شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

MONA MAGHRABY

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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MONA MAGHRABY

Cairo University

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
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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.

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