AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Modeling Soil Profile And Geotechnical Properties Using Geo-Statistical Algorithms

BY

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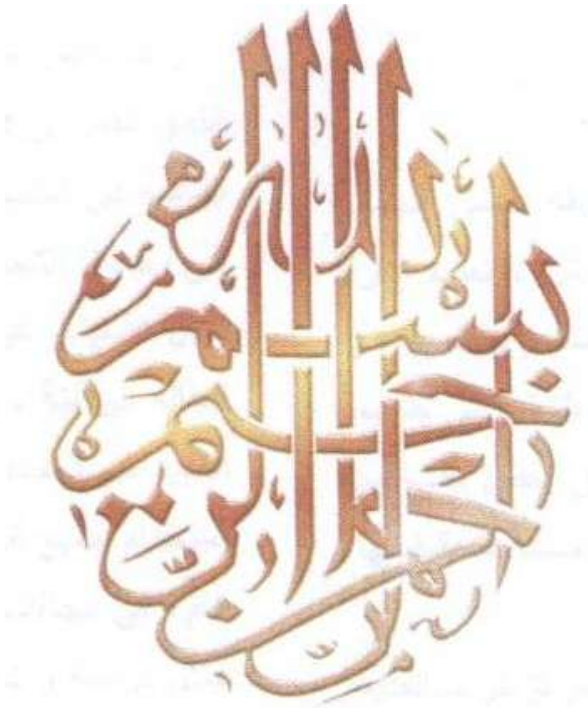

وَعِندَهُ مَفَاتِحُ الْغَيْبِ لاَ يَعْلَمُهَا إِلاَّ هُوَ وَيَعْلَمُ مَا فِي الْبَرِّ وَالْبَحْرِ وَمَا تَسْقُطُ ،،

،، مِن وَرَقَةٍ إِلاَّ يَعْلَمُهَا وَلاَ حَبَّةٍ فِي ظُلُمَاتِ الأَرْضِ وَلاَ رَطْبٍ وَلاَ يَابِسٍ إِلاَّ فِي كِتَابٍ مُّبِينٍ

صدق الله العظيم

الانعام ٥٩

DETICATION

To my Father

To my Mother

To my Wife

To my Children

To my Brothers

To my Family

EXAMINING COMMITTEE

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STATEMENT

This thesis is submitted to Ain Shams Universityfor the degree of Doctor of Philosophy in Civil Engineering (Structural Departement).

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University from 2009 to 2015 .

No part of this thesis has been submitted for a degree or qualification at any other University or Institute.

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Abstract of Phd Thesis submitted by:

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Modeling soil profile and geotechnical properties using Geo-statistical algorithms

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Abstract

In geotechnical engineering, the investigation of soil properties at a specific site depends on both lab tests that are held on a limited number of soil sample, as well as field tests like CPT test. Usually budget is considered a main constraint against the availability to collect more samples that can give to some extent realistic representation of soil profile and its spatial variability. In most of geotechnical work, the design was depending on deterministic either spatial or non spatial techniques in the identification of soil layers and the corresponding soil

properties without considering the significances of soil spatial variability. Such approach of estimations led to the loss of many valuable information from investigation of the spatial relations of this data. Hence, this thesis introduces Geo-Statistics in soil profiling as a technique that showed high applicability in fields related to geotechnical engineering like mining and petroleum engineering. The thesis introduced Geo-statistics as a concept and tried to investigate the reasons for such techniques for not being a traditional part of the work of Geotechnical engineers. Besides that, it discussed a group of Geo-statistical algorithms and software. Moreover, it showed the practical implementation of these techniques on modeling soil profile using CPT sample data through the integration between GIS and a specialized 3D Geo-statistical modeling software. Finally, it addressed the problems of implementing these techniques on large scale data (City Scale) and showed some proposed solutions for such problems.

The thesis focused on two city scale problems. First, is the problem of logging archived boreholes data and the fact that the reports were not following a unified structured technique in data logging to be used in soil classification . The second problem is related to Variogram stationarity which is considered one of the main assumptions in Geo-statistical modeling.

For the first problem a proposed technique is introduced to handle non uniform logged data of the archived boreholes to get clear solid classes of soil as a first step for soil profile geo-statistical modeling and it discusses a program developed as part of its practical work based on intelligent pattern recognition concepts to automate the proposed technique. This program aimed at converting the un-structured

descriptive soil text to a group of soil classes. The program is called "Expert classifier".

For the second problem, it showed a proposed methodology using GIS to handle the assumption of using unique Variogram in soil profile geo-statistical modeling which could be unsuitable for some large scale cases. In the thesis, Sgems (which is developed in Stanford university for geo-statistical modeling) , ARCGIS (for spatial data handling) software and Sequential indicator simulation algorithm (for geo-statistical simulation) were introduced and the reasons behind these choices were discussed , this is beside a group of modules and software developed to fulfill a proposed workflow of geo-statistical modeling of soil profile. A pilot implementation was done on CPT data from Kuwait city and the practical implementation was done on boreholes from 10th of Ramadan city in Egypt

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" الحمد لله الذي هدانا لهذا وما كنا لنهتدى لولا أن هدانا الله "
صدق الله العظيم

الأعراف " ٤٣ "

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Mohammed Abd El Fadil Ismail Abd El Fadil

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