

## DUBAI ACCREDITATION DEPARTMENT

### REPORT ON PTP 170<sup>th</sup> INTER-LABORATORY PROFICIENCY TESTING PROGRAM DETERMINATION OF DRY DENSITY / MOISTURE CONTENT RELATIONSHIP IN SOIL

Date: 30 December 2008

#### 1. INTRODUCTION

This document presents the results of the 170<sup>th</sup> inter-laboratory proficiency-testing program conducted during the month of October involving the determination of **Dry Density / Moisture Content Relationship in Soil** with thirty one laboratories participating.

This program is part of the Inter-laboratory Comparison Programs organized by Dubai Accreditation Department (DAC) of Dubai Municipality (DM) for monitoring the validity of test results of laboratories operating in Dubai as a requirement of the Local Order 52/1990 and ISO/IEC 17011: 2004.

#### 2. EXPERIMENTAL DESIGN

##### 2.1 Homogeneity:

DAC had ensured the homogeneity of the samples prior to their distribution to the participating laboratories by conducting homogeneity test on six samples (randomly selected). Based on the test results the homogeneity is statistically evaluated as per *ISO 13528:2005 as explained in DAC-G3-03*.

##### 2.2 Participants:

Twenty eight private laboratories and three governmental laboratories (fifteen of them are accredited by DAC for construction materials testing) participated in this program. A total of thirty one laboratories participated in this program.

##### 2.3 Samples Tested:

One (1) Soil sample of approximately 25 kg consists of brown Fine to Medium Sand specimen was distributed to all participating laboratories, with each participant being given one sample with a unique identification number provided during the time of collection.

#### 3. CONFIDENTIALITY

Each laboratory is given a code number to maintain confidentiality of results and to protect their identities. Only the concerned laboratory knows its code number.

#### 4. TEST METHOD

Instructions were given to the participants to test the samples for Determination of dry density moisture content relationship as per (BS 1377: Part4:1990 T.3.5.4.2 AMD 13925: 2002)  
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### 5. TEST RESULTS

The test results submitted by the participating laboratories are presented in Appendix A. In order to protect the identity of the participating laboratories, each one was assigned a code number. The numbers in the column headings, Lab #, of the tables represents the code numbers for the participating laboratories.

### 6. EVALUATION OF RESULTS

#### 6.1 Method of Analysis

The analysis of the participant's results is based on *ISO 13528:2005 (Statistical Methods for the Use in Proficiency Testing by Inter-laboratory Comparisons)*

#### 6.2 Calculations of Z- Scores

Appendix B gives the details of the calculation of the laboratories results and their Z-Scores which are obtained from the raw data. Also Z- Score and participant's results are represented in a bar chart and X-Y scattered plots C. The Z-Score analysis is based on an international Standard (*ISO 13528:2005*).

#### 6.3 Outlier Results

Test	Labs outside the z-scores $\pm 3$
Maximum Dry Density	Labs : 9 ; 11 ; 18
Optimum Moisture Content	Lab: 9

After evaluating the Z-Score the test results provided by the above mentioned laboratories are outside the Z - score limits of  $\pm 3$ , the above mentioned laboratories are requested to investigate the root cause of the outlier results, implement corrective action and a report shall be available for checking by assessment team during the nearest assessment visit.

Also other participating laboratories have showed Z-score values higher than **two** which representing **not outlier** but a warning limit, these laboratories are advised to investigate the potential root cause of such results.

### 7. APPENDICES

#### 7.1 Appendix A: Raw Data

#### 7.2 Appendix B: Calculation of z-scores and other statistics

#### 7.3 Appendix C: Charts

---- End of Report ----

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## Determination of Dry Density / Moisture Content Relationship in Soil

### Appendix A: Raw Data

**Table - 1: Maximum Dry Density**

Lab #	Results
Lab 1	1.74
Lab 2	1.73
Lab 3	1.73
Lab 4	1.74
Lab 5	1.71
Lab 6	1.75
Lab 7	1.75
Lab 8	1.74
Lab 9	2.02
Lab 10	1.73
Lab 11	1.834
Lab 12	1.72
Lab 13	1.75
Lab 14	1.74
Lab 15	1.75
Lab 16	1.73
Lab 17	1.74
Lab 18	1.79
Lab 19	1.74
Lab 20	1.74
Lab 21	1.73
Lab 22	1.74
Lab 23	1.74
Lab 24	1.74
Lab 25	1.73
Lab 26	1.74
Lab 27	1.73
Lab 28	1.73
Lab 29	1.74
Lab 30	1.75
Lab 31	1.75

**Table - 2: Optimum Moisture Content**

Lab #	Results
Lab 1	14
Lab 2	15
Lab 3	14
Lab 4	14
Lab 5	13
Lab 6	15
Lab 7	15
Lab 8	15
Lab 9	9.2
Lab 10	14
Lab 11	11.9
Lab 12	11.2
Lab 13	12.49
Lab 14	14
Lab 15	15
Lab 16	14
Lab 17	14
Lab 18	13
Lab 19	15
Lab 20	14
Lab 21	14
Lab 22	14
Lab 23	14
Lab 24	14
Lab 25	14
Lab 26	14
Lab 27	13.7
Lab 28	14
Lab 29	14
Lab 30	14
Lab 31	14

## Determination of Dry Density / Moisture Content Relationship in Soil

### Appendix - B Calculations of Z-Score and Other Statistics

Table -1 Maximum Dry Density

Iteration	0	xi-x*	1	(xi-x*) <sup>2</sup>	2	(xi-x*) <sup>2</sup>	3	(xi-x*) <sup>2</sup>	4	(xi-x*) <sup>2</sup>	5	(xi-x*) <sup>2</sup>	6	(xi-x*) <sup>2</sup>	Z Score
$\delta = 1.5 s^*$	---		0.02		0.02		0.02		0.02		0.02		0.02		
$x^* - \delta$	---		1.72		1.72		1.72		1.72		1.72		1.72		
$x^* + \delta$	---		1.76		1.76		1.76		1.76		1.76		1.76		
Lab 5	1.71	0.03	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	-2.73
Lab 12	1.72	0.02	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00	-1.82
Lab 10	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 16	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 2	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 21	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 25	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 27	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 28	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 3	1.73	0.01	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	1.73	0.00	-0.91
Lab 1	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 14	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 17	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 19	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 20	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 22	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 23	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 24	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 26	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 29	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 4	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 8	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	0
Lab 13	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 15	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 30	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 31	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 6	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 7	1.75	0.01	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	1.75	0.00	0.91
Lab 18	1.79	0.05	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	4.55
Lab 11	1.83	0.09	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	8.18
Lab 9	2.02	0.28	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	1.76	0.00	25.45
Average	1.75		1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	1.74	0.00	
SD	0.05		0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	
New x*	1.74	0.01	1.740	0.01	1.740	0.01	1.740	0.01	1.740	0.01	1.74	0.01	1.74	0.01	
New s*	0.01		0.013		0.012		0.011		0.011		0.01		0.011		

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Target value	1.74
Low Acceptable	1.71
High Acceptable	1.77
Acceptable Range	1.71 - 1.77

## Determination of Dry Density / Moisture Content Relationship in Soil

**Table - 2 Optimum Moisture Content**

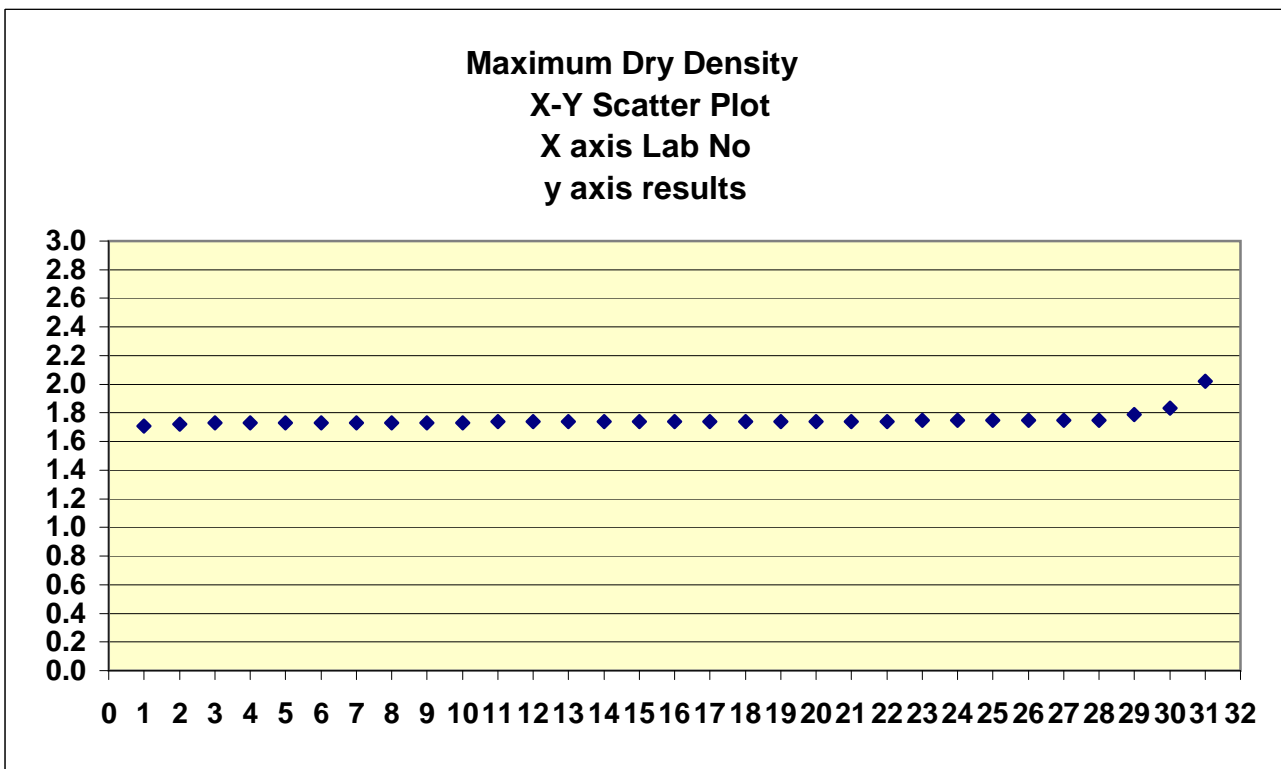
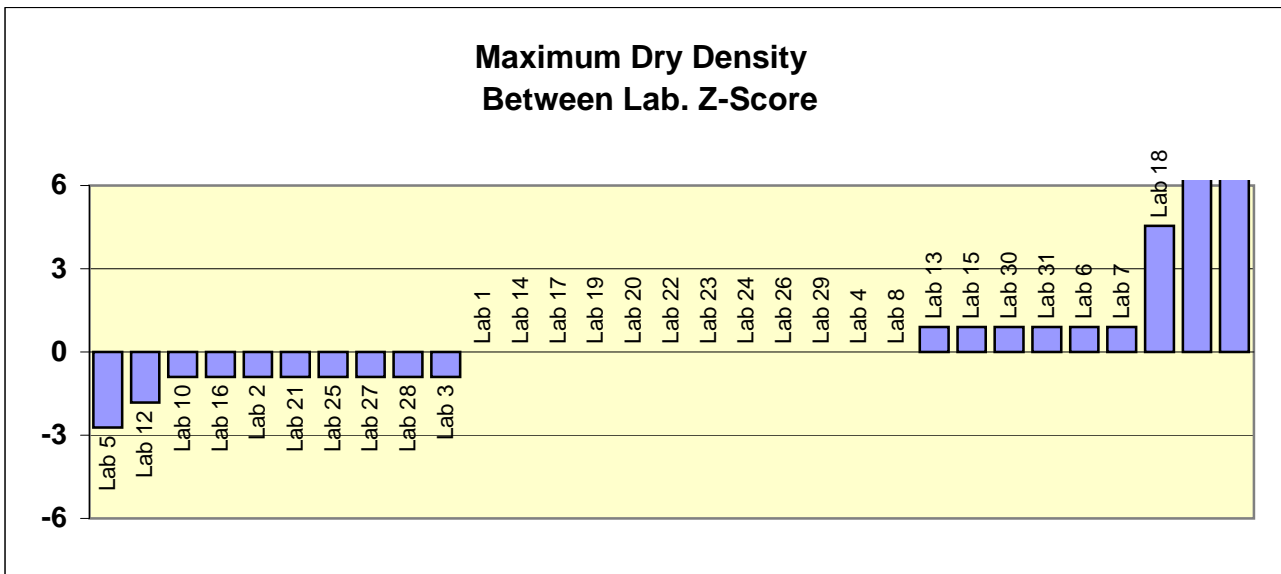
Iteration	0	xi-x*	1	(xi-x*) <sup>2</sup>	2	(xi-x*) <sup>2</sup>	3	(xi-x*) <sup>2</sup>	4	(xi-x*) <sup>2</sup>	5	(xi-x*) <sup>2</sup>	6	(xi-x*) <sup>2</sup>	Z Score
$\delta = 1.5 s^*$	---		0.00		0.00		0.00		0.00		0.00		0.00		
$x^* - \delta$	---		14.00		14.00		14.00		14.00		14.00		14.00		
$x^* + \delta$	---		14.00		14.00		14.00		14.00		14.00		14.00		
Lab 9	9.2	4.80	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-3.97</b>
Lab 12	11.2	2.80	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-2.31</b>
Lab 11	11.9	2.10	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-1.74</b>
Lab 13	12.5	1.51	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-1.24</b>
Lab 18	13.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-0.83</b>
Lab 5	13.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-0.83</b>
Lab 27	13.7	0.30	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>-0.25</b>
Lab 1	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 10	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 14	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 16	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 17	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 20	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 21	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 22	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 23	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 24	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 25	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 26	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 28	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 29	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 3	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 30	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 31	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 4	14.0	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0</b>
Lab 15	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
Lab 19	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
Lab 2	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
Lab 6	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
Lab 7	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
Lab 8	15.0	1.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	14.00	0.00	<b>0.83</b>
<b>Average</b>	<b>13.8</b>		<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	
<b>SD</b>	<b>1.21</b>		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	
<b>New x*</b>	<b>14.00</b>	<b>0.00</b>	<b>14.000</b>	<b>0.00</b>	<b>14.000</b>	<b>0.00</b>	<b>14.000</b>	<b>0.00</b>	<b>14.000</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	<b>14.00</b>	<b>0.00</b>	
<b>New s*</b>	<b>0.00</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>		<b>0.00</b>		<b>0.00</b>		

N 31

Target value	<b>14.00</b>
Low Acceptable	<b>10.37</b>
High Acceptable	<b>17.63</b>
Acceptable Range	<b>10.37-17.63</b>

# Determination of Dry Density / Moisture Content Relationship in Soil

## Appendix - C Charts Dry Density Moisture Content Relationship in Soil



# Determination of Dry Density / Moisture Content Relationship in Soil

## Appendix - C Charts Dry Density Moisture Content Relationship in Soil

