STUDY ON THE APPLICABILITY OF FINITE ELEMENT ANALYSIS ON PREDICTING THE BEHAVIOR OF AXIALLY LOADED PILES

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Master of Science in Geotechnical Engineering

Department of Civil Engineering

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Thesis submitted in partial fulfillment of the requirements for the degree

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date: 13/03/2024

The above candidate has carried out research for the Master thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Prof. L. I. N. De Silva

Signature of the Supervisor: Date: 05/03/2024

ABSTRACT

Study on the Applicability of Finite Element Analysis on Predicting the Behavior of Axially Loaded Piles

The performance of axially loaded piles is a key factor in ensuring the stability and safety of various civil engineering structures, including buildings and bridges, within the field of geotechnical engineering. Accurate prediction of pile behavior is essential during the pile design stage. This master's thesis presents a comprehensive investigation into the applicability of Finite Element Analysis (FEA) as a predictive tool for assessing the behavior of axially loaded piles, with a focus on the Sri Lankan context.

The research methodology involves a comparative analysis of field test data with numerical and manual calculation data. A dataset comprising 12 pile tests and borehole data was collected from the Colombo suburb area and Mannar Island in Sri Lanka. This dataset includes five PDA tests and one MLT test at each location. Simultaneously, a 3D finite element model is developed using PLAXIS 3D software to represent the pile-soil interaction. The finite element model is precisely calibrated and validated against the field test data to ensure its accuracy and reliability. In addition to FEA, manual calculations of pile capacities and settlements were performed using the collected borehole data and compared with the field test data.

The findings of this study suggest that FEA can effectively predict the behavior of axially loaded piles with a high degree of precision when calibrated appropriately. Notably, the results show strong agreement with experimental test data when the Elastic Modulus of soil (E_{50}) is increased by a factor of five in both Colombo and Mannar areas.

The implications of this study are highly relevant to geotechnical engineers, designers, and construction professionals, as it serves as a valuable resource for designing axially loaded piles in the specific context of Sri Lanka.

In conclusion, this master's thesis demonstrates that Finite Element Analysis is a powerful and reliable tool for predicting the behavior of axially loaded piles. It has the potential to significantly enhance the efficiency and reliability of pile design and construction in geotechnical engineering projects.

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