COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Ankitha Arvan

for the degree of Doctor of Philosophy (Ph.D.)

"Analysis of Deep Foundation Systems in Multi-layered Soil Strata"

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ABSTRACT OF DISSERTATION
Analysis of Deep Foundation Systems in Multi-layered Soil Strata

Deep foundations or pile foundations are the most preferable choices for several structures such as bridges, high-rise buildings, offshore structures and many other structures which experience heavy loads. The pile foundations are subjected to axial loads and a significant amount of lateral forces such as the wind, wave, earthquake, dredging and impact loads. In the case of an axially loaded pile, the load is transferred to the soil through the side friction at the soil-pile interface and the base resistance is offered by the soil bed. For a laterally loaded pile, the load carrying mechanism is different as the lateral load is resisted by the soil-pile interaction effect, which in turn depends on the pile material, pile diameter, soil properties and slope of the ground. The foundation system should be designed in such a way that the piles are capable enough to resist the large forces from the lateral action of wind, wave and/or earthquake. Published literature shows that a proper Pile-to-Pile Cap (PTPC) connection itself can increase the lateral resistance against these forces. Another major factor that influences the performance of deep foundations is the soil beneath it. The behavior of the structure under static or dynamic loading conditions is highly influenced by the soil-structure interactions. It is very important to analyze the structure to predict accurate structural behavior so as to improve the safety of the structures under extreme loading conditions. The soil-pile system behavior is highly non-linear and hence the difficulty in the accountability of the influencing factors necessitates a careful study on the soil-structure interaction problem considering the multi-layered soil strata and their varying properties.

Based upon the scope of the study, this dissertation is divided into two parts: (A) Behavior, performance and evaluation of substructure connections, and (B) Load-settlement responses of a pile embedded in a multi-layered non-linear elastic soil strata. A rigorous literature review has been performed to understand the factors affecting the connection performances and the load-displacement behavior of piles embedded in multi-layered non-linear soil strata. The review also includes existing experimental and analytical/numerical investigations concerning the scope of the study. The main objective of the study in Part A is to understand and develop a connection design capable of producing adequate moment capacity of the pile by eliminating any special reinforcement details and simply relying on plain pile embedments. It suggests tools and guidelines to assist in

the practical and efficient design of substructure connections. The primary objective of the study in Part B is to develop a computationally efficient continuum-based mathematical model that takes the three-dimensional soil-pile interaction into account. It also includes development of standalone applications: GEOS-ALPILE, GEOS-LLPILE and GEOS-GLPILE for pile subjected to axial loads, lateral loads and the combined action of axial and lateral loads respectively. Such an application facilitates the use of the developed approach by researchers, practitioner engineers and academia purposes. Both the studies (parts A and B) are further validated by the use of Artificial Neural Network (ANN) models that serve as an additional computational tool in the design and analyses of deep foundation systems. Further research recommendations have also been presented in terms of relating both the parts of the study and extension to group action of the piles.

BIOGRAPHICAL SKETCH
Born in Hyderabad, India.
B.S., Guru Nanak Institutions, Hyderabad, Telangana, India, 2014
M.S., University of Bologna, Bologna, Italy, 2018
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Time in Preparation: 2018-2022

Qualifying Examination Passed: Fall 2019

Journal Publications:

Madasamy Arockiasamy and Arvan Prakash Ankitha. 2021.
“Behavior, Performance and Evaluation of Prestressed Concrete/steel Pipe/Steel H-Pile to Pile Cap Connections: State-of-the-Art Review”.
Practice Periodical on Structural Design and Construction, American Society of Civil Engineers (ASCE).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2021.
“Energy-based Approach: Analysis of a Vertically Loaded Pile in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Energy-based Approach: Analysis of a Laterally Loaded Pile in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Energy-based Approach – Part I: User-friendly Standalone Application for The Analysis of a Vertically Loaded Pile in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Energy-based Approach – Part II: User-friendly Standalone Application for The Analysis of a Laterally Loaded Pile in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Energy-based Approach – Part III: User-friendly Standalone Application for The Analysis of a Bridge-Pile Foundation System in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Arvan Prakash Ankitha; Rahul Dev Raju; Madasamy Arockiasamy; and Khaled Sobhan. 2022.
“State-of-the-Art Review on Offshore Wind Turbine (OWT)-Monopile Foundation Systems in Multi-layered Soil Strata under Aerodynamic and Hydrodynamic loads”.
Practice Periodical on Structural Design and Construction, American Society of Civil Engineers (ASCE).

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Analysis Methods for Understanding the Effect of Embedment Depth concerning Pile-to-Pile Cap Connections”.
Practice Periodical on Structural Design and Construction, ASCE.
Status: Submitted

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Application of Artificial Intelligence Techniques in the analysis of Pile-to-Pile Cap Connections”.
Practice Periodical on Structural Design and Construction, ASCE.
Status: Submission in Progress

Arvan Prakash Ankitha and Madasamy Arockiasamy. 2022.
“Application of Artificial Intelligence Techniques in the analysis of Piles in Multi-layered Non-linear Soil Strata”.
Geotechnics, Multidisciplinary Digital Publishing Institute (MDPI).

Status: Submission in Progress

Arvan Prakash Ankitha, Madasamy Arockiasamy, Nakin Suksawang and Harry Alan Craik. 2022.
“Finite Element Analysis of a Double Composite Box Girder Bridge”.
Journal of Bridge Engineering, ASCE.
Status: Submission in Progress

Isaac Elishakoff, Arvan Prakash Ankitha and Alessandro Marzani. 2019.
“Rigorous versus naïve implementation of the Galerkin method for stepped beams”.
Acta Mechanica, Springer.
DOI: https://link.springer.com/article/10.1007/s00707-019-02393-z

Isaac Elishakoff, Marco Amato, Arvan Prakash Ankitha and Alessandro Marzani. 2021.
“Rigorous implementation of the Galerkin method for stepped structures needs generalized functions”.
Journal of Sound and Vibration, Elsevier.
DOI: https://www.sciencedirect.com/science/article/pii/S0022460X20305381