



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم

# بسم الله الرحمن الرحيم



**MONA MAGHRABY**



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التوثيق الإلكتروني والميكروفيلم



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# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

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**MONA MAGHRABY**



**BEHAVIOR OF MECHANICALLY STABILIZED  
EARTH WALL CORNERS FROM FIELD MONITORING  
AND 3D NUMERICAL MODELING**

By

**Abdelwahab Tahsin A. Mohsen**

A Thesis Submitted to the  
Faculty of Engineering at Cairo University  
in Partial Fulfillment of the  
Requirements for the Degree of  
**DOCTOR OF PHILOSOPHY**  
In  
**CIVIL ENGINEERING - PUBLIC WORKS**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY  
GIZA, EGYPT  
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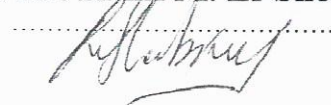
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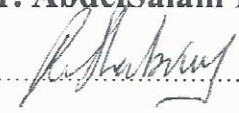
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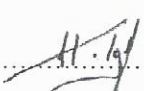
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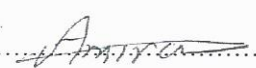
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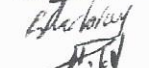
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**Title of Thesis:**

**Behavior of Mechanically Stabilized Earth Wall Corners from Field Monitoring and 3D Numerical Modeling**

**Key Words:**

Mechanically Stabilized Earth (MSE) wall; Geosynthetic/ geogrids; 3D numerical modeling; field monitoring; strain gauge.

**Summary:**

MSE walls are widely used as a cost-effective earth-retaining system. The current design standards are based primarily on the understanding of two-dimensional plane-strain behavior regardless of the 3D behavior and the mechanisms associated with wall curves and corners. The objective of this research work is to better understand the behavior of MSE wall corners under service loading by performing field monitoring accompanied by a thorough material characterization and validation using 3D finite element modelling. A parametric study was performed using 3D finite element model to study the effects of curve radius, curve angle including concave/ convex configurations, geogrid stiffness, facing stiffness, and soil relative density on the performance of curved walls. A comprehensive field monitoring program was performed on a modular-block MSEW of curved configuration located at New Giza, Giza, Egypt. The wall height is 11 m with right angle configuration of radius 15 m, reinforced with 18 layers of polyester (PET) geogrids. The field monitoring program comprised: (a) strain gauges installation for 22 geogrid layers distributed between three stations with a total of 194 points, and (b) surveying of facing deformation at 144 points located at eight stations along with the straight and curved segments of the wall. Material characterization and laboratory tests were undertaken on the used backfill soil and geogrids. Assessment of variation of geogrid stiffness with time and calibration factors between global to local strains were derived. The 3D numerical model performed in Plaxis was preliminary validated based on the monitoring records of Wall 1 Royal Military College of Canada developed by Hatami & Bathurst (2005). The 3D model was also validated against the instrumented wall upon completion with good agreement between measured and calculated geogrid loads and facing deformations. The measured strains, derived tensile forces, and facing displacements for the plane-strain (PS) section are relatively larger than that within the curved zone. The outer radial deformation along the wall curve results in non-uniform hoop strains that cause circumferential relative movements of the blocks resulting in block separation and sometimes cracking. However, separation/cracking is a local phenomenon and does not affect the global stability.

## Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Abdelwahab Tahsin A. Mohsen

Date: 06/07/2020

Signature:



## **Dedication**

I dedicate this dissertation to my beloved parents, my daughter, my sons, my wife, my sister, my brothers, my family, my friends and everyone taught me anything in this life.

## Acknowledgments

I would like to express my deep gratitude to my Ph.D. committee chair and main advisor Prof. Dr. AbdelSalam M. Salem. Without his continuous guidance I would not have been able to accomplish this monumental task. I sincerely acknowledge the venerable support, encouragement, patience, and guidance of my advisor Prof. Dr. Rami M. El-Sherbiny. I am indebted to his support over the years.

I would like to appreciate and thank my parents Tahsin, and Nagwa for their love, and extreme exceptional support over the years. My family was always understandable, and helpful with my long hours of work, study, and tension. Usually, giving me an inspiration, and motivation to continue in research work.

I would like to thank the board and staff of soil mechanics laboratory, Faculty of Engineering, Cairo University for their consistent support. I want also to acknowledge Eng. Amro Nassar, and site team members at New Giza compound for their continuous backing during the filed instrumentations. I like to appreciate the valuable efforts of Dr. Traek Khallaf, and team members of Misr Raymond Laboratory, Cairo. I express my gratitude to the technical support of Dr. Mohy El-Mashad, and members of Geotechnical Institute Laboratory, National Irrigation Research Center in Qanater, Egypt.

I want to thank all of my friends for the help and spiritual support, and Special appreciations are due to my close friends Dr. Tarek Fakhr, and Eng. Aly Saber who dedicated a lot of time supporting and encouraging me within the research work.

Finally, I would like to extend my gratitude to my colleagues at ACE Consulting Engineers “Moharram- Bakhoun”, especially the board members Prof. Dr. Ahmed Moharram, Prof. Dr. Ibrahim Moharram, and Prof. Dr. Mourad Bakhoun.

# Table of Contents

|                                                        |             |
|--------------------------------------------------------|-------------|
| <b>Disclaimer.....</b>                                 | <b>i</b>    |
| <b>Dedication.....</b>                                 | <b>ii</b>   |
| <b>Acknowledgments.....</b>                            | <b>iii</b>  |
| <b>Table of Contents.....</b>                          | <b>iv</b>   |
| <b>List of Tables.....</b>                             | <b>ix</b>   |
| <b>List of Figures .....</b>                           | <b>x</b>    |
| <b>Nomenclature.....</b>                               | <b>xvii</b> |
| <b>Abstract .....</b>                                  | <b>xxi</b>  |
| <b>CHAPTER 1 : INTRODUCTION .....</b>                  | <b>1</b>    |
| 1.1. GENERAL .....                                     | 1           |
| 1.2. PROBLEM STATEMENT .....                           | 1           |
| 1.3. OBJECTIVE.....                                    | 2           |
| 1.4. THESIS ORGANIZATION .....                         | 3           |
| <b>CHAPTER 2 : LITERATURE REVIEW .....</b>             | <b>4</b>    |
| 2.1. INTRODUCTION.....                                 | 4           |
| 2.2. CORNERS OF MSE WALLS .....                        | 5           |
| 2.2.1. Overview.....                                   | 5           |
| 2.2.2. Types of Curved MSE Walls .....                 | 6           |
| 2.3. MECHANISM AND BEHAVIOR .....                      | 7           |
| 2.3.1. Stress Transfer Mechanism.....                  | 7           |
| 2.3.1.1. Friction load transfer .....                  | 9           |
| 2.3.1.2. Passive resistance .....                      | 11          |
| 2.3.2. Stability of MSE Wall.....                      | 11          |
| 2.3.2.1. External stability.....                       | 11          |
| 2.3.2.2. Internal stability.....                       | 12          |
| 2.4. EMPIRICAL DESIGN METHODS FOR MSE WALL.....        | 13          |
| 2.4.1. Tieback Wedge Method.....                       | 13          |
| 2.4.2. FHWA Structure Stiffness Method.....            | 14          |
| 2.4.3. Working Stress Method .....                     | 14          |
| 2.4.4. AASHTO Simplified Method .....                  | 15          |
| 2.4.5. Simplified Stiffness (K-Stiffness) Method ..... | 17          |
| 2.5. NUMERICAL MODELING OF MSEW BEHAVIOR .....         | 19          |
| 2.5.1. Soil Properties and Constitutive Models.....    | 19          |

|                                                                      |    |
|----------------------------------------------------------------------|----|
| 2.5.2. Geogrid Stiffness (Modulus) Simulation .....                  | 22 |
| 2.5.3. Wall Facing Modeling .....                                    | 23 |
| 2.5.4. Compaction Effort Simulation .....                            | 23 |
| 2.5.5. 3D Numerical Modeling for MSEW Behavior .....                 | 24 |
| 2.5.5.1. 3D Numerical modeling for discontinuous reinforcement ..... | 24 |
| 2.5.5.2. 3D Numerical modeling for pullout tests .....               | 25 |
| 2.5.5.3. 3D Numerical modeling for corner turns .....                | 25 |
| 2.6. MSE WALL BEHAVIOR AND CODE PROVISIONS .....                     | 26 |
| 2.7. SUMMARY OF LITERATURE REVIEW .....                              | 29 |

### **CHAPTER 3 : RESEARCH METHODOLOGY AND FIELD**

#### **INSTRUMENTATION OF A CORNER MSEW .....30**

|                                                                |    |
|----------------------------------------------------------------|----|
| 3.1. RESEARCH METHODOLOGY .....                                | 30 |
| 3.2. CONFIGURATION OF THE INSTRUMENTED MSE WALL .....          | 32 |
| 3.2.1. Overview .....                                          | 32 |
| 3.2.2. Polyester (PET) Geogrid .....                           | 34 |
| 3.2.3. Modular Facing Blocks .....                             | 35 |
| 3.3. FIELD INSTRUMENTATION PROGRAM .....                       | 35 |
| 3.3.1. Strain Gauges Attached to the Geogrid Layers .....      | 35 |
| 3.3.2. Survey Monitoring for the Wall Facing Deformation ..... | 38 |
| 3.4. INSTRUMENTATION DEVICES .....                             | 39 |
| 3.4.1. Foil Strain Gauges .....                                | 39 |
| 3.4.2. Data Logger (Strain Indicator) .....                    | 40 |
| 3.4.3. Total Station .....                                     | 42 |
| 3.5. INSTALLATION OF STRAIN GAUGES .....                       | 45 |
| 3.5.1. Geogrid Surface Preparation .....                       | 45 |
| 3.5.2. Gauge Adhesion and Waterproofing .....                  | 45 |
| 3.5.3. Gauge Wiring .....                                      | 47 |
| 3.6. CONSTRUCTION SEQUENCE .....                               | 49 |

### **CHAPTER 4 : LABORATORY TESTS AND MATERIAL**

#### **CHARACTERIZATION .....53**

|                                                                     |    |
|---------------------------------------------------------------------|----|
| 4.1. INTRODUCTION .....                                             | 53 |
| 4.2. BACKFILL SOIL CHARACTERIZATION .....                           | 53 |
| 4.2.1. Grain Size Distribution .....                                | 53 |
| 4.2.2. Moisture-Density Relationship (Compaction) Test .....        | 54 |
| 4.2.3. Direct Shear Test .....                                      | 54 |
| 4.2.4. One-Dimensional Primary Consolidation Test (Oedometer) ..... | 57 |
| 4.2.5. Tri-Axial Consolidated Drained CD Test .....                 | 58 |
| 4.3. GEOGRID CHARACTERIZATION .....                                 | 61 |

|                                                                                            |            |
|--------------------------------------------------------------------------------------------|------------|
| 4.3.1. Overview .....                                                                      | 61         |
| 4.3.2. Test Apparatus and Specimen Preparation .....                                       | 61         |
| 4.3.3. Tensile Load Versus Strain Test Results .....                                       | 63         |
| 4.3.3.1. Tensile ultimate strength .....                                                   | 63         |
| 4.3.3.2. Secant modulus (stiffness).....                                                   | 66         |
| 4.3.4. Assessment of Variation of Stiffness with Time (Creep) .....                        | 70         |
| 4.3.5. Calibration Factor between Local and Global Strain .....                            | 73         |
| <b>CHAPTER 5 : INTERPRETATION OF FILED MONITORING RECORDS .....</b>                        | <b>77</b>  |
| 5.1. OVERVIEW .....                                                                        | 77         |
| 5.2. MONITORING RECORDS INTERPRETATION FOR STRAIN GAUGES .....                             | 78         |
| 5.2.1. Measured Local Strain for Staged Construction .....                                 | 78         |
| 5.2.2. Measured Local Strain at End of Construction .....                                  | 86         |
| 5.2.3. Global Strain at End of Construction.....                                           | 92         |
| 5.2.4. EOC- Locus of Measured Strain Hub and Potential Failure Surface.....                | 94         |
| 5.3. DERIVATION OF GEOGRID TENSILE FORCES BASED ON THE STRAIN<br>GAUGES MEASUREMENTS ..... | 96         |
| 5.3.1. EOC- Measured Geogrid Maximum Forces .....                                          | 96         |
| 5.3.2. Plane-Strain Section; Prediction of Maximum Force .....                             | 102        |
| 5.4. INTERPRETATION FOR FACING DISPLACEMENT MONITORING .....                               | 105        |
| <b>CHAPTER 6 : PRELIMINARY VALIDATION OF NUMERICAL<br/>MODEL .....</b>                     | <b>109</b> |
| 6.1. INTRODUCTION .....                                                                    | 109        |
| 6.2. REFERENCE INSTRUMENTED FULL SCALE MSEW MODEL .....                                    | 110        |
| 6.2.1. MSEW Geometry, Configuration, and Test Setup.....                                   | 110        |
| 6.2.2. Material Characterization for Backfill (RMCC Sand).....                             | 112        |
| 6.2.3. Geogrid Properties .....                                                            | 112        |
| 6.3. DEVELOPED 3D PLAXIS MODEL .....                                                       | 114        |
| 6.3.1. Geometry of the Model .....                                                         | 114        |
| 6.3.2. Boundary Conditions, Meshing, and Staged Construction Simulation.....               | 115        |
| 6.3.3. Material Characterization for Backfill Soil.....                                    | 116        |
| 6.4. MODEL VERIFICATION ANALYSIS AND RESULTS .....                                         | 118        |
| 6.4.1. Sensitivity Study for Relative Displacement at EOC .....                            | 119        |
| 6.4.2. Facing Displacement.....                                                            | 121        |
| 6.4.3. Connection Load .....                                                               | 122        |
| 6.4.4. Foundation Vertical Pressure .....                                                  | 123        |
| 6.4.5. Geogrid Strain .....                                                                | 125        |
| 6.5. FINDINGS .....                                                                        | 128        |
| <b>CHAPTER 7 : PRELIMINARY PARAMETRIC STUDY .....</b>                                      | <b>129</b> |

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| 7.1. PARAMETRIC STUDY DESIGNATION .....                                           | 129 |
| 7.1.1. Base Model Configuration .....                                             | 129 |
| 7.1.2. Sensitivity Study .....                                                    | 132 |
| 7.1.2.1. Influence of discretization .....                                        | 132 |
| 7.1.2.2. Influence of mesh density .....                                          | 133 |
| 7.1.2.3. Influence of anisotropic properties for facing blocks .....              | 133 |
| 7.1.3. Methodology for Parametric Study .....                                     | 135 |
| 7.1.4. Base Model Output Trend Overview .....                                     | 137 |
| 7.1.5. Stability Analysis .....                                                   | 140 |
| 7.2. INFLUENCE OF (R/H) RATIO .....                                               | 142 |
| 7.2.1. Facing Displacement .....                                                  | 142 |
| 7.2.2. Forces in Geogrid .....                                                    | 143 |
| 7.2.3. Lateral Earth Pressure .....                                               | 146 |
| 7.3. INFLUENCE OF CURVE INTERNAL ANGLE $\Theta$ (DIVERSION) .....                 | 147 |
| 7.3.1. Facing Displacement .....                                                  | 147 |
| 7.3.2. Forces in Geogrid .....                                                    | 149 |
| 7.4. INFLUENCE OF CURVE CONFIGURATION (OPEN- CONVEX AND<br>CLOSED- CONCAVE) ..... | 151 |
| 7.4.1. Facing Displacement .....                                                  | 151 |
| 7.4.2. Forces in Geogrid .....                                                    | 153 |
| 7.5. INFLUENCE OF WALL RETAINED HEIGHT .....                                      | 155 |
| 7.5.1. Facing Displacement .....                                                  | 155 |
| 7.5.2. Forces in Geogrid .....                                                    | 157 |
| 7.5.3. Lateral Earth Pressure .....                                               | 159 |
| 7.6. INFLUENCE OF GEOGRID STIFFNESS .....                                         | 160 |
| 7.6.1. Facing Displacement .....                                                  | 160 |
| 7.6.2. Forces in Geogrid .....                                                    | 163 |
| 7.6.3. Lateral Earth Pressure .....                                               | 165 |
| 7.7. INFLUENCE OF FACING STIFFNESS .....                                          | 167 |
| 7.7.1. Facing Displacement .....                                                  | 167 |
| 7.7.2. Forces in Geogrid .....                                                    | 168 |
| 7.7.3. Lateral Earth Pressure .....                                               | 171 |
| 7.8. INFLUENCE OF SOIL RELATIVE DENSITY (SOIL MODULUS) .....                      | 172 |
| 7.8.1. Facing Displacement .....                                                  | 172 |
| 7.8.2. Forces in Geogrid .....                                                    | 174 |
| 7.8.3. Lateral Earth Pressure .....                                               | 175 |
| 7.9. INFLUENCE OF SURCHARGE LOADING .....                                         | 176 |
| 7.9.1. Facing Displacement .....                                                  | 176 |
| 7.9.2. Forces in Geogrid .....                                                    | 178 |

|                                                                                               |            |
|-----------------------------------------------------------------------------------------------|------------|
| <b>CHAPTER 8 : NUMERICAL MODELING VALIDATION USING THE INSTRUMENTED CURVED MSE WALL .....</b> | <b>182</b> |
| 8.1. DEVELOPED 3D PLAXIS MODEL KEY FEATURES .....                                             | 182        |
| 8.1.1. Geometry Modelling.....                                                                | 182        |
| 8.1.2. Simulation of Curved Elements .....                                                    | 184        |
| 8.1.3. Sensitivity Study for Facing Anisotropic Properties.....                               | 185        |
| 8.1.4. Boundary Conditions, Meshing, and Staged Construction Simulation.....                  | 188        |
| 8.2. MATERIAL CHARACTERIZATION .....                                                          | 192        |
| 8.2.1. Backfill Soil .....                                                                    | 192        |
| 8.2.2. Geogrid .....                                                                          | 195        |
| 8.3. MODEL RESPONSE OVERVIEW .....                                                            | 195        |
| 8.3.1. Model displacements .....                                                              | 196        |
| 8.3.2. Geogrid Forces During Construction at Backfill of 56% H.....                           | 198        |
| 8.4. NUMERICAL MODEL VALIDATION .....                                                         | 200        |
| 8.4.1. EOC Stage; Verification of Maximum Geogrid Forces.....                                 | 200        |
| 8.4.2. EOC Stage; Verification of Lateral Facing Deformation .....                            | 202        |
| 8.4.3. Potential for Block Separation and Cracks at Curved Wall Corners .....                 | 204        |
| <b>CHAPTER 9 : ANALYSIS OF THE CURVED WALL BEHAVIOR.....</b>                                  | <b>206</b> |
| 9.1. INFLUENCE OF WALL HEIGHT H .....                                                         | 206        |
| 9.1.1. Facing Displacement at EOC.....                                                        | 208        |
| 9.1.2. Trends for Facing Displacement and Geogrid Maximum Forces at EOC .....                 | 210        |
| 9.2. INFLUENCE OF CURVE RADIUS R.....                                                         | 211        |
| 9.2.1. Facing Displacement at EOC.....                                                        | 213        |
| 9.2.2. Vertical Stresses Below Facing at EOC.....                                             | 215        |
| 9.2.3. Trends for Facing Displacement and Geogrid Maximum Forces at EOC .....                 | 216        |
| <b>CHAPTER 10 : SUMMARY AND CONCLUSIONS.....</b>                                              | <b>218</b> |
| 10.1.SUMMARY .....                                                                            | 218        |
| 10.2.CONCLUSIONS .....                                                                        | 218        |
| 10.3.RECOMMENDATIONS .....                                                                    | 220        |
| <b>References .....</b>                                                                       | <b>222</b> |