DUBAI ACCREDITATION DEPARTMENT

REPORT ON 201 LABORATORY PROFICIENCY TESTING
DETERMINATION OF CALIFORNIA BEARING RATIO

2 March 2011

1. INTRODUCTION

This document presents the results of the 201 Inter-Laboratory Proficiency Testing program conducted during the month of January involving the **Determination of California Bearing Ratio (CBR)** with thirty three 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 and to ensure the competent of accredited and registered laboratories operating in Dubai as a requirement of the law no. 2/2010 and ISO/IEC 17011: 2004. Also laboratories from other emirates and from outside UAE were participated in this scheme.

2. EXPERIMENTAL DESIGN

2.1 Homogeneity:

DAC ensure the homogeneity of the samples prior to 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:

Thirty three laboratories were participated in this PTP including:

- Two governmental laboratories.
- Seventeen are private laboratories operating in Dubai including accredited and registered laboratories.
- Six private laboratories are from other Emirates.
- Five laboratories are from Qatar.
- Two laboratories are from Oman
- One laboratory is from Bahrain.

2.3 Samples Tested:

One sample of Cemented Sand approximately 20 Kg was distributed to all participating laboratories.

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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 as per BS 1377 Part 4, T.7: 1990, Amd: 13925:2002.

5. TEST RESULTS

The test results which were 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 (Appendix A).

Z- Score of each participant and its code number are represented in a bar chart and also the result of each participant is reflected as X-Y scattered plots Appendix C.

The Z-Score analysis is based on an international Standard ***(ISO 13528:2005)***.

6.3 Outlier Results

Test	Labs outside the z-scores ±3
California Bearing Ratio (Top)	**Lab 68; Lab EX16**
California Bearing Ratio (Bottom)	**Lab 68; Lab EX1; Lab EX4; Lab EX5; Lab EX7; Lab EX16; Lab EX24;**

After evaluating the Z-Score values the test results provided by the above mentioned laboratories are outside the Z - score limits of ± 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 is **not outlier** but, this is consider as a warring 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 ---

Determination of California Bearing Ratio (CBR)

CBR @ 2.5 mm (Top)

Lab #	Results
Lab 4	32
Lab 9	32
Lab 74	35
Lab 58	33
Lab 21	35
Lab 56	37
Lab 23	35
Lab 79	35
Lab 57	36
Lab 7	39
Lab 28	37
Lab EX11	32
Lab 39	37
Lab 82	36
Lab G01	39
Lab 3	38
Lab EX7	38
Lab EX17	38
Lab EX9	28
Lab EX18	38
Lab 89	36
Lab EX1	39
Lab EX6	33
Lab EX4	29
Lab 67	37
Lab EX5	39
Lab EX24	31
Lab EX14	31
Lab 68	9
Lab EX22	36
Lab EX10	31
Lab EX20	35
Lab EX16	24

CBR @ 2.5 mm (Bottom)

Lab #	Results
Lab 4	34
Lab 9	34
Lab 74	36
Lab 58	39
Lab 21	38
Lab 56	36
Lab 23	36
Lab 79	37
Lab 57	37
Lab 7	40
Lab 28	39
Lab EX11	35
Lab 39	35
Lab 82	37
Lab G01	40
Lab 3	36
Lab EX7	24
Lab EX17	39
Lab EX9	29
Lab EX18	40
Lab 89	38
Lab EX1	45
Lab EX6	37
Lab EX4	17
Lab 67	38
Lab EX5	44
Lab EX24	13
Lab EX14	38
Lab 68	10
Lab EX22	37
Lab EX10	33
Lab EX20	35
Lab EX16	27

CBR @ 5 mm (Top)

Lab #	Results
Lab 4	36
Lab 9	37
Lab 74	37
Lab 58	33
Lab 21	30
Lab 56	40
Lab 23	38
Lab 79	35
Lab 57	37
Lab 7	41
Lab 28	39
Lab EX11	35
Lab 39	40
Lab 82	38
Lab G01	31
Lab 3	40
Lab EX7	28
Lab EX17	34
Lab EX9	35
Lab EX18	34
Lab 89	37
Lab EX1	29
Lab EX6	38
Lab EX4	24
Lab 67	39
Lab EX5	40
Lab EX24	24
Lab EX14	33
Lab 68	10
Lab EX22	39
Lab EX10	36
Lab EX20	37
Lab EX16	20

CBR @ 5 mm (Bottom)

Lab #	Results
Lab 4	38
Lab 9	40
Lab 74	39
Lab 58	39
Lab 21	32
Lab 56	38
Lab 23	40
Lab 79	39
Lab 57	38
Lab 7	42
Lab 28	40
Lab EX11	38
Lab 39	38
Lab 82	40
Lab G01	33
Lab 3	39
Lab EX7	19
Lab EX17	37
Lab EX9	36
Lab EX18	37
Lab 89	40
Lab EX1	32
Lab EX6	40
Lab EX4	15
Lab 67	40
Lab EX5	43
Lab EX24	10
Lab EX14	41
Lab 68	11
Lab EX22	40
Lab EX10	38
Lab EX20	38
Lab EX16	25

Determination of California Bearing Ratio (CBR)

Appendix B: Calculation of z-scoree and other statistics

CBR @ Top

Iteration	0	xi-x*	1	$(xi-x^*)^2$	2	$(xi-x^*)^2$	3	$(xi-x^*)^2$	4	$(xi-x^*)^2$	5	$(xi-x^*)^2$	6	$(xi-x^*)^2$	
$\delta = 1.5\ s^*$	---		4.45		4.32		4.32		4.32		4.32		4.32		
$x^* - \delta$	---		32.55		32.56		32.57		32.57		32.57		32.57		
$x^* + \delta$	---		41.45		41.21		41.21		41.20		41.20		41.20		**Z Score**
Lab 68	10	27.00	32.55	18.78	32.56	18.70	32.57	18.67	32.57	18.65	32.57	18.64	32.57	18.63	-9.34
Lab EX16	24	13.00	32.55	18.78	32.56	18.70	32.57	18.67	32.57	18.65	32.57	18.64	32.57	18.63	-4.48
Lab EX4	29	8.00	32.55	18.78	32.56	18.70	32.57	18.67	32.57	18.65	32.57	18.64	32.57	18.63	-2.74
Lab EX24	31	6.00	32.55	18.78	32.56	18.70	32.57	18.67	32.57	18.65	32.57	18.64	32.57	18.63	-2.05
Lab 58	33	4.00	33.00	15.09	33.00	15.10	33.00	15.11	33.00	15.11	33.00	15.11	33.00	15.11	-1.35
Lab EX14	33	4.00	33.00	15.09	33.00	15.10	33.00	15.11	33.00	15.11	33.00	15.11	33.00	15.11	-1.35
Lab 21	35	2.00	35.00	3.55	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	-0.66
Lab 79	35	2.00	35.00	3.55	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	-0.66
Lab EX11	35	2.00	35.00	3.55	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	-0.66
Lab EX9	35	2.00	35.00	3.55	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	35.00	3.56	-0.66
Lab 4	36	1.00	36.00	0.78	36.00	0.79	36.00	0.79	36.00	0.79	36.00	0.79	36.00	0.79	-0.31
Lab EX10	36	1.00	36.00	0.78	36.00	0.79	36.00	0.79	36.00	0.79	36.00	0.79	36.00	0.79	-0.31
Lab 57	37	0.00	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	0.04
Lab 74	37	0.00	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	0.04
Lab 89	37	0.00	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	0.04
Lab 9	37	0.00	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	0.04
Lab EX20	37	0.00	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	37.00	0.01	0.04
Lab 23	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab 82	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab EX17	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab EX18	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab EX6	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab EX7	38	1.00	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	38.00	1.24	0.39
Lab 28	39	2.00	39.00	4.47	39.00	4.47	39.00	4.47	39.00	4.46	39.00	4.46	39.00	4.46	0.73
Lab 67	39	2.00	39.00	4.47	39.00	4.47	39.00	4.47	39.00	4.46	39.00	4.46	39.00	4.46	0.73
Lab EX1	39	2.00	39.00	4.47	39.00	4.47	39.00	4.47	39.00	4.46	39.00	4.46	39.00	4.46	0.73
Lab EX22	39	2.00	39.00	4.47	39.00	4.47	39.00	4.47	39.00	4.46	39.00	4.46	39.00	4.46	0.73
Lab G01	39	2.00	39.00	4.47	39.00	4.47	39.00	4.47	39.00	4.46	39.00	4.46	39.00	4.46	0.73
Lab 3	40	3.00	40.00	9.70	40.00	9.70	40.00	9.69	40.00	9.69	40.00	9.69	40.00	9.69	1.08
Lab 39	40	3.00	40.00	9.70	40.00	9.70	40.00	9.69	40.00	9.69	40.00	9.69	40.00	9.69	1.08
Lab 56	40	3.00	40.00	9.70	40.00	9.70	40.00	9.69	40.00	9.69	40.00	9.69	40.00	9.69	1.08
Lab EX5	40	3.00	40.00	9.70	40.00	9.70	40.00	9.69	40.00	9.69	40.00	9.69	40.00	9.69	1.08
Lab 7	41	4.00	41.00	16.93	41.00	16.92	41.00	16.92	41.00	16.92	41.00	16.91	41.00	16.91	1.43
Average	35.79		36.88	206.74	36.89	206.38	36.89	206.20	36.89	206.12	36.89	206.08	36.89	206.06	
SD	5.80		2.54	6.46	2.54	6.45	2.54	6.44	2.54	6.44	2.54	6.44	2.54	6.44	
New x*	**37**	**2.00**	**36.88**	**2.54**	**36.89**	**2.54**	**36.89**	**2.54**	**36.89**	**2.54**	**36.89**	**2.54**	**36.89**	**2.54**	
New s*	**2.97**		**2.88**		**2.88**		**2.88**		**2.88**		**2.88**		**2.88**		

N= 33 **Target value** **36.89** **Low Acceptable** **28.25** **High Acceptable** **45.5202** **Acceptable Range (28-46)**

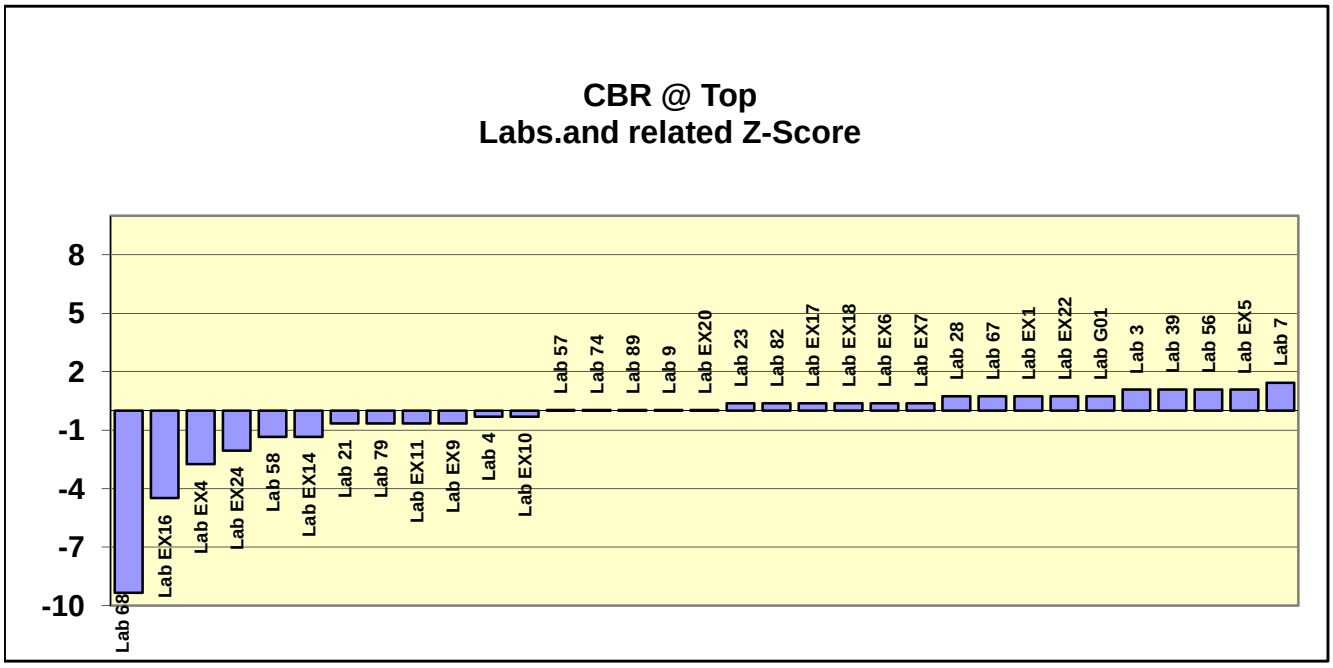
Determination of California Bearing Ratio (CBR)

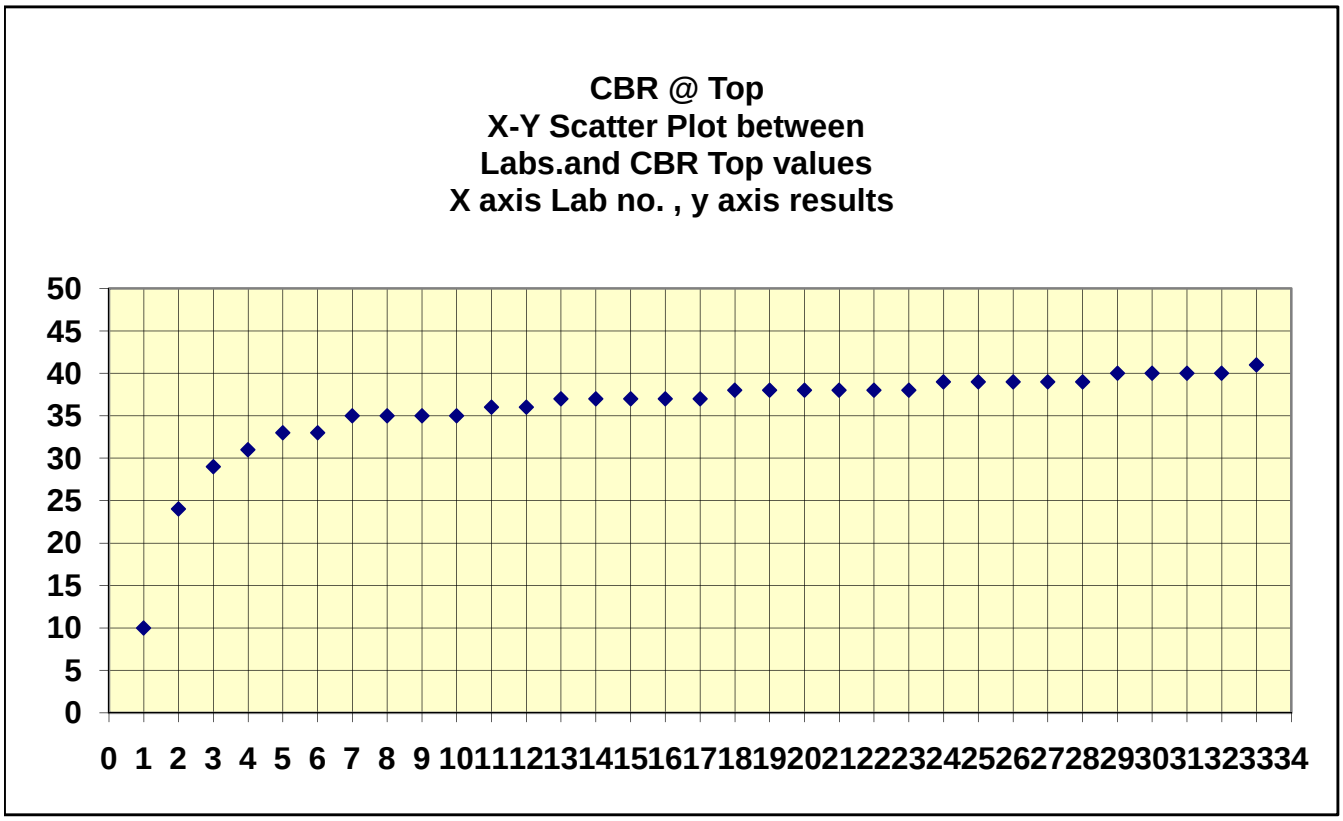
Appendix B: Calculation of z-scoree and other statistics

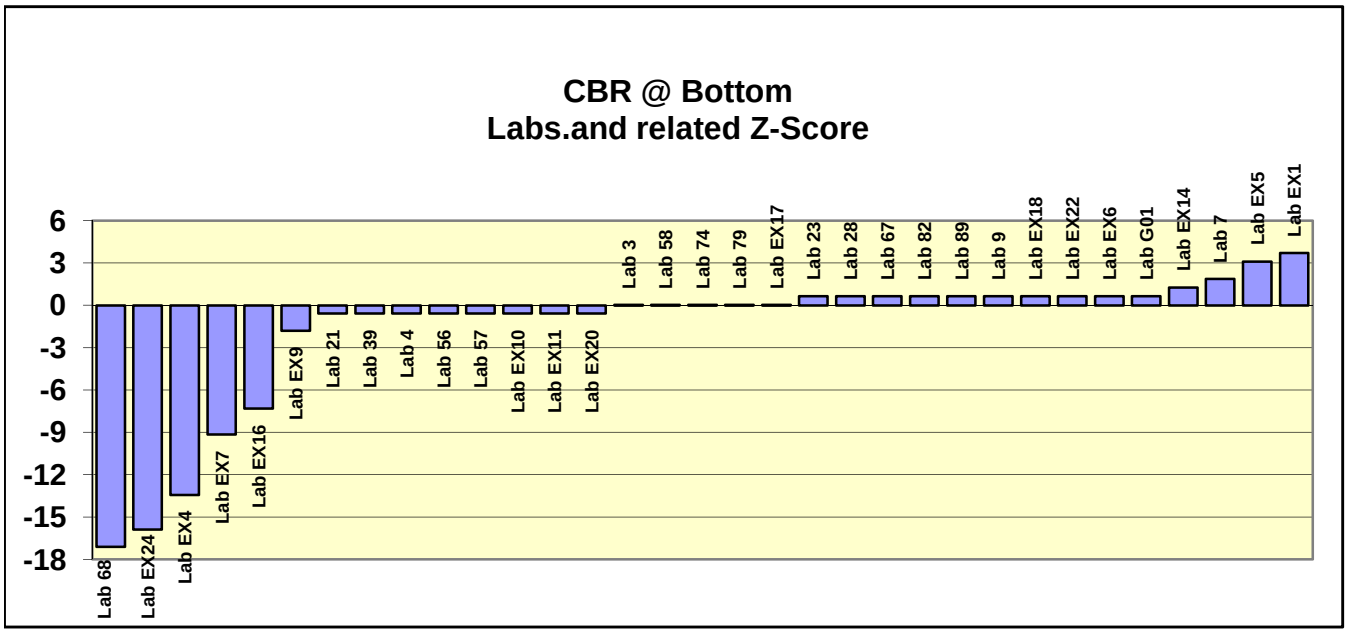
CBR @ Bottom

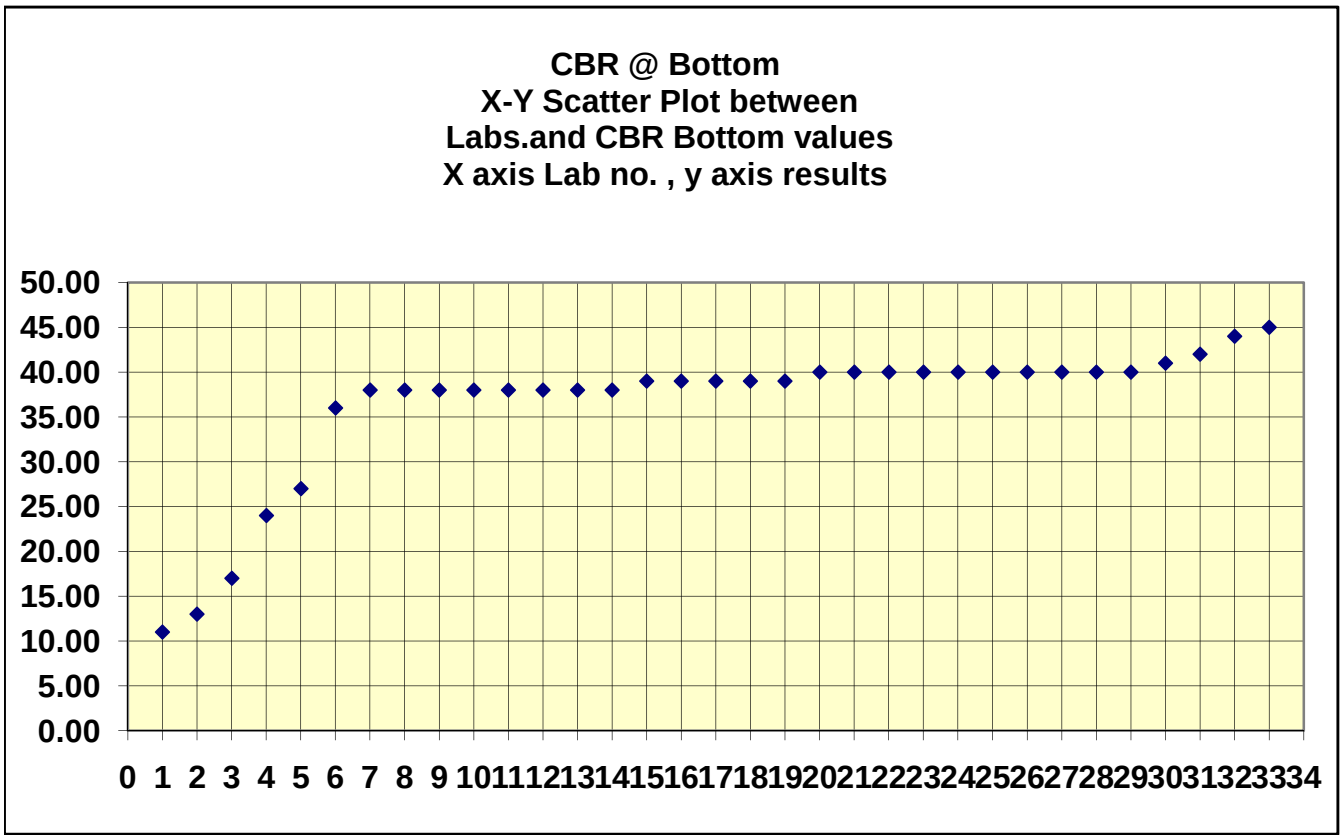
Iteration	0	xi-x*	1	$(xi-x^*)^2$	2	$(xi-x^*)^2$	3	$(xi-x^*)^2$	4	$(xi-x^*)^2$	5	$(xi-x^*)^2$	6	$(xi-x^*)^2$	
δ = 1.5 s*	---		2.22		2.45		2.45		2.45		2.45		2.45		
x* - δ	---		36.78		36.47		36.47		36.47		36.47		36.47		
x* + δ	---		41.22		41.37		41.37		41.37		41.37		41.37		**Z Score**
Lab 68	11.00	28.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-17.10
Lab EX24	13.00	26.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-15.88
Lab EX4	17.00	22.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-13.43
Lab EX7	24.00	15.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-9.14
Lab EX16	27.00	12.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-7.30
Lab EX9	36.00	3.00	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	36.78	4.59	-1.79
Lab 21	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab 39	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab 4	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab 56	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab 57	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab EX10	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab EX11	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab EX20	38.00	1.00	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	38.00	0.84	-0.56
Lab 3	39.00	0.00	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	0.05
Lab 58	39.00	0.00	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	0.05
Lab 74	39.00	0.00	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	0.05
Lab 79	39.00	0.00	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	0.05
Lab EX17	39.00	0.00	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	39.00	0.01	0.05
Lab 23	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab 28	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab 67	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab 82	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab 89	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab 9	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab EX18	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab EX22	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab EX6	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab G01	40.00	1.00	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	40.00	1.17	0.66
Lab EX14	41.00	2.00	41.00	4.33	41.00	4.33	41.00	4.33	41.00	4.33	41.00	4.33	41.00	4.33	1.27
Lab 7	42.00	3.00	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	1.89
Lab EX5	44.00	5.00	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	3.11
Lab EX1	45.00	6.00	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	41.22	5.32	3.72
Average	36.33		38.92	66.32	38.92	66.32	38.92	66.32	38.92	66.32	38.92	66.32	38.92	66.32	
SD	8.25		1.44	2.07	1.44	2.07	1.44	2.07	1.44	2.07	1.44	2.07	1.44	2.07	
New x*	**39**	**1.00**	**38.92**	**1.44**	**38.92**	**1.44**	**38.92**	**1.44**	**38.92**	**1.44**	**38.92**	**1.44**	**38.92**	**1.44**	
New s*	**1.48**		**1.63**		**1.63**		**1.63**		**1.63**		**1.63**		**1.63**		

N= 33 **Target value** **38.92** **Low Acceptable** **34.02** **High Acceptable** **43.82** **Acceptable Range (34-44)**


CBR @ Top
Labs.and related Z-Score
8
5
2
-1
-4
-7
-10
Lab 68
Lab EX16
Lab EX4
Lab EX24
Lab 58
Lab EX14
Lab 21
Lab 79
Lab EX11
Lab EX9
Lab 4
Lab EX10
Lab 57
Lab 74
Lab 89
Lab 9
Lab EX20
Lab 23
Lab 82
Lab EX17
Lab EX18
Lab EX6
Lab EX7
Lab 28
Lab 67
Lab EX1
Lab EX22
Lab G01
Lab 3
Lab 39
Lab 56
Lab EX5
Lab 7


CBR @ Top
X-Y Scatter Plot between
Labs.and CBR Top values
X axis Lab no. , y axis results
50
45
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34


CBR @ Bottom
Labs.and related Z-Score
6
3
0
-3
-6
-9
-12
-15
-18
Lab 68
Lab EX24
Lab EX4
Lab EX7
Lab EX16
Lab EX9
Lab 21
Lab 39
Lab 4
Lab 56
Lab 57
Lab EX10
Lab EX11
Lab EX20
Lab 3
Lab 58
Lab 74
Lab 79
Lab EX17
Lab 23
Lab 28
Lab 67
Lab 82
Lab 89
Lab 9
Lab EX18
Lab EX22
Lab EX6
Lab G01
Lab EX14
Lab 7
Lab EX5
Lab EX1


CBR @ Bottom
X-Y Scatter Plot between
Labs.and CBR Bottom values
X axis Lab no. , y axis results
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34