

REPORT BY:

G.B.S ENGINEER

PROJECT:

**SUB SOIL INVESTIGATION FOR
CONSTRUCTION OF PROPOSED BRIDGE
OVER RIVER YAMUNA NEAR ANANDI
BHAIRAV TEMPLE ON ANANDI
BHAIRAV - DERA BANJARA,(GIJOLI)
ROAD IN DISTRICT AGRA**

ON BEHALF OF :

**UTTAR PRADESH BRIDGE CORPORATION LTD
AGRA**

G.B.S ENGINEER

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CHECK POST, KHADRI, SITAPUR ROAD,
LUCKNOW - 226020**

**SUB SOIL INVESTIGATION REPORT FOR DESIGN AND CONSTRUCTION OF
BRIDGE OVER YAMUNA RIVER**

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SUB SOIL INVESTIGATION REPORT FOR DESIGN AND CONSTRUCTION OF BRIDGE OVER YAMUNA RIVER

1. INTRODUCTION :

UTTAR PRADESH BRIDGE CORPORATION LTD AGRA has awarded the work of **SUB SOIL INVESTIGATION FOR CONSTRUCTION OF PROPOSED BRIDGE OVER RIVER YAMUNA NEAR ANANDI BHAIRAV TEMPLE ON ANANDI BHAIRAV – DERA BANJARA ,(GIJOLI) ROAD IN DISTRICT AGRA.** This report presents the details of Geotechnical investigations carried out and data obtained from various field and laboratory tests, their presentation in graphical form, and their compilation for the proposed Structure.

2. SCOPE OF WORK:

The Scope of geotechnical investigation work includes the following parameters: -

- Conducting standard penetration tests in-situ to obtain shear strength parameters of soil.
- Collect undisturbed soil samples from cohesive soil stratum to determine the engineering properties such as shear strength and compressibility.
- Determine ground water level in each borehole. It was also required to collect ground water sample from each borehole for chemical analysis.
- Collect and transport selected samples in soil & rock testing laboratory and conduct relevant tests to determine engineering properties of different subsoil strata.
- Prepare a geotechnical investigation report based on the data collected from field and the results of the laboratory tests.

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➤ **DEFINATION OF ACRONYMS**

CH = Silty clay of High plasticity	CI = Silty clay of Medium plasticity
CL = Silty clay of Low plasticity	ML = Clay silt of Low plasticity
ML = Sandy Silt	SM = Silty Sand , SC = Clayey Sand
SW/SP = Well/Poorly graded sand	SM-SP =Poorly graded sand-silt mixture
EGL = Existing ground level.	BGL = below ground level
GSF= General Shear Failure	LSF=Local Shear Failure
ISF=Intermediate Shear Failure	

3. METHODOLOGY OF FIELD INVESTIGATION:

All field work was carried out in accordance with the latest addition of the applicable code of practice / procedures as laid down by the Bureau of Indian Standards.

BOREHOLES:

Bore-hole was selected by Engineer in charge in order to obtain comprehensive sub-soil data for this site. Soil samples collected for different test at different levels. The sub-soil exploration work at the proposed site was carried out manually / mechanically using 150 mm diameter shell and augur manual equipment in soft strata and power driven mechanical boring in hard strata using diamond cutter, as per IS: 1892- 1979.

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4. STANDARD PENETRATION TEST (SPT):

The SPT was conducted in the boreholes at every 1.50 m interval and change of strata as per specifications. Standard split spoon sampler attached to lower end of drill rods was driven in the boreholes by means of standard hammer of 63.50 kg falling freely from a height of 75 cm. The sampler was driven 45 cm as per specifications and number of blows required for each 15 cm penetration was recorded. The number of blows for the first 15 cm penetration was not taken into account as it is considered seating drive.

The number of blows for next 30 cm penetration was designated as SPT 'N' value. Wherever the total penetration was less than 45 cm, the number of blows & the depth penetrated is incorporated in respective bore logs. Disturbed Soil samples obtained from standard split spoon sampler were collected in polythene bags of suitable size. These samples were properly sealed, labeled, recorded and carefully transported to laboratory for testing.

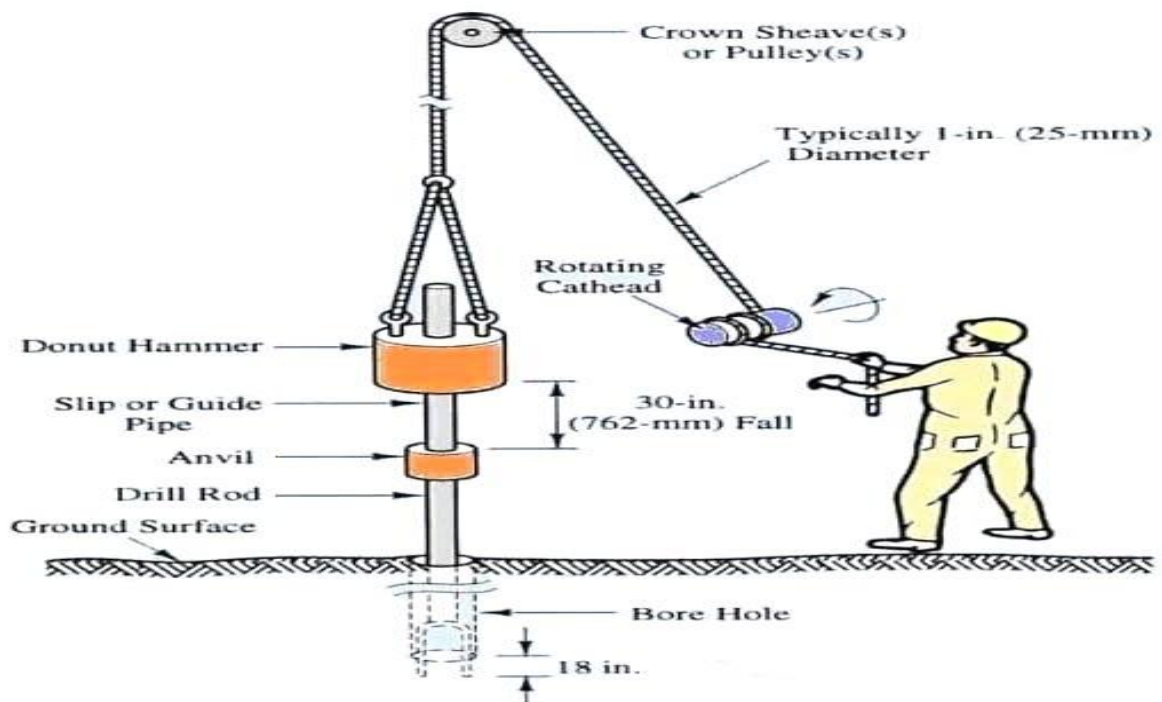


Fig: Standard Penetration Test

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S.P.T. VALUES:

Corrections: - Two different correction are applied on Field SPT 'N' Value of Cohesion less soil

I. **Due to Over –Burden (N')** - The N value for cohesion less soil has been corrected for overburden as: -

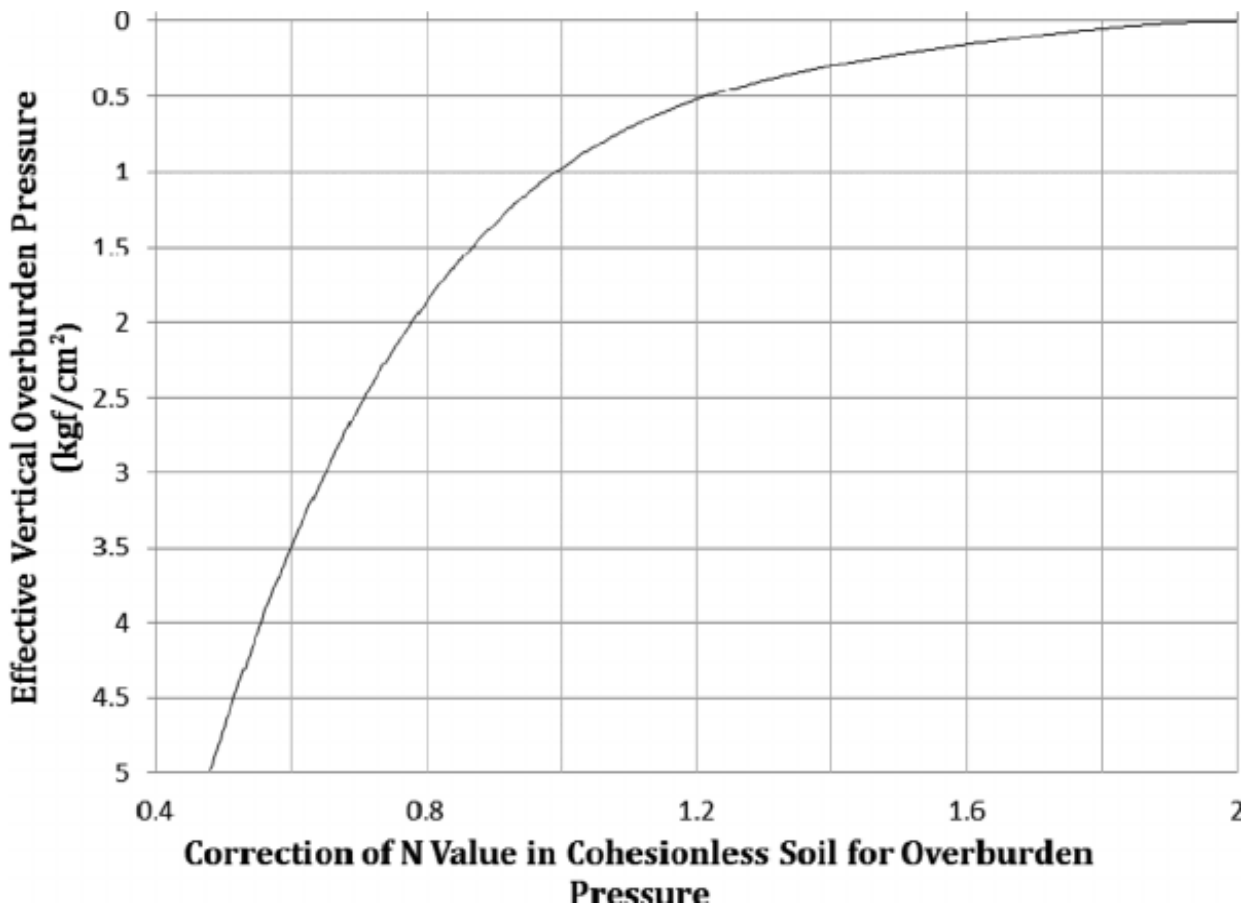


Fig.-1 of IS- 2131-1981

II. **Due to dilitancy (N'')** - If the stratum consists of fine sand and silt below water table for values of N' greater than 15,

$$N'' = 15 + (N' - 15) / 2$$

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5. CONSISTENCY / RELATIVE DENSITY OF SOIL WITH SPT VALUES AS PER IRC: 75-2015

Consistency of Cohesive Soils

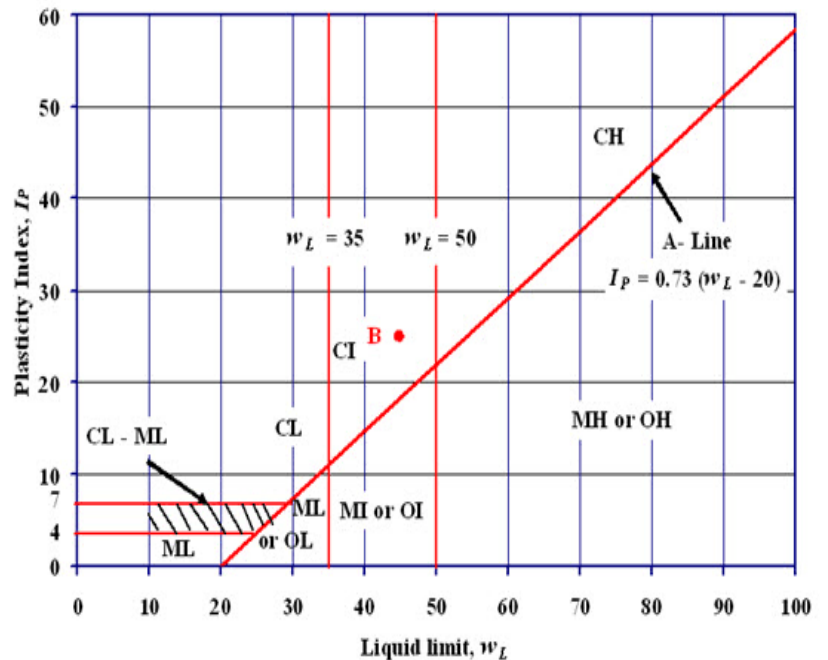
SPT Value	Consistency
0-2	Very Soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very Stiff
>30	Hard

Density Condition of Granular Soils

SPT Value	Density Descriptor
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense

Plastic Limit

Plasticity	Liquid Limit
Low Plastic	<35
Medium Plastic	35 to 50
High Plastic	>50



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6. DISTURBED SAMPLES:

In all boreholes, disturbed soil samples was taken at every 1.5 m interval and at significant change of stratum (or as per specified). Soil from cutting edge of undisturbed samplers and from split spoon sampler used for standard penetration tests was taken as disturbed samples. These samples were placed without delay in adequately sealed polythene bags.

7. UNDISTURBED SOIL SAMPLES (UDS):

The UDS were collected from the boreholes at every 1.50 m interval & change of strata as per sampling specifications, in thin walled sampling tubes of 100 mm dia. and 450 mm length. These sampling tubes after retrieval from the boreholes were properly waxed and sealed at both ends. These were carefully labeled and transported to the laboratory for testing. UDS wherever slipped during lifting, were duly marked in the bore logs as well in the soil profile.

8. GROUND WATER TABLE:

During exploration work of the Location, the water table in the borehole will be allowed to stabilize after depressing the water level adequately by bailing. Stability of the borehole sides and bottom will be ensured at all times, ground water table measurement shall be done after minimum 2 hrs of bailing in sandy strata and after 24 hrs in cohesive strata.

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9. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

Natural moisture contents were determined by oven drying method as per IS 2720 (Part II)-1973. The results have been reported in result sheet attached.

Dry and Bulk density of soil strata were obtained using Shelby tubes in accordance with IS 2720 (Part XXIX)-1975. The results have been reported in result sheet attached.

Particle size analysis test by hydrometer method were performed in accordance with IS 2720 (Part IV) - 1965 on the part of soil samples obtained after the sieve analysis. The results have been reported in result sheet attached.

Atterberg Limits' tests were performed in accordance with IS 2720 (Part V) - 1985 and results have been reported in result sheet attached.

Specific gravity tests were performed in accordance with IS 2720 (Part III Section1) -1980 and the results have been reported in result sheet attached.

Triaxial Compression Test under Unconsolidated Un-drained (UU) condition as per IS: 2720 (Part-XI)-2011 were performed on the undisturbed soil samples obtained during the field investigation. The results have been reported in result sheet attached.

Direct shear tests were performed as per IS 2720 (Part XIII)-2015, on the undisturbed soil samples obtained during the field investigation. The results and the density of samples have been reported in result sheet attached.

Consolidation tests were performed as per IS 2720 (Part XV)-1986, on the undisturbed soil samples obtained during the field investigation. The result in the form of compression index (Cc) is reported in result sheet attached.

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10. REFERENCE CODES:

All field work/Laboratory tests were carried out in accordance with the latest addition of the applicable code of practice / procedures as lay down by the Bureau of Indian Standards. List of applicable codes are as below

Sr. No	Ref: IS CODE	PARTICULARS OF PROPERTIES
1	IS: 1892-1974	Field Work Including Existent Ground Water Table
2	SP 36 (Part-2:1988)	Compendium of Indian Standard on soil engineering (part-2, field testing of soil for civil engineering purposes)
3	SP 36 (Part-1:1987)	Compendium of Indian Standard on soil engineering (Part-1, laboratory testing of soil for civil engineering purposes)
4	IS: 2132-1986	Sampling in Undisturbed and Disturbed Form
5	IS: 2131-1981	Standard Penetration Test
6	IS: 2720	All Laboratory Tests on Soil Samples Collected
7	IS: 6403-1981	Code of Practice for determination of Bearing Capacity of Shallow Foundations
8	IS: 8009(Part I)-1976	Code of Practice for Calculation of Settlement of Foundations
9	IS:2911(Part-1/Sec-2)-2010	Design and Construction of Pile Foundations Code of Practice
10	IS:1892-1979	Code of Practice for subsurface investigation for foundations
11	IS: 1904-1986	Permissible Maximum Settlement, Differential Settlement and Angular Distortion

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11. METHODOLOGY OF CALCULATION

ANALYSIS OF OPEN FOUNDATION

The allowable bearing capacity of the sub soil strata has been computed from shear & settlement consideration as per IS: 6403-1981, IS: 1904-1976 & IS: 8009 Part-I 1976. The details of foundation analysis are given in the subsequent pages.

From Shear Failure Criteria:

Net Safe Bearing capacity from Shear Failure consideration has been computed in accordance with IS: 6403-1981. A factor of safety of 2.5 is selected based on clause 706.3.1.1.1 of IRC 78-2014 to estimate the net safe bearing capacity from ultimate net bearing capacity.

The ultimate net bearing capacity in case of general shear failure is given by following expression,

$$q_{nu} = cN_c S_c d_c i_c + q(N_q - 1)S_q d_q i_q + \frac{1}{2} B \gamma N_\gamma S_\gamma d_\gamma i_\gamma \times W'$$

The ultimate net bearing capacity in case of local shear failure is given by following expression,

$$q'_{nu} = \frac{2}{3} cN'_c S_c d_c i_c + q(N'_q - 1)S_q d_q i_q + \frac{1}{2} B \gamma N'_\gamma S_\gamma d_\gamma i_\gamma \times W'$$

Where,

Bearing Capacity Factors	Depth Factors	Shape Factors	Inclination Factors	Water Table Correction
N_c	D_c	S_c	I_c	W'
N_q	D_q	S_q	I_q	
N_γ	D_γ	S_γ	I_γ	

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12. From Settlement Failure Criteria:

Allowable Bearing Pressure from Settlement Failure consideration has been computed in accordance with IS: 8009 (Part-I). The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure.

The Immediate Settlement in cohesion-less soil is estimated using SPT value as per IS: 8009 (Part-I). Zone of influence below foundation has been considered up to 1.5 times the width of the foundation.

The Consolidation settlement in cohesive soil is estimated as per IS: 8009 (Part-I). Zone of influence below foundation has been considered up to 1.5 times the width of the foundation.

Consolidation Settlement:

$$S = \sum \frac{C_c H_i}{1 + e_o} \log \left(\frac{P_o + \Delta P}{P_o} \right)$$

Design Parameters for Settlement Failure Criteria as follows:

Immediate Settlement:

For the Calculation of the Immediate Settlement using the graph of Settlement unit pressure from standard penetration test as per IS 8009 Part 1/ Sec 2 (Fig. 9).

Total settlement $S_t =$

$S_t = (\text{Consolidation Settlement} + \text{Immediate Settlement}) \times \text{Rigidity factor} \times \text{Depth Correction}$

Note: Permissible settlement is governed from Table 1 of IS: 1904 – 1986.

****Rigidity factor taken as 0.80**

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13. RECOMMENDATION FOR WELL FOUNDATION

Bore Hole No.	Depth of Foundation below GL	Depth of Foundation below LWL	RL of GL	RL of LWL	RL of Founding level from LWL	Type of foundation	Diameter	Net Safe Bearing Capacity	Settlement Produced	Gross Safe Bearing Capacity
	(m)						(m)	Tonne/sqm	(mm)	Tonne/sqm
1	42.60	36.00	153.595	147.0	111.00	WELL	8.00	84.10	70.65	105.10
	43.60	37.00	153.595	147.0	110.00	WELL	8.00	85.40	70.43	106.40
	44.60	38.00	153.595	147.0	109.00	WELL	8.00	86.69	70.22	107.69
	45.60	39.00	153.595	147.0	108.00	WELL	8.00	87.98	70.01	108.98
	46.60	40.00	153.595	147.0	107.00	WELL	8.00	89.28	69.82	110.28
2	35.53	36.00	146.525	147.0	111.00	WELL	8.00	83.25	72.42	104.85
	36.53	37.00	146.525	147.0	110.00	WELL	8.00	84.63	72.30	106.23
	37.53	38.00	146.525	147.0	109.00	WELL	8.00	86.00	72.18	107.6
	38.53	39.00	146.525	147.0	108.00	WELL	8.00	87.38	72.06	108.98
	39.53	40.00	146.525	147.0	107.00	WELL	8.00	88.75	71.95	110.35
3	43.81	36.00	154.812	147.0	111.00	WELL	8.00	123.07	86.30	142.07
	44.81	37.00	154.812	147.0	110.00	WELL	8.00	125.59	86.59	144.59
	45.81	38.00	154.812	147.0	109.00	WELL	8.00	128.14	86.89	147.14
	46.81	39.00	154.812	147.0	108.00	WELL	8.00	130.70	87.18	149.7
	47.81	40.00	154.812	147.0	107.00	WELL	8.00	133.28	87.48	152.28

****Ksf = 1.10**

****Bold values mentioned in the above table should be adopted at the respective site.**

**** Recommended Gross Safe Bearing Capacity for the Design**

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BORE HOLE NO.	COHESION	ANGLE AND INTERNAL FRICTION
1	0.68	8
2	0.65	9
3	0.65	10

RECOMMENDATION FOR PILE FOUNDATION

Bore Hole	Pile Diametre	Pile Length Below Cut-off Level	Pile Cut-off Length	Safe Pile Capacity (compression)	Safe Pile Capacity (Uplift)	Load Capacity of Pile (Lateral)	Depth of fixity
	(mm)	(m)	(m)	(Tonnes)	(Tonnes)	(Tonnes)	(m)
						Fixed Head	Fixed Head
2	1200	20.00	2.30	197.07	127.65	41.56	10.21
		21.00		209.70	136.26		
		22.00		222.80	145.20		
		23.00		236.46	154.46		
		24.00		250.58	164.05		
		25.00		262.73	173.97		
		26.00		275.40	184.22		
		27.00		288.56	194.80		
		28.00		302.21	205.73		

The above recommendations are based on the field investigation data results, the laboratory tests results of the samples collected and from the calculation as per Indian standard. (Shear parameter has calculate the all bore hole but the settlement only calculated for the lowest value bore hole because recommended only this bore hole), the test locations and our experience in this regard. If the actual sub soil conditions during excavation for the foundations differ from that has been reported, a reference should be made to us for suggestions.


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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

BOREHOLE 01		Depth of borehole		Water table below borehole level (m)		Factor of safety		Ultimate Net Bearing Capacity																																
		55.00	metre	4.85		2.50		Local shear	Intermediate	Net Safe Bearing Capacity																														
				Water table used for calculation (m)	3.00	Assumed post monsoon rise (m)	1.85																																	
Shearing Resistance Parameters																																								
Input Parameters																																								
S. No.	Type of foundation	Depth (m)	Length (m)	Width (m)	Diameter (m)	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Void Ratio	Effective Surcharge	Bearing Capacity Factors				Shape Factors				Depth Factors				Inclination Factors				General shear	Local shear	Net Safe Bearing Capacity											
						(gms/cc)	(kN/m ³)	(gms/cc)			(kN/m ³)	c	φ	φ'	e	q	N _c	N _q	N _γ	N _c '	N _q '	N _γ '	S _c	S _q	S _γ	D _c				D _q	D _γ	D _c '	D _q '	D _γ '	I _c	I _q	I _γ	kN/m ²	kN/m ²	kN/m ²
1	CIRCULAR	42.60	-	-	8.00	2.04	10.89	2.09	11.38	0.68	8	5.38	0.534	463.86	7.53	2.06	0.86	6.61	1.62	0.49	1.30	1.20	0.60	2.22	1.00	2.17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2061.98	-	-	824.79	
2	CIRCULAR	43.60	-	-	8.00	2.04	10.87	2.09	11.36	0.68	8	5.38	0.534	474.06	7.53	2.06	0.86	6.61	1.62	0.49	1.30	1.20	0.60	2.25	1.00	2.20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2093.70	-	-	837.48
3	CIRCULAR	44.60	-	-	8.00	2.04	10.86	2.09	11.35	0.68	8	5.38	0.534	484.26	7.53	2.06	0.86	6.61	1.62	0.49	1.30	1.20	0.60	2.28	1.00	2.22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2125.41	-	-	850.16
4	CIRCULAR	45.60	-	-	8.00	2.04	10.84	2.09	11.33	0.68	8	5.38	0.534	494.46	7.53	2.06	0.86	6.61	1.62	0.49	1.30	1.20	0.60	2.31	1.00	2.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2157.13	-	-	862.85
5	CIRCULAR	46.60	-	-	8.00	2.04	10.83	2.09	11.32	0.68	8	5.38	0.534	504.66	7.53	2.06	0.86	6.61	1.62	0.49	1.30	1.20	0.60	2.34	1.00	2.28	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2188.84	-	-	875.54

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1																
Depth	42.60	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	BOREHOLE 1						
			Water Table depth for calculation	3.00			Rigidity factor	0.80								
			Length	-			metre	Applied Pressure at foundation base		824.79	kn/m ²	Type of foundation			CIRCULAR	
S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N"	P _o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				kn/m ²	kn/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	42.60	42.60	2.04	-	-	-	529.81	269.32	-	-	88.314	-	70.65
2	2	CLAY	42.60	54.60	12.00	2.12	0.528	0.063	-							
Depth of foundation																

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	43.60	metre	Settlement effective zone depth	1.50	X Width	Depth factor		Type of foundation	CIRCULAR	BOREHOLE 1		
						Rigidity factor	1.00			Consolidation settlement	Immediate settlement	Total settlement
							0.80					
Length	-	metre	Water Table depth for calculation	3.00	(m) bgl							
Diameter	8.00	metre	Applied Pressure at foundation base	837.48	kN/m ²							

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	43.60	43.60	2.04	-	-	-	540.01	273.46	-	-	88.039	-	70.43
2	2	CLAY	43.60	55.60	12.00	2.12	0.528	0.063	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth Length Diameter	44.60 - 8.00	metre metre metre	Settlement effective zone depth		1.50 3.00 850.16	X Width (m) bgl kN/m ²	Depth factor		Type of foundation	BOREHOLE 1			
			Water Table depth for calculation				Rigidity factor	1.00 0.80		CIRCULAR	Consolidation settlement	Immediate settlement	Total settlement
			Layer Start depth	Layer End depth									

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress P _o kN/m ²	Increment stress ΔP kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
1	1	CLAY	0.00	44.60	44.60	2.04	-	-	-	550.21	277.60	-	-	87.773	-	70.22
2	2	CLAY	44.60	56.60	12.00	2.12	0.528	0.063	-	550.21	277.60	-	-	87.773	-	70.22

Depth of foundation																
1	1	CLAY	0.00	44.60	44.60	2.04	-	-	-	550.21	277.60	-	-	87.773	-	70.22
2	2	CLAY	44.60	56.60	12.00	2.12	0.528	0.063	-	550.21	277.60	-	-	87.773	-	70.22

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	45.60	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 1	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation		
			8.00	metre			3.00	metre		
Diameter	8.00	metre	Applied Pressure at foundation base		862.85	kN/m ²				

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress kN/m ² P _o	Increment stress kN/m ² ΔP	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
1	1	CLAY	0.00	45.60	45.60	2.04	-	-	-	560.41	281.75	-	-	87.517	-	70.01
2	2	CLAY	45.60	57.60	12.00	2.12	0.528	0.063	-	560.41	281.75	-	-	87.517	-	70.01

Depth of foundation

Depth of foundation																
1	1	CLAY	0.00	45.60	45.60	2.04	-	-	-	560.41	281.75	-	-	87.517	-	70.01
2	2	CLAY	45.60	57.60	12.00	2.12	0.528	0.063	-	560.41	281.75	-	-	87.517	-	70.01

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	46.60	metre	Settlement effective zone depth	1.50	X Width	Depth factor		Type of foundation	CIRCULAR	BOREHOLE 1		
						Rigidity factor	1.00			Consolidation settlement	Immediate settlement	Total settlement
Length	-	metre	Water Table depth for calculation	3.00	(m) bgl							
Diameter	8.00	metre	Applied Pressure at foundation base	875.54	kN/m ²							

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	46.60	46.60	2.04	-	-	-	570.61	285.89	-	-	87.270	-	69.82
2	2	CLAY	46.60	58.60	12.00	2.12	0.528	0.063	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1																
BOREHOLE 2												Total settlement (mm)				
Depth	35.53	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	Rigidity factor	0.80	Type of foundation	CIRCULAR			
			Water Table depth for calculation	Applied Pressure at foundation base												
Length	-	metre			11.00											
Diameter	8.00	metre			816.47											
S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (KN/m ²)	Increment stress (KN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N"	P _o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				KN/m ²	KN/m ²	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	35.53	35.53	1.98	-	-	-	515.84	266.60	-	-	90.528	-	72.42
2	2	CLAY	35.53	47.53	12.00	2.13	0.511	0.063	-							
Depth of foundation																

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	36.53	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 2	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	1.00		
			metre	metre			metre	metre	0.80	CIRCULAR
Diameter	8.00	metre			11.00	829.94		Type of foundation		

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress P _o kN/m ²	Increment stress ΔP kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY						Cc	N"	P _o kN/m ²	ΔP kN/m ²	(mm)	W'	(mm)	(mm)	(mm)
		SAND								kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	36.53	36.53	1.98	-	-	-	525.45	271.00	-	-	90.373	-	72.30
2	2	CLAY	36.53	48.53	12.00	2.13	0.511	0.063	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth Length Diameter	37.53 - 8.00	metre metre metre	Settlement effective zone depth		1.50 11.00 843.42	X Width (m) bgl kN/m ²	Depth factor		Type of foundation	BOREHOLE 2		
			Water Table depth for calculation				1.00 0.80	CIRCULAR				
			Applied Pressure at foundation base									

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress P _o kN/m ²	Increment stress ΔP kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
1	1	CLAY	0.00	37.53	37.53	1.98	-	-	-	535.06	275.40	-	-	90.224	-	72.18
2	2	CLAY	37.53	49.53	12.00	2.13	0.511	0.063	-	535.06	275.40	-	-	90.224	-	72.18

Depth of foundation																
1	1	CLAY	0.00	37.53	37.53	1.98	-	-	-	535.06	275.40	-	-	90.224	-	72.18
2	2	CLAY	37.53	49.53	12.00	2.13	0.511	0.063	-	535.06	275.40	-	-	90.224	-	72.18

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4																
											BOREHOLE 2					
Depth	38.53	metre	Settlement effective zone depth	1.50	X Width	Depth factor		Type of foundation		Settlement for Unit Pressure	Water Correction factor	Total settlement				
						Rigidity factor	1.00	0.80	CIRCULAR							
Length	-	metre	Water Table depth for calculation	11.00	(m) bgl											
Diameter	8.00	metre	Applied Pressure at foundation base	856.89	kN/m ²											
S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N"	P _o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)
													Depth of foundation			
1	1	CLAY	0.00	38.53	38.53	1.98	-	-	-	544.67	279.80	-	-	90.080	-	72.06
2	2	CLAY	38.53	50.53	12.00	2.13	0.511	0.063	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	39.53	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 2	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	1.00		
			8.00	metre			0.80	CIRCULAR		
Length	-	metre			11.00					
Diameter	8.00	metre			870.37					

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress P _o kN/m ²	Increment stress ΔP kN/m ²	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY						Cc	N"	P _o kN/m ²	ΔP kN/m ²	(mm)	W'	(mm)		
		SAND								kN/m ²	kN/m ²	(mm)		(mm)		(mm)

		Depth of foundation														
1	1	CLAY	0.00	39.53	39.53	1.98	-	-	-	554.29	284.20	-	-	89.941	-	71.95
2	2	CLAY	39.53	51.53	12.00	2.13	0.511	0.063	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1																
Depth	43.81	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 3							
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	Type of foundation	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement			
			metre	metre			0.80							CIRCULAR	(mm)	(mm)
Length	-	metre	Water Table depth for calculation	Applied Pressure at foundation base	11.00	kgf/cm ²										
Diameter	8.00	metre	Applied Pressure at foundation base	Applied Pressure at foundation base	1206.99	kgf/cm ²										
S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Ratio	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N"	P _o	ΔP	(mm)	W'	(mm)	(mm)	(mm)
		SAND	(m)	(m)	(m)	(gms/cc)				KN/m ²	KN/m ²	(mm)		(mm)	(mm)	(mm)
													Depth of foundation			
1	1	CLAY	0.00	43.81	43.81	1.98	-	-	-	597.19	394.12	-	-	107.877	-	86.30
2	2	CLAY	43.81	55.81	12.00	2.16	0.469	0.060	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	44.81	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 3	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	1.00		
			8.00	metre			0.80	CIRCULAR		
Length	-	metre	11.00	1231.69	11.00	1231.69	Type of foundation			
Diameter	8.00	metre	1231.69	1231.69	1231.69	1231.69	Type of foundation			

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	44.81	44.81	1.98	-	-	-	606.80	402.18	-	-	108.240	-	86.59
2	2	CLAY	44.81	56.81	12.00	2.16	0.469	0.060	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	45.81	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		1.00	BOREHOLE 3	
			Water Table depth for calculation	Rigidity factor			Type of foundation				
			Applied Pressure at foundation base	CIRCULAR							
Length	-	metre		11.00				0.80			
Diameter	8.00	metre		1256.68							

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress P _o (kN/m ²)	Increment stress ΔP (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY							N"	P _o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	45.81	45.81	1.98	-	-	-	616.41	410.34	-	-	108.611	-	86.89
2	2	CLAY	45.81	57.81	12.00	2.16	0.469	0.060	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	46.81	metre	Settlement effective zone depth		1.50	X Width (m) bgl	Depth factor		BOREHOLE 3	
			Water Table depth for calculation	Applied Pressure at foundation base			Rigidity factor	1.00		
			8.00	metre			0.80	CIRCULAR		
Length	-	metre	11.00	1281.78	11.00	kgf	Type of foundation			
Diameter	8.00	metre	1281.78	1281.78	1281.78	kgf/m ²				

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio	Compression Index	Corrected SPT	Effective stress (kN/m ²)	Increment stress (kN/m ²)	Settlement for Unit Pressure (mm)	Water Correction factor	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
		CLAY					e	Cc	N''	P _o	ΔP	(mm)	W'	(mm)		
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m ²	kN/m ²	(mm)		(mm)	(mm)	(mm)

Depth of foundation																
1	1	CLAY	0.00	46.81	46.81	1.98	-	-	-	626.02	418.54	-	-	108.978	-	87.18
2	2	CLAY	46.81	58.81	12.00	2.16	0.469	0.060	-							

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth Length Diameter	47.81 - 8.00	metre metre metre	Settlement effective zone depth		1.50 11.00 1307.08	X Width (m) bgl kN/m ²	Depth factor		CIRCULAR	BOREHOLE 3			
			Water Table depth for calculation				Rigidity factor	Settlement for Unit Pressure		Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
			Applied Pressure at foundation base										

S. No.	Layer No.	Type of Layer	Layer Start depth (m)	Layer End depth (m)	Layer Thickness (m)	Density (gms/cc)	Void Ratio e	Compression Index Cc	Corrected SPT N"	Effective stress kN/m ² P _o	Increment stress kN/m ² ΔP	Settlement for Unit Pressure (mm)	Water Correction factor W'	Consolidation settlement (mm)	Immediate settlement (mm)	Total settlement (mm)
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Depth of foundation																
1	1	CLAY	0.00	47.81	47.81	1.98	-	-	-	635.63	426.80	-	-	109.346	-	87.48
2	2	CLAY	47.81	59.81	12.00	2.16	0.469	0.060	-							

**LATERAL LOAD CARRYING CAPACITY OF PILE IN SOIL/ INTERMEDIATE
GEO-MATERIAL, (AS PER IRC:78-2014)**

Method : For Pile in Preloaded Clay and Normally loaded clay / Sand

Bore Hole No.	2	Pile Type.	Bored Cast In-situ Concrete Pile
Diameter of Pile (mm) :		1200	
Cut off Level of the pile (m) :		2.00	
Scour Level / LIQUEFACTION (m) :		0	
Length of Pile (m) :		30.00	
Length of below cut off level (m) :		28.00	
Type of Pile Head :		Fixed Head	
Grade of Concrete :		35	
Type of Soil :		NORMALLY LOADED CLAY	
Water table :		0.00	
SPT (N) Value :		10.00	
Undrained Cohesion Cu (kg/cm ²):		0.00	
Undrained shear strength qu (kg/cm ²):		-	
Moment of Inertia, I (m ⁴):		0.10	
Modulus of elasticity of pile, E (MPA) :		29580.4	
Modulus of subgrade reaction of soil (Granular soil), (MN/m ³) :		1.4	
Modulus of subgrade reaction of soil (Cohesive soil), (MN/m ³) :		-	
Stiffness Factor (m) :	T	4.64	
	R	-	
For Fixed Head Condition (m) :	e/T	0.00	
	zf/T	2.20	
Cantilever Length, (m) :		0.00	
Depth of Fixity (m) :		10.21	
Pile Behaviour :		Long	
1% Deflection at the Scour level :		12.00	
Deflection at Pile Top : Y		12.00	
Lateral Capacity of Pile (kN) :		407.62	
Lateral Capacity of Pile (Tonne) :		41.56	

RESULT SHEET

Particle Size Analysis

Bore Hole No. Total depth of Bore Hole (m)	1		55.00		Depth of Water Level (m bgl)				4.85				Type of Test				Particle Size Analysis												
	Reduced Level (Assumed)		Type of Sample		Coordinate		Easting		Northing		Completed on										Commenced on		Void Ratio	Shear Characteristics		Compression Index	Angle of Internal Friction		
metre	metre	N	N'	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	% Material Passing		IS Sieve		Atterberg Limits		IS group symbol		Dry Bulk Density (gms/cc)	Specific Gravity (G)	Cohesion (Kg/cm ²)	Friction	(Cc)	CD/UU	Gravel	Sand		Silt	Clay				
1	2	4	5	3	4	6	7	8	9	10	LL	PL	PI	15									16			17	18	19	20
19.65	20.10	133.945	-	133.495	UD	-	-	96	90	88	80	-	36	22	14	CI	2.09	19.35	1.75	-	-	-	-	-	4	16	57	23	
20.10	20.55	133.495	-	133.045	SPT	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
21.15	21.60	132.445	-	131.995	UD	-	-	95	89	84	79	-	37	21	16	CI	2.10	19.28	1.76	-	-	-	-	-	5	16	59	20	
21.60	22.05	131.995	-	131.545	SPT	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
22.65	23.10	130.945	-	130.495	UD	-	-	94	88	86	82	-	36	21	15	CI	2.10	19.16	1.76	-	-	-	-	-	6	12	59	23	
23.10	23.55	130.495	-	130.045	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
24.15	24.60	129.445	-	128.995	UD	-	-	97	91	87	81	-	36	21	15	CI	2.09	18.26	1.77	-	-	-	-	-	3	16	61	20	
24.60	25.05	128.995	-	128.545	SPT	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
25.65	26.10	127.945	-	127.495	UD	-	-	98	92	89	83	-	38	21	17	CI	2.12	18.01	1.80	-	-	-	-	-	2	15	62	21	
26.10	26.55	127.495	-	127.045	SPT	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
27.15	27.60	126.445	-	125.995	UD	-	-	97	94	88	82	-	38	21	17	CI	2.10	17.88	1.78	-	-	-	-	-	3	15	60	22	
27.60	28.05	125.995	-	125.545	SPT	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
28.65	29.10	124.945	-	124.495	UD	-	-	98	95	86	84	-	37	21	16	CI	2.09	17.66	1.78	-	-	-	-	-	2	14	63	21	
29.10	29.55	124.495	-	124.045	SPT	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
30.15	30.60	123.445	-	122.995	UD	-	-	99	96	87	81	-	37	22	15	CI	2.13	19.26	1.79	-	-	-	-	-	1	18	60	21	
30.60	31.05	122.995	-	122.545	SPT	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31.65	32.10	121.945	-	121.495	UD	-	-	97	94	86	80	-	38	22	16	CI	2.12	19.12	1.78	-	-	-	-	-	3	17	57	23	
32.10	32.55	121.495	-	121.045	SPT	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
33.15	33.60	120.445	-	119.995	UD	-	-	95	90	84	81	-	38	21	17	CI	2.10	18.92	1.77	-	-	-	-	-	5	14	59	22	
33.60	34.05	119.995	-	119.545	SPT	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
34.65	35.10	118.945	-	118.495	UD	-	-	96	94	82	78	3.106	38	22	16	CI	2.11	19.05	1.77	2.68	0.514	0.60	7°	-	UU	4	18	57	21
35.10	35.55	118.495	-	118.045	SPT	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
36.15	36.60	117.445	-	116.995	UD	-	-	97	92	84	80	-	38	22	16	CI	2.11	19.22	1.77	-	-	-	-	-	3	17	59	21	
36.60	37.05	116.995	-	116.545	SPT	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
37.65	38.10	115.945	-	115.495	UD	-	-	98	92	87	81	-	37	22	15	CI	2.14	18.75	1.80	-	-	-	-	-	2	17	60	21	
38.10	38.55	115.495	-	115.045	SPT	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Bore Hole No. Total depth of Bore Hole (m)	2 60.00	Coordinate		Easting		Depth of Water Level (m bgl)		12.70												Particle Size Analysis										
		Type of Sample		Northing		Completed on		IS group symbol		Wet Bulk Density		Original Moisture		Dry Bulk Density		Specific Gravity		Void Ratio						Shear Characteristics		Compression Index		Type of Test		
		N	N'	SPT Value	SPT Value corrected due to overburden	N"	N'	SPT Value corrected due to dilatancy	4.750	2.000	0.425	0.075	LL	PL	PI	Silt Factor	(gms/cc)	(gms/cc)	(gms/cc)	(gms/cc)	(G)	(e)	(Kg/psccm)	(Ø)	(Cc)	CD/UU	Gravel	Sand	Silt	Clay
1	metre	2	metre	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
0.00 - 0.60	146.525 - 145.925	DS	-	-	-	-	100	98	95	89	-	33	21	12	CL	1.82	15.80	1.57	-	-	-	-	-	-	-	0	11	76	13	
0.60 - 1.05	145.925 - 145.475	SPT 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.50 - 2.10	145.025 - 144.425	UD	-	-	-	-	99	97	92	87	-	32	22	10	CL	1.82	16.20	1.57	-	-	-	-	-	-	-	1	12	73	14	
2.10 - 2.55	144.425 - 143.975	SPT 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.15 - 3.60	143.375 - 142.925	UD	-	-	-	-	99	97	92	82	2.081	32	21	11	CL	1.85	16.80	1.58	2.65	0.677	0.15	11°	-	UU	1	17	67	15		
3.60 - 4.05	142.925 - 142.475	SPT 8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.65 - 5.10	141.875 - 141.425	UD	-	-	-	-	99	96	93	83	-	34	20	14	CL	1.88	17.50	1.60	-	-	-	-	-	-	-	1	16	69	14	
5.10 - 5.55	141.425 - 140.975	SPT 12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.15 - 6.60	140.375 - 139.925	UD	-	-	-	-	98	95	91	84	-	33	20	13	CL	1.88	17.30	1.60	-	-	-	-	-	-	-	2	14	71	13	
6.60 - 7.05	139.925 - 139.475	SPT 13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.65 - 8.10	138.875 - 138.425	UD	-	-	-	-	99	97	93	80	-	35	21	14	CL	1.89	17.20	1.61	-	-	-	-	-	-	-	1	19	65	15	
8.10 - 8.55	138.425 - 137.975	SPT 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.15 - 9.60	137.375 - 136.925	UD	-	-	-	-	98	96	92	84	-	33	21	12	CL	1.91	18.50	1.61	-	-	-	-	-	-	-	2	14	70	14	
9.60 - 10.05	136.925 - 136.475	SPT 15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.65 - 11.10	135.875 - 135.425	UD	-	-	-	-	99	98	95	89	2.387	33	22	11	CL	1.94	18.95	1.63	2.67	0.638	0.35	10°	-	UU	1	10	75	14		
11.10 - 11.55	135.425 - 134.975	SPT 17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.15 - 12.60	134.375 - 133.925	UD	-	-	-	-	98	97	93	86	-	34	20	14	CL	1.94	18.20	1.64	-	-	-	-	-	-	-	2	12	74	12	
12.60 - 13.05	133.925 - 133.475	SPT 19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.65 - 14.10	132.875 - 132.425	UD	-	-	-	-	100	98	94	30	-	NON-PLASTIC	SM	SM	SM	1.87	17.10	1.60	2.60	0.625	0.00	30°	-	CD	0	70	26	4		
14.10 - 14.55	132.425 - 131.975	SPT 21	19.05	17.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.15 - 15.60	131.375 - 130.925	UD	-	-	-	-	100	99	94	34	-	NON-PLASTIC	SM	SM	SM	1.87	17.30	1.59	-	-	-	-	-	-	-	0	66	31	3	
15.60 - 16.05	130.925 - 130.475	SPT 19	16.63	15.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.65 - 17.10	129.875 - 129.425	UD	-	-	-	-	99	97	93	35	-	NON-PLASTIC	SM	SM	SM	1.89	17.20	1.61	-	-	-	-	-	-	-	1	64	31	4	
17.10 - 17.55	129.425 - 128.975	SPT 23	19.44	17.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18.15 - 18.60	128.375 - 127.925	UD	-	-	-	-	99	96	92	86	-	37	21	16	CI	1.99	18.56	1.68	2.67	0.589	0.45	11°	-	UU	1	13	64	22		
18.60 - 19.05	127.925 - 127.475	SPT 27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

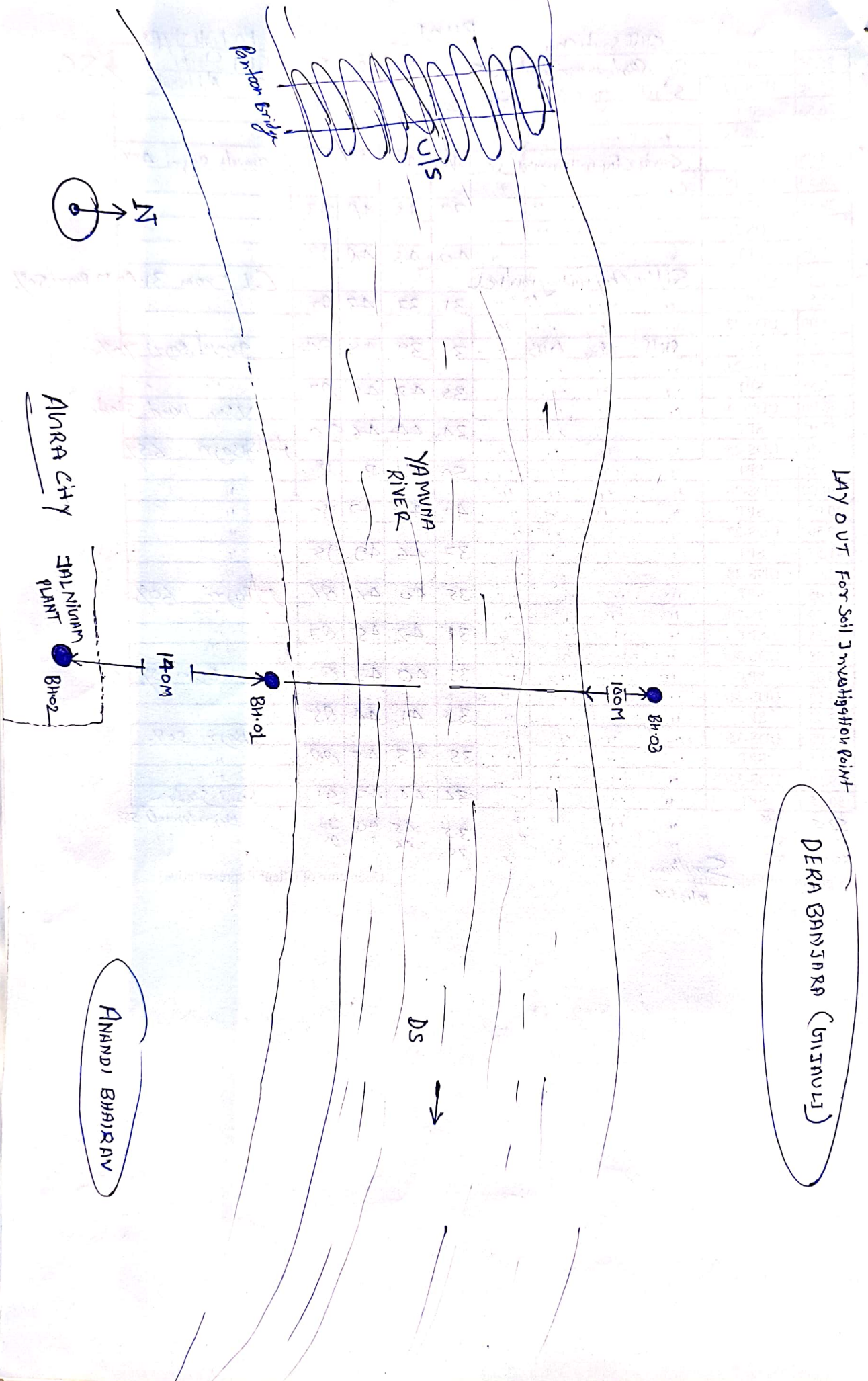
Bore Hole No. Total depth of Bore Hole (m)	2 60.00	Coordinate		Easting		Depth of Water Level (m bgl)				12.70										Particle Size Analysis								
		Type of Sample	SPT Value	N	N'	SPT Value corrected due to overburden	N''	% Material Passing IS Sieve			Atterberg Limits		IS group symbol	Wet Bulk Density (gms/cc)	Original Moisture (%)	Dry Bulk Density (gms/cc)	Specific Gravity (G)	Void Ratio (e)	Shear Characteristics		Compression Index (Cc)	Type of Test	Gravel %	Sand %	Silt %	Clay %		
								4.750	2.000	0.425	0.075	LL							PL	PI							Cohesion (Kg/cm ²)	Angle of Internal Friction (Ø)
39.15 - 39.60	107.375 - 106.925	UD	-	-	-	-	96	92	87	81	-	38	21	17	CI	2.13	19.00	1.79	0.503	0.70	9°	0.065	UU	4	15	58	23	
39.60 - 40.05	106.925 - 106.475	SPT 100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40.65 - 41.10	105.875 - 105.425	UD	-	-	-	-	97	94	86	80	-	37	23	14	CI	2.15	19.30	1.80	-	-	-	-	-	3	17	59	21	
41.10 - 41.55	105.425 - 104.975	SPT 93	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42.15 - 42.60	104.375 - 103.925	UD	-	-	-	-	96	92	84	80	-	38	22	16	CI	2.13	19.50	1.78	-	-	-	-	-	4	16	58	22	
42.60 - 43.05	103.925 - 103.475	SPT 97	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43.65 - 44.10	102.875 - 102.425	UD	-	-	-	-	99	94	87	84	-	37	23	14	CI	2.15	20.24	1.79	0.508	0.7	10°	0.060	UU	1	15	61	23	
44.10 - 44.55	102.425 - 101.975	SPT 98	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45.15 - 45.60	101.375 - 100.925	UD	-	-	-	-	97	92	86	83	-	37	23	14	CI	2.15	19.85	1.79	-	-	-	-	-	3	14	59	24	
45.60 - 46.05	100.925 - 100.475	SPT 95	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46.65 - 47.10	99.875 - 99.425	UD	-	-	-	-	96	94	87	81	-	36	22	14	CI	2.14	18.75	1.80	-	-	-	-	-	4	15	58	23	
47.10 - 47.55	99.425 - 98.975	SPT 100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48.15 - 48.60	98.375 - 97.925	UD	-	-	-	-	97	93	85	82	-	37	22	15	CI	2.10	18.20	1.78	0.522	0.72	10°	0.060	UU	3	15	57	25	
48.60 - 49.05	97.925 - 97.475	SPT 92	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49.65 - 50.10	96.875 - 96.425	UD	-	-	-	-	96	92	84	78	-	36	21	15	CI	2.10	17.80	1.78	-	-	-	-	-	4	18	54	24	
50.10 - 50.55	96.425 - 95.975	SPT 95	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51.15 - 51.60	95.375 - 94.925	UD	-	-	-	-	98	94	89	81	-	37	23	14	CI	2.10	17.30	1.79	-	-	-	-	-	2	17	60	21	
51.60 - 52.05	94.925 - 94.475	SPT 97	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52.65 - 53.10	93.875 - 93.425	UD	-	-	-	-	97	93	87	80	-	36	21	15	CI	2.11	17.20	1.80	-	-	-	-	-	3	17	57	23	
53.10 - 53.55	93.425 - 92.975	SPT 100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54.15 - 54.60	92.375 - 91.925	UD	-	-	-	-	96	94	86	79	-	37	23	14	CI	2.10	16.85	1.80	-	-	-	-	-	4	17	56	23	
54.60 - 55.05	91.925 - 91.475	SPT 100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55.65 - 56.10	90.875 - 90.425	UD	-	-	-	-	96	92	84	78	-	36	21	15	CI	2.12	18.30	1.79	-	-	-	-	-	4	18	54	24	
56.10 - 56.55	90.425 - 89.975	SPT 93	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57.15 - 57.60	89.375 - 88.925	UD	-	-	-	-	97	94	89	81	-	37	23	14	CI	2.12	18.00	1.80	-	-	-	-	-	3	16	57	24	
57.60 - 58.05	88.925 - 88.475	SPT 99	99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bore Hole No. Total depth of Bore Hole (m)	3		60.00		Easting		Depth of Water Level (m bgl)		6.80										Particle Size Analysis																					
	Reduced Level (Assumed)		Coordinate		Northing		Completed on		IS Sieve		Atterberg Limits		IS group symbol		Wet Bulk Density		Original Moisture		Dry Bulk Density		Specific Gravity		Void Ratio		Shear Characteristics		Compression Index		Type of Test		Gravel		Sand		Silt		Clay			
	metre	metre	N	N'	SPT Value	SPT Value corrected	N"	SPT Value corrected due to dilatancy	4.750	2.000	0.425	0.075	%	LL	PL	PI	(gms/cc)	(gms/cc)	%	(gms/cc)	(gms/cc)	(G)	(e)	(Kg/cm ²)	(Ø)	(Cc)	CD/UU	%	%	%	%	%	%	%						
1			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28												
0.00	154.812	154.212	DS	-	-	10.83	100	100	98	53	-	NON-PLASTIC	ML	1.81	19.22	1.52	-	-	-	-	-	-	-	-	-	0	47	49	4											
1.50	153.312	152.712	UD	-	-	11.23	100	99	98	55	-	NON-PLASTIC	ML	1.82	19.11	1.53	-	-	-	-	-	-	-	-	-	0	45	52	3											
2.10	152.712	152.262	SPT	9	11.23	11.23	100	99	98	55	-	NON-PLASTIC	ML	1.82	19.11	1.53	-	-	-	-	-	-	-	-	-	0	45	52	3											
3.15	151.662	151.212	UD	-	-	13.10	100	100	98	52	0.695	NON-PLASTIC	ML	1.84	18.85	1.55	2.55	0.645	0.00	28°	-	-	-	CD	0	48	49	3												
3.60	151.212	150.762	SPT	12	13.10	13.10	100	99	97	54	-	NON-PLASTIC	ML	1.85	18.71	1.56	-	-	-	-	-	-	-	-	0	46	50	4												
4.65	149.712	149.262	UD	-	-	12.81	100	97	93	3	-	NON-PLASTIC	SP	1.87	18.36	1.58	-	-	-	-	-	-	-	-	0	97	3	0												
5.10	148.662	148.212	UD	-	-	17.40	100	97	93	3	-	NON-PLASTIC	SP	1.87	18.36	1.58	-	-	-	-	-	-	-	-	0	97	3	0												
6.15	147.162	146.712	SPT	17	19.80	17.40	98	95	92	4	-	NON-PLASTIC	SP	1.89	18.25	1.60	-	-	-	-	-	-	-	-	2	94	4	0												
6.60	146.712	146.262	SPT	25	27.41	21.21	98	94	90	3	-	NON-PLASTIC	SP	1.90	18.05	1.61	-	-	-	-	-	-	-	-	2	95	3	0												
7.65	145.662	145.212	UD	-	-	22.58	97	93	90	4	0.865	NON-PLASTIC	SP	1.91	17.89	1.62	2.60	0.605	0.00	33°	-	-	-	CD	3	93	4	0												
8.10	144.162	143.712	UD	-	-	24.34	97	93	90	4	-	NON-PLASTIC	SP	1.91	17.89	1.62	2.60	0.605	0.00	33°	-	-	-	CD	3	93	4	0												
8.55	143.712	143.262	SPT	34	33.68	24.34	97	94	91	3	-	NON-PLASTIC	SP	1.93	17.78	1.64	-	-	-	-	-	-	-	-	3	94	3	0												
9.15	142.662	142.212	UD	-	-	26.44	97	94	91	3	-	NON-PLASTIC	SP	1.93	17.78	1.64	-	-	-	-	-	-	-	-	3	94	3	0												
9.60	142.212	141.762	SPT	40	37.87	26.44	97	93	90	2	-	NON-PLASTIC	SP	1.94	17.65	1.65	-	-	-	-	-	-	-	-	3	95	2	0												
10.65	141.162	140.712	UD	-	-	28.38	99	97	95	30	-	NON-PLASTIC	SM	1.89	18.26	1.60	-	-	-	-	-	-	-	-	1	69	28	2												
11.10	139.662	139.212	UD	-	-	26.30	99	97	95	30	-	NON-PLASTIC	SM	1.89	18.26	1.60	-	-	-	-	-	-	-	-	1	69	28	2												
11.55	139.212	138.762	SPT	43	37.60	26.30	98	96	93	32	-	NON-PLASTIC	SM	1.92	18.21	1.62	-	-	-	-	-	-	-	-	2	66	29	3												
12.15	138.162	137.712	UD	-	-	26.91	98	96	93	32	-	NON-PLASTIC	SM	1.92	18.21	1.62	-	-	-	-	-	-	-	-	2	66	29	3												
12.60	137.712	137.262	SPT	46	38.81	26.91	99	97	94	35	-	NON-PLASTIC	SM	1.93	18.15	1.63	-	-	-	-	-	-	-	-	1	64	33	2												
13.65	136.662	136.212	UD	-	-	26.66	99	97	94	35	-	NON-PLASTIC	SM	1.93	18.15	1.63	-	-	-	-	-	-	-	-	1	64	33	2												
14.10	136.212	135.762	SPT	47	38.31	26.66	99	97	94	35	-	NON-PLASTIC	SM	1.93	18.15	1.63	-	-	-	-	-	-	-	-	1	64	33	2												

Bore Hole No.	3	Coordinate	Easting	Depth of Water Level (m bgl)			RESULT SHEET										Particle Size Analysis												
				Total depth of Bore Hole (m)			Completed on			Wet Bulk Density (gms/cc)	Original Moisture (%)	Dry Bulk Density (gms/cc)	Specific Gravity (G)	Void Ratio (e)	Shear Characteristics		Compression Index (Cc)	Type of Test	Gravel (%)	Sand (%)	Silt (%)	Clay (%)							
Depth of Bore Hole	metre	Type of Sample	SPT Value	SPT Value corrected due to overburden	N'	N''	% Material Passing IS Sieve								Silt Factor	Atterberg Limits							IS group symbol	Cohesion (Kg/cm ²)	Angle of Internal Friction (Ø)				
							4.750	2.000	0.425	0.075	LL	PL	PI																
metre	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		
58.65 - 59.10	96.162 - 95.712	UD	-	-	-	95	89	86	83	-	38	21	17	CI	2.18	17.16	1.86	-	-	-	-	-	-	-	5	12	61	22	
59.10 - 59.55	95.712 - 95.262	SPT	96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59.55 - 60.00	95.262 - 94.812	DS	-	-	-	96	90	87	84	-	37	22	15	CI	2.16	17.55	1.84	-	-	-	-	-	-	4	12	61	23	-	-

Site - Soil testing for bridge over River Yamuna
 Dist - DPM USBG Ltd BCU Ayra.

LAY OUT For Soil Investigation Point



Date - 18/12-24