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NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

A GOVT. OF INDIA UNDERTAKING

Consultancy Services for Feasibility Study and Detailed Project Report for Four / Six Laning from Km 38.000 to Km 168.167 of Daboka-Dimapur Section of NH-36 & 39 in the State of Assam & Nagaland under NHDP, Phase – III B, Pkg. No. NHDP – III/DL5/21, Group - G

DIMAPUR BYPASS (NAGALAND PART)

FINAL DETAILED PROJECT REPORT
VOLUME III : MATERIAL REPORT

Archtech Consultants Pvt. Ltd.
CONSULTANTS & ENGINEERS
11, Shakespeare Sarani, Kolkata-700071

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2016

NATIONALHIGHWAYS INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

PREPARATION OF DETAILED PROJECT REPORT FOR DEVELOPMENT OF NH 36 & NH 39

FROM DOBOKA TO DIMAPUR UNDER PHASE 'B' OF SARDP-NE

(Pkg-I) - Dimapur Bypass (Nagaland Part)

FINAL DETAILED PROJECT REPORT

ON

ROAD & PAVEMENT AND MATERIAL INVESTIGATIONS

July, 2016

TABLE OF CONTENT

1. Introduction

The report presents the results of Pavement investigations and soil & material survey works for the proposed 4- laning from Doboka to Dimapur of NH-36 & 39 in the state of Assam and Nagaland. The road starts from Km 38.000 and end at Km 168.167 of NH 36 and it meets at Km 107.800 of NH39.

The investigation was conducted via site visit, collection of representative material, testing the samples both in the field and laboratory.

All samples from the respective test locations were brought to the laboratory at Guwahati established where they were further examined and were subjected to specified and required testing.

1.1: Purpose and Scope

The purpose and scope of our services were as follows:

a) To determine the characteristics and strength of the subgrade along the existing road.

The tests included to accomplish these are as follows:

- In-situ density and moisture content at each test pit.
- Field CBR using DCP at each test pit..
- Modified Proctor tests to determine maximum dry density and optimum moisture content of the subgrade soil in the laboratory.
- Characterization (grain size and Atterberg Limits) of subgrade soil.
- Laboratory CBR (both unsoaked and 4-day soaked) at three energy level.

b) Determination of Pavement Composition i.e. material type and corresponding thickness of different layers / composition of Pavement. The side of test pits should be cleaned properly and thickness of each individual layers of pavement to be measured and recorded in the field.

c) To evaluate the suitability of borrow material for use in construction of embankment and/or subgrade and location of borrow area.

The laboratory tests included under this are as follows:

- Sieve Analysis
- Liquid and Plastic Limits
- Soil Classification
- MDD and OMC
- CBR at three energy level

d) To locate the quarries and testing of stone aggregate as available to evaluate their suitability for use in construction of Pavement, such as Wet Mix Macadam (WMM), Dense Bituminous Macadam (DBM), Bituminous Concrete and Cement Concrete.
The tests included under this are as follows:

- Sieve analysis
- Flakiness and Elongation Index
- Specific Gravity and Water Absorption
- Aggregate Impact Value
- Stripping Value
- Soundness

e) Testing of available sand in the close proximity of the existing highway for use in bituminous mixtures and cement concrete work.

The tests included to determine the suitability of fine aggregates are as follows:

- Sieve analysis
- Fineness Modules
- Specific gravity
- Deleterious content

In order to accomplish this purpose, we have performed the required and all necessary field work and laboratory tastings as follows:

f) Testing of available water to determine their suitability for various types of works and determine their adequacy for construction activities.
In order to accomplish this purpose, we have performed the required and all necessary field work and laboratory tastings as follows:

- PH Value
- Suspended matter
- Chemical Constituents of Chloride, Sulphate
- Organise / Inorganise matters.

■ **Field density Test:**
Field density test was conducted by the core cutter method as guided by IS 2720-1996 (Part XXVII) at the subgrade of each test pit.

Laboratory Investigations:

The following laboratory tests were carried out on representative samples by following relevant IS Code:

- **Atterberg Limits (IS:2720-Part 5) :**

  The liquid and plastic limits of soils, which are cohesive in nature, were determined to classify the soil and qualitatively assess their consistency and compressibility.

- **Natural Moisture Content (IS:2720-Part 2) :**

  Natural moisture content of the representative samples were found to determine the dry density and to study the degree of compressibility of the subgrade soil.

- **Grain Size Distribution (IS:2720 Part 4) :**

  Sieve analysis were performed on soil samples collected from test pits and borrow area to study the compaction characteristics and their suitability as to their use as construction material for embankment and / or subgrade.

- **Modified Proctor Test (IS:2720 Part 8) :**

  Modified proctor test gives the higher degree of compaction. In this test, the soil is compacted in Standard Proctor Mould (capacity 1/30 cu. Ft. or 945ml) but in 5 layers being given 25 blows of 4.5kg rammer dropped from a height of 450mm. This test determines the maximum dry density of the soil and corresponding optimum moisture content. These parameters are used to find the degree of compaction of subgrade soil of the existing pavement and also to determine the compaction criteria to be followed to assure the quality of compaction during construction of embankment and / or preparation of subgrade. The results of all modified proctor tests are presented here is in this report.

- **California bearing ratio test (IS:2720-Part 16) :**

  California bearing ratio tests were performed on bulk samples collected from pavement subgrade of existing highway, from new alignment of widening portion and on borrow materials. The CBR was determined for 3 energy level on both unsoaked and 4 days soaked conditions. To achieve the required CBR of 7, the compaction criteria to be required were also studied. The results of all CBR Tests are shown in tabular form in the later part of this report.

a) Material Investigation :

The material commonly used in highway embankment, subgrade and pavement comprise of soil, gravel (both water borne and pit), stone metal. So it is very important as well as necessary to identify the potential source in substantial quantity of these materials near or in the close vicinity of the construction area.

All representative samples as collected from different borrow area and quarries were brought to the laboratory at Guwahati and were subjected to appropriate and specified laboratory tastings to evaluate their suitability for various components of work and to establish quality and quantity of these material and recommendations as to their use.

Mass haul diagram for haulage purpose are prepared indicating location of selected borrow area, quarries and estimated available quantity.

i) Borrow Area Soil:

Survey was conducted to locate the potential source of borrow area soil required for the construction of embankment and subgrade. The distance from the highway to these borrow areas are shown in the lead chart and is attached in this report. The laboratory tests as detailed earlier in this report were conducted on all samples and the results of which are shown in the attached plates.

i) Laboratory Tests of Aggregates:

a) Coarse Aggregates:

- Sieve Analysis : (IS:383-1997)
- Flakiness and Elongation Index : (IS:2386 Part 1)
- Specific gravity and water absorption : (IS:2386 Part 3)
- Aggregate Impact Value (AIV) : (IS:2386 Part 5)
- Stripping Values
- Soundness

Discussion and Evaluations

The investigations were performed by conducting in-situ testing and supplemented by laboratory testing and measurement of existing pavement thickness. In addition to this, sub grade soil along the widening portion, borrow materials, such as soil and aggregates were tested in the laboratory for evaluation as to their suitability for their use in construction of the proposed highway.

In general the test data reveal that the in-situ field dry density at the existing pavement subgrade varies in the range of 1.54 to 1.80 gms/cc, the laboratory MDD varies in the range of 1.72 to 1.60 gm/cc and the corresponding laboratory CBR values vary in the range 4 to 6 for lowest energy level, 5 to 8 for mid energy level and 6 to a maximum of 12 for the highest energy level.

2. PAVEMENT INVESTIGATION

2.1 General

The existing project road is a flexible pavement and is in poor condition in some stretches. There are a few low laying sections along the road from heavy rains during monsoons. The water stagnates along road side damaging the subgrade and pavement component layers.

2.2 Existing Pavement Composition

The Project road NH-36 is in a poor condition although the pavement comprises of a severely worn out wearing course (PC), a base course (WBM) and stone soling.

The crust thickness and the type of pavement layers were recorded and are given in Table-2.1. The average thickness of the pavement component layers is presented in Tables of Pavement Condition Survey**.**

2.3 Pavement Condition Survey

The pavement condition survey was carried out by visual means supplemented by measurements as per the guidelines mentioned in IRC: SP: 19 – 2001. Detailed field study included pavement condition, shoulder condition, embankment condition, drainage condition etc. The existing pavement conditions were identified and the results have been summarized for every km interval sectional length of the project roads in Table-2.1

The condition of existing road was measured for cracks, reveling, potholes, patching, present of rut and pavement edges drop.

The Riding Quality, in terms of (i) Speed (in km/hr) and (ii) quality (Good, Fair, Poor, Very Poor).

Route depth was measured transversely across the outer wheel paths using 3m long straight edge and graduated wedge.

Shoulder and embankment conditions were observed by visual means and the existence of distress, its cause and extent were noted. Nearly 65% was observed as felled and remaining as in fair condition. The results of Pavement Condition Survey in each km are summarized in the Tables-2.1.

Table No.:2.1

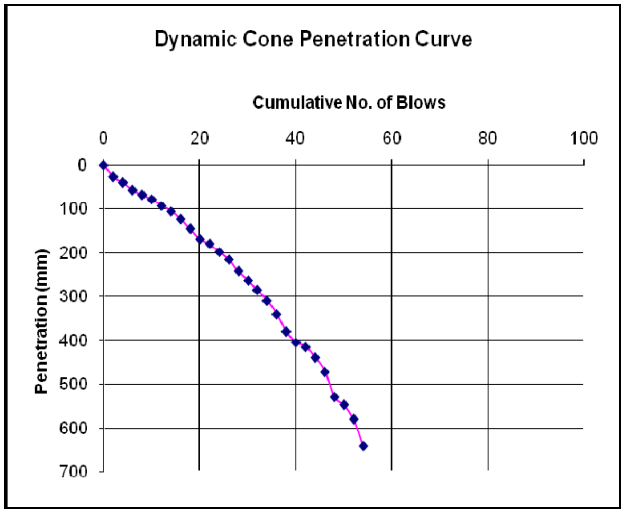
Pit Reference	Pavement Composition			Sub grade type	*Soil Classification	LL	PL	PI	Moisture Content (%)	Field Dry Density (gm/cc)
	GSB (MM)	WBM (MM)	BITUMIN-OUS(MM)							
40+100	0	180	60	Silty Clay	CL	34.53	27.39	7.14	19	0.19
45+150	0	180	60	Silty Clay	CL	36.834	25.522	11.31	11	0.12
50+100	0	180	60	Silty Clay	CL	30.014	22.452	7.56	8	0.14
55+200	0	180	60	Silty Clay	CL	28.564	21.212	7.35	9	0.10
60+100	0	180	65	Silty Clay	CL	30.114	21.002	9.11	11	0.08
65+000	0	200	65	Silty Clay	CL	28.854	22.622	6.23	12	0.11
70+000	0	200	75	Silty Clay	CL	26.364	19.232	7.13	13	0.15
75+100	0	200	75	Silty Clay	CL	28.344	21.422	6.92	5	0.06
80+200	0	200	60	Silty Clay	CL	29.524	21.412	8.11	8	0.09
85+000	0	200	60	Silty Clay	CL	28.654	22.212	6.44	9	0.10
90+000	0	200	60	Silty Clay	CL	27.37	20.33	7.04	11	0.12
95+400	0	200	60	Silty Clay	CL	28.3642	20.002	8.36	17	0.20
100+200	0	200	70	Silty Clay	CL	29.7642	21.232	8.53	15	0.18
105+250	0	200	70	Silty Clay	CL	29.4142	20.052	9.36	19	0.22
110+100	0	200	70	Silty Clay	CL	30.0442	22.342	7.70	18	0.20
115+500	0	0	0	Silty Clay	CL	28.4242	19.732	8.69	26	0.29
120+000	0	0	0	Silty Clay	CL	26.8742	20.242	6.63	17	0.20
125+150	0	180	75	Silty Clay	CL	27.3342	19.502	7.83	12	0.14
130+100	0	180	75	Silty Clay	CL	28.4142	20.012	8.40	12	0.14
135+100	0	180	75	Silty Clay	CL	27.3542	19.552	7.80	16	0.18
140+350	0	180	60	Silty Clay	CL	28.0342	19.792	8.24	9	0.10
145+100	0	180	60	Silty Clay	CL	29.7142	20.032	9.68	21	0.23
150+550	0	180	60	Silty Clay	CL	30.5542	22.282	8.27	11	0.13
155+000	0	180	45	Silty Clay	CL	32.2342	23.512	8.72	21	0.20
160+000	0	250	45	Silty Clay	CL	28.54	22.2	6.34	10	0.11
165+000	0	250	65	Silty Clay	CL	27.53	19.85	7.68	13	0.16

3. DYNAMIC CONE PENETRATION TEST

It is simple device for investigating the compactness of the sub soil layer without making bore hole. The data obtain by this test provides a continuous record of soil resistance. The test is quick and the penetration values may be used for determination of bearing capacity.

FIELD TEST RESULTS

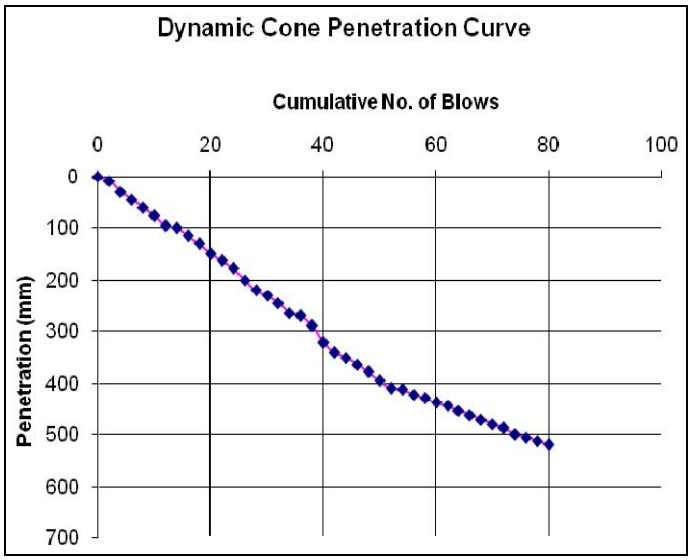
FIELD TEST RESULT AT CHAINAGE=40.100KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	9	35
200-400	10	29
400-600	10	25

cum. No. of blows	Penetration (mm)
0	0
2	27
4	40
6	57
8	68
10	78
12	92
14	105
16	123
18	145
20	168
22	180
24	198
26	215
28	242
30	263
32	285
34	310
36	340
38	380
40	405
42	416
44	440
46	472
48	530
50	548
52	580
54	642

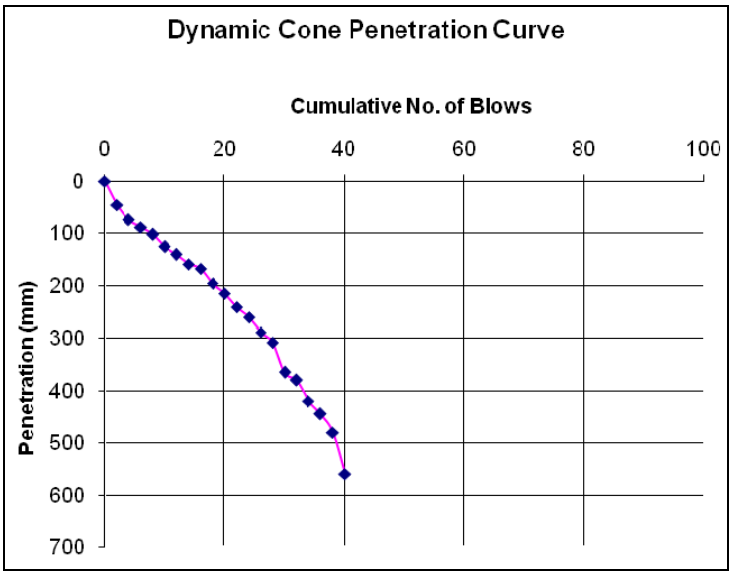
FIELD TEST RESULT AT CHAINAGE=50.150KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	10	39
200-400	9	40
400-600	8	42

cum. No. of blows	Penetration (mm)
0	0
2	8
4	30
6	45
8	60
10	76
12	96
14	100
16	115
18	130
20	148
22	163
24	178
26	200
28	221
30	231
32	245
34	265
36	270
38	290
40	322
42	341
44	351
46	364
48	378
50	395
52	410
54	412
56	422
58	430
60	438
62	445
64	454
66	463
68	472
70	480
72	488
74	500
76	506
78	512
80	520

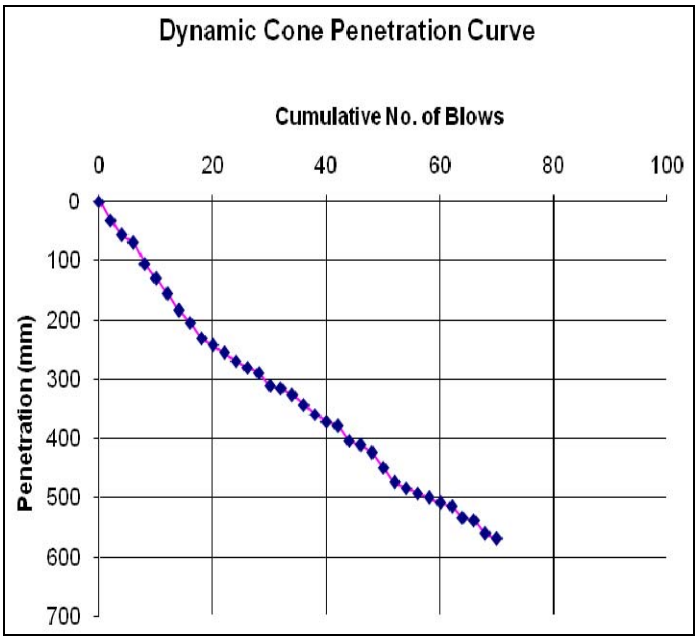
FIELD TEST RESULT AT CHAINAGE=60.000KM



cum. No. of blows	Penetration (mm)
0	0
2	45
4	74
6	88
8	102
10	126
12	141
14	159
16	168
18	196
20	215
22	241
24	261
26	289
28	308
30	365
32	380
34	420
36	445
38	480
40	560

Depth Range	DCP (mm/blow)	CBR (%)
0-200	10	27
200-400	11	24
400-600	14	19

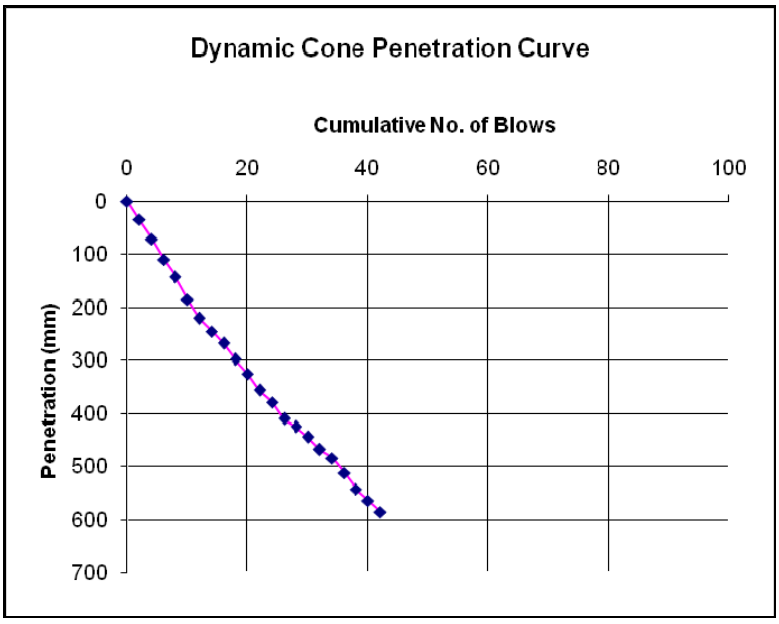
FIELD TEST RESULT AT CHAINAGE=70.120KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	12	24
200-400	10	33
400-600	9	35

cum. No. of blows	Penetration (mm)
0	0
2	32
4	57
6	70
8	105
10	130
12	156
14	184
16	205
18	230
20	242
22	255
24	269
26	280
28	289
30	310
32	315
34	326
36	342
38	360
40	372
42	380
44	405
46	412
48	425
50	450
52	475
54	485
56	493
58	501
60	509
62	516
64	534
66	539
68	561
70	570

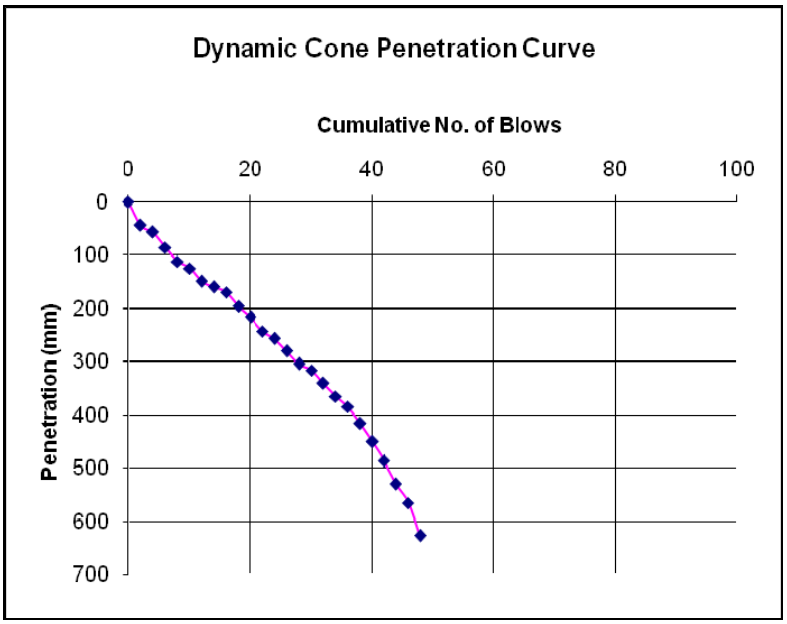
FIELD TEST RESULT AT CHAINAGE=80.000KM



cum. No. of blows	Penetration (mm)
0	0
2	35
4	71
6	110
8	143
10	185
12	221
14	245
16	268
18	298
20	325
22	356
24	379
26	410
28	425
30	445
32	468
34	485
36	512
38	543
40	564
42	586

Depth Range	DCP (mm/blow)	CBR (%)
0-200	18	14
200-400	15	17
400-600	13	22

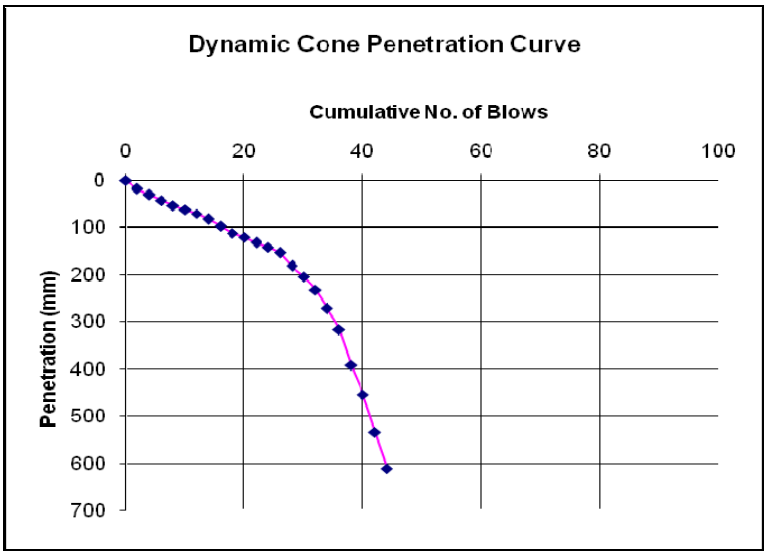
FIELD TEST RESULT AT CHAINAGE=90.000KM



cum. No. of blows	Penetration (mm)
0	0
2	44
4	57
6	86
8	112
10	125
12	150
14	160
16	170
18	196
20	216
22	243
24	257
26	281
28	305
30	316
32	341
34	366
36	386
38	417
40	451
42	488
44	531
46	566
48	628

Depth Range	DCP (mm/blow)	CBR (%)
0-200	12	27
200-400	11	26
400-600	14	24

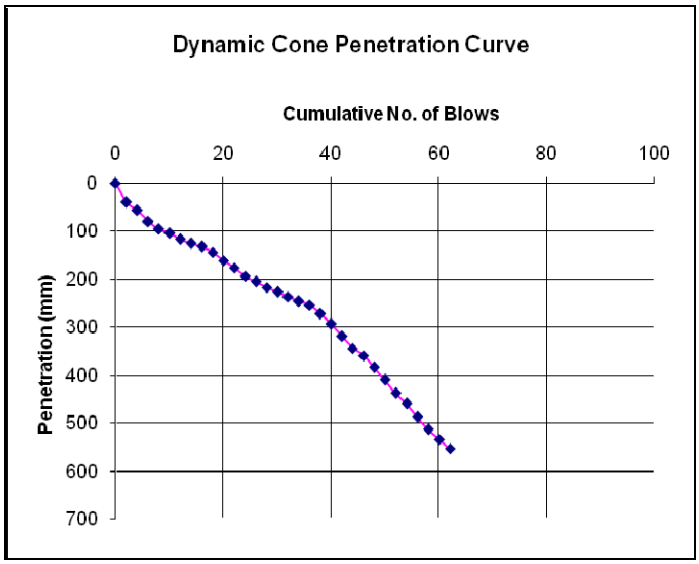
FIELD TEST RESULT AT CHAINAGE=100.100KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	8	38
200-400	11	27
400-600	15	19

cum. No. of blows	Penetration (mm)
0	0
2	18
4	31
6	43
8	54
10	63
12	71
14	83
16	97
18	112
20	121
22	132
24	142
26	154
28	182
30	204
32	232
34	272
36	317
38	392
40	455
42	534
44	612

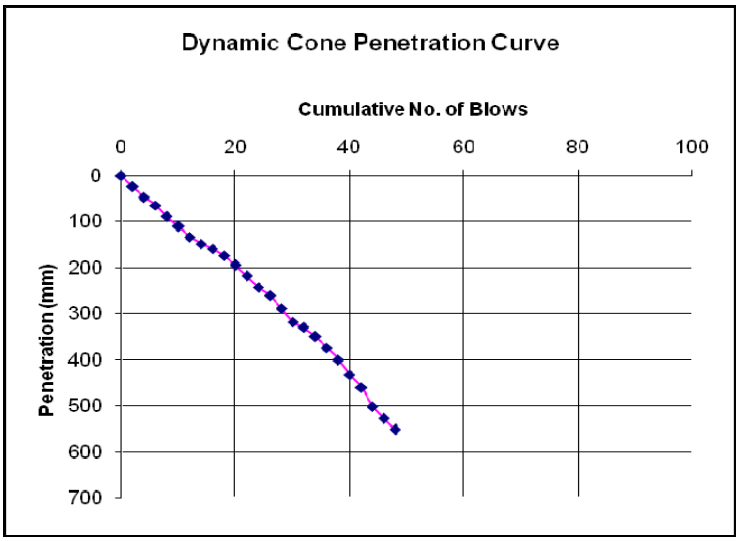
FIELD TEST RESULT AT CHAINAGE=110.000KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	9	35
200-400	10	34
400-600	11	30

cum. No. of blows	Penetration (mm)
0	0
2	40
4	57
6	80
8	96
10	104
12	117
14	126
16	132
18	144
20	161
22	176
24	194
26	206
28	217
30	227
32	237
34	247
36	254
38	272
40	294
42	320
44	344
46	360
48	384
50	410
52	438
54	460
56	488
58	514
60	534
62	554

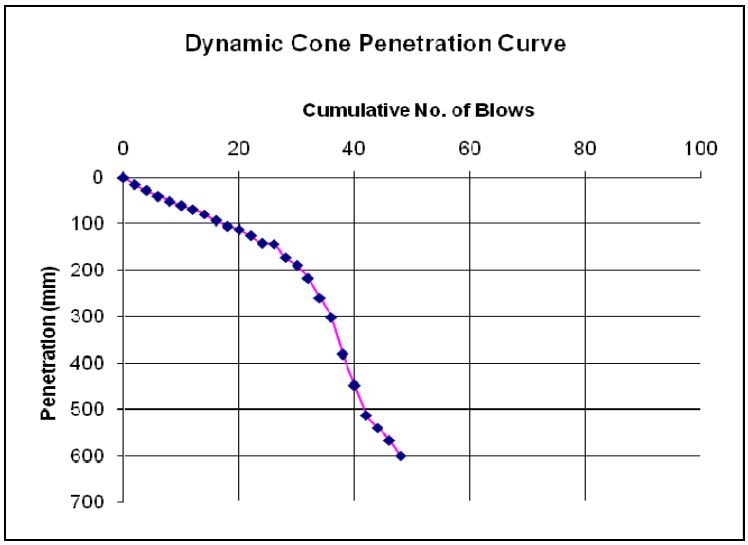
FIELD TEST RESULT AT CHAINAGE=120.200KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	10	28
200-400	10	28
400-600	12	25

cum. No. of blows	Penetration (mm)
0	0
2	25
4	47
6	64
8	89
10	111
12	133
14	149
16	159
18	174
20	195
22	219
24	243
26	261
28	288
30	319
32	330
34	350
36	375
38	400
40	433
42	461
44	502
46	529
48	552

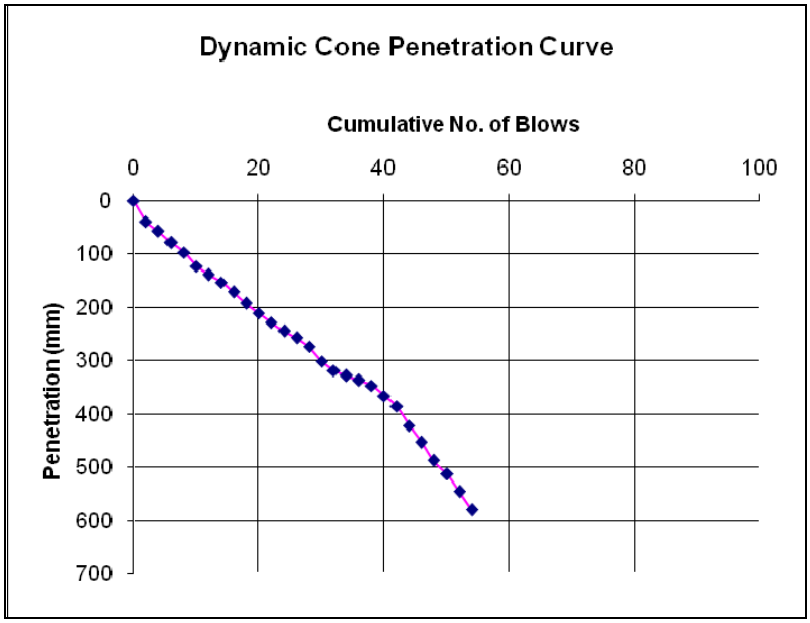
FIELD TEST RESULT AT CHAINAGE=130.000KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	9	38
200-400	10	27
400-600	12	25

cum. No. of blows	Penetration (mm)
0	0
2	16
4	29
6	41
8	52
10	61
12	69
14	80
16	94
18	105
20	112
22	126
24	143
26	144
28	172
30	191
32	217
34	260
36	302
38	382
40	449
42	512
44	540
46	566
48	602

FIELD TEST RESULT AT CHAINAGE=140.100KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	9	32
200-400	10	30
400-600	12	27

cum. No. of blows	Penetration (mm)
0	0
2	39
4	57
6	79
8	97
10	123
12	139
14	153
16	171
18	193
20	211
22	228
24	244
26	257
28	274
30	301
32	319
34	328
36	337
38	347
40	366
42	386
44	422
46	453
48	488
50	512
52	546
54	580

FIELD TEST RESULT AT CHAINAGE=150.000KM

cum. No. of blows	Penetration (mm)
0	0
2	17
4	32
6	44
8	55
10	64
12	69
14	79
16	103
18	117
20	129
22	143
24	152
26	187
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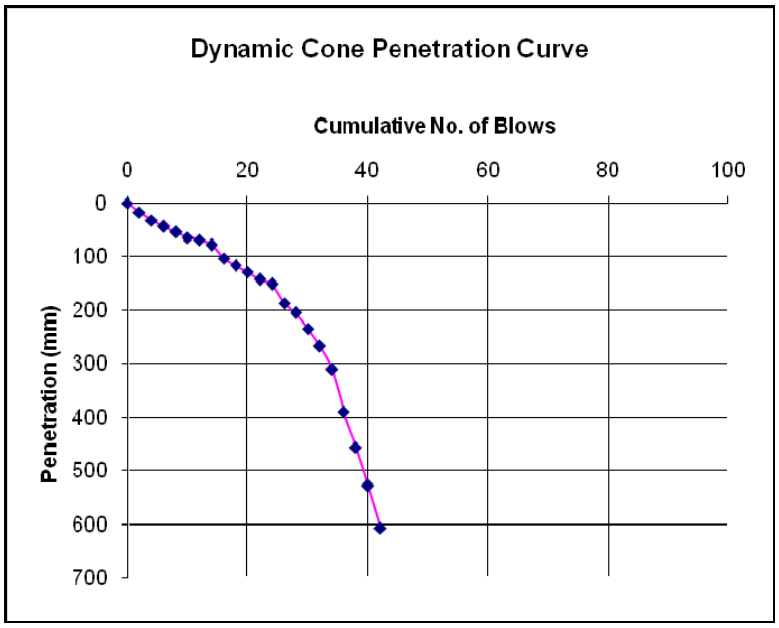
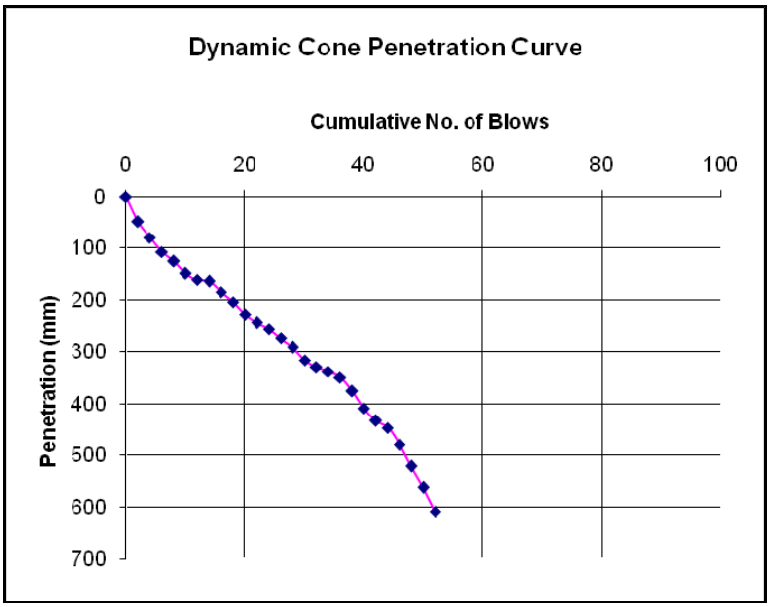
32	268
34	311
36	391
38	456
40	529
42	607



Depth Range	DCP (mm/blow)	CBR (%)
0-200	9	36
200-400	12	25
400-600	14	18

FIELD TEST RESULT AT CHAINAGE=160.000KM



Depth Range	DCP (mm/blow)	CBR (%)
0-200	11	26
200-400	12	25
400-600	11	24

cum. No. of blows	Penetration (mm)
0	0
2	48
4	80
6	108
8	126
10	150
12	162
14	165
16	185
18	205
20	228
22	244
24	256
26	274
28	292
30	316
32	330
34	338
36	349
38	376
40	410
42	434
44	448
46	481
48	522
50	563
52	610

4. SAND REPLACEMENT METHOD

Field density test was conducted by the sand replace method as guided by (IS: 2386 Part III)-1988. The equipments are used in the sand replacement method are

a) Sand pouring cylinder mounted above a pouring cone and separated by a shutter.
b) Calibrating container
c) Chisel, scoop, balance etc.

The various test result of different field location are given below

Location: 40.100 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	2.989	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.313	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.373	gm
6	Weight of sand required for filling the pit (4-5)	1.318	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	908.966	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.001	gm/cc
13	Water Content of excavated soil	19	%
14	Dry Density of soil	0.189	gm/cc

13. Water Content of excavated soil		
container no.=	I/16	
wt of empty container=	12.5	gm
wt of cont. + wet soil=	75.63	gm
wt of cont. + dry soil =	65.64	gm
water content of excavated soil=	19	%

Location: 50.150 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.329	gm
2	Weight of empty Pan	1.669	gm
3	Weight of excavated Soil (1-2)	1.66	gm
4	Weight of sand bottle with sand	6.689	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.329	gm
6	Weight of sand required for filling the pit (4-5)	1.359	gm
7	Weight of graduated jar	1.764	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.359	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	937.241	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	20	%
14	Dry Density of soil	0.198	gm/cc

13. Water Content of excavated soil		
container no.=	I/27	
wt of empty container=	13.26	gm
wt of cont. + wet soil=	56.32	gm
wt of cont. + dry soil =	49.26	gm
water content of excavated soil=	20	%

Location: 60.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.185	gm
2	Weight of empty Pan	1.674	gm
3	Weight of excavated Soil (1-2)	1.508	gm
4	Weight of sand bottle with sand	6.689	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.054	gm
6	Weight of sand required for filling the pit (4-5)	1.635	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	1127.586	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.001	gm/cc
13	Water Content of excavated soil	19	%
14	Dry Density of soil	0.187	gm/cc

13. Water Content of excavated soil		
container no.=	I/14	
wt of empty container=	13.2	gm
wt of cont. + wet soil=	56.32	gm
wt of cont. + dry soil =	49.56	gm
water content of excavated soil=	19	%

Location: 70.120 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.316	gm
2	Weight of empty Pan	1.674	gm
3	Weight of excavated Soil (1-2)	1.64	gm
4	Weight of sand bottle with sand	6.689	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.320	gm
6	Weight of sand required for filling the pit (4-5)	1.371	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.358	gm
9	Weight of 1100 cc sand (8-7)	1.593	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	946.704	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	15	%
14	Dry Density of soil	0.148	gm/cc

13. Water Content of excavated soil		
container no.=	110	
wt of empty container=	21.95	gm
wt of cont. + wet soil=	120.65	gm
wt of cont. + dry soil =	108.065	gm
water content of excavated soil=	15	%

Location: 80.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.126	gm
2	Weight of empty Pan	1.673	gm
3	Weight of excavated Soil (1-2)	1.451	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.510	gm
6	Weight of sand required for filling the pit (4-5)	1.181	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	814.483	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	14	%
14	Dry Density of soil	0.142	gm/cc

13. Water Content of excavated soil		
container no.=	I/7	
wt of empty container=	13.65	gm
wt of cont. + wet soil=	57.85	gm
wt of cont. + dry soil =	52.41	gm
water content of excavated soil=	14	%

Location: 90.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.214	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.526	gm
4	Weight of sand bottle with sand	6.689	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.286	gm
6	Weight of sand required for filling the pit (4-5)	1.405	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	968.966	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	11	%
14	Dry Density of soil	0.116	gm/cc

13. Water Content of excavated soil		
container no.=	I/15	
wt of empty container=	12.85	gm
wt of cont. + wet soil=	68.45	gm
wt of cont. + dry soil =	62.74	gm
water content of excavated soil=	11	%

Location: 100.100 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.265	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.589	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.313	gm
6	Weight of sand required for filling the pit (4-5)	1.374	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	947.586	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	15	%
14	Dry Density of soil	0.154	gm/cc

13. Water Content of excavated soil		
container no.=	105	
wt of empty container=	22.05	gm
wt of cont. + wet soil=	105.64	gm
wt of cont. + dry soil =	94.61	gm
water content of excavated soil=	15	%

Location: 110.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.156	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.480	gm
4	Weight of sand bottle with sand	6.658	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.451	gm
6	Weight of sand required for filling the pit (4-5)	1.207	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	832.414	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	18	%
14	Dry Density of soil	0.186	gm/cc

13. Water Content of excavated soil		
container no.=	I/11	
wt of empty container=	12.75	gm
wt of cont. + wet soil=	59.63	gm
wt of cont. + dry soil =	52.34	gm
water content of excavated soil=	18	%

Location: 120.200 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.465	gm
2	Weight of empty Pan	1.674	gm
3	Weight of excavated Soil (1-2)	1.791	gm
4	Weight of sand bottle with sand	6.689	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.453	gm
6	Weight of sand required for filling the pit (4-5)	1.236	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	852.414	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	10	%
14	Dry Density of soil	0.107	gm/cc

13. Water Content of excavated soil		
container no.=	I/2	
wt of empty container=	12.05	gm
wt of cont. + wet soil=	58.46	gm
wt of cont. + dry soil =	54.068	gm
water content of excavated soil=	10	%

Location: 130.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.389	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.713	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.460	gm
6	Weight of sand required for filling the pit (4-5)	1.231	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	848.966	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	10	%
14	Dry Density of soil	0.104	gm/cc

13. Water Content of excavated soil		
container no.=	I/11	
wt of empty container=	13.78	gm
wt of cont. + wet soil=	76.35	gm
wt of cont. + dry soil =	70.564	gm
water content of excavated soil=	10	%

Location: 140.100 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.345	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.669	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.275	gm
6	Weight of sand required for filling the pit (4-5)	1.416	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	976.552	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	15	%
14	Dry Density of soil	0.156	gm/cc

13. Water Content of excavated soil		
container no.=	I/16	
wt of empty container=	12.54	gm
wt of cont. + wet soil=	72.56	gm
wt of cont. + dry soil =	64.52	gm
water content of excavated soil=	15	%

Location: 150.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.389	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.713	gm
4	Weight of sand bottle with sand	6.691	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.468	gm
6	Weight of sand required for filling the pit (4-5)	1.223	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.410	gm
9	Weight of 1100 cc sand (8-7)	1.645	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	817.812	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	13	%
14	Dry Density of soil	0.129	gm/cc

13. Water Content of excavated soil		
container no.=	I/23	
wt of empty container=	13.65	gm
wt of cont. + wet soil=	62.54	gm
wt of cont. + dry soil =	57.025	gm
water content of excavated soil=	13	%

Location: 160.000 km

Sl No	Particulars	Quantity	Unit
1	Weight of Pan + Soil (excavated)	3.350	gm
2	Weight of empty Pan	1.676	gm
3	Weight of excavated Soil (1-2)	1.564	gm
4	Weight of sand bottle with sand	6.589	gm
5	Weight of sand bottle after pouring the sand in to the pit	5.373	gm
6	Weight of sand required for filling the pit (4-5)	1.216	gm
7	Weight of graduated jar	1.765	gm
8	Weight of graduated jar full with sand (up to 1100 cc)	3.360	gm
9	Weight of 1100 cc sand (8-7)	1.595	gm
10	Bulk Density of Sand= (9)/1100 cc	0.001	gm/cc
11	Volume of Pit= (6)/(10)	838.621	cm^3
12	Bulk Density of excavated soil= (3)/(11)	0.002	gm/cc
13	Water Content of excavated soil	10	%
14	Dry Density of soil	0.106	gm/cc

13. Water Content of excavated soil		
container no.=	108	
wt of empty container=	23.56	gm
wt of cont. + wet soil=	125.63	gm
wt of cont. + dry soil =	116.025	gm
water content of excavated soil=	10	%

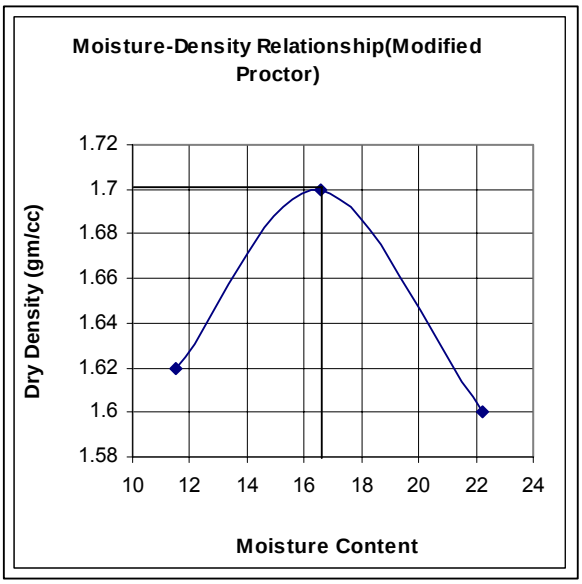
5. MODIFIED PROCTOR TEST

Modified proctor test gives the heidher deegree of compaction. In this test the soil is compacted in Standard Proctor Mould in 5 layers being given 25 blows of 4.5kg rammer dropped from a height of 450mm. This test determine the maximum Dry Densitry of the soil and corresponding optimum moisture content. Some Laboratory test results are given below.

CHAINAGE: 40+100

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
11.52	1.62
16.6	1.7
22.22	1.6



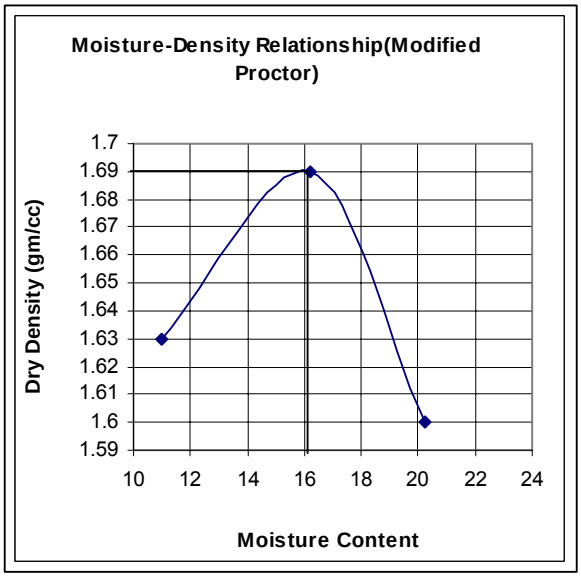
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.7	16.6

CHAINAGE: 50+150

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
11.02	1.63
16.2	1.69
20.26	1.6



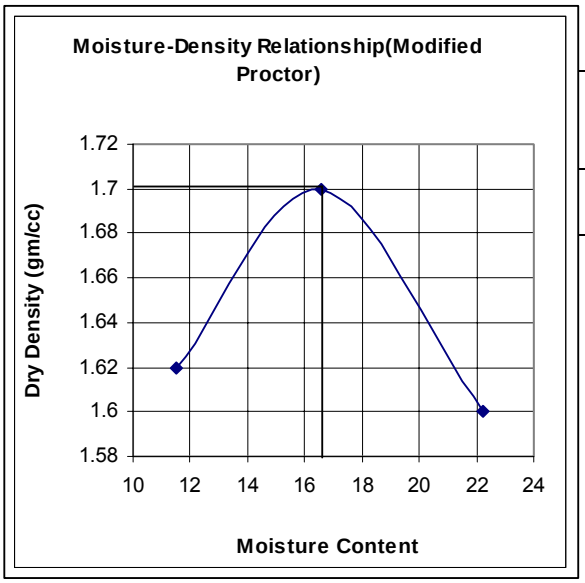
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.69	16.2

CHAINAGE: 60+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
11.52	1.62
16.6	1.7
22.24	1.6



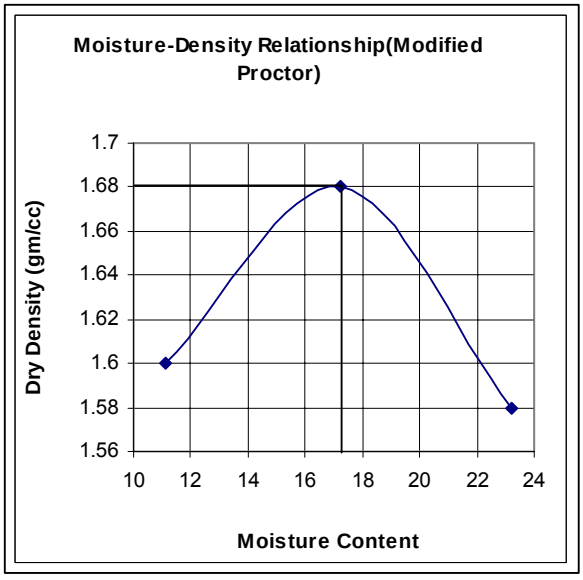
Proctor Graph Output

Maximum Dry Density	Optimum Moisture Content
1.7	16.6

CHAINAGE: 70+120

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
11.11	1.6
17.2	1.68
23.23	1.58



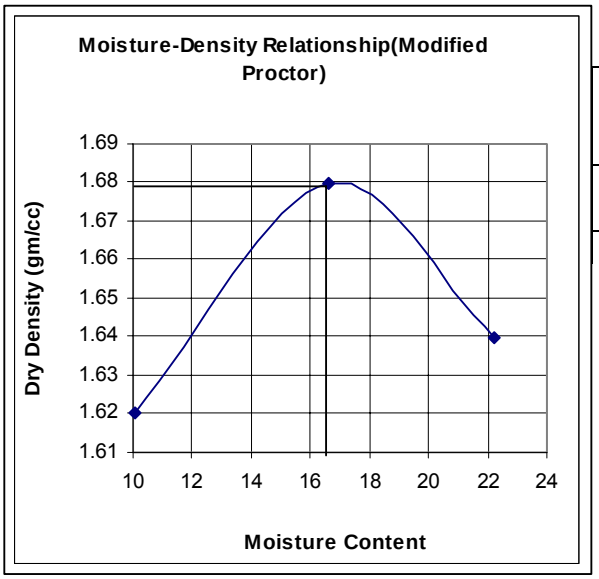
Proctor Graph Output

Maximum Dry Density	Optimum Moisture Content
1.68	17.2

CHAINAGE: 80+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.09	1.62
16.6	1.68
22.2	1.64



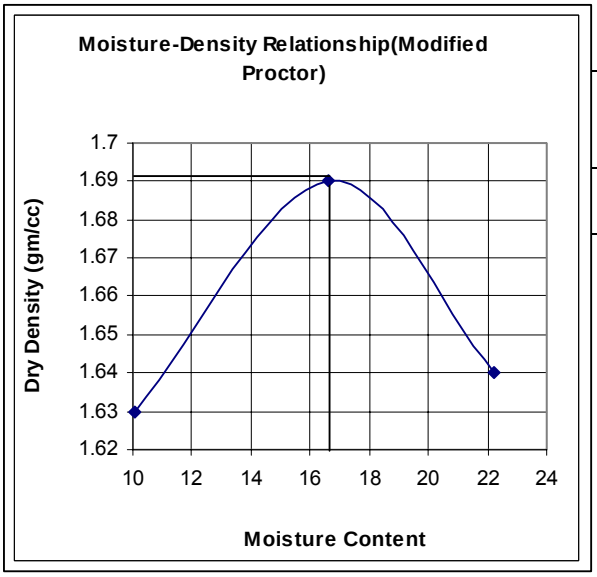
Proctor Graph Output

Maximum Dry Density	Optimum Moisture Content
1.68	16.5

CHAINAGE: 90+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.09	1.63
16.6	1.69
22.21	1.64



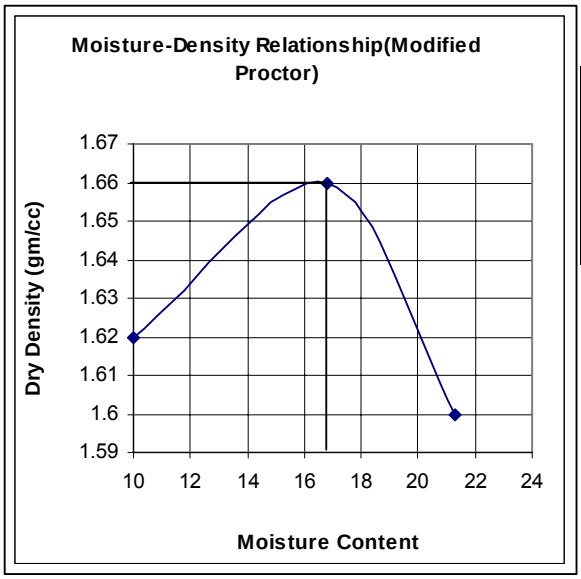
Proctor Graph Output

Maximum Dry Density	Optimum Moisture Content
1.69	16.6

CHAINAGE: 100+100

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.02	1.62
16.8	1.66
21.26	1.60



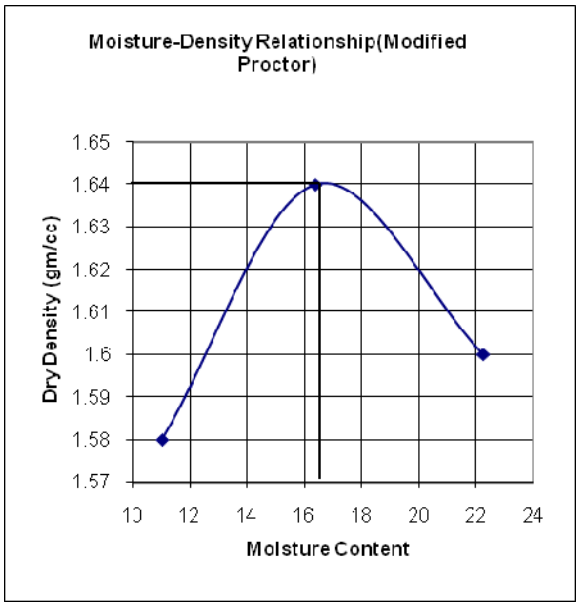
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.66	16.8

CHAINAGE: 110+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
11.04	1.58
16.4	1.64
22.26	1.60



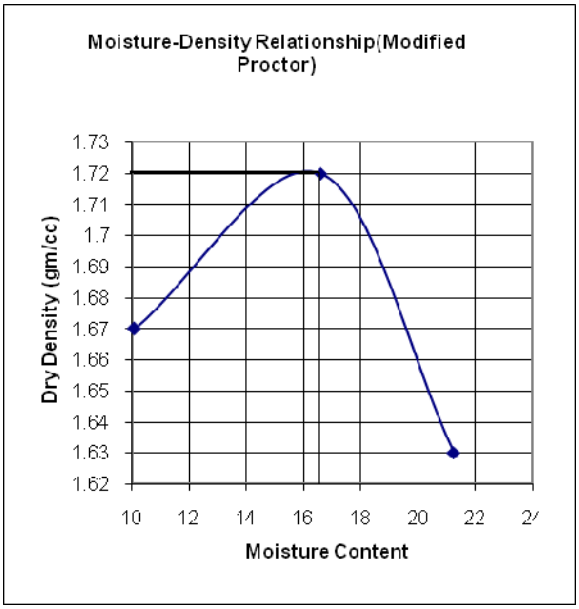
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.64	16.5

CHAINAGE: 120+200

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.1	1.67
16.6	1.72
21.24	1.63



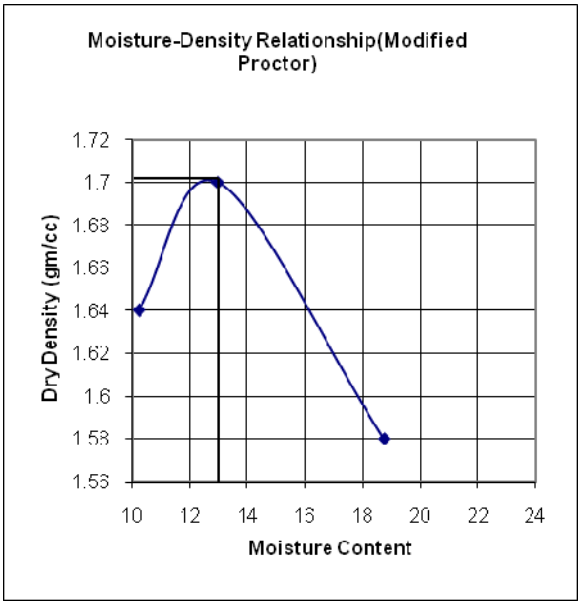
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.72	16.7

CHAINAGE:130+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.25	1.64
12.98	1.7
18.75	1.58



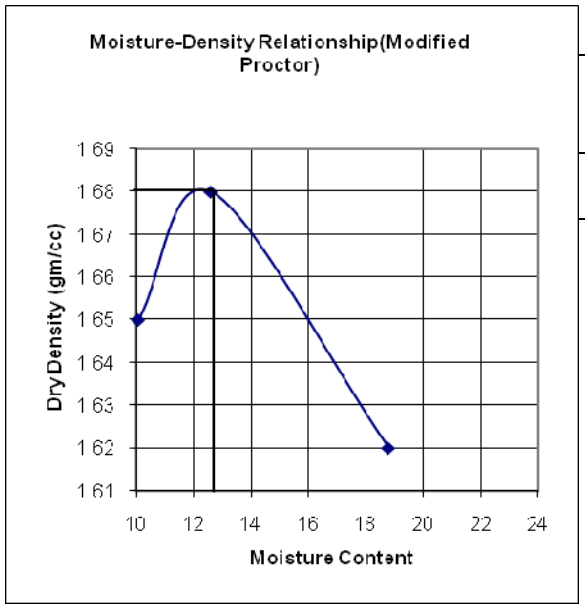
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.7	13

CHAINAGE: 140+100

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.07	1.65
12.6	1.68
18.79	1.62



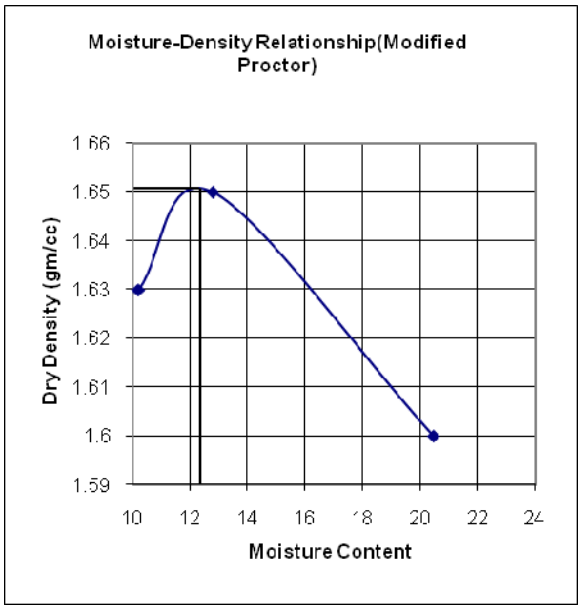
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.68	12.7

CHAINAGE: 150+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.22	1.63
12.8	1.65
20.45	1.60



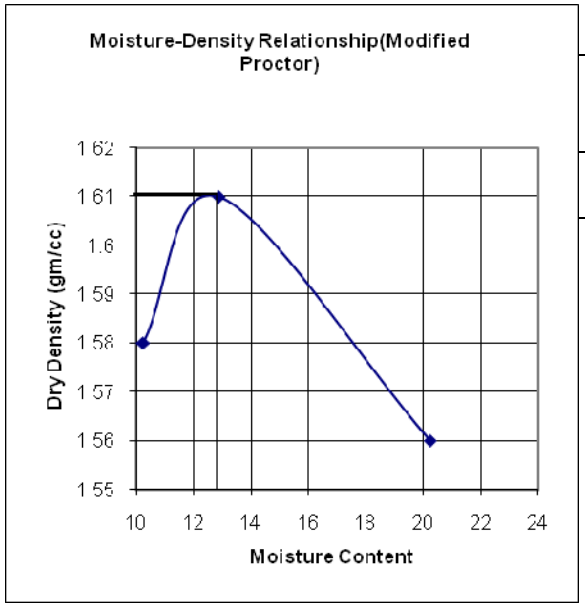
Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.65	12.3

CHAINAGE: 160+000

Laboratory Output

Moisture content (%)	Dry Density (gm/cc)
10.24	1.58
12.87	1.61
20.24	1.56



Proctor Graph Output

Maximum Dry Density	**Optimum Moisture** Content
1.61	13

6. CALIFORNIA BEARING RATION TEST

Califirnia Bearing Ratio Test were performed on bulk samples collected from pavement subgrade of existing highway, from new alignment of widening portion and on borrow materials. The CBR was determined for 3 energy level on both unsoaked and 4 day soaked conditions. To achieve the required CBR of 7, the compaction critera to be required were also studied. The results of different CBR test are shown in below.

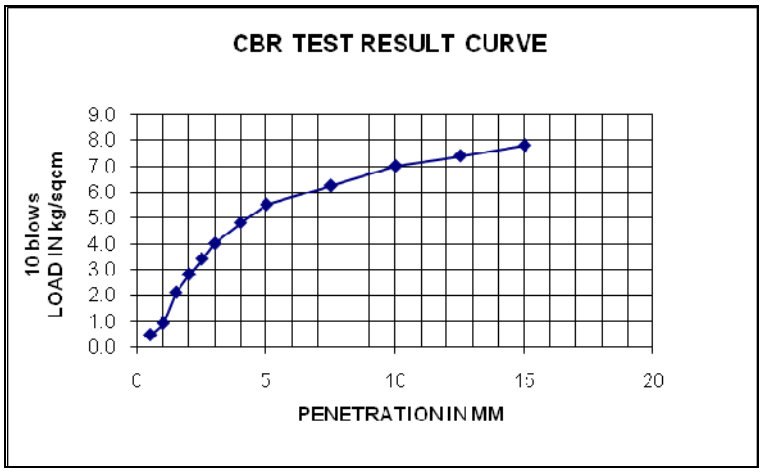
LOCATION: 40+100 km

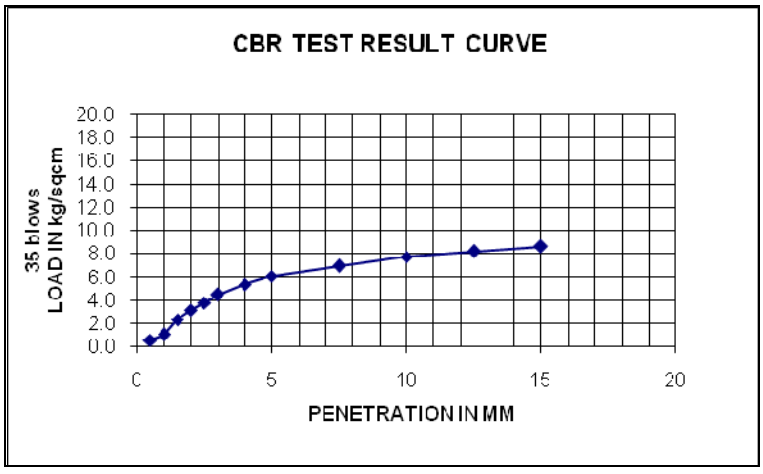
Test condition: Soaked

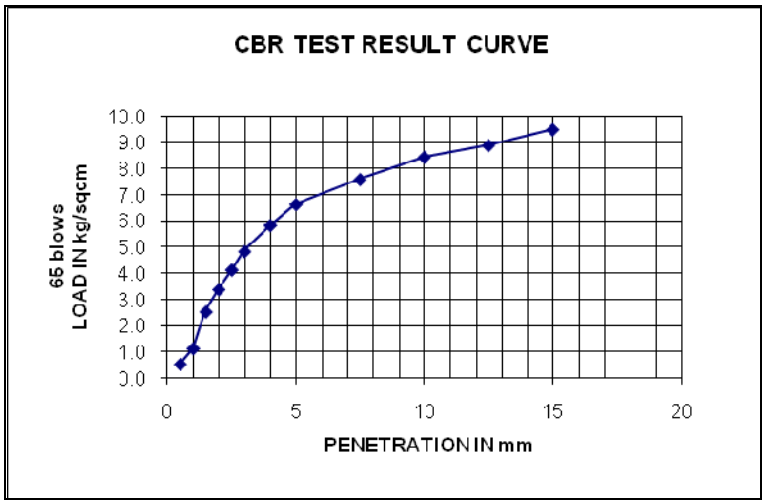
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9282	9854	10192	9728	10300	10643
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3942	4514	4852	4388	4960	5303
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.75	2.01	2.16	1.95	2.20	2.36
Water Content (%)	16.8	16.5	16.2	30	28	27
Dry Density (gms/cc)	1.50	1.72	1.86	1.50	1.72	1.86

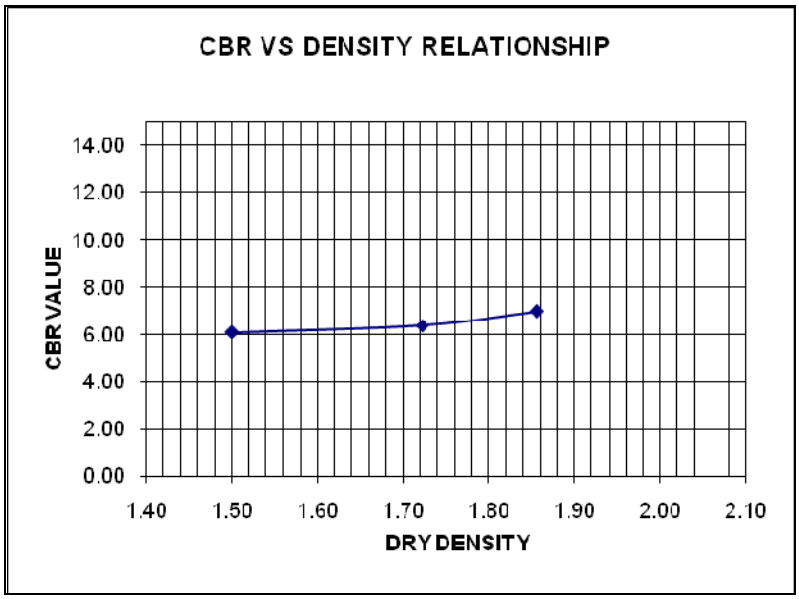
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	9	10	11	0.5	0.5	0.6							
1.0	18	20	23	0.9	1.0	1.2							
1.5	42	46	51	2.1	2.3	2.6							
2.0	56	62	68	2.8	3.1	3.4							
2.5	68	75	83	3.4	3.8	4.2	70	4.0	4.4	4.8	5.7	6.3	6.9
3.0	80	88	97	4.0	4.4	4.9							
4.0	96	106	117	4.8	5.3	5.9							
5.0	110	121	133	5.5	6.1	6.7	105	6.4	6.7	7.3	6.1	6.4	7.0
7.5	125	138	152	6.3	6.9	7.6							
10.0	140	154	169	7.0	7.7	8.5							
12.5	148	163	178	7.4	8.2	8.9							
15.0	156	172	190	7.8	8.6	9.5							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	5.71	6.29	6.86
5	6.10	6.38	7.0



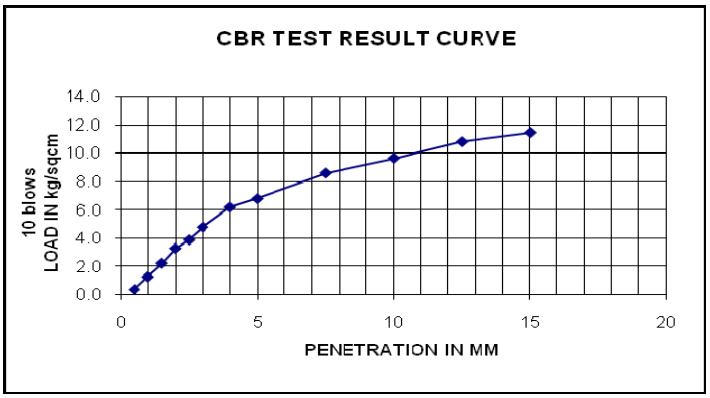
MDD=1.70 gm/cc; 97% of MDD=1.65 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=6.30 (from graph)

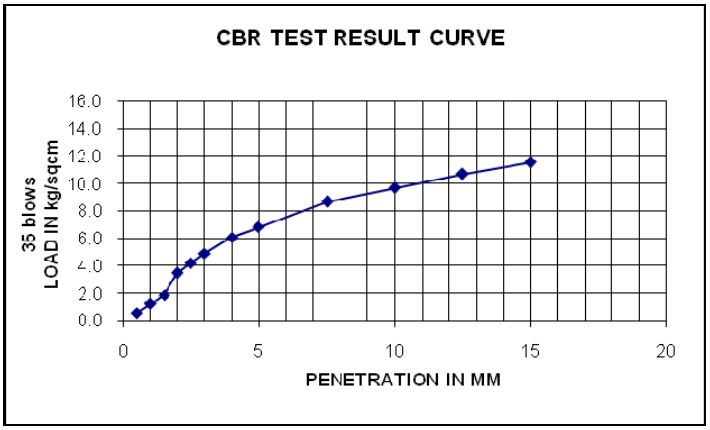
LOCATION: 50+150 km

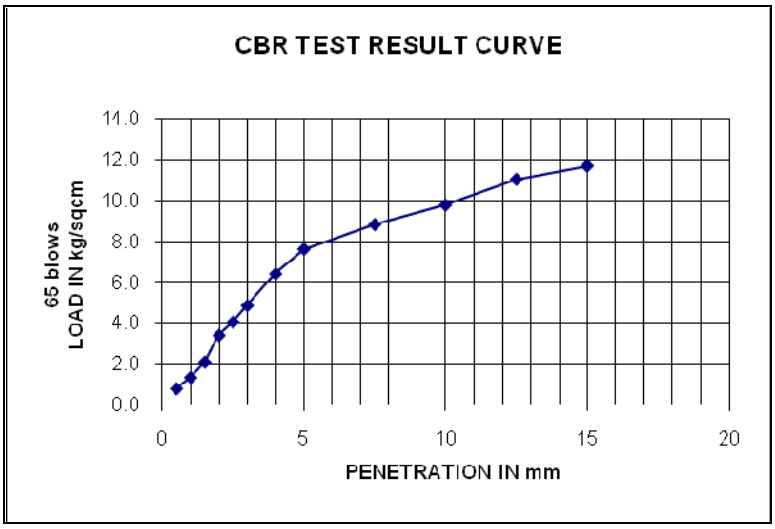
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9476	9989	10265	10088	10585	10831
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4136	4649	4925	4748	5245	5491
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.84	2.07	2.19	2.11	2.33	2.44
Water Content (%)	17.6	17	17.5	35	32	31
Dry Density (gms/cc)	1.56	1.77	1.86	1.56	1.77	1.86

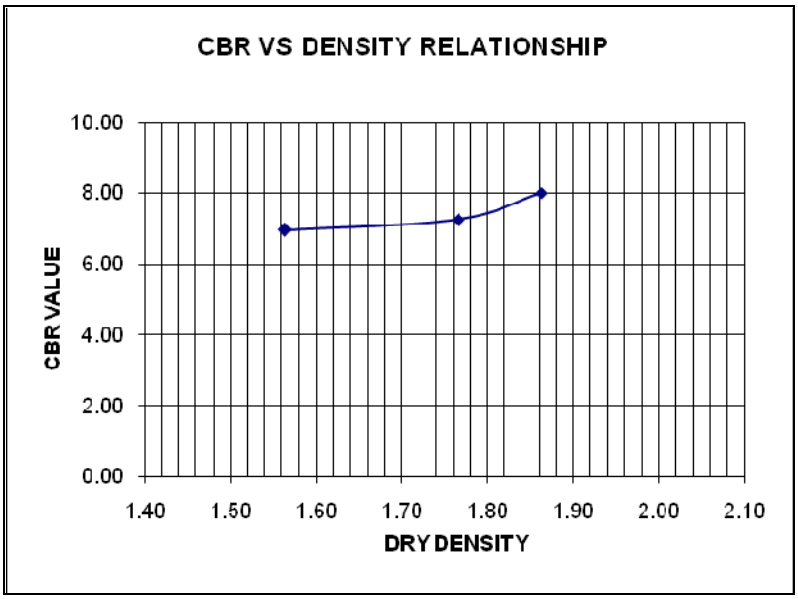
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	8	12	16	0.4	0.6	0.8							
1.0	26	25	27	1.3	1.3	1.4							
1.5	45	38	42	2.3	1.9	2.1							
2.0	66	70	68	3.3	3.5	3.4							
2.5	78	85	81	3.9	4.3	4.1	70	4.4	5.0	4.9	6.3	7.1	7.0
3.0	96	99	97	4.8	5.0	4.9							
4.0	124	122	128	6.2	6.1	6.4							
5.0	136	137	152	6.8	6.9	7.6	105	7.3	7.6	8.4	7.0	7.2	8.0
7.5	172	174	176	8.6	8.7	8.8							
10.0	193	194	195	9.7	9.7	9.8							
12.5	216	214	220	10.8	10.7	11.0							
15.0	229	231	233	11.5	11.6	11.7							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	6.29	7.14	7.00
5	6.95	7.24	8.00



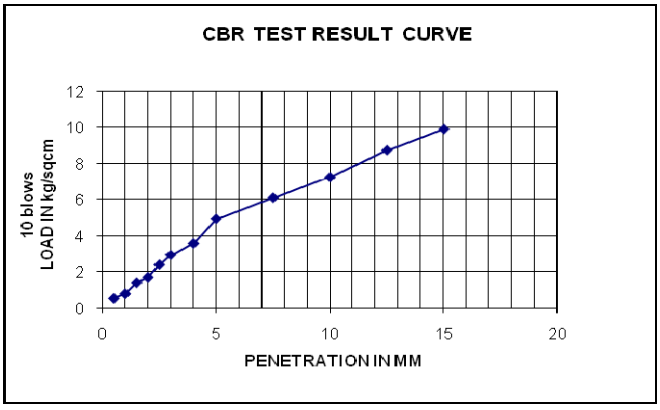
MDD=1.72 gm/cc; 97% of MDD=1.67 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=7.00 (from graph)

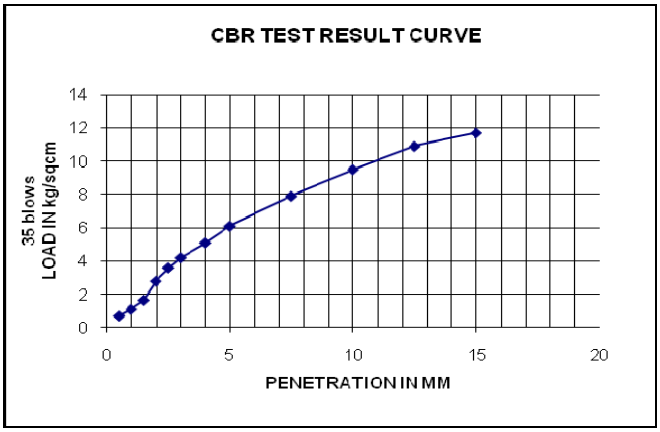
LOCATION: 60+000 km

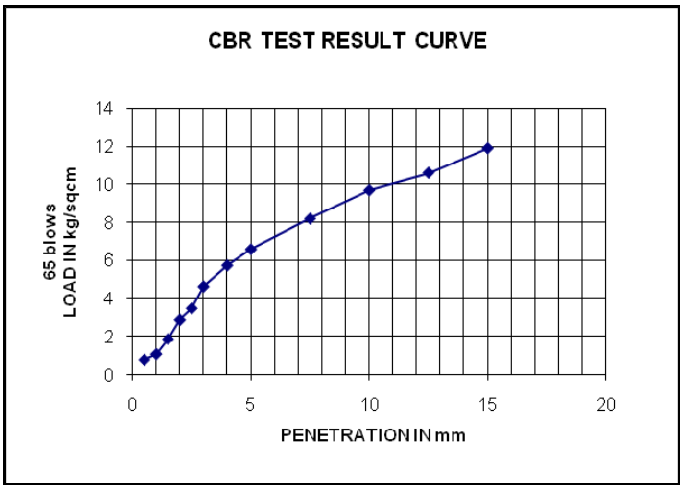
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9173	9785	10098	9613	10211	10495
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3833	4445	4758	4273	4871	5155
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.70	1.98	2.11	1.90	2.16	2.29
Water Content (%)	16.6	16.8	16.3	30	28	26
Dry Density (gms/cc)	1.46	1.69	1.82	1.46	1.69	1.82

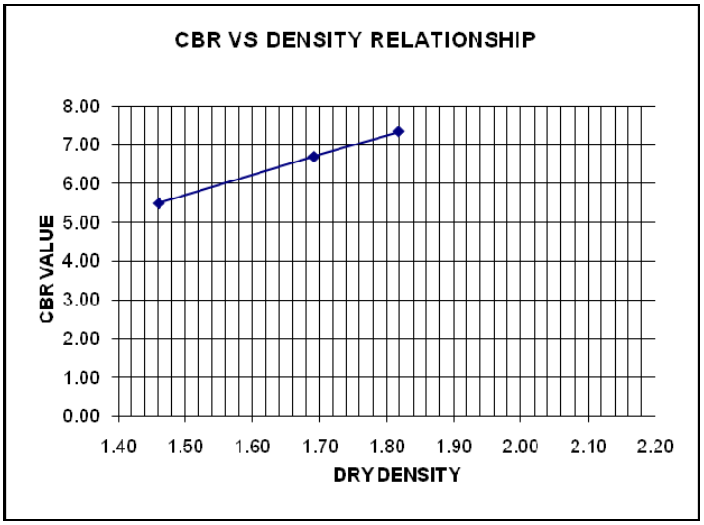
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	11	14	16	0.55	0.7	0.8							
1.0	16	22	22	0.8	1.1	1.1							
1.5	28	33	38	1.4	1.65	1.9							
2.0	34	56	58	1.7	2.8	2.9							
2.5	48	72	70	2.4	3.6	3.5	70	3.2	4.5	4.6	4.57	6.43	6.57
3.0	59	84	93	2.95	4.2	4.65							
4.0	72	102	115	3.6	5.1	5.75							
5.0	99	122	132	4.95	6.1	6.6	105	5.75	7.0	7.7	5.48	6.67	7.33
7.5	122	158	164	6.1	7.9	8.2							
10.0	145	190	194	7.25	9.5	9.7							
12.5	175	218	212	8.75	10.9	10.6							
15.0	198	234	238	9.9	11.7	11.9							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	4.57	6.43	6.57
5	5.50	6.70	7.33



MDD=1.63 gm/cc; 97% of MDD=1.58 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=6.00 (from graph)

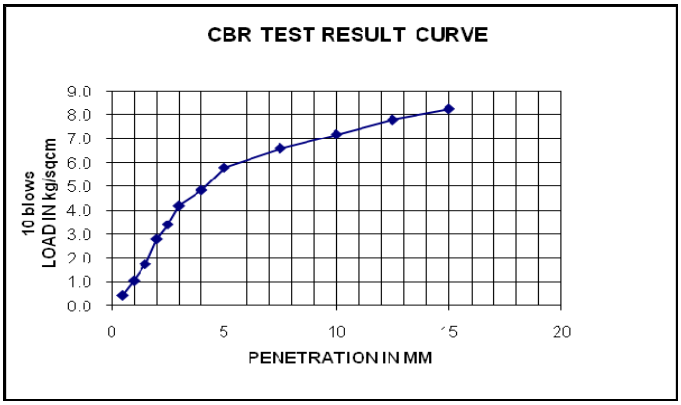
LOCATION: 70+120 km

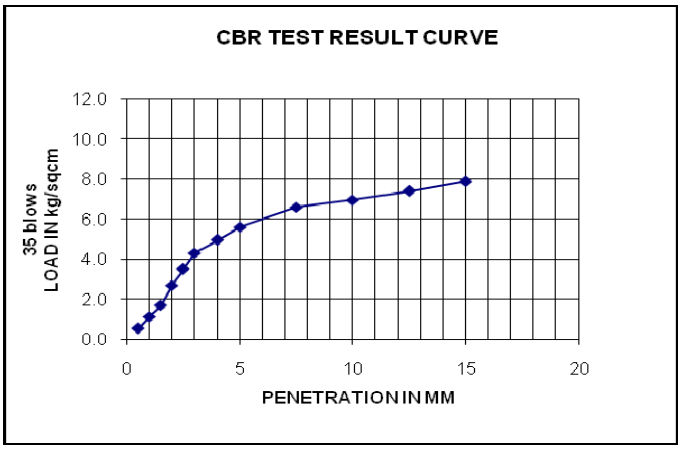
Test condition: Soaked

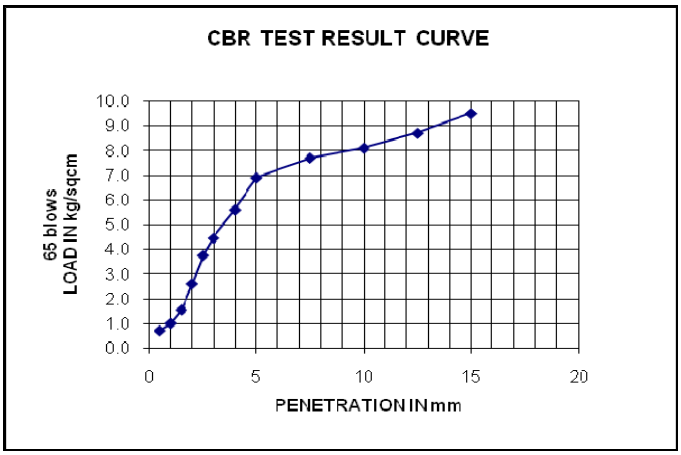
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9456	9948	10262	10127	10674	11019
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4116	4608	4922	4787	5334	5679
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.83	2.05	2.19	2.13	2.37	2.52
Water Content (%)	17.8	17.5	17	37	36	35
Dry Density (gms/cc)	1.55	1.74	1.87	1.55	1.74	1.87

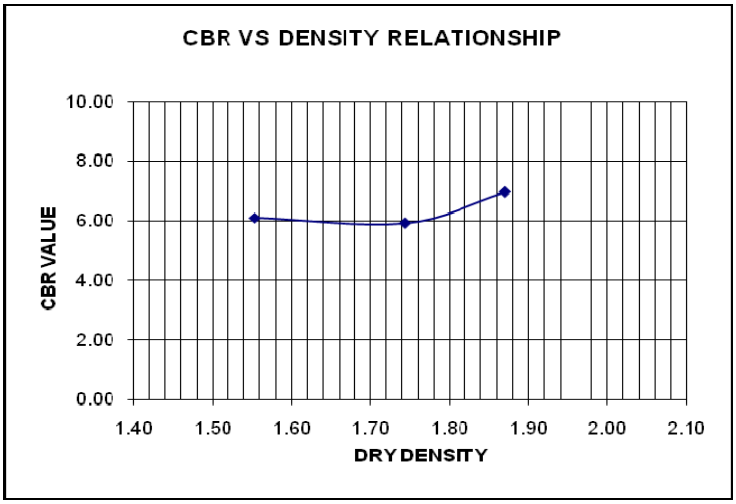
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	9	11	14	0.5	0.6	0.7							
1.0	21	23	20	1.1	1.2	1.0							
1.5	35	34	31	1.8	1.7	1.6							
2.0	56	54	52	2.8	2.7	2.6							
2.5	68	70	75	3.4	3.5	3.8	70	4.0	4.1	4.2	5.7	5.9	6.0
3.0	84	86	89	4.2	4.3	4.5							
4.0	97	99	112	4.9	5.0	5.6							
5.0	116	112	138	5.8	5.6	6.9	105	6.4	6.2	7.3	6.1	5.9	7.0
7.5	132	132	154	6.6	6.6	7.7							
10.0	144	139	162	7.2	7.0	8.1							
12.5	156	148	174	7.8	7.4	8.7							
15.0	165	158	190	8.3	7.9	9.5							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	5.71	5.86	6.00
5	6.10	5.90	7.0



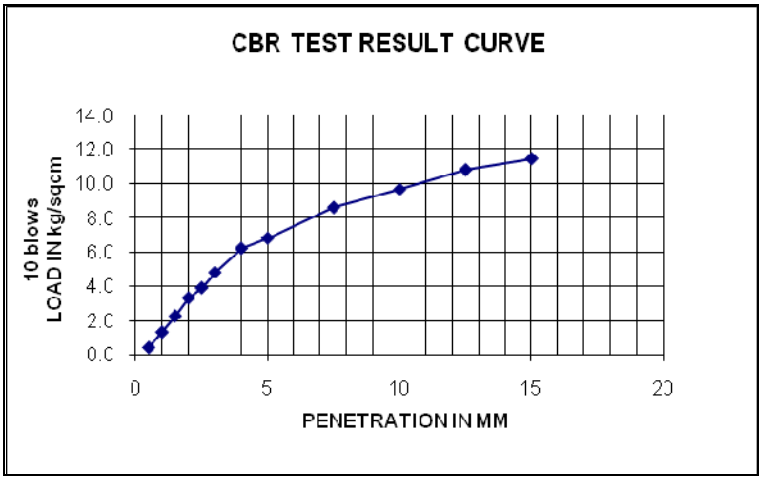
MDD=1.70 gm/cc; 97% of MDD=1.65 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=5.90 (from graph)

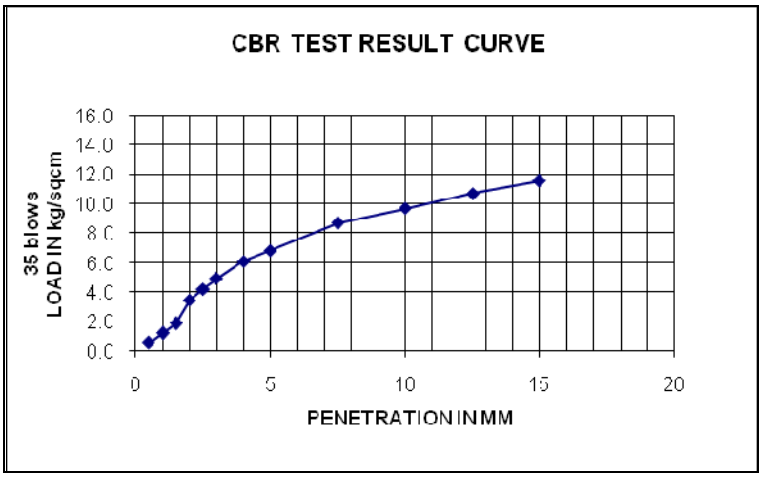
LOCATION: 80+000 km

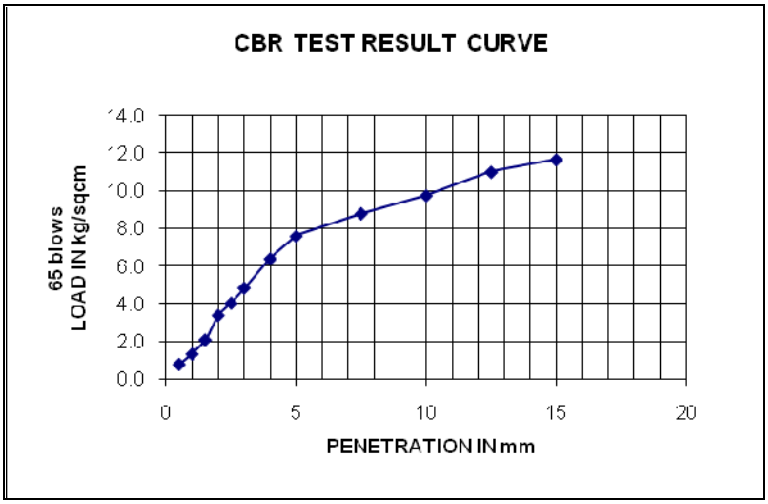
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9365	9982	10212	9827	10407	10544
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4025	4642	4872	4487	5067	5204
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.79	2.06	2.17	1.99	2.25	2.31
Water Content (%)	19.3	19.1	18.9	33	30	27
Dry Density (gms/cc)	1.50	1.73	1.82	1.50	1.73	1.82

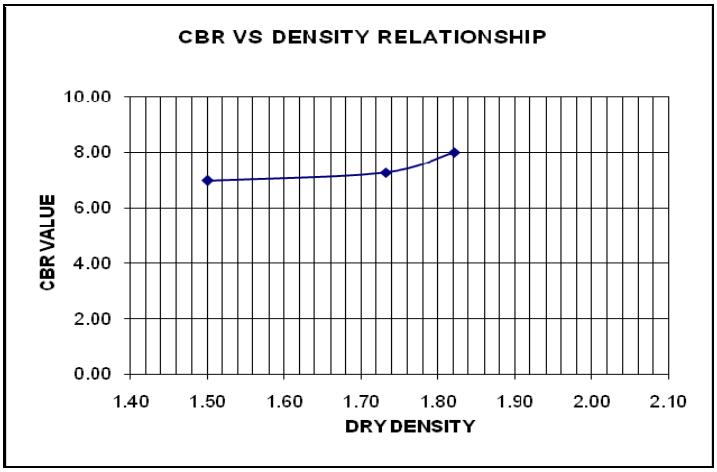
Penetration Data														Proving Ring Used: 1000kg
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)			
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows			
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65	
0.5	8	12	16	0.4	0.6	0.8								
1.0	26	25	27	1.3	1.3	1.4								
1.5	45	38	42	2.3	1.9	2.1								
2.0	66	70	68	3.3	3.5	3.4								
2.5	78	85	81	3.9	4.3	4.1	70	4.4	5.0	4.9	6.3	7.1	7.0	
3.0	96	99	97	4.8	5.0	4.9								
4.0	124	122	128	6.2	6.1	6.4								
5.0	136	137	152	6.8	6.9	7.6	105	7.3	7.6	8.4	7.0	7.2	8.0	
7.5	172	174	176	8.6	8.7	8.8								
10.0	193	194	195	9.7	9.7	9.8								
12.5	216	214	220	10.8	10.7	11.0								
15.0	229	231	233	11.5	11.6	11.7								







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	6.29	7.14	7.00
5	6.95	7.24	8.00



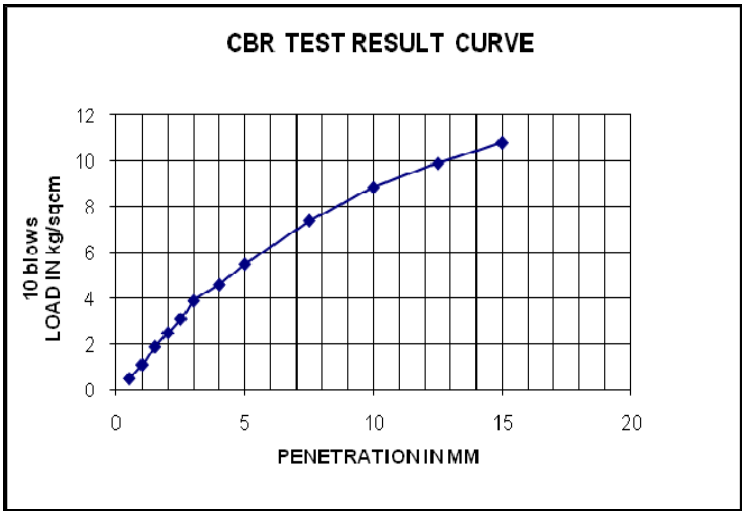
MDD=1.65 gm/cc; 97% of MDD=1.60 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=7.00 (from graph)

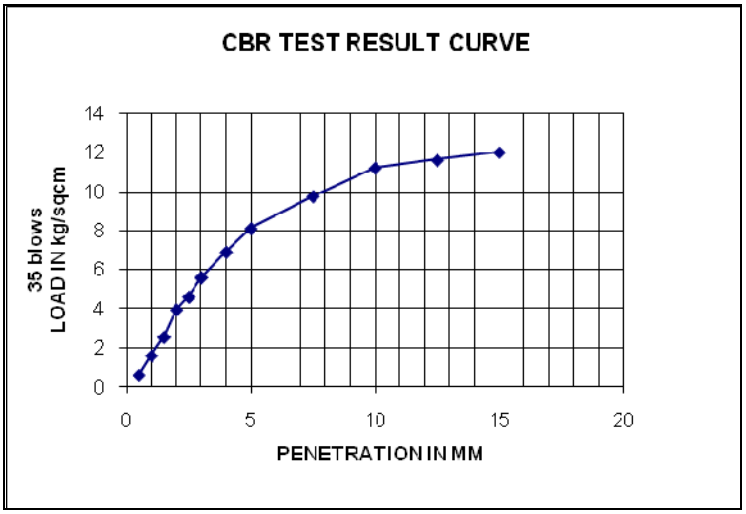
LOCATION: 90+000 km

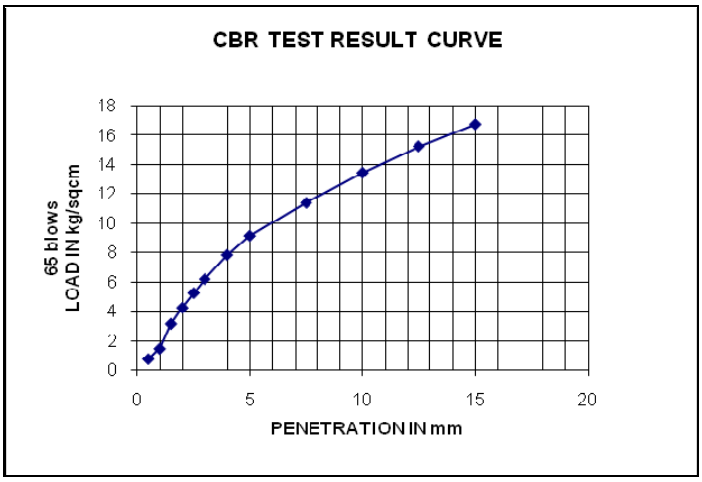
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9323	9921	10322	9792	10241	10622
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3983	4581	4982	4452	4901	5282
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.77	2.04	2.21	1.98	2.18	2.35
Water Content (%)	18.1	18.7	17.9	32	27	25
Dry Density (gms/cc)	1.50	1.72	1.88	1.50	1.72	1.88

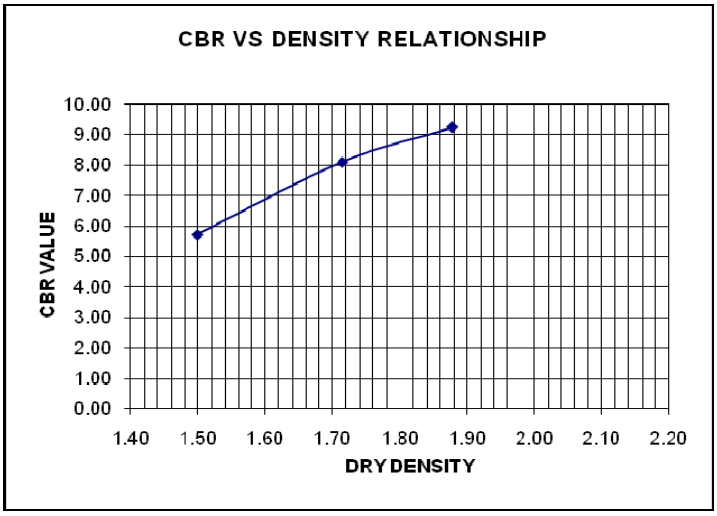
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	10	12	14	0.5	0.6	0.7							
1.0	22	32	28	1.1	1.6	1.4							
1.5	38	51	62	1.9	2.55	3.1							
2.0	50	79	84	2.5	3.95	4.2							
2.5	62	92	104	3.1	4.6	5.2	70	3.6	5	5.8	5.14	7.14	8.29
3.0	78	112	123	3.9	5.6	6.15							
4.0	92	138	156	4.6	6.9	7.8							
5.0	110	162	182	5.5	8.1	9.1	105	6.0	8.5	9.7	5.71	8.10	9.24
7.5	148	195	227	7.4	9.75	11.35							
10.0	177	224	268	8.85	11.2	13.4							
12.5	198	232	304	9.9	11.6	15.2							
15.0	216	240	334	10.8	12	16.7							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	5.14	7.14	8.29
5	5.71	8.10	9.24



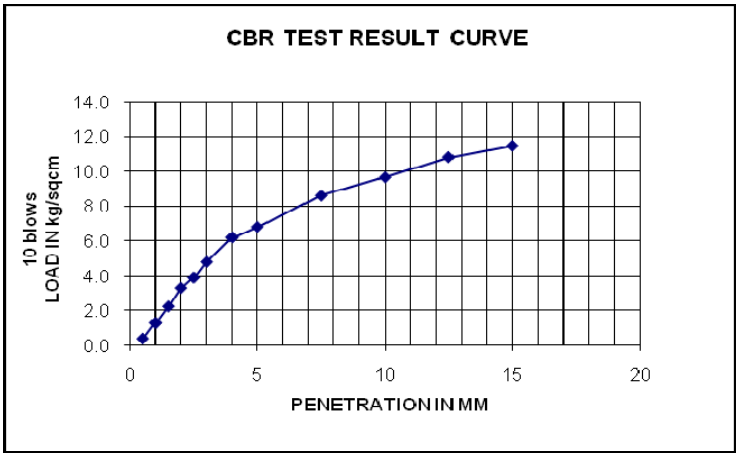
MDD=1.65 gm/cc; 97% of MDD=1.60 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=7.00 (from graph)

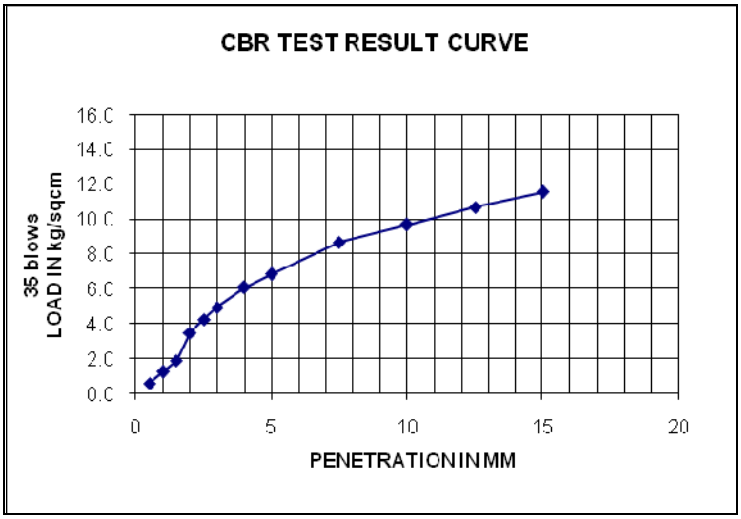
LOCATION: 100+100 km

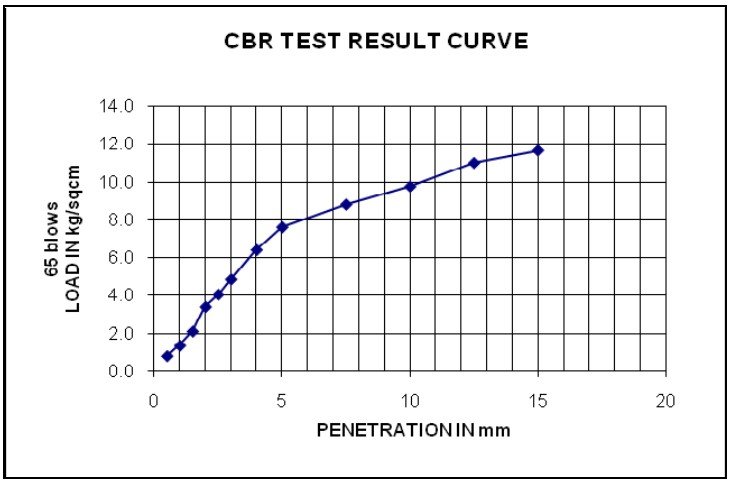
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9406	9990	10210	10008	10586	10645
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4066	4650	4870	4668	5246	5305
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.81	2.07	2.16	2.07	2.33	2.36
Water Content (%)	17.6	17	17.5	35	32	28
Dry Density (gms/cc)	1.54	1.77	1.84	1.54	1.77	1.84

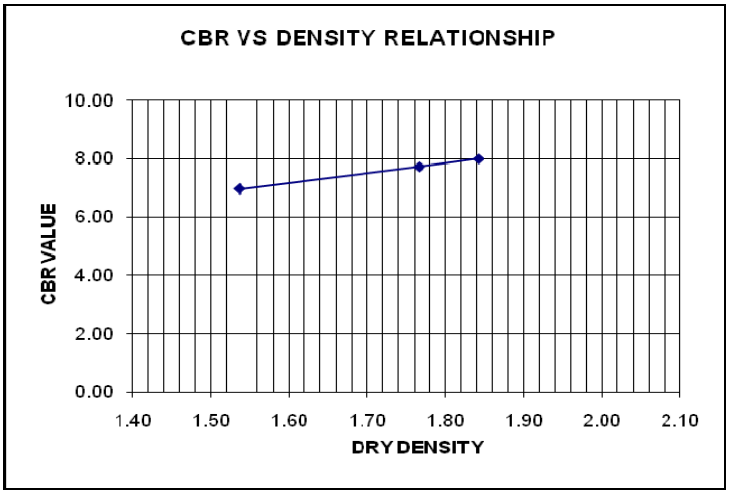
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	8	12	16	0.4	0.6	0.8							
1.0	26	25	27	1.3	1.3	1.4							
1.5	45	38	42	2.3	1.9	2.1							
2.0	66	70	68	3.3	3.5	3.4							
2.5	78	85	81	3.9	4.3	4.1	70	4.4	5.5	4.9	6.3	7.9	7.0
3.0	96	99	97	4.8	5.0	4.9							
4.0	124	122	128	6.2	6.1	6.4							
5.0	136	137	152	6.8	6.9	7.6	105	7.3	8.1	8.4	7.0	7.7	8.0
7.5	172	174	176	8.6	8.7	8.8							
10.0	193	194	195	9.7	9.7	9.8							
12.5	216	214	220	10.8	10.7	11.0							
15.0	229	231	233	11.5	11.6	11.7							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	6.29	7.86	7.00
5	6.95	7.71	8.00



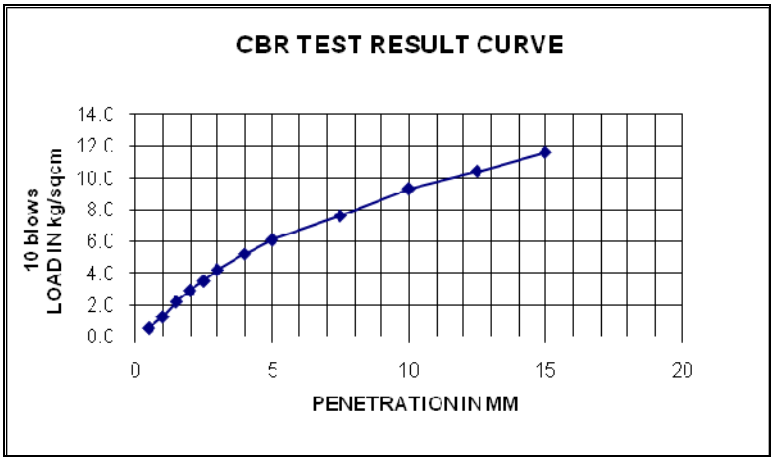
MDD=1.71 gm/cc; 97% of MDD=1.66 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=7.00 (from graph)

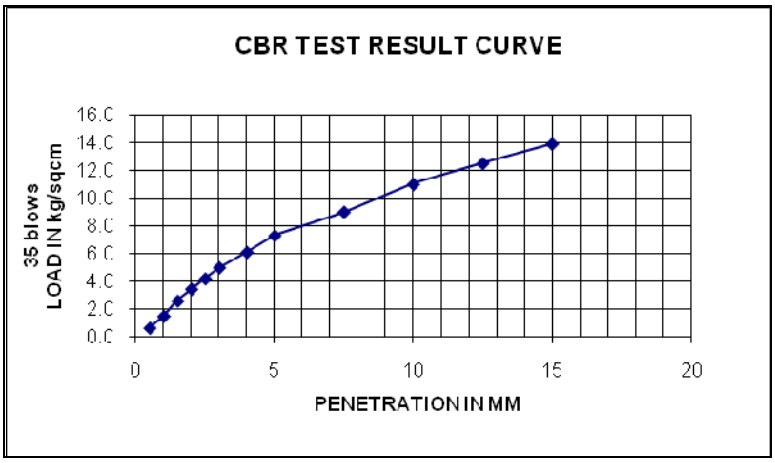
LOCATION: 110+000 km

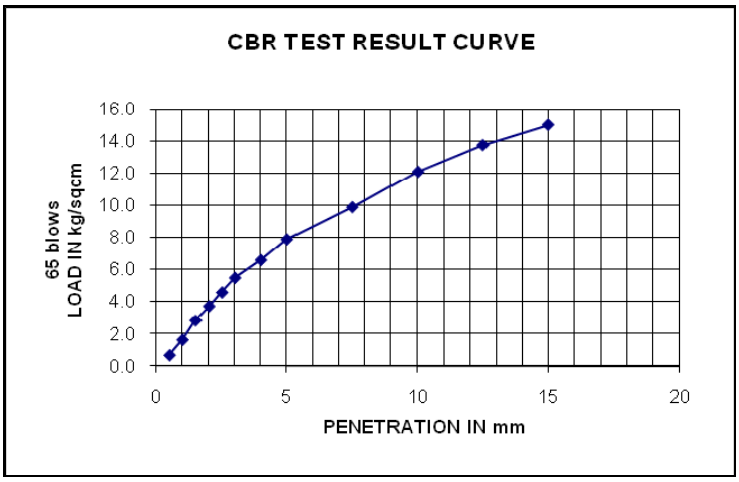
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9262	9855	10232	9680	10192	10524
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3922	4515	4892	4340	4852	5184
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.74	2.01	2.17	1.93	2.16	2.30
Water Content (%)	19.3	19.1	18.9	32	28	26
Dry Density (gms/cc)	1.46	1.68	1.83	1.46	1.68	1.83

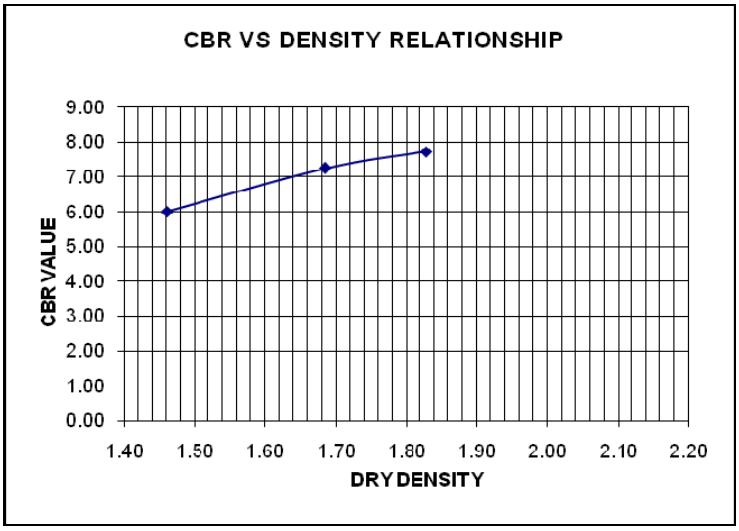
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	11	13	14	0.6	0.7	0.7							
1.0	25	30	33	1.3	1.5	1.7							
1.5	44	52	57	2.2	2.6	2.9							
2.0	58	69	75	2.9	3.5	3.8							
2.5	70	84	92	3.5	4.2	4.6	70	3.7	4.5	4.8	5.3	6.4	6.9
3.0	84	100	110	4.2	5.0	5.5							
4.0	104	122	132	5.2	6.1	6.6							
5.0	122	146	158	6.1	7.3	7.9	105	6.3	7.6	8.1	6.0	7.2	7.7
7.5	152	180	198	7.6	9.0	9.9							
10.0	186	220	242	9.3	11.0	12.1							
12.5	208	250	275	10.4	12.5	13.8							
15.0	232	278	300	11.6	13.9	15.0							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	5.29	6.43	6.86
5	6.00	7.24	7.71



MDD=1.72 gm/cc; 97% of MDD=1.67 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=7.00 (from graph)

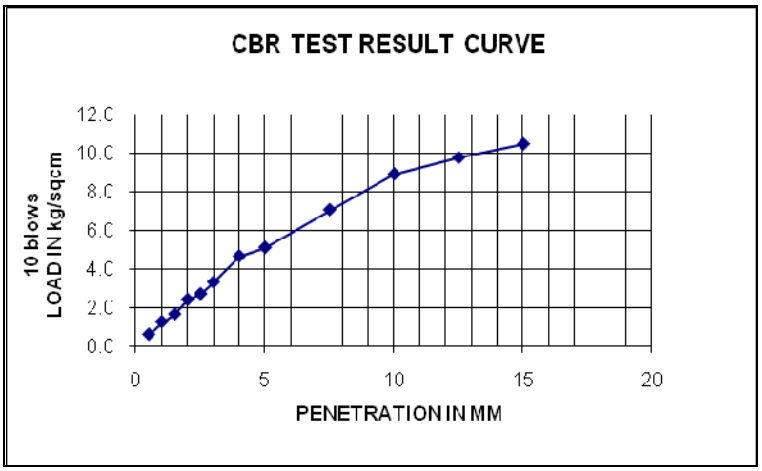
LOCATION: 120+200 km

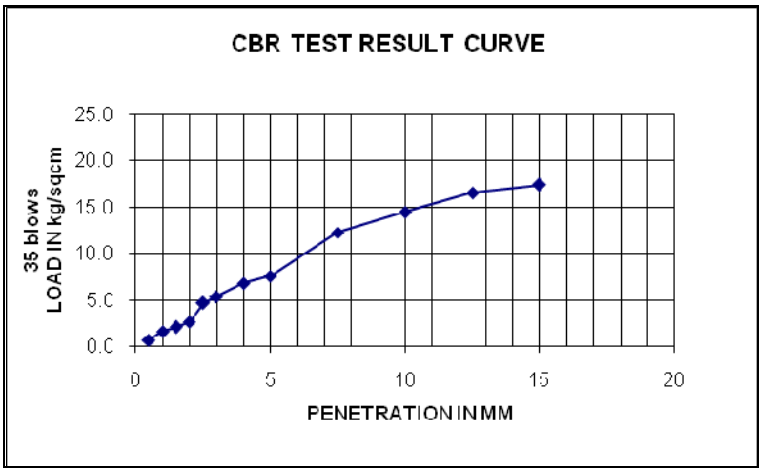
Test condition: Soaked

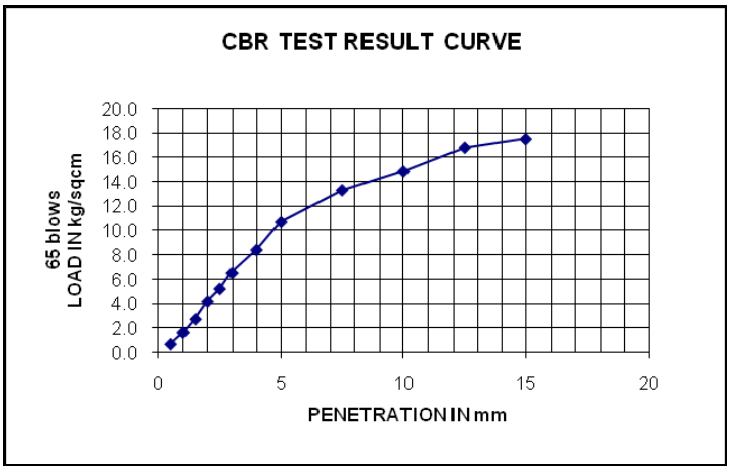
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9500	9946	10223	9943	10406	10679
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4160	4606	4883	4603	5066	5339
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.85	2.05	2.17	2.05	2.25	2.37
Water Content (%)	19.3	19.1	18.9	32	31	30
Dry Density (gms/cc)	1.55	1.72	1.83	1.55	1.72	1.83

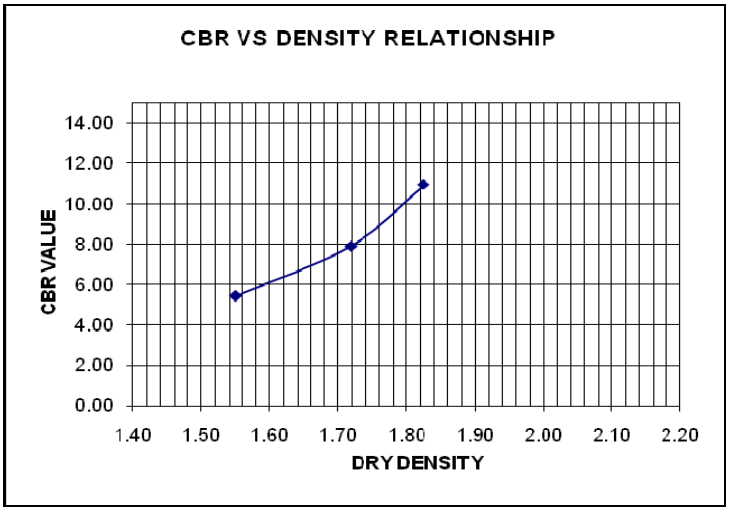
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	12	13	14	0.6	0.7	0.7							
1.0	25	31	33	1.3	1.6	1.7							
1.5	33	40	55	1.7	2.0	2.8							
2.0	48	52	84	2.4	2.6	4.2							
2.5	54	92	105	2.7	4.6	5.3	70	3.3	5.3	6.0	4.7	7.6	8.6
3.0	66	107	131	3.3	5.4	6.6							
4.0	93	135	169	4.7	6.8	8.5							
5.0	102	151	215	5.1	7.6	10.8	105	5.7	8.3	11.5	5.4	7.9	11.0
7.5	141	245	267	7.1	12.3	13.4							
10.0	178	289	298	8.9	14.5	14.9							
12.5	195	330	337	9.8	16.5	16.9							
15.0	209	347	351	10.5	17.4	17.6							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	4.71	7.57	8.57
5	5.43	7.90	11.0



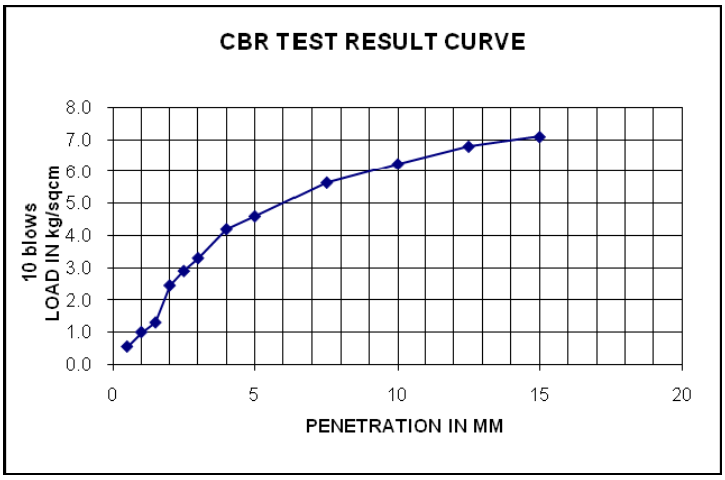
MDD=1.65 gm/cc; 97% of MDD=1.60 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=6.10 (from graph)

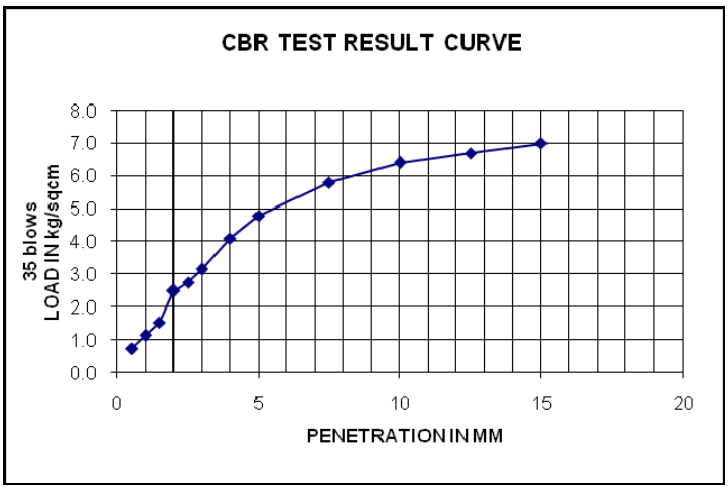
LOCATION: 130+000 km

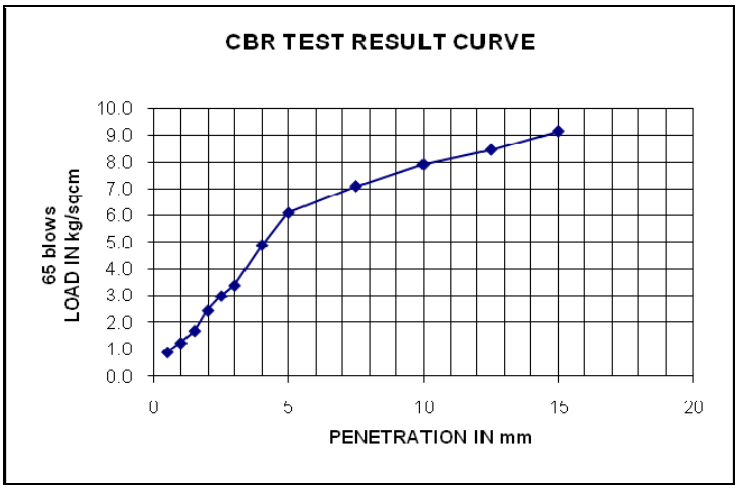
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9366	9992	10456	9954	10645	11112
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4026	4652	5116	4614	5305	5772
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.79	2.07	2.27	2.05	2.36	2.57
Water Content (%)	17.8	17.5	17	35	34	32
Dry Density (gms/cc)	1.52	1.76	1.94	1.52	1.76	1.94

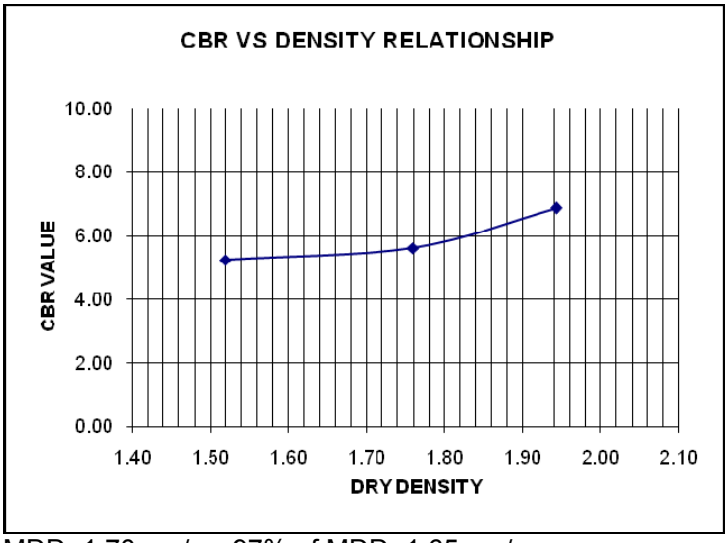
Penetration Data							Proving Ring Used: 1000kg						
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	11	15	18	0.6	0.8	0.9							
1.0	20	23	25	1.0	1.2	1.3							
1.5	26	31	34	1.3	1.6	1.7							
2.0	49	50	49	2.5	2.5	2.5							
2.5	58	55	60	2.9	2.8	3.0	70	3.8	4.0	4.1	5.4	5.7	5.9
3.0	66	63	68	3.3	3.2	3.4							
4.0	84	82	98	4.2	4.1	4.9							
5.0	92	96	122	4.6	4.8	6.1	105	5.5	5.9	7.2	5.2	5.6	6.9
7.5	113	116	142	5.7	5.8	7.1							
10.0	125	128	158	6.3	6.4	7.9							
12.5	136	134	169	6.8	6.7	8.5							
15.0	142	140	183	7.1	7.0	9.2							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	5.43	5.71	5.86
5	5.24	5.62	6.9



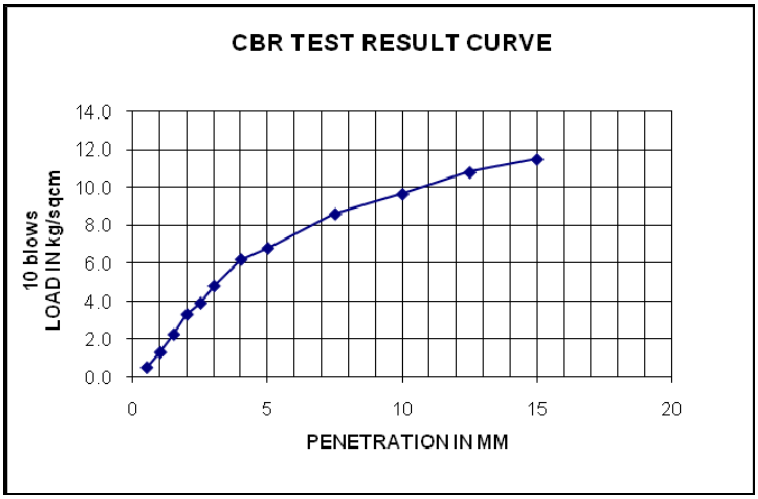
MDD=1.70 gm/cc; 97% of MDD=1.65 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=5.50 (from graph)

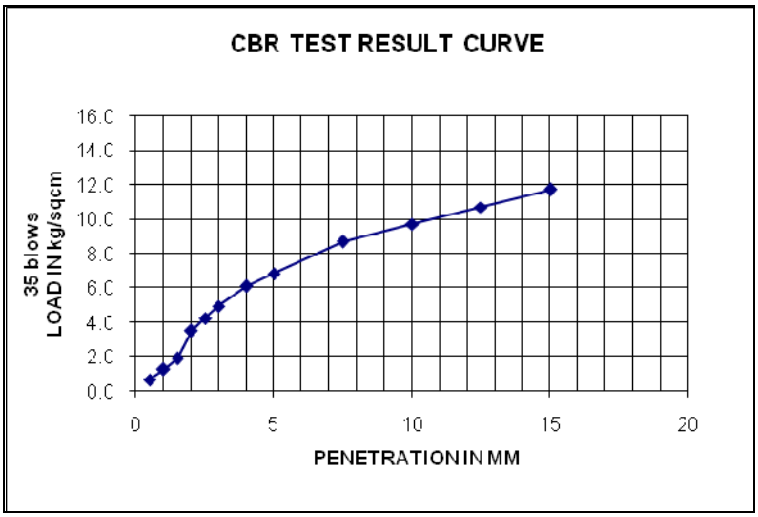
LOCATION: 140+100 km

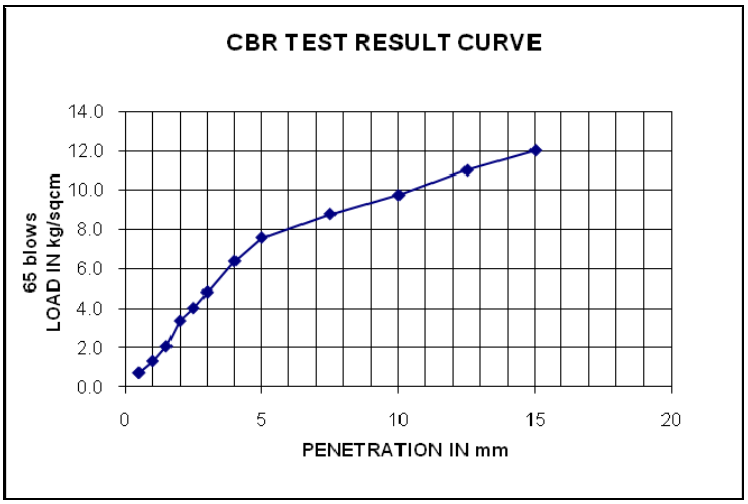
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9255	9768	10212	9712	10197	10585
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3915	4428	4872	4372	4857	5245
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.74	1.97	2.17	1.94	2.16	2.33
Water Content (%)	16.4	16.7	16.1	30	28	25
Dry Density (gms/cc)	1.49	1.69	1.87	1.49	1.69	1.87

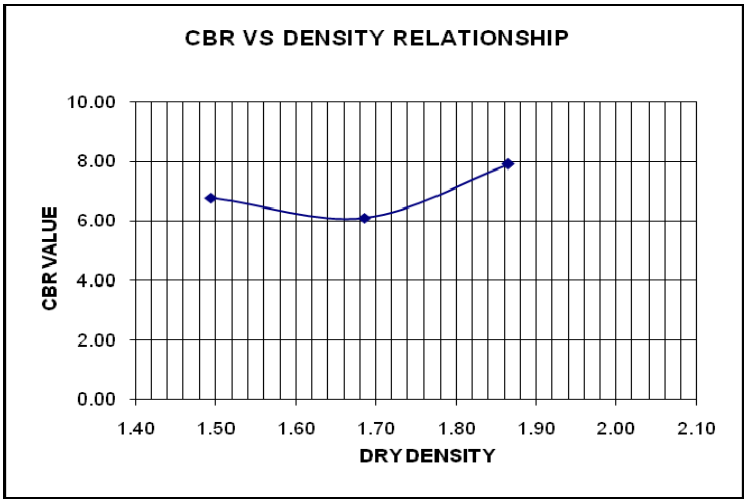
Penetration Data														Proving Ring Used: 1000kg
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)			
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows			
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65	
0.5	10	13	15	0.5	0.7	0.8								
1.0	26	25	27	1.3	1.3	1.4								
1.5	45	38	42	2.3	1.9	2.1								
2.0	66	70	68	3.3	3.5	3.4								
2.5	78	85	81	3.9	4.3	4.1	70	4.2	4.6	4.8	6.0	6.6	6.9	
3.0	96	99	97	4.8	5.0	4.9								
4.0	124	122	128	6.2	6.1	6.4								
5.0	136	137	152	6.8	6.9	7.6	105	7.1	6.4	8.3	6.8	6.1	7.9	
7.5	172	174	176	8.6	8.7	8.8								
10.0	193	194	195	9.7	9.7	9.8								
12.5	216	214	220	10.8	10.7	11.0								
15.0	230	234	240	11.5	11.7	12.0								







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	6.00	6.57	6.86
5	6.76	6.10	7.90



MDD=1.62 gm/cc; 97% of MDD=1.57 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=6.40 (from graph)

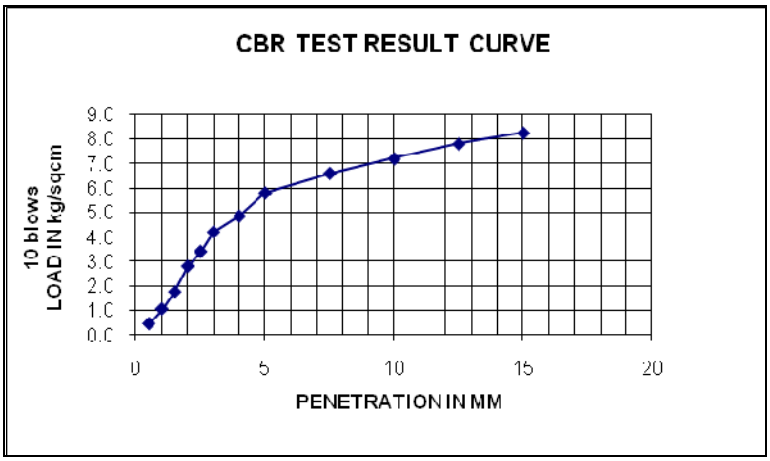
LOCATION: 150+000 km

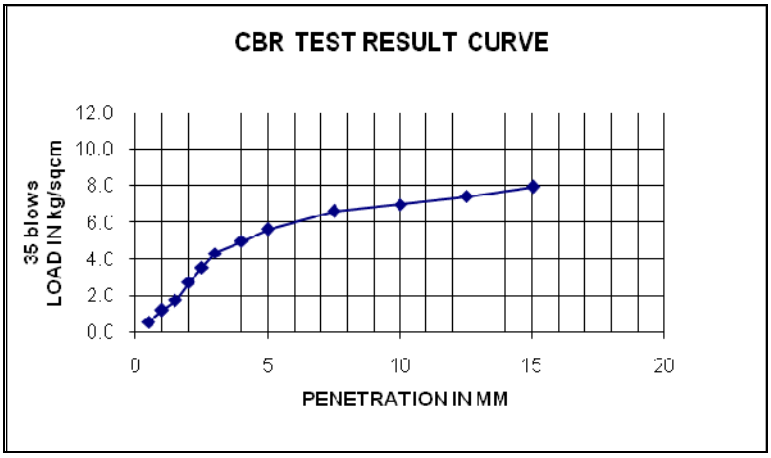
Test condition: Soaked

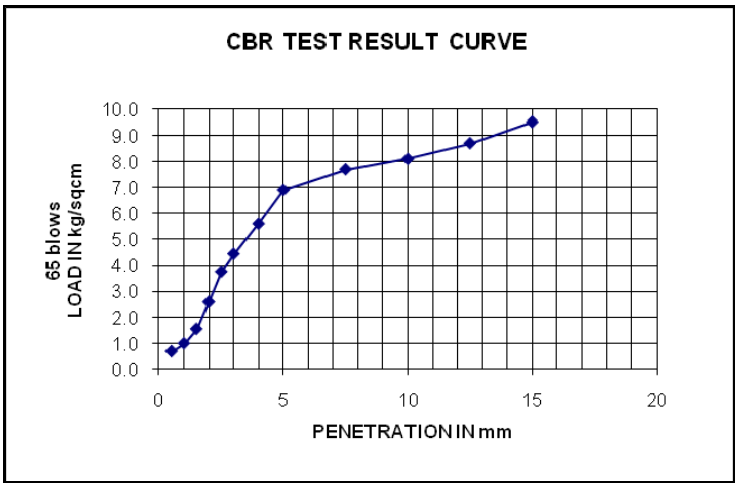
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9256	9788	10520	10087	10488	11302
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	3916	4448	5180	4747	5148	5962
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.74	1.98	2.30	2.11	2.29	2.65
Water Content (%)	17.8	17.5	17.3	37	36	35
Dry Density (gms/cc)	1.54	1.68	1.96	1.54	1.68	1.96

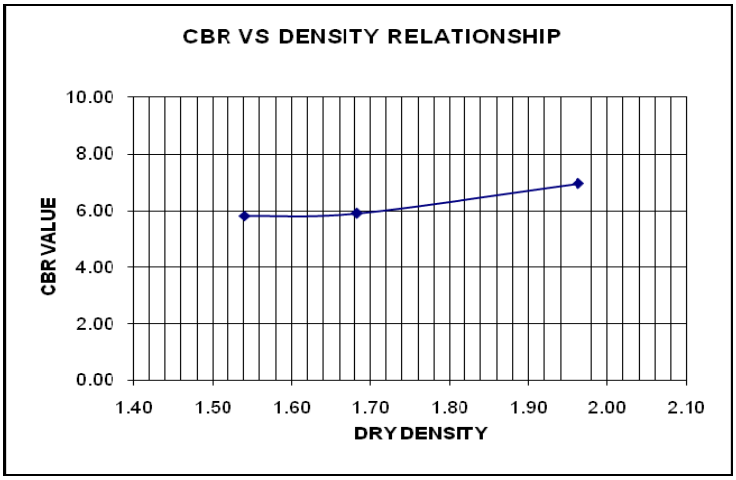
Penetration Data									Proving Ring Used: 1000kg					
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)		
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65
0.5	9	11	14	0.5	0.6	0.7							
1.0	21	23	20	1.1	1.2	1.0							
1.5	35	34	31	1.8	1.7	1.6							
2.0	56	54	52	2.8	2.7	2.6							
2.5	68	70	75	3.4	3.5	3.8	70	5.7	4.1	4.2	8.1	5.9	6.0
3.0	84	86	89	4.2	4.3	4.5							
4.0	97	99	112	4.9	5.0	5.6							
5.0	116	112	138	5.8	5.6	6.9	105	6.1	6.2	7.3	5.8	5.9	7.0
7.5	132	132	154	6.6	6.6	7.7							
10.0	144	139	162	7.2	7.0	8.1							
12.5	156	148	174	7.8	7.4	8.7							
15.0	165	158	190	8.3	7.9	9.5							







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	8.14	5.86	6.00
5	5.81	5.90	7.0



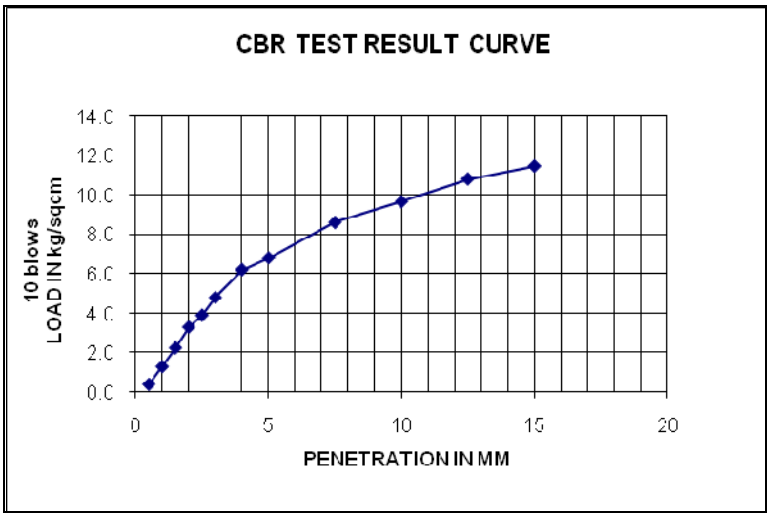
MDD=1.70 gm/cc; 97% of MDD=1.65 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=5.80 (from graph)

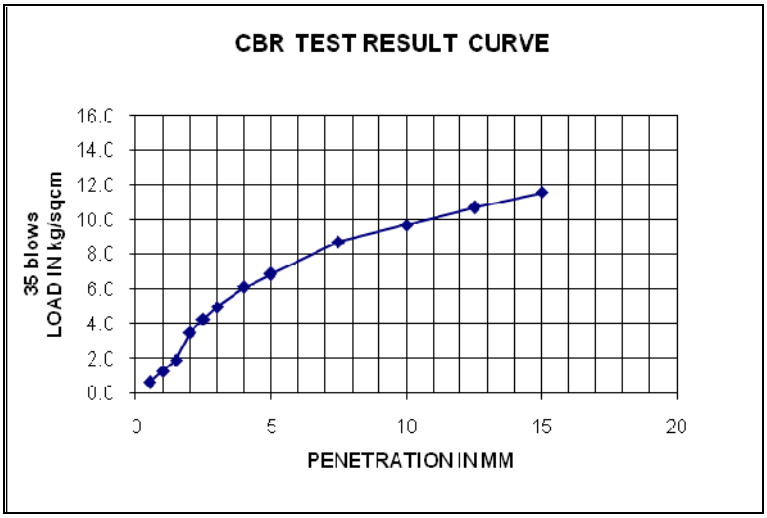
LOCATION: 160+000 km

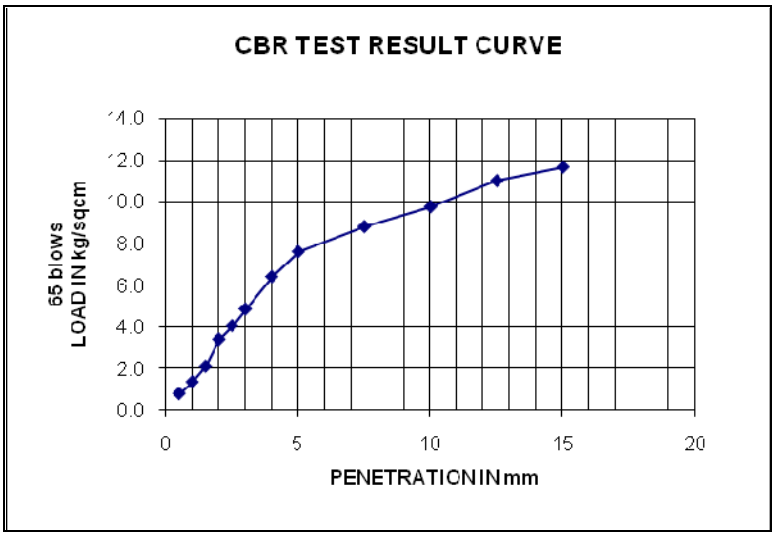
Test condition: Soaked
Nature of Sample: Compacted in 5 layers with 10/35/65 blows of 4.9kg rammer having 45cm drop at OMC

Water Content and Dry Density Data	Before Soaking			After Soaking		
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows
Wt Wet Soil+Mould (gm)	9432	9840	10256	10037	10494	10904
Wt Mould (gm)	5340	5340	5340	5340	5340	5340
Wt Wet Soil (gm)	4092	4500	4916	4697	5154	5564
Vol. Soil (cc)	2250	2250	2250	2250	2250	2250
Wet Density (gms/cc)	1.82	2.00	2.18	2.09	2.29	2.47
Water Content (%)	17.6	17	17.5	35	34	33
Dry Density (gms/cc)	1.55	1.71	1.86	1.55	1.71	1.86

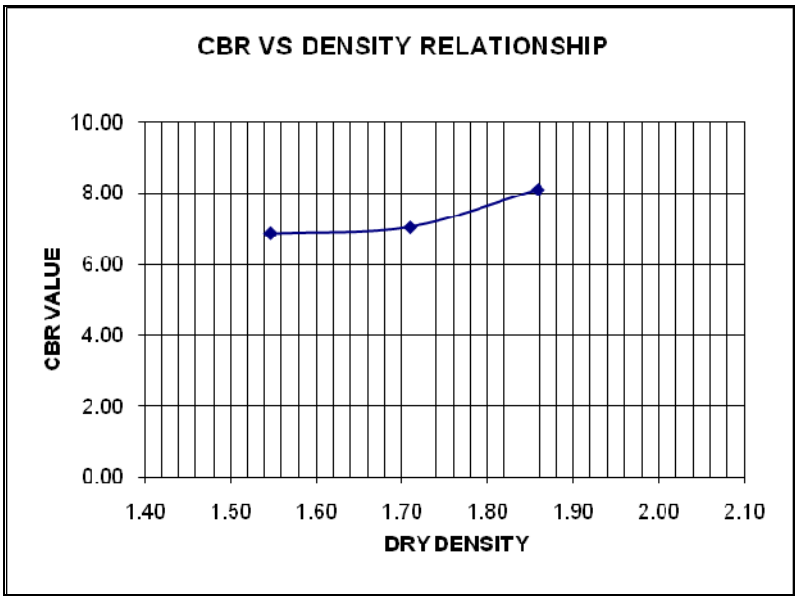
Penetration Data														Proving Ring Used: 1000kg
Penetration (mm)	TEST LOAD						Standard Load kg/cm2	Corrected Load (kg/cm2)			CBR (%)			
	Proving ring Reading			In kg/cm^2				No. of blows			No. of blows			
	10 blows	35 blows	65 blows	10 blows	35 blows	65 blows		10	35	65	10	35	65	
0.5	8	12	16	0.4	0.6	0.8								
1.0	26	25	27	1.3	1.3	1.4								
1.5	45	38	42	2.3	1.9	2.1								
2.0	66	70	68	3.3	3.5	3.4								
2.5	78	85	81	3.9	4.3	4.1	70	4.3	4.8	5.0	6.1	6.9	7.1	
3.0	96	99	97	4.8	5.0	4.9								
4.0	124	122	128	6.2	6.1	6.4								
5.0	136	137	152	6.8	6.9	7.6	105	7.2	7.4	8.5	6.9	7.0	8.1	
7.5	172	174	176	8.6	8.7	8.8								
10.0	193	194	195	9.7	9.7	9.8								
12.5	216	214	220	10.8	10.7	11.0								
15.0	229	231	233	11.5	11.6	11.7								







Penetration (mm)	Soaked CBR (%)		
	10 blows	35 blows	65 blows
2.5	6.14	6.86	7.14
5	6.86	7.05	8.10



MDD=1.70 gm/cc; 97% of MDD=1.65 gm/cc
The CBR value to be adopted=CBR value of 97% of MDD=6.80 (from graph)

8. SUMMERY OF TEST RESULTS: Sub-grade of existing pavement-

Sl. No.	Chainage	Sieve Analysis (% Passing by Weight)						Atterberg's	Limit	Plasticity Index	Soil-Classification	Field Data		Laboratory Compaction		Soaked CBR at 3 Energy Levels						Soaked CBR at 97% of MDD	Unsoaked CBR at 3 Energy Levels						Unsoaked CBR at 97% of MDD
		20	10	4.75	2	425	75					Dry Density (gm/cc)	Water Content (%)	MDD	OMC	10 Blows		35 Blows		65 Blows			10 Blows		35 Blows		65 Blows		
														(gm/cc)	(%)	DD	CBR (%)	DD	CBR (%)	DD	CBR (%)		DD	CBR (%)	DD	CBR (%)	DD	CBR (%)	
	(km)	mm	mm	mm	mm	µ	µ	LL	PL																				
1	40+100	100	100	99.76	93.17	80.96	73.43	34.53	27.39	7.14	CL	0.19	19.00	1.76	17.1	1.50	5.70	1.72	6.30	1.86	6.90	6.3	1.50	5.82	1.72	6.85	1.86	7.40	7.1
2	42+000	100	100	98.40	91.7	76.78	64.29	32.54	23.09	9.45	CL	0.15	15.00	1.79	17.4	1.71	5.71	1.90	5.90	2.09	6.63	6.4	1.71	5.84	1.90	6.41	2.09	7.11	6.9
3	43+100	100	100	99.11	92.37	74.35	62.58	34.34	26.76	7.58	CL	0.14	13.50	1.85	18.0	1.64	5.98	1.83	6.16	2.01	6.93	6.0	1.64	6.11	1.83	6.70	2.01	7.43	7.2
4	44+000	100	100	98.53	91.83	77.47	65.26	31.54	23.30	8.24	CL	0.13	13.00	1.86	18.1	1.78	5.27	1.96	5.45	2.15	6.13	6.4	1.78	5.38	1.96	5.93	2.15	6.58	6.4
5	45+000	100	100	99.33	92.57	71.73	61.26	29.34	19.80	9.54	CL	0.14	14.00	1.84	17.9	1.81	4.95	1.99	5.14	2.18	5.77	6.2	1.81	5.06	1.99	5.58	2.18	6.19	6.1
6	46+150	100	100	98.13	91.45	80.94	68.23	28.54	20.70	7.84	CL	0.12	11.50	1.80	17.5	1.65	5.63	1.84	5.81	2.02	6.53	6.1	1.65	5.75	1.84	6.32	2.02	7.01	6.8
7	47+000	100	100	98.85	92.46	71.23	31.05	35.83	25.65	10.18	CL	0.11	10.50	1.90	18.5	1.74	6.37	1.92	6.55	2.11	7.37	6.4	1.74	6.51	1.92	7.12	2.11	7.90	7.6
8	48+000	100	100	98.23	93.24	71.07	57.87	30.43	21.00	9.43	CL	0.17	16.50	1.89	18.4	1.83	6.21	2.02	6.40	2.20	7.19	6.3	1.83	6.34	2.02	6.95	2.20	7.71	7.5
9	49+000	100	100	99.63	93.59	79.54	74.53	29.01	22.58	6.43	CL	0.17	17.00	1.85	18.0	1.75	6.31	1.93	6.49	2.12	7.29	6.4	1.75	6.44	1.93	7.06	2.12	7.83	7.6
10	50+150	100	100	98.02	91.3	73.78	63.08	27.54	20.00	7.54	CL	0.20	20.00	1.70	16.6	1.56	6.30	1.77	7.10	1.86	7.00	7.0	1.56	6.44	1.77	7.72	1.86	7.51	7.7
11	51+000	100	100	98.44	91.69	72.94	62.35	31.34	22.91	8.43	CL	0.11	10.50	1.86	18.1	1.70	6.45	1.89	6.64	2.08	7.46	6.5	1.70	6.59	1.89	7.22	2.08	8.00	7.7
12	52+000	100	100	99.00	92.21	69.74	60.16	30.67	21.37	9.30	CL	0.11	11.00	1.88	18.3	1.72	5.15	1.91	5.34	2.09	6.00	6.4	1.72	5.26	1.91	5.80	2.09	6.44	6.3
13	53+100	100	100	99.33	92.52	87.44	74.96	31.53	24.39	7.14	CL	0.09	8.50	1.91	18.6	1.75	4.92	1.94	5.11	2.12	5.74	6.2	1.75	5.03	1.94	5.55	2.12	6.16	6.0
14	54+000	100	100	97.44	90.76	85.04	72.87	28.78	22.25	6.53	CL	0.10	10.00	1.78	17.3	1.63	6.01	1.81	6.20	2.00	6.96	6.0	1.63	6.14	1.81	6.73	2.00	7.47	7.2
15	55+000	100	100	96.23	90.23	88.51	73.19	27.56	21.34	6.22	CL	0.08	7.50	1.77	17.2	1.62	6.57	1.80	6.76	1.99	7.59	6.6	1.62	6.71	1.80	7.34	1.99	8.15	7.9
16	56+000	100	100	97.00	90.97	83.44	73.7	29.43	22.09	7.34	CL	0.12	11.50	1.84	17.9	1.68	6.36	1.87	6.54	2.06	7.35	6.4	1.68	6.50	1.87	7.11	2.06	7.89	7.6
17	57+150	100	100	98.53	92.4	78.07	69.26	31.76	21.31	10.45	CL	0.13	12.50	1.79	17.4	1.64	5.73	1.82	5.92	2.01	6.65	6.4	1.64	5.86	1.82	6.43	2.01	7.14	6.9
18	58+000	100	100	97.44	91.38	75.94	66.98	29.76	19. ¨	;	9 ˆ6.16	2.06	6.93	6.2	1.68	6.11	1.87	6.70	2.06	7.4									3	7.2
19	59+000	100	100	98.53	92.4	81.73	72.17	30.53	21.99	8.54	CL	0.15	15.00	1.86	18.1	1.70	6.01	1.89	6.20	2.08	6.96	6.1	1.70	6.14	1.89	6.73	2.08	7.47	7.2

20	60+000	100	100	97.47	91.4	86.07	76.06	29.14	21.60	7.54	CL	0.19	19.00	1.69	16.2	1.46	4.57	1.69	6.43	1.82	6.57	6.0	1.46	4.67	1.69	6.99	1.82	7.05	6.7
21	61+000	100	100	97.32	89.29	89.41	74.6	29.11	21.13	7.98	CL	0.19	19.00	1.85	18.0	1.76	4.96	1.94	5.15	2.13	5.78	5.5	1.76	5.07	1.94	5.59	2.13	6.21	6.1
22	62+000.	100	100	98.23	89.51	78.07	67.95	28.34	21.47	6.87	CL	0.13	12.50	1.84	17.9	1.75	5.67	1.93	5.86	2.12	6.58	5.6	1.75	5.79	1.93	6.37	2.12	7.06	6.9
23	63+000	100	100	98.13	89.42	77.99	70.16	27.54	20.00	7.54	CL	0.16	16.00	1.88	18.3	1.79	5.59	1.97	5.77	2.16	6.49	6.4	1.79	5.71	1.97	6.27	2.16	6.96	6.8
24	64+100	100	100	99.24	90.43	78.86	68.65	32.54	23.01	9.53	CL	0.12	12.00	1.90	18.5	1.81	6.00	1.99	6.18	2.18	6.95	6.1	1.81	6.13	1.99	6.72	2.18	7.46	7.2
25	65+000	100	100	97.44	88.8	80.74	70.31	31.34	21.39	9.95	CL	0.15	15.00	1.91	18.6	1.82	6.39	2.00	6.58	2.19	7.39	6.4	1.82	6.53	2.00	7.15	2.19	7.93	7.7
26	66+000	100	100	96.23	87.69	76.5	66.57	29.53	20.30	9.23	CL	0.12	12.00	1.85	18.0	1.76	5.06	1.94	5.24	2.13	5.89	6.1	1.76	5.17	1.94	5.70	2.13	6.32	6.2
27	67+000	100	100	98.09	89.39	74.67	64.94	29.95	21.21	8.74	CL	0.10	10.00	1.84	17.9	1.75	5.57	1.93	5.75	2.12	6.46	5.6	1.75	5.68	1.93	6.25	2.12	6.93	6.7
28	68+000	100	100	98.25	89.53	78.08	67 ¸ Â ¨ ú Ä^			2.05	6	91	6.0	1.68	6.10	1.86	6.69	2.05	7.42										7.2
29	69+000	100	100	99.20	87.79	90.42	72.4	27.85	22.75	5.10	CL	0.08	8.00	1.78	17.3	1.69	5.17	1.87	5.36	2.06	6.02	6.5	1.69	5.28	1.87	5.82	2.06	6.46	6.3
30	70+120	100	100	98.53	89.83	75.07	67.64	28.74	22.20	6.54	CL	0.15	15.00	1.70	16.6	1.55	5.70	1.74	5.90	1.87	6.00	5.9	1.55	5.82	1.74	6.41	1.87	6.44	6.7
31	71+000	100	100	97.66	89.04	77.44	69.8	29.53	21.99	7.54	CL	0.12	11.50	1.79	17.4	1.66	5.27	1.85	5.45	2.03	6.13	6.5	1.66	5.38	1.85	5.93	2.03	6.58	6.4
32	72+000	100	100	98.05	89.39	74.71	67.31	30.43	22.29	8.14	CL	0.16	15.50	1.80	17.5	1.67	5.57	1.86	5.75	2.04	6.46	6.0	1.67	5.68	1.86	6.25	2.04	6.93	6.7
33	73+150	100	100	99.00	90.26	80.91	72.98	32.54	23.01	9.53	CL	0.17	16.50	1.78	17.3	1.65	5.44	1.84	5.62	2.02	6.32	5.6	1.65	5.56	1.84	6.11	2.02	6.78	6.6
34	74+000	100	100	97.44	88.84	74.25	66.89	31.34	25.22	6.12	CL	0.15	14.50	1.88	18.3	1.75	5.79	1.94	5.97	2.12	6.71	5.8	1.75	5.91	1.94	6.49	2.12	7.20	7.0
35	75+000	100	100	98.24	89.57	87.44	78.96	29.76	23.22	6.54	CL	0.13	13.00	1.89	18.4	1.76	5.15	1.95	5.34	2.13	6.00	6.4	1.76	5.26	1.95	5.80	2.13	6.44	6.3
36	76+000	100	100	99.03	85.54	66.76	29.63	25.36	19.36	6.00	CL	0.10	10.00	1.77	17.2	1.64	6.60	1.83	6.79	2.01	7.63	6.7	1.64	6.74	1.83	7.38	2.01	8.18	7.9
37	77+000	100	100	97.86	88.15	73.45	44.59	27.87	17.33	10.54	CL	0.09	8.50	1.76	17.1	1.63	6.39	1.82	6.58	2.00	7.39	6.4	1.63	6.53	1.82	7.15	2.00	7.93	7.7
38	78+000	100	100	97.22	87.57	80.74	61.26	26.57	16.74	9.83	CL	0.08	8.00	1.78	17.3	1.65	5.59	1.84	5.77	2.02	6.49	6.0	1.65	5.71	1.84	6.27	2.02	6.96	6.8
39	79+000	100	100	97.48	87.8	74.73	56.77	28.73	21.19	7.54	CL	0.07	7.00	1.93	18.7	1.79	5.98	1.98	6.16	2.16	6.93	6.0	1.79	6.11	1.98	6.70	2.16	7.43	7.2
40	80+000	100	100	97.38	91.6	65.81	29.07	27.34	21.55	5.79	CL	0.14	14.00	1.68	17.2	1.50	6.30	1.73	7.10	1.82	7.00	7.0	1.50	6.44	1.73	7.72	1.82	7.51	7.7
41	81+000	100	100	98.63	87.85	68.94	55.45	29.54	23.01	6.53	CL	0.10	9.50	1.84	17.9	1.69	6.54	1.88	6.72	2.06	7.56	6.6	1.69	6.68	1.88	7.31	2.06	8.11	7.8
42	82+000	100	100	98.53	87.76	74.74	67.93	30.43	24.56	5.87	CL	0.08	7.50	1.86	18.1	1.71	6.44	1.90	6.63	2.08	7.45	6.5	1.71	6.58	1.90	7.20	2.08	7.99	7.7
43	83+100	100	100	97.75	87.07	77.67	70.63	31.57	25.03	6.54	CL	0.11	11.00	1.85	18.0	1.70	5.13	1.89	5.32	2.07	5.97	6.5	1.70	5.24	1.89	5.78	2.07	6.41	6.3

44	84+000	100	100	99.03	88.21	81.34	74.02	32.53	24.00	8.53	CL	0.13	12.50	1.83	17.8	1.68	5.54	1.87	5.73	2.05	6.44	6.1	1.68	5.66	1.87	6.23	2.05	6.91	6.7
45	85+000	100	100	89.63	79.85	74.74	67.93	29.13	19.98	9.15	CL	0.17	17.00	1.78	17.3	1.63	6.15	1.82	6.33	2.01	7.12	6.2	1.63	6.28	1.82	6.88	2.01	7.64	7.4
46	86+000	100	100	99.59	88.71	85.31	72.2	28.52	21.54	6.98	CL	0.09	8.50	1.77	17.2	1.62	5.03	1.81	5.21	2.00	5.86	6.4	1.62	5.13	1.81	5.66	2.00	6.28	6.2
47	87+150	100	100	97.13	86.52	70.74	57.6	27.43	19.92	7.51	CL	0.11	11.00	1.75	17.0	1.61	6.53	1.79	6.71	1.98	7.54	6.6	1.61	6.67	1.79	7.30	1.98	8.09	7.8
48	88+000	100	100	97.24	86.62	66.94	53.56	28.54	22.90	5.64	CL	0.19	19.00	1.85	18.0	1.70	5.97	1.89	6.15	2.07	6.91	6.0	1.70	6.10	1.89	6.69	2.07	7.42	7.2
49	89+000	100	100	96.59	78.58	84.65	74.73	27.65	22.34	5.31	CL	0.12	12.00	1.86	18.1	1.71	6.21	1.90	6.40	2.08	7.19	6.3	1.71	6.34	1.90	6.95	2.08	7.71	7.5
50	90+000	100	100	98.31	97.03	89.63	75.29	26.15	19.82	6.33	CL	0.11	11.00	1.68	16.5	1.50	5.14	1.72	7.14	1.88	8.29	7.0	1.50	5.25	1.72	7.76	1.88	8.90	7.8
51	91+000	100	100	97.73	93.68	80.94	61.26	27.56	21.46	6.10	CL	0.13	13.00	1.75	17.0	1.66	5.65	1.84	5.84	2.03	6.56	6.4	1.66	5.77	1.84	6.34	2.03	7.04	6.8
52	92+000	100	100	99.60	94.44	90.41	74.07	27.36	20.13	7.23	CL	0.12	11.50	1.78	17.3	1.69	5.69	1.87	5.88	2.06	6.60	5.8	1.69	5.81	1.87	6.39	2.06	7.09	6.9
53	93+000	100	100	98.23	90.35	83.63	71.49	29.53	23.41	6.12	CL	0.13	13.00	1.88	18.3	1.79	6.08	1.97	6.27	2.16	7.04	6.1	1.79	6.21	1.97	6.81	2.16	7.56	7.3
54	94+000	100	100	98.63	95.55	88.55	72.13	28.76	21.36	7.40	CL	0.16	15.50	1.87	18.2	1.78	5.01	1.96	5.20	2.15	5.84	6.0	1.78	5.12	1.96	5.65	2.15	6.27	6.1
55	95+100	100	100	97.72	91.55	83.44	74.03	29.41	23.88	5.53	CL	0.10	9.50	1.84	17.9	1.75	4.95	1.93	5.14	2.12	5.77	5.9	1.75	5.06	1.93	5.58	2.12	6.19	6.1
56	96+000.	100	100	97.51	92.33	85.24	75.65	28.76	21.64	7.12	CL	0.08	8.00	1.82	17.7	1.73	6.16	1.91	6.34	2.10	7.13	6.2	1.73	6.29	1.91	6.89	2.10	7.65	7.4
57	97+050.	100	100	97.13	91.97	80.77	71.62	28.34	19.80	8.54	CL	0.12	11.50	1.76	17.1	1.67	6.39	1.85	6.58	2.04	7.39	6.4	1.67	6.53	1.85	7.15	2.04	7.93	7.7
58	98+100	100	100	97.83	92.63	77.47	68.65	27.84	22¨ ¨	¦ ~	¤	5.84	2.06	6.56	5.7	1.69	5.77	1	87	6	34	2.06	7.04							6.8
59	99+000	100	100	97.77	92.57	72.09	63.81	29.43	23.19	6.24	CL	0.11	10.50	1.86	18.1	1.77	5.68	1.95	5.87	2.14	6.59	5.7	1.77	5.80	1.95	6.38	2.14	7.07	6.9
60	100+100	100	100	98.53	96.7	74.96	66.39	30.53	22.99	7.54	CL	0.15	15.00	1.69	16.6	1.54	6.30	1.77	7.90	1.84	7.00	7.0	1.54	6.44	1.77	8.59	1.84	7.51	8.0
61	101+000	100	100	98.64	93.39	69.67	61.63	29.76	23.31	6.45	CL	0.18	17.50	1.84	17.9	1.80	5.27	1.98	5.45	2.17	6.13	5.6	1.80	5.38	1.98	5.93	2.17	6.58	6.4
62	102+000	100	100	98.20	92.98	70.96	62.79	28.34	18.60	9.74	CL	0.16	16.00	1.74	16.9	1.70	5.97	1.88	6.15	2.07	6.91	6.0	1.70	6.10	1.88	6.69	2.07	7.42	7.2
63	103+150	100	100	99.00	93.73	81.44	72.23	27.21	18.67	8.54	CL	0.15	14.50	1.78	17.3	1.74	5.06	1.92	5.24	2.11	5.89	5.5	1.74	5.17	1.92	5.70	2.11	6.32	6.2
64	104+000	100	100	99.13	94.77	82.74	73.4	27.43	19.89	7.54	CL	0.20	19.50	1.86	18.1	1.82	5.19	2.01	5.38	2.19	6.05	5.9	1.82	5.31	2.01	5.85	2.19	6.49	6.3
65	105+000	100	100	99.24	93.96	84.99	75.42	26.87	20.33	6.54	CL	0.18	18.00	1.87	18.2	1.83	4.94	2.02	5.13	2.20	5.76	6.1	1.83	5.05	2.02	5.57	2.20	6.18	6.1
66	106+100	100	100	98.52	93.28	80.04	70.97	29.31	23.57	5.74	CL	0.15	15.00	1.93	18.7	1.88	6.39	2.07	6.58	2.25	7.39	6.4	1.88	6.53	2.07	7.15	2.25	7.93	7.7
67	107+000	100	100	98.62	93.38	74.77	66.22	30.43	20.31	10.12	CL	0.13	12.50	1.84	17.9	1.80	6.63	1.98	6.82	2.17	7.66	6.7	1.80	6.78	1.98	7.41	2.17	8.22	7.9

68	108+000	100	100	98.14	92.92	74.07	65.59	28.43	18.70	9.73	CL	0.11	11.00	1.86	18.1	1.82	6.71	2.01	6.89	2.19	7.75	6.8	1.82	6.85	2.01	7.49	2.19	8.31	8.0
69	109+000	100	100	97.51	92.33	73.07	57.54	25.46	17.01	8.45	CL	0.10	9.50	1.78	17.3	1.74	6.21	1.92	6.40	2.11	7.19	6.3	1.74	6.34	1.92	6.95	2.11	7.71	7.5
70	110+000	100	100	97.52	92.34	70.96	62.79	27.87	20.33	7.54	CL	0.18	18.00	1.66	16.8	1.46	5.30	1.68	6.40	1.83	6.90	7.0	1.46	5.41	1.68	6.96	1.83	7.40	7.0
71	111+000	100	100	98.25	93.03	83.96	74.5	29.53	22.75	6.78	CL	0.10	10.00	1.78	16.2	1.70	6.72	1.89	6.90	2.07	7.76	6.8	1.70	6.86	1.89	7.50	2.07	8.32	8.0
72	112+000	100	100	98.53	93.29	81.54	72.32	30.87	24.63	6.24	CL	0.19	18.50	1.85	16.9	1.77	5.97	1.96	6.15	2.15	6.91	6.0	1.77	6.10	1.96	6.69	2.15	7.42	7.2
73	113+000	100	100	97.51	92.33	75.04	66.47	31.43	25.67	5.76	CL	0.17	17.00	1.86	17.0	1.78	6.21	1.97	6.40	2.16	7.19	6.3	1.78	6.34	1.97	6.95	2.16	7.71	7.5
74	114+000	100	100	98.44	93.21	73.07	64.69	29.53	20.99	8.54	CL	0.16	16.00	1.87	17.1	1.79	6.71	1.98	6.89	2.17	7.75	6.8	1.79	6.85	1.98	7.49	2.17	8.31	8.0
75	115+000	100	100	98.33	93.1	87.63	77.8	28.54	18.30	10.24	CL	0.13	13.00	1.94	17.7	1.86	5.54	2.04	5.73	2.23	6.44	5.6	1.86	5.66	2.04	6.23	2.23	6.91	6.7
76	116+100	100	100	98.25	93.03	90.43	80.32	29.34	18.80	10.54	CL	0.15	15.00	1.78	16.2	1.70	5.13	1.89	5.32	2.07	5.97	6.5	1.70	5.24	1.89	5.78	2.07	6.41	6.3
77	117+150	100	100	98.90	96.57	90.01	73.27	28.41	20.18	8.23	CL	0.20	19.50	1.82	16.6	1.74	6.55	1.93	6.73	2.11	7.57	6.6	1.74	6.69	1.93	7.32	2.11	8.12	7.8
78	118+100	100	100	98.64	95.57	88.94	716 ¨	¨ ¦	˜	1.95	6.40	2.14	7.19	6.3	1.76	6.34	1.95	6.95	2.14	7.7								1	7.5
79	119+000	100	100	99.05	87.94	87.56	72.33	27.42	19.86	7.56	CL	0.12	12.00	1.94	17.7	1.86	5.78	2.04	5.96	2.23	6.70	5.8	1.86	5.90	2.04	6.48	2.23	7.19	7.0
80	120+200	100	100	98.01	92.43	89.61	74.52	25.87	20.37	5.50	CL	0.10	10.00	1.64	16.5	1.55	4.70	1.72	7.60	1.83	8.60	6.1	1.55	4.80	1.72	8.26	1.83	9.23	7.9
81	121+150	100	100	99.60	96.7	87.83	72.18	26.33	19.63	6.70	CL	0.16	15.50	1.78	17.3	1.69	4.99	1.88	5.18	2.06	5.82	5.9	1.69	5.10	1.88	5.63	2.06	6.24	6.1
82	122+000	100	100	97.86	90.91	78.03	69.15	27.84	20.30	7.54	CL	0.11	11.00	1.74	16.9	1.65	6.43	1.84	6.62	2.02	7.44	6.5	1.65	6.57	1.84	7.19	2.02	7.98	7.7
83	123+000	100	100	98.53	91.54	87.63	77.79	26.85	19.20	7.65	CL	0.10	9.50	1.85	18.0	1.76	6.08	1.95	6.27	2.13	7.04	6.1	1.76	6.21	1.95	6.81	2.13	7.56	7.3
84	124+100	100	100	97.51	90.59	88.74	78.79	27.84	21.09	6.75	CL	0.09	8.50	1.82	17.7	1.73	5.73	1.92	5.92	2.10	6.65	5.8	1.73	5.86	1.92	6.43	2.10	7.14	6.9
85	125+100	100	100	98.61	95.55	80.91	71.09	27.41	20.14	7.27	CL	0.13	12.50	1.78	17.3	1.69	5.69	1.88	5.88	2.06	6.60	5.8	1.69	5.81	1.88	6.39	2.06	7.09	6.9
86	126+050	100	100	98.53	93.77	77.67	69.61	28.57	20.03	8.54	CL	0.11	11.00	1.93	18.7	1.83	6.64	2.02	6.83	2.21	7.67	6.7	1.83	6.79	2.02	7.42	2.21	8.23	7.9
87	127+000	100	100	98.22	95.33	80.43	72.12	29.87	22.42	7.45	CL	0.16	15.50	1.82	17.7	1.73	5.79	1.92	5.97	2.10	6.71	5.8	1.73	5.91	1.92	6.49	2.10	7.20	7.0
88	128+100	100	100	99.02	97.36	81.23	72.85	26.35	19.68	6.67	CL	0.17	16.50	1.76	17.1	1.67	5.49	1.86	5.68	2.04	6.38	5.6	1.67	5.61	1.86	6.17	2.04	6.84	6.7
89	129+000	100	100	99.14	96.44	82.65	74.14	31.54	22.11	9.43	CL	0.14	13.50	1.88	18.3	1.79	4.94	1.98	5.13	2.17	5.76	5.0	1.79	5.05	1.98	5.57	2.17	6.18	6.1
90	130+000	100	100	98.75	90.37	87.44	78.5	32.53	22.00	10.53	CL	0.10	10.00	1.72	16.7	1.52	5.40	1.76	5.70	1.94	5.90	5.5	1.52	5.52	1.76	6.20	1.94	6.33	6.5
91	131+150	100	100	98.23	96.7	87.44	78.5	27.03	19.92	7.11	CL	0.10	9.50	1.85	18.0	1.83	5.65	2.02	5.84	2.20	6.56	5.7	1.83	5.77	2.02	6.34	2.20	7.04	6.8

92	132+000	100	100	97.72	91.35	75.65	67.77	28.57	21.82	6.75	CL	0.10	9.50	1.84	17.9	1.82	6.01	2.01	6.20	2.19	6.96	6.1	1.82	6.14	2.01	6.73	2.19	7.47	7.2
93	133+100	100	100	98.53	90.66	80.03	71.76	29.43	23.19	6.24	CL	0.11	11.00	1.79	17.4	1.77	6.13	1.96	6.31	2.14	7.09	6.2	1.77	6.26	1.96	6.86	2.14	7.61	7.4
94	134+100	100	100	98.22	92.48	79.33	71.12	30.54	24.81	5.73	CL	0.12	12.00	1.78	17.3	1.76	5.97	1.94	6.15	2.13	6.91	6.0	1.76	6.10	1.94	6.69	2.13	7.42	7.2
95	135+000	100	100	98.14	94.68	73.65	65.95	31.43	23.79	7.64	CL	0.17	17.00	1.93	18.7	1.91	5.57	2.09	5.75	2.28	6.46	5.6	1.91	5.68	2.09	6.25	2.28	6.93	6.7
96	136+100	100	100	97.73	95.69	83.47	72.19	28.71	20.16	8.55	CL	0.22	21.50	1.85	18.0	1.83	5.80	2.02	5.98	2.20	6.72	5.9	1.83	5.92	2.02	6.50	2.20	7.21	7.0
97	137+000	100	100	97.23	93.68	87.44	75.26	29.35	19.14	10.21	CL	0.20	20.00	1.78	17.3	1.76	6.60	1.94	6.79	2.13	7.63	6.7	1.76	6.74	1.94	7.38	2.13	8.18	7.9
98	138+100	100	100	97.33	94.77	81.74	71.47	30.53	23.78	6.75	CL	0.20	20.00	1.77	17.2	1.75	6.64	1.93	6.83	2.12	7.67	6.7	1.75	6.79	1.93	7.42	2.12	8.23	7.9
99	139+150	100	100	99.06	87.94	83.54	7¸ £	¡ £ §	5.11	2.25	5.74	6.7	1.87	5.03	2.06	5.55	2.25	6.1										6	6.0
100	140+100	100	100	98.53	93.38	82.04	72.74	28.54	20.69	7.85	CL	0.15	15.00	1.70	13.0	1.49	6.00	1.69	6.60	1.87	6.90	6.4	1.49	6.13	1.69	7.17	1.87	7.40	7.4
101	141+100	100	100	98.23	93.09	73.44	65	27.54	19.00	8.54	CL	0.09	9.45	1.81	17.6	1.79	5.10	1.97	5.29	2.16	5.94	5.2	1.79	5.21	1.97	5.74	2.16	6.37	6.2
102	142+000	100	100	97.72	92.61	80.74	71.57	26.74	17.20	9.54	CL	0.15	15.00	1.83	17.8	1.81	4.92	2.00	5.11	2.18	5.74	5.0	1.81	5.03	2.00	5.55	2.18	6.16	6.0
103	143+000	100	100	98.45	90.35	75.62	66.97	28.74	21.20	7.54	CL	0.11	11.00	1.86	18.1	1.84	5.22	2.03	5.40	2.21	6.07	5.3	1.84	5.33	2.03	5.87	2.21	6.51	6.4
104	144+000	100	100	98.23	93.09	77.93	69.04	29.53	21.00	8.53	CL	0.13	13.00	1.79	17.4	1.77	5.57	1.95	5.75	2.14	6.46	5.6	1.77	5.68	1.95	6.25	2.14	6.93	6.7
105	145+150	100	100	98.03	92.91	81.34	72.11	27.84	20.31	7.53	CL	0.10	10.00	1.78	17.3	1.76	5.65	1.94	5.84	2.13	6.56	5.7	1.76	5.77	1.94	6.34	2.13	7.04	6.8
106	146+000	100	100	98.15	93.02	88.04	78.14	29.54	23.01	6.53	CL	0.12	12.00	1.74	16.9	1.72	6.00	1.90	6.18	2.09	6.95	6.1	1.72	6.13	1.90	6.72	2.09	7.46	7.2
107	147+100	100	100	98.53	90.37	82.54	73.19	30.14	24.27	5.87	CL	0.19	19.00	1.85	18.0	1.83	6.60	2.02	6.79	2.20	7.63	6.7	1.83	6.74	2.02	7.38	2.20	8.18	7.9
108	148+000	100	100	98.42	93.27	81.78	72.51	31.54	25.31	6.23	CL	0.09	9.00	1.86	18.1	1.84	6.63	2.03	6.82	2.21	7.66	6.7	1.84	6.78	2.03	7.41	2.21	8.22	7.9
109	149+100	100	100	98.14	90.77	77.44	68.6	28.54	22.53	6.01	CL	0.08	8.00	1.82	17.7	1.80	5.95	1.99	6.13	2.17	6.89	6.0	1.80	6.07	1.99	6.66	2.17	7.39	7.2
110	150+000	100	100	99.75	95.36	79.86	71.87	31.23	23.64	7.59	CL	0.13	13.00	1.68	12.7	1.54	8.10	1.68	5.90	1.96	6.00	5.8	1.54	8.27	1.68	6.41	1.96	6.44	7.5
111	151+100	100	100	98.22	94.77	74.07	69.16	32.36	24.87	7.49	CL	0.18	18.00	1.78	16.4	1.69	6.60	1.87	6.79	2.06	7.63	6.7	1.69	6.74	1.87	7.38	2.06	8.18	7.9
112	152+000	100	100	99.04	90.79	79.74	64.29	29.54	21.01	8.53	CL	0.20	20.00	1.86	17.2	1.77	6.75	1.95	6.94	2.14	7.79	6.8	1.77	6.90	1.95	7.54	2.14	8.36	8.1
113	153+100	100	100	98.15	89.77	81.34	64.29	28.24	20.90	7.34	CL	0.13	13.00	1.84	17.0	1.75	6.21	1.93	6.40	2.12	7.19	6.3	1.75	6.34	1.93	6.95	2.12	7.71	7.5
114	154+000	100	100	99.76	82.56	81.73	70.37	27.86	20.16	7.70	CL	0.14	13.50	1.78	16.4	1.69	6.28	1.87	6.47	2.06	7.27	6.3	1.69	6.42	1.87	7.03	2.06	7.80	7.5
115	155+000	100	100	98.23	85.81	76.07	60.47	27.24	20.89	6.35	CL	0.18	18.00	1.83	16.9	1.74	5.58	1.92	5.76	2.11	6.47	5.6	1.74	5.70	1.92	6.26	2.11	6.95	6.8

116	156+100	100	100	98.55	89.77	74.03	61.26	26.57	20.43	6.14	CL	0.13	13.00	1.84	17.0	1.75	5.57	1.93	5.75	2.12	6.46	5.6	1.75	5.68	1.93	6.25	2.12	6.93	6.7
117	157+000	100	100	98.45	87.47	79.74	69.16	28.54	20.01	8.53	CL	0.11	11.00	1.78	16.4	1.69	5.04	1.87	5.22	2.06	5.87	6.8	1.69	5.14	1.87	5.68	2.06	6.30	6.2
118	158+000	100	100	97.72	92.57	81.33	74.58	25.83	19.85	5.98	CL	0.14	13.50	1.77	16.3	1.68	5.12	1.86	5.31	2.05	5.96	6.7	1.68	5.23	1.86	5.77	2.05	6.40	6.3
119	159+100	100	100	97.33	90.77	83.74	69.6	26.87	19.03	7.84	CL	0.16	15.50	1.91	17.7	1.82	6.87	2.00	7.05	2.19	7.92	6.9	1.82	7.01	2.00	7.66	2.19	8.50	8.2
120	160+000	100	100	97.74	86.51	84.73	71.26	28.54	22.20	6.34	CL	0.10	10.00	1.65	12.3	1.55	6.10	1.71	6.90	1.86	7.10	6.8	1.55	6.23	1.71	7.50	1.86	7.62	7.6
121	161+00	100	100	97.14	86.06	76.72	64.27	29.14	23.38	5.76	CL	0.09	9.00	1.86	18.1	1.69	5.27	1.87	5.45	2.06	6.13	5.3	1.69	5.38	1.87	5.93	2.06	6.58	6.4
122	162+000	100	100	99.66	92.46	79.66	75.39	26.33	18.46	7.87	CL	0.09	8.50	1.84	17.9	1.67	5.04	1.85	5.22	2.04	5.87	5.1	1.67	5.14	1.85	5.68	2.04	6.30	6.2
123	163+000	100	100	98.64	89.48	79.52	75.97	27.44	18.57	8.87	CL	0.11	11.00	1.83	17.8	1.66	5.68	1.84	5.87	2.03	6.59	5.7	1.66	5.80	1.84	6.38	2.03	7.07	6.9
124	164+100	100	100	98.51	87.81	73.45	71.3	29.1	20.87	8.23	CL	0.13	13.00	1.84	17.9	1.67	6.60	1.85	6.79	2.04	7.63	6.7	1.67	6.74	1.85	7.38	2.04	8.18	7.9
125	165+000	100	100	99.55	95.6	80.93	74.59	28.61	20.36	8.25	CL	0.13	12.50	1.61	13.0	1.53	5.60	1.72	5.78	1.91	6.50	6.5	1.53	5.72	1.72	6.28	1.91	6.97	6.8
126	166+000	100	100	98.53	91.54	87.63	77.79	26.85	19.52	7.33	CL	0.11	11.00	1.65	14.9	1.56	6.20	1.75	6.39	1.93	7.18	6.2	1.56	6.33	1.75	6.94	1.93	7.70	7.4
127	167+000	100	100	97.51	90.59	88.74	78.79	27.84	21.09	6.75	CL	0.11	10.50	1.82	16.4	1.6	5.80	1.79	5.99	1.97	6.73	6.4	1.60	5.92	1.79	6.51	1.97	7.22	7.0
128	168+000	100	100	98.61	95.55	80.91	71.09	27.41	20.14	7.27	CL	0.12	12.00	1.60	14.4	1.62	6.45	1.81	6.64	1.99	7.46	6.5	1.62	6.59	1.81	7.21	1.99	8.00	7.7

9. BORROW AREA

All together Ten (10) Borrow Area sites are selected in consultation with concerned PWD engineers. These are near ch-41.000km to 48.500km, ch-63.50km, ch-71.500km, ch-75.00km, ch-82.200km, ch-92.480km, ch-100.000km, ch-108.000km, ch-134.980km & ch-147.000km. The soil types of all Borrow areas are of CI (Silty Clay) type.

The location of these borrow areas are shown below & the test results are summarized in table-9.1.

Some Photos of Borrow Areas at Different Locations are shown below:

(Near ch-45.000)

(Near ch-108.000)

Table: 9.1 TEST RESULTS OF BORROW AREA SOIL

Sl. No.	Chainage	Sieve Analysis (% Passing by Weight)						Atterberg's Limit		PI	Soil-Classification	Laboratory Compaction		Soaked CBR at 3 Energy Levels						Soaked CBR at 97% of MDD	Unsoaked CBR at 3 Energy Levels						Unsoaked CBR at 97% of MDD	Sweeling Index
		20	10	4.75	2.36	600	75					MDD	OMC	10 Blows		35 Blows		65 Blows			10 Blows		35 Blows		65 Blows			
	(km)	mm	mm	mm	mm	µ	µ	LL	PL			(gm/cc)	(%)	DD	CBR (%)	DD	CBR (%)	DD	CBR (%)		DD	CBR (%)	DD	CBR (%)	DD	CBR (%)		
1	45.000 (RHS)	100	100	99.95	95.64	87.3	72.29	32.52	22.8	9.72	CL	1.66	15.4	1.76	6.56	1.89	10.7	1.93	15.9	9.39	1.58	7.50	1.72	12.4	1.84	18.94	11.24	14.71
2	63.500 (LHS)	100	100	98.83	94.21	88.6	71.34	31.74	22.26	9.48	CL	1.70	15.4	1.78	6.91	1.91	8.8	1.97	13.9	8.59	1.60	7.90	1.74	10.1	1.88	16.51	10.28	13.99
3	71.500 (LHS)	100	100	99.6	98.76	82.39	71.96	30.88	20.87	10.00	CL	1.67	14.7	1.8	7.17	1.94	10.0	1.95	15.9	8.66	1.62	8.20	1.76	11.6	1.86	18.92	10.36	14.80
4	75.000 (LHS)	100	100	99.05	92.34	87.97	73.88	31.72	22.79	8.93	CL	1.63	14.5	1.74	8.22	1.88	11.4	1.91	15	10.5	1.56	9.40	1.71	13.2	1.82	17.83	12.58	15.16
5	82.200 (LHS)	100	100	98.79	93.25	88.59	71.18	29.51	22.98	6.53	CL	1.66	15.6	1.71	6.65	1.85	10.8	1.98	13.9	8.25	1.54	7.60	1.68	12.4	1.89	16.47	9.87	16.70
6	92.480 (LHS)	100	100	98.83	94.21	88.6	71.34	31.7	21.18	10.52	CL	1.60	15.6	1.79	6.04	1.88	12.0	1.91	14.7	9.59	1.61	6.90	1.71	13.9	1.82	17.42	11.48	14.80
7	100.050 (LHS)	100	100	98.8	93.61	79.51	74.23	31.38	22.31	9.07	CL	1.68	14.7	1.8	5.97	1.91	9.7	1.94	15.5	10.3	1.62	6.82	1.74	11.3	1.85	18.47	12.34	17.87
8	108.00 (LHS)	100	100	99.83	93.47	87.59	72.9	32.96	23.71	9.25	CL	1.61	14.7	1.82	6.26	1.96	9.0	1.96	14.2	9.42	1.64	7.16	1.78	10.4	1.87	16.93	11.28	19.86
9	134.980 (LHS)	100	100	98.4	90.16	89.57	68.94	31.62	23.26	8.36	CL	1.65	15.6	1.77	7.21	1.96	9.9	1.92	14.7	9.81	1.59	8.24	1.78	11.5	1.83	17.42	11.74	19.49
10	147.000 (LHS)	100	100	99.96	93.06	79.71	72.04	32.31	23.59	8.72	CL	1.68	15.0	1.81	7.66	1.94	10.7	1.95	13.9	10.6	1.63	8.76	1.76	12.4	1.86	16.48	12.69	15.25

10. MATERIAL QUARRY

LOCATION: BIPIN QUARRY: It is on 32.00km of NH36. Which is 3km lead to the approach road of NH36. From there it is 7.70km to the project road. It is on LHS of NH36.

Location and name of quarry if any (correlated with index map)	Type of Rock (General group, classification or trade name)	Specimen No.	Los-Angeles Abrasion Value (IS 2386 Part-IV)	Aggregate Impact Value		Water Absorptions (IS 2386 Part III)	Flakiness Index *** (IS 2386 Part I)		Elongation Index		Combine Flakiness and Elongation Index		Soundness test	Stripping Value *** (IS 6241)	Remarks regarding performance of the aggregate wherever a systematic evalution has been made	Addl. Remarks, like, old/new quarry, approximate quantity available, existing access to quarry, etc.
				Dry test (IS 2386 Part-IV)	Wet test (IS 5640)		Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Loss of aggregate after 10cycle immersion in sodium sulphate solution (IS2386-partV) (%)			
1	2	3	4	5	6	7	8	9						10	11	12
BIPIN QUARRY	Sandstone	1	19.5	14	15	0.56	15.3	12.35	12.84	16.58	28.14	28.93	7	4	Satisfactory	Satisfactory
	Sandstone	2	19.2	12	16	0.53	15.64	12.15	12.2	16.68	27.84	28.83	7.5	4	Satisfactory	Satisfactory
	Sandstone	3	20.5	13	17	0.59	15.25	12.45	12.64	16.25	27.89	28.7	7	4	Satisfactory	Satisfactory
		Average	19.73	13.00	16.00	0.56	15.40	12.32	12.56	16.50	27.96	28.82	7.17	4.00		

LOCATION: LONGNIT QUARRY: It is on 147.00km of NH36. This is at a leading distance of 3km from NH36. It is in the right side of NH.36.

Location and name of quarry if any (correlated with index map)	Type of Rock (General group, classification or trade name)	Specimen No.	Los-Angeles Abrasion Value (IS 2386 Part-IV)	Aggregate Impact Value		Water Absorptions (IS 2386 Part III)	Flakiness Index *** (IS 2386 Part I)		Elongation Index		Combine Flakiness and Elongation Index		Soundness test	Stripping Value *** (IS 6241)	Remarks regarding performance of the aggregate wherever a systematic evalution has been made	Addl. Remarks, like, old/new quarry, approximate quantity available, existing access to quarry, etc.
				Dry test (IS 2386 Part-IV)	Wet test (IS 5640)		Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Loss of aggregate after 10cycle immersion in sodium sulphate solution (IS2386-partV) (%)			
1	2	3	4	5	6	7	8	9						10	11	12
LONGNIT QUARRY	Sandstone	1	20.25	13	16	0.54	15.25	12.56	12.25	15.94	27.5	28.5	7.5	3	Satisfactory	Satisfactory
	Sandstone	2	19.6	14	17	0.62	14.89	11.95	11.85	16.25	26.74	28.2	7.6	5	Satisfactory	Satisfactory
	Sandstone	3	21.65	13	15	0.52	15.46	12.24	12.94	16.84	28.4	29.08	7.5	4	Satisfactory	Satisfactory
	Average		20.50	13.33	16.00	0.56	15.20	12.25	12.35	16.34	27.55	28.59	7.53	4.00		

LOCATION: FAIJONG QUARRY: It is on 147.00km of NH36. This is at a leading distance of 15km from NH36.

Location and name of quarry if any (correlated with index map)	Type of Rock (General group, classification or trade name)	Specimen No.	Los-Angeles Abrasion Value (IS 2386 Part-IV)	Aggregate Impact Value		Water Absorptions (IS 2386 Part III)	Flakiness Index *** (IS 2386 Part I)		Elongation Index		Combine Flakiness and Elongation Index		Soundness test	Stripping Value *** (IS 6241)	Remarks regarding performance of the aggregate wherever a systematic evalution has been made	Addl. Remarks, like, old/new quarry, approximate quantity available, existing access to quarry, etc.
				Dry test (IS 2386 Part-IV)	Wet test (IS 5640)		Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Loss of aggregate after 10cycle immersion in sodium sulphate solution (IS2386-partV) (%)			
1	2	3	4	5	6	7	8	9						10	11	12
FAIJONG QUARRY	Sandstone	1	19.56	14	15	0.56	15.25	12.56	11.85	16.24	27.1	28.8	7	4	Satisfactory	Satisfactory
	Sandstone	2	21.54	13	15	0.58	14.89	12.89	13.29	15.75	28.18	28.64	7.2	4	Satisfactory	Satisfactory
	Sandstone	3	20.48	15	15	0.53	15.46	12.24	12.45	15.84	27.91	28.08	7.1	4	Satisfactory	Satisfactory
	Average		20.53	14.00	15.00	0.56	15.20	12.56	12.53	15.94	27.73	28.51	7.10	4.00		

LOCATION: LISUGHAT QUARRY: It is at a distance of 15km from Dimapur

Location and name of quarry if any (correlated with index map)	Type of Rock (General group, classification or trade name)	Specimen No.	Los-Angeles Abrasion Value (IS 2386 Part-IV)	Aggregate Impact Value		Water Absorptions (IS 2386 Part III)	Flakiness Index *** (IS 2386 Part I)		Elongation Index		Combine Flakiness and Elongation Index		Soundness test Loss of aggregate after 10cycle immersion in sodium sulphate solution (IS2386-partV) (%)	Stripping Value *** (IS 6241)	Remarks regarding performance of the aggregate wherever a systematic evalution has been made	Addl. Remarks, like, old/new quarry, approximate quantity available, existing access to quarry, etc.
				Dry test (IS 2386 Part-IV)	Wet test (IS 5640)		Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm	Nominal Size 40 mm	Nominal Size 20 mm				
1	2	3	4	5	6	7	8	9						10	11	12
LISUGHAT QUARRY	Sandstone	1	19.56	13	14	0.54	15.26	12.25	11.87	15.24	27.13	27.49	7.5	3	Satisfactory	Satisfactory
	Sandstone	2	19.26	14	13	0.52	14.75	12.36	12.35	15.75	27.1	28.11	7	5	Satisfactory	Satisfactory
	Sandstone	3	19	15	13	0.58	15.35	12.87	12.68	15.62	28.03	28.49	7.3	4	Satisfactory	Satisfactory
	Average		19.27	14.00	13.33	0.55	15.12	12.49	12.30	15.54	27.42	28.03	7.27	4.00		

10.1: LABORATORY TEST REPORT ON FINE AGGREGATE SAND

LOCATION: Doboka Sand Mahal- It is on 40km of NH36. It is a roadside quarry and RHS of NH36.

Name of quarry	Specimen No.	Sieve Analysis % Passing							Silt and Clay	Fineness Modulus	Zone	Water absorptions (IS:2386 Part III)	Specific Gravity	Deleterious Material Contents	Remarks / performance of the aggregate wherever evaluation has been made
		4.75 mm	2.36 mm	1.18 mm	600 mic	300 mic	150 mic	75 mic							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Doboka Sand Mahal	Sample - 1	100.00	100.00	98.25	92.12	46.15	4.32	1.04	1.04	1.04	IV	0.29	2.64	Nill	Sub-base and embankment filling works.
	Sample - 2	100.00	100.00	98.20	91.58	45.48	3.75	0.92	0.92	1.35	IV	0.28	2.63	Nill	
	Sample - 3	100.00	100.00	99.05	91.90	44.25	3.60	0.93	0.93	1.41	IV	0.30	2.65	Nill	

LOCATION: Sarakati Sand Mahal- It is on 70km of NH36. It is also a roadside Quarry and RHS of NH36.

Name of quarry	Specimen No.	Sieve Analysis % Passing							Silt and Clay	Fineness Modulus	Zone	Water absorptions (IS:2386 Part III)	Specific Gravity	Deleterious Material Contents	Remarks / performance of the aggregate wherever evaluation has been made
		4.75 mm	2.36 mm	1.18 mm	600 mic	300 mic	150 mic	75 mic							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Sarakati Sand Mahal	Sample - 1	100.00	100.00	99.25	94.56	44.82	3.26	0.95	0.95	1.45	IV	0.29	2.66	Nill	Sub-base and embankment filling works.
	Sample - 2	100.00	100.00	98.35	91.35	45.37	3.50	0.89	0.89	1.52	IV	0.34	2.63	Nill	
	Sample - 3	100.00	100.00	97.80	92.57	46.50	3.45	1.01	1.01	1.30	IV	0.26	2.64	Nill	

LOCATION: Longnit River Quarry- It is on 121.00km of NH36. It required a 3km lead from RHS of NH36.

Name of quarry	Specimen No.	Sieve Analysis % Passing							Silt and Clay	Fineness Modulus	Zone	Water absorptions (IS:2386 Part III)	Specific Gravity	Deleterious Material Contents	Remarks / performance of the aggregate wherever evaluation has been made
		4.75 mm	2.36 mm	1.18 mm	600 mic	300 mic	150 mic	75 mic							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Longnit River Quarry	Sample - 1	100.00	100.00	98.25	93.54	44.23	3.28	0.84	84	1.58	IV	0.35	2.60	Nill	Sub-base and embankment filling works.
	Sample - 2	100.00	100.00	97.36	93.85	46.57	4.05	0.92	0.92	1.45	IV	0.31	2.64	Nill	
	Sample - 3	100.00	100.00	98.65	92.78	44.65	3.74	1.04	1.04	1.42	IV	0.28	2.65	Nill	

11. WATER SOURCE

Samples of potable water from Silveta river source were collected. It is on 108.00km to 114.00km and RHS of Nh36. The tests were carried out as described in IS: 456:2000 to ascertain the quality of water for construction work as per following:

- To neutralize 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
- To neutralize 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCI.
- The permissible limits for solids shall be as follows when tested in accordance with IS: 3025:

Solids Permissible Limits (max)
Organic 200 mg/lit
Inorganic 3000 mg/lit
Sulphates (SO4) 500 mg/lit
Chlorides (CI) 500 mg/lit *
Suspended matter 2000 mg/lit

*Note: In case of structures of lengths 30 m and below, the permissible limit of chlorides may be increased up to 1000 mg/lit.

- The pH value shall not be less than 6; it is preferable to have pH value 7.

The sample test results are given in Table 11.1, which gives an indication of the nature and quality of the sub-surface water in the underlying aquifer only.

11.1 Analysis of Test Results:

The Test results are given in Table: 11.1 below. The laboratory test results reveal that the amount of chloride and sulphates present are well below the permissible limit of 500 mg/litre. Moreover the ph of the water is also > 6.0. Suspended solid matter is also below the limiting value of 2000 mg /litre.

Since the sources are potable, the presence of organic matter as tested gave negative results; minimal amount of organic impurities observed. Thus, it can be summarized that the nature and quality of water available from the sources as identified, collected and tested by the consultant, is good and fit for construction for the pavement and concrete purpose.

Table: 11.1 LABORATORY TEST REPORT ON WATER SOURCES

Location	Nature of Source	Name of Test							
		pH Value	Quantity of 0.02 N NaOH solution required to neutralize 100mm of water sample using phenolphthalein as indicator	Quantity of 0.02 NH2SO4 solution required to neutralize 100mm of water sample using mixed indicator	Organic Matter in terms of Oxygen absorbed by acid permangate solution	Inorganic solids	Sulphate as SO4	Chloride as Cl	Suspended Solids
(km)			(ml)	(ml)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
108.00 to 114.00	River source	6.7	4.2	4.1	0.14	47	225	5.7	1028

12. Bitumen

The bitumen shall be harder grade paving bitumen of penetration grade 80/100 or 60/70 as directed by the engineer-in-charge complying with IS: 73 for paving bitumen requirements. The nearest source of bitumen supply is IOCL refinery and the binder for prime and tack coat shall be bituminous emulsion complying with specification IS 8887 as available in Guwahati.

Bitumen test

1. Specific gravity = 0.96