CETANZ

Civil Engineering Testing Association of New Zealand

TECHNICAL REPORT ON

California Bearing Ratio Proficiency 2019/2020

CETANZ Technical Report	**TR13**
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California Bearing Ratio Proficiency 2019/2020

1. Introduction

In 2019 CETANZ organised a CBR interlab, the purpose of this was to provide results that should enable participants to improve their performance.

1. Contribute to confidence of mutual users of Civil Engineering Laboratories.
2. Identify problems with, or between, laboratories.
3. Provide an indication of the industry's ability to perform the test method.
4. Potentially identifying needs for test method improvement.
5. Gather information from laboratories about their current estimates of Uncertainty of Measurement.

The following Laboratories participated in the scheme:

Winstone Aggregates CEA
Fulton Hogan Auckland Lab Auckland
WSP-Opus Auckland
Probase Engineering Hamilton
Geotechnics Nz Ltd Tauranga
Higgins Contractors Palmerston North
WSP Opus Lower Hutt
WSP Opus Tauranga
Geotechnics Auckland
Fulton Hogan Ltd -Wakato Hamilton
Roadtest Ltd Auckland
Geocivil Limited Whangarei
WSP Opus Napier
Civil Engineering Laboratory Services Ltd Nelson
Downer NZ Panmure Auckland
Road Science Mt Maunganui
WSP Opus Gisborne Gisborne
Winstone Aggregates Paraparaumu
Road Science Auckland
Geotechnics Nz Ltd Auckland
Envirolab Geotest Ltd Auckland
WSP-Opus Laboratory Whanganui
Road Science Wellington
Winstone Aggregates Auckland
Geotechnics Nz Ltd Christchurch
WSP-Opus International Consultants Ltd Whangarei
Stevenson Aggregates Ltd Auckland
WSP-Opus Laboratory Hamilton
Fulton Hogan Canterbury Christchurch
WSP Opus New Plymouth New Plymouth

To ensure anonymity of results each laboratory was assigned a unique identifier by Keith Towl of IANZ.

2. Sample Preparation

Winstone Aggregates' CEA sampled and prepared material for testing. Two materials were tested.

Aggregate
Clay/Ash

The selection of materials was designed to give a range of results at both the lower and higher end of the spectrum

A bulk sample was collected, sieved through a 37.5mm sieve then split into portions through a riffle box. Each sample was bagged and sealed before couriering to participating labs

3. Testing

Laboratories were asked to complete full tests on each material in accordance with the standard method at natural moisture content, compacted to NZS4402:1986 4.1.1 Standard Compaction

4. Results

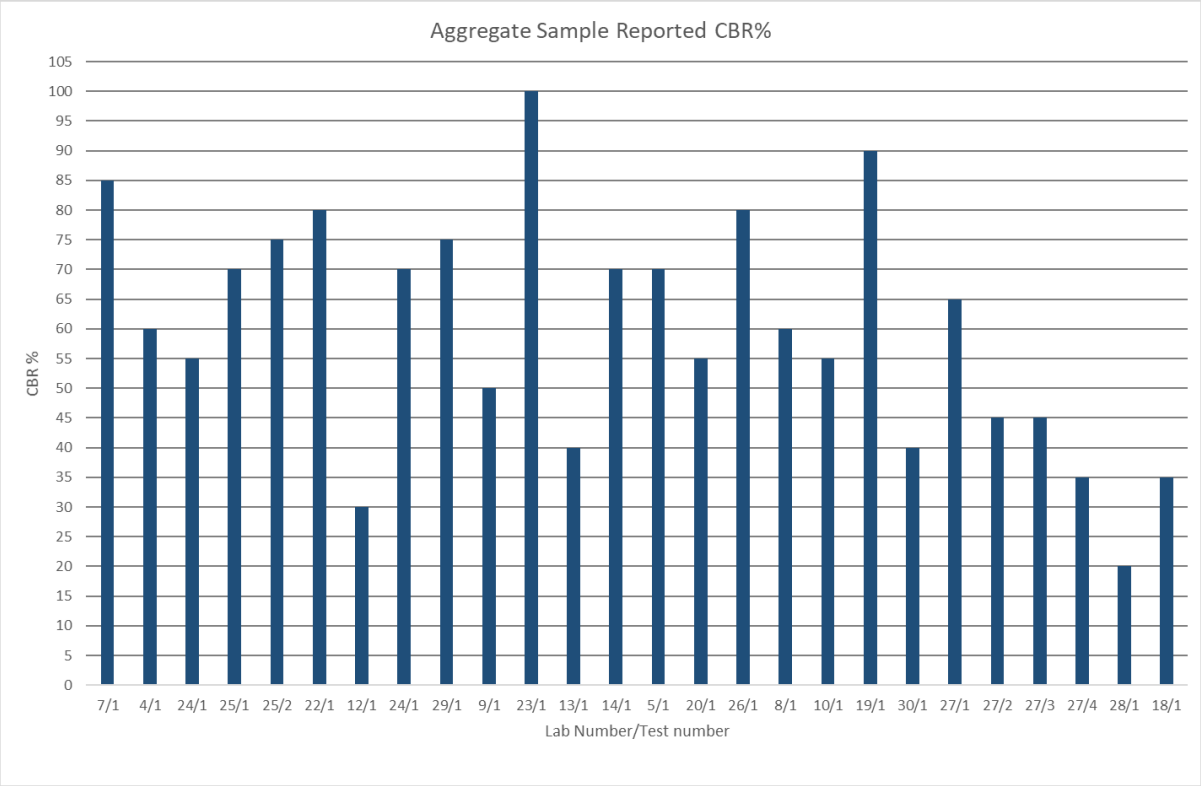
A summary of results is below 26 (Aggregate) 28 (Clay/Ash) results are included in the analysis of the results.

For the analysis of results all results were included. There were results present that potentially could be considered outliers. Difficulties with defining an outlier and the importance of representing the full range of results have meant these numbers have been retained.

5. Analysis

Graphs 1 & 2 show the results for the 2 different materials included in the program.
Table 1 shows the raw results and Table 2 shows the Z Scores.

Graph 1



Graph 2

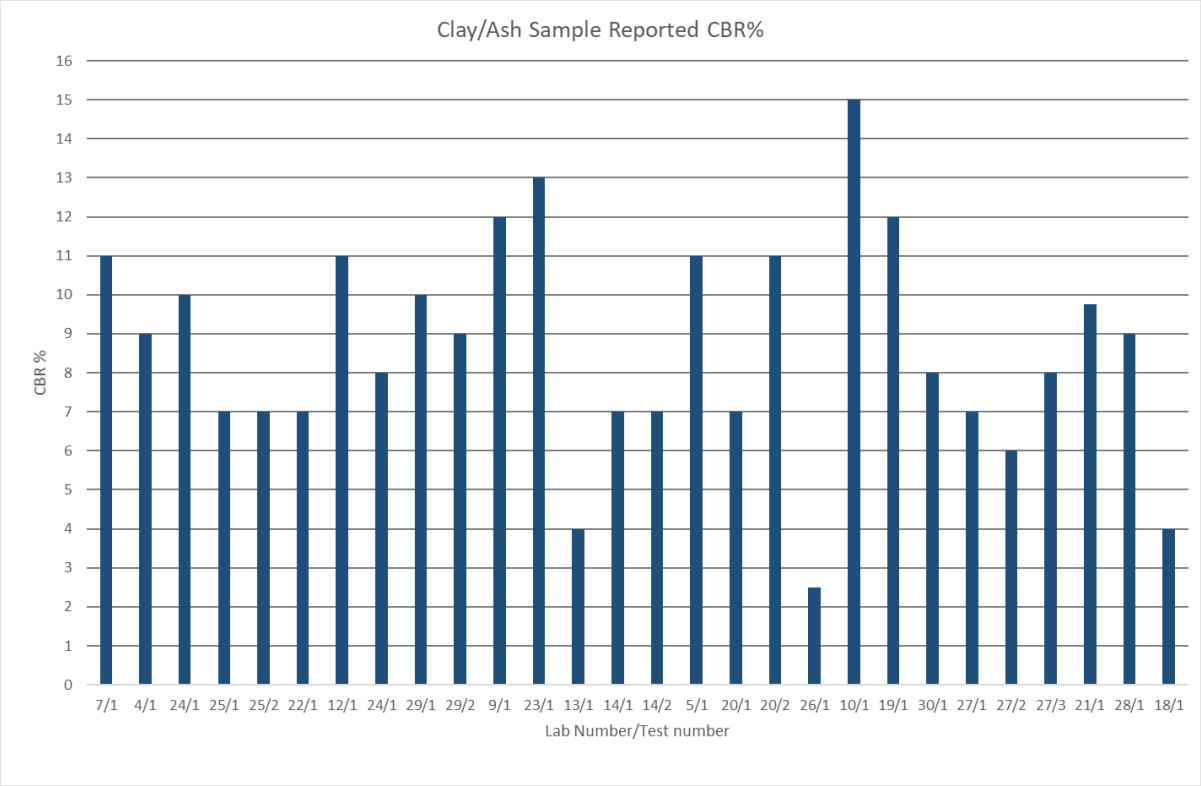

Clay/Ash Sample Reported CBR%
CBR %
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
7/1 4/1 24/1 25/1 25/2 22/1 12/1 24/1 29/1 29/2 9/1 23/1 13/1 14/1 14/2 5/1 20/1 20/2 26/1 10/1 19/1 30/1 27/1 27/2 27/3 21/1 28/1 18/1
Lab Number/Test number

Table 1a

Aggregate Sample								
Lab No	**Test no**	**Dry Density t/m³**	**Before compaction MC%**	**Swell %**	**2.5mm CBR%**	**5mm CBR%**	**MC% after penetration**	**Reported CBR%**
7	**1**	2.000	5.5	0.00	80.3	82.5	7.0	85
4	**1**	1.980	5.0	0.00	Not Reported	60.0	6.8	60
24	**1**	Not Reported	52.2	0.00	46.6	55.5	45.2	55
25	**1**	1.996	4.9	0.00	57.1	70.1	7.1	70
25	**2**	2.015	4.6	0.00	57.2	72.3	7.3	75
22	**1**	1.984	5.2	-0.02	72.0	78.9	6.4	80
12	**1**	1.900	4.9	-0.20	25.0	30.0	6.9	30
24	**1**	1.940	5.8	0.00	60.6	69.0	7.1	70
29	**1**	1.999	5.9	0.00	70.8	76.7	7.0	75
9	**1**	1.980	6.0	0.00	45.0	50.0	6.3	50
23	**1**	1.991	5.5	0.14	84.7	97.7	6.4	100
13	**1**	1.940	6.4	-0.80	35.0	40.0	7.4	40
14	**1**	Not Reported	4.8	0.00	61.4	70.1	6.9	70
5	**1**	1.98	5.0	-0.03	65	70	6.8	70
20	**1**	1.93	5.1	0.8	30.5	55.9	8.5	55
26	**1**	1.95	5.8	0.09	80	80	5.9	80
8	**1**	1.92	6.0	0.4	60	60	6.9	60
10	**1**	1.94	6.0	0	43.6	54.9	6.9	55
19	**1**	2.04	4.5	0	85	18	6.4	90
30	**1**	1.92	4.7	-0.2	31.1	40.5	7.4	40
27	**1**	2.00	6.5	0	53	65	7.2	65
27	**2**	1.92	5.6	0	33.3	45	6.5	45
27	**3**	1.94	5.6	0	33.3	45	7.3	45
27	**4**	1.94	7.3	0	27.3	35	11.6	35
28	**1**	1.97	1.1	0	15	20	8.4	20
18	**1**	1.94	3.6	0	35.3	35.8	8.5	35

Table 1b

Clay/Ash Sample								
Lab No	**Test no**	**Dry Density t/m³**	**Before compaction MC%**	**Swell %**	**2.5mm CBR%**	**5mm CBR%**	**MC% after penetration**	**Reported CBR%**
7	**1**	1.110	48.8	0.00	11.0	10.9	50.6	11
4	**1**	1.100	49.9	-0.60	Not Reported	9.0	51.5	9
24	**1**	1.100	49.8	0.00	9.6	9.1	50.1	10
25	**1**	1.210	50.4	0.00	6.8	7.0	50.9	7
25	**2**	1.113	50.5	0.20	5.6	6.6	51.1	7
22	**1**	1.110	50.1	0.02	6.1	7.0	50.7	7
12	**1**	1.060	50.1	0.40	11.0	9.0	52.5	11
24	**1**	1.100	49.7	0.00	7.6	8.1	53.3	8
29	**1**	1.108	49.9	0.07	8.9	10.1	48.8	10
29	**2**	1.103	49.9	0.10	7.8	8.9	50.2	9
9	**1**	1.100	47.9	0.00	12.0	11.0	51.0	12
23	**1**	1.171	40.1	0.33	12.9	13.1	50.7	13
13	**1**	1.060	54.6	0.00	4.0	4.0	54.9	4
14	**1**	1.101	50.1	0.0	6.1	6.9	51.5	7
14	**2**	1.120	50.4	0.8	6.5	7.3	51.4	7
5	**1**	1.100	49.7	0.1	9.0	11.0	53.8	11
20	**1**	1.000	49.7	0.0	5.3	7.2	55.0	7
20	**2**	1.089	50.3	0.0	8.2	10.7	53.5	11
26	**1**	1.076	53.2	0.0	2.0	2.5	54.2	2.5
10	**1**	1.080	46.8	0.2	14.7	12.8	52.6	15
19	**1**	1.110	48.5	-0.2	12.0	11.0	51.4	12
30	**1**	1.110	50.2	0.0	6.1	7.7	50.3	8
27	**1**	1.120	49.8	0.0	5.3	7.0	49.8	7
27	**2**	1.080	50.1	0.0	6.1	6.0	49.8	6
27	**3**	1.080	46.5	0.0	7.6	7.0	52.3	8
21	**1**	1.083	50.2	0.0	1.0	9.8	50.9	9.75
28	**1**	1.120	49.7	0.0	Not Reported	Not Reported	49.6	9
18	**1**	1.080	53.1	0.0	4.1	4.1	53.8	4

Table 2a

Aggregate Z-Scores						
Lab No	**Test no**	**Dry Density t/m3**	**Swell %**	**2.5mm CBR%**	**5mm CBR%**	**Reported CBR%**
7	**1**	1.2	0.0	1.3	1.2	1.3
4	**1**	0.6	0.0	Not Reported	0.1	0.0
24	**1**	Not Reported	0.0	-0.3	-0.1	-0.3
25	**1**	1.0	0.0	0.2	0.6	0.5
25	**2**	1.6	0.0	0.2	0.7	0.8
22	**1**	0.7	-0.1	0.9	1.0	1.0
12	**1**	-1.6	-0.8	-1.4	-1.4	-1.5
24	**1**	-0.5	0.0	0.4	0.5	0.5
29	**1**	1.1	0.0	0.9	0.9	0.8
9	**1**	0.6	0.0	-0.4	-0.4	-0.5
23	**1**	0.9	0.6	1.6	2.0	2.0
13	**1**	-0.5	-3.2	-0.9	-0.9	-1.0
14	**1**	Not Reported	0.0	0.4	0.6	0.5
5	**1**	0.6	-0.1	0.6	0.6	0.5
20	**1**	-0.7	3.2	-1.1	-0.1	-0.3
26	**1**	-0.3	0.4	1.3	1.1	1.0
8	**1**	-1.0	1.6	0.3	0.1	0.0
10	**1**	-0.5	0.0	-0.5	-0.2	-0.3
19	**1**	2.3	0.0	1.6	-2.0	1.5
30	**1**	-1.1	-0.8	-1.1	-0.9	-1.0
27	**1**	1.2	0.0	0.0	0.4	0.3
27	**2**	-1.1	0.0	-1.0	-0.6	-0.8
27	**3**	-0.5	0.0	-1.0	-0.6	-0.8
27	**4**	-0.5	0.0	-1.3	-1.1	-1.3
28	**1**	0.3	0.0	-1.9	-1.9	-2.0
18	**1**	-0.5	0.0	-0.9	-1.1	-1.3

Table 2b

Clay/Ash Z-Scores						
Lab No	**Test no**	**Dry Density t/m^4**	**Swell %**	**2.5mm CBR%**	**5mm CBR%**	**Reported CBR%**
7	**1**	0.3	0.0	1.1	1.1	0.9
4	**1**	0.0	-2.7	Not Reported	0.3	0.2
24	**1**	0.0	0.0	0.7	0.4	0.5
25	**1**	3.1	0.0	-0.1	-0.4	-0.5
25	**2**	0.4	0.9	-0.5	-0.6	-0.5
22	**1**	0.3	0.1	-0.3	-0.4	-0.5
12	**1**	-1.1	1.8	1.1	0.3	0.9
24	**1**	0.0	0.0	0.1	0.0	-0.2
29	**1**	0.2	0.3	0.5	0.8	0.5
29	**2**	0.1	0.4	0.2	0.3	0.2
9	**1**	0.0	0.0	1.5	1.1	1.2
23	**1**	2.0	1.5	1.7	1.9	1.6
13	**1**	-1.1	0.0	-1.0	-1.6	-1.6
14	**1**	0.0	0.0	-0.3	-0.5	-0.5
14	**2**	0.6	3.6	-0.2	-0.3	-0.5
5	**1**	0.0	0.3	0.5	1.1	0.9
20	**1**	-2.8	0.0	-0.6	-0.3	-0.5
20	**2**	-0.3	0.0	0.3	1.0	0.9
26	**1**	-0.7	0.1	-1.6	-2.2	-2.1
10	**1**	-0.6	0.9	2.3	1.8	2.3
19	**1**	0.3	-0.9	1.5	1.1	1.2
30	**1**	0.3	0.0	-0.3	-0.2	-0.2
27	**1**	0.6	0.0	-0.6	-0.4	-0.5
27	**2**	-0.6	0.0	-0.3	-0.8	-0.9
27	**3**	-0.6	0.0	0.1	-0.4	-0.2
21	**1**	-0.5	0.0	-1.9	0.6	0.4
28	**1**	0.6	0.0	Not Reported	Not Reported	0.2
18	**1**	-0.6	0.0	-0.9	-1.5	-1.6

5. Conclusions

The results of the proficiency scheme have indicated a large variation across the industry in CBR readings, however the Dry Densities and Compacted moistures were relatively consistent.

The data gives us a Standard Deviation of 2.8 on the Clay/Ash and 20 on the Aggregate.

CBR% on the aggregate ranged from 20 to 100 and on the Clay/Ash the range was 2.5 to 15

6. Further action

Advise stakeholders of uncertainty of the test method and use of subsequent data.

7. Referenced Documents

NZS4407:2015: 3.15
NZS4402:1986 4.1.1

8. Disclaimer

The information in this publication is to encourage high standards within the civil engineering testing industry. The information is intended as a technical report for CETANZ members only and in no way purports to be a robust statistical analysis. CETANZ cannot accept any liability of any sort for unsatisfactory site or laboratory work carried out by Companies who are members of CETANZ or organisations who claim to be following this report. CETANZ assumes no responsibility for any loss which may arise from reliance on the report and disclaims all liability accordingly. Specialist and/or legal advice should always be sought on any specific problem or matter.

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