NUMERICAL MODELING OF A DEEP EXCAVATION AND COMPARISON WITH MONITORING DATA

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Degree of Master of Science in Geotechnical Engineering

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DECLARATION

I declare that this is my own work and this thesis/dissertation 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).

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

Name of Supervisor: Prof. S.A.S. Kulathilaka

Signature of the Supervisor: Date: 08.05.2024

DEDICATION

This thesis is dedicated to my loving parents Mr. D.A. Padmasiri and Mrs. H.H.V.R. de Silva and my loving husband Mr. K.K. Karunaratne

For their endless love, support and encouragement

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ABSTRACT

With urbanization, space available for construction is limited and available space has to be used very effectively. As a result, people tend to use underground spaces for parking and other service requirements. Accordingly, deep excavations with several levels of basements have become a standard practice in the construction of high rise buildings in urban areas. Any excavation which extends beyond the ground water level is required to be supported by an appropriate earth retaining system to retain the soil and ensure the water tightness of the retaining system while proceeding with the excavation. The main purpose of the retaining systems is to maintain both horizontal and vertical ground movements within allowable limits to avoid any damage to the adjacent built environment and the excavation itself. To achieve the main purpose of retaining walls for deep excavations, the estimation of lateral deformation is required to be done very precisely during the design stage. Further, the estimated deformations are required to be compared with the actual monitoring data during the execution stage. In this research, monitoring data of an excavation supported by a diaphragm wall laterally supported at several levels were compared with the results of the numerical simulation obtained by the finite element method, and for the first analysis Mohr-Coulomb model was used as a constitute model. Then the finite element modelling method was streamlined to obtain more accurate results. Two modifications were adopted for the basic model to improve the performance. First, the elastic modulus of soil was increased considering the unloading effect of soil and next the small strain theory was used. The results of the analysis showed that the model with the combination of both modifications provides more sensible results. There were some anomalies in the actual monitoring data.

Keywords: Deep excavation, Earth retaining system, Diaphragm wall, Lateral deformation**,** Monitoring data, Elastic modulus, Small strain theory

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AAA	Alert, Action, Alarm
BH	Borehole
CIRIA	Construction Industry Research and Information Association
ELS	Earth Lateral Supports
FEM	Finite Element Method
HSS	Hardening Soil Model
PSZ	Primary Strain Zone
SPT	Standard Penetration Test
SS	Small Strain
SSZ	Small Strain Zone
UCS	Uniaxial Compressive Strength

LIST OF APPENDICES