engineering, 2019. [Google Scholar] [Publisher Link]

[28] PLAXIS 2D: Geotechnical Engineering Software, Bentley, 2025. [Online]. Available: https://www.bentley.com/software/plaxis-2d