DETERMINATION OF FIELD DRY DENSITY OF SANDY SOILS USING A DYNAMIC CONE PENETRATION TEST

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DECLARATION

I affirm that the content presented in this thesis is the result of my individual effort, and it has not been previously submitted for a degree or diploma in any other educational institution. To the best of my knowledge and belief, I assert that there is no inclusion of material without proper acknowledgement, and it does not incorporate any work previously published by another person except where explicitly acknowledged in the text.

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Date : 22nd April 2024

I confirm that I have read the thesis and endorse its acceptance as meeting the partial requirements for the award of the Master of Science degree in Geotechnical Engineering.

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Name of the Supervisor : Prof. U.P. Nawagamuwa

Date : 22nd April 2024

ABSTRACT

Determination of Field Dry Density of Sandy Soils Using A Dynamic Cone Penetration Test

The degree of compaction plays a critical part in assessing the quality of soil layers during road and highway construction. However, conventional field density testing methods are time-consuming and may not fully ensure compaction compliance throughout construction. Thus, there is a need for efficient quality control and assurance procedures to maintain project progress while upholding construction quality.

This study aims to establish relationships between the Dynamic Cone Penetration (DCP) Rate and field dry density, facilitating efficient field density assessment without solely relying on traditional methods like the sand cone test. Although previous researchers have developed correlations to determine field dry density with the DCP penetration index, regression analysis results indicate their incompatibility with local soil conditions due to variations in soil formations and environmental factors. Hence, reliability analysis and modification are necessary to tailor these correlations to local conditions. Therefore, this study develops numerical correlations between the DCP penetration index (PRI) and field dry density (FDD) of subgrade soil using data obtained from laboratory and field investigations related to road construction. Following this, the outcomes of tests including Atterberg limits, sieve analysis, DCP penetration, Proctor Compaction, and field density tests are subjected to further analysis. Soil classifications were conducted in accordance with the Unified Soil Classification System (USCS).

The regression analysis is performed using MATLAB software, employing a curve fitting tool with robust regression options, such as Least Average Residual (LAR) and Bisquare, to mitigate the impact of outliers during model fitting. This study proposes to modify the existing correlations and two new correlations using regression analysis in the form of first and second-order numerical equations, with multiple variables representing the DCP Penetration Index (PRI) and the Field Moisture Content (FMC).

Keywords: Field Dry Density, DCP Penetration Index, Field Moisture Content

ACKNOWLEDGEMENT

I am deeply grateful to all those who have supported me throughout my postgraduate journey and the completion of this thesis.

Firstly, I sincerely appreciate my research supervisor, **Prof. U.P. Nawagamuwa,** from the Department of Civil Engineering, University of Moratuwa. His invaluable insights and constructive feedback have significantly enhanced the quality of this work.

I extend my thanks to **Prof. L.I.N De Silva**, the course coordinator, for providing me with the opportunity to conduct this research study. Additionally, I am thankful to the Department of Civil Engineering, University of Moratuwa, for their support, necessary funding, and facilities, which have been instrumental in completing this research.

I would also like to acknowledge the Road Development Authority, Research and Development Division (RDA), and the Inclusive Connectivity and Development Project for providing me with the laboratory and field investigation test report data. Their contribution has been invaluable to the progress of this research.

Lastly, I want to express my heartfelt gratitude to my parents, loving wife, and friends for their unwavering encouragement, love, and understanding throughout this journey. Their emotional support has been a constant source of strength.

To everyone who has played a role in this endeavor, thank you.

A.M.I.M Wijesundara

March, 2024

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LIST OF ABBREVIATIONS

Abbreviation	Description
AASHTO	American Association of State Highway & Transportation Officials
ASTM	American Society of Testing and Materials
BS	British Standard
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetration
DCPI	Dynamic Cone Penetration Index
FDD	Field Dry Density
FMC	Field Moisture Content
ICDP	Inclusive Connectivity & Development Project
LWD	Light Weight Deflectometer
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
QC	Quality Control
QA	Quality Assurance
RDA	Road Development Authority
RMSE	Root Mean Square Error
SC	Clayey Sand
SM	Silty Sand
SSCM	Standard Specification of Construction Management
SSE	Sum of Squared Error
TRRL	Transportation and Road Research Laboratory
USCS	Unified Soil Classification System
WB	World Bank