



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

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DECLARATION

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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

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TABLE OF CONTENT

ABSTRACT	I
ACKNOWLEDGEMENT	II
LIST OF ABBREVIATIONS.....	VII
CHAPTER 01.....	1
1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	2
1.3 Aims and Objectives	3
CHAPTER 02.....	4
2 LITERATURE REVIEW	4
2.1 Introduction	4
2.2 Field Density and Degree of Compaction	4
2.3 The Standard Field Density Test Methods	5
2.3.1 The Sand Cone Method (Sand Replacement Method).....	5
2.3.2 The Core Cutter Method/Drive Cylinder Method.....	5
2.3.3 The Shelby Tube Method	5
2.3.4 The Nuclear Density Gauges	6
2.3.5 Static Plate Load Tests.....	7
2.3.6 Dynamic Plate Load Tests (Falling Weight Deflector Meter-FWD)	7
2.3.7 The Laboratory Compaction: Proctor Compaction Tests (Standard and Modified)	7
2.3.8 The Soil Index properties: Atterberg limits	8
2.3.9 The Dynamic Cone Penetrometer (DCP).....	8
2.4 Relationships Between DCPI and California Bearing Ratio (CBR).....	10
2.5 Relationships Between the DCPI and Field Dry Density (FDD) and Field Moisture Content	11
2.6 Relationships Between the DCPI and Field Dry Density (FDD).....	12
CHAPTER 03.....	17
3 METHODOLOGY	17
3.1 Introduction	17
3.2 Field data collection	19
3.3 Numerical Analysis with MATLAB Software.....	24
3.3.1 Regression Analysis for Validation of Previously Developed Correlations	24
3.3.2 Modification of Existing Correlations to Obtained Best Fit Model.....	27
3.3.3 Developing New Best Fit Model/Correlation for Determination of Field Dry Density of Sandy Soil with a Dynamic Cone Penetration Index	27
3.4 Regression Analysis	27
3.5 Curve-Fitting Application in MATLAB Software	30
CHAPTER 04.....	31
4 RESULTS AND DISCUSSION	31

4.1	Introduction	31
4.2	MATLAB Regression Analysis with Curve Fitting Tool	32
4.3	Regression Analysis for Evaluate Best Fit Model for FDD for Local Clayey Sand	32
4.3.1	Regression Analysis Results of Existing Model Validating for Clayey Sand.....	32
4.3.2	Regression Analysis Results of Existing Model Modification for Clayey Sand.....	33
4.3.3	Regression Analysis Results of Trailed New Correlations for Clayey Sand	35
4.4	Regression Analysis for Evaluate Best Fit Model for FDD for Local Silty Sand	39
4.4.1	Regression Analysis Results of Existing Model Validating for Silty Sand	39
4.4.2	Regression Analysis Results of Existing Model Modification for Silty Sand	40
4.4.3	Regression Analysis Results of Trailed New Correlations for Silty Sand (SM).....	41
4.5	Regression Analysis for Evaluate Best Fit Model for FDD for Local All Sandy Soil	44
4.5.1	Regression Analysis Results of Existing Model Validating for All Sandy Soil	44
4.5.2	Regression Analysis Results of Existing Model Modification for All Sandy Soil	46
4.5.3	Regression Analysis Results of Trailed New Correlations for All Sandy Soil	47
4.6	Summary of MATLAB Regression Analysis Results for Each Soil Category concerning the analysed Equations.....	51
4.7	Check Statistical Relationship of Evaluated Bestfit Correlations From MATLAB Analysis Using SPSS Software.	52
4.7.1	SPSS Statistical Analysis of New Correlation MF-2-M for Local All Sandy Soil	52
4.7.2	SPSS Statistical Analysis of New Correlation MF-3 for Local All Sandy Soil.....	53
4.7.3	SPSS Statistical Analysis of New Correlation MF-4 for Local All Sandy Soil.....	53
4.7.4	Summary of SPSS Software Non-linear Regression Analysis Results for All Sandy Category Considering Best Fit Correlations From the MATHLAB Analysis.....	54
CHAPTER 05		55
5	CONCLUSION AND RECOMMENDATION	55
5.1	Conclusion	55
5.2	Recommendation	59
5.3	Recommendation for Future Studies.....	59
REFERENCE		61
APPENDIX A		65
MATLAB Analysis Data and Detail Summary of Regression Analysis		65

LIST OF TABLES

Table 3.1 Collected Number of Test Data	21
Table 3.2 Format for the Collected Field and Laboratory Test Data	22
Table 3.3 Summary of Soil Category Sample Size for the Numerical Analysis	24
Table 3.4 Selected Other Researcher's Model Equations for The Validating with Regression Analysis Using MATLAB	26
Table 3.5 Modified Co relations from The Other Researchers.....	28
Table 3.6 Tried New Correlation for MATLAB Regression Analysis	29
Table 4.1 Filtered Data Types for Further Analysis	31
Table 4.2 Summary of Regression Analysis Results	51
Table 4.3 Summary of SPSS Nonlinear Regression Analysis Results For All Sandy Soil	54
Table 5.1 Summary of Best Fit Correlations for Represent FDD of Local Sandy Soil	57
Table A.1 Detail Summary of Regression Analysis of Trial Correlations for Clayey Sand (SC)	74
Table A.2 Detail Summary of Regression Analysis of Trial Correlations for Silty Sand (SM)	76
Table A.3 Detail Summary of Regression Analysis of Trial Correlations for All Sand	78

LIST OF FIGURES

Figure 2.1 DCP Apparatus (Sawangsuriya & Edil, 2005)	10
Figure 2.2 Relationship between the dry density (γ_d) and the LDCP Index (Mansour et al., 2019)	13
Figure 2.3 Relationship between the water content and the LDCP Index (Mansour et al., 2019).....	14
Figure 2.4 Relationship Between Sand Cone and DCP Outputs (Ampadu & Arthur, 2005).....	16
Figure 3.1 Flow Chart of Research Methodology and Approach	18
Figure 3.2 Geographical Locations of Sample Collected (Reference Google Map).....	20
Figure 3.3 Classified Number of Soil Samples.....	23
Figure 4.1 Regression Plot of Modification of Model-2(Eq.4) for FDD vs FMC & PRI for SC	35
Figure 4.2 Regression Plot of New Correlation MF-3 for FDD vs FMC & PRI for SC.....	36
Figure 4.3 Regression Plot of New Correlation MF-4 for FDD vs FMC & PRI for SC.....	37
Figure 4.4 Regression Plot of Modification of Model-2(Eq.4) for FDD vs FMC & PRI for SM.....	41
Figure 4.5 Regression Plot of New Correlation of MF-4 for FDD vs FMC & PRI for SM	42
Figure 4.6 Regression Plot of Validation of Model-2(Eq.4) for FDD vs FMC & PRI for Sandy Soil.....	45
Figure 4.7 Regression Plot of Modification of Coefficient of Model-2(Eq.4) for FDD vs FMC & PRI Sandy Soil	47
Figure 4.8 Regression Plot of New Correlation MF-3 for FDD vs FMC & PRI for Sandy Soil	48
Figure 4.9 Regression Plot of New Correlation MF-4 for FDD vs FMC vs PRI for Sandy Soil.....	49
Figure 4.10 SPSS Analysis Output ANOVA & Parameter Estimates Results For MF-2-M	53

Figure 4.11 SPSS Analysis Output ANOVA & Parameter Estimates Results For MF-3.....	53
Figure 4.12 SPSS Analysis Output ANOVA & Parameter Estimates Results For MF-4.....	54
Figure A.1 Script File for Clayey Sand Soil.....	66
Figure A.2 Workspace and Imported Variables of Clayey Sand.....	66
Figure A.3 Regression Analysis Plot of Validation of Model-1(Eq.10) for FDD vs PRI for SC	67
Figure A.4 Regression Analysis Pot of Validation of Model-2(Eq.4) for FDD vs PRI & FMC for SC.....	67
Figure A.5 Regression Analysis Pot of Validation of Model-3(Eq.11) for FDD vs PRI for SC	67
Figure A.6 Regression Analysis Pot of Modification of Model-1(Eq.10) for FDD vs PRI for SC	68
Figure A.7 Regression Pot of New Correlation of MF-5 for FDD vs PRI & MDD for SC.....	68
Figure A.8 Regression Pot of New Correlation of MF-6 for FDD vs PRI for SC.....	68
Figure A.9 Regression Pot of New Correlation of MF-7 for FDD vs PRI & MDD for SC.....	69
Figure A.10 Regression Pot of Validation of Model-1(Eq.10) for FDD vs PRI for SM	69
Figure A.11 Regression Pot of Validation of Model-2(Eq.4) for FDD vs PRI & FMC for SM.....	69
Figure A.12 Regression Pot of Validation of Model-3(Eq.11) for FDD vs PRI & FMC for SM.....	70
Figure A.13 Regression Analysis Pot of Modification of Model-1(Eq.10) for FDD vs PRI for SM	70
Figure A.14 Regression Analysis Plot of New Correlation of MF-3 for FDD vs PRI & FMC for SM.....	70
Figure A.15 Regression Analysis Plot of New Correlation of MF-5 for FDD vs PRI & MDD for SM.....	71
Figure A.16 Regression Analysis Plot of New Correlation of MF-6 for FDD vs PRI for SM.....	71
Figure A.17 Regression Analysis Plot of New Correlation of MF-7 for FDD vs for Silty Sand.....	71
Figure A.18 Regression Analysis Plot of Validation of Model-1(Eq.10) for FDD vs PRI for Sandy Soil.....	72
Figure A.19 Regression Analysis Plot of Validation of Model-3(Eq.11) for FDD vs PRI for Sandy Soil.....	72
Figure A.20 Regression Analysis Plot of Modification of Model-1(Eq.10) for FDD vs PRI for Sandy Soil.....	72
Figure A.21 Regression Analysis Plot of New Correlation MF-5 for FDD vs MDD vs PRI for Sandy Soil	73
Figure A.22 Regression Analysis Plot of New Correlation MF-6 for FDD vs PRI for Sandy Soil.....	73
Figure A.23 Regression Analysis Plot of New Correlation MF-7 for FDD vs MDD vs PRI for Sandy Soil	73

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