

**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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University of Moratuwa
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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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Date: 08.05.2024

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

Declaration	i
Dedication	ii
Acknowledgement	iii
Abstract	iv
Table of Contents	v
List of Figures	vii
List of Tables	i
List of Abbreviations	iii
List of Appendices	iv
CHAPTER 1	1
INTRODUCTION	1
1.1 Background	1
1.2 Problem identification	2
1.3 Objectives	3
1.4 Methodology Applied	3
1.5 Thesis Outline	4
CHAPTER 2	5
LITERATURE REVIEW	5
2.1. Introduction	5
2.2. Types of Embedded Walls	6
2.3. Sequence of Construction.....	8
2.4. Conventional Design of Embedded Retaining Walls.....	9
2.5. Analytical Methods to Design of Embedded Retaining Walls	9
2.6. Back Analysis and Monitoring of Deep Excavation	19
CHAPTER 03	25
INITIAL DESIGN AND DETAILS OF THE PROJECT	25
3.1. Site Location and General Environment	25
3.2. Details of Soil Investigation	26
3.3. Details of the Earth Retaining System	30

3.4. Monitoring.....	34
CHAPTER 04	44
IDEALIZATION PROCESS	44
4.1. Selection of Sections	44
4.2. Idealization of Soil Properties	45
4.3. Idealization of Rock Properties	51
4.4. Idealization of Temporary Supports and Permeant Supports of Earth Retaining System	52
4.5. Idealization of Earth Retaining System.....	60
4.6. Idealization of Loads from Adjacent Environment.....	61
4.7. Details of the Finite Element Model	61
CHAPTER 05	65
RESULTS OF THE ANALYSIS.....	65
5.1. Lateral Deformation of Diaphragm Wall for Initial Stiffness Values Condition.....	66
5.2. Lateral Deformation of Diaphragm Wall for Modification 1.....	71
5.3. Analysis Methodology for Modification 2.....	76
5.4. Lateral Deformation of Diaphragm Wall for the other sections under the selected combination of E in Modification 2.....	79
5.5. Comparison of Analytical Results with Monitoring Data.....	83
5.6. Lateral Deformations Further away from the wall at the Retained Side.....	88
5.7. Comparison of Vertical Settlement	93
5.8. Comparison of Bending Moments of Diaphragm Wall	97
CHAPTER 06	98
SUMMARY AND CONCLUSIONS	98
REFERENCES	100

LIST OF FIGURES

Figure	Description	Page
Figure 2.1	Bottom up construction sequence	8
Figure 2.2	Top-down construction sequence	8
Figure 2.3	Subgrade Reaction Model	9
Figure 2.4	Mistakes in modeling ground anchors	12
Figure 2.5	Mohr Coulomb Model	13
Figure 2.6	Loading unloading modulus of soil	14
Figure 2.7	Stress path under a typical excavation problem	14
Figure 2.8	Expected material behavior in excavation problem	15
Figure 2.9	k_0 procedure for horizontal geometry	16
Figure 2.10	Cases where k_0 procedure is inaccurate	16
Figure 2.11	Impermeable wall and bottom seepage	17
Figure 2.12	Groundwater flow through permeable wall	18
Figure 2.13	Two strain zones of an excavation	19
Figure 2.14	Lateral deformation curves	23
Figure 3.1	Site location	25
Figure 3.2	Borehole locations	26
Figure 3.3	Levels of temporary and permanent supports	30
Figure 3.4	Temporary support arrangement of level 1	31
Figure 3.5	Temporary support arrangement of level 2	32
Figure 3.6	Temporary support arrangement of level 3	32
Figure 3.7	Temporary support at site	32
Figure 3.8	Zones during excavation	33
Figure 3.9	Details of inclinometer	35
Figure 3.10	Inclinometer readings – Section 1	37
Figure 3.11	Inclinometer readings – Section 2	39
Figure 3.12	Inclinometer readings – Section 3	41
Figure 3.13	Inclinometer readings – Section 4	43
Figure 4.1	Selections of sections	44

Figure 4.2	Idealization Method 1	53
Figure 4.3	Idealization Method 2	54
Figure 4.4	Idealization Method 3	55
Figure 4.5	Two strain zones of an excavation	62
Figure 4.6	Results of the analysis	63
Figure 5.1	Lateral deformation – Section 1	67
Figure 5.2	Lateral deformation – Section 2	68
Figure 5.3	Lateral deformation – Section 3	69
Figure 5.4	Lateral deformation – Section 4	70
Figure 5.5	Lateral deformation – Section 1	72
Figure 5.6	Lateral deformation – Section 2	73
Figure 5.7	Lateral deformation – Section 3	74
Figure 5.8	Lateral deformation – Section 4	75
Figure 5.9	Comparison of results with different stiffness modifications	77
Figure 5.10	Comparison of results with different distance	78
Figure 5.11	Lateral deformation – Section 1	79
Figure 5.12	Lateral deformation – Section 2	80
Figure 5.13	Lateral deformation – Section 3	81
Figure 5.14	Lateral deformation – Section 4	82
Figure 5.15	Comparison of Monitoring Data with Analysis – Section 1	84
Figure 5.16	Comparison of Monitoring Data with Analysis – Section 2	85
Figure 5.17	Comparison of Monitoring Data with Analysis – Section 3	86
Figure 5.18	Comparison of Monitoring Data with Analysis – Section 4	87
Figure 5.19	Lateral deformation away from the wall – Section 1	89
Figure 5.20	Lateral deformation away from the wall – Section 2	90
Figure 5.21	Lateral deformation away from the wall – Section 3	91
Figure 5.22	Lateral deformation away from the wall – Section 4	92
Figure 5.23	Vertical settlement- Section 1	93
Figure 5.24	Vertical settlement- Section 2	94
Figure 5.25	Vertical settlement- Section 3	94
Figure 5.26	Vertical settlement- Section 4	95
Figure 5.27	Relative earth pressure coefficient for three scenarios	95

Figure 5.28	Pressure distribution- Section 1	96
Figure 5.29	Bending moment of diaphragm wall- Section 1	97
Figure 6.1	Comparison of lateral deformations of the wall	99

LIST OF TABLES

Table	Description	Page
Table 2.1	R_{inter} for different conditions	12
Table 3.1	Details of the depths of drilling	26
Table 3.2	Summary of subsurface profile	27
Table 3.3	Rock coring parameters	29
Table 3.4	UCS values of rock samples	29
Table 3.5	Details of temporary supports	31
Table 3.6	Details of permanent supports	33
Table 3.7	Construction sequence	34
Table 3.8	Inclinometer related to analyzed sections	35
Table 3.9	Construction sequence for Section 1	36
Table 3.10	Construction sequence for Section 2	38
Table 3.11	Construction sequence for Section 3	40
Table 3.12	Construction sequence for Section 4	42
Table 4.1	Selected sections to analysis	45
Table 4.2	Shear strength properties of BH 01	46
Table 4.3	Shear strength properties of BH 02	47
Table 4.4	Shear strength properties of BH 04	47
Table 4.5	Stiffness parameters of BH 01	48
Table 4.6	Stiffness parameters of BH 02	48
Table 4.7	Stiffness parameters of BH 04	48
Table 4.8	Flow parameters of BH 01	50
Table 4.9	Flow parameters of BH 02	50
Table 4.10	Flow parameters of BH 04	51
Table 4.11	Rock properties of BH	52
Table 4.12	Idealized properties of temporary supports	53
Table 4.13	Idealized properties of temporary support	54
Table 4.14	Properties of temporary support at Section 1	56
Table 4.15	Properties of permanent support at Section 1	56

Table 4.16	Properties of temporary support at Section 2	57
Table 4.17	Properties of permanent support at Section 2	57
Table 4.18	Properties of temporary support at Section 3	58
Table 4.19	Properties of permanent support at Section 3	58
Table 4.20	Properties of temporary support at Section 4	59
Table 4.21	Properties of permanent support at Section 4	59
Table 4.22	Idealized stiffness parameters of diaphragm wall	60
Table 4.23	Details of applied loads as surcharge	61
Table 4.24	Various E values used in the analysis	64
Table 4.25	Various H_e values used in the analysis	64

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

Appendix	Description	Page
Appendix - A	Vertical Sub-surface Profile	102
Appendix – B	Borehole Investigation Report	104
Appendix – C	Details of Temporary Supports	152
Appendix – D	Details of Permanent Supports	156
Appendix – E	Monitoring Data	162