डेडीकेटेड फ्रेट कोरीडोर

DESIGN AND CONSTRUCTION OF CIVIL, STRUCTURES AND TRACK WORKS FOR SINGLE LINE RAILWAY INVOLVING FORMATION IN EMBANKMENTS/CUTTINGS, BALLAST ON FORMATION, TRACK WORKS, BRIDGES, STRUCTURES, BUILDINGS, YARDS, INTEGRATION WITH IR EXISTING RAILWAY SYSTEM AND TESTING & COMMISSIONING ON DESIGN-BUILD LUMP SUM BASIS FOR SAHNEWAL - PILKHANI SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Contract Package: 301

ICB No. HQ/EN/EC/D-B/SAHNEWAL - PILKHANI

PART - 4 - REFERENCE DOCUMENT

GEO TECH DATA - VOLUME - 3

SAHNEWAL TO PILKHANI

From Km. 360.200 to Km. 187.500

GEO TECH DATA

MARKANDA RIVER

VOL 5/7

EMPLOYER

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

(A GOVERNMENT OF INDIA ENTERPRISES)

MINISTRY OF RAILWAYS

COUNTRY : INDIA

PREFACE

This volume contains the report on detailed geotechnical investigation work for bridge on river Markanda on the Dedicated Freight Corridor alignment.

CONTENTS

1. INTRODUCTION

Dedicated Freight Corridor Corporation India Limited (A Govt. of India Enterprise),Ambala awarded the Geotechnical investigation work along with preparation of GADs for 3 river locations vide their letter no.-UMB/EN/Tender.GI dated -04.08.2012 to M/S Arkitechno Consultants (India) Pvt. Ltd., Bhubaneswar. On receipt of the work order, ATCPL mobilized required resources at the site and carried out necessary field works. The samples collected during the field tests were sent to the testing laboratory of ATCPL of Bhubaneswar for testing.

2. SITE DESCRIPTION

The project site is located in the state of Haryana.

The project site is located in Zone-IV of Seismic zone of India as specified in IS-1893(PT-1).

3. METHODOLOGY OF INVESTIGATION

The geotechnical Investigation work broadly encompasses the following activities:-

- Making boreholes, at specified locations, conducting SPT & collecting samples there form.
- Conducting various laboratory tests on samples to assess their physical/engineering properties.
- Tabulation of all observations made at the site as well as during laboratory tests in standard format.
- Analysis of observations / test results.

4. SUMMARY OF FIELD WORK

4.1 Exploratory boreholes have been drilled at the following locations & their details are presented in Appendix-1 of this report.

Table No.- 1- Borehole location and depth

Borehole No's	Depth of Boring (m)
Markanda River	
BH-1(A2)	50.0
BH-2(P5)	50.0
BH-3(P4)	50.0
BH-4(P3)	50.0
BH-5(P2)	50.0
BH-6(P1)	50.0
BH-7(A1)	50.0

5. SUMMARY OF LABORATORY TESTS

Soil samples have been tested for various properties as per the provision of latest versions of I.S. codes. The particular of tests are presented in Table 2 of this report.

Table no-2

SL. NO.	PARTICULARS OF TEST	IS CODE REFERENCE
FOR SOIL SAMPLE		
1.	Natural Moisture Content & Bulk Density	IS 2720 (Part - 7)
2.	Grain Size Analysis (Sieve)	IS 2720 (Part - 4)
3.	Liquid Limit and Plastic Limits	IS 2720 (Part - 5)
4.	Hydrometer Analysis	IS 2720 (Part -4)
5.	Specific Gravity	IS 2720 (Part -3)
6.	Direct Shear Test	IS 2720 (Part -13)
7.	Triaxial Shear Test	IS 2720 (Part -11)
8.	Shrinkage Limit	IS 2720 (Part -6)
9.	Free Swell Index	IS 2720 (Part - 40)
10.	Unconfined compressive strength of soil	IS 2720 (Part-10)
11.	Consolidation	IS 2720 (Part-15)

Summary of laboratory tests done on Soil samples are presented below in table no-3.

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-1(Markanda River-Ambala)	1.5	SPT	1.79	1.58	13.25	0	66.57	33.43						Sandy Silt	2.65					DST	0.03	14			0.68
	4.5	SPT				0	68.40	31.60		18	NP	_		Silty Sand											
	7.5	UDS	1.99	1.68	18.79					29	17	12		Silty Clay	2.66		0.23	5	0.280	TST	0.21	8	0.134	0.0118	0.59
	10.5	UDS	2.01	1.68	19.64	0	5.68	29.41	64.91	30	16	14			2.67		0.23	5	0.310	TST	0.20	7	0.183	0.0123	0.59
	12.0	SPT	2.06	1.72	19.57	0	5.47	27.62	66.91	34	17	17			2.66	1.18									0.54
	13.5	UDS				0	6.32	6.32	87.36	29	16	13					0.22	8	0.330	TST			0.168	0.0134	
	15.0	SPT	2.07	1.71	20.91	0	5.51	94.49		35	17	18			2.66	1.76									0.55
	16.5	UDS															0.24	8	0.320	TST	0.22	8	0.158	0.0126	
	18.0	SPT	2.09	1.76	18.86	0	6.18	28.74	65.08	34	17	17			2.65	1.88									0.51
	19.5	UDS				0	5.32	94.68									0.31	8	0.360	TST	0.22	9	0.166	0.0147	
	22.5	UDS	2.07	1.72	20.53	0	5.63	27.65	66.72	35	18	17			2.66		0.33	8	0.350	TST	0.21	10	0.187	0.0156	0.55
	24.0	SPT	1.89	1.69	11.63	0	78.26	21.74		17	NP	_		Fine Sand	2.65		0.28								0.57
	27.0	SPT				0	0.53	99.47		39	17	22		Clay		4.38	0.31	16	0.410						
	33.0	SPT	2.17	1.75	24.13	0	0.64	29.18	70.18	40	20	20			2.68	4.26							0.211	0.0183	0.53
	39.0	SPT	2.19	1.77	23.49	0	0.29	99.71		38	17	21			2.69	4.41		15	0.440						0.52
	40.5	SPT				0	0.41	16.51	83.08	40	19	21				4.44	0.28		0.430				0.218	0.0168	
	50.0	SPT	1.91	1.68	13.96	0	68.01	31.99		18	NP	_		Sandy Silt	2.66					DST	0.08	14			0.59

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-2(Markanda River-Ambala)	1.5	SPT				0	64.82	35.18		18	NP	_	SM	Sandy Silt											
	6.0	SPT	1.87	1.68	11.59									Fine Sand	2.56										0.53
	7.5	SPT				0	77.41	22.59		18	NP	_	SM												
	10.5	UDS	1.99	1.61	23.72	0	1.05	30.40	68.55	39	20	19	CI	Clay	2.68		0.41	15	0.390	TST	0.18	8	0.186	0.0116	0.67
	13.5	UDS				0	0.86	99.14		40	20	20	CI				0.38	18	0.410	TST	0.17	9	0.188	0.0115	
	15.0	SPT	2.00	1.64	21.81	0	1.11	98.89		39	19	20	CI		2.68	7.84									0.63
	16.5	UDS								38	17	21					0.88	17	0.440	TST	0.21	10	0.211	0.0116	
	18.0	SPT	1.99	1.60	24.50	0	0.89	29.61	69.50	39	17	22	CI		2.69	8.91	0.40								0.68
	19.5	UDS	2.01	1.65	21.67	0	0.62	32.23	67.15						2.68		0.42	16	0.430	TST			0.196	0.0119	0.62
	21.0	SPT	2.03	1.66	22.62	0	0.53	30.57	68.90	38	18	20	CI		2.68	9.73									0.62
	22.5	UDS	2.00	1.62	23.17					36	17	19			2.70		0.43	19	0.380	TST	0.22	10	0.188	0.0116	0.66
	24.0	SPT	2.05	1.69	20.97	0	0.28	99.72		37	17	20	CI		2.69	10.81	0.43								0.59
	25.5	UDS	2.04	1.69	20.48	0	1.17	34.03	64.80	38	17	21	CI				0.43	18	0.420	TST	0.21	9	0.193	0.0115	
	28.5	UDS	2.11	1.73	22.30					39	19	20			2.68		0.43	17	0.440	TST	0.23	10	0.184	0.0116	0.55
	30.0	SPT	2.15	1.72	24.71	0	0.51	20.41	79.08	40	19	21	CI		2.68	9.73									0.55
	31.5	UDS	2.12	1.75	20.84	0	0.83	99.17		38	18	20	CI		2.69		0.44	15	0.460	TST	0.24	9		0.0153	0.53
	33.0	SPT				0	0.67	99.33		40	20	20	CI			10.81	0.45								
	37.5	SPT	2.18	1.79	21.69					36	18	18	CI		2.68	11.46		17	0.430				0.211		0.50
	40.5	SPT				0	1.08	98.92		37	18	19	CI			12.73									
	42.0	SPT				0	1.91	17.25	80.84	39	19	20	CI		2.69	11.84	0.48	16	0.420				0.214		
	48.0	SPT	2.20	1.78	23.29	0	2.26	97.74		38	19	19	CI		2.70	12.44									0.51
	50.0	SPT	2.23	1.81	23.40	0	0.56	18.13	81.31	40	20	20	CI		2.68	10.73	0.44	18	0.440						0.48

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
Bh-3(Markanda River-Ambala)	1.5	SPT	1.82	1.64	11.29	0	79.17	20.83		15	NP	_	SM	Fine Sand	2.64	_		Nil	_	_	_	_	_	_	_
	3.0	SPT	1.83	1.64	11.72	0	81.24	18.76		14	NP	_	SM		2.65	_		Nil	_	_	_	_	_	_	_
	4.5	SPT	1.85	1.67	10.87	0	80.29	19.71		15	NP	_	SM		2.65	_		Nil	_	_	_	_	_	_	_
	6.0	SPT	1.86	1.66	12.09	0	77.92	22.08		16	NP	_	SM		2.64	_		Nil	_	_	_	_	_	_	_
	7.5	UDS	1.90	1.59	19.75	0	1.84	15.27	82.89	43	20	23	CI	Clay	2.66	8.73	_	27	0.370	TST	0.18	8	0.198	0.0156	_
	9.0	SPT	1.91	1.59	20.18	0	1.56	17.64	80.80	40	19	21	CI		2.67	8.41	_	25	_	_	_	_	_	_	_
	10.5	UDS	1.93	1.60	20.51	0	1.09	18.71	80.20	40	18	22	CI		2.66	8.32	_	24	0.410	TST	0.21	10	0.179	0.0167	_
	13.5	UDS	1.95	1.63	19.39	0	1.65	16.28	82.07	41	21	20	CI		2.66	8.18	_	27	0.420	TST	0.22	11	0.168	0.0173	_
	15.0	SPT	1.94	1.59	21.65	0	0.97	18.36	80.67	39	18	21	CI		2.68	8.64	_	25	0.420	_	_	_	_	_	_
	16.5	UDS	1.95	1.62	20.27	0	1.32	16.82	81.86	40	20	20	CI		2.67	7.32	_	25	0.440	TST	0.21	11	0.171	0.0168	_
	19.5	UDS	1.97	1.64	19.92	0	1.43	17.05	81.52	41	20	21	CI		2.66	8.44	_	26	0.450	TST	0.20	10	0.186	0.0171	_
	22.5	UDS	1.99	1.65	20.54	0	1.51	17.11	81.38	40	19	21	CI		2.65	8.26	_	25	0.44	TST	0.22	11	0.179	0.0183	_
	24.0	SPT	2.00	1.65	21.15	0	1.37	19.18	79.45	39	19	20	CI		2.65	8.31	_	23	_	_	_	_	_	_	_
	27.0	SPT	2.07	1.73	19.70	0	1.19	17.47	81.34	42	20	22	CI		2.66	7.99	_	26	_	_	_	_	_	_	0.54
	30.0	SPT	2.05	1.73	18.66	0	1.53	27.59	70.88	36	17	19	CI	Silty Clay	2.65	8.64	_	14	_	_	_	_	_	_	0.53
	33.0	SPT	2.08	1.75	18.56	0	0.67	30.42	68.91	37	17	20	CI		2.65	7.86	_	13	_	_	_	_	_	_	0.51
	34.5	SPT	2.09	1.76	19.04	0	0.48	27.16	72.36	39	18	21	CI		2.66	7.93	_	14	_	_	_	_	_	_	0.52
	36.0	SPT	2.15	1.79	20.28	0	1.24	17.97	80.79	40	20	20	CI	Clay	2.67	7.28	_	26	_	_	_	_	_	_	0.49
	39.0	SPT	2.16	1.80	19.83	0	1.39	17.81	80.80	41	20	21	CI		2.68	7.48	_	27	_	_	_	_	_	_	0.49
	43.5	SPT	2.18	1.80	21.42	0	1.26	19.13	79.61	39	18	21	CI		2.67	7.51	_	25	_	_	_	_	_	_	0.49
	46.5	SPT	2.17	1.95	11.21	0	32.64	67.36		15	NP	_	SM-ML	Sandy Silt	2.64	_	_	Nil	_	_	_	_	_	_	0.35
	50.0	SPT	2.20	1.98	11.33	0	29.91	70.09		14	NP	_	SM-ML		2.64	_	_	Nil	_	_	_	_	_	_	0.34

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-4(Markanda River-Ambala)	1.5	SPT	1.82	1.63	11.37	0	64.67	35.33		16	NP	_	SM	Fine Sand	2.65	_	_	Nil	_	_	_	_	_	_	_
	3.0	SPT	1.84	1.63	12.61	0	69.29	30.71		15	NP	_	SM		2.64	_	_	Nil	_	_	_	_	_	_	_
	4.5	SPT	1.84	1.65	11.74	0	71.14	28.86		14	NP	_	SM		2.64	_	_	Nil	_	_	_	_	_	_	_
	6.0	SPT	1.85	1.65	12.15	0	68.48	31.52		15	NP	_	SM		2.65	_	_	Nil	_	_	_	_	_	_	_
	7.5	UDS	1.90	1.58	20.63	0	1.19	17.18	81.63	42	20	22	CI	Clay	2.66	9.31	_	26	0.38	TST	0.17	8	0.188	0.0146	
	10.5	UDS	1.92	1.60	19.71	0	1.78	16.56	81.66	43	21	22	CI		2.67	_	_	27	_	_	_	_	_	_	_
	12.0	SPT	1.91	1.59	20.28	0	1.83	17.62	80.55	40	19	21	CI		2.67	8.66	_	25	0.41	TST	0.19	9	0.193	0.0158	_
	13.5	UDS	1.92	1.61	19.59	0	2.07	15.41	82.52	44	21	23	CI		2.68	9.24	_	26	0.41	TST	0.21	11	0.241	0.0183	_
	16.5	UDS	1.94	1.61	20.78	0	1.34	18.03	80.63	40	20	20	CI		2.67	8.73	_	25	0.43	TST	0.2	10	0.196	0.0172	_
	18.0	SPT	1.93	1.61	19.92	0	6.37	15.41	78.22	38	19	19	CI		2.66	_	_	23	_	_	_	_	_	_	_
	19.5	UDS	1.95	1.60	21.54	0	1.63	18.26	80.11	39	18	21	CI		2.67	7.43	_	24	0.44	TST	0.18	11	0.174	0.0168	_
	22.5	SPT	2.04	1.84	10.82	0	30.73	69.27		15	NP	_	SM-ML	Sandy Silt	2.65	_	_	Nil	_	_	_	_	_	_	0.44
	25.5	SPT	2.01	1.69	18.95	0.74	4.03	17.12	78.11	38	18	20	CI	Clay	2.68	8.73	_	22	_	_	_	_	_	_	0.59
	28.5	UDS	2.03	1.69	20.41	0	2.18	16.25	81.57	41	20	21	CI		2.67	8.54	_	25	0.42	TST	0.21	10	0.171	0.0173	0.58
	31.5	UDS	2.05	1.72	19.37	0	1.59	17.32	81.09	40	20	20	CI		2.67	_	_	26	0.41	TST	0.22	11	0.186	0.0168	0.55
	33.0	SPT	2.04	1.70	19.66	0	1.89	16.54	81.57	40	19	21	CI		2.66	7.56	_	27	_	_	_	_	_	_	0.56
	34.5	UDS	2.16	1.78	21.69	0	1.87	18.91	79.22	39	19	20	CI		2.67	_	_	25	0.38	TST	0.21	10	0.173	0.0158	0.50
	37.5	SPT	2.18	1.84	18.48	0	0.96	29.61	69.43	38	18	20	CI	Silty Clay	2.66	3.76	_	12	_	_	_	_	_	_	0.45
	40.5	SPT	2.19	1.84	18.72	0	1.97	27.58	70.45	39	19	20	CI		2.65	_	_	15	_	_	_	_	_	_	0.44
	42.0	SPT	2.00	1.68	19.17	0	1.73	29.42	68.85	36	17	19	CI		2.66	_	_	16	_	_	_	_	_	_	0.58
	45.0	SPT	2.16	1.85	16.56	0	16.34	38.41	45.25	29	18	11	CI	Clayey Silt	2.64	_	_	8	_	_	_	_	_	_	0.42
	48.0	SPT	2.18	1.86	17.24	0	15.94	36.54	47.52	30	19	11	CI		2.67	_	_	10	_	_	_	_	_	_	0.44
	50.0	SPT	2.19	1.88	16.80	0	17.13	38.27	44.60	28	17	11	CI		2.64	_	_	9	_	_	_	_	_	_	0.41

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-5(Markanda River-Saharanpur)	1.5	SPT	1.82	1.63	11.56	0	79.64	20.36		15	NP	_	SM	Fine Sand	2.64	_	_	Nil	_	DST	_	_	_	_	_
	3.0	SPT	1.83	1.64	11.29	0	77.93	22.07		14	NP	_	SM		2.64	_	_	Nil	_	DST	_	_	_	_	_
	4.5	SPT	1.84	1.65	11.47	0	79.38	20.62		15	NP	_	SM		2.65	_	_	Nil	_	DST	_	_	_	_	_
	6.0	SPT	1.85	1.65	12.14	0	80.17	19.83		15	NP	_	SM		2.64	_	_	Nil	_	DST	_	_	_	_	_
	9.0	SPT	1.90	1.57	20.81	0	1.09	18.32	80.59	42	20	22	CI	Clay	2.66	8.48	_	26	_	_	_	_	_	_	_
	10.5	UDS	1.92	1.59	20.38	0	1.55	19.04	79.41	41	19	22	CI		2.67	8.32	_	25	0.37	TST	0.18	7	0.199	0.0173	_
	13.5	UDS	1.94	1.62	19.52	0	1.39	17.75	80.86	43	20	23	CI		2.66	8.61	_	26	0.39	TST	0.19	9	0.178	0.0164	_
	16.5	UDS	1.93	1.63	18.17	0	0.98	29.32	69.70	39	19	20	CI	Silty Clay	2.65	4.33	_	13	0.36	TST	0.17	8	0.163	0.0173	_
	18.0	SPT	1.96	1.64	19.39	0	1.25	31.04	67.71	37	18	19	CI		2.66	_	_	14	_	_	_	_	_	_	_
	19.5	UDS	1.96	1.65	18.92	0	1.46	29.81	68.73	38	19	19	CI		2.65	3.79	_	13	0.35	TST	0.18	9	0.174	0.0181	_
	21.0	SPT	1.97	1.62	21.26	0	2.14	15.3	82.56	43	21	22	CI	Clay	2.67	_	_	26	_	_	_	_	_	_	_
	22.5	UDS	2.04	1.71	19.43	0	1.76	16.59	81.65	42	21	21	CI		2.66	8.48	_	25	0.38	TST	0.19	11	0.193	0.0193	0.56
	25.5	UDS	2.06	1.71	20.61	0	1.85	16.43	81.72	43	20	23	CI		2.66	9.73	_	24	0.42	TST	0.21	12	0.186	0.0174	0.56
	28.5	UDS	2.07	1.71	21.05	0	1.29	19.17	79.54	40	19	21	CI		2.67	_	_	25	_	_	_	_	_	_	0.56
	30.0	SPT	2.18	1.82	19.72	0	1.98	18.51	79.51	39	19	20	CI		2.68	_	_	27	_	_	_	_	_	_	0.47
	31.5	UDS	2.10	1.75	20.14	0	1.72	17.28	81.00	40	20	20	CI		2.67	8.73	_	26	0.44	TST	0.23	12	0.179	0.0163	0.53
	33.0	SPT	2.04	1.82	12.36	0	36.33	63.67		15	NP	_	SM-ML	Sandy Silt	2.64	_	_	Nil	_	_	_	_	_	_	0.45
	36.0	SPT	2.03	1.82	11.39	0	34.41	65.59		14	NP	_	SM-ML		2.65	_	_	Nil	_	_	_	_	_	_	0.45
	37.5	SPT	2.15	1.92	11.84	0	31.86	68.14		13	NP	_	SM-ML		2.64	_	_	Nil	_	_	_	_	_	_	0.37
	40.5	SPT	2.15	1.85	16.25	0	17.09	34.51	48.40	31	17	14	CI	Clayey Silt	2.66	_	_	9	0.31	TST	0.22	10	0.166	0.0171	0.44
	46.5	SPT	2.17	1.86	16.54	0	15.83	35.72	48.45	30	15	15	CI		2.67	_	_	8	_	_	_	_	_	_	0.43
	48.0	SPT	2.16	1.93	11.75	0	34.76	65.24		15	NP	_	SM-ML	Sandy Silt	2.64	_	_	Nil	_	_	_	_	_	_	0.37

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-6(Markanda River-Saharanpur)	1.5	SPT	1.82	1.62	12.68	0	55.63	44.37		15	NP	_	SM	Silty Sand	2.65	_	_	Nil	_	_	_	_	_	_	_
	3.0	SPT	1.83	1.63	12.07	0	58.21	41.79		14	NP	_	SM		2.64	_	_	Nil	_	_	_	_	_	_	_
	4.5	SPT	1.85	1.65	11.95	0	57.69	42.31		15	NP	_	SM		2.65	_	_	Nil	_	_	_	_	_	_	_
	6.0	SPT	1.86	1.67	11.18	0	76.92	23.08		13	NP	_	SM	Fine Sand	2.64	_	_	Nil	_	_	_	_	_	_	_
	7.5	SPT	1.84	1.64	12.26	0	78.66	21.34		13	NP	_	SM		2.65	_	_	Nil	_	_	_	_	_	_	_
	10.5	UDS	1.91	1.61	18.43	0	1.28	30.14	68.58	36	17	19	CI	Silty Clay	2.66	4.33	_	12	0.33	TST	0.16	9	0.148	0.0141	
	12.0	SPT	1.94	1.63	18.97	0	1.46	28.31	70.23	38	19	19	CI		2.67	_	_	14	_	_	_	_	_	_	_
	13.5	UDS	1.97	1.64	20.01	0	1.75	28.2	70.05	36	18	18	CI		2.66	4.541	_	13	0.36	TST	0.16	10	0.146	0.143	_
	16.5	UDS	1.95	1.63	19.77	0	1.82	15.61	82.57	44	21	23	CI	Clay	2.67	_	_	26	_	_	_	_	_	_	_
	18.0	SPT	1.97	1.64	20.42	0	1.16	18.29	80.55	40	20	20	CI		2.67	_	_	25	_	_	_	_	_	_	_
	19.5	UDS	1.98	1.64	20.63	0	1.43	17.57	81.00	42	21	21	CI		2.68	8.72	_	26	0.43	TST	0.22	12	0.198	0.136	_
	21.0	SPT	1.94	1.63	19.38	0	1.67	15.92	82.41	43	21	22	CI		2.67	_	_	27	_	_	_	_	_	_	_
	22.5	UDS	2.08	1.71	21.55	0	1.25	16.39	82.36	42	20	22	CI		2.68	9.18	_	26	0.44	TST	0.22	12	0.199	0.0135	0.57
	25.5	UDS	2.07	1.70	22.03	0	1.38	19.01	79.61	39	18	21	CI		2.67	8.92	_	24	0.42	TST	0.21	11	0.198	0.0134	0.57
	27.0	SPT	2.09	1.74	20.41	0	1.69	17.28	81.03	41	19	22	CI		2.66	_	_	26	_	_	_	_	_	_	0.53
	30.0	SPT	2.08	1.71	21.44	0	1.5	16.82	81.68	42	20	22	CI		2.67	_	_	27	_	_	_	_	_	_	0.56
	34.5	SPT	2.16	1.84	17.21	0	14.96	39.05	45.99	31	17	14	CL	Clayey Silt	2.63	3.84	_	9	0.41	_	_	_	_	_	0.43
	39.0	SPT	2.15	1.84	16.96	0	16.52	37.61	45.87	30	15	15	CL		2.64	4.16	_	8	_	_	_	_	_	_	0.44
	42.0	SPT	2.17	1.86	16.74	0	14.87	38.95	46.18	32	17	15	CL		2.64	3.73	_	10	0.41	_	_	_	_	_	0.42
	45.0	SPT	2.19	1.86	17.51	0	17.29	37.46	45.25	29	16	13	CL		2.65	_	_	9	_	_	_	_	_	_	0.42
	48.0	SPT	2.16	1.84	17.62	0	15.64	38.73	45.63	30	16	14	CL		2.64	_	_	8	0.38	_	_	_	_	_	0.44
	50.0	SPT	2.14	1.83	16.95	0	16.48	36.94	46.58	32	16	16	CL		2.65	_	_	10	_	_	_	_	_	_	0.45

SUMMERY SHEET RESULTS LABORATORY TEST OF SOIL SAMPLE (TABLE NO.-3)

Bore Hole No	Depth (m)	Type of Sample	Density		Natural Moisture Content (%)	Gradation				Consistency			Soil		Specific gravity	Shrinkage Limit (%)	Swell Pressure	Free Swell Index (%)	Unconfined Compressive Strength	SHEAR PARAMETERS			One Dimensional Consolidation Test		Void Ratio
			Bulk Density (gm/cc)	Dry Density (gm/cc)		Gravel content (%)	Sand Content (%)	Silt content (%)	Clay content (%)	LL (%)	PL (%)	PI (%)	IS Classification	Description						TYPE OF TEST	Cohesion (Kg/cm2)	Angle of internal Friction (Degree)	C_c	C_v	
BH-7(Markanda River-Saharanpur)	4.5	SPT	1.82	1.63	11.69	0	53.27	46.73		15	NP	_	SM	Silty Sand	2.64	_	_	Nil	_	_	_	_	_	_	
	6.0	SPT	1.83	1.63	12.18	0	51.93	48.07		16	NP	_	SM		2.65	_	_	Nil	_	_	_	_	_	_	
	9.0	SPT	1.89	1.58	19.25	0	1.64	16.51	81.85	43	20	23	CI	Clay	2.67	_	_	24	_	_	_	_	_	_	
	10.5	UDS	1.91	1.58	21.04	0	1.39	17.08	81.53	42	20	22	CI		2.67	8.77	_	25	0.41	TST	0.18	8	0.186	0.0163	
	13.5	UDS	1.92	1.60	20.37	0	1.47	17.24	81.29	41	19	22	CI		2.66	9.16	_	23	0.4	TST	0.18	10	0.173	0.0158	
	16.5	SPT	1.84	1.65	11.52	0	79.56	20.44		15	NP	_	SM	Fine Sand	2.65	_	_	Nil	_	_	_	_	_	_	
	18.0	SPT	1.90	1.59	19.47	0	1.89	16.92	81.19	41	20	21	CI	Clay	2.67	_	_	25	_	_	_	_	_	_	
	19.5	UDS	1.92	1.60	20.33	0	1.04	18.46	80.50	40	19	21	CI		2.66	7.83	_	24	0.44	TST	0.21	12	0.171	0.0158	
	21.0	SPT	1.94	1.61	20.75	0	1.32	16.71	81.97	42	20	22	CI		2.67	_	_	26	_	_	_	_	_	_	
	22.5	UDS	2.03	1.68	21.16	0	1.75	17.28	80.97	40	18	22	CI		2.68	8.16	_	24	0.46	TST	0.19	11	0.184	0.0169	
	25.5	UDS	2.05	1.70	20.24	0	1.68	18.12	80.20	41	20	21	CI		2.67	8.17	_	25	0.45	TST	0.2	11	0.186	0.0158	0.57
	28.5	UDS	2.07	1.74	19.28	0	1.37	19.03	79.60	39	18	21	CI		2.67	8.21	_	23	0.44	TST	0.2	10	0.188	0.0163	0.54
	30.0	SPT	2.13	1.90	12.40	0	32.85	67.15		15	NP	_	SM-ML	Sandy Silt	2.64	_	_	Nil	_	_	_	_	_	_	0.39
	31.5	SPT	2.14	1.91	11.97	0	34.27	65.73		14	NP	_	SM-ML		2.65	_	_	Nil	_	_	_	_	_	_	0.39
	33.0	SPT	2.14	1.92	11.36	0	34.81	65.19		14	NP	_	SM-ML		2.65	_	_	Nil	_	_	_	_	_	_	0.38
	36.0	SPT	2.15	1.91	12.59	0	35.12	64.88		13	NP	_	SM-ML		2.64	_	_	Nil	_	_	_	_	_	_	0.38
	37.5	SPT	2.26	2.02	11.78	0	32.7	67.30		15	NP	_	SM-ML		2.65	_	_	Nil	_	_	_	_	_	_	0.31
	40.5	SPT	2.14	1.76	21.42	0	1.42	17.23	81.35	42	19	23	CI	Clay	2.67	8.53	_	26	0.46	_	_	_	_	_	0.51
	46.5	SPT	2.16	1.86	16.28	0	16.53	36.27	47.20	29	17	12	CL	Clayey Silt	2.65	2.86	_	9	0.39	_	_	_	_	_	0.43
	48.0	SPT	2.21	1.88	17.54	0	17.18	37.06	45.76	28	16	12	CL		2.64	3.71	_	8	_	_	_	_	_	_	0.40

6. DESCRIPTION OF FIELD AND LABORATORY TESTS DONE AND DATA OBTAINED.

6.1 Standard Penetration Tests (SPT)

Standard Penetration Tests (SPT) is conducted at different depths in these boreholes. SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom at the depth of testing using 63.5 kg hammer falling from 75 cm height. The SPT weight was manually lifted to the specified height and allowed to fall freely on the anvil with the use of cathead winch with one to one and half turn of the drum. In this ways the number of blows required to penetrate the last two 15cm penetration is considered as "N" values. Blow count for the penetration of every 15cm was recorded and the N is reported as the blow count for 30cm penetration of the sampler leaving the first 15cm penetration as seating drive. When the number of blows exceeded 50 to penetrate the first or second 15cm length of the sampler, the SPT N is regarded as more than 100 as described in IS2131-1981.The test is terminated in such case and a record of penetration of the sampler under 50 blows is made.SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded. These tests were conducted at close intervals of 1.5m at various depths so that a continuous SPT N profile is available.

6.2 Laboratory tests on soil sample

6.2.1 Bulk Density

Bulk densities of soil samples are determined as per I.S 2720 (Part-9).

The in-situ bulk unit weight and dry unit weight of a soil sample is determined from the SPT sample collected from the site. It is the ratio of mass & volume. As per IS-2720 (Pt-II), the moisture content of the samples is determined.

Standard penetration tests have been conducted in bore hole locations at various depth. Split spoon samplers were used in SPT tests. The samples obtained from split spoon samplers were subjected to bulk unit weight and moisture content determination tests.

6.2.2 Natural moisture content

Moisture content of a soil is the ratio of the weights of water to the weight of dry soil. It is usually expressed as a percentage. Water content of samples collected from pits was determined as per procedure laid down in the I. S. 2720 (Part – 9). The data have been presented in the Laboratory Investigation Sheets.

6.2.3 Grain size analysis

The soil aggregate comprises of particles of different sizes in the different proportion. For classification of soil met at various depths of the boreholes, grain size analysis was conducted as per I.S 2720 (Part 4). The test results are enclosed in this report as summery of the laboratory test.

6.2.4 Hydrometer analysis

The tests have been conducted to determine the particle size distribution of soil particles. The tests have been conducted as per guidelines of IS 2720 (Part – 4). The detail procedure has been elaborated in IS 2720(Part-4) and the test results are enclosed in this report.

6.2.5 Liquid limit, Plastic limits & Plastic index

This test is conducted to determine the consistency behavior of soil. The detail procedure has been elaborated in IS: 2720(Part -5).120g of soil sample is taken and passing it through 425 micron sieve. Thoroughly mix the soil sample with water in the evaporating dish. Place a portion of the paste in the cup of the device. & Squeeze to about 1cm at the point of maximum thickness. Cut the groove using the grooving tool. Operate the device by turning the crank at the rate of two revolutions /sec .The specimen shall be of such consistency that the number of drops required to close the groove shall be between 15 & 35 & the points on the flow curve are evenly distributed in this range.

For determination of plastic limit of soil samples, about 20g of soil sample is taken and passing it through 425 micron sieve. Then the soil sample is mix with distilled water and a soil mass is obtained. The soil mass is rolled in between the figure till the threads are 3mm diameter. At this stage soil is crumbled & reaches its plasticity. From this crumble piece water content is determined which represents the plastic limit of the sample.

6.2.6 Specific gravity

Specific gravity of the soil was determined as per I. S. (Part – 3). Values of the specific gravity of samples obtained during tests have been reported in the Laboratory Investigation Sheets.

6.2.7 Free swell index of soil

Free swell index is conducted to determine the free swell index of soil. The test is conducted as per IS 2720(Part-40). 2x10gms of oil sample taken in a two different graduated glass tube. One of the samples is filled with distilled water and another is filled with kerosene up to 60ml. & then it is allowed to attain equilibrium state of volume without change in the volume of soil. It is calculated as follows:

Free swell index, Percent $= \frac{V_{d-V_k}}{Vk}$ x 100,

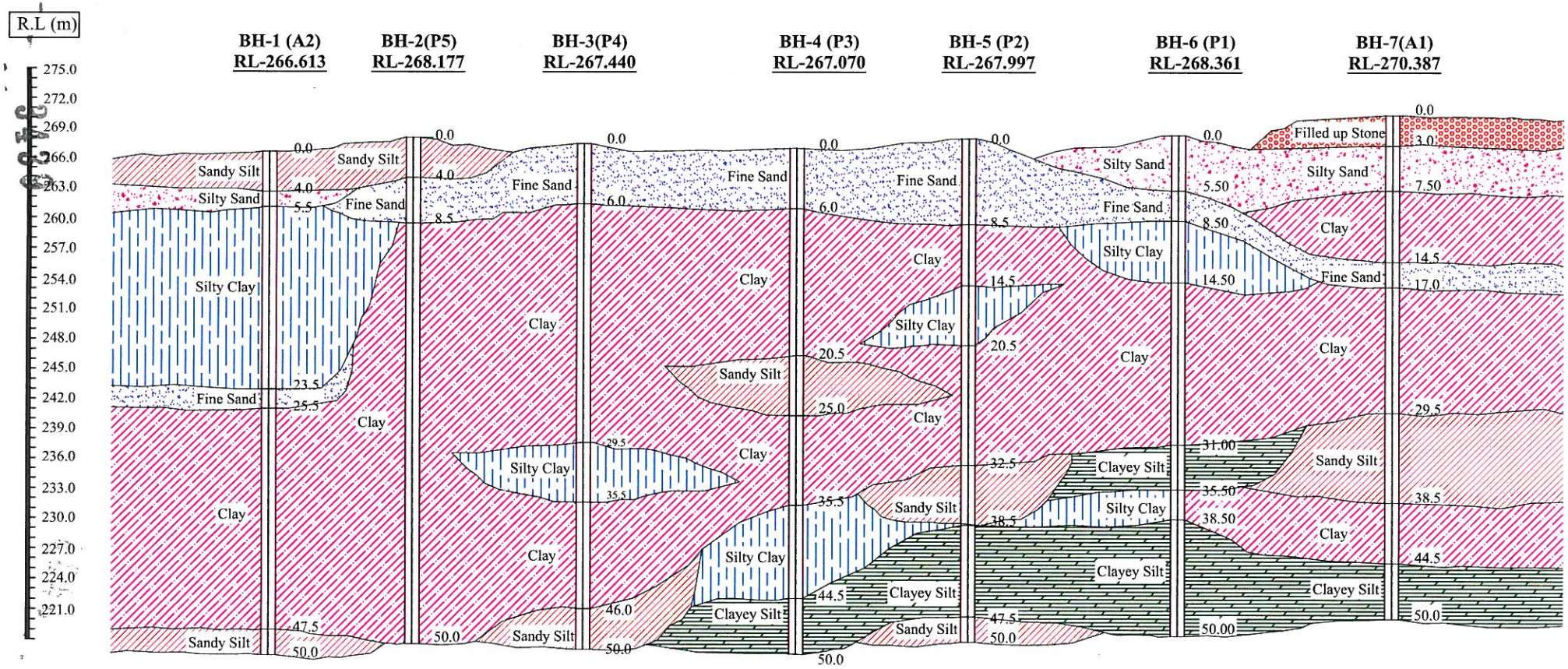
Where Vd = Volume of soil in water, Vk = Volume of soil in Kerosene.

7. Analysis of Results

a. Sub soil profile

Considering the bore log details of all boreholes, the sub-soil strata at proposed sites are presented herewith.

b. The soil profile as observed from the borelog details mainly consists of clayey soil strata with sandy soil strata at certain locations. However no rock bed has been encountered within the depth of exploration.



SUB SOIL PROFILE OF MARKANDA RIVER
Fig No.-1

c. Ground water table

Ground water table has been encountered at the boreholes within the depth of boring during the perio of exploration. However, seasonal & annual variation in the ground water table may occur. The depth o ground water is presented in table no.4.

Table no. – 4

Markanda River

Borehole Nos	Termination Depth (m)	Depth of Ground Water Table from E.G.L (m)
BH-1(A2)	50.0	-
BH-2(P5)	50.0	2.2
BH-3(P4)	50.0	1.9
BH-4(P3)	50.0	1.75
BH-5(P2)	50.0	1.7
BH-6(P1)	50.0	3.15
BH-7(A1)	50.0	-

8. DESIGN GEOTECHNICAL PARAMETER

The Design Geotechnical Parameters for all borehole locations have been arrived at by analyzing the subsoil profiles and the same are presented in Table no.-5.

DESIGN GEOTECHNICAL PARAMETERS

Table No.-5

Markanda River

Reference Boreholes: BH-1(A2)

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m^2)	Angle of internal friction,Ø (degree)	Submerged density (t/m^3)
Layer-1	Sandy Silt	GL to 4.0m	13.0	8.66	0°	1
Layer-2	Silty Sand	4.0m to 5.5	19.0	12.66	33°	1
Layer-3	Silty Clay	5.5m to 23.5m	24	16.0	-	1
Layer-4	Fine Sand	23.5m to 25.5m	25**	-	35** (Restricted)	1
Layer-5	Clayey Soil	25.5m to 36.0m	41	20.0*	-	1
Layer-6	Clayey Soil	36.0m to 47.5m	>50	20.0*	-	1
Layer-7	Sandy Silt	47.5m to 50.0m	>50	20.0*	-	1

Note:-* Cohesion has been restricted to 20t/m^2.

****The value of Ø has been restricted to 35° which corresponds to N value of 25.**

Reference Boreholes: **BH-2(P5)**

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction,Ø (degree)	Submerged density (t/m^3)
Layer-1	Sandy Silt	GL to 4.0m	11.0	7.33	0°	1
Layer-2	Fine Sand	4.0m to 8.5	21	14.0	33°	1
Layer-3	Clayey Soil	8.5m to 29.5m	18	12.0		1
Layer-4	Clayey Soil	29.5m to 38.5m	43	20.0*	-	1
Layer-5	Clayey Soil	38.5m to 50.0m	>50	20.0*		1

Note:-* Cohesion has been restricted to 20t/m^2.

Reference Boreholes: **BH-3(P4)**

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction,Ø (degree)	Submerged density (t/m^3)
Layer-1	Fine Sand	GL to 6.0m	19.0	-	33°	1
Layer-2	Clayey Soil	6.0m to 17.5m	22.0	14.0	-	1
Layer-3	Clayey Soil	17.5m to 29.5m	40.0	20.0*	-	1
Layer-4	Silty Clay	29.5m to 35.5m	45.0	20.0*	-	1
Layer-5	Clayey Soil	35.5m to 41.5m	43.0	20.0*	-	1
Layer-6	Clayey Soil	41.5m to 46.0m	>50	20.0*	-	1
Layer-7	Sandy Silt	46.0m to 50.0m	>50	20.0*	-	1

Note:-* Cohesion has been restricted to 20t/m^2.

3442

Reference Boreholes: **BH-4(P3)**

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction,Ø (degree)	Submerged density (t/m^3)
Layer-1	Fine Sand	GL to 6.0m	20.0	-	33	1
Layer-2	Clayey Soil	6.0m to 20.5m	19.0	12.66	-	1
Layer-3	Sandy Silt	20.5m to 25.0m	32.0	20.0*	-	1
Layer-4	Clayey Soil	25.0m to 35.5m	24.0	16.0	-	1
Layer-5	Silty Clay	35.5m to 44.5m	>50	20.0*	-	1
Layer-6	Clayey Silt	44.5m to 50.0m	>50	20.0*	-	1

Note:-* Cohesion has been restricted to 20t/m^2.

Reference Boreholes: **BH-5(P2)**

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction, Ø (degree)	Submerged Density (t/m^3)
Layer-1	Find sand	GL to 8.5m	19	-	33	1
Layer-2	Clayey Soil	8.5m-14.5m	17	11.33	0	1
Layer-3	Silty Clay	14.5m-20.5m	22	14.66	0	1
Layer-4	Clayey soil	20.5m-32.5m	26	17.33	0	1
Layer-5	Sandy Silt	32.5m-38.5m	43	20.00*	0	1
Layer-6	Clayey Silt	38.5m-47.5m	N>50	20.00*	0	1
Layer-7	Sandy Silt	47.5m-50.0m	N>50	20.00*	0	1

Note:-* Cohesion has been restricted to $20t/m^2$.

Reference Boreholes: BH-6 (P1)

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction, Ø (degree)	Submerged density (t/m^3)
Layer-1	Silty Sand	GL to 8.5m	17	0	33	1
Layer-2	Silty Clay	8.5m-14.5m	19	12.66	0	1
Layer-3	Clay	14.5m-31.0m	35	20.00*	0	1
Layer-4	Clayey Silt	31.0m-35.5m	45	20.00*	0	1
Layer-5	Silty Clay	35.5m-38.5m	46	20.00*	0	1
Layer-6	Clayey Silt	38.5m-50.0m	N>50	20.00*	0	1

Note:-* Cohesion has been restricted to $20t/m^2$.

3444

Reference Boreholes: BH-7 (A1)

Layer	Sub-strata	Depth below GL (m)	SPT 'N' value (Avg)	Cohesion, C (t/m2)	Angle of internal friction, Ø (degree)	Submerged density (t/m^3)
Layer-1	Filled up Stone	GL to 3.0m	25**	0	35**(restricted)	1
Layer-2	Silty Sand	3.0m-7.5m	18	0	33	1
Layer-3	Clay	7.5m-14.5m	14	9.33	0	1
Layer-4	Fine Sand	14.5m-17.0m	23	0	34	1
Layer-5	Clay	17.0m-29.5m	21	14.00	0	1
Layer-6	Sandy Silt	29.5m-38.5	N>50	20.00*	0	1
Layer-7	Clay	38.5m-44.5m	45	20.00*	0	1
Layer-8	Clayey Silt	44.5m-50.0m	N>50	20.00*	0	1

Note: - * Cohesion has been restricted to $20t/m^2$.

**** The value of Ø has been restricted to 35° which corresponds to N value of 25.**

9. RECOMMENDED FOUNDATION STRUCTURE

9.1 Considering the presence of clay soil & sandy soil layers & heavy weight transmitted by the bridge structure, it is recommended to provide well foundations to support the abutment & piers.

9.2 It is recommended to provide 9.0m dia well foundation at these locations.

9.3 The safe bearing capacity (considering shear failure) & safe bearing pressure (considering 50 ° 75mmsettlement) of the well foundation structure have been computed as per the recommendations of IS-6403-1981 & IS-8009(Pt-1)-1976.

9.4 However the designer may adopted suitable foundation system considering the requirements of superstructure.

10. WELL FOUNDATION

10.1.1 As per the directive from the client the soil samples obtained from boreholes drilled subsequently were given to M/s Dr.Ghuman and Gupta Geotech Consultants, Chandigarh for silt factor calculation .The reports presented by M/s Dr.Ghuman and Gupta Geotech Consultants, Chandigarh along with the copy of letter from the client dated-27.12.2013 are enclosed with this report vide appendix no-IV.

10.1.2 It is observed that silt factor data obtained from M/s Dr.Ghuman and Gupta Geotech Consultants do not cover all the borehole locations. In order to calculate the scour depth at the bridge site the minimum value of silt factor (0.64) as recommended by M/s Dr.Ghuman and Gupta Geotech Consultants has been adopted for calculation purposes in this report.

10.1.3 Considering the hydraulic data the maximum scour level has been found out & presented in table no.-6. In determination of SBC & SBP, soil strata in between EGL & maximum scour level has been taken to be ineffective.

Table No.-6

Markanda River

Bore hole Location	Existing Ground Level(m)	Scour Depth(m)	Scour Level(m)
BH-1(A2)	266.613	10.45	262.70
BH-2(P5)	268.177	16.45	256.70
BH-3(P4)	267.440	16.45	256.70
BH-4(P3)	267.070	16.45	256.70
BH-5(P2)	267.997	16.45	256.70
BH-6(P1)	268.361	16.45	256.70
BH-7(A1)	270.387	10.45	262.70

10.2 Determination of the depth of the well foundation has been done considering the criteria of provision of minimum grip length as per clause no-705-3.1 of IRC -78:2000.Acordingly the depth of well foundation satisfying these criteria shall be as follows-

Abutments -22.0m

Piers-22.0m

10.3 The SBC (shear failure) & SBP (50mm & 75mm settlement) for each location have been computed & Presented in table no.-7.

Table No.-7

Markanda River

Location	E.G.L (m)	Founding Depth (m)	Founding RL(m)	Founding stratum	SBC (shear failure) (t/m2)	Safe Bearing Pressure Considering Settlement of	
						50mm (t/m^2)	75 mm (t/m^2)
BH-1(A2)	266.613	22	244.613	Silt Clay	59.95	26.72	40.08
BH-2(P5)	268.177	22	246.177	Clayey Soil	39.57	25.19	37.78
BH-3(P4)	267.440	22	245.440	Clayey Soil	66.83	26.29	39.43
BH-4(P3)	267.070	22	245.070	Sandy Silt	67.27	27.14	40.71
BH-5(P2)	267.997	22	245.997	Clayey Soil	57.35	25.06	37.59
BH-6(P1)	268.361	22	246.361	Clayey Soil	65.74	30.32	45.48
BH-7(A1)	270.387	22	248.387	Clayey Soil	49.32	39.61	59.42

11. RECOMMENDATIONS

Based on the field and laboratory investigations, the following recommendations are made.

11.1 The project area lies in the Zone-IV of the seismic zone as per IS.1893 (pt- 1):2002.

11.2 Depending on the sub-surface formation, it is proposed to provide well foundation for the superstructure. It is recommended to provide well of 9.0m dia at all locations.

11.3 The allowable Bearing Pressure considering shear failure & settlement of 50mm/75mm for each location have been computed & presented in table no.-8.

11.4 However the designer may adopt suitable parameters for design of foundation considering the super structure requirements and economy aspects.

Table No-8

Location	E.G.L (m)	Founding Depth (m)	Founding RL(m)	Allowable Bearing Pressure Considering shear failure Settlement of	
				50mm (t/m2)	75 mm (t/m2)
BH-1(A2)	266.613	22	244.613	26.0	40.0
BH-2(P5)	268.177	22	246.177	25.0	37.0
BH-3(P4)	267.440	22	245.440	26.0	39.0
BH-4(P3)	267.070	22	245.070	27.0	40.0
BH-5(P2)	267.997	22	245.997	25.0	37.0
BH-6(P1)	268.361	22	246.361	30.0	45.0
BH-7(A1)	270.387	22	248.387	39.0	49.0

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(Dr. P.K.DASH)

Senior Consultant Geo-Technical

M/s ARKITECHNO Consultants (I) Pvt. ltd.

Bhubaneswar.

12. REFERENCES

Sl No	Code No	Title
1	IS: 1498 - 1970	Classification and Identification of Soils for general Engineering Purposes.
2	IS: 1892 - 1979	Code of Practice for Subsurface Investigation for Foundation.
3	IS: 1893 (P-1) - 2002	Criteria for earthquake Resistant Design of Structures
4	IS: 2131-1991 reaffirmed 1997)	Method of Standard Penetration Test for Soils.
5	IS: 2720 (Relevant parts)	Method of Test for Soils (Relevant Parts).
6	IS: 6403-1981(Reaffirmed 1997)	Code of practice for determination of Bearing capacity of Shallow foundations.
7	IS: 8009 (Part-I)-1976	Code of practice for calculation of settlements of foundations.
8	IS: 4968 (Part-III)	Method for Subsurface Sounding for Soils - Static Cone Penetration Test.
9	IRC 78-2000	Standard Specifications Code of Practice for Road Bridges Section - VII
10		**Bowles, J.E,** Foundation Analysis and design, McGraw-Hill, New York.
11		**Nayak, N.V,** Foundation design manual, DhanpatRai Publications, New Delhi.
12		**Tomlinson**, M.J, Foundation Design and Construction ,ELBS,5TH edition.

Appendix -I

(Field Borelog Details and SPT 'N' Correction)

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 266.613
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.15
Bore Hole No.	: BH-1(A2)	Date of commencement	: 11.09.12
Location	: Markanda River, Near Abutment, Towards Ambala	Date of Completion	: 14.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50	Sandy Silt		0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	4	5	7	12							Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50			3.0	SPT	4	7	8	15							Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50	Silty Sand		4.5	SPT	6	8	10	18	19						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50	Silty Clay		6.0	SPT	7	10	13	23							Sample Collected
6.00	6.50	0.50			6.5	DS											DS Taken
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	UDS											UDS Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	9	12	14	26							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50			12.0	SPT	6	9	12	21							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50			15.0	SPT	8	11	11	22							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	UDS											UDS Collected

3452

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 266.613
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.15
Bore Hole No.	: BH-1(A2)	Date of commencement	: 11.09.12
Location	: Markanda River, Near Abutment, Towards Ambala	Date of Completion	: 14.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
16.50	17.00	0.50	Silty Clay		17.0	DS											DS Taken
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	8	12	13	25							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50			21.0	SPT	9	14	16	30							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50			23.5	DS											DS Taken
23.50	24.00	0.50	Fine Sand		24.0	SPT	19	28	32	60	30						Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	SPT	23	35	41	76	34						Sample Collected
25.50	26.00	0.50	Clay		26.0	SPT	8	14	20	34							Sample Collected
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	10	17	24	41							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	SPT	10	19	21	40							Sample Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	12	20	23	43							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	SPT	11	17	22	39							Sample Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50			33.0	SPT	10	21	24	45							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	SPT	9	19	25	44							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken

3453

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 266.613
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.15
Bore Hole No.	: BH-1(A2)	Date of commencement	: 11.09.12
Location	: Markanda River, Near Abutment, Towards Ambala	Date of Completion	: 14.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
35.00	35.50	0.50			35.5	DS											DS Taken
35.50	36.00	0.50			36.0	SPT	13	23	24	47							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	12	21	29	50							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50			39.0	SPT	15	24	31	55							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	13	29	29	58							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50	Clay		41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	15	28	33	61							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	15	25	30	55							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50			45.0	SPT	17	27	30	57							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	13	24	28	52							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	27	36	39	75							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50	Sandy Silt		49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	24	40	46	86							Sample Collected

3454

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 268.177
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.20
Bore Hole No	: BH-2(P5)	Date of commencement	: 09.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 11.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50	Sandy Silt		0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	4	4	6	10							Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50			3.0	SPT	5	6	7	13							Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50	Fine Sand		4.5	SPT	7	9	11	20	20						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	7	10	13	23	21						Sample Collected
6.00	6.50	0.50			6.5	DS											DS Taken
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	SPT	8	12	15	27	22						Sample Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50	Clay		9.0	SPT	3	5	5	10							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50			12.0	SPT	4	5	7	12							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50			15.0	SPT	6	9	11	20							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	UDS											UDS Collected
16.50	17.00	0.50			17.0	DS											DS Taken

3455

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 268.177
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.20
Bore Hole No.	: BH-2(P5)	Date of commencement	: 09.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 11.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	6	8	9	17							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50			21.0	SPT	7	9	12	21							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50			23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	8	10	13	23							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	UDS											UDS Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50	Clay		26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	7	12	14	26							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	UDS											UDS Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	9	19	19	38							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	UDS											UDS Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50			33.0	SPT	10	18	23	41							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	SPT	10	21	25	46							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 268.177
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 2.20
Bore Hole No.	: BH-2(P5)	Date of commencement	: 09.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 11.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
35.50	36.00	0.50			36.0	SPT	12	22	22	44							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	11	20	27	47							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50			39.0	SPT	12	23	28	51							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	14	24	30	54							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	13	21	29	50							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50	Clay		43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	15	26	26	52							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50			45.0	SPT	13	21	28	49							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	14	23	27	50							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	14	26	28	54							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	17	30	36	66							Sample Collected

3457

BORE LOG DETAILS

Client	:	DFCC	Existing Ground Lvl. (RL in Mtr)	:	267.440
Project	:	G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	:	1.90
Bore Hole No.	:	BH-3(P4)	Date of commencement	:	14.09.12
Location	:	Markanda River, Near Pier, Towards Ambala	Date of Completion	:	17.09.12
Type of Boring	:	Rotary Drilling	Conducted By	:	T.K Das
Dia of Bore	:	150mm in soil			
Type of Sampler used	:	UDS/Split spoon Sampler/Core barrel			

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT			N value	N Corrected	Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth					Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50	Fine Sand		0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	5	7	7	14	20						Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50			3.0	SPT	5	8	9	17	19						Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50			4.5	SPT	6	9	10	19	19						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	9	12	14	26							Sample Collected
6.00	6.50	0.50	Clay		6.5	SPT	4	8	10	18							Sample Collected
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	UDS											UDS Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	5	9	14	23							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50			12.0	SPT	5	10	10	20							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50			15.0	SPT	7	11	18	29							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	UDS											UDS Collected
16.50	17.00	0.50			17.0	DS											DS Taken

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.440
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.90
Bore Hole No.	: BH-3(P4)	Date of commencement	: 14.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 17.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	10	15	20	35							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50			21.0	SPT	9	12	19	31							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50	Clay		23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	9	19	27	46							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	UDS											UDS Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	11	18	23	41							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	SPT	11	21	26	47							Sample Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	13	18	24	42							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	SPT	16	23	28	51							Sample Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50	Silty Clay		33.0	SPT	12	19	26	45							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	SPT	13	21	24	45							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.440
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.90
Bore Hole No.	: BH-3(P4)	Date of commencement	: 14.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 17.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
35.50	36.00	0.50			36.0	SPT	12	14	25	39							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	10	21	24	45							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50			39.0	SPT	14	18	23	41							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	13	19	28	47							Sample Collected
40.50	41.00	0.50	Clay		41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	13	23	30	53							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	12	20	29	49							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50			45.0	SPT	15	22	32	54							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	22	32	38	70							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	27	36	41	77							Sample Collected
48.00	48.50	0.50	Sandy Silt		48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	30	42	47	89							Sample Collected

3163

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.07
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.75
Bore Hole No.	: BH-4(P3)	Date of commencement	: 22.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 24.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50	Fine Sand		0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	4	6	7	13	19						Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50			3.0	SPT	7	9	11	20	22						Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50			4.5	SPT	5	8	13	21	20						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	7	12	12	24	21						Sample Collected
6.00	6.50	0.50	Clay		6.5	SPT	3	6	7	13							Sample Collected
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	UDS											UDS Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	5	7	10	17							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50			12.0	SPT	6	8	13	21							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50			15.0	SPT	6	10	12	22							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	UDS											UDS Collected
16.50	17.00	0.50			17.0	DS											DS Taken
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	8	11	14	25							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken

3401

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.07
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.75
Bore Hole No.	: BH-4(P3)	Date of commencement	: 22.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 24.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
18.50	19.00	0.50	Clay		19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50	Sandy Silt		21.0	SPT	9	11	16	27							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	SPT	12	17	19	36							Sample Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50			23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	11	14	20	34							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50	Clay		25.5	SPT	7	9	13	22							Sample Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	7	10	10	20							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	UDS											UDS Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	10	12	13	25							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	UDS											UDS Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50			33.0	SPT	10	13	18	31							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	UDS											UDS Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken

3463

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.07
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.75
Bore Hole No.	: BH-4(P3)	Date of commencement	: 22.09.12
Location	: Markanda River, Near Pier, Towards Ambala	Date of Completion	: 24.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
35.50	36.00	0.50	Silty Clay		36.0	SPT	12	26	26	52							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	15	21	29	50							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50			39.0	SPT	14	24	31	55							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	14	29	30	59							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	17	26	36	62							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	13	21	37	58							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50	Clayey Silt		45.0	SPT	15	29	31	60							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	18	27	38	65							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	15	32	32	64							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	17	30	42	72							Sample Collected

3463

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.997
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.70
Bore Hole No.	: BH-5(P2)	Date of commencement	: 25.09.12
Location	: Markanda River, Near Pier, Towards Saharanpur	Date of Completion	: 28.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value Observed	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50			0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	5	6	9	15	15						Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50			3.0	SPT	5	9	9	18	17						Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50	Fine Sand		4.5	SPT	8	11	12	23	19						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	6	10	17	27	21						Sample Collected
6.00	6.50	0.50			6.5	DS											DS Taken
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	SPT	7	13	18	31	23						UDS Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	4	8	10	18							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50	Clay		12.0	SPT	4	8	8	16							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.997
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.70
Bore Hole No.	: BH-5(P2)	Date of commencement	: 25.09.12
Location	: Markanda River, Near Pier, Towards Saharanpur	Date of Completion	: 28.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value Observed	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
14.50	15.00	0.50	Silty Clay		15.0	SPT	5	8	11	19							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	UDS											UDS Collected
16.50	17.00	0.50			17.0	DS											DS Taken
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	7	10	16	26							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50	Clay		21.0	SPT	6	9	11	20							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50			23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	5	11	12	23							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	UDS											UDS Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	7	13	15	28							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	UDS											UDS Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	10	16	20	36							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	UDS											UDS Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 267.997
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 1.70
Bore Hole No.	: BH-5(P2)	Date of commencement	: 25.09.12
Location	: Markanda River, Near Pier, Towards Saharanpur	Date of Completion	: 28.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value Observed	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
32.50	33.00	0.50	Sandy Silt		33.0	SPT	12	17	23	40							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	SPT	13	12	25	37							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken
35.50	36.00	0.50			36.0	SPT	10	19	26	45							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	14	21	30	51							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50	Clayey Silt		39.0	SPT	11	19	24	43							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	14	21	28	49							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	12	20	33	53							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	16	22	37	59							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50			45.0	SPT	13	26	29	55							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	17	30	31	61							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50	Sandy Silt		48.0	SPT	20	28	39	67							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	25	37	44	81							Sample Collected

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 268.361
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 3.15
Bore Hole No.	: BH-6(P1)	Date of commencement	: 23.09.12
Location	: Markanda River, Near Pier, Towards Saharanpur	Date of Completion	: 27.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
0.00	0.50	0.50			0.5	DS											DS Taken
0.50	1.00	0.50			1.0	DS											DS Taken
1.00	1.50	0.50			1.5	SPT	4	5	7	12	12						Sample Collected
1.50	2.00	0.50			2.0	DS											DS Taken
2.00	2.50	0.50			2.5	DS											DS Taken
2.50	3.00	0.50	Silty Sand		3.0	SPT	4	7	7	14	14						Sample Collected
3.00	3.50	0.50			3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50			4.5	SPT	6	9	10	19	17						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	7	11	14	25	20						Sample Collected
6.00	6.50	0.50			6.5	DS											DS Taken
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50	Fine Sand		7.5	SPT	9	12	16	28	22						Sample Collected
7.50	8.00	0.50			8.0	DS											DS Taken
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	4	8	9	17							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50	Silty Clay		12.0	SPT	4	10	12	22							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50			15.0	SPT	6	11	15	26							Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50	Clay		16.5	UDS											UDS Collected
16.50	17.00	0.50			17.0	DS											DS Taken
17.00	17.50	0.50			17.5	DS											DS Taken
17.50	18.00	0.50			18.0	SPT	5	12	12	24							Sample Collected

3467

BORE LOG DETAILS

Client	:	DFCC	Existing Ground Lvl. (RL in Mtr)	:	268.361
Project	:	G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	:	3.15
Bore Hole No.	:	BH-6(P1)	Date of commencement	:	23.09.12
Location	:	Markanda River, Near Pier, Towards Saharanpur	Date of Completion	:	27.09.12
Type of Boring	:	Rotary Drilling	Conducted By	:	T.K Das
Dia of Bore	:	150mm in soil			
Type of Sampler used	:	UDS/Split spoon Sampler/Core barrel			

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
18.00	18.50	0.50	Clay		18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50			21.0	SPT	7	8	10	18							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50			23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	9	9	12	21							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	UDS											UDS Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	11	24	28	52							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	SPT	14	22	33	55							Sample Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	15	25	26	51							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50	Clayey Silt		31.5	SPT	10	17	23	40							Sample Collected
31.50	32.00	0.50			32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50			33.0	SPT	13	21	26	47							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken
34.00	34.50	0.50			34.5	SPT	13	20	30	50							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken

3463

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 268.361
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 3.15
Bore Hole No.	: BH-6(P1)	Date of commencement	: 23.09.12
Location	: Markanda River, Near Pier, Towards Saharanpur	Date of Completion	: 27.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
35.50	36.00	0.50	Silty Clay		36.0	SPT	11	19	26	45							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	14	22	25	47							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50	Clayey Silt		39.0	SPT	13	19	29	48							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	13	22	34	56							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	15	27	27	54							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	15	29	31	60							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50			45.0	SPT	17	24	39	63							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	14	27	32	59							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	18	32	41	73							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	21	30	47	77							Sample Collected

3469

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 270.387
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 3.20
Bore Hole No	: BH-7(A1)	Date of commencement	: 18.09.12
Location	: Markanda River, Near Abutment, Towards Saharanpur	Date of Completion	: 21.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth 0 - 15 cm	15 - 30 cm	30 - 45 cm	N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
0.00	0.50	0.50	Filled up Stone		0.5												
0.50	1.00	0.50			1.0												
1.00	1.50	0.50			1.5												
1.50	2.00	0.50			2.0												
2.00	2.50	0.50			2.5												
2.50	3.00	0.50			3.0												
3.00	3.50	0.50	Silty Sand		3.5	DS											DS Taken
3.50	4.00	0.50			4.0	DS											DS Taken
4.00	4.50	0.50			4.5	SPT	5	7	10	17	16						Sample Collected
4.50	5.00	0.50			5.0	DS											DS Taken
5.00	5.50	0.50			5.5	DS											DS Taken
5.50	6.00	0.50			6.0	SPT	8	9	13	22	19						Sample Collected
6.00	6.50	0.50			6.5	DS											DS Taken
6.50	7.00	0.50			7.0	DS											DS Taken
7.00	7.50	0.50			7.5	SPT	8	11	12	23	19						Sample Collected
7.50	8.00	0.50	Clay		8.0	SPT	3	4	5	9							Sample Collected
8.00	8.50	0.50			8.5	DS											DS Taken
8.50	9.00	0.50			9.0	SPT	4	6	7	13							Sample Collected
9.00	9.50	0.50			9.5	DS											DS Taken
9.50	10.00	0.50			10.0	DS											DS Taken
10.00	10.50	0.50			10.5	UDS											UDS Collected
10.50	11.00	0.50			11.0	DS											DS Taken
11.00	11.50	0.50			11.5	DS											DS Taken
11.50	12.00	0.50			12.0	SPT	6	9	11	20							Sample Collected
12.00	12.50	0.50			12.5	DS											DS Taken
12.50	13.00	0.50			13.0	DS											DS Taken
13.00	13.50	0.50			13.5	UDS											UDS Collected
13.50	14.00	0.50			14.0	DS											DS Taken
14.00	14.50	0.50			14.5	DS											DS Taken
14.50	15.00	0.50	Fine Sand		15.0	SPT	8	13	17	30	23						Sample Collected
15.00	15.50	0.50			15.5	DS											DS Taken
15.50	16.00	0.50			16.0	DS											DS Taken
16.00	16.50	0.50			16.5	SPT	10	14	19	33	24						Sample Collected
16.50	17.00	0.50			17.0	DS											DS Taken

3479

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 270.387
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 3.20
Bore Hole No.	: BH-7(A1)	Date of commencement	: 18.09.12
Location	: Markanda River, Near Abutment, Towards Saharanpur	Date of Completion	: 21.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					Remarks
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
17.00	17.50	0.50			17.5	SPT	5	9	11	20							Sample Collected
17.50	18.00	0.50			18.0	SPT	7	11	12	23							Sample Collected
18.00	18.50	0.50			18.5	DS											DS Taken
18.50	19.00	0.50			19.0	DS											DS Taken
19.00	19.50	0.50			19.5	UDS											UDS Collected
19.50	20.00	0.50			20.0	DS											DS Taken
20.00	20.50	0.50			20.5	DS											DS Taken
20.50	21.00	0.50			21.0	SPT	7	9	12	21							Sample Collected
21.00	21.50	0.50			21.5	DS											DS Taken
21.50	22.00	0.50			22.0	DS											DS Taken
22.00	22.50	0.50			22.5	UDS											UDS Collected
22.50	23.00	0.50			23.0	DS											DS Taken
23.00	23.50	0.50	Clay		23.5	DS											DS Taken
23.50	24.00	0.50			24.0	SPT	6	8	9	17							Sample Collected
24.00	24.50	0.50			24.5	DS											DS Taken
24.50	25.00	0.50			25.0	DS											DS Taken
25.00	25.50	0.50			25.5	UDS											UDS Collected
25.50	26.00	0.50			26.0	DS											DS Taken
26.00	26.50	0.50			26.5	DS											DS Taken
26.50	27.00	0.50			27.0	SPT	8	12	12	24							Sample Collected
27.00	27.50	0.50			27.5	DS											DS Taken
27.50	28.00	0.50			28.0	DS											DS Taken
28.00	28.50	0.50			28.5	UDS											UDS Collected
28.50	29.00	0.50			29.0	DS											DS Taken
29.00	29.50	0.50			29.5	DS											DS Taken
29.50	30.00	0.50			30.0	SPT	14	19	22	41							Sample Collected
30.00	30.50	0.50			30.5	DS											DS Taken
30.50	31.00	0.50			31.0	DS											DS Taken
31.00	31.50	0.50			31.5	SPT	17	21	26	47							Sample Collected
31.50	32.00	0.50	Sandy Silt		32.0	DS											DS Taken
32.00	32.50	0.50			32.5	DS											DS Taken
32.50	33.00	0.50			33.0	SPT	16	24	25	49							Sample Collected
33.00	33.50	0.50			33.5	DS											DS Taken
33.50	34.00	0.50			34.0	DS											DS Taken

3471

BORE LOG DETAILS

Client	: DFCC	Existing Ground Lvl. (RL in Mtr)	: 270.387
Project	: G.I. for 3 Nos. Important Bridges	Depth of Ground Water from EGL (in Mtr)	: 3.20
Bore Hole No.	: BH-7(A1)	Date of commencement	: 18.09.12
Location	: Markanda River, Near Abutment, Towards Saharanpur	Date of Completion	: 21.09.12
Type of Boring	: Rotary Drilling	Conducted By	: T.K Das
Dia of Bore	: 150mm in soil		
Type of Sampler used	: UDS/Split spoon Sampler/Core barrel		

Depth(m)		Length of Run	Description of Strata	Log of Bore	Sampling		SPT					Details of Rock Core					
From	To				Depth	Type	Blows Required for Penetration of depth			N value	N Corrected	Total Length (cm)	No of Pieces	Length of core greater than 10cm	% of Core Recovery	RQD Value (%)	Remarks
							0 - 15 cm	15 - 30 cm	30 - 45 cm								
34.00	34.50	0.50	Sandy Silt		34.5	SPT	17	23	29	52							Sample Collected
34.50	35.00	0.50			35.0	DS											DS Taken
35.00	35.50	0.50			35.5	DS											DS Taken
35.50	36.00	0.50			36.0	SPT	19	27	31	58							Sample Collected
36.00	36.50	0.50			36.5	DS											DS Taken
36.50	37.00	0.50			37.0	DS											DS Taken
37.00	37.50	0.50			37.5	SPT	19	30	32	62							Sample Collected
37.50	38.00	0.50			38.0	DS											DS Taken
38.00	38.50	0.50			38.5	DS											DS Taken
38.50	39.00	0.50	Clay		39.0	SPT	13	19	26	45							Sample Collected
39.00	39.50	0.50			39.5	DS											DS Taken
39.50	40.00	0.50			40.0	DS											DS Taken
40.00	40.50	0.50			40.5	SPT	15	21	21	42							Sample Collected
40.50	41.00	0.50			41.0	DS											DS Taken
41.00	41.50	0.50			41.5	DS											DS Taken
41.50	42.00	0.50			42.0	SPT	15	20	25	45							Sample Collected
42.00	42.50	0.50			42.5	DS											DS Taken
42.50	43.00	0.50			43.0	DS											DS Taken
43.00	43.50	0.50			43.5	SPT	14	23	27	50							Sample Collected
43.50	44.00	0.50			44.0	DS											DS Taken
44.00	44.50	0.50			44.5	DS											DS Taken
44.50	45.00	0.50	Clayey Silt		45.0	SPT	16	24	35	59							Sample Collected
45.00	45.50	0.50			45.5	DS											DS Taken
45.50	46.00	0.50			46.0	DS											DS Taken
46.00	46.50	0.50			46.5	SPT	19	29	38	67							Sample Collected
46.50	47.00	0.50			47.0	DS											DS Taken
47.00	47.50	0.50			47.5	DS											DS Taken
47.50	48.00	0.50			48.0	SPT	19	27	43	70							Sample Collected
48.00	48.50	0.50			48.5	DS											DS Taken
48.50	49.00	0.50			49.0	DS											DS Taken
49.00	49.50	0.50			49.5	DS											DS Taken
49.50	50.00	0.50			50.0	SPT	23	32	47	79							Sample Collected

3472

CALCULATIONS FOR CORRECTED SPT (N) VALUES

CHAINAGE NO	DEPTH OF SAMPLE	BULK / SUB DENSITY (t/m3) γ	OVERBURDEN PRESSURE (t/m2)	OVERBURDEN CORRECTION FACTOR (Cn)	OBSERVED SPT 'N' VALUE (N)	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
	0.0						
BH-1(Markanda River)	4.5	1.00	4.50	1.26	18	23	19
	24.0	1.00	24.00	0.74	60	44	30
	25.5	1.00	25.50	0.69	76	52	34
	0.0						
BH-2(Markanda River)	4.5	1.00	4.50	1.22	20	24	20
	6.0	1.00	6.00	1.18	23	27	21
	7.5	1.00	7.50	1.10	27	30	22
	0.0						
BH-3(Markanda River)	1.5	1.00	1.50	1.72	14	24	20
	3.0	1.00	3.00	1.40	17	24	19
	4.5	1.00	4.50	1.22	19	23	19
	0.0						
BH-4(Markanda River)	1.5	1.00	1.50	1.72	13	22	19
	3.0	1.00	3.00	1.40	20	28	22
	4.5	1.00	4.50	1.22	21	26	20
	6.0	1.00	6.00	1.16	24	28	21
	0.0						
BH-5(Markanda River)	1.5	1.00	1.50	1.72	15	26	15
	3.0	1.00	3.00	1.40	18	25	17
	4.5	1.00	4.50	1.22	23	28	19
	6.0	1.00	6.00	1.18	27	32	21
	7.5	1.00	7.50	1.10	31	34	23
	0.0						
BH-6(Markanda River)	1.5	1.00	1.50	1.72	12	21	12
	3.0	1.00	3.00	1.40	14	20	14
	4.5	1.00	4.50	1.22	19	23	17
	6.0	1.00	6.00	1.18	25	30	20
	7.5	1.00	7.50	1.10	28	31	22
	0.0						
BH-7(Markanda River)	4.5	1.00	4.50	1.22	17	21	16
	6.0	1.00	6.00	1.18	22	26	19
	7.5	1.00	7.50	1.10	23	25	19
	15.0	1.00	15.00	0.90	30	27	23
	16.5	1.00	16.50	0.86	33	28	24

3473

Appendix -II

(Sample Calculation)

WELL FOUNDATION

Refrence - IS Code (6403-1981) & 8009(Pt-1)

Location -BH-2(P5) Markanda River

Diameter of Wel **(B)**	=	900 cm	9 m
Depth of Wel **(H_f)**	=	2200 cm	22 m
Depth of scour from ground level	=	1147.7 cm	11.477 m
Effective depth of Well	=	1052.3 cm	10.523 m
Depth of Well / Dia of Well	=	1.169222	

Safe Bearing Capacity

N = 18

Cohesion in Kgf/Cm^2 **(C)** = 1.20

Saturated unit weight of foundation soil in kg/cm^3 **(γ_{sat})** = 0.002

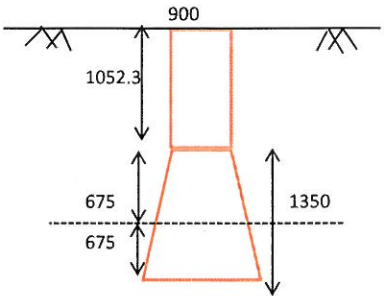
Submerged unit weight of foundation soil in kg/cm^3 = 0.001

Safe Factor ,

S_c	=	1.3	**Ref., clause no. -(5.1.2.1) , IS - 6403-1981**
NØ	=	$\tan^2(\Pi/4)$ +	**Ref., clause no. -(5.1.2.2) , IS - 6403-1981**
Depth Factor	=	1.00	
d_c	=	1.234	
Correction factor for Water table **(W')**	=	0.50	
(Assuming water table at the E.G.L)			
General shear failure criteria vaild			
N_c	=	5.14	**Ref., clause no. -(5.2.1.1), IS - 6403-1981,**
Net Ultimate Bearing Capacity **(q_d)**in kg/cm^2	=	**cNc Sc dc**	**Ref., clause no. -(5.1.2) , IS - 6403-1981,**
	=	9.89	kg / cm^2
Factor of Safety **(FOS)**	=	2.5	
Safe Bearing Capacity **(q_{safe})**	=	q_d /FOS	
	=	**3.96**	kg/cm^2
	=	39.6	t/m^2

3475

Safe bearing pressure



From lab test,

Initial Void Ratio at mid-height of layer (e_0) = 0.53

From code-8009 (part-1) ,

Compression Index (C_c) = **0.3 (e_0 - 0.27)** = 0.078

Ref. clause no-.(9.2.2.2), IS - 6403-1981

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xdia of well is assumed to the involved in setlement

Initial effective Pressure at mid-height of layer (P_0) in kg/cm^2 = 1.7273

Assuming Load applied **(q)** in kg/cm^2 = 1

Area of the top layer where load applied in cm^2 = 636172.512

Area of the middle layer where load applied in cm^2 = 1948278.32

Pressure Increment (Δ_p) in kg/cm^2 = 0.33

Ref.-clause no. -(9.2.2.2) , IS - 8009 (Pt-1)

Settlement (S_{oed}) in cm

$$= \frac{H_t}{1+e_0} \; C_c \log_{10}\left(\frac{P_0 + \Delta_p}{P_0}\right)$$

= 5.18

Ref.- clause no. -(9.5) , IS -8009(Pt-1)

D / √ LB	=	1.1692
√LB / D	=	0.855
L / B	=	1
Depth Factor	=	0.685
Rigidity Factor	=	0.8
λ	=	0.7

Settlement for 1kg / cm^2 = **S_{oed} x λ x Depth Factor x Rigidity Factor**

= 1.985 cm

= 19.9 mm

19.9 mm Settle Caused due to = 1 kg / cm^2

50 mm Settle Caused due to = 2.519 kg / cm^2

= 25.19 t/m^2

75 mm Settle Caused due to = 3.778 kg / cm^2

= 37.78 t/m^2

Net Safe Bearing Capacity (q_{safe}) = 39.57 t/m^2

Safe Bearing Pressure for 50mm settlement = 25.19 t/m^2

Safe Bearing Pressure for 75mm settlement = 37.78 t/m^2

3476

WELL FOUNDATION

Refer - IS code 6403, 8009(part-I)

Location :- Markanda River_BH-1(A2)

Diameter of Well **(B)**	=	900 cm	9	m
Depth of Well **(d_f)**	=	2200 cm	22	m
Depth of scour from ground level	=	391.3 cm	3.913	m
Effective depth of Well	=	1808.7 cm	18.087	m

Founding Stratum = Silty Clay

D / B = 2.00966667

Shear Criteria

N = **24**

C = **1.60** kg/ cm^2

(Ref: Page no-30, Foundation Design Manual, Narayan V. Nayak)

Saturated unit weight of foundation soil **(γ_{sat})** = 0.002 Kg/Cm^3

Submerged unit weight of foundation soil **(γ')** = 0.001 Kg/Cm^3

Bearing Capacity Factor,

N_c = 5.14 (Ref : Clause no. 5.3.1.1 , IS : 6403-1981)

Shape Factor,

S_c = 1.30 (Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

Depth Factor ,

d_c = 1.40 (Ref : Clause no. 5.1.2.1 , IS : 6403-1981)

Net Ultimate Bearing Capacity **(q_d)** = **cNc Sc dc** = 14.99 kg/cm^2 (Ref : Clause no. 5.1.2.1 IS : 6403-1981)

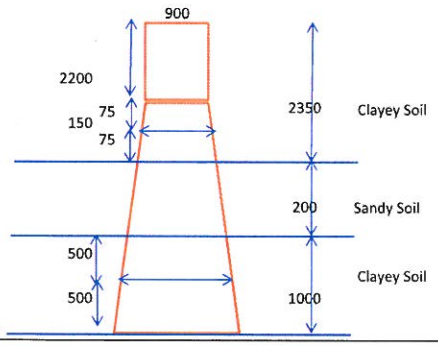
Factor of Safety **(FOS)** = 2.50

Net Safe Bearing Capacity **(q_{safe})** = **q_d /FOS**

= 5.995 kg/cm^2

= 59.95 t / m^2

Safe Bearing Pressure



3477

For Clayey Soil Stratum :

From lab test,

Initial Void Ratio at mid-height of layer (e_0) = 0.53

Compression Index (C_c) = **0.3 (e_0 - 0.27)**

Assumptions : = 0.08

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xdia of well is assumed to the involved in setlement

Initial effective Pressure at mid-height of layer (P_0) in kg/cm^2 = 1.884

Assuming Load applied **(q)** in kg/cm^2 = 1

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 746619.1291

Pressure Increment (Δ_p) in kg/cm^2 = 0.8521

$$\frac{H_t}{1+e_0} = 98.04$$

$$\log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right) = 0.162$$

Settlement ($S_{oed}1$) $$= \frac{H_t}{1+e_0} C_c \log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right)$$

= 1.24 cm

For Sandy Soil Stratum :

N avareage of the sandy soil layer = 25

Assumptions :

- Load is dispersed in soil as per 2v : 1h Principle
- The zone of Soil within a depth of 1.5xwidth of footing is considered for settlement

Assuming Load applied **(q)** = 1 kg/cm^2

Area of the top layer of foundation = 636172.5124

Area of top layer of sandy strata = 865901.4751 cm^2

Foundation Pressure **(p)** = 0.73 kg/cm^2

Settlement **(S_i) = pB I (1 - μ2) / E** (Ref : Clause no - 9.2.3.2 , IS : 8009 (Part -1) - 1976)

Where, Influence factor **(I)** = 0.85

Poisson's Ratio **(μ)** = 0.30 (Ref:Table no-1.16.2,Foundation Design Manual, Narayan V. Nayak)

Modulus of Elasticity **(E)** = **1200(N+6)**

= 37200 kp_a

= 372 kg/cm^2

(Ref : Bowles, J.E. 2002, Foundation Analysis & Design, McGraw-Hill,New York with Permission)

Settlement **(S_i) =** 1.3749 cm

For Clayey Soil Stratum :

Initial effective Pressure at mid-height of layer (P_0) in kg/cm^2 = 2.66

Assuming Load applied **(q)** in kg/cm^2 = 1

Area of the top layer where load applied in cm^2 = 636172.5124

Area of the middle layer where load applied in cm^2 = 2405281.875

Pressure Increment (Δ_p) in kg/cm^2 = 0.26

$$\frac{H_t}{1+e_0} = 653.59$$

$$\log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right) = 0.041$$

Settlement ($S_{oed}2$) $$= \frac{H_t}{1+e_0} C_c \log_{10}\left(\frac{P_0+\Delta_p}{P_0}\right)$$

= 2.10 cm

D / √ LB = 2.01

√LB / D = 0.50

L / B = 1.00

(Ref : Fig no - 12 , IS : 8009 (Part -1) - 1976)

Depth Factor = 0.63

Rigitidity Factor = 0.80

λ = 0.70

(($S_{oed}1$+$S_{oed}2$)λ+ S_i) = 3.71 cm

Settlement for 1kg / cm^2 = **((Soed1+Soed2)λ+ Si) x Depth Factor x Rigidity Factor**

= 1.87 cm

18.7 mm Settlement at	=	1.00 kg / cm^2	=	10.00 t / m^2
1 mm Settlement at	=	0.05 kg / cm^2	=	0.53 t / m^2
50 mm Settlement at	=	2.67 kg / cm^2	=	26.724 t / m^2
75 mm Settlement at	=	4.01 kg / cm^2	=	40.086 t / m^2

Net Safe Bearing Capacity (q_{safe}) = 59.953 t / m^2

Safe Bearing Pressure for 50mm settlement = 26.724 t / m^2

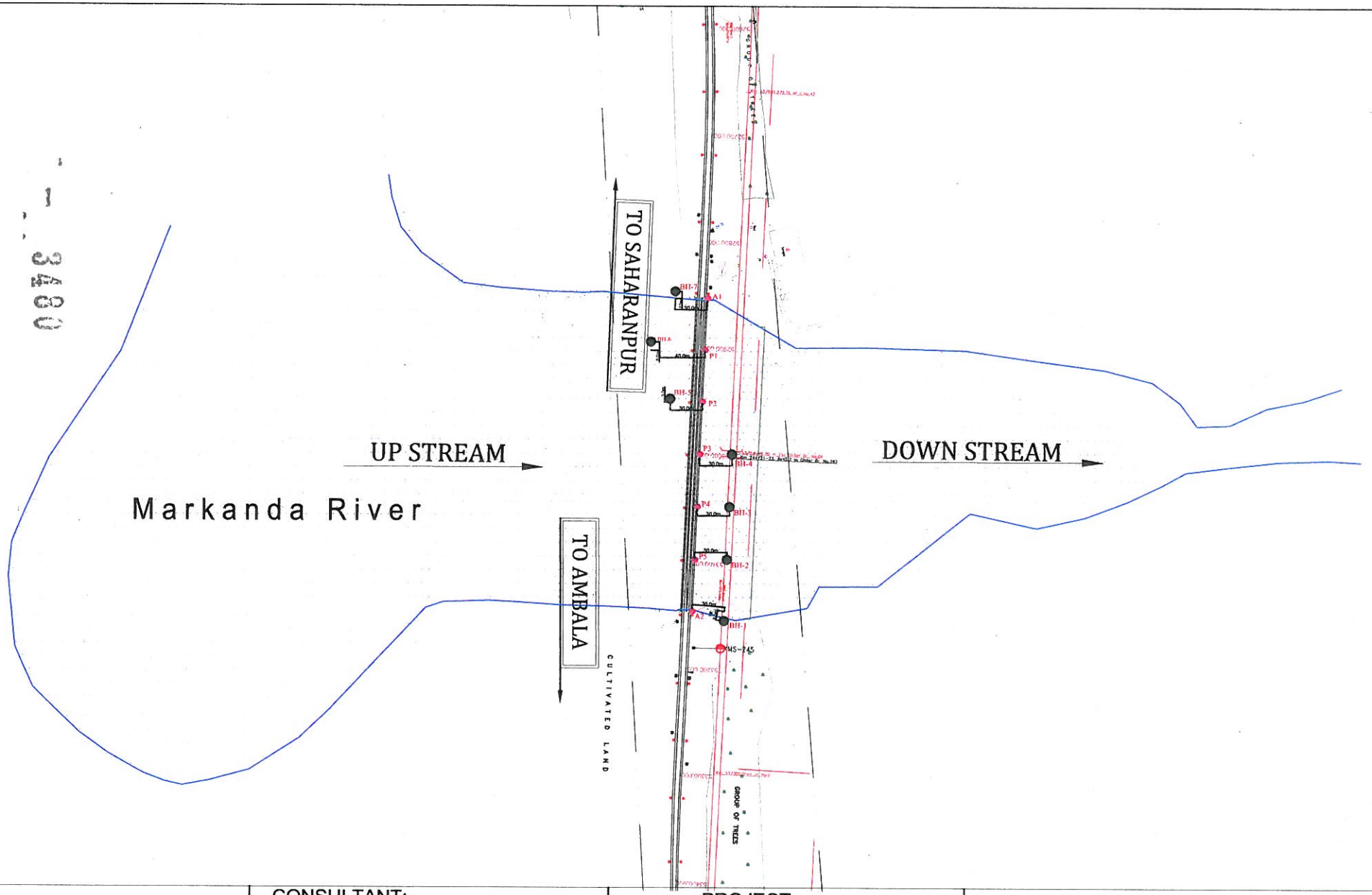
Safe Bearing Pressure for 75mm settlement = 40.086 t / m^2

3478

Bridge at Km (10+786)

① Borelocation Plan
② River cross-section 1 km both in U/S and D/S side.
③ Catchment area marking in Toposheet
④ Discharge Calculations
⑤ Silt factor Calculations

BOREHOLE LOCATION PLAN



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CONSULTANT:-
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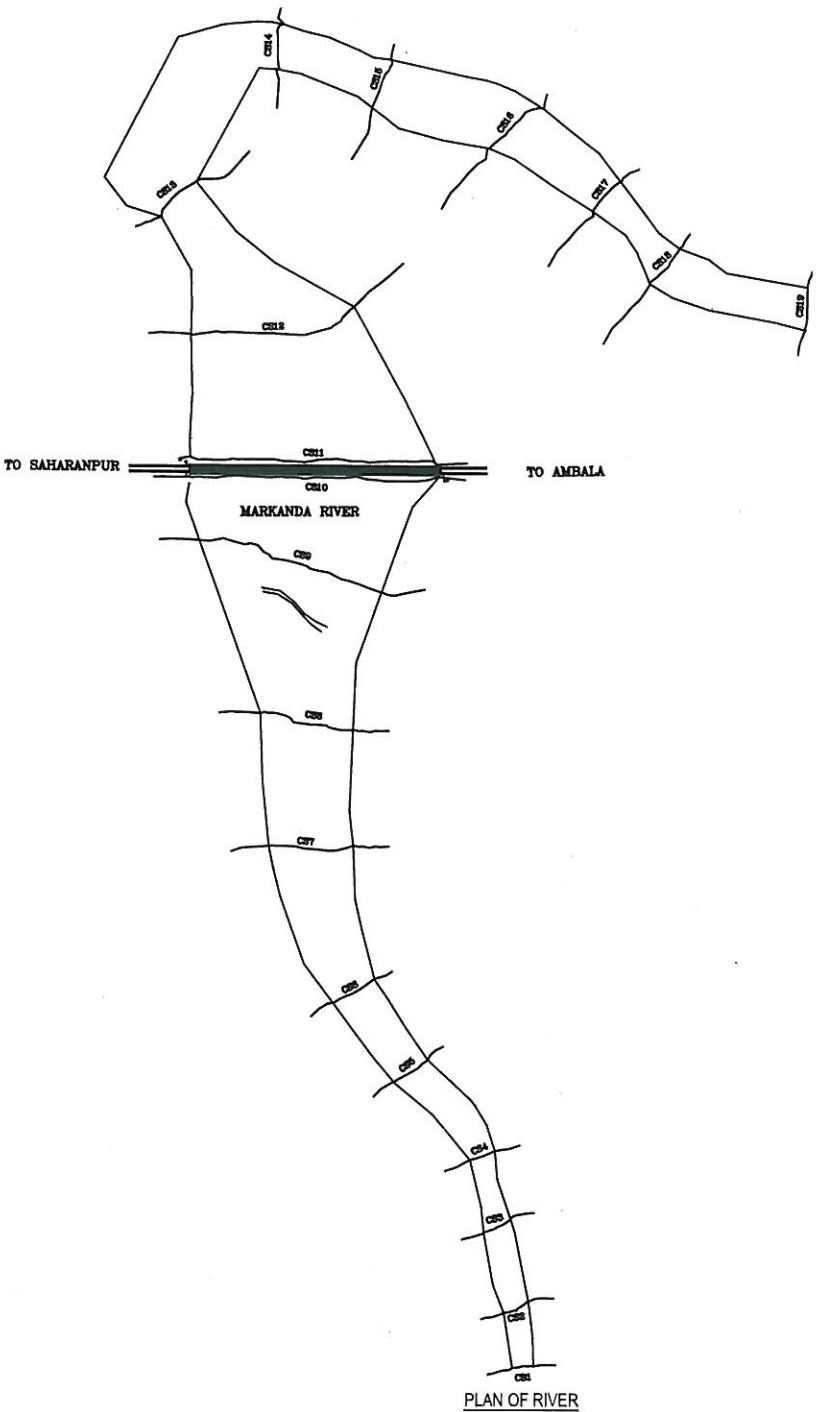
ARKITECHNO Consultants (India) Pvt.Ltd
Plot # N3/91,IRC Village, Nayapalli,Bhubaneswar-751015,Odisha
F : +91-674-2554205,L : +91-674-2553689
email : business@arkitechno.com,Web : www.arkitechno.com

PROJECT:-
GEOTECHNICAL INVESTIGATION FOR 3 NOS IMPORTANT BRIDGES

LOACTION PLAN ALONG MARKANDA RIVER

DRG NO.	ATCPL/DFCC/MR/LP-01	DRN BY:-I.B	CHKD BY:-JKR
DATE	JUNE-2013	SCALE	AS SHOWN

MARKANDA RIVER PROFILE AT-PROP:-53+000 SPAN SIZE :- 6 X 45.7M on 1 KM SURVEY BOTH IN U/S & D/S



PLAN OF RIVER

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:-
6 x 45.7m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NMA	
Apprvd By:		

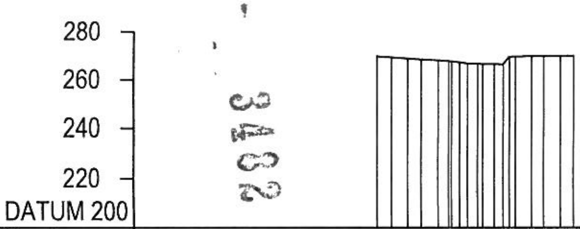
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
Phone:+91-674-2554205,Telefax:2553689
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS

REV.

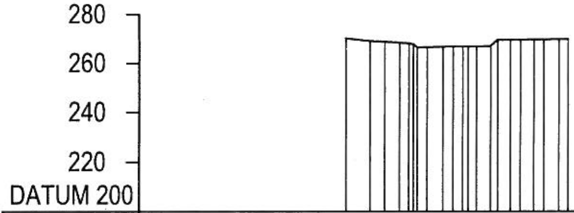
3481

3482



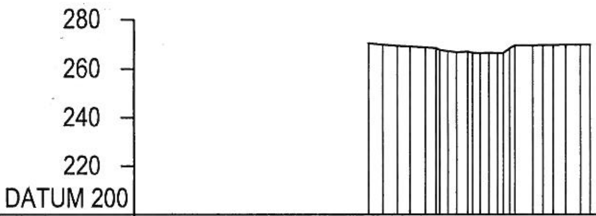
EXIST.LVL	269.660	269.230	268.700	268.370	268.000	267.730	267.510	267.070	266.630	266.480	266.410	266.410	266.320	269.380	269.510	269.570	269.640	269.710	269.770
DISTANCE	0.000	5.870	12.340	17.890	24.720	29.040	30.100	33.360	36.610	40.660	42.710	47.360	51.000	53.470	55.960	62.420	67.430	74.150	79.520

CROSS SECTION - 1



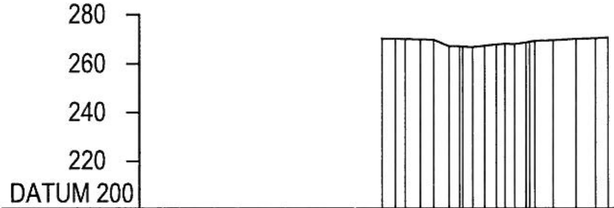
EXIST.LVL	270.000	269.030	268.710	268.330	268.070	267.670	266.420	266.520	266.590	266.660	266.730	266.760	266.800	266.870	269.310	269.330	269.390	269.470	269.520	269.600	269.650
DISTANCE	0.000	9.740	15.760	21.730	25.450	27.320	28.960	32.990	39.340	43.430	47.280	49.570	52.890	58.620	61.440	66.640	70.730	76.120	80.120	86.220	90.030

CROSS SECTION - 3



EXIST.LVL	270.330	269.900	269.370	269.050	268.670	268.410	267.700	267.230	266.750	267.000	266.540	266.410	266.540	266.400	266.390	268.150	269.400	269.520	269.590	269.650	269.700	269.750	269.780
DISTANCE	0.000	5.710	11.470	16.700	22.920	27.240	28.590	32.020	35.460	40.010	42.010	44.980	48.650	52.060	54.430	56.900	59.120	66.280	70.390	74.490	79.640	85.520	89.520

CROSS SECTION - 2



EXIST.LVL	269.660	269.610	269.530	269.400	269.270	266.670	266.610	266.420	266.250	266.730	267.230	267.500	267.390	268.060	268.320	268.700	269.030	269.560	269.740	269.990
DISTANCE	0.000	5.310	9.360	15.500	20.830	27.010	31.330	32.700	36.700	41.430	46.240	49.790	53.640	58.150	59.610	61.890	69.190	78.460	86.300	91.400

CROSS SECTION - 4

DATE	DESCRIPTION	CHKD.	APPRD.
	R VIS NS		

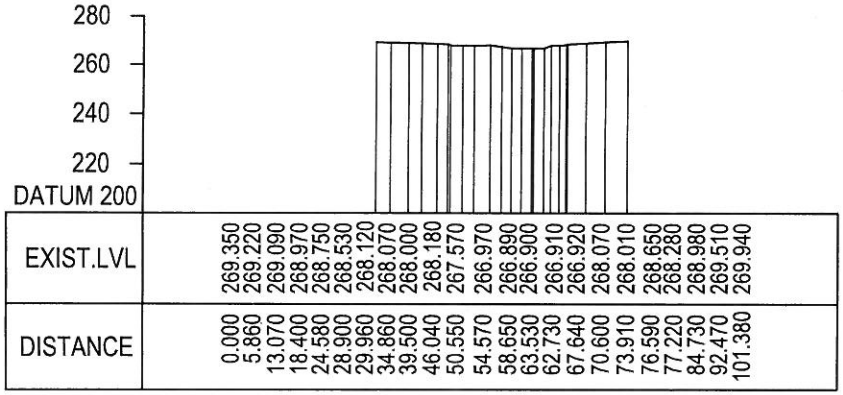
CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt 133001
Telefax: 0171 2612 2

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:-

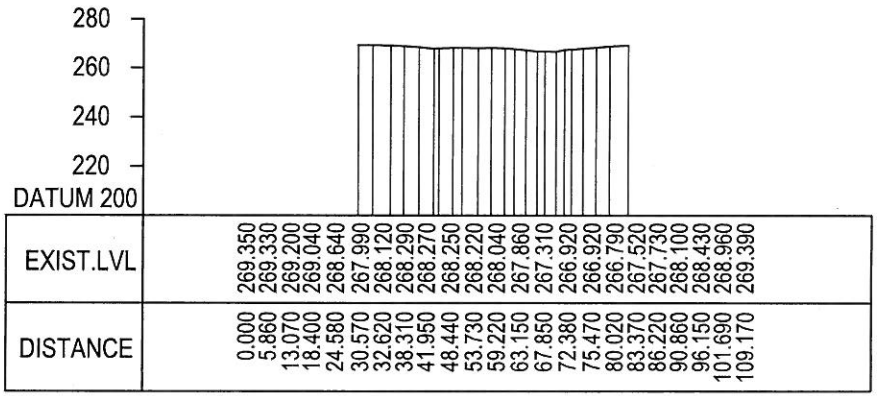
SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD BY	NN	
Appd By:		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
Web,www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS
REV 60
SHEET -1

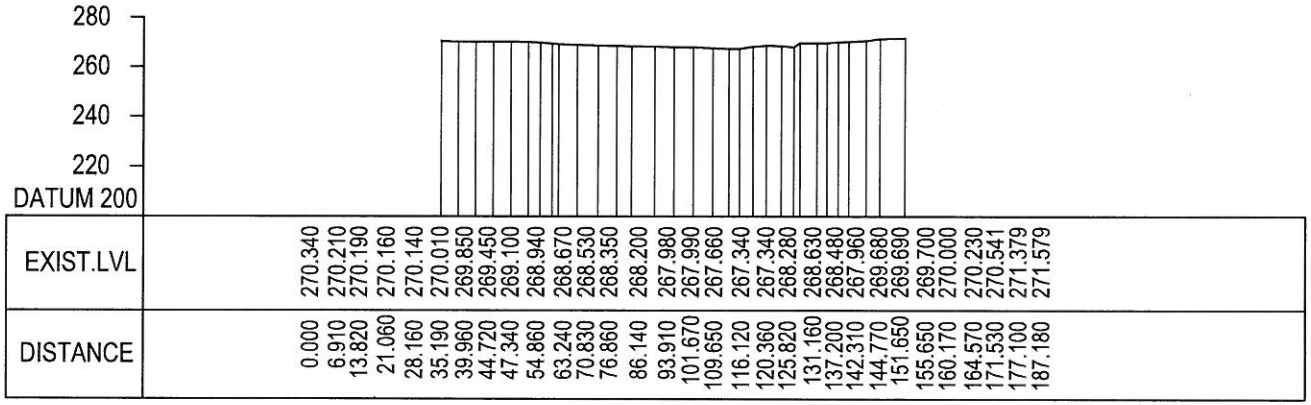


CROSS SECTION - 5



CROSS SECTION - 6

3483



CROSS SECTION - 7

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:-
6 x 45.7m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NNA	
Appvd By:		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
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Bhubaneswar-751015,Odisha
Phone:+91-674-2554205,Telefax:2553689
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS

REV.61 | SHEET NO-2

280
260
240
220
DATUM 200

EXIST.LVL	DISTANCE
271.254	0.000
270.681	12.840
270.310	33.200
270.080	48.130
270.110	52.700
269.160	53.380
268.770	57.180
268.820	62.170
268.870	67.150
268.870	71.740
268.880	76.330
268.110	77.990
267.850	81.740
267.590	85.490
268.180	88.320
268.760	91.150
268.400	97.080
267.690	100.300
267.740	105.990
267.790	111.670
268.290	117.840
268.710	122.960
268.670	127.570
268.570	129.100
267.690	129.890
267.750	132.260
267.790	137.250
267.810	143.750
267.820	147.940
268.270	153.770
268.710	159.600
269.100	161.760
269.500	168.640
269.660	172.640
269.800	177.170
269.820	181.570
269.840	188.520
269.860	194.100
269.990	204.180

CROSS SECTION - 8

280
260
240
220
DATUM 200

EXIST.LVL	DISTANCE
269.995	0.000
269.975	12.840
269.970	33.200
269.950	48.130
269.690	58.100
269.640	74.270
269.960	82.660
270.080	99.430
270.220	107.010
270.410	115.740
270.130	125.530
269.940	132.320
268.570	138.870
268.520	145.160
268.470	156.060
268.730	164.970
268.630	176.350
268.240	181.120
269.340	185.400
269.030	194.990
269.260	207.970
269.280	215.490
269.210	223.990
268.100	233.640
268.010	240.180
267.880	249.620
267.780	257.650
267.700	263.470
268.230	265.430
269.120	272.550
269.360	275.120
269.530	279.440
269.690	283.550
269.820	286.910
269.840	292.570
269.860	299.520
269.880	304.940
270.010	314.710

CROSS SECTION - 9

280
260
240
220
DATUM 200

EXIST.LVL	DISTANCE
271.680	0.000
271.700	25.610
272.050	40.140
271.710	42.040
270.380	49.340
270.110	61.940
270.310	70.720
270.290	77.830
270.260	84.930
270.170	97.400
270.050	107.930
269.950	117.220
269.860	125.700
269.770	133.720
269.710	144.410
269.650	148.160
269.320	154.150
268.870	162.470
268.560	168.280
269.600	174.000
269.460	180.700
269.330	187.400
269.750	195.840
270.180	204.280
270.160	215.230
270.150	222.120
270.290	235.690
270.220	248.170
269.880	257.270
268.630	270.400
268.620	285.550
268.610	306.490
270.250	318.560
270.690	329.110
271.870	333.670
273.130	363.290

CROSS SECTION - 10

3484

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

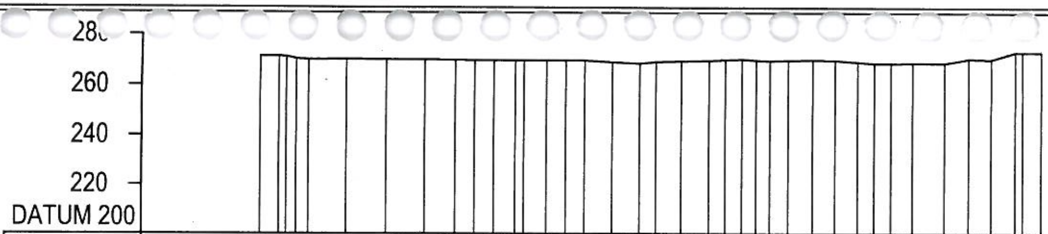
CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171 2612712

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:- [illegible]

SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NN	
Appd By:		

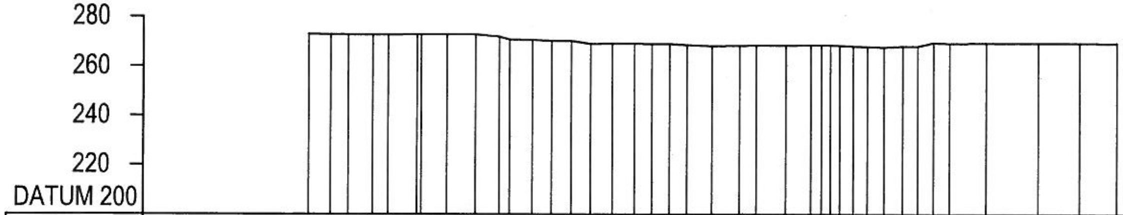
ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
Phone:+ [illegible] ,Telefax [illegible]
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS
REV. 62
SHEET -3



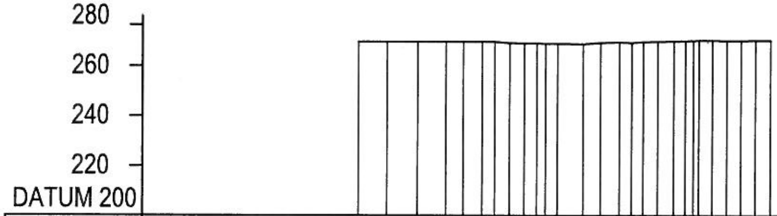
DISTANCE	EXIST.LVL
0.000	271.312
7.590	271.380
10.600	272.530
20.310	270.230
29.400	269.980
39.090	270.200
52.060	270.080
60.730	269.970
67.480	269.830
74.220	269.700
83.320	269.710
92.410	269.730
102.250	269.660
109.630	269.610
115.310	269.650
121.000	269.700
127.680	269.150
134.360	268.610
145.490	269.180
155.760	269.520
162.370	269.740
173.460	270.010
184.550	270.280
192.240	269.950
199.940	269.630
209.040	269.920
212.630	270.030
221.290	269.860
229.050	269.300
236.820	268.740
249.190	268.770
264.800	268.820
280.820	268.860
296.140	270.530
301.030	270.230
305.060	273.140
316.190	273.110
328.300	273.070

CROSS SECTION - 11



DISTANCE	EXIST.LVL
0.000	272.840
6.420	272.680
12.840	272.520
18.880	272.570
26.420	272.530
33.200	272.650
38.830	272.640
44.360	272.630
48.130	272.630
51.790	271.810
56.050	270.600
66.190	270.410
78.130	270.070
84.760	270.070
96.020	268.890
106.110	269.000
113.130	268.990
120.310	268.980
127.290	268.970
136.170	268.580
145.060	268.200
152.880	268.270
160.690	268.340
168.520	268.430
177.790	268.530
181.940	268.570
191.470	268.430
203.070	268.250
213.360	268.100
215.090	267.810
226.790	267.670
232.960	267.960
242.890	268.070
250.050	269.380
258.780	269.210
273.560	269.230
288.670	269.250
305.300	269.270
326.440	269.300

CROSS SECTION - 12



DISTANCE	EXIST.LVL
0.000	269.732
6.000	269.725
11.830	269.719
17.640	269.710
23.450	269.700
28.860	269.700
31.120	269.690
34.300	269.120
38.960	269.070
45.450	269.000
51.390	268.950
55.980	268.900
60.950	268.850
68.640	269.290
75.560	269.600
85.960	269.340
90.820	269.680
94.350	269.860
99.370	269.950
105.310	270.090
111.320	270.230
116.380	270.350
124.010	270.300
131.060	270.260
142.420	270.270
154.700	270.290
166.300	270.310

CROSS SECTION - 13

3485

DATE	DESCRIPTION	CHKD.	APPRD.

REVISIONS

CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cantt-133001
Telefax: 0171-2612412

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:-
6 x 45.7m OPEN WEB GIRDER

SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NNA	
Appvd By:		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
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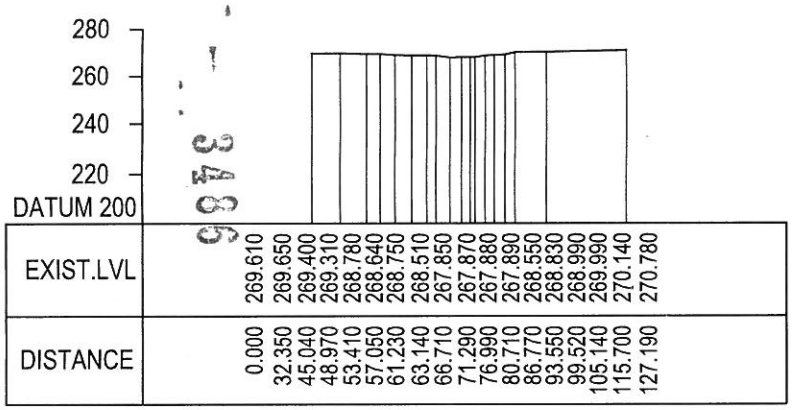
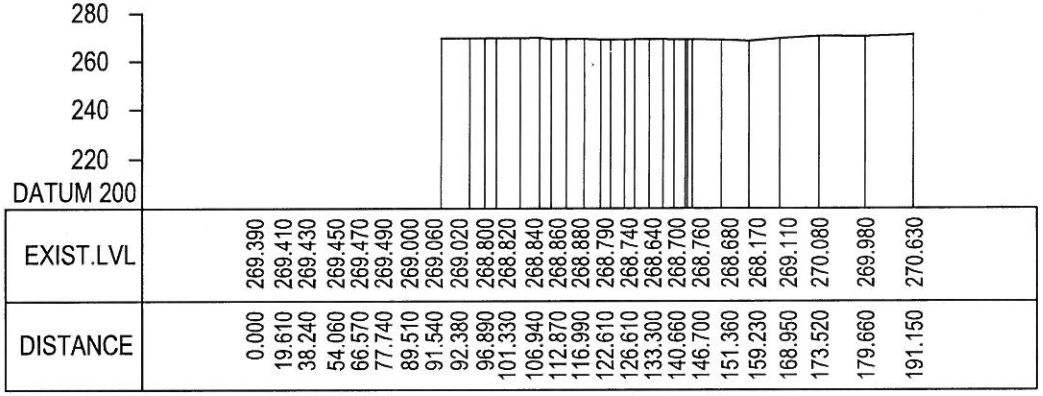
Bhubaneswar-751015,Odisha
Phone:+91-674-2554205,Telefax:2553689
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS
REV. 68
SHEET NO-4



CROSS SECTION - 14



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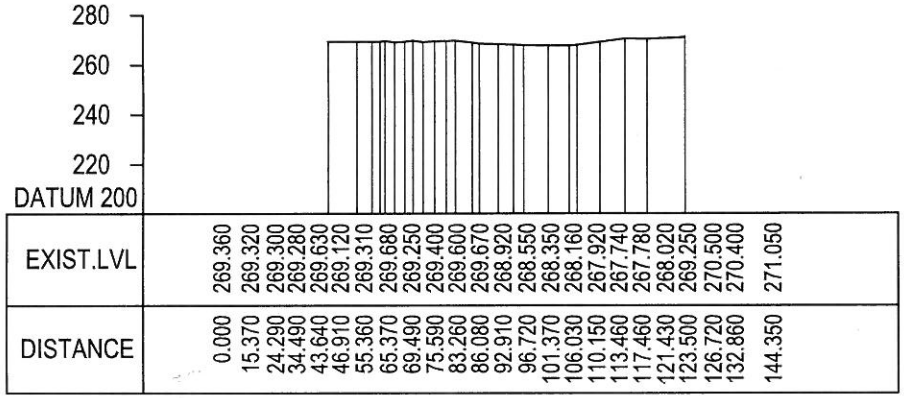
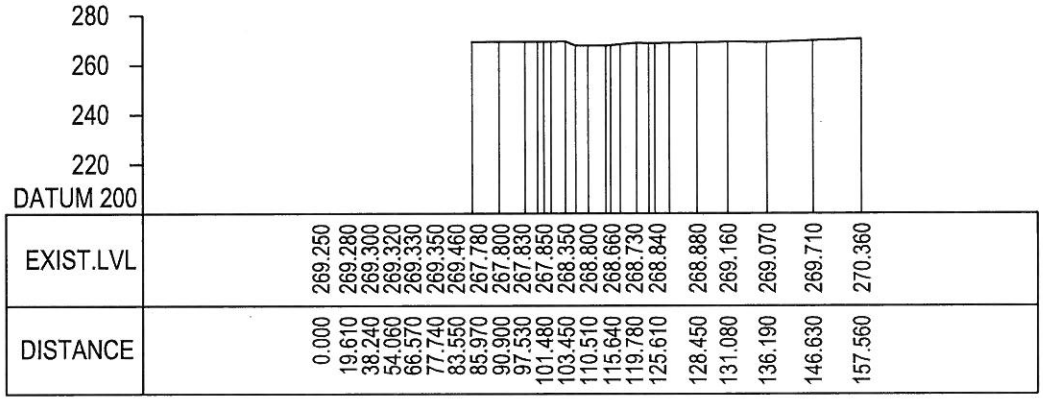


CROSS SECTION - 15



CROSS SECTION - 17

DATE	DESCRIPTION	CHKD.	APPRD.
	REVISIONS		

CLIENT:- DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
Old Railway colony (Near Anand Market)
Ambala Cant-133001
Telefax...017... 2612712

TITLE:-
CROSS SECTION OF MARKANDA RIVER AT PROP.CH:-53+000
SPAN SIZE:- 6 x 7m EN...EB...DI...

SCALE :	AS SHOWN	SIGNATURE
DATE :	APRIL-2013	
PREP.BY	GM	
DESG.BY		
CHKD. BY	NK	
Appvd By.		

ARKITECHNO
ARKITECHNO Consultants (India) Pvt.Ltd
ISO 9001-2008 Certified Company
Plot No# N3/91,IRC Village,Nayapalli
Bhubaneswar-751015,Odisha
Phone:+...67...55/...5,Telefax:...53...
Web:www.arkitechno.com

DRAWING NO.
ATCPL/DFCC/2013/BR/68/CS

REV 64

SHEET -5