GEOTECHNICAL INVESTIGATION REPORT
FOR
CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR AND DEHRI-ON-SONE RAILWAYS STATIONS ON MUGHALSARAI - SONENAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

MAJOR BRIDGE ACROSS RIVER SONE

STATE OF BIHAR

SUBMITTED TO:

डेडीकेटेड फ्रेट कोरीडोर

Dedicated Freight Corridor Corporation of India Ltd.

(A GOVERNMENT OF INDIA UNDERTAKING)

SHYAMA KUNJ, PLAT NO. 121/1, DAFI,
ON VARANASI – MUGHALSARAI BYPASS
VARANASI

JANUARY 2013

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Following details are attached.....

- Sub-surface profile
- Consolidated Logs including laboratory test results
- Standard penetration Test Curves
- Liquefaction assessment sheets
- Grain size analysis curves
- Silt factor calculations
- Sample Pile Capacity calculations / SBC for well foundation

GEOTECHNICAL INVESTIGATION REPORT FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR AND DEHRI-ON-SONE RAILWAYS STATIONS ON MUGHALSARAI - SONENAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

MAJOR BRIDGE ACROSS RIVER SONE

STATE OF BIHAR

1.0 INTRODUCTION

The client, **Dedicated freight corridor corporation ltd. (DFCCIL),** has undertaken the "***Construction of Important DFCC Bridge across River Sone (having approximate length of 3.06 Kms with tentative span arrangement 93 x 30.48m) on North Side of New IR Sone bridge for Double Track of DFCC Railway Line between Sone Nagar (Railway Km 549.03) and Dehri-On-Sone (Rly. Km 554.806) Railway Stations on Mughalsarai – Sonenagar Section of Eastern Dedicated Freight Corridor***".

The objective of this Detailed Geo-technical Investigation is to interpret the engineering properties of the sub-surface stratum for the purpose of design of the sub-structures. M/s DFCCIL, have entrusted the work of Geotechnical Investigation to ***M/s INDIAN GEOTECHNICAL SERVICES, Delhi*****.** M/s Indian Geo-technical Services carried out the investigations, field tests, sampling and laboratory testing under the instructions of Contractor and Consultant.

Fieldwork including Drilling of bore holes and sample collection was carried out, during October – December 2012. Laboratory tests were conducted on selected soil samples to determine the design parameters, confirming to relevant IS specifications and the guidelines received from time to time from Consultant and Client.

This report includes the details of Methodology of Investigation, collection of samples, field test results, and laboratory test results including their interpretation / analysis, recommendations for the properties essential to the design of foundations and recommendations about foundations**.**

1.1 Scope of This Report

This report contains the following information;

- Introduction
- Planning of geotechnical Investigation programme including scope of work
- Geological Information of the Region
- Methodology of Investigation
- Subsurface Conditions / Geotechnical Assessment
- Foundation support

2.0 PLANNING OF GEOTECHNICAL INVESTIGATION PROGRAMME

On the basis of nature of the project, it was decided to carry out soil exploration in order to:

(i) obtain soil samples, both representative and undisturbed (wherever necessary and possible) for classification tests and other laboratory tests for determining engineering properties;

(ii) obtain soundings of penetration resistance by Standard Penetration test in the boreholes;

(iii) chemical analysis of soil / water sample to check durability of concrete.

2.1 Scope of Work

To investigate the subsurface conditions, 11 boreholes at approximate distance of 300m were carried out to cover the total length of proposed bridge (*having approximate length of 3.06 Kms*). Boreholes were carried out approx 28.5m North side of New IR Sone Bridge. Field in-situ tests, like Standard Penetration Test were conducted in the boreholes, Disturbed / undisturbed soil samples were collected.

2.1.1 The summary of the fieldwork is given below:

Borehole Details

Structure / Location	Borehole No	Location	Borehole top / Bed level (m)	Depth of Borehole (m)
Major DFCC bridge over River Sone	BH-01	Abutment Howrah Side (A-1)	100.080	50.00
	BH-02	In front of Pier-9	98.375	50.00
	BH-03	In front of P-18	97.940	50.00
	BH-04	In front of P-27	98.706	50.00
	BH-05	In front of P-36	99.570	50.00
	BH-06	In front of P-46	100.115	50.00
	BH-07	In front of P-55	98.960	50.00
	BH-08	In front of P-65	99.120	50.00
	BH-09	In front of P-77	99.020	50.00
	BH-10	In front of P-84	98.000	50.00
	BH-11	Abutment Dehri-On-Sone Side (A-2)	102.380	50.00

Depth of boreholes / locations of boreholes were given by M/s DFCCIL based on Span Arrangements and requirement.

2.1.2 Conducting Standard Penetration Tests during boring operation.

2.1.3 Collecting disturbed samples / undisturbed soil samples and water sample from the borehole.

2.1.4 Summary of Laboratory Testing program is given below; Laboratory testing was planned on selected disturbed / un-disturbed soil samples / water sample.

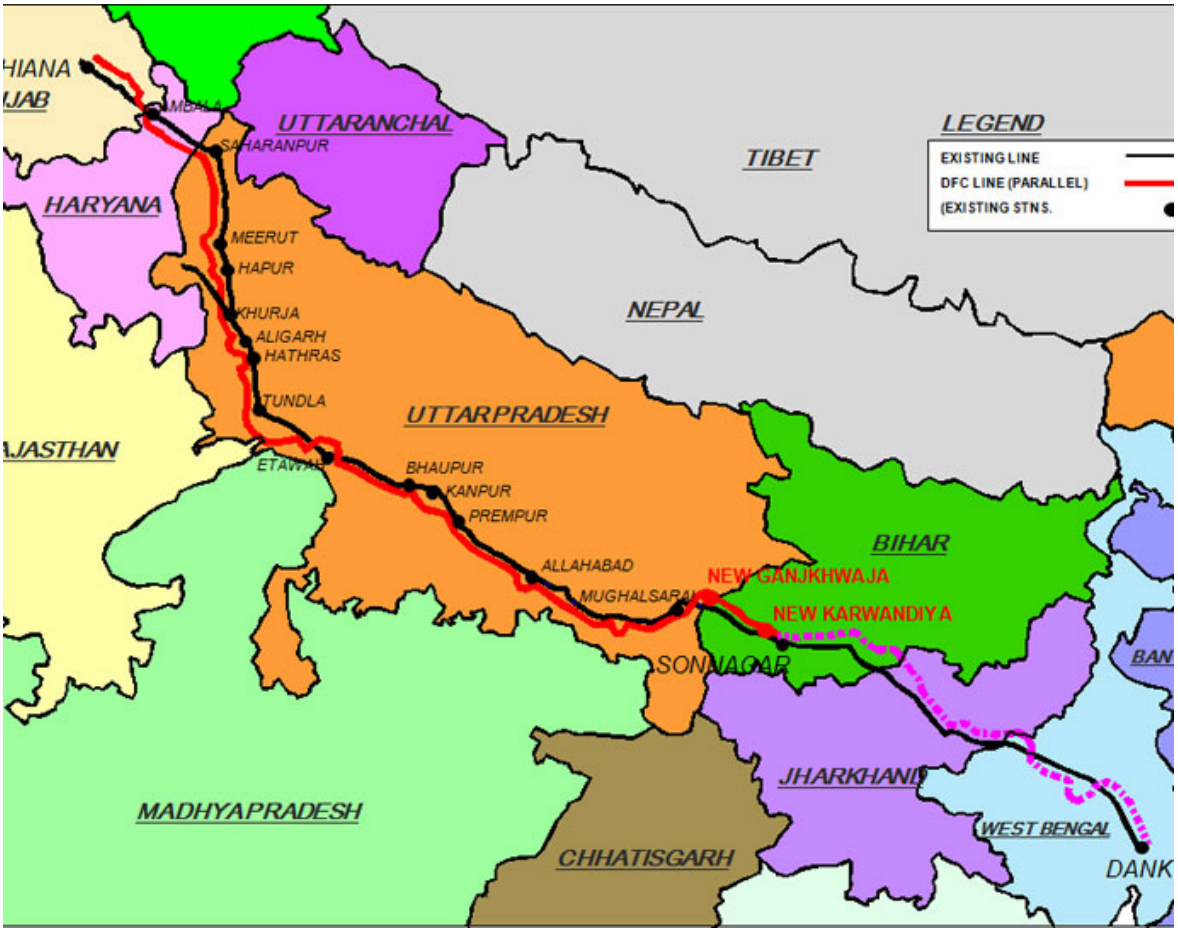
Sl. No.	Particulars of Properties	Ref: IS Code	Disturbed Soil Sample	Undisturbed Soil Samples	Water Sample
1.	Sieve Analysis / Hydrometer	IS: 2720 (Part IV)	√	√	
2.	Natural Moisture Content / Bulk / Dry Density	IS: 2720 (Part II)		√	
3.	Specific Gravity	IS: 2720 (Part III)	√	√	
4.	Liquid Limit/Plastic Limit/ Plasticity Index	IS: 2720 (Part V)	√	√	
5.	Shrinkage Limit	IS: 2720 (Part VI)	√		
6.	Direct Shear Test (for non-cohesive soils)	IS: 2720 (Part XIII)	√	√	
7.	Unconfined Compressive Strength Test	IS: 2720 (Part X)		√	
8.	Unconsolidated Un-drained Tri-axial Test	IS: 2720 (Part XI)		√	
9.	Consolidated Un-drained / Consolidated Drained Tests (for cohesive samples)	IS: 2720 (Part XII)		√	
10.	Free Swell / Swell Pressure (if swelling is critical)	IS: 2720 (Part XL & XLI)	√	√	
11.	Consolidation Tests (Cohesive soils below water table) for soft to very stiff soils	IS: 2720 (Part XV)		√	
12.	Chemical Analysis on Soil Samples	IS: 2720 & IS 3025	√	√	
13.	Chemical Analysis on water samples collected from boreholes	IS: 3025 & IS 5401			√

All field work, field tests, collection of samples and laboratory Tests were carried out as per relevant IS / Indian Railways specifications.

3.0 GEOLOGICAL INFORMATION OF THE REGION

3.1 Location

The site is referred to as *Important DFCC Bridge across River Sone (having approximate length of 3.06 Kms with tentative span arrangement 93 x 30.48m) on North Side of New IR Sone bridge between Sone Nagar (Railway Km 549.03) and Dehri-On-Sone (Rly. Km 554.806) Railway Stations on Mughalsarai – Sonenagar Section of Eastern Dedicated Freight Corridor.*



3.2 Climate

The **climate of Project Site** is warm subtropical climate with cool, dry winters from December to February and dry, hot summers from April to June. The rainy season is from mid-June to mid-September, gets an average rainfall of 900 - 1000 millimeters from the south-west monsoon winds, and occasionally frontal rainfall in January. In winter the maximum temperature is around 25 °C (77 °F) and the minimum is in the 2 to 3 degrees Celsius range. Fog is quite common from late December to late January. Summers are extremely hot with temperatures rising to the 40 to 45 degree Celsius range, the average highs being in the high 30s.

3.3 Topography, Geography and General geology

The project site is part of Indo-Gangetic Plain. It is the world's most extensive tract of uninterrupted alluvium. These deep, river-deposited sediments give rise to fertile soils.

Thus Indo-Gangetic plain's soil is the backbone of agricultural and industrial development in Bihar and Uttar Pradesh. The Indo-Gangetic plain in Bihar and Uttar Pradesh consists of a thick alluvial mantle of drift origin overlying in most part. The siwalik and older tertiary rocks. The soil is mainly young loam rejuvenated every year by constant deposition of silt, clay and sand brought by different streams but mainly by floods in Bihar and Uttar Pradesh.

The most common soil in Bihar and Uttar Pradesh is Gangetic alluvium of Indo-Gangetic plain region, Piedmont Swamp Soil which is found in northwestern part of West Champaran district and Terai Soil which is found in northern part of Bihar along the border of Nepal. Clayey soil; sandy soil and loamy soil are common in Bihar and Uttar Pradesh.

Topographically the plain is homogeneous, with only the floodplain bluffs, changes in river channels and other related features of river erosion forming natural features.

Sediments of the Indo-Gangetic Plain are part of the foredeep of the Himalaya. The Cenozoic succession in these deposits begins with the Eocene – Oligocene ‘Nummulitic’ Dagshal and Kasauli formations and their equivalents.

3.4 Seismicity

The state of Bihar and Uttar Pradesh lies in the Gangetic Plain. This is a fore-deep, a downwarp of the Himalayan foreland, of variable depth, converted into flat plains by long-vigorous sedimentation. This is known as a geosyncline and the Gangetic Plain is the Indo-Gangetic Geosyncline. The floor of the Gangetic trough (if see without all the sediments) is not an even plain, but shows corrugated inequalities and buried ridges (shelf faults). Western Bihar sits on the sub-surface Faizabad ridge while the eastern sections sit on the Munger-Saharsa Ridge. The central sections of Bihar lie atop the Gandak depression and East Uttar Pradesh shelf.

As per IS: 1893 (Part-1) 2002, the site falls in seismic zone – III. Considering the history of past earthquakes and available seismic data, an earthquake of magnitude 7.0 is considered in the present analysis.

Liquefaction

Liquefaction is the sudden loss of shear strength of the loose fine-grained sands due to earthquake-induced vibration under saturated conditions.

Assessment of liquefaction potential of foundation strata is made by simplified approach proposed by Seed & Idriss (1983 – 1985) from the SPT data and peak ground

acceleration likely to occur at the site. In this method, cyclic shear stress likely to be induced in the foundation strata by Design Basis Earthquake (DBE) is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata.

Cyclic Stress Ratio (CSR)

The equivalent average of shear stress τ_{av} likely to be induced in the foundation material due to an earthquake is calculated by using the equation

τ_{av} = $0.65 * \gamma * h * (a_{max} / g) * r_d$

τ_{av} = equivalent average of shear stress likely to be induced by DBE

γ = Unit weight of foundation material

= depth at which cyclic shear stress is calculated

a_{max} = maximum surface acceleration

r_d = Stress reduction factor

= $1.0 – 0.00765 * h$ if h < 9.15 m

= $1.174 – 0.0267 * h$ if h = 9.15 m to 23 m

= $0.744 – 0.008 * h$ if h = 23.0 m to 30.0 m

= 0.50 if h > 30.0 m

If the equivalent average of shear stress τ_{av} is normalized with the initial effective overburden pressure (σ_o), the term is called seismic demand of soil layer or cyclic stress ratio (CSR).

CSR = $0.65 * (\sigma_o / \sigma_o') * (a_{max} / g) * r_d$

Cyclic Resistance Ratio (CRR)

It expresses capacity of soil to resist liquefaction. CRR is determined using correlation between corrected blow count $(N_1)_{60}$ and CRR for earthquake of magnitude 7.5. $(N_1)_{60}$ is the SPT blow count corrected to an effective overburden pressure of 100 kPa and to hammer energy efficiency of 60 %. The corrected blow count $(N_1)_{60}$ is determined as follows.

$(N_1)_{60}$ = $N_m C_N C_E C_B C_R C_S$

Where,

N_m = uncorrected SPT blow clount

C_E = correction factor for hammer energy ratio

C_B = Correction factor for borehole dia = 1.05 for 150 mm dia borehole

C_R = Correction factor for rod length = 0.75 for 3.0 m to 4.0 m

= 0.85 for 4.0 m to 6.0 m

= 0.95 for 6.0 m to 10.0 m

= 1.0 for 10.0 m to 30.0 m

C_S = correction factor for standard sampler = 1.0

Correction factor for effective overburden pressure (C_N) is given by the following relation.

C_N = Sqrt (P_a / σ_o')

Where P_a = Atmospheric pressure

The value of SPT blow count for soil with fines content (FC) can be adjusted to the equivalent clean sand value of $(N_1)_{60CS}$ as follows:

$(N_1)_{60CS}$ $\alpha + \beta (N_1)_{60}$

where α and β can be determined as follows.

$\alpha = 0.0$ and $\beta = 0.0$ for FC <= 5.0 %

$\alpha = \exp [(1.76 - (190/FC^2)]$ for 5.0 % < FC < 35.0 %

$\beta = [0.99 + (FC^{1.5}/1000)]$

$\alpha = 5.0$ and $\beta = 1.20$ for FC >= 35.0 %

$CRR_{M = 7.5}$ is given by the following equation.

$$CRR_{M=7.5} = \frac{1}{34 - (N_1)_{60CS}} + \frac{(N_1)_{60CS}}{135} + \frac{50}{[10*(N_1)_{60CS} + 45]^2} - \frac{1}{200}$$

Hence the CRR for a particular earthquake magnitude is determined as

$$CRR = CRR_{M = 7.5} * MSF * K_\sigma$$

The MSF value is 1.44 for earthquake of magnitude 6.5. K_σ is taken as 1.

The factor of safety against liquefaction, FS_L, is given as

$FS_L = CRR/CSR$

The value of CSR and CRR are computed at different depth and depth susceptible to liquefaction is determined. Liquefaction is probable when FS_L is $\leq$ 1.0.

Andrews and Martin (2000) have re-evaluated the liquefaction field case histories from the database of Seed et al. (1984, 1985), and have transposed the "Modified Chinese Criteria" to U.S. conventions (with clay sizes defined as those less than about 0.002mm). Their findings are largely summarized in table below:

	Liquid Limit[1]<32	Liquid Limit > 32
Clay content[2] <10%	Susceptible	Further studies required
Clay content[2] > 10%	Further studies required	Not susceptible

Note: 1. Liquid Limit determined by Casagrande type percussion apparatus.
2. Clay defined as grains finer than 0. 002mm.

4.0 METHODOLOGY OF INVESTIGATION

The investigation was planned to obtain the subsurface stratification in the proposed project site and collect soil samples for laboratory testing to determine the engineering properties such as shear strength, along with basic engineering classification of the subsurface stratum to arrive at the foundation design parameters.

4.1 Boreholes

The Boreholes in soil were progressed by shell & auger boring method as per IS: 1892 – 1979 and approved methodology. Boring was advanced at selected / specified borehole locations. The following steps were adopted during boring operations;

1) Boring rig with power winch was assembled at site and was shifted and erected at the borehole location.
2) Taking out the top soil up to approximately 500 mm.
3) The auger was joined at the end of hollow drill rod, which is rotated manually.
4) After reaching the drill rods attached with the auger attained its full depth another piece (extension rod) was attached and continued the drilling up to the level of water table.
5) Below the water table shell was used instead of auger, casing pipe was lowered as per requirement.
6) Casing was used as per the prevailing soil conditions, to stabilize the borehole.
7) Required field tests i. e, Standard Penetration Tests and collection of undisturbed / disturbed samples was conducted as per requirements at specified depths / levels, the same has been discussed in detail in this document.
8) This process was continued till the achievement of full depth of bore hole as per requirement.

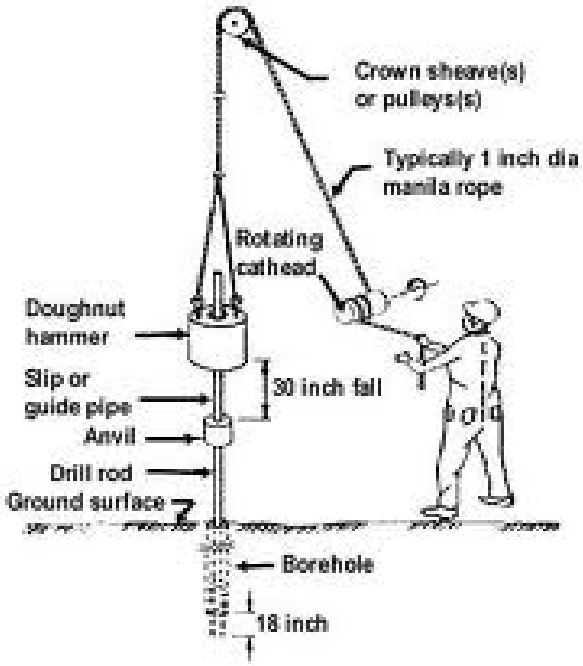
4.2 Standard Penetration Tests (SPT)

Standard Penetration Tests were conducted at 1.5 m interval as per the procedure in IS: 2131 – 1981.

For conducting the test, the bottom of the borehole was properly cleaned and split spoon sampler was properly seated in position in the borehole. The split spoon sampler resting on the bottom of borehole was allowed to sink under its own weight; then the sampler was seated 15 cm with the blows of the hammer of 63.5 Kg weight falling through 75 cm. Thereafter, the split spoon sampler was further driven by 30 cm. The number of blows required to affect each 15 cm of penetration was recorded. The first 15 cm of drive is considered to be seating drive.

The total blows of penetration for the second and third 15 cm of penetration is termed the penetration resistance N. The ‘N’ values are indicative of the compactness / relative density of cohesion less soils and consistency of cohesive soils.

In case the blow count of SPT in soil (including the number of blows for seating) exceeds 100, the corresponding penetration was recorded and this particular test at that depth stopped. If the total penetration is more than the seating penetration of 15 cm, then breakup of blow count for 15 cm seating penetration and for remaining portion of penetration is also be given.



SPT 'N' values are correlated with relative density of non-cohesive stratum as per BS: 5930 (1999) - for sandy Strata and with consistency of cohesive stratum.

CORRELATION FOR CLAY/PLASTIC SILT		CORRELATION FOR SAND/NON-PLASTIC SILT	
Consistency	Penetration Value	Relative Density	Penetration Value
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

4.3 Disturbed Sampling (Soil) in boreholes

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.

Disturbed Soil Sample from SPT

4.4 Undisturbed Sampling (Soil) in Boreholes

Undisturbed sampling was done in accordance with IS: 2132 – 1986. Undisturbed soil samples (UDS) was obtained at every 3.0 m interval as per approved methodology and sampling schedule.

Undisturbed samples were collected using 100mm dia. and 450mm long MS tubes provided with sampler head with ball check arrangement. Collection of undisturbed samples in very hard cohesive soils / dense granular soils / gravels / cobbles / pebbles / boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

Immediately after taking an undisturbed sample in a tube, the adopter head was removed along with the disturbed material. The visible ends of the sample shall each be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of just molten wax. More molten wax will then be added to give a total thickness of not less than 25mm.

4.5 Ground Water Table

The depth at which groundwater is struck during boring was carefully noted and the depth of water table was ascertained subsequently in the completed borehole by one of the following methods:

The water table in the borehole was allowed to stabilize after depressing the water level adequately by bailing. Stability of the borehole sides and bottom was be ensured at all times.

The borehole was filled with water and then bailed out to various depths. Observations were made at each depth to see if the water level is rising or falling. The depth at which neither a fall nor rise is observed, was considered as the water table depth.

4.6 Laboratory testing

Laboratory tests were carried out as directed by client, consultant in accordance with the procedures described in the relevant Indian Standard Codes (IS: 2720) of practiced.

The laboratory testing was done on collected material as per relevant IS codes. The laboratory-testing program consisted of testing the soil index and strength properties, as well as the consolidation characteristics. The index tests were performed to determine the soil moisture content, unit weight, specific gravity, gradation characteristics (gravel, sand and fines content – the silt & clay fractions) and consistency limit. The strength tests were performed to determine the shear parameters (cohesion, friction angle) of soil; the consolidation tests were performed to find out the consolidation properties. The index tests were performed on disturbed split-spoon soil samples or undisturbed samples, except the natural moisture content and dry density tests, which were performed only on the undisturbed soil samples. The strength tests consisted of the direct shear box and the Unconfined Compressive strength tests / tri-axial unconsolidated undrained (UU) tests.

The consolidation characteristics tests were preformed on a one-dimensional consolidometer. The strength and consolidation tests were performed on undisturbed soil samples.

FEW PICTURES SHOWING LABORATORY TESTING IN PROGRESS

SAMPLE EXTRUDER (SOIL) HYDRAULICALLY OPERATED

ELECTRONIC WEIGHING BALANCES

ATTERBERG'S LIMITTEST (SOIL) IN PROGRESS

5.0 SUBSURFACE CONDITIONS / PROPOSED DESIGN PARAMETERS

5.1 Subsurface Conditions

Based on the boring information, the generalized subsurface conditions at the site are as follows.

Stratum 1 **Silty Sand / Clayey Sand / Fine to Medium Sand (SM/SC/SP-SM/SP)**

Stratum 2 **Silty Gravels / Sandy Gravels / Gravelly Sand (GP/GP-GM/SP-GP/GP-SP/SP-SM-GP)**

Stratum 3 **Clayey Silt / Silty Clay of low to high plasticity (CL/CI/CH)**

Structure / Location	Borehole No.	Stratum – I	Stratum - 2	Stratum - 3
		Stratum depth (from (m) – to (m))		
Major DFCC bridge over Sone River	BH-1	3.0 – 11.0, 12.0 – 15.0, 19.0 – 24.0, 34.0 – 36.0, 45.0 – 48.0	11.0 – 12.0, 15.0 – 16.0, 36.0 – 45.0	16.0 – 19.0, 24.0 – 34.0, 48.0 – 50.0
	BH-2	0.0 – 13.0, 16.0 – 19.0, 34.0 – 50.0	--	13.0 – 16.0, 19.0 – 34.0
	BH-3	0.0 – 5.0, 9.0 – 12.0, 16.0 – 19.0, 33.0 – 35.0, 36.0 – 42.0, 45.0 – 50.0	5.0 – 6.0, 32.0 – 33.0, 35.0 – 36.0	6.0 – 9.0, 12.0 – 16.0, 19.0 – 32.0, 42.0 – 45.0
	BH-4	0.0 – 6.0, 9.0 – 14.0, 15.0 – 24.0, 37.0 – 38.0, 39.0 – 41.0, 42.0 – 50.0	6.0 – 9.0, 14.0 – 15.0, 38.0 – 39.0, 41.0 – 42.0	24.0 – 37.0
	BH-5	0.0 – 5.0, 9.0 – 21.0, 41.0 – 50.0	5.0 – 9.0	21.0 – 41.0
	BH-6	0.0 – 22.0, 35.0 – 50.0	--	22.0 – 35.0
	BH-7	1.0 – 5.0, 12.0 – 15.0, 20.0 – 24.0, 40.0 – 50.0	5.0 – 12.0, 34.0 – 40.0	0.0 – 1.0, 15.0 – 20.0, 24.0 – 34.0
	BH-8	0.0 – 11.0, 12.0 – 16.0, 21.0 – 22.0, 35.0 – 41.0, 42.0 – 44.0, 45.0 – 50.0	11.0 – 12.0, 41.0 – 42.0, 44.0 – 45.0	16.0 – 21.0, 22.0 – 35.0
	BH-9	0.0 – 9.0, 21.0 – 27.0, 34.0 – 45.0, 47.0 – 50.0	9.0 – 21.0	27.0 – 34.0, 45.0 – 47.0
	BH-10	0.0 – 8.0, 9.0 - 11.0, 12.0 – 31.0, 36.0 – 38.0, 45.0 – 50.0	8.0 – 9.0, 11.0 – 12.0, 38.0 – 45.0	31.0 – 36.0
	BH-11	1.5 – 3.0, 6.0 – 14.0, 15.0 – 30.0, 31.0 – 34.0, 39.0 – 50.0	14.0 – 15.0	3.0 – 6.0, 30.0 – 31.0, 34.0 – 39.0

5.2 Standard Penetration Test Resistance (Field SPT 'N' Values)

Borehole Depth(m)	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6	BH-7	BH-8	BH-9	BH-10	BH-11
1.50	8	12	7	6	9	10	10	5	13	16	15
3.00	7	13	10	11	12	14	8	12	20	19	11
4.50	11	9	13	14	16	17	14	13	23	22	9
6.00	23	51	31	31	36	39	20	30	26	25	17
7.50	27	45	23	37	41	44	25	33	33	28	21
9.00	41	38	36	40	27	43	30	38	34	38	24
10.50	36	41	41	39	37	39	36	41	38	44	26
12.00	40	39	58	43	43	36	40	45	44	49	33
13.50	42	65	63	47	47	44	49	47	49	35	48
15.00	61	61	62	28	45	44	23	31	53	44	58
16.50	68	81	68	32	37	38	28	35	46	48	51
18.00	77	88	75	35	41	42	36	44	49	56	43
19.50	200	86	82	37	44	45	37	48	54	61	49
21.00	78	93	86	41	51	66	42	38	57	63	54
22.50	82	87	89	48	52	42	47	42	56	71	60
24.00	74	83	64	59	55	46	50	47	62	75	67
25.50	200	99	66	65	59	51	49	48	65	81	75
27.00	41	65	60	62	51	46	54	50	35	82	84
28.50	60	67	67	63	54	52	58	55	40	79	92
30.00	61	73	56	54	44	55	56	46	41	87	51
31.50	62	68	61	57	42	49	61	52	45	40	58
33.00	69	77	>100	55	45	55	57	56	46	44	67
34.50	51	>100	>100	58	85	47	66	60	58	49	35
36.00	>100	>100	>100	57	61	69	73	58	59	76	40
37.50	>100	>100	>100	77	75	73	75	54	61	79	46
39.00	>100	>100	>100	>100	86	72	77	68	67	80	60
40.50	>100	>100	>100	>100	66	76	80	74	74	>100	>100
42.00	>100	>100	58	>100	>100	>100	>100	>100	>100	>100	>100
43.50	>100	>100	62	>100	>100	>100	>100	>100	>100	>100	>100
45.00	>100	>100	>100	>100	>100	>100	>100	>100	48	>100	>100
46.50	>100	>100	>100	>100	>100	>100	>100	>100	54	>100	>100
48.00	51	>100	78	>100	>100	>100	>100	>100	65	>100	>100
50.00	58	>100	82	>100	>100	>100	>100	>100	78	>100	>100

> 100 (Refusal)

5.3 Penetration Resistance and Proposed Design Parameters (Soil)

In design calculations, the following soil parameters are proposed:

DEPTH (m)	SOIL TYPE	DESIGN 'N' VALUE	DESIGN PARAMETERS		
			Υ_{sat} (T/m^3)	Cu, T/m^2	$\phi°$
BH – 01					
0.00 – 3.00	Fill	--	1.80	--	--
3.00 – 6.00	SP-SM	10	1.90	0	30
6.00 – 11.00	SP/SP-SM	22	2.00	0	32
11.00 – 16.00	GP/SP-SM/GP-GM-SP	26	2.00	0	33
16.00 – 19.00	CI	50	2.00	2.5	30
19.00 – 24.00	SM	35	2.00	0	33
24.00 – 34.00	CH	50	2.00	22.5	0
34.00 – 36.00	SM	21	2.00	0	32
36.00 – 46.00	SP-SM-GP/GP/GP-SP/SP-SM	50	2.00	0	33
46.00 – 48.00	SC	50	2.00	1.5	31
48.00 – 50.00	CI	50	2.00	22.5	0
BH – 02					
0.00 – 6.00	SP/SP-SM	13	2.00	0	31
6.00 – 9.00	SC	30	2.00	1.7	31
9.00 – 13.00	SP	26	2.00	0	33
13.00 – 16.00	CI	50	2.00	2.6	30
16.00 – 19.00	SM/SP-SM	40	2.00	0	33
19.00 – 34.00	CH	50	2.00	22.5	0
34.00 – 50.00	SP/SP-SM/SM	50	2.00	0	33
BH – 03					
0.00 – 2.00	SP	8	1.90	--	--
2.00 – 5.00	SP	13	2.00	0	31
5.00 – 6.00	SP-GP	--	2.00	0	32
6.00 – 9.00	CI	25	2.00	12.6	0
9.00 – 12.00	SP	26	2.00	0	33
12.00 – 16.00	CI	50	2.00	1.5	30
16.00 – 19.00	SP	35	2.00	0	34
19.00 – 32.00	CH/CI	50	2.00	22.0	0
32.00 – 42.00	GP-GM/SP	50	2.00	0	33
42.00 – 45.00	CH	50	2.00	22.0	0
45.00 – 48.00	SP-SM/SP	50	2.00	0	33
48.00 – 50.00	CI	50	2.00	22.5	0
BH – 04					
0.00 – 1.00	SM	--	1.80	--	--
1.00 – 3.00	SP-SM	7	1.90	0	30
3.00 – 6.00	SP-SM	13	2.00	0	31

DEPTH (m)	SOIL TYPE	DESIGN 'N' VALUE	DESIGN PARAMETERS		
			Υ_{sat} (T/m^3)	Cu, T/m^2	$\phi°$
6.00 – 15.00	GP-SP/SP	26	2.00	0	33
15.00 – 21.00	SC	20	2.00	1.3	31
21.00 – 24.00	SM	22	2.00	0	32
24.00 – 37.00	CH	50	2.00	22.5	0
37.00 – 50.00	SP/GP-SP/SP-GP	50	2.00	0	33
BH – 05					
0.00 – 3.00	SP	10	1.90	0	30
3.00 – 5.00	SP	15	2.00	0	31
5.00 – 9.00	SP-GP	27	2.00	0	33
9.00 – 12.00	SP	24	2.00	0	32
12.00 – 16.00	SP/SM	28	2.00	0	33
16.00 – 18.00	SC	22	2.00	1.4	31
18.00 – 21.00	SM	23	2.00	0	32
21.00 – 41.00	CH	50	2.00	22.5	0
41.00 – 50.00	SP/SP-SM	50	2.00	0	33
BH – 06					
0.00 – 3.00	SP-SM	12	1.90	0	30
3.00 – 6.00	SP-SM	16	2.00	0	31
6.00 – 16.00	SP	26	2.00	0	33
16.00 – 21.00	SC	24	2.00	1.0	31
21.00 – 22.00	SP	30	2.00	0	33
22.00 – 25.00	CH	44	2.00	20.0	0
25.00 – 35.00	CH	50	2.00	21.5	0
35.00 – 42.00	SP/SP-SM	27	2.00	0	33
42.00 – 50.00	SP	50	2.00	0	33
BH – 07					
0.00 – 1.00	CI	--	1.80	--	--
1.00 – 5.00	SP	12	1.90	0	30
5.00 – 12.00	GP/SP-GP/GP-SP	22	2.00	0	32
12.00 – 15.00	SP	28	2.00	0	33
15.00 – 20.00	CI	30	2.00	15.0	0
20.00 – 24.00	SP	24	2.00	0	33
24.00 – 28.00	CI	50	2.00	22.0	0
28.00 – 34.00	CH	50	2.00	22.5	0
34.00 – 40.00	SP-SM-GP/GP-SP	28	2.00	0	33
40.00 – 50.00	SP/SP-SM	50	2.00	0	33
BH – 08					
0.00 – 3.00	SP	6	1.90	0	28
3.00 – 6.00	SP	14	2.00	0	31
6.00 – 9.00	SP	25	2.00	0	32

DEPTH (m)	SOIL TYPE	DESIGN 'N' VALUE	DESIGN PARAMETERS		
			Υ_{sat} (T/m^3)	Cu, T/m^2	$\phi°$
9.00 – 16.00	GP-SP/SP	27	2.00	0	33
16.00 – 21.00	CI	40	2.00	1.8	30
21.00 – 22.00	SP	22	2.00	0	32
22.00 – 27.00	CI	45	2.00	20.5	0
27.00 – 35.00	CH	50	2.00	22.5	0
35.00 – 41.00	SP	25	2.00	0	33
41.00 – 50.00	GP/SP/GP-SP	50	2.00	0	33
BH – 09					
0.00 – 3.00	SP/SP-SM	15	2.00	0	31
3.00 – 9.00	SP/SM	22	2.00	0	32
9.00 – 27.00	GP-SP/GP-GM/SP-GP/SP-SM/SP	28	2.00	0	33
27.00 – 31.00	CH	38	2.00	18.5	0
31.00 – 34.00	CI	45	2.00	21.0	0
34.00 – 45.00	SP-SM/SM	26	2.00	0	33
45.00 – 47.00	CH	50	2.00	22.5	0
47.00 – 50.00	SM	25	2.00	0	33
BH – 10					
0.00 – 3.00	SP	16	2.00	0	31
3.00 – 8.00	SP-SM/SP	20	2.00	0	32
8.00 – 18.00	GP/SP-SM/GP-SP/SP-SM	27	2.00	0	33
18.00 – 31.00	SP-SM	33	2.00	0	33
31.00 – 36.00	CH	44	2.00	21.5	0
36.00 – 40.00	SP-SM/GP/GP-GM	29	2.00	0	33
40.00 – 50.00	SP-SM-GP/SM/SP-SM	50	2.00	0	33
BH – 11					
0.00 – 1.50	Fill	--	1.80	--	--
1.50 – 3.00	SM	18	1.90	0	30
3.00 – 6.00	CL	10	1.90	5.5	6
6.00 – 11.00	SP-SM/SP	17	2.00	0	31
11.00 – 14.00	SP	23	2.00	0	32
14.00 – 24.00	GP/SP/SP-SM	26	2.00	0	33
24.00 – 30.00	SP/SP-SM	32	2.00	0	34
30.00 – 31.00	CI	50	2.00	18.0	0
31.00 – 34.00	SP-SM	25	2.00	0	33
34.00 – 36.00	CI	35	2.00	15.5	0
36.00 – 39.00	CH	43	2.00	20.0	0
39.00 – 40.00	SP-SM	23	2.00	0	32
40.00 – 50.00	SP-SM/SP	50	2.00	0	33

Groundwater table was encountered between 0.80m to 6.80m depth below the existing ground level / Borehole top. The groundwater table is expected to fluctuate depending upon the climatic factor, drainage conditions and other factors. Water table is considered at bed level for all design purposes.

5.3 Assessment of Liquefaction

Considerations for checking Liquefaction:

Probability of liquefaction has been checked at every borehole location.

Water table Depth	=	at ground Level
Seismic Zone	=	III
Zone Factor	=	0.16
Maximum earthquake magnitude	=	7.0

Subsurface strata below ground level susceptible to liquefaction in earthquake event are tabulated (Filled-up soils are considered as liquefiable);

Location	Down to Depth Below Ground level (m)	Remarks
BH - 1	0.00 – 4.00	Scour Level (86.837m/77.274m) is much lower than the lowest level of probable liquefaction (93.375m); hence scour level will govern the design in normal as well as in seismic condition also.
BH - 2	0.00 – 5.00	
BH - 3	0.00 – 4.00	
BH - 4	0.00 – 3.00	
BH - 5	0.00 – 3.00	
BH - 6	0.00 – 3.00	
BH - 7	0.00 – 4.00	
BH - 8	0.00 – 3.00	
BH - 9	Non Liquefiable	
BH - 10	Non Liquefiable	
BH - 11	Non Liquefiable	

The top soils are loose and prone to liquefy down to 3m to 5m depth in an earth quake event. The sites may be considered "**Non-Susceptible"** in earth quake event beyond 5m depth from borehole top. Details calculations also have been attached in Annexure-I.

5.4 Silt factor and Scour depths

We presume that the scour is likely to occur for bridges over river. Silt factors have been determined and calculations are attached in Annexure –I.

The bed level, high flood level (HFL), scour level and corresponding scour depths have been provided by M/s DFCCIL, as below;

Structure.	HFL (Highest Flood level)	Design Scour level (m)	
		Abutment	Pier
Sone River Bridge	103.474	86.837	77.274

5.5 Chemical Analysis Test Results

Sub-soil samples / groundwater collected from boreholes were analyzed chemically in the laboratory. Following results are reported.

BOREHOLE NO.	SOIL SAMPLE			WATER SAMPLE			Class
	pH	Chloride	Sulphate	pH	Chloride	Sulphate	
		%	%		mg/l	mg/l	
BH - 1	6.8	0.01	0.08	6.9	51.25	280.95	1
BH - 2	6.9	0.01	0.09	7.0	50.25	278.54	1
BH - 3	6.8	0.02	0.09	7.1	49.98	276.38	1
BH - 4	6.7	0.01	0.08	6.9	50.95	290.25	1
BH - 5	6.9	0.02	0.08	7.0	51.58	280.38	1
BH - 6	6.8	0.01	0.09	6.9	52.48	283.25	1
BH - 7	6.8	0.02	0.09	7.1	51.95	276.85	1
BH - 8	6.9	0.02	0.09	7.0	52.55	288.25	1
BH - 9	6.8	0.01	0.08	6.8	49.98	272.95	1
BH - 10	6.8	0.01	0.09	6.9	52.48	284.08	1
BH - 11	6.7	0.01	0.08	6.8	50.85	275.55	1

Results of chemical analysis indicate that the sub-soils / groundwater fall in class 1 that means soil / water is not aggressive to concrete and not corrosive to reinforcement steel. Ordinary Portland cement with specified minimum cement content and maximum w/c ratio with clear cover to reinforcement for the concrete can be used as per IS: 456-2000. Concrete expert may be referred for advice.

6.0 FOUNDATION SUPPORT

Considering the nature of sub-surface strata, type of proposed structures, expected scour and loads on foundations, M/s DFCC proposed to use deep foundation (Piles / Well) system to support the heavy loads on foundations of Major DFCC Bridge across river Sone.

6.1 Pile Foundation

Based on soil design parameters and calculations attached in Annexure - I, recommendations are presented below for 1200 mm and 1500 mm diameter bored piles. The cut-off level has been considered as 1.8 m and 2.3 m depth below the existing ground level / bed level respectively.

Design Consideration:

Sl. No.	Parameter	Value
1.	K (Coefficient of earth pressure)	1.00
2.	Overburden pressure to calculate the shaft resistance and end bearing resistance of pile	Maximum overburden pressure at bottom of pile for calculation of shaft resistance and bearing resistance is limited to overburden pressure at depth equal to 15 times diameter of pile considered from existing ground level.
3.	Depth of water table	Ground water is considered at bed level.
4.	Maximum deflection at Pile cut-off level or at bottom of free length for calculating the lateral load capacity of pile in Normal Condition	5 mm as per the allowable limit
5.	Vertical Capacity in Seismic Condition	While calculating the pile load capacity in seismic condition, over burden pressure / friction due to liquefiable strata have been ignored
6.	Other parameters	As per IS:2911 (part1/Sec2) or as per Latest version of IRC: 78
7.	Buckling of Piles	Due to high scour depths resulting large free length, Slenderness ratio is checked as per IRC-21, IS: 456 considering the piles as long slender columns.

Recommendations: Since there is no appreciable variation in sub-surface stratum, hence for the purpose of pile capacity analysis, boreholes have been grouped and accordingly Pile capacities are tabulated below.

Cohesive soils (Clayey Silt / Silty Clay of low to high plasticity) of different thicknesses is observed down to 34m to 41m from existing bed level in most of the pier boreholes, it is recommended not to terminate the pile in cohesive stratum. It shall be ensured that pile is embedded minimum 2 times diameter in good bearing strata (generally Dense Granular material). Hence minimum pile length for piers shall be 42m below cutoff level which is about 1.8m / 2.3m below existing bed level.

At actual execution of piles, borehole shall be done at every pier location and sub-surface stratum shall be confirmed. It shall be ensured that pile is not terminated in cohesive stratum if such stratum is observed the pile length shall be modified accordingly and shall be ensured that pile is embedded minimum 2 times diameter in good bearing strata (generally Dense Granular material).

Structure	DIAMETER OF PILE (mm)	SUB-STRUCTURE	LENGTH OF PILE BELOW CUT-OFF LEVEL (m)	RECOMMENDED SAFE VERTICAL LOAD CAPACITY (Tonnes)	RECOMMENDED SAFE UPLIFT LOAD CAPACITY (Tonnes)	RECOMMENDED SAFE HORIZONTAL LOAD CAPACITY (Tonnes)	RECOMMENDED DEPTH OF FIXITY BELOW CUT-OFF LEVEL (m)
				Normal Condition	Normal Condition	Normal Condition	Normal Condition
Major DFCC Bridge across river Sone	1200	Abutment -1 (Howrah Side)	38.0	370	160	7.5	20.9
			40.0	380	180		
			42.0	390	210		
		Pier	42.0	455	170	9.0	26.1
			44.0	475	190		
			46.0	500	205		
		Abutment -2 (Dehri-On-Sone Side)	40.0	425	145	7.5	20.9
			42.0	450	160		
			44.0	470	180		

Structure	DIAMETER OF PILE (mm)	SUB-STRUCTURE	LENGTH OF PILE BELOW CUT-OFF LEVEL (m)	RECOMMENDED SAFE VERTICAL LOAD CAPACITY (Tonnes)	RECOMMENDED SAFE UPLIFT LOAD CAPACITY (Tonnes)	RECOMMENDED SAFE HORIZONTAL LOAD CAPACITY (Tonnes)	RECOMMENDED DEPTH OF FIXITY BELOW CUT-OFF LEVEL (m)
				Normal Condition	Normal Condition	Normal Condition	Normal Condition
Major DFCC Bridge across river Sone	1500	Abutment -1 (Howrah Side)	38.0	570	225	13.0	21.9
			40.0	580	265		
			42.0	590	300		
		Pier	42.0	700	225	13.0	27.1
			44.0	750	250		
			46.0	780	275		
		Abutment -2 (Dehri-On-Sone Side)	40.0	675	205	13.0	21.9
			42.0	705	230		
			44.0	735	255		

Note: We have not taken into account any enhancement in pile capacities, which is allowed as per codes in seismic condition. The same may be considered as per relevant codes.

The above pile capacities are based on the static analysis. These capacities may be used as a guide line for design. Final capacities should be confirmed on site by initial pile load test as per IS specification.

Buckling of Pile (IS: 456 & IRC-21):

Structurally, piles are long slender columns with lateral support from the surrounding soil. If unsupported, these columns will fail in buckling instability and not due to the crushing of the pile material. In case of large free length, the pile does not get enough lateral support and it may simply buckle i.e. become unstable.

The parameters r_{min} (minimum radius of gyration) and L_{eff} (effective length of the pile = Free length + Depth of fixity below free length) are introduced to analyse the piles. The definitions of the parameters are given below.

1. r_{min} : The minimum radius of gyration of the pile section about any axis of bending (m).This parameter can represent piles of any shape (square, tubular or circular) and is used by structural engineers for studying buckling instability and is given by below Equation.

   r_{min} = Square root (I/A)

   Where I is second moment area of the pile section about the weakest axis (m4) and A is area of the pile section (m2). For solid circular piles r_{min} is 0.25 times the diameter of the pile.

   r_{min} for 1200mm diameter pile = 0.30m

   r_{min} for 1200mm diameter pile = 0.375m

2. L_{eff} for Abutment = 21.0m, L_{eff} for Pier = 26.0 m, for 1200mm diameter piles
   L_{eff} for Abutment = 22.0m, L_{eff} for Pier = 27.0 m, for 1500mm diameter piles

3. Slenderness ratio for 1200mm diameter piles for Abutment = 70 > 50, Slenderness ratio for 1200mm diameter piles for pier = 87 > 50
   Slenderness ratio for 1500mm diameter piles for Abutment = 59 > 50, Slenderness ratio for 1500mm diameter piles for pier = 72 > 50

The piles having slenderness ratios above 50 are expected to fail in buckling instability also lateral deflection at cutoff level will be very high in order of 18.5mm for abutment piles and 42mm for pier piles for 1200mm diameter pile.

Since the piles are failing in "Buckling" it is recommended that piles should be designed to avoid buckling failure or alternate foundation system like Well Foundation shall be adopted.

6.2 Well Foundations

Considering the nature of soil, type of proposed structures, expected scour and loads on foundations, well foundation is recommended. For satisfactory performance of a foundation, the following criteria must be satisfied;

(i) The foundation must not fail in shear.

(ii)The foundation must not settle by an amount more than the permissible settlement.

The smaller of the bearing pressure values obtained according to (I) and (ii) above, is adopted as the allowable bearing capacity.

Bearing Capacity for Well Foundations

Bearing capacity for well foundations in soil has been analyzed similarly as of open foundation. Load Bearing Capacity of Well Foundation shall be determined only from the End Bearing of Foundation Strata and the Side Friction along the Well Shaft shall not be considered.

Settlement for Well Foundations

The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure. In cohesive deposition, the post construction settlement is caused by dissipation of pore pressures and hence is time dependent so that consolidation settlement is computed for such soils as per IS: 8009 (Part-1), depth correction factor is applied as per IS: 8009 (Part-2). The immediate settlements in clays are estimated using the elastic theory considering the effect of a rigid stratum underlying the foundation soils (Reference: “Foundation Analysis and Design” by J.E.Bowles). The immediate settlements in cohesion-less soil are estimated using elastic theory as mentioned above

Recommendations

The bore logs and profiles developed on the basis of sub-soil investigation work conducted at Sone River Bridge location and considering founding level of well at RL 64.00m and 60.00m at abutment on Howrah side and Dehri on side respectively and RL 55m at pier location indicate that the well is founded on dense sandy strata.

For wells constructed in cohesion-less soils / very hard clays, the settlement due to dead load of sub-structure will take place by the time the construction is completed and the necessary adjustment in the final level can be made before erection of the super-structure. In such cases, settlement shall be evaluated only for the dead load of the super-structure, Ref: **- INDIAN RAILWAY STANDARD**, Code of Practice for the Design of Sub-Structures and Foundations of bridges, Clause 4.6 of APPENDIX V*.*

Design data provided by Design Consultant

Live load and weight of superstructure	Max. 20 % of total load (considered 25 % of total load)
Maximum permissible settlement of any individual foundation due to dead load of superstructure and live load	25mm
Hence Maximum Total permissible settlement of individual foundation	=25mm x 4 = 100mm Considered in calculations = 75mm

Based on soil design parameters and calculations attached in Annexure - I, net and gross allowable bearing capacities for 8.0 / 10.0 / 12.0 m diameter circular well is calculated and tabulated below in normal condition.

Location	Maximum Scour Level (MSL), m	Foundation Level, m	Depth of Foundation (m) below scour level D_f	Diameter of Well, B (m)	Net Safe Bearing Capacity, T/m^2	Gross Allowable Bearing Capacity, T/m^2
Abutment towards Howrah Side (A1)	86.837	64.00	22.84	8.00	80	100
				10.00	65	85
				12.00	55	75
Piers	77.274	55.00	22.27	8.00	80	100
				10.00	65	85
				12.00	55	75
Abutment towards Dehri on Sone Side (A2)	86.837	60.00	26.84	8.00	80	105
				10.00	65	90
				12.00	55	80

Note: We have not taken into account any enhancement in SBC values, which is allowed as per codes in seismic condition. The same may be considered as per relevant codes.

The choice of the value for design is a matter of engineering judgment, field and laboratory tests assessment. The recommendations have been made based on subsurface strata encountered in the limited number of boreholes as reported herein and our engineering judgment. If any significant departure from the reported data is noticed during actual construction, the Geotechnical consultants may be referred for advice.

7.0 CONCLUSIONS AND RECOMMENDATIONS

- The client, Dedicated freight corridor corporation ltd. (DFCCIL), has undertaken the "*Construction of Important DFCC Bridge across River Sone (having approximate length of 3.06 Kms with tentative span arrangement 93 x 30.48m) on North Side of New IR Sone bridge for Double Track of DFCC Railway Line between Sone Nagar (Railway Km 549.03) and Dehri-On-Sone (Rly. Km 554.806) Railway Stations on Mughalsarai – Sonenagar Section of Eastern Dedicated Freight Corridor*".
- To investigate the subsurface conditions, 11 boreholes at approximate distance of 300m were carried out to cover the total length of proposed bridge (*having approximate length of 3.06 Kms*). Boreholes were carried out approx 28.5m North side of New IR Sone Bridge. Field in-situ tests, like Standard Penetration Test were conducted in the boreholes, Disturbed / undisturbed soil samples were collected.
- Sub-surface strata is mainly medium dense to dense non-cohesive (granular) in nature. During the drilling progress, mainly three types of layer were encountered, described in detail in clause 5.1 of this report.

  Stratum 1 — Silty Sand / Clayey Sand / Fine to Medium Sand (SM/SC/SP-SM/SP)

  Stratum 2 — Silty Gravels / Sandy Gravels / Gravelly Sand (GP/GP-GM/SP-GP/GP-SP/SP-SM-GP)

  Stratum 3 — Clayey Silt / Silty Clay of low to high plasticity (CL/CI/CH)
- Standard penetration tests (SPT) were conducted to get the continuous penetration resistance along the depth, and were found refusal (N > 50) beyond 24m depth and N > 100 beyond 40m in almost all boreholes indicating its coarse size / dense / hard and compact nature.
- As per IS: 1893 (Part-1) 2002, the site falls in seismic zone – III. Considering the history of past earthquakes and available seismic data, an earthquake of magnitude 7.0 and maximum peak ground acceleration (PGA) of 0.16g is recommended for all design purposes. The top soils are loose and prone to liquefy down to 3m to 5m depth in an earth quake event. The sites may be considered "**Non-Susceptible"** in earth quake event beyond 5m depth from borehole top, also Scour Level (86.837m/77.274m) is much lower than the lowest level of probable liquefaction (93.375m); hence scour level will govern the design in normal as well as in seismic condition also.
- Considering the nature of sub-surface strata, type of proposed structures, expected scour and loads on foundations, M/s DFCC proposed to use deep foundation (Piles / Well) system to support the heavy loads on foundations of Major DFCC Bridge across river Sone.
- Pile Foundation: Recommendations for 1200mm and 1500mm diameter piles are presented in clause 6.1 of report, vertical load carrying capacity of 370 t to 500 t may be used for 1200mm diameter piles of varying length of 38m to 46m, 570 t to 780 t may be used for 1500mm diameter piles in design.

Structurally, piles are long slender columns with lateral support from the surrounding soil. In present studies scour depths are too high and hence unsupported lengths are also too high resulting slenderness ratio much more than 50 and piles are expected to fail in "*Buckling Instability*". *Since the piles are expected to fail in "Buckling" it is recommended that piles should be designed to avoid buckling failure or alternate foundation system like Well Foundation shall be adopted*.

- Well Foundation: Considering high scour depths, well foundation seems the most feasible foundation scheme for proposed bridge. Net / gross allowable Bearing capacity of circular wells of 8.0m / 10.0m / 12.0m diameter is recommended in clause 6.2. Founding level of wells have been decided based on minimum grip length required and also well shall be seated on dense non-cohesive soils.

  For wells constructed in cohesion-less soils / very hard clays, the settlement due to dead load of sub-structure will take place by the time the construction is completed and the necessary adjustment in the final level can be made before erection of the super-structure. In such cases, settlement shall be evaluated only for the dead load of the super-structure, Ref: **- INDIAN RAILWAY STANDARD**, Code of Practice for the Design of Sub-Structures and Foundations of bridges, Clause 4.6 of APPENDIX V. Maximum permissible settlement of well due to Dead Load of Superstructure and live load is considered as 25mm and maximum settlement due to total load is considered as 75mm in Net Allowable Bearing Capacity calculations.

  At recommended depth (or below) Net Allowable Bearing Capacity of 55 T/m^2 to 80 T/m^2 and Gross Allowable Bearing Capacity of 75 T/m^2 to 100 T/m^2 may be assigned for the design of 12.0m diameter to 8.0m diameter well foundations in Normal conditions. These capacities may be enhanced in Seismic Condition as per relevant applicable codes.

- The choice of the value for design is a matter of engineering judgment, field and laboratory tests assessment. The recommendations have been made based on subsurface strata encountered in the limited number of boreholes as reported herein and our engineering judgment. If any significant departure from the reported data is noticed during actual construction, the Geotechnical consultants may be referred for advice.

for INDIAN GEOTECHNICAL SERVICES

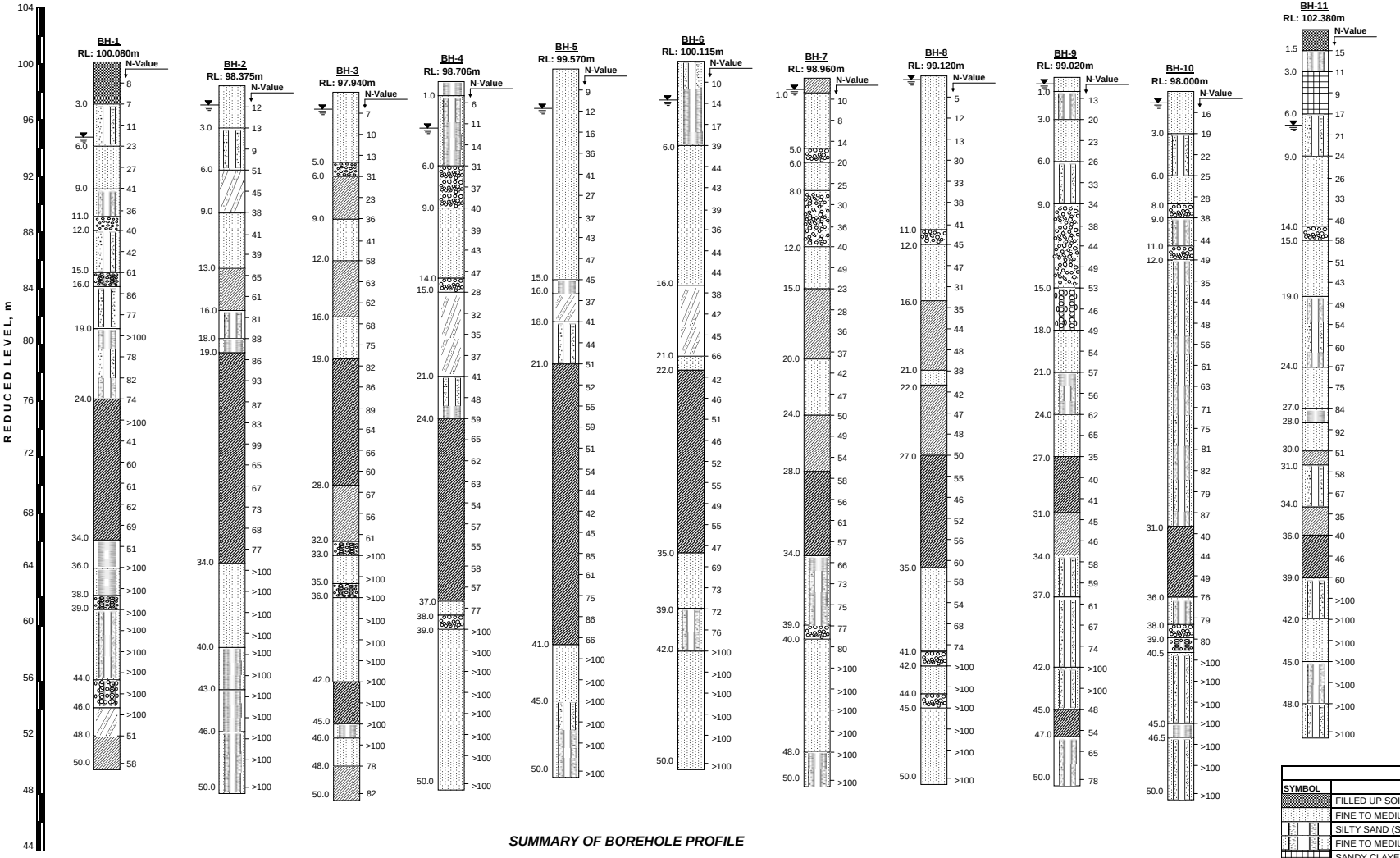
AJAY KUMAR GARG
Geotechnical Consultant / Partner

ANNEXURE – I

Following details are attached.....

- Sub-surface profile
- Consolidated Logs including laboratory test results
- Standard penetration Test Curves
- Liquefaction assessment sheets
- Grain size analysis curves
- Silt factor calculations
- Sample Pile Capacity calculations / SBC for well foundation

INDIAN GEOTECHNICAL SERVICES



SUMMARY OF BOREHOLE PROFILE

STRUCTURE : BRIDGE

PROJECT : PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

LEGEND	
SYMBOL	DESCRIPTION
	FILLED UP SOIL
	FINE TO MEDIUM SAND / MEDIUM TO FINE (SP)
	SILTY SAND (SM)
	FINE TO MEDIUM SAND / MEDIUM TO FINE (SP-SM)
	SANDY CLAYEY SILT (CL)
	CLAYEY SILT (CI)
	SILTY CLAY (CH)
	CLAYEY SILTY SAND (SC)
	SANDY GRAVEL (GP/GP-SP) / GRAVELLY SAND (SP-GP)
	SANDY GRAVEL (GP-GM)
	WATER TABLE

BOREHOLE NO. - 1 | **DATE STARTED : 07/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 100.080 | **DATE COMPLETED : 11/11/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_o	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
100.080	1.0	DS	1		0.00 - 1.00						Filled Up Soil (Road Materials) 3.00m	--	0.00	13.00	61.00	26.00	38.60	24.80	13.80	--	--	--	--	--	--	--	--	--
	2.0	SPT	1		1.50 - 1.95	8	30	8	8																			
	3.0	UDS	1		2.50-2.80							--	0.00	11.00	63.00	26.00	41.40	25.70	15.70	1.78	1.54	15.80	2.68	--	--	--	--	--
	4.0	SPT	2		3.00 - 3.45	7	30	7	8		Grey Medium to Fine Sand (SP-SM)	--	0.00	88.00	12.00	0.00	Non Plastic			--	--	--	2.64	--	--	--	--	--
95.080	5.0	SPT	3	5.20 m	4.50 - 4.95	11	30	11	12																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	23	30	23	19		Grey Gravelly Coarse to Medium Sand (SP)	DST+	19.00	77.00	4.00	0.00	Non Plastic			--	1.6	--	--	--	0.00	32	--	--
	8.0	SPT	5		7.50 - 7.95	27	30	27	20																			
	9.0	UDS/DS	3		8.50 - 8.80	Slipped																						
90.080	10.0	SPT	6		9.00 - 9.45	41	30	41	26		Grey Gravelly Medium to Fine Sand (SP-SM)	--	28.00	68.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	11.0	SPT	7		10.50 - 10.95	36	30	36	23																			
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP)	--	88.00	10.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	13.0	SPT	8		12.00 - 12.45	40	30	40	24		Grey Gravelly Coarse to Medium Sand (SP-SM)	--	30.00	68.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	42	30	42	24			DST+	6.00	89.00	5.00	0.00	Non Plastic			--	1.63	--	--	--	0.00	33	--	--
85.080	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	61	30	61	31		Grey Sandy Gravels (GP-GM)	--	46.00	45.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	68	30	68	68		Brown Clayey Sandy Silt of medium plasticity (CI)	DST+	0.00	38.00	38.00	24.00	40.90	25.30	15.60	--	1.71	--	2.67	--	2.60	30	--	--
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	77	30	77	77																			
80.080	20.0	SPT	13		19.50 - 19.90	76	25	>100	>50		Grey Gravelly Silty Sand (SM)	--	2.00	68.00	30.00	0.00	Non Plastic			--	--	--	2.67	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	78	30	78	34																			
	23.0	SPT	15		22.50 - 22.95	82	30	82	35			DST+	29.00	45.00	26.00	0.00	Non Plastic			--	1.65	--	--	--	0.50	33	--	--
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
75.080	25.0	SPT	16		24.00 - 24.45	74	30	74	74		Brown Silty Clay with gravels of high plasticity (CH)	--	18.00	9.00	30.00	43.00	59.30	30.50	28.80	--	--	--	2.72	--	--	--	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
UU = UNCONSOLIDATED UNDRAINED DST = DIRECT SHEAR TEST DST+ = DIRECT SHEAR TEST (REMOULDED)
UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 1 | **DATE STARTED : 07/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 100.080 | **DATE COMPLETED : 11/11/2012**

INDIAN GEOTECHNICAL SERVICES NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_o	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
74.080	26.0	SPT	17		25.50 - 25.87	88	22	>100	>100		Brown Silty Clay of high plasticity (CH)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	41	30	41	41																				
	29.0	SPT	19		28.50 - 28.95	60	30	60	60			UC+	0.00	8.00	52.00	40.00	54.10	29.10	25.00	--	1.73	--	--	--	22.80	--	--	--
70.080	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	61	30	61	61																				
	32.0	SPT	21		31.50 - 31.95	62	30	62	62																				
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	69	30	69	69			UC+	0.00	3.00	55.00	42.00	58.30	30.20	28.10	--	1.74	--	--	--	23.20	--	--	--
65.080	35.0	SPT	23		34.50 - 34.95	51	30	51	21		Grey Gravelly Silty Sand (SM)	DST+	21.00	65.00	14.00	0.00	Non Plastic			--	1.65	--	2.64	--	0.00	32	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.40	77	25	>100	>50		Grey Gravelly Fine to Medium Sand (SP-SM-GP)	--	39.00	52.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	38.0	SPT	25		37.50 - 37.83	79	18	>100	>50																				
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP)	--	69.00	27.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
60.080	40.0	SPT	26		39.00 - 39.38	78	23	>100	>50		Grey Gravelly Fine to Medium Sand (SP-SM-GP)	DST+	40.00	54.00	6.00	0.00	Non Plastic			--	1.72	--	--	--	0.00	34	--	--
	41.0	SPT	27		40.50 - 40.82	77	17	>100	>50																				
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.35	80	20	>100	>50		Grey Gravelly Coarse to Medium Sand (SP-SM-GP)	--	33.00	61.00	6.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.83	75	18	>100	>50																				
55.080	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP-SP)	--	51.00	45.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	46.0	SPT	30		45.00 - 45.36	78	21	>100	>50		Grey Gravelly Coarse to Medium Sand (SP-SM)	--	27.00	69.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.90	75	25	>100	>50		Brown Clayey Silty Sand of low plasticity (SC)	--	0.00	56.00	32.00	12.00	29.50	21.70	7.80	--	--	--	--	--	--	--	--	--
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.45	51	30	51	51		Brown Sandy Clayey Silt of medium plasticity (CI)	--	3.00	31.00	33.00	33.00	49.40	28.40	21.00	--	--	--	--	--	--	--	--	--
50.080	50.0	SPT	33		50.00 - 50.45	58	31	58	58																				

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48 ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LIN BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 2 | **DATE STARTED : 15/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.375 | **DATE COMPLETED : 19/11/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_o	COMPRESSION INDEX C_c
98.375	1.0	DS	1		0.00 - 1.00						Grey Medium to Fine Sand (SP)	--	0.00	98.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1	1.35 m	1.50 - 1.95	12	30	12	16																			
	3.0	UDS/DS	1		2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	13	30	13	16		Grey Fine to Medium Sand (SP-SM)	DST+	3.00	90.00	7.00	0.00	Non Plastic			--	1.56	--	--	--	0.00	31	--	--
93.375	5.0	SPT	3		4.50 - 4.95	9	30	9	11																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	51	30	51	36		Brown Clayey Silty Sand of medium plasticity (SC)	DST+	2.00	50.00	28.00	20.00	37.40	24.60	12.80	--	1.65	--	2.66	--	1.70	31	--	--
	8.0	SPT	5		7.50 - 7.95	45	30	45	31																			
	9.0	UDS/DS	3		8.50 - 8.80	Hard to Penetrate / Slipped																						
88.375	10.0	SPT	6		9.00 - 9.45	38	30	38	27		Grey Gravelly Coarse to Medium Sand (SP)	--	22.00	76.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	11.0	SPT	7		10.50 - 10.95	41	30	41	27																			
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped																						
	13.0	SPT	8		12.00 - 12.45	39	30	39	25		Grey Fine to Medium Sand (SP)	DST+	4.00	93.00	3.00	0.00	Non Plastic			--	1.66	--	2.60	--	0.00	33	--	--
	14.0	SPT	9		13.50 - 13.95	65	30	65	65		Brown Clayey Sandy Silt of medium plasticity (CI)	--	2.00	35.00	36.00	27.00	47.10	27.00	20.10	--	--	--	2.68	--	--	--	--	--
83.375	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	61	30	61	61																			
	17.0	SPT	11		16.50 - 16.95	81	30	81	41		Grey Silty Sand (SM)	DST+	0.00	73.00	27.00	0.00	Non Plastic			--	1.65	--	2.64	--	0.50	34	--	--
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	88	30	88	42		Grey Gravelly Fine to Medium Sand (SP-SM)	--	22.00	76.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
78.375	20.0	SPT	13		19.50 - 19.95	86	30	86	86		Brown Silty Clay of high plasticity (CH)	--	5.00	15.00	40.00	40.00	54.70	25.10	29.60	--	--	--	2.71	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	93	30	93	93																			
	23.0	SPT	15		22.50 - 22.95	87	30	87	87																			
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
73.375	25.0	SPT	16		24.00 - 24.45	83	30	83	83			UU+	2.00	6.00	51.00	41.00	56.80	29.60	27.20	--	1.74	--	--	--	23.80	4	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 2 | **DATE STARTED : 15/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.375 | **DATE COMPLETED : 19/11/2012**

INDIAN GEOTECHNICAL SERVICES NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_o	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
72.375	26.0	SPT	17		25.50 - 25.95	99	30	99	99		Brown Silty Clay of high plasticity (CH)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	65	30	65	65																				
	29.0	SPT	19		28.50 - 28.95	67	30	67	67			--	2.00	7.00	52.00	39.00	54.60	29.60	25.00	--	--	--	2.69	--	--	--	--	--
68.375	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	73	30	73	73																				
	32.0	SPT	21		31.50 - 31.95	68	30	68	68																				
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	77	30	77	77			--	0.00	13.00	48.00	39.00	55.90	29.50	26.40	--	--	--	--	--	--	--	--	--
63.375	35.0	SPT	23		34.50 - 34.90	74	25	>100	>50		Grey Gravelly Fine to Medium Sand (SP)	DST+	16.00	82.00	2.00	0.00	Non Plastic			--	1.72	--	--	--	0.00	34	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.38	78	23	>100	>50																				
	38.0	SPT	25		37.50 - 37.85	79	20	>100	>50			--	13.00	83.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																							
58.375	40.0	SPT	26		39.00 - 39.45	78	25	>100	>50																				
	41.0	SPT	27		40.50 - 40.92	80	27	>100	>50		Grey Fine to Medium Sand (SP-SM)	--	3.00	86.00	11.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.39	76	24	>100	>50																				
	44.0	SPT	29		43.50 - 43.90	75	25	>100	>50		Grey Silty Sand (SM)	--	2.00	85.00	13.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
53.375	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.32	76	17	>100	>50																				
	47.0	SPT	31		46.50 - 46.84	79	19	>100	>50		Grey Medium to Fine Sand (SP-SM)	--	2.00	89.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.32	77	17	>100	>50																				
48.375	50.0	SPT	33		50.00 - 50.33	75	18	>100	>50			--	2.00	89.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48 ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LIN BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 3 | **DATE STARTED : 24/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 97.940 | **DATE COMPLETED : 02/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_o	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
97.940	1.0	DS	1		0.00 - 1.00							--	2.00	95.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1	1.15 m	1.50 - 1.95	7	30	7	10																			
	3.0	UDS/DS	1		2.50-2.80	Slipped					Grey Fine to Medium Sand (SP)																	
	4.0	SPT	2		3.00 - 3.45	10	30	10	13			DST+	2.00	94.00	4.00	0.00	Non Plastic			--	1.55	--	--	2.61	0.00	31	--	--
92.940	5.0	SPT	3		4.50 - 4.95	13	30	13	15																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped					Grey Gravelly Fine to Medium Sand (SP-GP)	--	46.00	51.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	7.0	SPT	4		6.00 - 6.45	31	30	31	31		Brown Gravelly Clayey Sandy Silt of medium plasticity (CI)	--	11.00	35.00	35.00	19.00	41.30	25.60	15.70	--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	23	30	23	23																			
	9.0	UDS	3		8.50 - 8.80							UU	--	--	--	--	40.80	25.30	15.50	2.00	1.62	23.10	2.67	--	12.60	4	--	--
87.940	10.0	SPT	6		9.00 - 9.45	36	30	36	26		Grey Gravelly Coarse to Medium Sand (SP)	DST+	19.00	78.00	3.00	0.00	Non Plastic			--	1.67	--	--	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	41	30	41	27																			
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped																						
	13.0	SPT	8		12.00 - 12.45	58	30	58	58		Brown Clayey Sandy Silt of medium plasticity (CI)	DST+	0.00	49.00	36.00	15.00	35.90	23.60	12.30	--	1.66	--	2.67	--	1.50	31	--	--
	14.0	SPT	9		13.50 - 13.95	63	30	63	63																			
82.940	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	62	30	62	62			--	0.00	49.00	32.00	19.00	39.30	25.20	14.10	--	--	--	2.68	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	68	30	68	35		Grey Fine to Medium Sand (SP)	DST+	8.00	88.00	4.00	0.00	Non Plastic			--	1.68	--	--	--	0.00	34	--	--
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	75	30	75	37																			
77.940	20.0	SPT	13		19.50 - 19.95	82	30	82	82		Brown Silty Clay of high plasticity (CH)	--	2.00	13.00	47.00	38.00	52.90	29.20	23.70	--	--	--	2.7	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	86	29	86	86																			
	23.0	SPT	15		22.50 - 22.95	89	30	89	89																			
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
72.940	25.0	SPT	16		24.00 - 24.45	64	30	64	64			UU+	0.00	4.00	55.00	41.00	57.70	30.00	27.70	--	1.73	--	--	--	23.30	4	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 3 | **DATE STARTED : 24/11/2012**

REDUCED LEVEL OF GROUND BORE (M) : 97.940 | **DATE COMPLETED : 02/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
71.940	26.0	SPT	17		25.50 - 25.95	66	30	66	66		Brown Silty Clay of high plasticity (CH)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																						
	28.0	SPT	18		27.00 - 27.45	60	30	60	60																			
	29.0	SPT	19		28.50 - 28.95	67	30	67	67		Brown Sandy Clayey Silt of medium plasticity (CI)	--	0.00	22.00	49.00	29.00	46.70	27.00	19.70	--	--	--	2.68	--	--	--	--	--
67.940	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																						
	31.0	SPT	20		30.00 - 30.45	56	30	56	56																			
	32.0	SPT	21		31.50 - 31.95	61	30	61	61																			
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP-GM)	--	77.00	16.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	34.0	SPT	22		33.00 - 33.42	75	27	>100	>50		Grey Fine to Medium Sand (SP)	DST+	7.00	90.00	3.00	0.00	Non Plastic			--	1.72	--	--	--	0.00	34	--	--
62.940	35.0	SPT	23		34.50 - 34.90	77	25	>100	>50																			
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP-GM)	--	70.00	23.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	37.0	SPT	24		36.00 - 36.37	76	22	>100	>50		Grey Fine to Medium Sand (SP)	--	2.00	94.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	38.0	SPT	25		37.50 - 37.86	75	21	>100	>50																			
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																						
57.940	40.0	SPT	26		39.00 - 39.35	78	20	>100	>50		Grey Coarse to Medium Sand (SP)	--	9.00	88.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.88	77	23	>100	>50																			
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																						
	43.0	SPT	28		42.00 - 42.45	58	30	58	58		Brown Silty Clay of high plasticity (CH)	--	0.00	6.00	49.00	45.00	64.30	31.80	32.50	--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.95	62	30	62	62																			
52.940	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																						
	46.0	SPT	30		45.00 - 45.34	75	19	>100	>50		Grey Fine to Medium Sand (SP-SM)	--	3.00	91.00	6.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.85	76	20	>100	>50		Grey Coarse to Medium Sand (SP)	--	8.00	89.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																						
	49.0	SPT	32		48.00 - 48.45	78	30	78	78		Brown Sandy Clayey Silt of medium plasticity (CI)	--	2.00	28.00	42.00	28.00	45.00	26.70	18.30	--	--	--	--	--	--	--	--	--
47.940	50.0	SPT	33		50.00 - 50.45	82	30	82	82																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. -4 | **DATE STARTED : 05/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.706 | **DATE COMPLETED : 10/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
98.706	1.0	DS	1		0.00 - 1.00						Grey Silty Sand (SM)	--	6.00	60.00	34.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1		1.50 - 1.95	6	30	6	9			DST+	0.00	91.00	9.00	0.00	Non Plastic			--	1.50	--	2.63	--	0.00	30	--	--
	3.0	UDS/DS	1	3.20 m	2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	11	30	11	13		Grey Medium to Fine Sand (SP-SM)	--	0.00	91.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
93.706	5.0	SPT	3		4.50 - 4.95	14	30	14	15																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	31	30	31	24			--	60.00	39.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	37	30	37	26		Grey Sandy Gravels (GP-SP)	--	73.00	25.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	9.0	UDS/DS	3		8.50 - 8.80	Hard to Penetrate / Slipped																						
88.706	10.0	SPT	6		9.00 - 9.45	40	30	40	27			DST+	22.00	76.00	2.00	0.00	Non Plastic			--	1.66	--	2.61	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	39	30	39	25			--	41.00	58.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped					Grey Gravelly Coarse to Medium Sand (SP)																	
	13.0	SPT	8		12.00 - 12.45	43	30	43	26																			
	14.0	SPT	9		13.50 - 13.95	47	30	47	27			DST+	18.00	80.00	2.00	0.00	Non Plastic			--	1.67	--	--	--	0.00	33	--	--
83.706	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP-SP)	--	66.00	30.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	16.0	SPT	10		15.00 - 15.45	28	30	28	19			--	2.00	60.00	24.00	14.00	36.30	23.90	12.40	--	--	--	2.67	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	32	30	32	20		Brown Clayey Silty Sand of medium plasticity (SC)																	
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	35	30	35	21			DST+	9.00	52.00	27.00	12.00	34.40	23.60	10.80	--	1.59	--	--	--	1.30	31	--	--
78.706	20.0	SPT	13		19.50 - 19.95	37	30	37	21		Brown Clayey Silty Sand of low plasticity (SC)																	
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	41	29	41	22			DST+	5.00	63.00	32.00	0.00	Non Plastic			--	1.60	--	2.66	--	0.00	32	--	--
	23.0	SPT	15		22.50 - 22.95	48	30	48	24		Grey Silty Sand (SM)																	
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
73.706	25.0	SPT	16		24.00 - 24.45	59	30	59	59		Brown Silty Clay of high plasticity (CH)	UU+	0.00	8.00	51.00	41.00	56.00	29.50	26.50	--	1.72	--	--	--	22.50	4	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. -4 | **DATE STARTED : 05/12/2012** | **INDIAN GEOTECHNICAL SERVICES NEW DELHI**

REDUCED LEVEL OF GROUND BORE (M) : 98.706 | **DATE COMPLETED : 10/12/2012**

FIELD TEST RESULTS												LABORATORY TEST RESULTS																	
ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
72.706	26.0	SPT	17		25.50 - 25.95	65	30	65	65		Brown Silty Clay of high plasticity (CH)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	62	30	62	62			--	0.00	6.00	51.00	43.00	58.40	30.20	28.20	--	--	--	2.72	--	--	--	--	--
	29.0	SPT	19		28.50 - 28.95	63	30	63	63																			
68.706	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	54	30	54	54																			
	32.0	SPT	21		31.50 - 31.95	57	30	57	57			UC+	0.00	5.00	57.00	38.00	52.30	28.60	23.70	--	1.71	--	--	--	22.70	--	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	55	30	55	55																			
63.706	35.0	SPT	23		34.50 - 34.95	58	30	58	58																			
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.45	57	30	57	57			--	0.00	42.00	19.00	39.00	54.90	29.20	25.70	--	--	--	2.71	--	--	--	--	--
	38.0	SPT	25		37.50 - 37.95	77	30	77	28		Grey Fine to Medium Sand (SP)	DST+	2.00	96.00	2.00	0.00	Non Plastic			--	1.70	--	--	--	0.00	34	--	--
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP-SP)	--	53.00	44.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
58.706	40.0	SPT	26		39.00 - 39.43	75	28	>100	>50		Grey Fine to Medium Sand (SP)	--	0.00	98.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.90	78	25	>100	>50																			
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped					Grey Gravelly Fine to Medium Sand (SP-GP)	--	44.00	52.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	43.0	SPT	28		42.00 - 42.38	77	23	>100	>50		Grey Gravelly Coarse to Medium Sand (SP)	--	7.00	92.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.86	77	21	>100	>50																			
53.706	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.35	76	20	>100	>50			--	25.00	74.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.83	78	18	>100	>50																			
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.32	80	17	>100	>50			--	18.00	80.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
48.706	50.0	SPT	33		50.00 - 50.30	76	15	>100	>50																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 5 | **DATE STARTED : 12/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.570 | **DATE COMPLETED : 16/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	SPT: NO. OF BLOWS	SPT: PENETRATION (CM)	SPT: N, VALUE (Recorded)	SPT: N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
99.570	1.0	DS	1		0.00 - 1.00						Grey Fine Sand (SP)	--	0.00	97.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1	2.90 m	1.50 - 1.95	9	30	9	13																			
	3.0	UDS	1	▼	2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	12	30	12	14		Grey Medium to Fine Sand (SP)	DST+	2.00	95.00	3.00	0.00	Non Plastic			--	1.56	--	2.62	--	0.00	31	--	--
94.570	5.0	SPT	3		4.50 - 4.95	16	30	16	17																			
	6.0	UDS	2		5.50 - 5.80	Slipped					Grey Gravelly Fine to Medium Sand (SP-GP)																	
	7.0	SPT	4		6.00 - 6.45	36	30	36	27			--	43.00	56.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	41	30	41	28																			
	9.0	UDS	3		8.50 - 8.80	Slipped																						
89.570	10.0	SPT	6		9.00 - 9.45	27	30	27	21		Grey Gravelly Medium to Fine Sand (SP)	DST+	23.00	75.00	2.00	0.00	Non Plastic			--	1.62	--	2.61	--	0.00	32	--	--
	11.0	SPT	7		10.50 - 10.95	37	30	37	25																			
	12.0	UDS	4		11.50 - 11.80	Hard to Penetrate / Slipped																						
	13.0	SPT	8		12.00 - 12.45	43	30	43	27		Grey Medium to Fine Sand (SP)	--	4.00	94.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	47	30	47	28																			
84.570	15.0	UDS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	45	30	45	26		Grey Gravelly Silty Sand (SM)	--	12.00	72.00	16.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	37	30	37	22		Brown Clayey Silty Sand of low plasticity (SC)	DST+	0.00	66.00	24.00	10.00	32.10	22.10	10.00	--	1.63	--	2.66	--	1.40	31	--	--
	18.0	UDS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	41	30	41	23		Grey Silty Sand (SM)	DST+	4.00	75.00	21.00	0.00	Non Plastic			--	1.60	--	--	--	0.00	32	--	--
79.570	20.0	SPT	13		19.50 - 19.95	44	30	44	24																			
	21.0	UDS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	51	29	51	51		Brown Silty Clay of high plasticity (CH)	UU+	2.00	16.00	45.00	37.00	51.90	28.60	23.30	--	1.70	--	2.69	--	22.00	4	--	--
	23.0	SPT	15		22.50 - 22.95	52	30	52	52																			
	24.0	UDS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
74.570	25.0	SPT	16		24.00 - 24.45	55	30	55	55																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 5 | **DATE STARTED : 12/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.570 | **DATE COMPLETED : 16/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
73.570	26.0	SPT	17		25.50 - 25.95	59	30	59	59		Brown Silty Clay of high plasticity (CH)	--	2.00	17.00	41.00	40.00	56.60	29.70	26.90	--	--	--	--	--	--	--	--	--
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																						
	28.0	SPT	18		27.00 - 27.45	51	30	51	51																			
	29.0	SPT	19		28.50 - 28.95	54	30	54	54																			
69.570	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																						
	31.0	SPT	20		30.00 - 30.45	44	30	44	44			UC+	0.00	6.00	57.00	37.00	50.10	27.60	22.50	--	1.70	--	2.69	--	21.20	--	--	--
	32.0	SPT	21		31.50 - 31.95	42	30	42	42																			
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																						
	34.0	SPT	22		33.00 - 33.45	45	30	45	45																			
64.570	35.0	SPT	23		34.50 - 34.95	85	30	85	85			UU+	0.00	6.00	57.00	37.00	50.80	28.30	22.50	--	1.72	--	--	--	24.30	4	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																						
	37.0	SPT	24		36.00 - 36.45	61	30	61	61																			
	38.0	SPT	25		37.50 - 37.95	75	30	75	75																			
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																						
59.570	40.0	SPT	26		39.00 - 39.45	86	30	86	86			--	0.00	6.00	51.00	43.00	64.10	34.00	30.10	--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.95	66	30	66	66																			
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																						
	43.0	SPT	28		42.00 - 42.41	76	26	>100	>50		Grey Gravelly Fine to Medium Sand (SP)	DST+	22.00	75.00	3.00	0.00	Non Plastic			--	1.72	--	--	--	0.00	34	--	--
	44.0	SPT	29		43.50 - 43.89	76	24	>100	>50																			
54.570	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																						
	46.0	SPT	30		45.00 - 45.40	76	25	>100	>50		Grey Medium to Fine Sand (SP-SM)	--	2.00	93.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.88	77	23	>100	>50																			
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																						
	49.0	SPT	32		48.00 - 48.36	76	21	>100	>50			--	2.00	91.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
49.570	50.0	SPT	33		50.00 - 50.35	78	20	>100	>50																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 6 | **DATE STARTED : 18/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 100.115 | **DATE COMPLETED : 21/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
100.115	1.0	DS	1		0.00 - 1.00						Grey Medium to Fine Sand (SP-SM)	--	0.00	95.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1	2.70 m	1.50 - 1.95	10	30	10	14																			
	3.0	UDS/DS	1	▼	2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	14	30	14	16		Grey Fine to Medium Sand (SP-SM)	DST+	0.00	92.00	8.00	0.00	Non Plastic			--	1.57	--	2.63	--	0.00	31	--	--
95.115	5.0	SPT	3		4.50 - 4.95	17	30	17	17																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	39	30	39	28		Grey Gravelly Coarse to Medium Sand (SP)	--	11.00	87.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	44	30	44	30																			
	9.0	UDS/DS	3		8.50 - 8.80	Hard to Penetrate / Slipped																						
90.115	10.0	SPT	6		9.00 - 9.45	43	30	43	28			DST+	35.00	64.00	1.00	0.00	Non Plastic			--	1.64	--	2.59	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	39	30	39	26																			
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped																						
	13.0	SPT	8		12.00 - 12.45	36	30	36	23		Grey Gravelly Fine to Medium Sand (SP)	--	8.00	89.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	44	30	44	26																			
85.115	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	44	30	44	26			--	12.00	86.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	38	30	38	23		Brown Clayey Silty Sand of low plasticity (SC)	DST+	0.00	55.00	34.00	11.00	31.80	21.60	10.20	--	1.60	--	2.68	--	1.00	31	--	--
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	42	30	42	24			--	0.00	66.00	22.00	12.00	33.20	22.40	10.80	--	--	--	2.67	--	--	--	--	--
80.115	20.0	SPT	13		19.50 - 19.95	45	30	45	24																			
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	66	29	66	31		Grey Fine to Medium Sand (SP)	--	3.00	95.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	23.0	SPT	15		22.50 - 22.95	42	30	42	42		Brown Silty Clay of high plasticity (CH)	UU+	0.00	19.00	44.00	37.00	54.00	29.10	24.90	--	1.68	--	--	--	20.50	4	--	--
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
75.115	25.0	SPT	16		24.00 - 24.45	46	30	46	46																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 6 | **DATE STARTED : 18/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 100.115 | **DATE COMPLETED : 21/12/2012**

INDIAN GEOTECHNICAL SERVICES NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
74.115	26.0	SPT	17		25.50 - 25.95	51	30	51	51		Brown Silty Clay of high plasticity (CH)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	46	30	46	46			--	0.00	5.00	59.00	36.00	52.70	28.60	24.10	--	--	--	2.69	--	--	--	--	--
	29.0	SPT	19		28.50 - 28.95	52	30	52	52																			
70.115	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	55	30	55	55																			
	32.0	SPT	21		31.50 - 31.95	49	30	49	49			UC+	0.00	5.00	53.00	42.00	62.20	31.60	30.60	--	1.71	--	2.71	--	21.80	--	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	55	30	55	55																			
65.115	35.0	SPT	23		34.50 - 34.95	47	30	47	47																			
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped					Grey Medium to Fine Sand (SP)																		
	37.0	SPT	24		36.00 - 36.45	69	30	69	27			DST+	0.00	99.00	1.00	0.00	Non Plastic			--	1.66	--	--	--	0.00	34	--	--
	38.0	SPT	25		37.50 - 37.95	73	30	73	27																			
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																							
60.115	40.0	SPT	26		39.00 - 39.45	72	30	72	27		Grey Medium to Fine Sand (SP-SM)	--	0.00	95.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.95	76	30	76	27																			
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.42	77	27	>100	>50		Grey Fine to Medium Sand (SP)	--	2.00	97.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.90	76	25	>100	>50																			
55.115	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.35	77	20	>100	>50			--	2.00	96.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.90	75	25	>100	>50																			
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.34	75	19	>100	>50			--	2.00	96.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
50.115	50.0	SPT	33		50.00 - 50.32	75	17	>100	>50																			

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UU = UNCONSOLIDATED UNDRAINED DST = DIRECT SHEAR TEST DST+ = DIRECT SHEAR TEST (REMOULDED)
UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 7 | **DATE STARTED : 21/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.960 | **DATE COMPLETED : 26/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
98.960	1.0	DS	1	▼	0.00 - 1.00						Brown Clayey Silt of medium plasticity (CI)	--	0.00	14.00	60.00	26.00	42.80	25.90	16.90	--	--	--	--	--	--	--	--	--
	2.0	SPT	1	0.80 m	1.50 - 1.95	10	30	10	14		Grey Fine to Medium Sand with gravels(SP)	--	3.00	95.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	3.0	UDS/DS	1		2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	8	30	8	11			DST+	2.00	96.00	2.00	0.00	Non Plastic			--	1.52	--	2.60	--	0.00	30	--	--
93.960	5.0	SPT	3		4.50 - 4.95	14	30	14	16																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped				o o o o o o o o	Grey Sandy Gravels (GP)	--	94.00	5.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	7.0	SPT	4		6.00 - 6.45	20	30	20	19		Grey Gravelly Fine to Medium Sand (SP-GP)	--	37.00	61.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	25	30	25	21			DST+	32.00	67.00	1.00	0.00	Non Plastic			--	1.62	--	--	--	0.00	32	--	--
	9.0	UDS/DS	3		8.50 - 8.80	Slipped				o o o o o o o o	Grey Sandy Gravels (GP-SP)	--	67.00	32.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
88.960	10.0	SPT	6		9.00 - 9.45	30	30	30	23	o o o o o o o o		--	50.00	48.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	11.0	SPT	7		10.50 - 10.95	36	30	36	25	o o o o o o o o																		
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped				o o o o o o o o		--	77.00	22.00	1.00	0.00	Non Plastic			--	--	--	2.59	--	--	--	--	--
	13.0	SPT	8		12.00 - 12.45	40	30	40	26		Grey Gravelly Fine to Medium Sand (SP)	DST+	20.00	76.00	4.00	0.00	Non Plastic			--	1.66	--	--	--	0.00	33	--	--
	14.0	SPT	9		13.50 - 13.95	49	30	49	30																			
83.960	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	23	30	23	23		Brown Clayey Sandy Silt / Sandy Clayey Silt of medium plasticity (CI)	DST+	0.00	42.00	39.00	19.00	36.50	23.80	12.70	--	1.62	--	2.66	--	1.60	30	--	--
	17.0	SPT	11		16.50 - 16.95	28	30	28	28																			
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	36	30	36	36																			
78.960	20.0	SPT	13		19.50 - 19.95	37	30	37	37			--	0.00	21.00	45.00	34.00	49.60	27.90	21.70	--	--	--	--	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped					Grey Gravelly Fine to Medium Sand (SP)																		
	22.0	SPT	14		21.00 - 21.45	42	29	42	23			DST+	15.00	81.00	4.00	0.00	Non Plastic			--	1.64	--	--	--	0.00	33	--	--
	23.0	SPT	15		22.50 - 22.95	47	30	47	25																			
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
73.960	25.0	SPT	16		24.00 - 24.45	50	30	50	50		Brown Clayey Silt of medium plasticity (CI)	UU+	0.00	8.00	58.00	34.00	48.40	27.40	21.00	--	1.72	--	2.69	--	22.30	6	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 7 | **DATE STARTED : 21/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.960 | **DATE COMPLETED : 26/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
72.960	26.0	SPT	17		25.50 - 25.95	49	30	49	49		Brown Clayey Silt of medium plasticity (CI)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	54	30	54	54																				
	29.0	SPT	19		28.50 - 28.95	58	30	58	58		Brown Silty Clay of high plasticity (CH)	--	0.00	5.00	54.00	41.00	60.40	30.80	29.60	--	--	--	--	--	--	--	--	--
68.960	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	56	30	56	56																				
	32.0	SPT	21		31.50 - 31.95	61	30	61	61																				
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	57	30	57	57			UC+	0.00	4.00	59.00	37.00	52.60	28.60	24.00	--	1.73	--	--	--	22.70	--	--	--
63.960	35.0	SPT	23		34.50 - 34.95	66	30	66	27		Grey Gravelly Fine to Medium Sand (SP-SM-GP)	--	28.00	65.00	7.00	0.00	Non Plastic			--	--	--	2.63	--	--	--	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.45	73	30	73	28																				
	38.0	SPT	25		37.50 - 37.95	75	30	75	29			DST+	31.00	63.00	6.00	0.00	Non Plastic			--	1.66	--	--	--	0.00	34	--	--
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																							
58.960	40.0	SPT	26		39.00 - 39.45	77	30	77	29		Grey Sandy Gravels (GP-SP)	--	52.00	44.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.95	80	30	80	29		Grey Gravelly Medium to Fine Sand (SP)	DST+	19.00	77.00	4.00	0.00	Non Plastic			--	1.68	--	--	--	0.00	34	--	--
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.42	78	27	>100	>50			--	18.00	78.00	4.00	0.00	Non Plastic			--	--	--	2.61	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.90	77	25	>100	>50																				
53.960	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.41	76	26	>100	>50		Grey Medium to Fine Sand (SP)	--	0.00	96.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.88	77	23	>100	>50																				
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.35	78	20	>100	>50		Grey Gravelly Medium to Fine Sand (SP-SM)	--	0.00	93.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
48.960	50.0	SPT	33		50.00 - 50.34	76	19	>100	>50																				

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 8 | **DATE STARTED : 14/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.120 | **DATE COMPLETED : 19/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	SPT: NO. OF BLOWS	SPT: PENETRATION (CM)	SPT: N, VALUE (Recorded)	SPT: N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	GRAIN SIZE ANALYSIS: SAND (%)	GRAIN SIZE ANALYSIS: SILT (%)	GRAIN SIZE ANALYSIS: CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	SHEAR STRENGTH CHARACTERISTICS: Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
99.120	1.0	DS	1	0.20 m	0.00 - 1.00						Grey Fine to Medium Sand (SP)	--	0.00	99.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--	--
	2.0	SPT	1		1.50 - 1.95	5	30	5	7																				
	3.0	UDS/DS	1		2.50-2.80	Slipped																							
	4.0	SPT	2		3.00 - 3.45	12	30	12	16			DST+	0.00	96.00	4.00	0.00	Non Plastic			--	1.57	--	2.61	--	0.00	31	--	--
94.120	5.0	SPT	3		4.50 - 4.95	13	30	13	16																				
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																							
	7.0	SPT	4		6.00 - 6.45	30	30	30	25			--	0.00	98.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	33	30	33	26																				
	9.0	UDS/DS	3		8.50 - 8.80	Slipped																							
89.120	10.0	SPT	6		9.00 - 9.45	38	30	38	27			DST+	0.00	96.00	4.00	0.00	Non Plastic			--	1.65	--	2.61	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	41	30	41	28																				
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP-SP)	--	59.00	39.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	13.0	SPT	8		12.00 - 12.45	45	30	45	29		Grey Gravelly Coarse to Medium Sand (SP)	--	24.00	75.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	47	30	47	29																				
84.120	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																							
	16.0	SPT	10		15.00 - 15.45	31	30	31	21			--	29.00	70.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	35	30	35	35		Brown Clayey Sandy Silt / Clayey Silt of medium plasticity (CI)	DST+	2.00	42.00	32.00	24.00	40.70	25.30	15.40	--	1.67	--	2.67	--	1.80	31	--	--
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																							
	19.0	SPT	12		18.00 - 18.45	44	30	44	44																				
79.120	20.0	SPT	13		19.50 - 19.95	48	30	48	48																				
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																							
	22.0	SPT	14		21.00 - 21.45	38	30	38	22		Grey Fine to Medium Sand (SP)	--	6.00	92.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	23.0	SPT	15		22.50 - 22.95	42	30	42	42		Brown Sandy Clayey Silt / Clayey Silt of medium plasticity (CI)	UU+	2.00	26.00	44.00	28.00	43.90	26.40	17.50	--	1.70	--	2.68	--	20.50	5	--	--
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																							
74.120	25.0	SPT	16		24.00 - 24.45	47	30	47	47																				

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 8 | **DATE STARTED : 14/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.120 | **DATE COMPLETED : 19/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
73.120	26.0	SPT	17		25.50 - 25.95	48	30	48	48		Brown Sandy Clayey Silt / Clayey Silt of medium plasticity (CI)																	
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																						
	28.0	SPT	18		27.00 - 27.45	50	30	50	50		Brown Silty Clay of high plasticity (CH)	UC+	0.00	6.00	55.00	39.00	53.70	28.90	24.80	--	1.71	--	--	--	22.80	--	--	--
	29.0	SPT	19		28.50 - 28.95	55	30	55	55																			
69.120	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																						
	31.0	SPT	20		30.00 - 30.45	46	30	46	46																			
	32.0	SPT	21		31.50 - 31.95	52	30	52	52			--	3.00	8.00	51.00	38.00	54.00	29.10	24.90	--	--	--	2.69	--	--	--	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																						
	34.0	SPT	22		33.00 - 33.45	56	30	56	56																			
64.120	35.0	SPT	23		34.50 - 34.95	60	30	60	60																			
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped					Grey Fine to Medium Sand (SP)																	
	37.0	SPT	24		36.00 - 36.45	58	30	58	24			DST+	4.00	95.00	1.00	0.00	Non Plastic			--	1.65	--	--	--	0.00	33	--	--
	38.0	SPT	25		37.50 - 37.95	54	30	54	23																			
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																						
59.120	40.0	SPT	26		39.00 - 39.45	68	30	68	26			--	5.00	94.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.95	74	30	74	27																			
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP)	--	83.00	15.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	43.0	SPT	28		42.00 - 42.40	78	25	>100	>50		Grey Gravelly Fine to Medium Sand (SP)	--	27.00	70.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.92	83	27	>100	>50																			
54.120	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP-SP)	--	64.00	35.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	46.0	SPT	30		45.00 - 45.40	78	25	>100	>50		Grey Gravelly Fine to Medium Sand (SP)	--	27.00	69.00	4.00	0.00	Non Plastic			--	--	--	2.61	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.82	76	17	>100	>50																			
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																						
	49.0	SPT	32		48.00 - 48.34	78	19	>100	>50		Grey Fine to Medium Sand (SP)	--	3.00	93.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
49.120	50.0	SPT	33		50.00 - 50.35	75	20	>100	>50																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 9 | **DATE STARTED : 07/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.020 | **DATE COMPLETED : 12/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	SPT: NO. OF BLOWS	SPT: PENETRATION (CM)	SPT: N, VALUE (Recorded)	SPT: N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	GRAIN SIZE ANALYSIS: SAND (%)	GRAIN SIZE ANALYSIS: SILT (%)	GRAIN SIZE ANALYSIS: CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	SHEAR STRENGTH CHARACTERISTICS: Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
99.020	1.0	DS	1	▼	0.00 - 1.00						Grey Gravelly Fine to Medium Sand (SP)	--	13.00	83.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--	--
	2.0	SPT	1	0.40 m	1.50 - 1.95	13	30	13	17		Grey Gravelly Coarse to Medium Sand (SP-SM)	--	46.00	49.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--	--
	3.0	UDS/DS	1		2.50-2.80	Slipped																							
	4.0	SPT	2		3.00 - 3.45	20	30	20	21		Grey Gravelly Coarse to Fine Sand (SP)	DST+	25.00	74.00	1.00	0.00	Non Plastic			--	1.60	--	2.60	--	0.00	32	--	--
94.020	5.0	SPT	3		4.50 - 4.95	23	30	23	22																				
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																							
	7.0	SPT	4		6.00 - 6.45	26	30	26	23		Grey Silty Sand with gravels (SM)	--	17.00	66.00	17.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	33	30	33	26																				
	9.0	UDS/DS	3		8.50 - 8.80	Slipped																							
89.020	10.0	SPT	6		9.00 - 9.45	34	30	34	25		Grey Sandy Gravels (GP-SP)	DST+	52.00	44.00	4.00	0.00	Non Plastic			--	1.65	--	2.62	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	38	30	38	26																				
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped																							
	13.0	SPT	8		12.00 - 12.45	44	30	44	28			--	63.00	33.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	49	30	49	30																				
84.020	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																							
	16.0	SPT	10		15.00 - 15.45	53	30	53	30		Grey Sandy Gravels (GP-GM)	--	55.00	40.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	46	30	46	27																				
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																							
	19.0	SPT	12		18.00 - 18.45	49	30	49	27		Grey Gravelly Coarse to Medium Sand (SP-GP)	DST+	47.00	49.00	4.00	0.00	Non Plastic			--	1.66	--	2.62	--	0.00	33	--	--
79.020	20.0	SPT	13		19.50 - 19.95	54	30	54	28																				
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																							
	22.0	SPT	14		21.00 - 21.45	57	30	57	29		Grey Gravelly Coarse to Medium Sand (SP-SM)	--	29.00	64.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	23.0	SPT	15		22.50 - 22.95	56	30	56	28																				
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																							
74.020	25.0	SPT	16		24.00 - 24.45	62	30	62	29		Grey Gravelly Coarse to Medium Sand (SP)	--	16.00	80.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 9 | **DATE STARTED : 07/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 99.020 | **DATE COMPLETED : 12/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
73.020	26.0	SPT	17		25.50 - 25.95	65	30	65	30		Grey Gravelly Coarse to Medium Sand (SP)																	
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																						
	28.0	SPT	18		27.00 - 27.45	35	30	35	35		Brown Silty Clay of high plasticity (CH)	UU+	0.00	6.00	57.00	37.00	50.30	28.10	22.20	--	1.68	--	--	--	18.50	4	--	--
	29.0	SPT	19		28.50 - 28.95	40	30	40	40																			
69.020	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																						
	31.0	SPT	20		30.00 - 30.45	41	30	41	41																			
	32.0	SPT	21		31.50 - 31.95	45	30	45	45		Brown Clayey Silt of medium plasticity (CI)	UC+	0.00	10.00	63.00	27.00	44.00	26.30	17.70	--	1.70	--	--	--	21.20	--	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																						
	34.0	SPT	22		33.00 - 33.45	46	30	46	46																			
64.020	35.0	SPT	23		34.50 - 34.95	58	30	58	25		Grey Fine to Medium Sand (SP-SM)	--	0.00	88.00	12.00	0.00	Non Plastic			--	--	--	2.64	--	--	--	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																						
	37.0	SPT	24		36.00 - 36.45	59	30	59	24																			
	38.0	SPT	25		37.50 - 37.95	61	30	61	25		Grey Silty Sand (SM)	DST+	0.00	87.00	13.00	0.00	Non Plastic			--	1.64	--	--	--	0.00	33	--	--
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																						
59.020	40.0	SPT	26		39.00 - 39.45	67	30	67	26																			
	41.0	SPT	27		40.50 - 40.95	74	30	74	27			--	0.00	87.00	13.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																						
	43.0	SPT	28		42.00 - 42.40	74	25	>100	>50		Grey Medium to Fine Sand (SP-SM)	--	5.00	88.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.86	77	21	>100	>50																			
54.020	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																						
	46.0	SPT	30		45.00 - 45.45	48	30	48	48		Brown Silty Clay of high plasticity (CH)	UC+	4.00	13.00	46.00	37.00	52.40	28.70	23.70	--	1.71	--	--	--	22.80	--	--	--
	47.0	SPT	31		46.50 - 46.95	54	30	54	54																			
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																						
	49.0	SPT	32		48.00 - 48.45	65	30	65	23		Grey Silty Sand (SM)	--	2.00	83.00	15.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
49.020	50.0	SPT	33		50.00 - 50.45	78	30	78	26																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 10 | **DATE STARTED : 04/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 98.000 | **DATE COMPLETED : 05/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_o	COMPRESSION INDEX C_c
98.000	1.0	DS	1	▼	0.00 - 1.00						Grey Fine to Medium Sand (SP)	--	2.00	94.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1	0.80 m	1.50 - 1.95	16	30	16	19																			
	3.0	UDS/DS	1		2.50-2.80	Slipped																						
	4.0	SPT	2		3.00 - 3.45	19	30	19	20		Grey Fine to Medium Sand (SP-SM)	DST+	2.00	92.00	6.00	0.00	Non Plastic			--	1.60	--	2.62	--	0.00	32	--	--
93.000	5.0	SPT	3		4.50 - 4.95	22	30	22	21																			
	6.0	UDS/DS	2		5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	25	30	25	22		Grey Fine to Medium Sand (SP)	--	9.00	87.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	8.0	SPT	5		7.50 - 7.95	28	30	28	23																			
	9.0	UDS/DS	3		8.50 - 8.80	Slipped				o o o o o o o o	Grey Sandy Gravels (GP)	--	69.00	28.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
88.000	10.0	SPT	6		9.00 - 9.45	38	30	38	27		Grey Fine to Medium Sand (SP-SM)	DST+	8.00	86.00	6.00	0.00	Non Plastic			--	1.63	--	2.62	--	0.00	33	--	--
	11.0	SPT	7		10.50 - 10.95	44	30	44	29																			
	12.0	UDS/DS	4		11.50 - 11.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP-SP)	--	59.00	39.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	13.0	SPT	8		12.00 - 12.45	49	30	49	30		Grey Gravelly Fine to Medium Sand (SP-SM)	--	23.00	69.00	8.00	0.00	Non Plastic			--	--	--	2.63	--	--	--	--	--
	14.0	SPT	9		13.50 - 13.95	35	30	35	23																			
83.000	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped																						
	16.0	SPT	10		15.00 - 15.45	44	30	44	26		Grey Fine to Medium Sand (SP-SM)	DST+	2.00	91.00	7.00	0.00	Non Plastic			--	1.63	--	--	--	0.00	33	--	--
	17.0	SPT	11		16.50 - 16.95	48	30	48	27																			
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	56	30	56	30		Grey Coarse to Medium Sand (SP-SM)	--	7.00	87.00	6.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
78.000	20.0	SPT	13		19.50 - 19.95	61	30	61	31		Grey Fine to Medium Sand (SP-SM)	--	7.00	84.00	9.00	0.00	Non Plastic			--	--	--	2.62	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	63	30	63	31																			
	23.0	SPT	15		22.50 - 22.95	71	30	71	33			DST+	3.00	90.00	7.00	0.00	Non Plastic			--	1.68	--	--	--	0.00	34	--	--
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
73.000	25.0	SPT	16		24.00 - 24.45	75	30	75	34																			

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

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BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 10 | **DATE STARTED : 04/12/2012** | **INDIAN GEOTECHNICAL SERVICES NEW DELHI**

REDUCED LEVEL OF GROUND BORE (M) : 98.000 | **DATE COMPLETED : 05/12/2012**

FIELD TEST RESULTS												LABORATORY TEST RESULTS																	
					SPT TEST RESULTS								GRAIN SIZE ANALYSIS												SHEAR STRENGTH CHARACTERISTICS			
ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_o	COMPRESSION INDEX C_c
72.000	26.0	SPT	17		25.50 - 25.95	81	30	81	35		Grey Fine to Medium Sand (SP-SM)	--	6.00	85.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	82	30	82	35																				
	29.0	SPT	19		28.50 - 28.95	79	30	79	33			DST+	6.00	88.00	6.00	0.00	Non Plastic			--	1.66	--	2.63	--	0.00	34	--	--
68.000	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	87	30	87	35																				
	32.0	SPT	21		31.50 - 31.95	40	30	40	40		Brown Silty Clay of high plasticity (CH)	UU+	0.00	4.00	55.00	41.00	56.70	29.90	26.80	--	1.70	--	2.72	--	21.50	4	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	44	30	44	44																				
63.000	35.0	SPT	23		34.50 - 34.95	49	30	49	49			--	0.00	4.00	53.00	43.00	61.40	31.10	30.30	--	--	--	--	--	--	--	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.45	76	30	76	29		Grey Medium to Fine Sand (SP-SM)	DST+	0.00	89.00	11.00	0.00	Non Plastic			--	1.66	--	--	--	0.00	34	--	--
	38.0	SPT	25		37.50 - 37.95	79	30	79	29																				
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped					Grey Sandy Gravels (GP)	--	93.00	3.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
58.000	40.0	SPT	26		39.00 - 39.45	80	30	80	29		Grey Sandy Gravels (GP-GM)	--	55.00	40.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	41.0	SPT	27		40.50 - 40.90	76	25	>100	>50		Grey Gravelly Fine to Medium Sand (SP-SM-GP)	--	26.00	66.00	8.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.35	77	20	>100	>50			--	46.00	46.00	8.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.87	78	22	>100	>50																				
53.000	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.38	76	23	>100	>50		Grey Silty Sand with gravels (SM)	--	29.00	58.00	13.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.85	80	20	>100	>50		Grey Fine to Medium Sand (SP-SM)	--	4.00	89.00	7.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.36	75	21	>100	>50																				
48.000	50.0	SPT	33		50.00 - 50.33	75	18	>100	>50			--	4.00	87.00	9.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
UU = UNCONSOLIDATED UNDRAINED DST = DIRECT SHEAR TEST DST+ = DIRECT SHEAR TEST (REMOULDED)
UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48 ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LIN BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 11 | **DATE STARTED : 23/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 102.380 | **DATE COMPLETED : 26/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS: DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N, VALUE (Recorded)	N, VALUE (Corrected)	SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTE D IN THE LABORATORY	GRAIN SIZE ANALYSIS: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS: Cohesion, C, (t/sqm.)	Angle of friction (Degrees)	VOID RATIO, e_0	COMPRESSION INDEX C_c
102.380	1.0	DS	1		0.00 - 1.00						Filled Up Soil (Road Materials) 1.50m	--	0.00	74.00	26.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	2.0	SPT	1		1.50 - 1.95	15	30	15	22		Grey Silty Sand (SM)	--	0.00	76.00	24.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	3.0	UDS	1		2.50-2.80							DST	0.00	73.00	27.00	0.00	Non Plastic			1.76	1.55	13.60	2.63	--	0.30	30	--	--
	4.0	SPT	2		3.00 - 3.45	11	30	11	11		Brown Sandy Clayey Silt of low plasticity (CL)	--	0.00	12.00	70.00	18.00	33.60	22.20	11.40	--	--	--	2.67	--	--	--	--	--
97.380	5.0	SPT	3		4.50 - 4.95	9	30	9	9																			
	6.0	UDS/DS	2	6.80 m	5.50 - 5.80	Slipped																						
	7.0	SPT	4		6.00 - 6.45	17	30	17	16		Grey Fine to Medium Sand Sand (SP-SM)	DST+	2.00	91.00	7.00	0.00	Non Plastic			--	1.57	--	2.62	--	0.00	31	--	--
	8.0	SPT	5		7.50 - 7.95	21	30	21	17																			
	9.0	UDS/DS	3		8.50 - 8.80	Slipped																						
92.380	10.0	SPT	6		9.00 - 9.45	24	30	24	18		Grey Fine to medium Sand (SP)	--	4.00	94.00	2.00	0.00	Non Plastic			--	--	--	2.60	--	--	--	--	--
	11.0	SPT	7		10.50 - 10.95	26	30	26	18																			
	12.0	UDS/DS	4		11.50 - 11.80	Slipped																						
	13.0	SPT	8		12.00 - 12.45	33	30	33	21			DST+	7.00	92.00	1.00	0.00	Non Plastic			--	1.61	--	--	--	0.00	32	--	--
	14.0	SPT	9		13.50 - 13.95	48	30	48	26																			
87.380	15.0	UDS/DS	5		14.50 - 14.80	Hard to Penetrate / Slipped				o o o o o o o o	Grey Sandy Gravels (GP)	--	84.00	15.00	1.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	16.0	SPT	10		15.00 - 15.45	58	30	58	29		Grey Gravelly Coarse to Fine Sand (SP)	--	18.00	79.00	3.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	17.0	SPT	11		16.50 - 16.95	51	30	51	26																			
	18.0	UDS/DS	6		17.50 - 17.80	Hard to Penetrate / Slipped																						
	19.0	SPT	12		18.00 - 18.45	43	30	43	23		Grey Coarse to Fine Sand (SP)	DST+	9.00	90.00	1.00	0.00	Non Plastic			--	1.63	--	--	--	0.00	33	--	--
82.380	20.0	SPT	13		19.50 - 19.95	49	30	49	24		Grey Fine to Medium Sand (SP-SM)	--	4.00	91.00	5.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	21.0	UDS/DS	7		20.50 - 20.80	Hard to Penetrate / Slipped																						
	22.0	SPT	14		21.00 - 21.45	54	30	54	26			DST+	9.00	84.00	7.00	0.00	Non Plastic			--	1.65	--	--	--	0.00	33	--	--
	23.0	SPT	15		22.50 - 22.95	60	30	60	27																			
	24.0	UDS/DS	8		23.50 - 23.80	Hard to Penetrate / Slipped																						
77.380	25.0	SPT	16		24.00 - 24.45	67	30	67	29		Grey Fine to Medium Sand (SP)	--	3.00	95.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--

NOTE : 1. CLASSIFICATION OF SOIL AS PER IS : 1498

2. **ABBREVATION USED** : DS = DISTURBED SAMPLE SPT = STANDARD PENETRATION TEST UDS = UNDISTURBED SAMPLE
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UC : UNCONFINED COMPRESSION TEST

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE(RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE LOG CHART AND DATA SHEET

BOREHOLE NO. - 11 | **DATE STARTED : 23/12/2012**

REDUCED LEVEL OF GROUND BORE (M) : 102.380 | **DATE COMPLETED : 26/12/2012**

INDIAN GEOTECHNICAL SERVICES
NEW DELHI

FIELD TEST RESULTS

LABORATORY TEST RESULTS

ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / L.W.L	SPT TEST RESULTS					SYMBOLIC REPRESENTATION	DESCRIPTION OF SOIL WITH I.S. CLASSIFICATION	TYPE OF TEST CONDUCTED IN THE LABORATORY	GRAIN SIZE ANALYSIS				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	BULK DENSITY (t / cum.)	DRY DENSITY (t/cum)	MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELL INDEX, %	SHEAR STRENGTH CHARACTERISTICS		VOID RATIO, e_0	COMPRESSION INDEX C_c
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N. VALUE (Recorded)	N. VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)									Cohesion, C, (t/sqm.)	Angle of friction (Degrees)		
76.380	26.0	SPT	17		25.50 - 25.95	75	30	75	31		Grey Fine to Medium Sand (SP)																		
	27.0	UDS/DS	9		26.50 - 26.80	Hard to Penetrate / Slipped																							
	28.0	SPT	18		27.00 - 27.45	84	30	84	33		Grey Fine to Medium Sand (SP-SM)	DST+	0.00	91.00	9.00	0.00	Non Plastic			--	1.67	--	--	--	0.00	34	--	--
	29.0	SPT	19		28.50 - 28.95	92	30	92	35		Grey Fine to Medium Sand (SP)	--	4.00	94.00	2.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
72.380	30.0	UDS/DS	10		29.50 - 29.80	Hard to Penetrate / Slipped																							
	31.0	SPT	20		30.00 - 30.45	51	30	51	51		Brown Sandy Clayey Silt / Silty Clay of medium plasticity (CI)	--	2.00	27.00	43.00	28.00	44.90	26.70	18.20	--	--	--	2.68	--	--	--	--	--
	32.0	SPT	21		31.50 - 31.95	58	30	58	24		Grey Fine to Medium Sand (SP-SM)	--	0.00	88.00	12.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	33.0	UDS/DS	11		32.50 - 32.80	Hard to Penetrate / Slipped																							
	34.0	SPT	22		33.00 - 33.45	67	30	67	26																				
67.380	35.0	SPT	23		34.50 - 34.95	35	30	35	35		Brown Clayey Sandy Silt / Silty Clay of medium plasticity (CI)	UU+	0.00	29.00	47.00	24.00	38.60	24.70	13.90	--	1.68	--	--	--	15.50	8	--	--
	36.0	UDS/DS	12		35.50 - 35.80	Hard to Penetrate / Slipped																							
	37.0	SPT	24		36.00 - 36.45	40	30	40	40		Brown Silty Clay with sand of high plasticity (CH)	UC+	0.00	16.00	45.00	39.00	53.40	29.20	24.20	--	1.70	--	2.71	--	20.00	--	--	--
	38.0	SPT	25		37.50 - 37.95	46	30	46	46																				
	39.0	UDS/DS	13		38.50 - 38.80	Hard to Penetrate / Slipped																							
62.380	40.0	SPT	26		39.00 - 39.45	60	30	60	23		Grey Medium to Fine Sand (SP-SM)	DST+	0.00	92.00	8.00	0.00	Non Plastic			--	1.63	--	--	--	0.00	33	--	--
	41.0	SPT	27		40.50 - 40.90	83	25	>100	>50																				
	42.0	UDS/DS	14		41.50 - 41.80	Hard to Penetrate / Slipped																							
	43.0	SPT	28		42.00 - 42.35	85	20	>100	>50		Grey Fine to Medium Sand (SP)	--	2.00	94.00	4.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	44.0	SPT	29		43.50 - 43.80	75	15	>100	>50																				
57.380	45.0	UDS/DS	15		44.50 - 44.80	Hard to Penetrate / Slipped																							
	46.0	SPT	30		45.00 - 45.34	79	19	>100	>50		Grey Silty Sand (SM)	--	3.00	83.00	14.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
	47.0	SPT	31		46.50 - 46.75	75	10	>100	>50																				
	48.0	UDS/DS	16		47.50 - 47.80	Hard to Penetrate / Slipped																							
	49.0	SPT	32		48.00 - 48.20	76	5	>100	>50		Grey Fine to Medium Sand (SP-SM)	--	5.00	89.00	6.00	0.00	Non Plastic			--	--	--	--	--	--	--	--	--
52.380	50.0	SPT	33		50.00 - 50.15	75	15	>100	>50																				

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BORE LOG CHART AND DATA SHEET

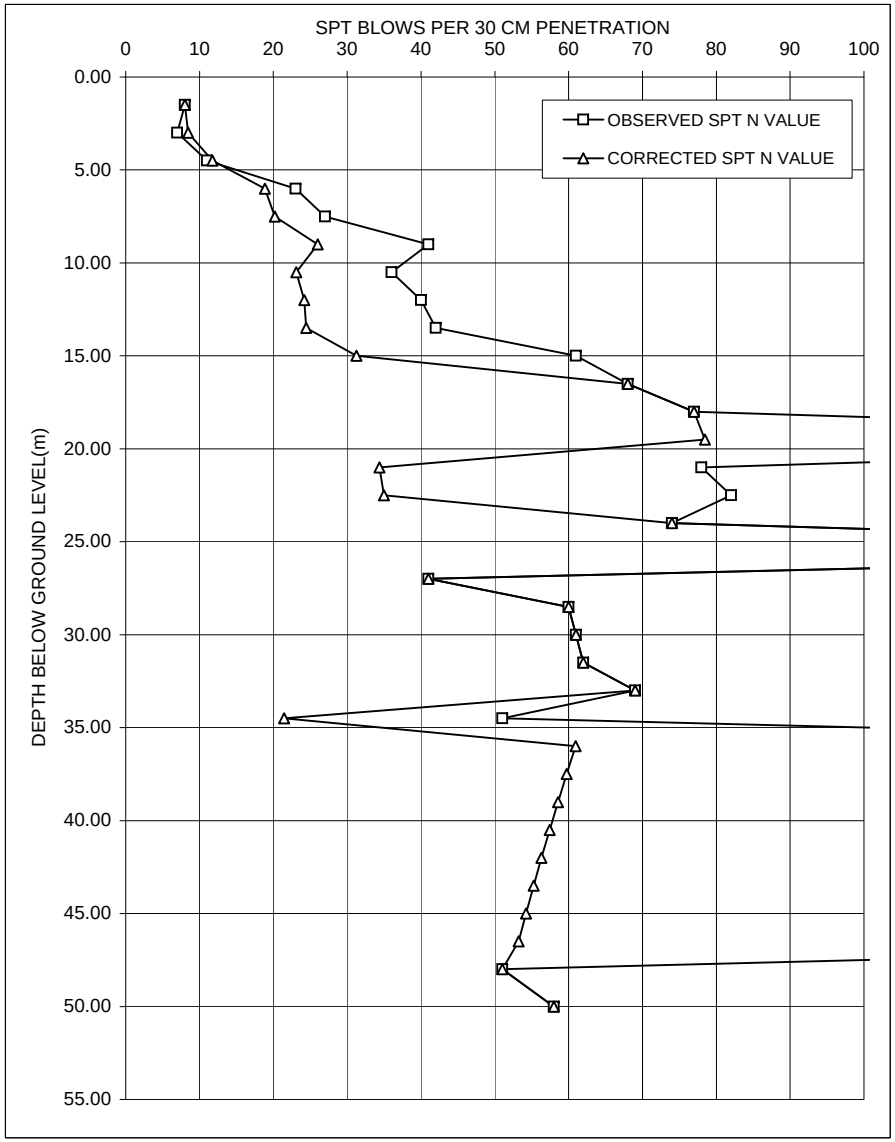
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 1 **GWT depth below EGL (m) : 5.20**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Plastic	1.80	2.70	0.270	1.00	8	8.00	8
3.00	Non Plastic	1.80	5.40	0.540	1.21	7	8.45	8
4.50	Non Plastic	1.90	8.25	0.825	1.07	11	11.73	12
6.00	Non Plastic	2.00	10.45	1.045	0.99	23	22.70	19
7.50	Non Plastic	2.00	11.95	1.195	0.94	27	25.44	20
9.00	Non Plastic	2.00	13.45	1.345	0.90	41	37.01	26
10.50	Non Plastic	2.00	14.95	1.495	0.87	36	31.22	23
12.00	Non Plastic	2.00	16.45	1.645	0.84	40	33.41	24
13.50	Non Plastic	2.00	17.95	1.795	0.81	42	33.86	24
15.00	Non Plastic	2.00	19.45	1.945	0.78	61	47.54	31
16.50	Plastic	2.00	20.95	2.095	1.00	68	68.00	68
18.00	Plastic	2.00	22.45	2.245	1.00	77	77.00	77
19.50	Non Plastic	2.00	23.95	2.395	0.71	200	141.95	78
21.00	Non Plastic	2.00	25.45	2.545	0.69	78	53.77	34
22.50	Non Plastic	2.00	26.95	2.695	0.67	82	54.96	35
24.00	Plastic	2.00	28.45	2.845	1.00	74	74.00	74
25.50	Plastic	2.00	29.95	2.995	1.00	200	200.00	200
27.00	Plastic	2.00	31.45	3.145	1.00	41	41.00	41
28.50	Plastic	2.00	32.95	3.295	1.00	60	60.00	60
30.00	Plastic	2.00	34.45	3.445	1.00	61	61.00	61
31.50	Plastic	2.00	35.95	3.595	1.00	62	62.00	62
33.00	Plastic	2.00	37.45	3.745	1.00	69	69.00	69
34.50	Non Plastic	2.00	38.95	3.895	0.55	51	27.90	21
36.00	Non Plastic	2.00	40.45	4.045	0.53	200	106.89	61
37.50	Non Plastic	2.00	41.95	4.195	0.52	200	104.46	60
39.00	Non Plastic	2.00	43.45	4.345	0.51	200	102.11	59
40.50	Non Plastic	2.00	44.95	4.495	0.50	200	99.84	57
42.00	Non Plastic	2.00	46.45	4.645	0.49	200	97.64	56
43.50	Non Plastic	2.00	47.95	4.795	0.48	200	95.52	55
45.00	Non Plastic	2.00	49.45	4.945	0.47	200	93.46	54
46.50	Non Plastic	2.00	50.95	5.095	0.46	200	91.46	53
48.00	Plastic	3.00	53.95	5.395	1.00	51	51.00	51
50.00	Plastic	3.00	57.95	5.795	1.00	58	58.00	58



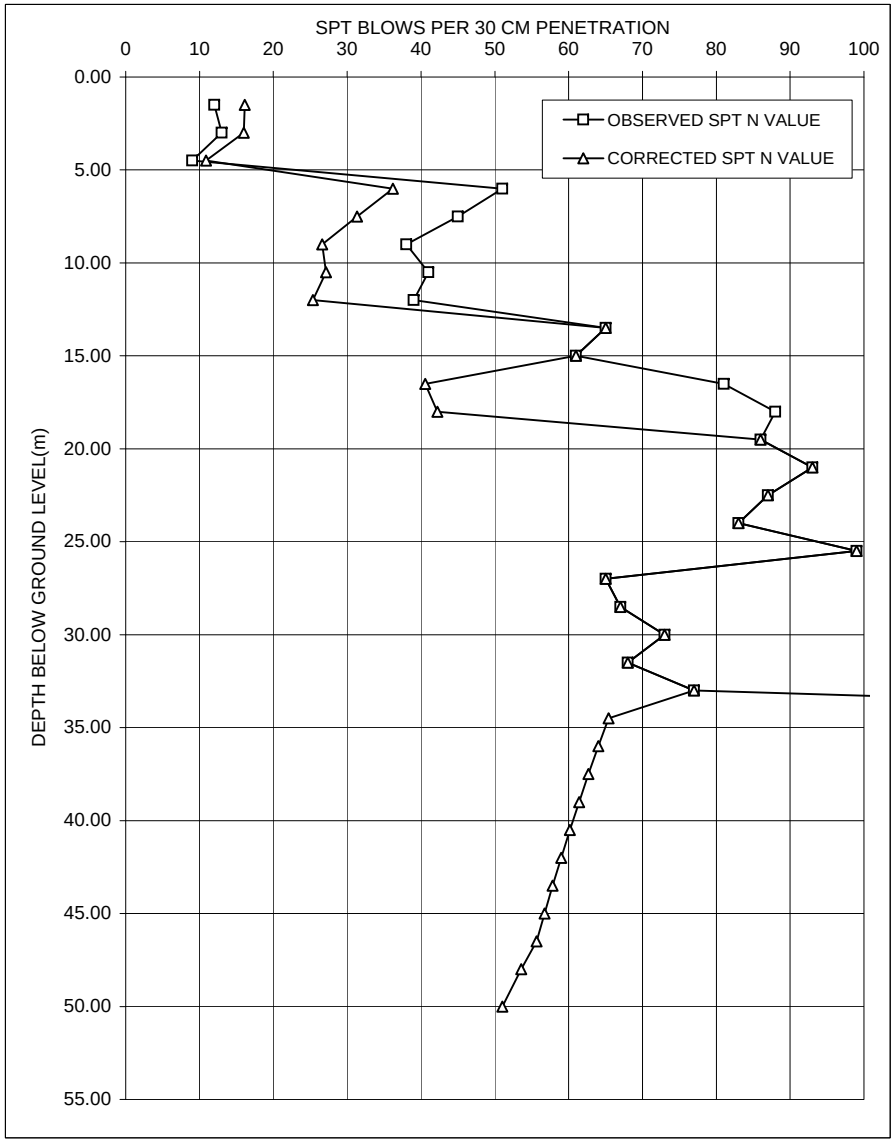
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 2 **GWT depth below EGL (m) : 1.35**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.90	2.70	0.270	1.44	12	17.28	16
3.00	Non Plastic	1.90	4.05	0.405	1.30	13	16.95	16
4.50	Non Plastic	1.90	5.40	0.540	1.21	9	10.87	11
6.00	Non Plastic	2.00	6.90	0.690	1.13	51	57.42	36
7.50	Non Plastic	2.00	8.40	0.840	1.06	45	47.70	31
9.00	Non Plastic	2.00	9.90	0.990	1.01	38	38.20	27
10.50	Non Plastic	2.00	11.40	1.140	0.96	41	39.28	27
12.00	Non Plastic	2.00	12.90	1.290	0.92	39	35.75	25
13.50	Plastic	2.00	14.40	1.440	1.00	65	65.00	65
15.00	Plastic	2.00	15.90	1.590	1.00	61	61.00	61
16.50	Non Plastic	2.00	17.40	1.740	0.82	81	66.14	41
18.00	Non Plastic	2.00	18.90	1.890	0.79	88	69.42	42
19.50	Plastic	2.00	20.40	2.040	1.00	86	86.00	86
21.00	Plastic	2.00	21.90	2.190	1.00	93	93.00	93
22.50	Plastic	2.00	23.40	2.340	1.00	87	87.00	87
24.00	Plastic	2.00	24.90	2.490	1.00	83	83.00	83
25.50	Plastic	2.00	26.40	2.640	1.00	99	99.00	99
27.00	Plastic	2.00	27.90	2.790	1.00	65	65.00	65
28.50	Plastic	2.00	29.40	2.940	1.00	67	67.00	67
30.00	Plastic	2.00	30.90	3.090	1.00	73	73.00	73
31.50	Plastic	2.00	32.40	3.240	1.00	68	68.00	68
33.00	Plastic	2.00	33.90	3.390	1.00	77	77.00	77
34.50	Non Plastic	2.00	35.40	3.540	0.58	200	115.81	65
36.00	Non Plastic	2.00	36.90	3.690	0.57	200	113.04	64
37.50	Non Plastic	2.00	38.40	3.840	0.55	200	110.37	63
39.00	Non Plastic	2.00	39.90	3.990	0.54	200	107.81	61
40.50	Non Plastic	2.00	41.40	4.140	0.53	200	105.34	60
42.00	Non Plastic	2.00	42.90	4.290	0.51	200	102.96	59
43.50	Non Plastic	2.00	44.40	4.440	0.50	200	100.66	58
45.00	Non Plastic	2.00	45.90	4.590	0.49	200	98.44	57
46.50	Non Plastic	2.00	47.40	4.740	0.48	200	96.29	56
48.00	Non Plastic	3.00	50.40	5.040	0.46	200	92.18	54
50.00	Non Plastic	3.00	54.40	5.440	0.44	200	87.08	51



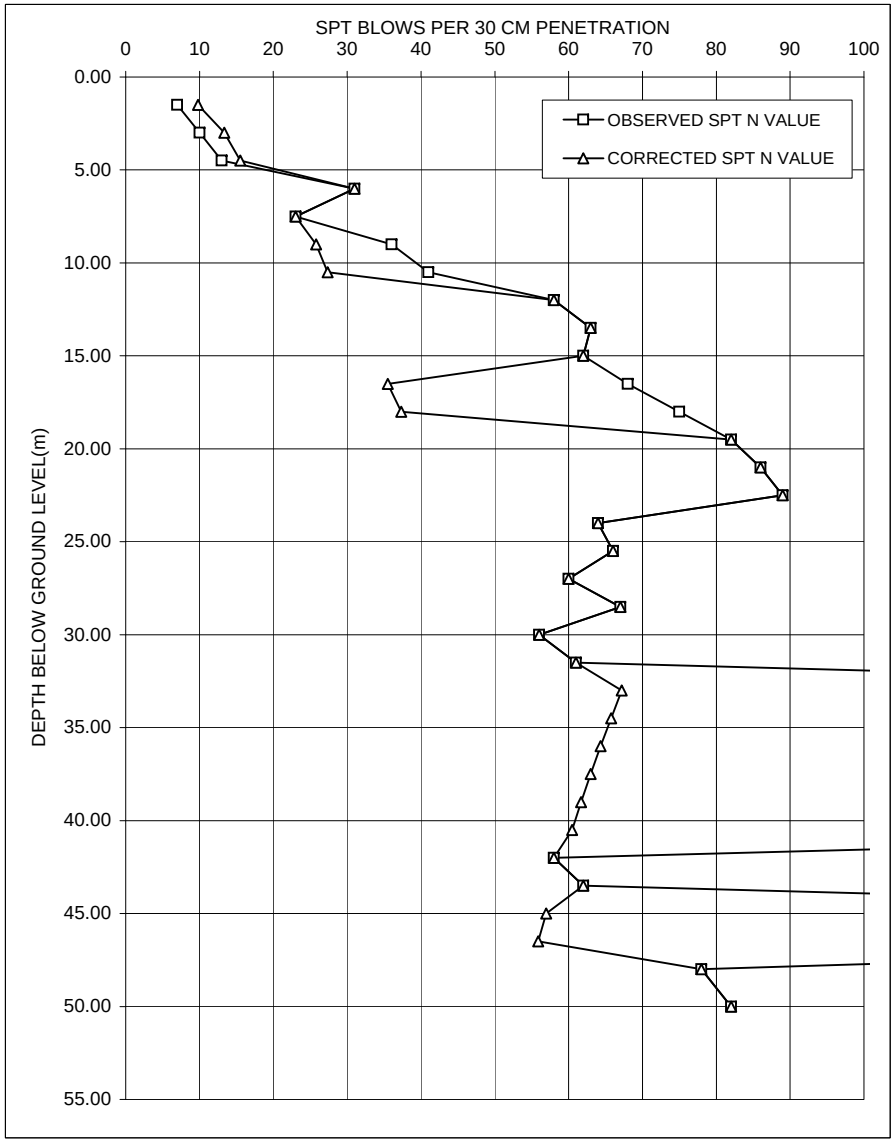
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 3 **GWT depth below EGL (m) : 1.15**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	2.35	0.235	1.40	7	9.80	10
3.00	Non Plastic	1.90	3.70	0.370	1.33	10	13.34	13
4.50	Non Plastic	1.90	5.05	0.505	1.23	13	15.99	15
6.00	Plastic	2.00	6.55	0.655	1.00	31	31.00	31
7.50	Plastic	2.00	8.05	0.805	1.00	23	23.00	23
9.00	Non Plastic	2.00	9.55	0.955	1.02	36	36.62	26
10.50	Non Plastic	2.00	11.05	1.105	0.97	41	39.70	27
12.00	Plastic	2.00	12.55	1.255	1.00	58	58.00	58
13.50	Plastic	2.00	14.05	1.405	1.00	63	63.00	63
15.00	Plastic	2.00	15.55	1.555	1.00	62	62.00	62
16.50	Non Plastic	2.00	17.05	1.705	0.82	68	55.99	35
18.00	Non Plastic	2.00	18.55	1.855	0.80	75	59.64	37
19.50	Plastic	2.00	20.05	2.005	1.00	82	82.00	82
21.00	Plastic	2.00	21.55	2.155	1.00	86	86.00	86
22.50	Plastic	2.00	23.05	2.305	1.00	89	89.00	89
24.00	Plastic	2.00	24.55	2.455	1.00	64	64.00	64
25.50	Plastic	2.00	26.05	2.605	1.00	66	66.00	66
27.00	Plastic	2.00	27.55	2.755	1.00	60	60.00	60
28.50	Plastic	2.00	29.05	2.905	1.00	67	67.00	67
30.00	Plastic	2.00	30.55	3.055	1.00	56	56.00	56
31.50	Plastic	2.00	32.05	3.205	1.00	61	61.00	61
33.00	Non Plastic	2.00	33.55	3.355	0.60	200	119.40	67
34.50	Non Plastic	2.00	35.05	3.505	0.58	200	116.48	66
36.00	Non Plastic	2.00	36.55	3.655	0.57	200	113.67	64
37.50	Non Plastic	2.00	38.05	3.805	0.55	200	110.98	63
39.00	Non Plastic	2.00	39.55	3.955	0.54	200	108.40	62
40.50	Non Plastic	2.00	41.05	4.105	0.53	200	105.91	60
42.00	Plastic	2.00	42.55	4.255	1.00	58	58.00	58
43.50	Plastic	2.00	44.05	4.405	1.00	62	62.00	62
45.00	Non Plastic	2.00	45.55	4.555	0.49	200	98.95	57
46.50	Non Plastic	2.00	47.05	4.705	0.48	200	96.78	56
48.00	Plastic	3.00	50.05	5.005	1.00	78	78.00	78
50.00	Plastic	3.00	54.05	5.405	1.00	82	82.00	82



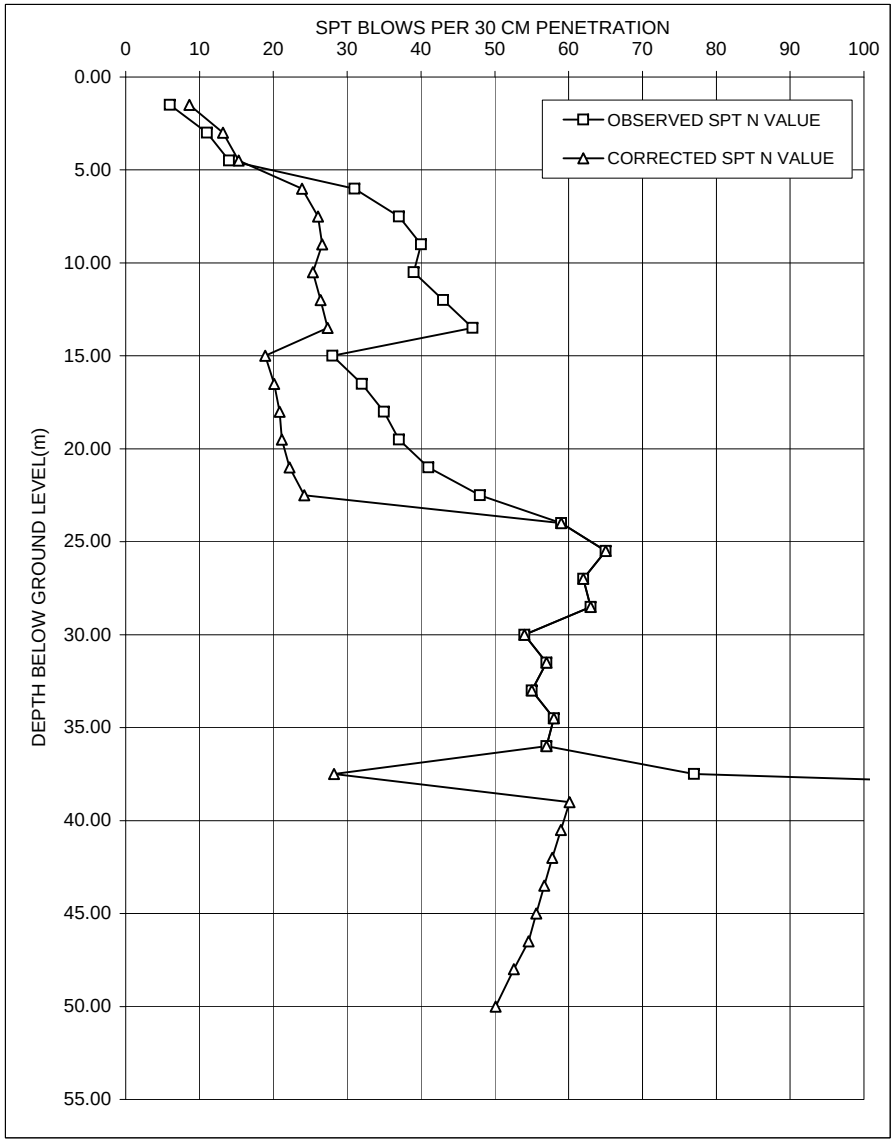
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 4 **GWT depth below EGL (m) : 3.20**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	2.70	0.270	1.44	6	8.64	9
3.00	Non Plastic	1.90	5.55	0.555	1.20	11	13.19	13
4.50	Non Plastic	1.90	7.10	0.710	1.12	14	15.63	15
6.00	Non Plastic	1.90	8.45	0.845	1.06	31	32.80	24
7.50	Non Plastic	2.00	9.95	0.995	1.00	37	37.13	26
9.00	Non Plastic	2.00	11.45	1.145	0.96	40	38.26	27
10.50	Non Plastic	2.00	12.95	1.295	0.92	39	35.70	25
12.00	Non Plastic	2.00	14.45	1.445	0.88	43	37.78	26
13.50	Non Plastic	2.00	15.95	1.595	0.85	47	39.75	27
15.00	Non Plastic	2.00	17.45	1.745	0.82	28	22.84	19
16.50	Non Plastic	2.00	18.95	1.895	0.79	32	25.22	20
18.00	Non Plastic	2.00	20.45	2.045	0.76	35	26.69	21
19.50	Non Plastic	2.00	21.95	2.195	0.74	37	27.34	21
21.00	Non Plastic	2.00	23.45	2.345	0.72	41	29.39	22
22.50	Non Plastic	2.00	24.95	2.495	0.70	48	33.41	24
24.00	Plastic	2.00	26.45	2.645	1.00	59	59.00	59
25.50	Plastic	2.00	27.95	2.795	1.00	65	65.00	65
27.00	Plastic	2.00	29.45	2.945	1.00	62	62.00	62
28.50	Plastic	2.00	30.95	3.095	1.00	63	63.00	63
30.00	Plastic	2.00	32.45	3.245	1.00	54	54.00	54
31.50	Plastic	2.00	33.95	3.395	1.00	57	57.00	57
33.00	Plastic	2.00	35.45	3.545	1.00	55	55.00	55
34.50	Plastic	2.00	36.95	3.695	1.00	58	58.00	58
36.00	Plastic	2.00	38.45	3.845	1.00	57	57.00	57
37.50	Non Plastic	2.00	39.95	3.995	0.54	77	41.47	28
39.00	Non Plastic	2.00	41.45	4.145	0.53	200	105.26	60
40.50	Non Plastic	2.00	42.95	4.295	0.51	200	102.88	59
42.00	Non Plastic	2.00	44.45	4.445	0.50	200	100.59	58
43.50	Non Plastic	2.00	45.95	4.595	0.49	200	98.37	57
45.00	Non Plastic	2.00	47.45	4.745	0.48	200	96.22	56
46.50	Non Plastic	2.00	48.95	4.895	0.47	200	94.14	55
48.00	Non Plastic	3.00	51.95	5.195	0.45	200	90.16	53
50.00	Non Plastic	3.00	55.95	5.595	0.43	200	85.20	50



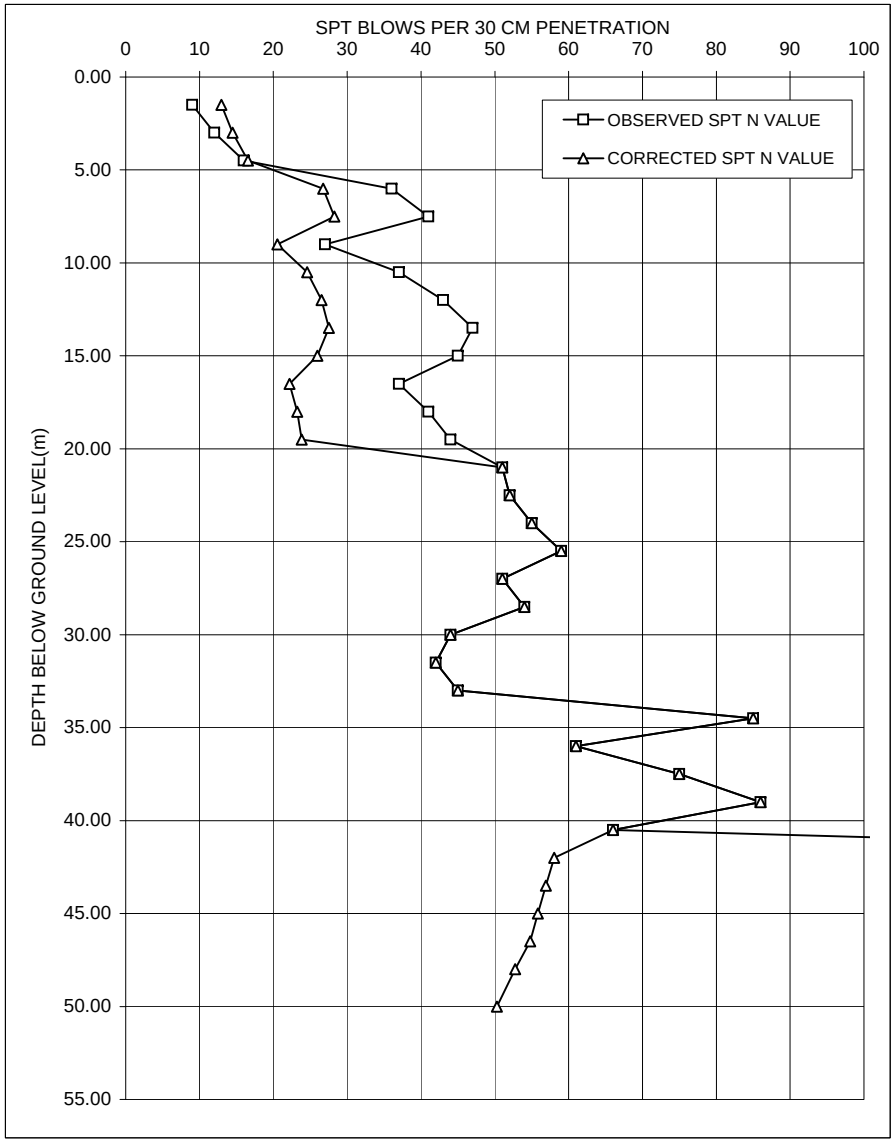
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 5 **GWT depth below EGL (m) : 2.90**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	2.70	0.270	1.44	9	12.96	13
3.00	Non Plastic	1.90	5.45	0.545	1.20	12	14.46	14
4.50	Non Plastic	1.90	6.80	0.680	1.13	16	18.09	17
6.00	Non Plastic	1.90	8.15	0.815	1.07	36	38.53	27
7.50	Non Plastic	2.00	9.65	0.965	1.01	41	41.56	28
9.00	Non Plastic	2.00	11.15	1.115	0.97	27	26.07	21
10.50	Non Plastic	2.00	12.65	1.265	0.92	37	34.16	25
12.00	Non Plastic	2.00	14.15	1.415	0.89	43	38.09	27
13.50	Non Plastic	2.00	15.65	1.565	0.85	47	40.04	28
15.00	Non Plastic	2.00	17.15	1.715	0.82	45	36.96	26
16.50	Non Plastic	2.00	18.65	1.865	0.79	37	29.35	22
18.00	Non Plastic	2.00	20.15	2.015	0.77	41	31.47	23
19.50	Non Plastic	2.00	21.65	2.165	0.74	44	32.71	24
21.00	Plastic	2.00	23.15	2.315	1.00	51	51.00	51
22.50	Plastic	2.00	24.65	2.465	1.00	52	52.00	52
24.00	Plastic	2.00	26.15	2.615	1.00	55	55.00	55
25.50	Plastic	2.00	27.65	2.765	1.00	59	59.00	59
27.00	Plastic	2.00	29.15	2.915	1.00	51	51.00	51
28.50	Plastic	2.00	30.65	3.065	1.00	54	54.00	54
30.00	Plastic	2.00	32.15	3.215	1.00	44	44.00	44
31.50	Plastic	2.00	33.65	3.365	1.00	42	42.00	42
33.00	Plastic	2.00	35.15	3.515	1.00	45	45.00	45
34.50	Plastic	2.00	36.65	3.665	1.00	85	85.00	85
36.00	Plastic	2.00	38.15	3.815	1.00	61	61.00	61
37.50	Plastic	2.00	39.65	3.965	1.00	75	75.00	75
39.00	Plastic	2.00	41.15	4.115	1.00	86	86.00	86
40.50	Plastic	2.00	42.65	4.265	1.00	66	66.00	66
42.00	Non Plastic	2.00	44.15	4.415	0.51	200	101.04	58
43.50	Non Plastic	2.00	45.65	4.565	0.49	200	98.80	57
45.00	Non Plastic	2.00	47.15	4.715	0.48	200	96.64	56
46.50	Non Plastic	2.00	48.65	4.865	0.47	200	94.55	55
48.00	Non Plastic	3.00	51.65	5.165	0.45	200	90.55	53
50.00	Non Plastic	3.00	55.65	5.565	0.43	200	85.56	50



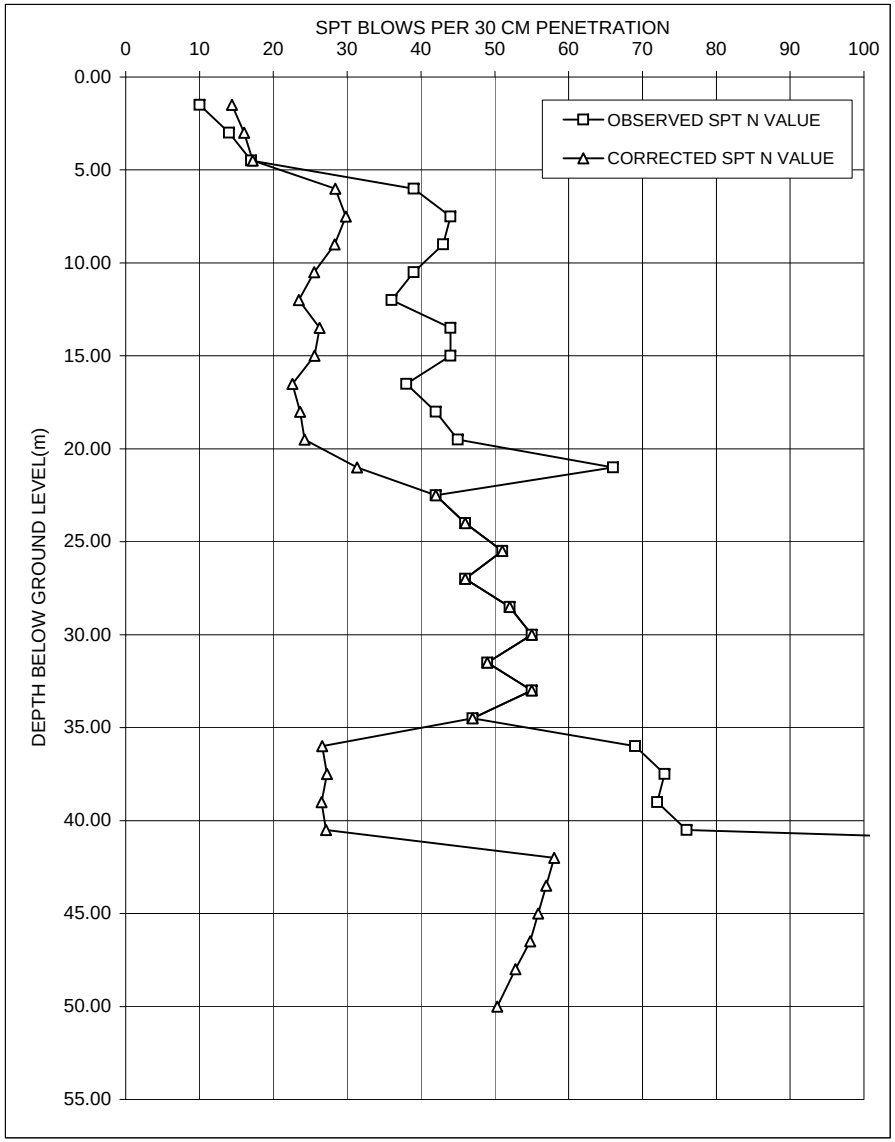
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 6 **GWT depth below EGL (m) : 2.70**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	2.70	0.270	1.44	10	14.40	14
3.00	Non Plastic	1.90	5.25	0.525	1.22	14	17.04	16
4.50	Non Plastic	1.90	6.60	0.660	1.14	17	19.39	17
6.00	Non Plastic	2.00	8.10	0.810	1.07	39	41.82	28
7.50	Non Plastic	2.00	9.60	0.960	1.02	44	44.68	30
9.00	Non Plastic	2.00	11.10	1.110	0.97	43	41.58	28
10.50	Non Plastic	2.00	12.60	1.260	0.92	39	36.06	26
12.00	Non Plastic	2.00	14.10	1.410	0.89	36	31.93	23
13.50	Non Plastic	2.00	15.60	1.560	0.85	44	37.54	26
15.00	Non Plastic	2.00	17.10	1.710	0.82	44	36.18	26
16.50	Non Plastic	2.00	18.60	1.860	0.79	38	30.18	23
18.00	Non Plastic	2.00	20.10	2.010	0.77	42	32.27	24
19.50	Non Plastic	2.00	21.60	2.160	0.74	45	33.49	24
21.00	Non Plastic	2.00	23.10	2.310	0.72	66	47.64	31
22.50	Plastic	2.00	24.60	2.460	1.00	42	42.00	42
24.00	Plastic	2.00	26.10	2.610	1.00	46	46.00	46
25.50	Plastic	2.00	27.60	2.760	1.00	51	51.00	51
27.00	Plastic	2.00	29.10	2.910	1.00	46	46.00	46
28.50	Plastic	2.00	30.60	3.060	1.00	52	52.00	52
30.00	Plastic	2.00	32.10	3.210	1.00	55	55.00	55
31.50	Plastic	2.00	33.60	3.360	1.00	49	49.00	49
33.00	Plastic	2.00	35.10	3.510	1.00	55	55.00	55
34.50	Plastic	2.00	36.60	3.660	1.00	47	47.00	47
36.00	Non Plastic	2.00	38.10	3.810	0.55	69	38.26	27
37.50	Non Plastic	2.00	39.60	3.960	0.54	73	39.53	27
39.00	Non Plastic	2.00	41.10	4.110	0.53	72	38.10	27
40.50	Non Plastic	2.00	42.60	4.260	0.52	76	39.30	27
42.00	Non Plastic	2.00	44.10	4.410	0.51	200	101.12	58
43.50	Non Plastic	2.00	45.60	4.560	0.49	200	98.88	57
45.00	Non Plastic	2.00	47.10	4.710	0.48	200	96.71	56
46.50	Non Plastic	2.00	48.60	4.860	0.47	200	94.62	55
48.00	Non Plastic	3.00	51.60	5.160	0.45	200	90.61	53
50.00	Non Plastic	3.00	55.60	5.560	0.43	200	85.62	50



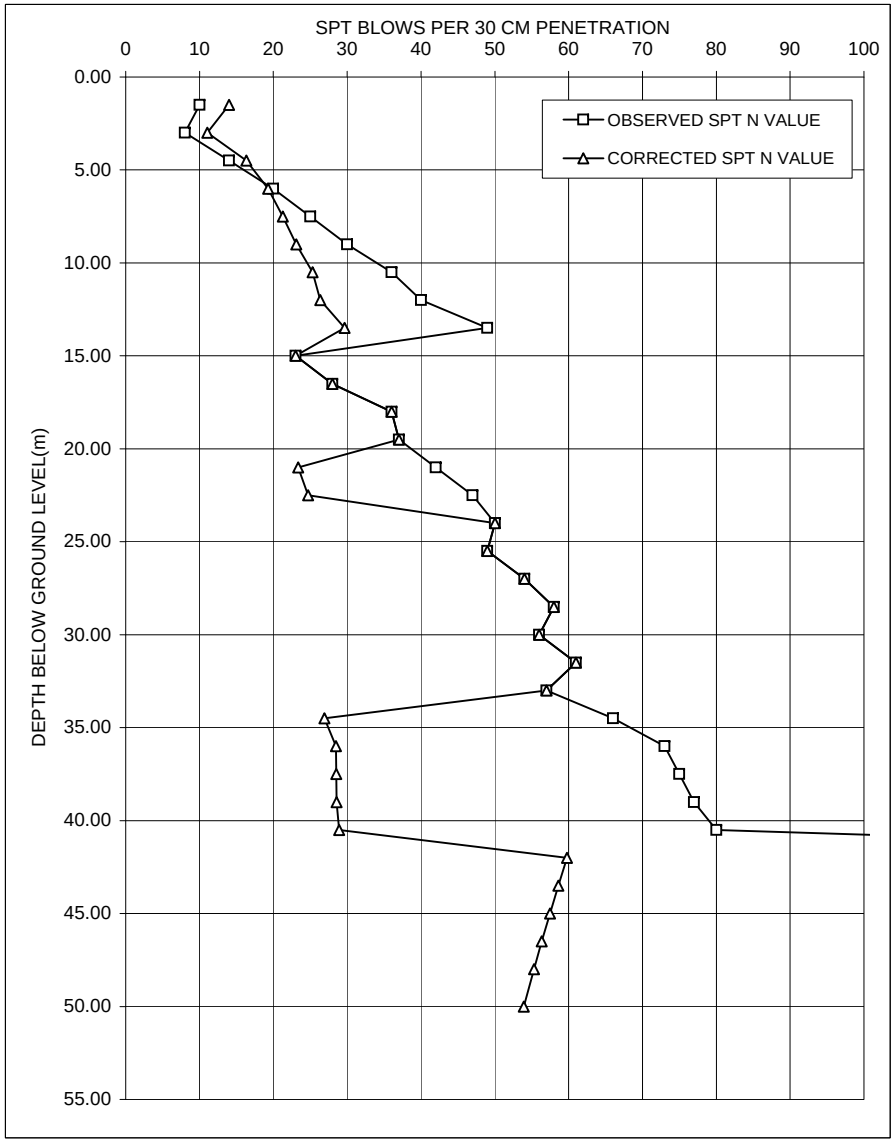
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 7 **GWT depth below EGL (m) : 0.80**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	2.00	0.200	1.40	10	14.00	14
3.00	Non Plastic	1.80	3.20	0.320	1.38	8	11.06	11
4.50	Non Plastic	1.90	4.55	0.455	1.27	14	17.71	16
6.00	Non Plastic	1.90	5.90	0.590	1.18	20	23.56	19
7.50	Non Plastic	2.00	7.40	0.740	1.10	25	27.56	21
9.00	Non Plastic	2.00	8.90	0.890	1.04	30	31.22	23
10.50	Non Plastic	2.00	10.40	1.040	0.99	36	35.59	25
12.00	Non Plastic	2.00	11.90	1.190	0.94	40	37.74	26
13.50	Non Plastic	2.00	13.40	1.340	0.90	49	44.29	30
15.00	Plastic	2.00	14.90	1.490	1.00	23	23.00	23
16.50	Plastic	2.00	16.40	1.640	1.00	28	28.00	28
18.00	Plastic	2.00	17.90	1.790	1.00	36	36.00	36
19.50	Plastic	2.00	19.40	1.940	1.00	37	37.00	37
21.00	Non Plastic	2.00	20.90	2.090	0.76	42	31.72	23
22.50	Non Plastic	2.00	22.40	2.240	0.73	47	34.41	25
24.00	Plastic	2.00	23.90	2.390	1.00	50	50.00	50
25.50	Plastic	2.00	25.40	2.540	1.00	49	49.00	49
27.00	Plastic	2.00	26.90	2.690	1.00	54	54.00	54
28.50	Plastic	2.00	28.40	2.840	1.00	58	58.00	58
30.00	Plastic	2.00	29.90	2.990	1.00	56	56.00	56
31.50	Plastic	2.00	31.40	3.140	1.00	61	61.00	61
33.00	Plastic	2.00	32.90	3.290	1.00	57	57.00	57
34.50	Non Plastic	2.00	34.40	3.440	0.59	66	38.85	27
36.00	Non Plastic	2.00	35.90	3.590	0.57	73	41.93	28
37.50	Non Plastic	2.00	37.40	3.740	0.56	75	42.05	29
39.00	Non Plastic	2.00	38.90	3.890	0.55	77	42.16	29
40.50	Non Plastic	2.00	40.40	4.040	0.53	80	42.79	29
42.00	Non Plastic	2.00	41.90	4.190	0.52	200	104.54	60
43.50	Non Plastic	2.00	43.40	4.340	0.51	200	102.19	59
45.00	Non Plastic	2.00	44.90	4.490	0.50	200	99.91	57
46.50	Non Plastic	2.00	46.40	4.640	0.49	200	97.71	56
48.00	Non Plastic	2.00	47.90	4.790	0.48	200	95.59	55
50.00	Non Plastic	2.00	49.90	4.990	0.46	200	92.85	54



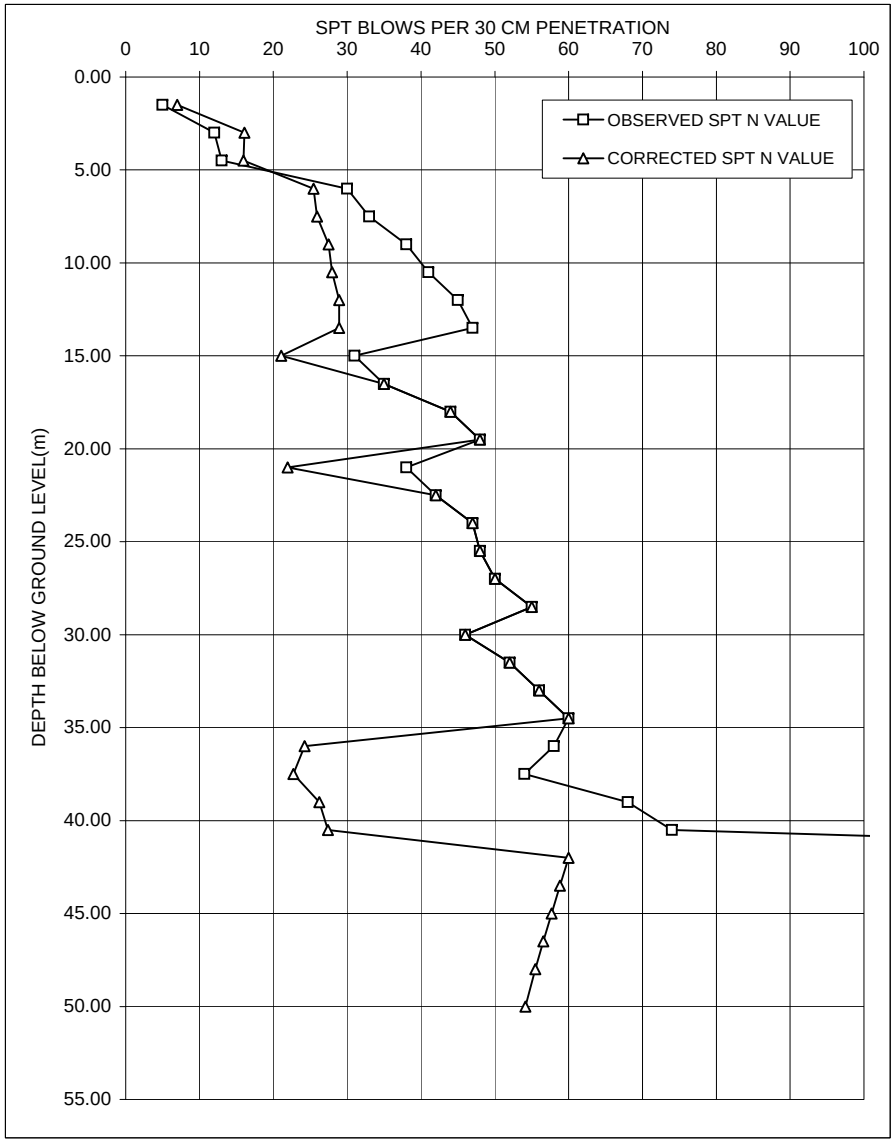
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 8 **GWT depth below EGL (m) : 0.20**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.80	1.40	0.140	1.40	5	7.00	7
3.00	Non Plastic	1.90	2.75	0.275	1.43	12	17.20	16
4.50	Non Plastic	1.90	4.10	0.410	1.30	13	16.90	16
6.00	Non Plastic	2.00	5.60	0.560	1.20	30	35.87	25
7.50	Non Plastic	2.00	7.10	0.710	1.12	33	36.84	26
9.00	Non Plastic	2.00	8.60	0.860	1.05	38	39.98	27
10.50	Non Plastic	2.00	10.10	1.010	1.00	41	40.94	28
12.00	Non Plastic	2.00	11.60	1.160	0.95	45	42.85	29
13.50	Non Plastic	2.00	13.10	1.310	0.91	47	42.84	29
15.00	Non Plastic	2.00	14.60	1.460	0.88	31	27.13	21
16.50	Plastic	2.00	16.10	1.610	1.00	35	35.00	35
18.00	Plastic	2.00	17.60	1.760	1.00	44	44.00	44
19.50	Plastic	2.00	19.10	1.910	1.00	48	48.00	48
21.00	Non Plastic	2.00	20.60	2.060	0.76	38	28.88	22
22.50	Plastic	2.00	22.10	2.210	1.00	42	42.00	42
24.00	Plastic	2.00	23.60	2.360	1.00	47	47.00	47
25.50	Plastic	2.00	25.10	2.510	1.00	48	48.00	48
27.00	Plastic	2.00	26.60	2.660	1.00	50	50.00	50
28.50	Plastic	2.00	28.10	2.810	1.00	55	55.00	55
30.00	Plastic	2.00	29.60	2.960	1.00	46	46.00	46
31.50	Plastic	2.00	31.10	3.110	1.00	52	52.00	52
33.00	Plastic	2.00	32.60	3.260	1.00	56	56.00	56
34.50	Plastic	2.00	34.10	3.410	1.00	60	60.00	60
36.00	Non Plastic	2.00	35.60	3.560	0.58	58	33.48	24
37.50	Non Plastic	2.00	37.10	3.710	0.56	54	30.42	23
39.00	Non Plastic	2.00	38.60	3.860	0.55	68	37.41	26
40.50	Non Plastic	2.00	40.10	4.010	0.54	74	39.77	27
42.00	Non Plastic	2.00	41.60	4.160	0.53	200	105.02	60
43.50	Non Plastic	2.00	43.10	4.310	0.51	200	102.65	59
45.00	Non Plastic	2.00	44.60	4.460	0.50	200	100.36	58
46.50	Non Plastic	2.00	46.10	4.610	0.49	200	98.15	57
48.00	Non Plastic	2.00	47.60	4.760	0.48	200	96.01	56
50.00	Non Plastic	2.00	49.60	4.960	0.47	200	93.25	54



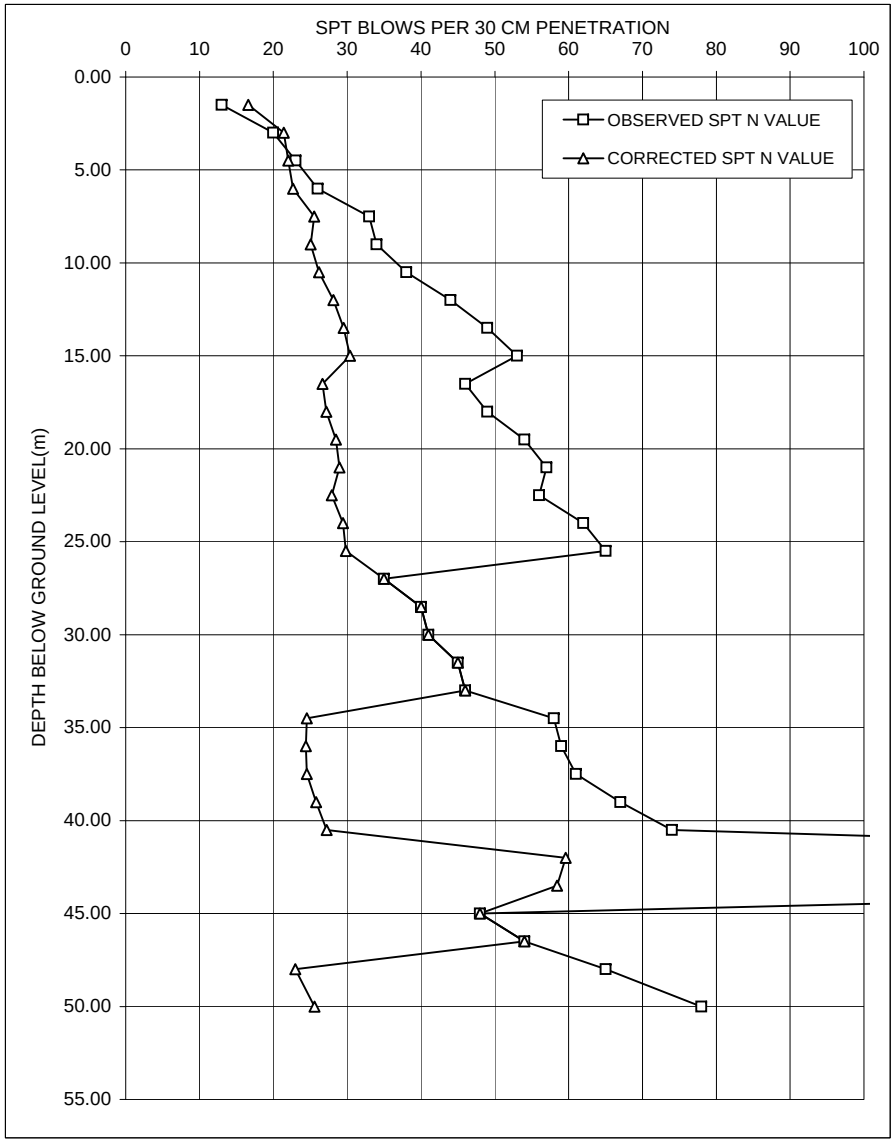
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 9 **GWT depth below EGL (m) : 0.40**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.90	1.75	0.175	1.40	13	18.20	17
3.00	Non Plastic	1.90	3.10	0.310	1.39	20	27.87	21
4.50	Non Plastic	2.00	4.60	0.460	1.26	23	29.01	22
6.00	Non Plastic	2.00	6.10	0.610	1.17	26	30.34	23
7.50	Non Plastic	2.00	7.60	0.760	1.09	33	36.09	26
9.00	Non Plastic	2.00	9.10	0.910	1.03	34	35.13	25
10.50	Non Plastic	2.00	10.60	1.060	0.98	38	37.33	26
12.00	Non Plastic	2.00	12.10	1.210	0.94	44	41.27	28
13.50	Non Plastic	2.00	13.60	1.360	0.90	49	44.05	30
15.00	Non Plastic	2.00	15.10	1.510	0.86	53	45.79	30
16.50	Non Plastic	2.00	16.60	1.660	0.83	46	38.29	27
18.00	Non Plastic	2.00	18.10	1.810	0.80	49	39.37	27
19.50	Non Plastic	2.00	19.60	1.960	0.78	54	41.94	28
21.00	Non Plastic	2.00	21.10	2.110	0.75	57	42.87	29
22.50	Non Plastic	2.00	22.60	2.260	0.73	56	40.83	28
24.00	Non Plastic	2.00	24.10	2.410	0.71	62	43.87	29
25.50	Non Plastic	2.00	25.60	2.560	0.69	65	44.68	30
27.00	Plastic	2.00	27.10	2.710	1.00	35	35.00	35
28.50	Plastic	2.00	28.60	2.860	1.00	40	40.00	40
30.00	Plastic	2.00	30.10	3.010	1.00	41	41.00	41
31.50	Plastic	2.00	31.60	3.160	1.00	45	45.00	45
33.00	Plastic	2.00	33.10	3.310	1.00	46	46.00	46
34.50	Non Plastic	2.00	34.60	3.460	0.59	58	34.03	25
36.00	Non Plastic	2.00	36.10	3.610	0.57	59	33.78	24
37.50	Non Plastic	2.00	37.60	3.760	0.56	61	34.09	25
39.00	Non Plastic	2.00	39.10	3.910	0.55	67	36.57	26
40.50	Non Plastic	2.00	40.60	4.060	0.53	74	39.46	27
42.00	Non Plastic	2.00	42.10	4.210	0.52	200	104.22	60
43.50	Non Plastic	2.00	43.60	4.360	0.51	200	101.88	58
45.00	Plastic	2.00	45.10	4.510	1.00	48	48.00	48
46.50	Plastic	2.00	46.60	4.660	1.00	54	54.00	54
48.00	Non Plastic	2.00	48.10	4.810	0.48	65	30.98	23
50.00	Non Plastic	2.00	50.10	5.010	0.46	78	36.11	26



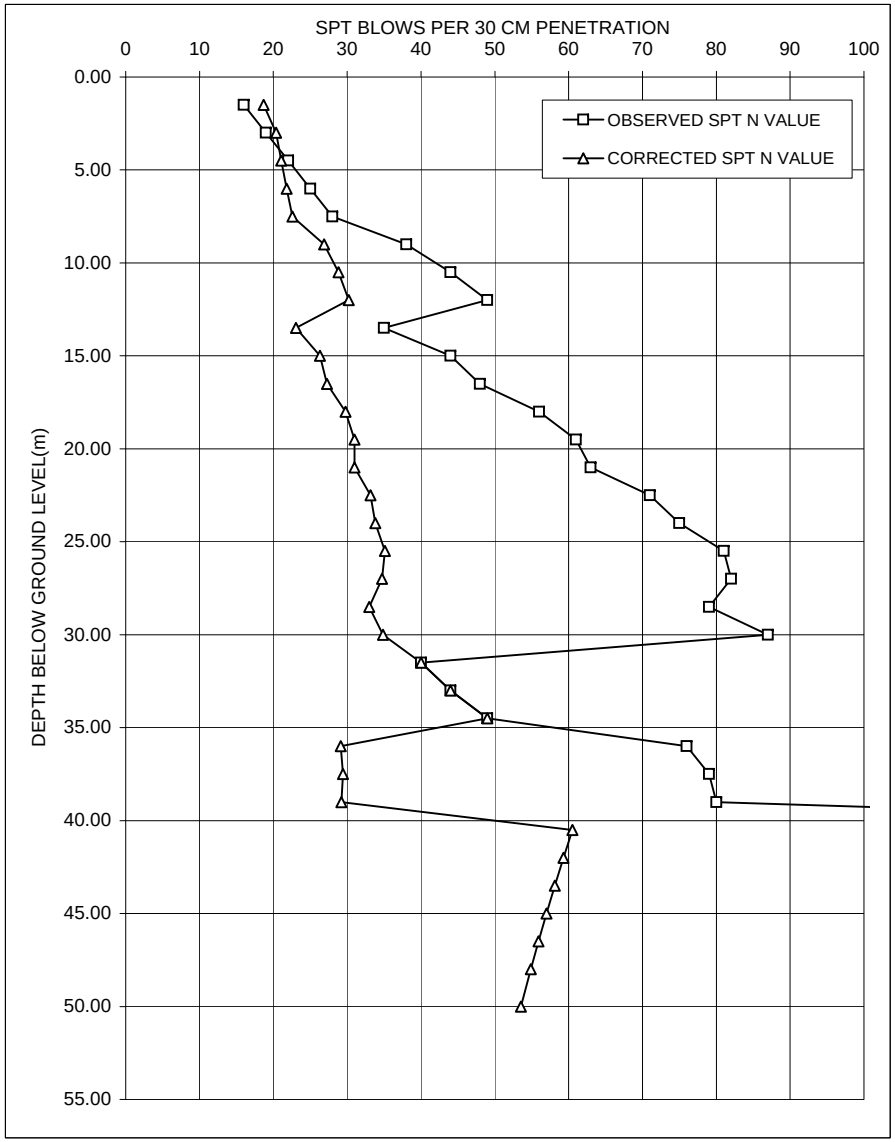
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 10 **GWT depth below EGL (m) : 0.80**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.90	2.15	0.215	1.40	16	22.40	19
3.00	Non Plastic	1.90	3.50	0.350	1.35	19	25.70	20
4.50	Non Plastic	2.00	5.00	0.500	1.23	22	27.14	21
6.00	Non Plastic	2.00	6.50	0.650	1.15	25	28.65	22
7.50	Non Plastic	2.00	8.00	0.800	1.08	28	30.14	23
9.00	Non Plastic	2.00	9.50	0.950	1.02	38	38.72	27
10.50	Non Plastic	2.00	11.00	1.100	0.97	44	42.68	29
12.00	Non Plastic	2.00	12.50	1.250	0.93	49	45.43	30
13.50	Non Plastic	2.00	14.00	1.400	0.89	35	31.12	23
15.00	Non Plastic	2.00	15.50	1.550	0.86	44	37.63	26
16.50	Non Plastic	2.00	17.00	1.700	0.82	48	39.57	27
18.00	Non Plastic	2.00	18.50	1.850	0.80	56	44.58	30
19.50	Non Plastic	2.00	20.00	2.000	0.77	61	46.97	31
21.00	Non Plastic	2.00	21.50	2.150	0.75	63	46.99	31
22.50	Non Plastic	2.00	23.00	2.300	0.72	71	51.35	33
24.00	Non Plastic	2.00	24.50	2.450	0.70	75	52.66	34
25.50	Non Plastic	2.00	26.00	2.600	0.68	81	55.26	35
27.00	Non Plastic	2.00	27.50	2.750	0.66	82	54.41	35
28.50	Non Plastic	2.00	29.00	2.900	0.65	79	51.01	33
30.00	Non Plastic	2.00	30.50	3.050	0.63	87	54.71	35
31.50	Plastic	2.00	32.00	3.200	1.00	40	40.00	40
33.00	Plastic	2.00	33.50	3.350	1.00	44	44.00	44
34.50	Plastic	2.00	35.00	3.500	1.00	49	49.00	49
36.00	Non Plastic	2.00	36.50	3.650	0.57	76	43.23	29
37.50	Non Plastic	2.00	38.00	3.800	0.56	79	43.87	29
39.00	Non Plastic	2.00	39.50	3.950	0.54	80	43.39	29
40.50	Non Plastic	2.00	41.00	4.100	0.53	200	105.99	60
42.00	Non Plastic	2.00	42.50	4.250	0.52	200	103.59	59
43.50	Non Plastic	2.00	44.00	4.400	0.51	200	101.27	58
45.00	Non Plastic	2.00	45.50	4.550	0.50	200	99.02	57
46.50	Non Plastic	2.00	47.00	4.700	0.48	200	96.86	56
48.00	Non Plastic	2.00	48.50	4.850	0.47	200	94.75	55
50.00	Non Plastic	2.00	50.50	5.050	0.46	200	92.05	54



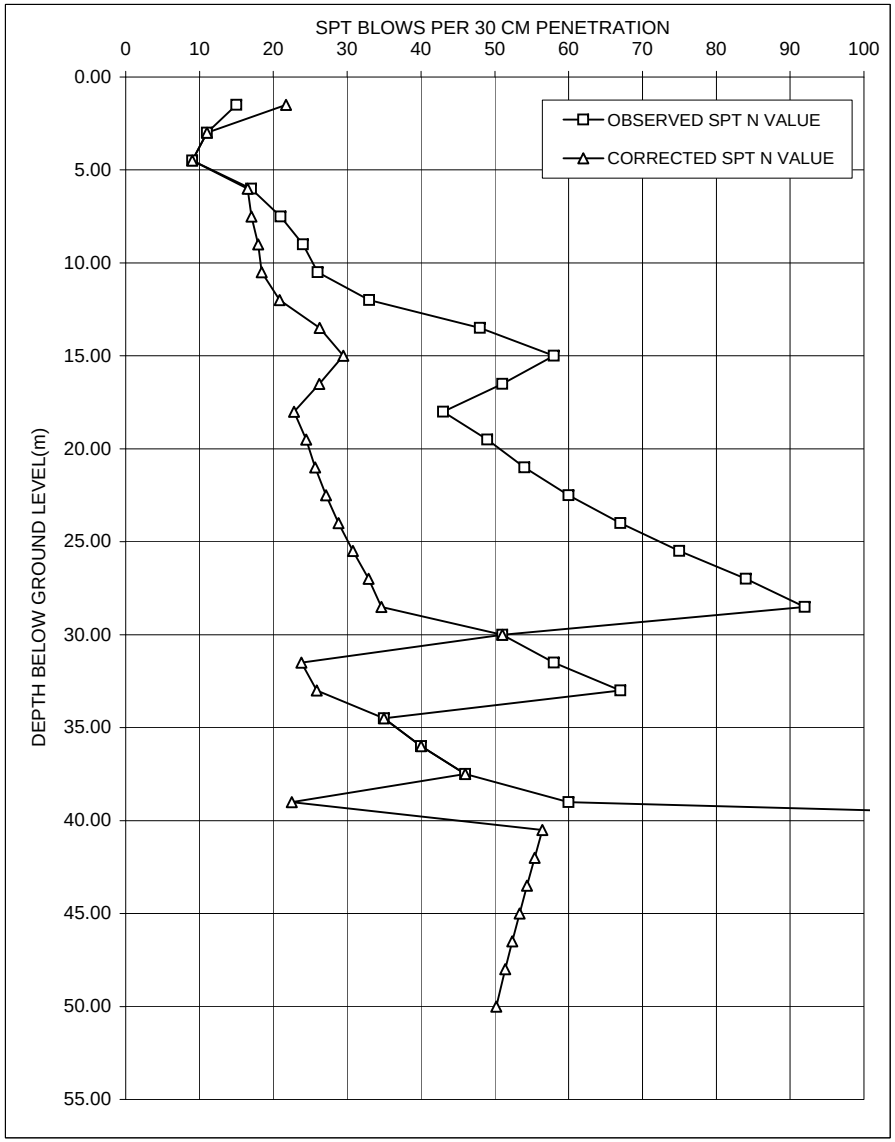
INDIAN GEOTECHNICAL SERVICES

CALCULATIONS FOR CORRECTED SPT (N) VALUES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO 11 **GWT depth below EGL (m) : 6.80**

DEPTH OF SAMPLE	TYPE OF SOIL	γ_{bulk} (Bulk Unit Weight), t/m^3	OVERBURDEN PRESSURE (t/m^2)	OVERBURDEN PRESSURE (kg/cm^2)	OVERBURDEN CORRECTION FACTOR	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N")
1.50	Non Plastic	1.76	2.64	0.264	1.45	15	21.71	22
3.00	Plastic	1.76	5.28	0.528	1.00	11	11.00	11
4.50	Plastic	1.90	8.13	0.813	1.00	9	9.00	9
6.00	Non Plastic	1.90	10.98	1.098	0.97	17	16.50	16
7.50	Non Plastic	2.00	13.28	1.328	0.91	21	19.05	17
9.00	Non Plastic	2.00	14.78	1.478	0.87	24	20.91	18
10.50	Non Plastic	2.00	16.28	1.628	0.84	26	21.81	18
12.00	Non Plastic	2.00	17.78	1.778	0.81	33	26.71	21
13.50	Non Plastic	2.00	19.28	1.928	0.78	48	37.55	26
15.00	Non Plastic	2.00	20.78	2.078	0.76	58	43.92	29
16.50	Non Plastic	2.00	22.28	2.228	0.73	51	37.43	26
18.00	Non Plastic	2.00	23.78	2.378	0.71	43	30.62	23
19.50	Non Plastic	2.00	25.28	2.528	0.69	49	33.89	24
21.00	Non Plastic	2.00	26.78	2.678	0.67	54	36.31	26
22.50	Non Plastic	2.00	28.28	2.828	0.65	60	39.25	27
24.00	Non Plastic	2.00	29.78	2.978	0.64	67	42.67	29
25.50	Non Plastic	2.00	31.28	3.128	0.62	75	46.53	31
27.00	Non Plastic	2.00	32.78	3.278	0.60	84	50.80	33
28.50	Non Plastic	2.00	34.28	3.428	0.59	92	54.26	35
30.00	Plastic	2.00	35.78	3.578	1.00	51	51.00	51
31.50	Non Plastic	2.00	37.28	3.728	0.56	58	32.58	24
33.00	Non Plastic	2.00	38.78	3.878	0.55	67	36.75	26
34.50	Plastic	2.00	40.28	4.028	1.00	35	35.00	35
36.00	Plastic	2.00	41.78	4.178	1.00	40	40.00	40
37.50	Plastic	2.00	43.28	4.328	1.00	46	46.00	46
39.00	Non Plastic	2.00	44.78	4.478	0.50	60	30.03	23
40.50	Non Plastic	2.00	46.28	4.628	0.49	200	97.89	56
42.00	Non Plastic	2.00	47.78	4.778	0.48	200	95.75	55
43.50	Non Plastic	2.00	49.28	4.928	0.47	200	93.69	54
45.00	Non Plastic	2.00	50.78	5.078	0.46	200	91.68	53
46.50	Non Plastic	2.00	52.28	5.228	0.45	200	89.73	52
48.00	Non Plastic	2.00	53.78	5.378	0.44	200	87.84	51
50.00	Non Plastic	2.00	55.78	5.578	0.43	200	85.40	50



Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 1

Actual Water table Depth : 5.20 m

Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	FILL	8	1.80	0.80	89.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	12.50	5.00	1.20	19.99	0.22	0.26	1.11	Non Liquefiable
3.00	SP-SM	7	1.80	0.80	12.00	0.98	5.40	2.40	0.23	1.70	1.17	1.05	0.80	1.00	11.66	1.55	1.03	13.58	0.15	0.17	0.76	Liquefiable
4.50	SP-SM	11	1.90	0.90	12.00	0.97	8.25	3.75	0.22	1.63	1.17	1.05	0.85	1.00	18.70	1.55	1.03	20.85	0.23	0.27	1.22	Non Liquefiable
6.00	SP	23	2.00	1.00	4.00	0.95	11.25	5.25	0.21	1.38	1.17	1.05	0.95	1.00	36.94	0.00	1.00	36.94	NA	NA	>1	Non Liquefiable
7.50	SP	27	2.00	1.00	4.00	0.94	14.25	6.75	0.21	1.22	1.17	1.05	0.95	1.00	38.24	0.00	1.00	38.24	NA	NA	>1	Non Liquefiable
9.00	SP-SM	41	2.00	1.00	4.00	0.93	17.25	8.25	0.20	1.10	1.17	1.05	0.95	1.00	52.53	0.00	1.00	52.53	NA	NA	>1	Non Liquefiable
10.50	SP-SM	36	2.00	1.00	4.00	0.89	20.25	9.75	0.19	1.01	1.17	1.05	1	1.00	44.66	0.00	1.00	44.66	NA	NA	>1	Non Liquefiable
12.00	SP-SM	40	2.00	1.00	2.00	0.85	23.25	11.25	0.18	0.94	1.17	1.05	1	1.00	46.20	0.00	1.00	46.20	NA	NA	>1	Non Liquefiable
13.50	SP-SM	42	2.00	1.00	5.00	0.81	26.25	12.75	0.17	0.89	1.17	1.05	1	1.00	45.56	0.00	1.00	45.56	NA	NA	>1	Non Liquefiable
15.00	GP-GM	61	2.00	1.00	9.00	0.77	29.25	14.25	0.17	0.84	1.17	1.05	1	1.00	62.60	0.56	1.02	64.22	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 2

Actual Water table Depth : 1.35 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	12	1.90	0.90	2.00	0.99	2.85	1.35	0.22	1.70	1.17	1.05	0.75	1.00	18.74	0.00	1.00	18.74	0.20	0.24	1.10	Non Liquefiable
3.00	SP-SM	13	2.00	1.00	7.00	0.98	5.85	2.85	0.21	1.70	1.17	1.05	0.80	1.00	21.66	0.12	1.01	21.96	0.24	0.29	1.38	Non Liquefiable
4.50	SP-SM	9	2.00	1.00	7.00	0.97	8.85	4.35	0.20	1.52	1.17	1.05	0.85	1.00	14.21	0.12	1.01	14.45	0.15	0.18	0.90	Liquefiable
6.00	SC	51	2.00	1.00	48.00	0.95	11.85	5.85	0.20	1.31	1.17	1.05	0.95	1.00	77.60	5.00	1.20	98.12	NA	NA	>1	Non Liquefiable
7.50	SC	45	2.00	1.00	48.00	0.94	14.85	7.35	0.20	1.17	1.17	1.05	0.95	1.00	61.08	5.00	1.20	78.30	NA	NA	>1	Non Liquefiable
9.00	SP	38	2.00	1.00	2.00	0.93	17.85	8.85	0.20	1.06	1.17	1.05	0.95	1.00	47.01	0.00	1.00	47.01	NA	NA	>1	Non Liquefiable
10.50	SP	41	2.00	1.00	2.00	0.89	20.85	10.35	0.19	0.98	1.17	1.05	1	1.00	49.37	0.00	1.00	49.37	NA	NA	>1	Non Liquefiable
12.00	SP	39	2.00	1.00	3.00	0.85	23.85	11.85	0.18	0.92	1.17	1.05	1	1.00	43.89	0.00	1.00	43.89	NA	NA	>1	Non Liquefiable
13.50	CI	65	2.00	1.00	63.00	0.81	26.85	13.35	0.17	0.87	1.17	1.05	1	1.00	68.91	5.00	1.20	87.70	NA	NA	>1	Non Liquefiable
15.00	CI	61	2.00	1.00	63.00	0.77	29.85	14.85	0.16	0.82	1.17	1.05	1	1.00	61.32	5.00	1.20	78.58	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 3

Actual Water table Depth : 1.15 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	7	1.80	0.80	3.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	10.93	0.00	1.00	10.93	0.12	0.14	0.62	Liquefiable
3.00	SP	10	2.00	1.00	4.00	0.98	5.70	2.70	0.21	1.70	1.17	1.05	0.80	1.00	16.66	0.00	1.00	16.66	0.18	0.21	0.98	Liquefiable
4.50	SP	13	2.00	1.00	4.00	0.97	8.70	4.20	0.21	1.54	1.17	1.05	0.85	1.00	20.89	0.00	1.00	20.89	0.23	0.27	1.30	Non Liquefiable
6.00	CI	31	2.00	1.00	54.00	0.95	11.70	5.70	0.20	1.32	1.17	1.05	0.95	1.00	47.78	5.00	1.20	62.34	NA	NA	>1	Non Liquefiable
7.50	CI	23	2.00	1.00	54.00	0.94	14.70	7.20	0.20	1.18	1.17	1.05	0.95	1.00	31.54	5.00	1.20	42.85	NA	NA	>1	Non Liquefiable
9.00	SP	36	2.00	1.00	3.00	0.93	17.70	8.70	0.20	1.07	1.17	1.05	0.95	1.00	44.92	0.00	1.00	44.92	NA	NA	>1	Non Liquefiable
10.50	SP	41	2.00	1.00	3.00	0.89	20.70	10.20	0.19	0.99	1.17	1.05	1	1.00	49.73	0.00	1.00	49.73	NA	NA	>1	Non Liquefiable
12.00	CI	58	2.00	1.00	51.00	0.85	23.70	11.70	0.18	0.92	1.17	1.05	1	1.00	65.69	5.00	1.20	83.82	NA	NA	>1	Non Liquefiable
13.50	CI	63	2.00	1.00	51.00	0.81	26.70	13.20	0.17	0.87	1.17	1.05	1	1.00	67.17	5.00	1.20	85.61	NA	NA	>1	Non Liquefiable
15.00	CI	62	2.00	1.00	51.00	0.77	29.70	14.70	0.16	0.82	1.17	1.05	1	1.00	62.64	5.00	1.20	80.17	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 4

Actual Water table Depth : 3.20 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP-SM	6	1.80	0.80	9.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	9.37	0.56	1.02	10.09	0.11	0.14	0.59	Liquefiable
3.00	SP-SM	11	1.90	0.90	9.00	0.98	5.55	2.55	0.22	1.70	1.17	1.05	0.80	1.00	18.33	0.56	1.02	19.19	0.21	0.24	1.11	Non Liquefiable
4.50	SP-SM	14	2.00	1.00	9.00	0.97	8.55	4.05	0.21	1.57	1.17	1.05	0.85	1.00	22.91	0.56	1.02	23.85	0.27	0.32	1.52	Non Liquefiable
6.00	GP	31	2.00	1.00	1.00	0.95	11.55	5.55	0.21	1.34	1.17	1.05	0.95	1.00	48.43	0.00	1.00	48.43	NA	NA	>1	Non Liquefiable
7.50	GP	37	2.00	1.00	2.00	0.94	14.55	7.05	0.20	1.19	1.17	1.05	0.95	1.00	51.28	0.00	1.00	51.28	NA	NA	>1	Non Liquefiable
9.00	SP	40	2.00	1.00	2.00	0.93	17.55	8.55	0.20	1.08	1.17	1.05	0.95	1.00	50.34	0.00	1.00	50.34	NA	NA	>1	Non Liquefiable
10.50	SP	39	2.00	1.00	1.00	0.89	20.55	10.05	0.19	1.00	1.17	1.05	1	1.00	47.66	0.00	1.00	47.66	NA	NA	>1	Non Liquefiable
12.00	SP	43	2.00	1.00	1.00	0.85	23.55	11.55	0.18	0.93	1.17	1.05	1	1.00	49.01	0.00	1.00	49.01	NA	NA	>1	Non Liquefiable
13.50	SP	47	2.00	1.00	2.00	0.81	26.55	13.05	0.17	0.88	1.17	1.05	1	1.00	50.40	0.00	1.00	50.40	NA	NA	>1	Non Liquefiable
15.00	SC	28	2.00	1.00	38.00	0.77	29.55	14.55	0.16	0.83	1.17	1.05	1	1.00	28.44	5.00	1.20	39.12	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 5

Actual Water table Depth : 2.90 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	9	1.80	0.80	3.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	14.06	0.00	1.00	14.06	0.15	0.18	0.78	Liquefiable
3.00	SP	12	1.90	0.90	3.00	0.98	5.55	2.55	0.22	1.70	1.17	1.05	0.80	1.00	19.99	0.00	1.00	19.99	0.22	0.26	1.16	Non Liquefiable
4.50	SP	16	2.00	1.00	3.00	0.97	8.55	4.05	0.21	1.57	1.17	1.05	0.85	1.00	26.18	0.00	1.00	26.18	0.32	0.38	1.78	Non Liquefiable
6.00	SP	36	2.00	1.00	1.00	0.95	11.55	5.55	0.21	1.34	1.17	1.05	0.95	1.00	56.24	0.00	1.00	56.24	NA	NA	>1	Non Liquefiable
7.50	SP	41	2.00	1.00	1.00	0.94	14.55	7.05	0.20	1.19	1.17	1.05	0.95	1.00	56.83	0.00	1.00	56.83	NA	NA	>1	Non Liquefiable
9.00	SP	27	2.00	1.00	2.00	0.93	17.55	8.55	0.20	1.08	1.17	1.05	0.95	1.00	33.98	0.00	1.00	33.98	NA	NA	>1	Non Liquefiable
10.50	SP	37	2.00	1.00	2.00	0.89	20.55	10.05	0.19	1.00	1.17	1.05	1	1.00	45.21	0.00	1.00	45.21	NA	NA	>1	Non Liquefiable
12.00	SP	43	2.00	1.00	2.00	0.85	23.55	11.55	0.18	0.93	1.17	1.05	1	1.00	49.01	0.00	1.00	49.01	NA	NA	>1	Non Liquefiable
13.50	SP	47	2.00	1.00	2.00	0.81	26.55	13.05	0.17	0.88	1.17	1.05	1	1.00	50.40	0.00	1.00	50.40	NA	NA	>1	Non Liquefiable
15.00	SM	45	2.00	1.00	16.00	0.77	29.55	14.55	0.16	0.83	1.17	1.05	1	1.00	45.70	2.77	1.05	50.94	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 6

Actual Water table Depth : 2.70 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP-SM	10	1.80	0.80	5.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	15.62	0.00	1.00	15.62	0.17	0.20	0.86	Liquefiable
3.00	SP-SM	14	1.90	0.90	8.00	0.98	5.55	2.55	0.22	1.70	1.17	1.05	0.80	1.00	23.32	0.30	1.01	23.92	0.27	0.32	1.46	Non Liquefiable
4.50	SP-SM	17	2.00	1.00	8.00	0.97	8.55	4.05	0.21	1.57	1.17	1.05	0.85	1.00	27.81	0.30	1.01	28.46	0.39	0.46	2.17	Non Liquefiable
6.00	SP	39	2.00	1.00	2.00	0.95	11.55	5.55	0.21	1.34	1.17	1.05	0.95	1.00	60.92	0.00	1.00	60.92	NA	NA	>1	Non Liquefiable
7.50	SP	44	2.00	1.00	2.00	0.94	14.55	7.05	0.20	1.19	1.17	1.05	0.95	1.00	60.98	0.00	1.00	60.98	NA	NA	>1	Non Liquefiable
9.00	SP	43	2.00	1.00	1.00	0.93	17.55	8.55	0.20	1.08	1.17	1.05	0.95	1.00	54.12	0.00	1.00	54.12	NA	NA	>1	Non Liquefiable
10.50	SP	39	2.00	1.00	1.00	0.89	20.55	10.05	0.19	1.00	1.17	1.05	1	1.00	47.66	0.00	1.00	47.66	NA	NA	>1	Non Liquefiable
12.00	SP	36	2.00	1.00	3.00	0.85	23.55	11.55	0.18	0.93	1.17	1.05	1	1.00	41.03	0.00	1.00	41.03	NA	NA	>1	Non Liquefiable
13.50	SP	44	2.00	1.00	3.00	0.81	26.55	13.05	0.17	0.88	1.17	1.05	1	1.00	47.18	0.00	1.00	47.18	NA	NA	>1	Non Liquefiable
15.00	SP	44	2.00	1.00	2.00	0.77	29.55	14.55	0.16	0.83	1.17	1.05	1	1.00	44.68	0.00	1.00	44.68	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 7

Actual Water table Depth : 0.80 m

Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	10	1.90	0.90	2.00	0.99	2.85	1.35	0.22	1.70	1.17	1.05	0.75	1.00	15.62	0.00	1.00	15.62	0.17	0.20	0.91	Liquefiable
3.00	SP	8	1.90	0.90	2.00	0.98	5.70	2.70	0.21	1.70	1.17	1.05	0.80	1.00	13.33	0.00	1.00	13.33	0.14	0.17	0.80	Liquefiable
4.50	SP	14	2.00	1.00	2.00	0.97	8.70	4.20	0.21	1.54	1.17	1.05	0.85	1.00	22.49	0.00	1.00	22.49	0.25	0.30	1.43	Non Liquefiable
6.00	SP	20	2.00	1.00	2.00	0.95	11.70	5.70	0.20	1.32	1.17	1.05	0.95	1.00	30.83	0.00	1.00	30.83	NA	NA	>1	Non Liquefiable
7.50	SP	25	2.00	1.00	1.00	0.94	14.70	7.20	0.20	1.18	1.17	1.05	0.95	1.00	34.29	0.00	1.00	34.29	NA	NA	>1	Non Liquefiable
9.00	GP	30	2.00	1.00	2.00	0.93	17.70	8.70	0.20	1.07	1.17	1.05	0.95	1.00	37.43	0.00	1.00	37.43	NA	NA	>1	Non Liquefiable
10.50	GP	36	2.00	1.00	2.00	0.89	20.70	10.20	0.19	0.99	1.17	1.05	1	1.00	43.67	0.00	1.00	43.67	NA	NA	>1	Non Liquefiable
12.00	SP	40	2.00	1.00	4.00	0.85	23.70	11.70	0.18	0.92	1.17	1.05	1	1.00	45.30	0.00	1.00	45.30	NA	NA	>1	Non Liquefiable
13.50	SP	49	2.00	1.00	4.00	0.81	26.70	13.20	0.17	0.87	1.17	1.05	1	1.00	52.25	0.00	1.00	52.25	NA	NA	>1	Non Liquefiable
15.00	CI	23	2.00	1.00	58.00	0.77	29.70	14.70	0.16	0.82	1.17	1.05	1	1.00	23.24	5.00	1.20	32.89	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 8

Actual Water table Depth : 0.20 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	5	1.80	0.80	1.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	7.81	0.00	1.00	7.81	0.09	0.11	0.49	Liquefiable
3.00	SP	12	1.90	0.90	4.00	0.98	5.55	2.55	0.22	1.70	1.17	1.05	0.80	1.00	19.99	0.00	1.00	19.99	0.22	0.26	1.16	Non Liquefiable
4.50	SP	13	2.00	1.00	4.00	0.97	8.55	4.05	0.21	1.57	1.17	1.05	0.85	1.00	21.27	0.00	1.00	21.27	0.23	0.28	1.30	Non Liquefiable
6.00	SP	30	2.00	1.00	2.00	0.95	11.55	5.55	0.21	1.34	1.17	1.05	0.95	1.00	46.86	0.00	1.00	46.86	NA	NA	>1	Non Liquefiable
7.50	SP	33	2.00	1.00	2.00	0.94	14.55	7.05	0.20	1.19	1.17	1.05	0.95	1.00	45.74	0.00	1.00	45.74	NA	NA	>1	Non Liquefiable
9.00	SP	38	2.00	1.00	4.00	0.93	17.55	8.55	0.20	1.08	1.17	1.05	0.95	1.00	47.83	0.00	1.00	47.83	NA	NA	>1	Non Liquefiable
10.50	SP	41	2.00	1.00	4.00	0.89	20.55	10.05	0.19	1.00	1.17	1.05	1	1.00	50.10	0.00	1.00	50.10	NA	NA	>1	Non Liquefiable
12.00	SP	45	2.00	1.00	1.00	0.85	23.55	11.55	0.18	0.93	1.17	1.05	1	1.00	51.29	0.00	1.00	51.29	NA	NA	>1	Non Liquefiable
13.50	SP	47	2.00	1.00	1.00	0.81	26.55	13.05	0.17	0.88	1.17	1.05	1	1.00	50.40	0.00	1.00	50.40	NA	NA	>1	Non Liquefiable
15.00	SP	31	2.00	1.00	1.00	0.77	29.55	14.55	0.16	0.83	1.17	1.05	1	1.00	31.48	0.00	1.00	31.48	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 9

Actual Water table Depth : 0.40 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP-SM	13	1.90	0.90	5.00	0.99	2.85	1.35	0.22	1.70	1.17	1.05	0.75	1.00	20.30	0.00	1.00	20.30	0.22	0.26	1.20	Non Liquefiable
3.00	SP	20	2.00	1.00	1.00	0.98	5.85	2.85	0.21	1.70	1.17	1.05	0.80	1.00	33.32	0.00	1.00	33.32	NA	NA	>1	Non Liquefiable
4.50	SP	23	2.00	1.00	1.00	0.97	8.85	4.35	0.20	1.52	1.17	1.05	0.85	1.00	36.31	0.00	1.00	36.31	NA	NA	>1	Non Liquefiable
6.00	SM	26	2.00	1.00	17.00	0.95	11.85	5.85	0.20	1.31	1.17	1.05	0.95	1.00	39.56	3.01	1.06	44.95	NA	NA	>1	Non Liquefiable
7.50	SM	33	2.00	1.00	17.00	0.94	14.85	7.35	0.20	1.17	1.17	1.05	0.95	1.00	44.80	3.01	1.06	50.50	NA	NA	>1	Non Liquefiable
9.00	GP	34	2.00	1.00	4.00	0.93	17.85	8.85	0.20	1.06	1.17	1.05	0.95	1.00	42.06	0.00	1.00	42.06	NA	NA	>1	Non Liquefiable
10.50	GP	38	2.00	1.00	4.00	0.89	20.85	10.35	0.19	0.98	1.17	1.05	1	1.00	45.76	0.00	1.00	45.76	NA	NA	>1	Non Liquefiable
12.00	GP	44	2.00	1.00	4.00	0.85	23.85	11.85	0.18	0.92	1.17	1.05	1	1.00	49.51	0.00	1.00	49.51	NA	NA	>1	Non Liquefiable
13.50	GP	49	2.00	1.00	4.00	0.81	26.85	13.35	0.17	0.87	1.17	1.05	1	1.00	51.95	0.00	1.00	51.95	NA	NA	>1	Non Liquefiable
15.00	GP-GM	53	2.00	1.00	5.00	0.77	29.85	14.85	0.16	0.82	1.17	1.05	1	1.00	53.28	0.00	1.00	53.28	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 10

Actual Water table Depth : 0.80 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SP	16	1.80	0.80	4.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	24.99	0.00	1.00	24.99	0.29	0.35	1.50	Non Liquefiable
3.00	SP-SM	19	2.00	1.00	6.00	0.98	5.70	2.70	0.21	1.70	1.17	1.05	0.80	1.00	31.65	0.03	1.00	31.83	NA	NA	>1	Non Liquefiable
4.50	SP-SM	22	2.00	1.00	6.00	0.97	8.70	4.20	0.21	1.54	1.17	1.05	0.85	1.00	35.35	0.03	1.00	35.54	NA	NA	>1	Non Liquefiable
6.00	SP	25	2.00	1.00	4.00	0.95	11.70	5.70	0.20	1.32	1.17	1.05	0.95	1.00	38.54	0.00	1.00	38.54	NA	NA	>1	Non Liquefiable
7.50	SP	28	2.00	1.00	4.00	0.94	14.70	7.20	0.20	1.18	1.17	1.05	0.95	1.00	38.40	0.00	1.00	38.40	NA	NA	>1	Non Liquefiable
9.00	SP-SM	38	2.00	1.00	6.00	0.93	17.70	8.70	0.20	1.07	1.17	1.05	0.95	1.00	47.41	0.03	1.00	47.66	NA	NA	>1	Non Liquefiable
10.50	SP-SM	44	2.00	1.00	6.00	0.89	20.70	10.20	0.19	0.99	1.17	1.05	1	1.00	53.37	0.03	1.00	53.65	NA	NA	>1	Non Liquefiable
12.00	SP-SM	49	2.00	1.00	8.00	0.85	23.70	11.70	0.18	0.92	1.17	1.05	1	1.00	55.49	0.30	1.01	56.49	NA	NA	>1	Non Liquefiable
13.50	SP-SM	35	2.00	1.00	8.00	0.81	26.70	13.20	0.17	0.87	1.17	1.05	1	1.00	37.32	0.30	1.01	38.09	NA	NA	>1	Non Liquefiable
15.00	SP-SM	44	2.00	1.00	7.00	0.77	29.70	14.70	0.16	0.82	1.17	1.05	1	1.00	44.46	0.12	1.01	44.96	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

Typical Computation of Liquefaction Potential by Simplified Method

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

Borehole No. : 11

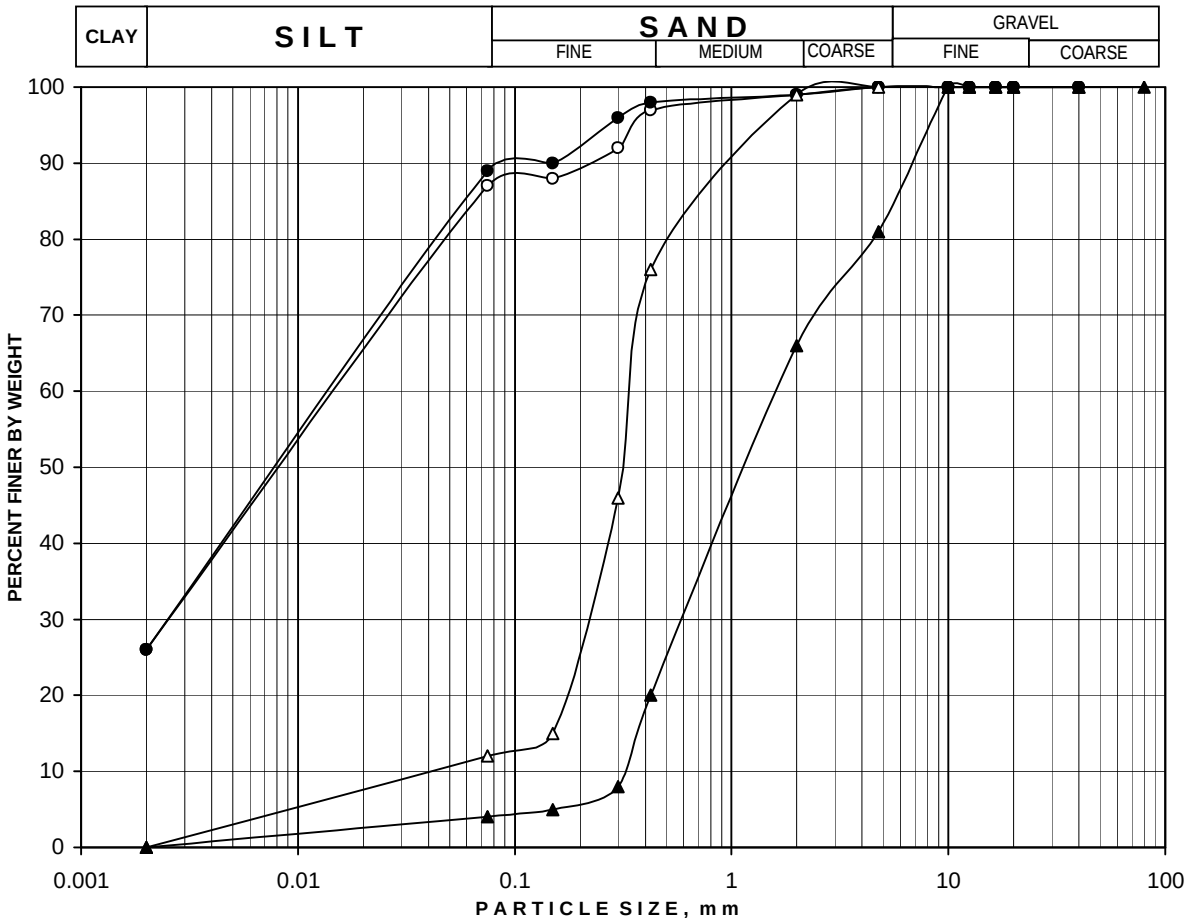
Actual Water table Depth : 6.80 m
Water table assumed for Calculation : 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m^3)	Submerged Density (t/m^3)	Fine Content (%)	Stress reduction coefficient (rd)	Total overburden pressure (σ_o), t/m^2	Effective overburden (σ_o), t/m^2	Cyclic Stress ratio (CSR)	C_N	C_E	C_B	C_R	C_S	SPT corrected $(N1)_{60}$	α	β	$(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.50	SM	15	1.80	0.80	24.00	0.99	2.70	1.20	0.23	1.70	1.17	1.05	0.75	1.00	23.43	4.18	1.11	30.13	NA	NA	>1	Non Liquefiable
3.00	CL	11	1.90	0.90	88.00	0.98	5.55	2.55	0.22	1.70	1.17	1.05	0.80	1.00	18.33	5.00	1.20	26.99	0.34	0.40	1.82	Non Liquefiable
4.50	CL	9	1.90	0.90	88.00	0.97	8.40	3.90	0.22	1.60	1.17	1.05	0.85	1.00	15.01	5.00	1.20	23.01	0.26	0.31	1.41	Non Liquefiable
6.00	SP-SM	17	2.00	1.00	7.00	0.95	11.40	5.40	0.21	1.36	1.17	1.05	0.95	1.00	26.92	0.12	1.01	27.27	0.35	0.41	1.97	Non Liquefiable
7.50	SP-SM	21	2.00	1.00	7.00	0.94	14.40	6.90	0.20	1.20	1.17	1.05	0.95	1.00	29.42	0.12	1.01	29.79	0.45	0.54	2.64	Non Liquefiable
9.00	SP	24	2.00	1.00	2.00	0.93	17.40	8.40	0.20	1.09	1.17	1.05	0.95	1.00	30.47	0.00	1.00	30.47	NA	NA	>1	Non Liquefiable
10.50	SP	26	2.00	1.00	2.00	0.89	20.40	9.90	0.19	1.01	1.17	1.05	1	1.00	32.01	0.00	1.00	32.01	NA	NA	>1	Non Liquefiable
12.00	SP	33	2.00	1.00	1.00	0.85	23.40	11.40	0.18	0.94	1.17	1.05	1	1.00	37.86	0.00	1.00	37.86	NA	NA	>1	Non Liquefiable
13.50	SP	48	2.00	1.00	1.00	0.81	26.40	12.90	0.17	0.88	1.17	1.05	1	1.00	51.77	0.00	1.00	51.77	NA	NA	>1	Non Liquefiable
15.00	SP	58	2.00	1.00	3.00	0.77	29.40	14.40	0.16	0.83	1.17	1.05	1	1.00	59.21	0.00	1.00	59.21	NA	NA	>1	Non Liquefiable

1) The project site falls in Zone - III. A maximum earthquake intensity of 7.0 has been considered in the analysis.
2) The Design ground acceleration amax/g = 0.16
3) CE = Correction for hammer energy ratio = ER/60, ER for Rope and pulley System = 70 % , Hence CE = 70/60 = 1.167
4) Borehole diameter = 150 mm , Hence CB = 1.05
5) CS = Correction for Standard sampler = 1.0
6) Magnitude scaling factor (MSF) = 1.19 has been taken in the analysis. (Recommened revised MSF)

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	0.00 - 1.00	Filled Up Soil (Road Materials)	0.00	13.00	61.00	26.00
●	1	2.50	Filled Up Soil (Road Materials)	0.00	11.00	63.00	26.00
△	1	3.00	Medium to Fine Sand (SP-SM)	0.00	88.00	12.00	0.00
▲	1	6.00	Gravelly Coarse to Medium Sand (SP)	19.00	77.00	4.00	0.00

INDIAN GEOTECHNICAL SERVICES

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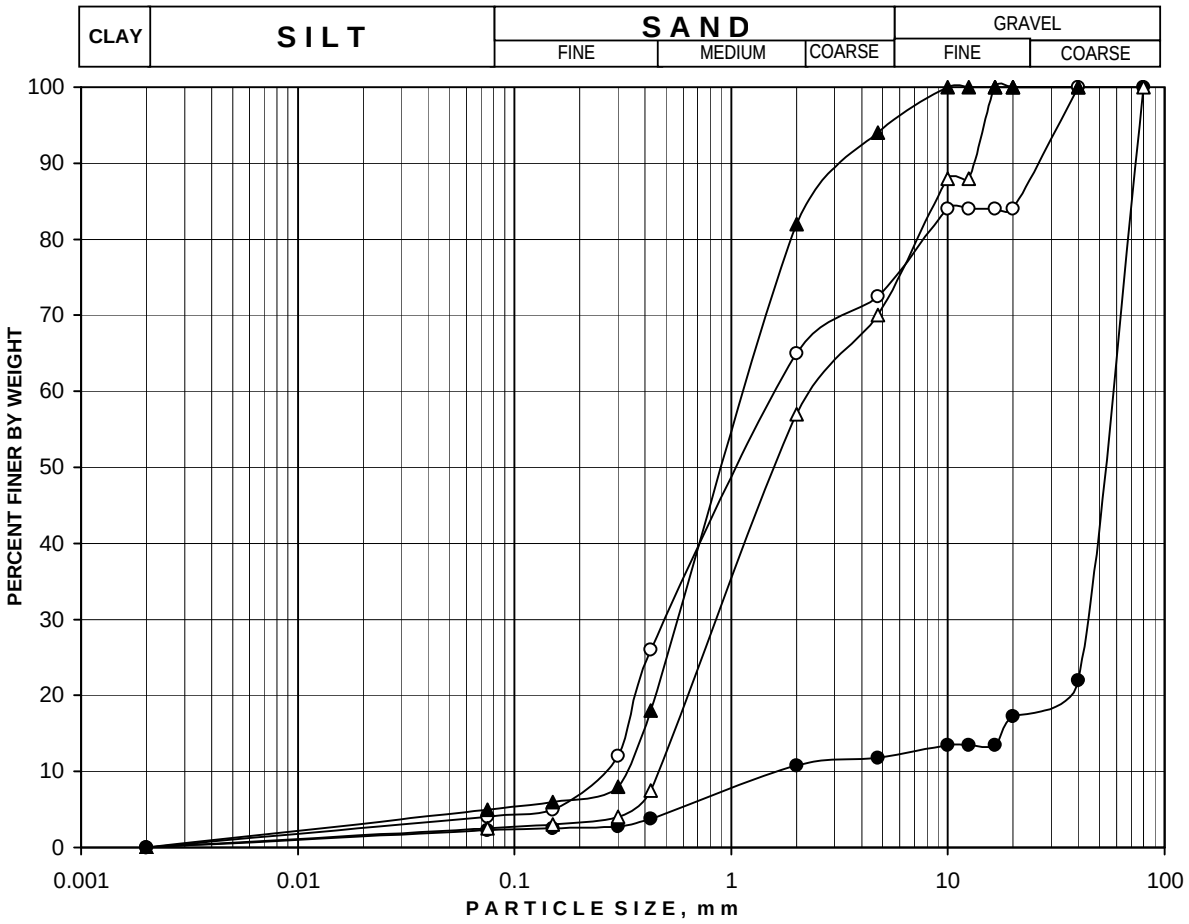

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	9.00	Gravelly Medium to Fine Sand (SP SM)	28.00	68.00	4.00	0.00
●	1	11.50	Sandy Gravels (GP)	88.00	10.00	2.00	0.00
△	1	12.00	Gravelly Coarse to Medium Sand (SP-SM)	30.00	68.00	2.00	0.00
▲	1	13.50	Gravelly Coarse to Medium Sand (SP-SM)	6.00	89.00	5.00	0.00

INDIAN GEOTECHNICAL SERVICES

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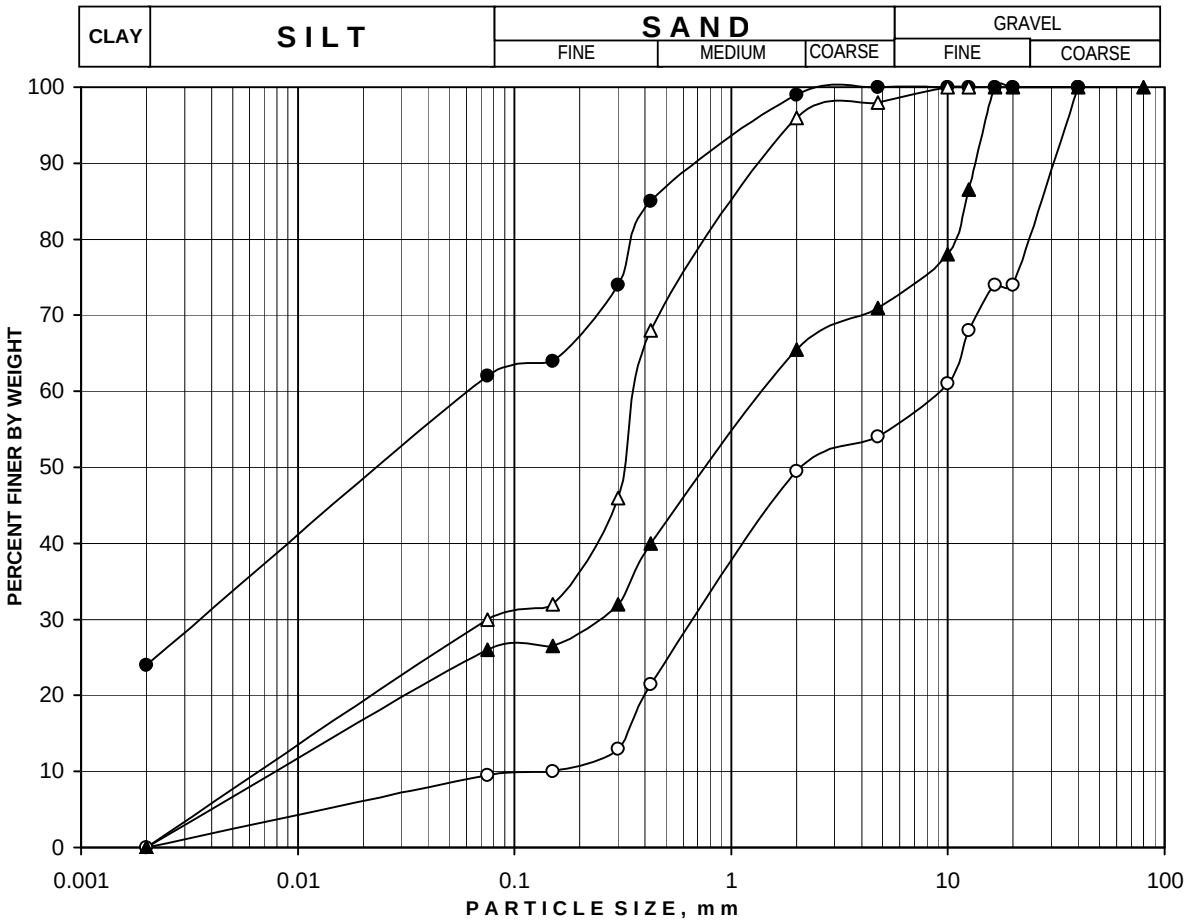

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	15.00	Sandy Gravels (GP-GM-SP)	46.00	45.00	9.00	0.00
●	1	16.50	Clayey Sandy Silt of medium plasticity (CI)	0.00	38.00	38.00	24.00
△	1	19.50	Gravelly Silty Sand (SM)	2.00	68.00	30.00	0.00
▲	1	22.50	Gravelly Silty Sand (SM)	29.00	45.00	26.00	0.00

INDIAN GEOTECHNICAL SERVICES

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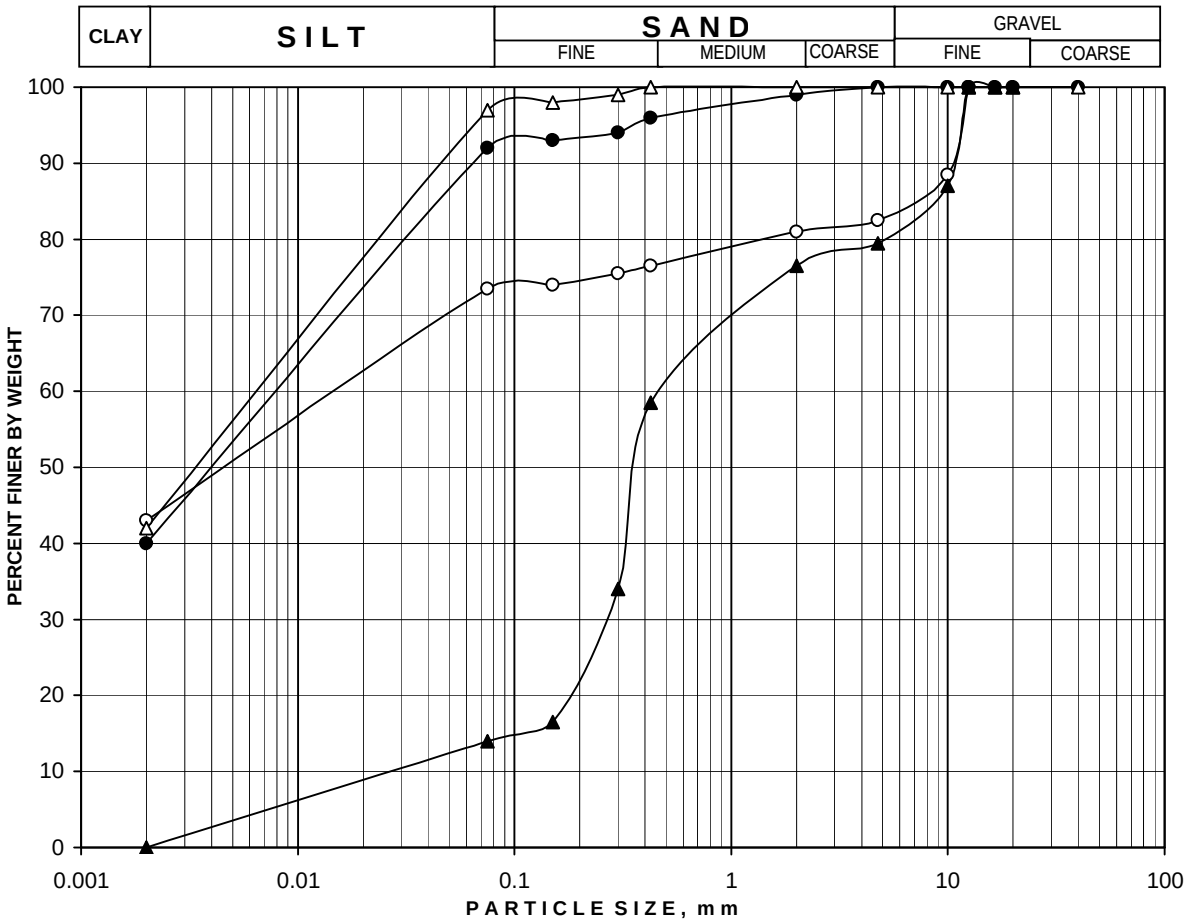

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	24.00	Silty Clay with gravels of high plasticity (CH)	18.00	9.00	30.00	43.00
●	1	28.50	Silty Clay of high plasticity (CH)	0.00	8.00	52.00	40.00
△	1	33.00	Silty Clay of high plasticity (CH)	0.00	3.00	55.00	42.00
▲	1	34.50	Gravelly Silty Sand (SM)	21.00	65.00	14.00	0.00

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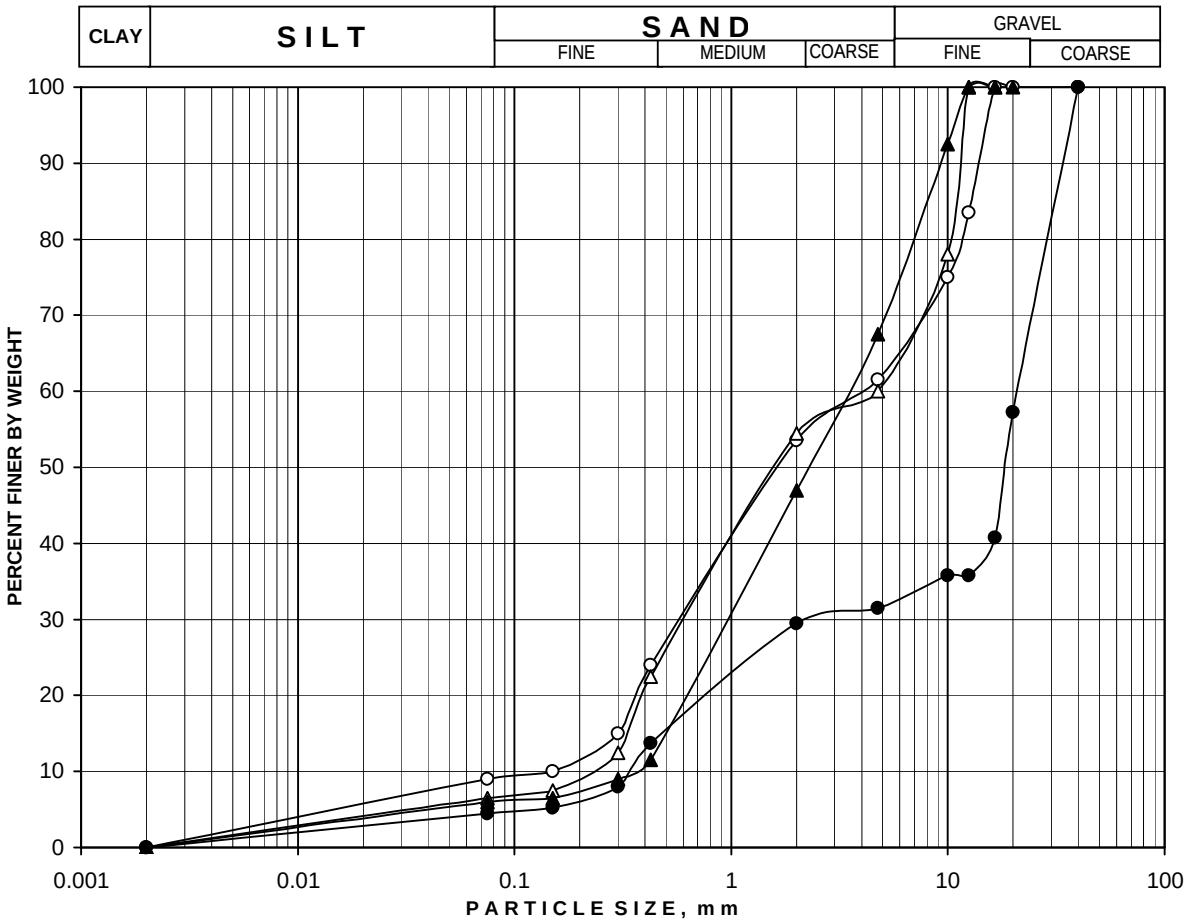

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	36.00	Gravelly Fine to Medium Sand (SP SM-GP)	39.00	52.00	9.00	0.00
●	1	38.50	Sandy Gravels (GP)	69.00	27.00	4.00	0.00
△	1	39.00	Gravelly Fine to Medium Sand (SP SM-GP)	40.00	54.00	6.00	0.00
▲	1	42.00	Gravelly Coarse to Medium Sand (SP-SM-GP)	33.00	61.00	6.00	0.00

INDIAN GEOTECHNICAL SERVICES

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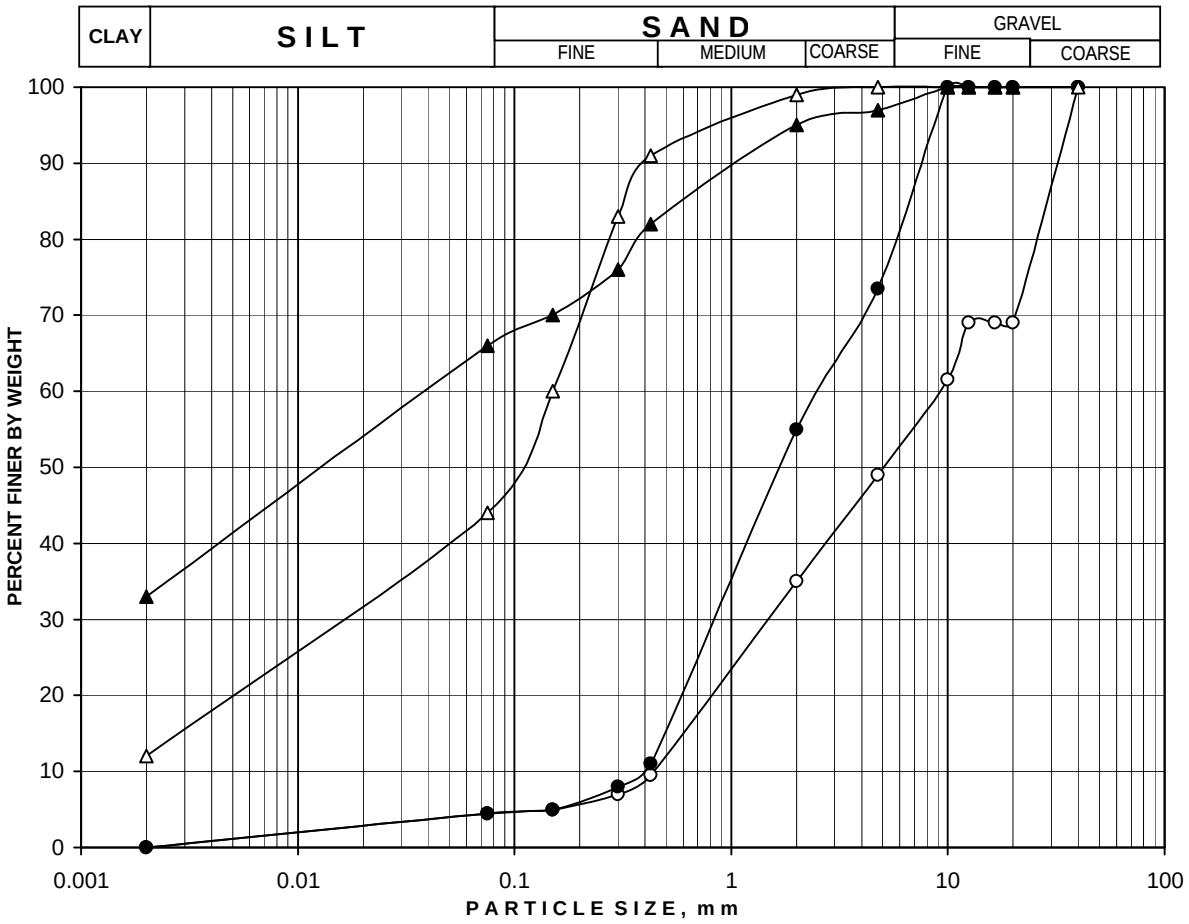

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	1	44.50	Sandy Gravels (GP-SP)	51.00	45.00	4.00	0.00
●	1	45.00	Gravelly Coarse to Medium Sand (SP-SM)	27.00	69.00	4.00	0.00
△	1	46.50	Clayey Silty Sand of low plasticity (SC)	0.00	56.00	32.00	12.00
▲	1	48.00	Sandy Clayey Silt of medium plasticity (CI)	3.00	31.00	33.00	33.00

INDIAN GEOTECHNICAL SERVICES

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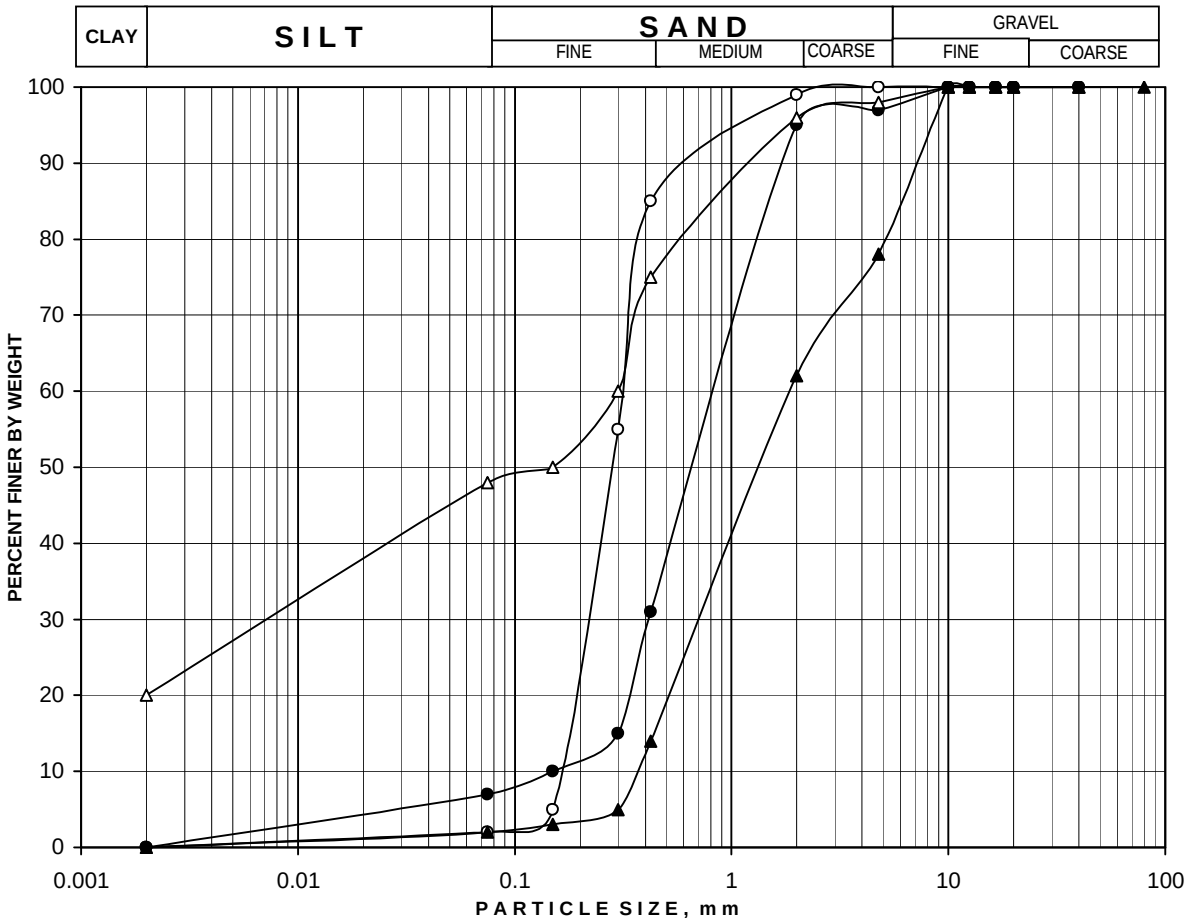

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	2	0.00 - 1.00	Medium to Fine Sand (SP)	0.00	98.00	2.00	0.00
●	2	3.00	Fine to Medium Sand (SP-SM)	3.00	90.00	7.00	0.00
△	2	6.00	Clayey Silty Sand of medium plasticity (SC)	2.00	50.00	28.00	20.00
▲	2	9.00	Gravelly Coarse to Medium Sand (SP)	22.00	76.00	2.00	0.00

INDIAN GEOTECHNICAL SERVICES

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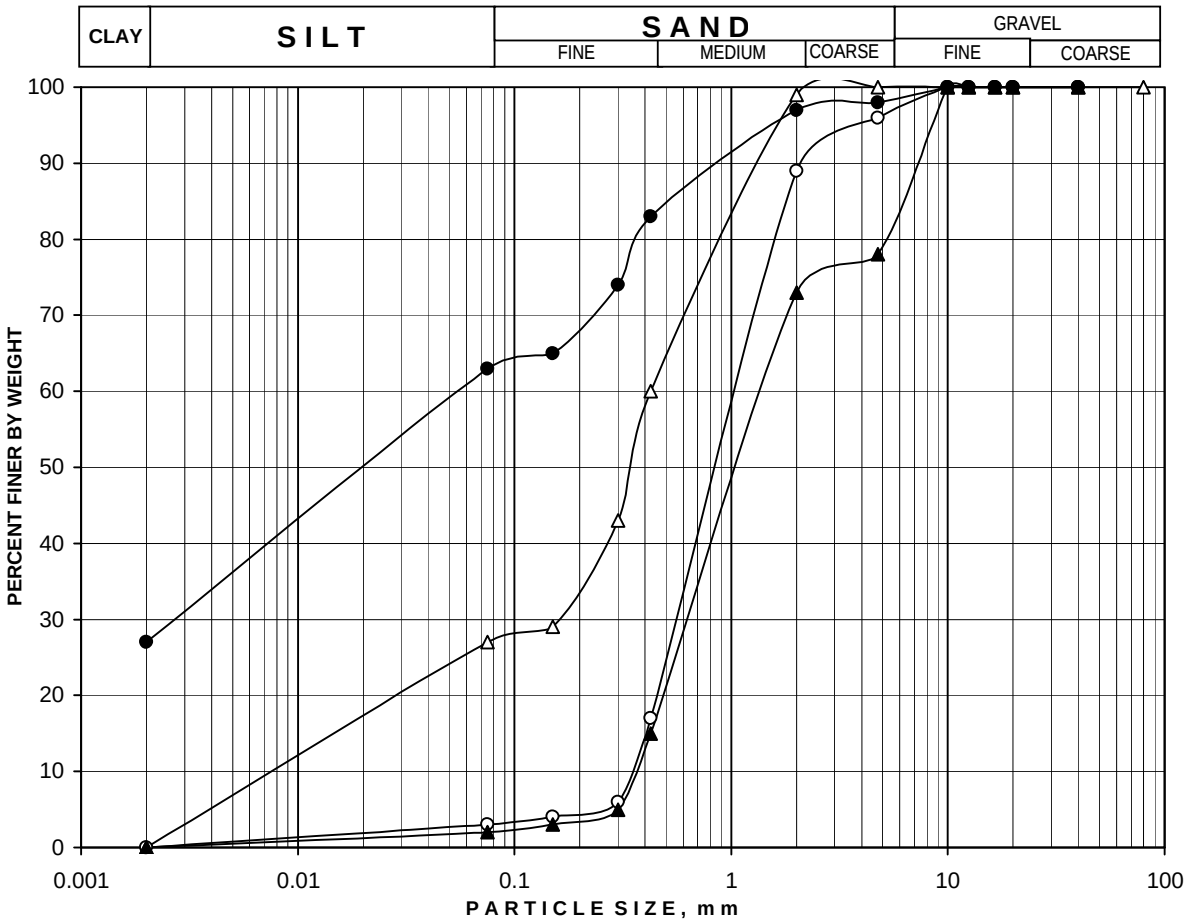
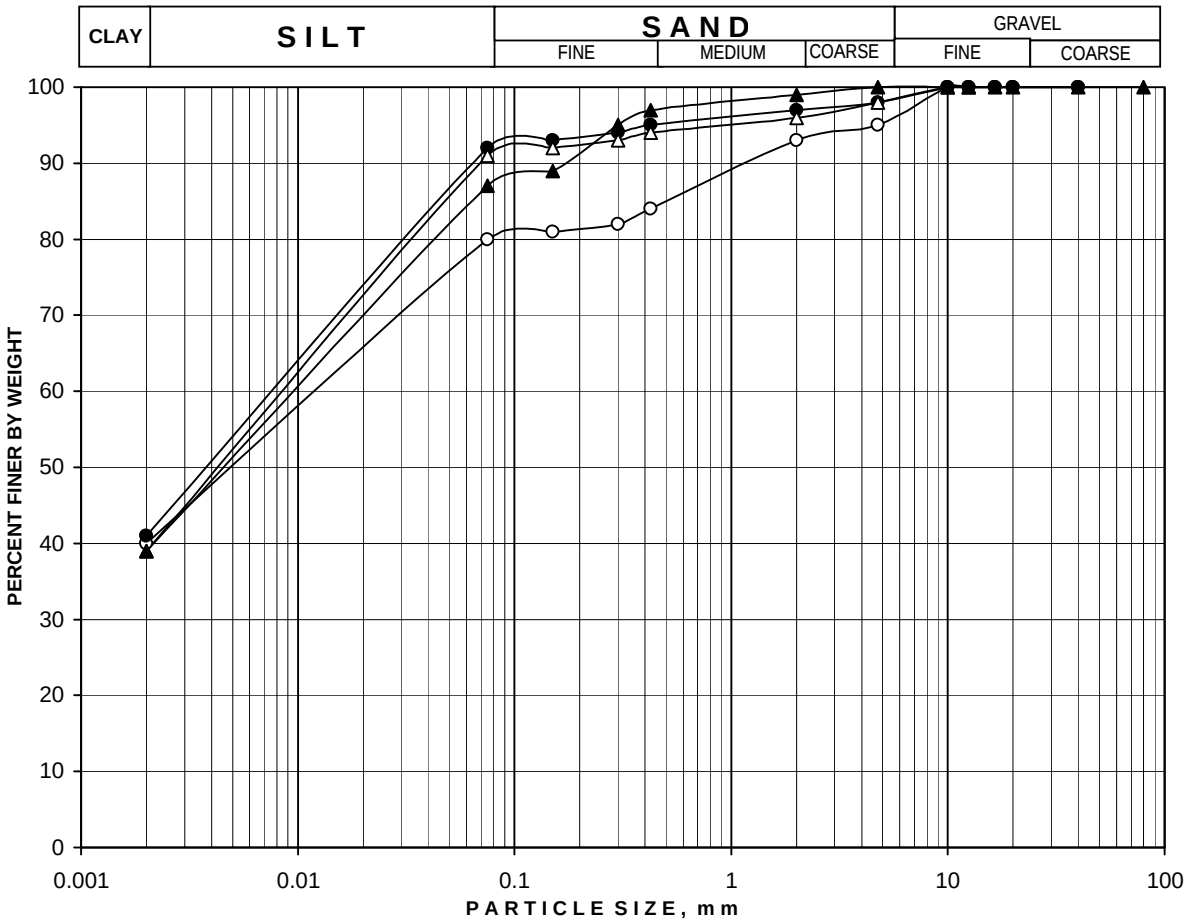


Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	2	12.00	Fine to Medium Sand (SP)	4.00	93.00	3.00	0.00
●	2	13.00	Clayey Sandy Silt of medium plasticity (CI)	2.00	35.00	36.00	27.00
△	2	16.00	Silty Sand (SM)	0.00	73.00	27.00	0.00
▲	2	18.00	Gravelly Fine to Medium Sand (SP SM)	22.00	76.00	2.00	0.00

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	2	19.50	Silty Clay of high plasticity (CH)	5.00	15.00	40.00	40.00
●	2	24.00	Silty Clay of high plasticity (CH)	2.00	6.00	51.00	41.00
△	2	28.50	Silty Clay of high plasticity (CH)	2.00	7.00	52.00	39.00
▲	2	33.00	Silty Clay of high plasticity (CH)	0.00	13.00	48.00	39.00

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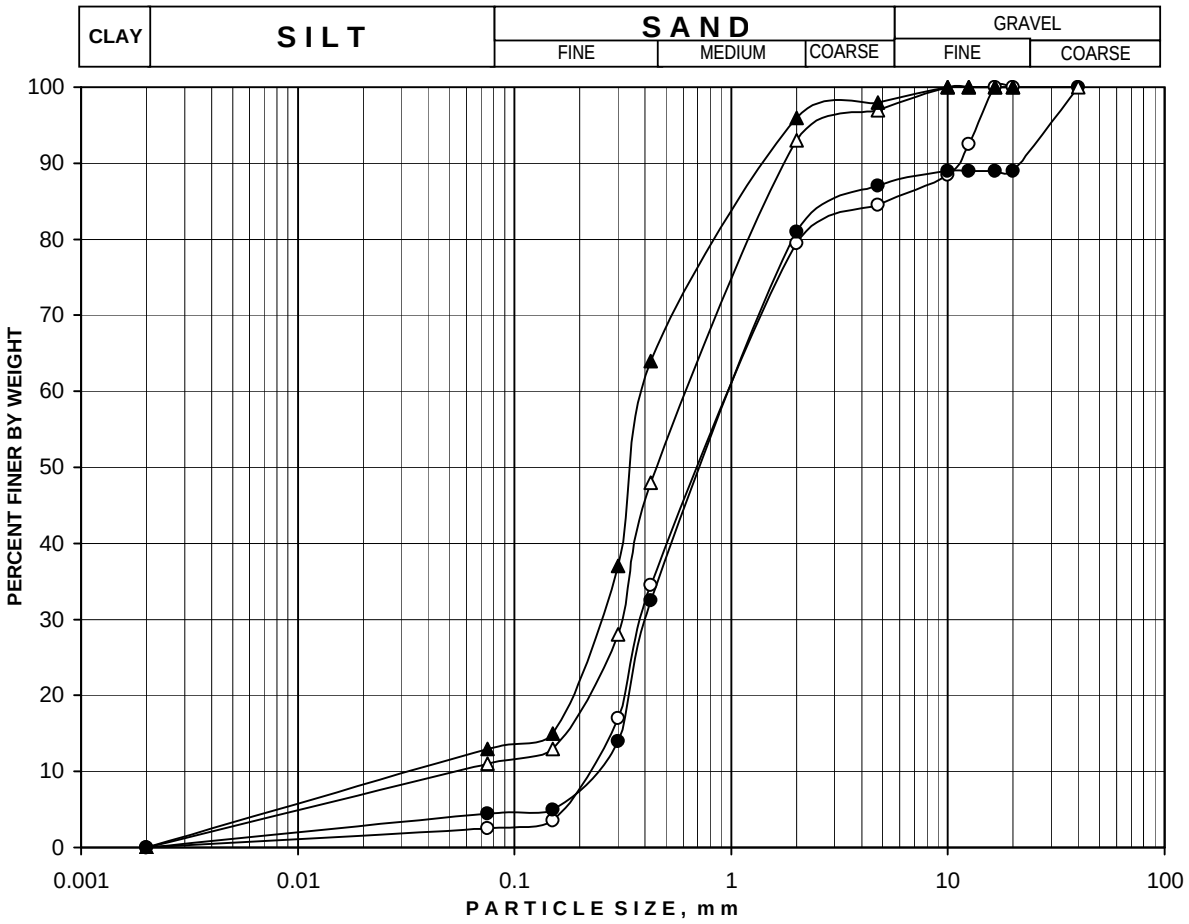

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	2	34.50	Gravelly Fine to Medium Sand (SP)	16.00	82.00	2.00	0.00
●	2	37.50	Gravelly Fine to Medium Sand (SP)	13.00	83.00	4.00	0.00
△	2	41.50	Fine to Medium Sand (SP-SM)	3.00	86.00	11.00	0.00
▲	2	43.50	Silty Sand (SM)	2.00	85.00	13.00	0.00

INDIAN GEOTECHNICAL SERVICES

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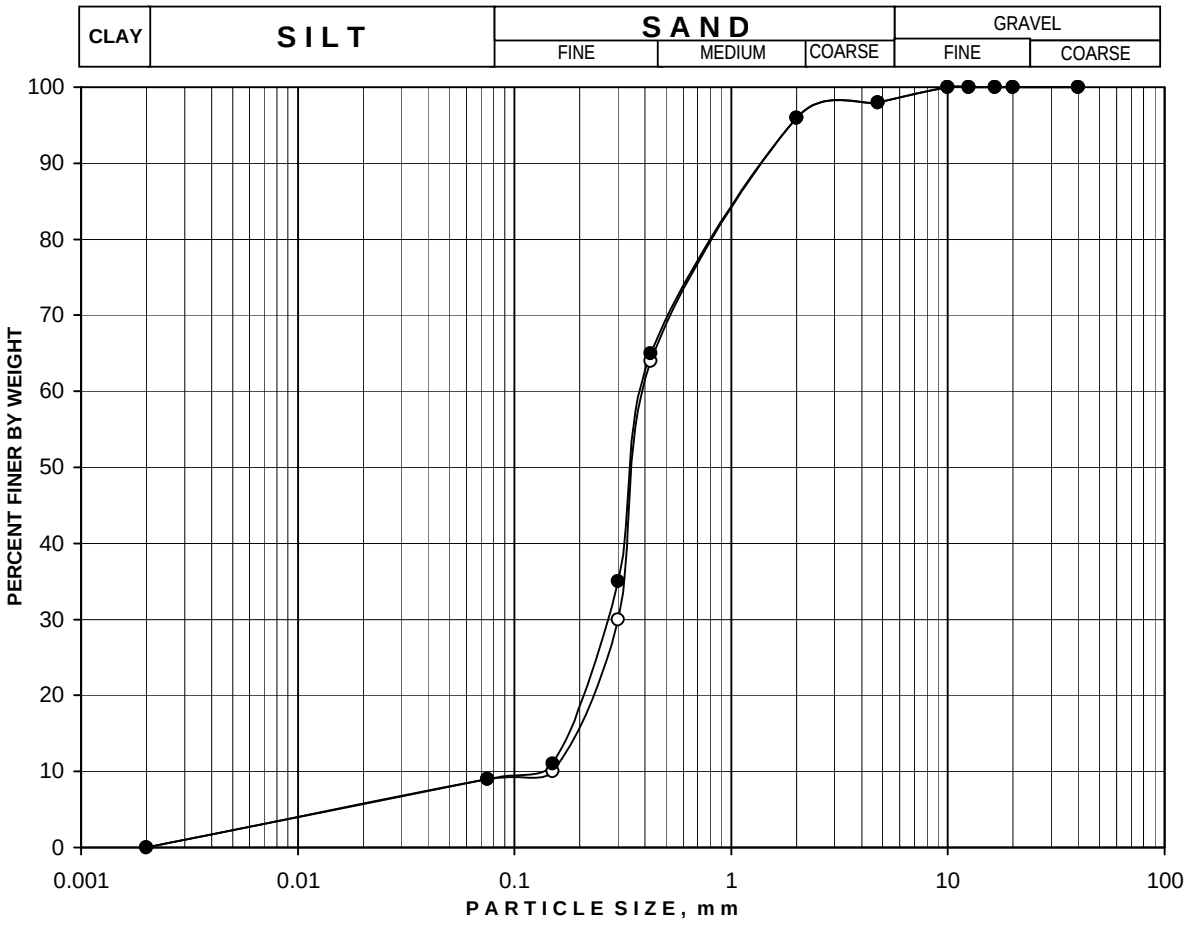

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	2	46.50	Medium to Fine Sand (SP-SM)	2.00	89.00	9.00	0.00
●	2	50.00	Medium to Fine Sand (SP-SM)	2.00	89.00	9.00	0.00

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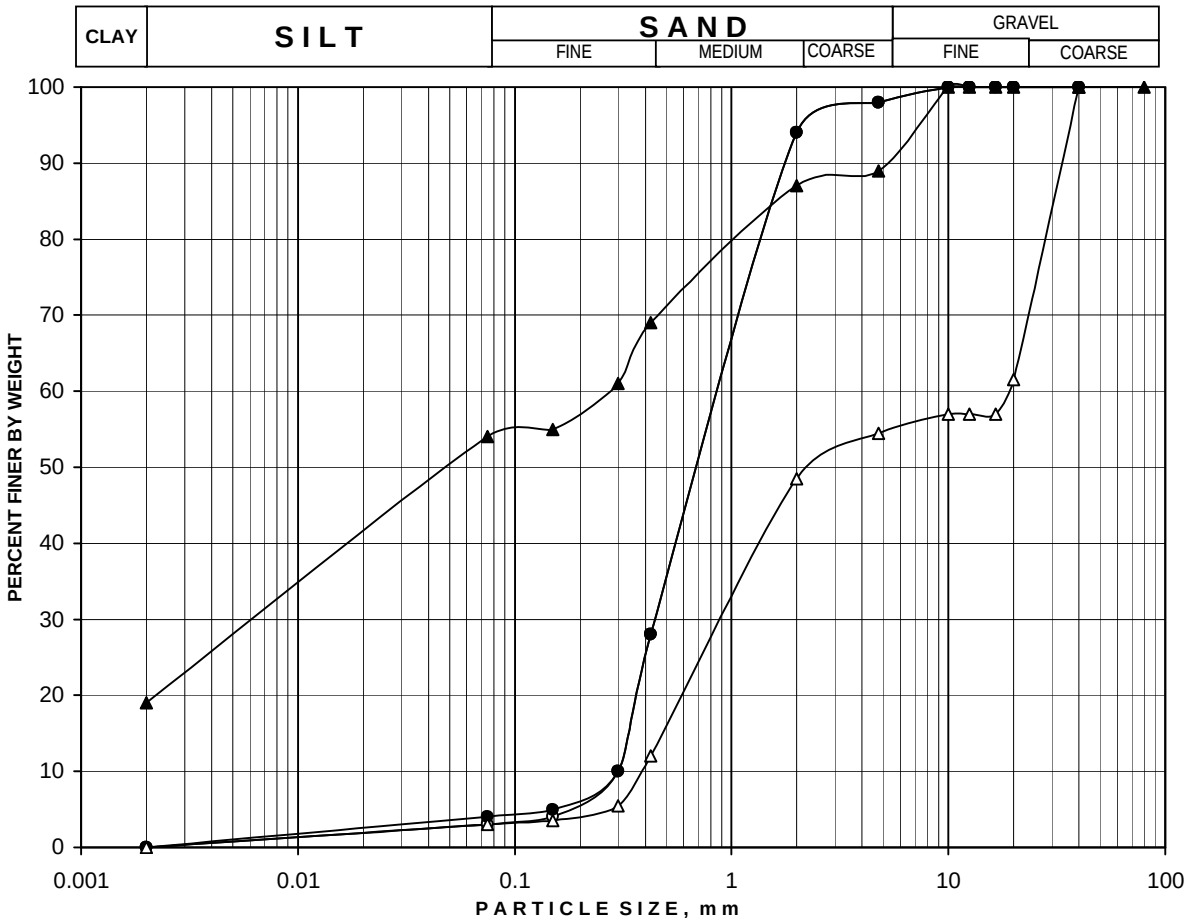

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	3	0.00 - 1.00	Fine to Medium Sand (SP)	2.00	95.00	3.00	0.00
●	3	3.00	Fine to Medium Sand (SP)	2.00	94.00	4.00	0.00
△	3	5.50	Gravelly Fine to Medium Sand (SP-GP)	46.00	51.00	3.00	0.00
▲	3	6.00	Gravelly Clayey Sandy Silt of medium plasticity (CI)	11.00	35.00	35.00	19.00

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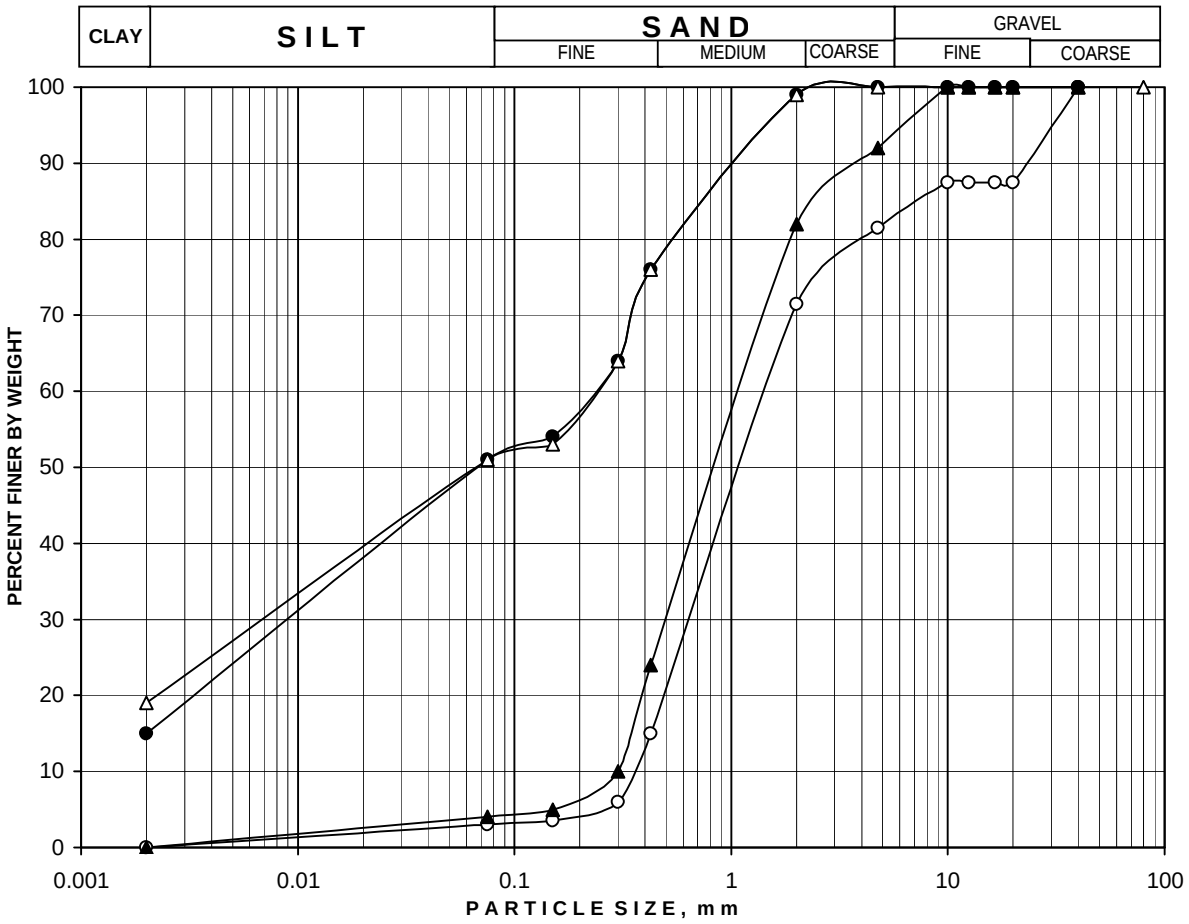

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	3	9.00	Gravelly Coarse to Medium Sand (SP)	19.00	78.00	3.00	0.00
●	3	12.00	Clayey Sandy Silt of medium plasticity (CI)	0.00	49.00	36.00	15.00
△	3	15.00	Clayey Sandy Silt of medium plasticity (CI)	0.00	49.00	32.00	19.00
▲	3	16.50	Fine to Medium Sand (SP)	8.00	88.00	4.00	0.00

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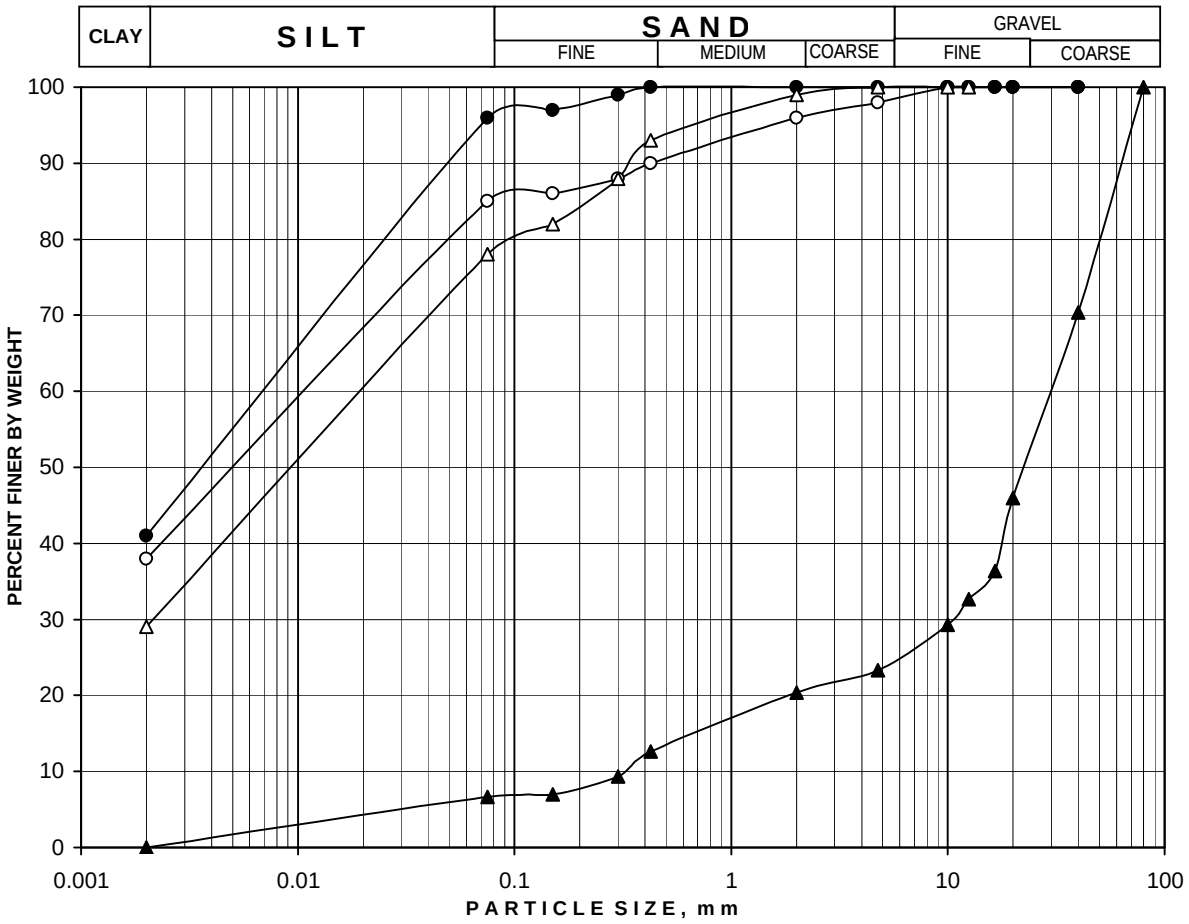

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	3	19.50	Silty Clay of high plasticity (CH)	2.00	13.00	47.00	38.00
●	3	24.00	Silty Clay of high plasticity (CH)	0.00	4.00	55.00	41.00
△	3	28.50	Silty Clay of high plasticity (CH)	0.00	22.00	49.00	29.00
▲	3	32.50	Sandy Gravels (GP-GM)	77.00	16.00	7.00	0.00

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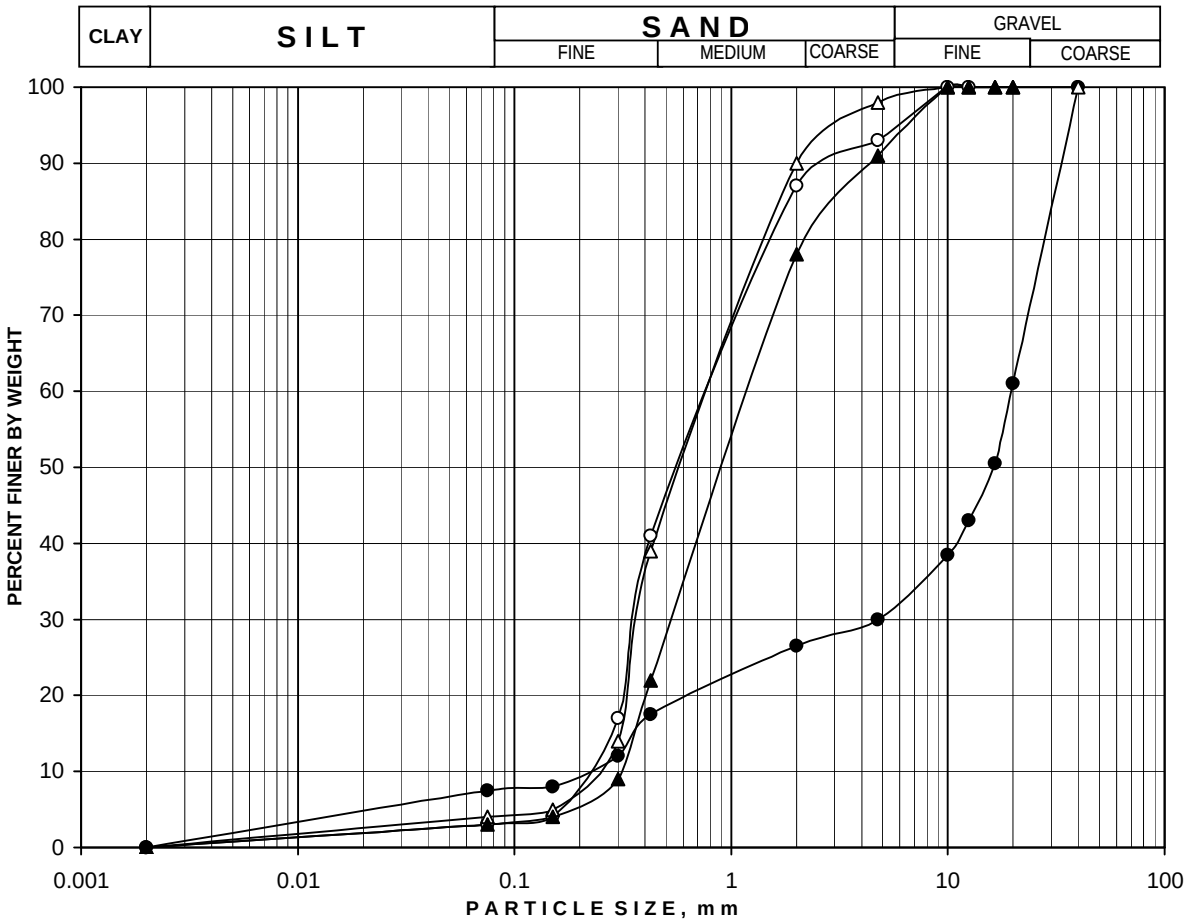

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	3	33.00	Fine to Medium Sand (SP)	7.00	90.00	3.00	0.00
●	3	35.50	Sandy Gravels (GP-GM)	70.00	23.00	7.00	0.00
△	3	36.00	Fine to Medium Sand (SP)	2.00	94.00	4.00	0.00
▲	3	39.00	Coarse to Medium Sand (SP)	9.00	88.00	3.00	0.00

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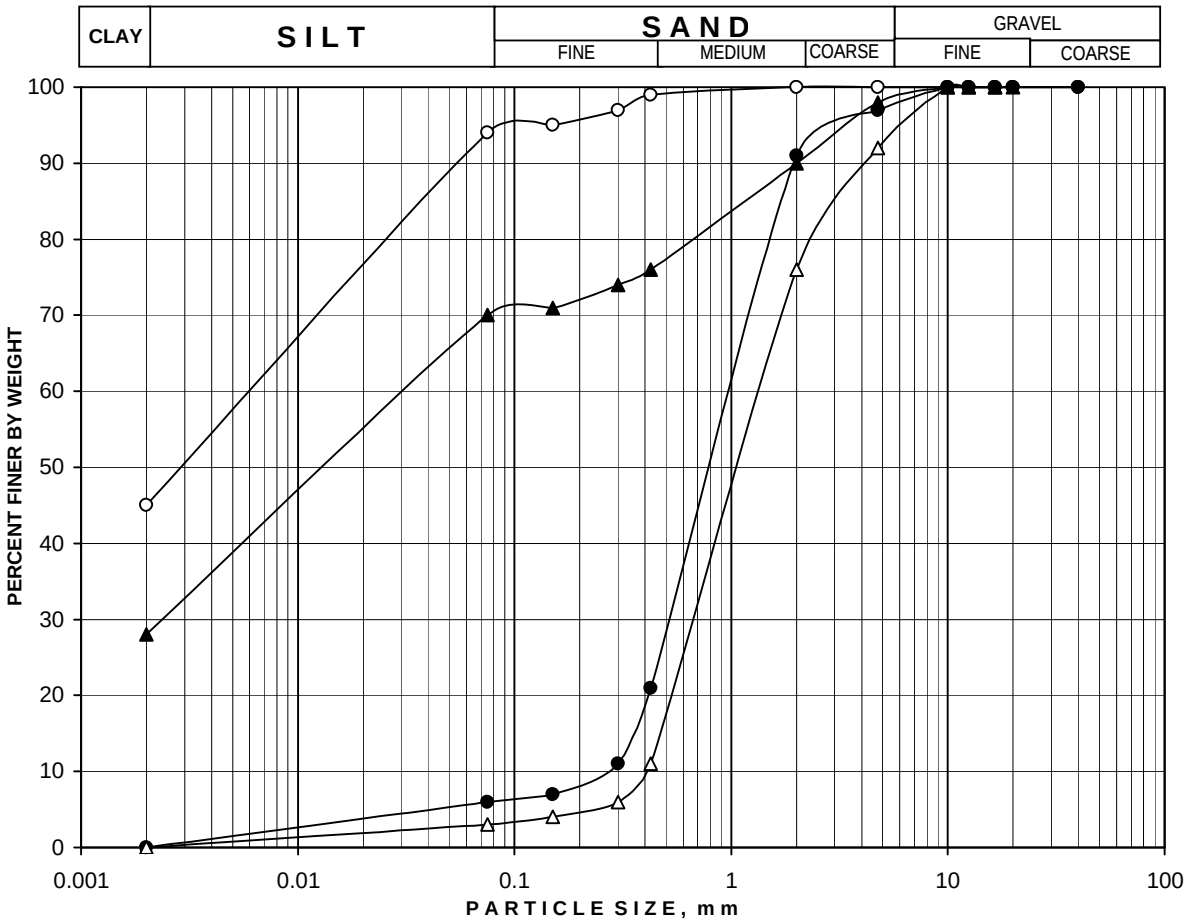

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	3	42.00	Silty Clay of high plasticity (CH)	0.00	6.00	49.00	45.00
●	3	45.00	Fine to Medium Sand (SP-SM)	3.00	91.00	6.00	0.00
△	3	46.50	Coarse to Medium Sand (SP)	8.00	89.00	3.00	0.00
▲	3	48.00	Sandy Clayey Silt of medium plasticity (CI)	2.00	28.00	42.00	28.00

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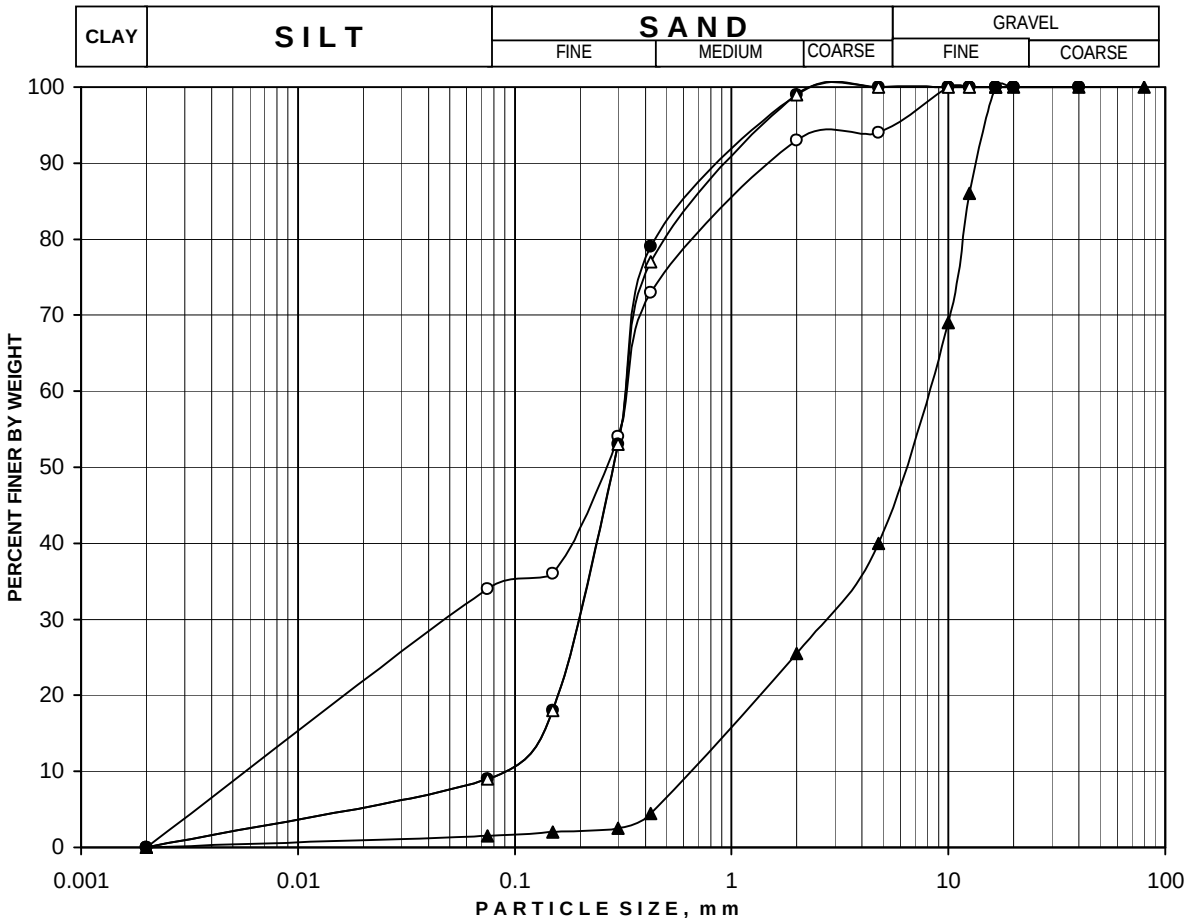

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	0.00 - 1.00	Silty Sand (SM)	6.00	60.00	34.00	0.00
●	4	1.50	Medium to Fine Sand (SP-SM)	0.00	91.00	9.00	0.00
△	4	3.00	Medium to Fine Sand (SP-SM)	0.00	91.00	9.00	0.00
▲	4	6.00	Sandy Gravels (GP-SP)	60.00	39.00	1.00	0.00

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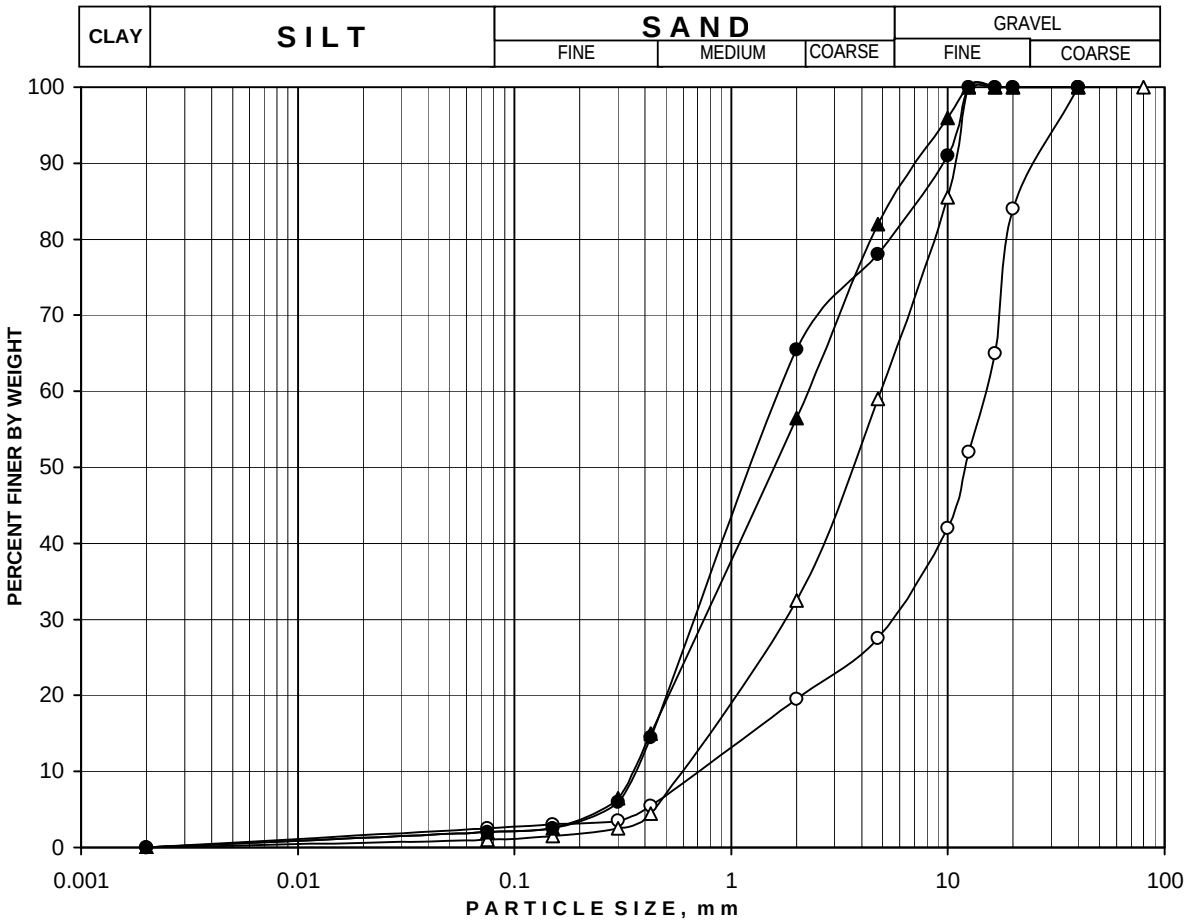

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	7.50	Sandy Gravels (GP)	73.00	25.00	2.00	0.00
●	4	9.00	Gravelly Coarse to Medium Sand (SP)	22.00	76.00	2.00	0.00
△	4	10.50	Gravelly Coarse to Medium Sand (SP)	41.00	58.00	1.00	0.00
▲	4	13.50	Gravelly Coarse to Medium Sand (SP)	18.00	80.00	2.00	0.00

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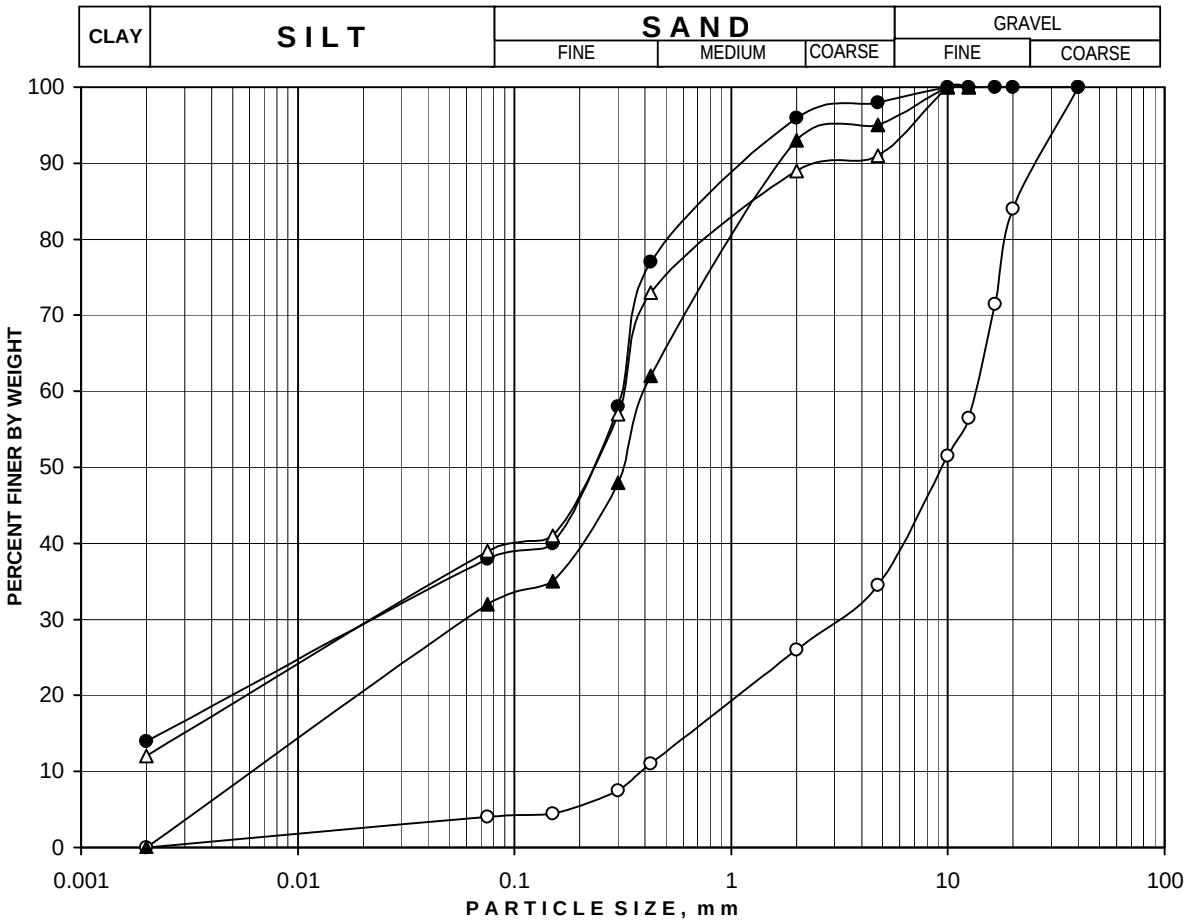

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	14.50	Sandy Gravels (GP-SP)	66.00	30.00	4.00	0.00
●	4	15.00	Clayey Silty Sand of medium plasticity (SC)	2.00	60.00	24.00	14.00
△	4	18.00	Clayey Silty Sand of medium plasticity (SC)	9.00	52.00	27.00	12.00
▲	4	21.00	Silty Sand (SM)	5.00	63.00	32.00	0.00

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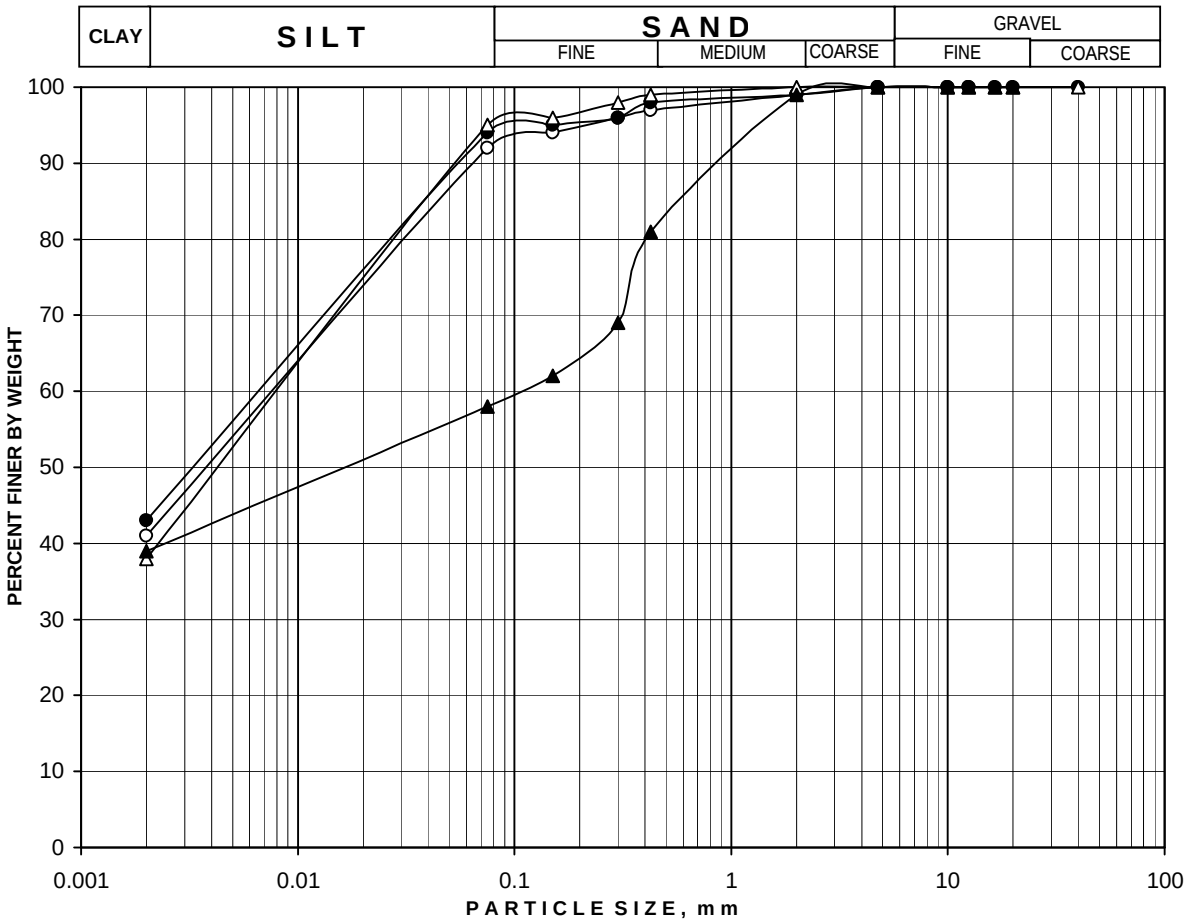

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	24.00	Silty Clay of high plasticity (CH)	0.00	8.00	51.00	41.00
●	4	27.00	Silty Clay of high plasticity (CH)	0.00	6.00	51.00	43.00
△	4	31.50	Silty Clay of high plasticity (CH)	0.00	5.00	57.00	38.00
▲	4	36.00	Silty Clay of high plasticity (CH)	0.00	42.00	19.00	39.00

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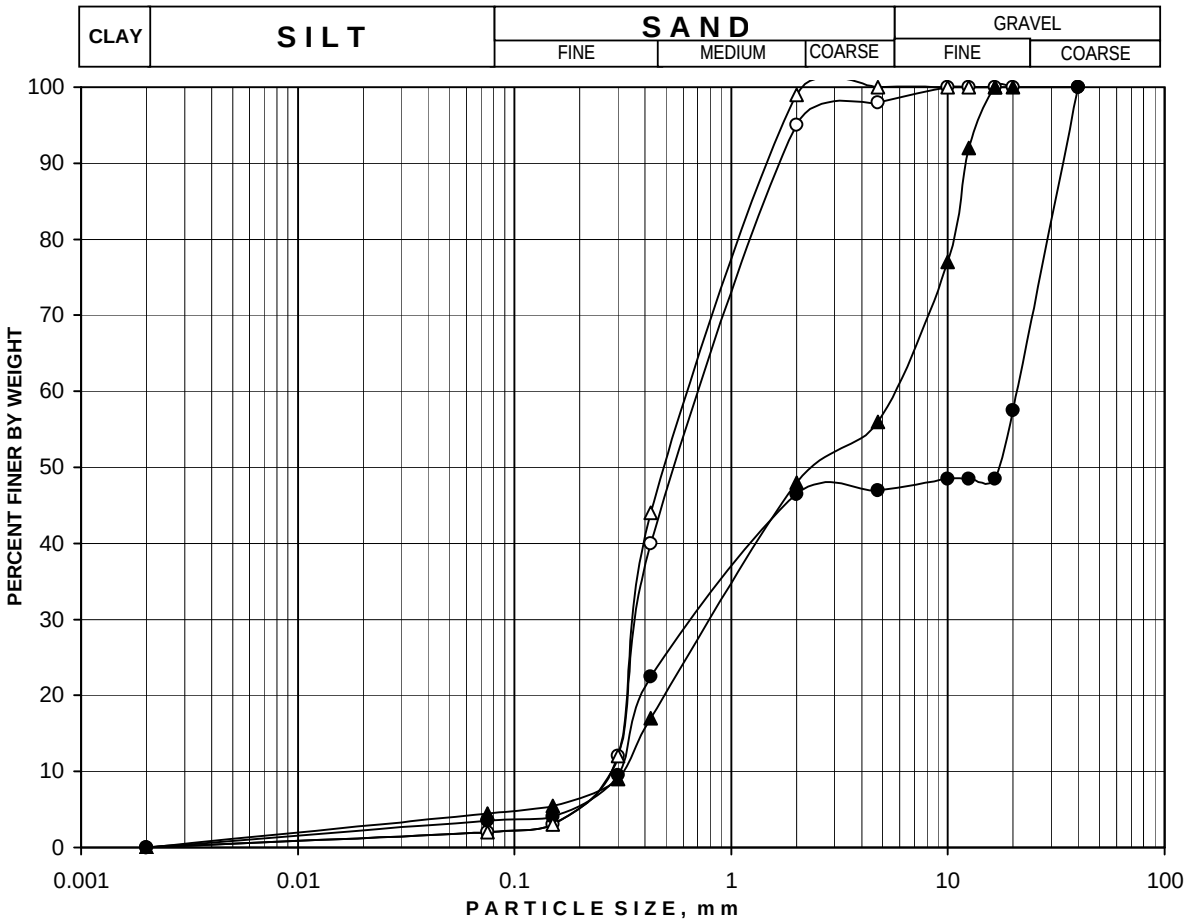

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	37.50	Fine to Medium Sand (SP)	2.00	96.00	2.00	0.00
●	4	38.50	Sandy Gravels (GP-SP)	53.00	44.00	3.00	0.00
△	4	39.00	Fine to Medium Sand (SP)	0.00	98.00	2.00	0.00
▲	4	41.50	Gravelly Fine to Medium Sand (SP GP)	44.00	52.00	4.00	0.00

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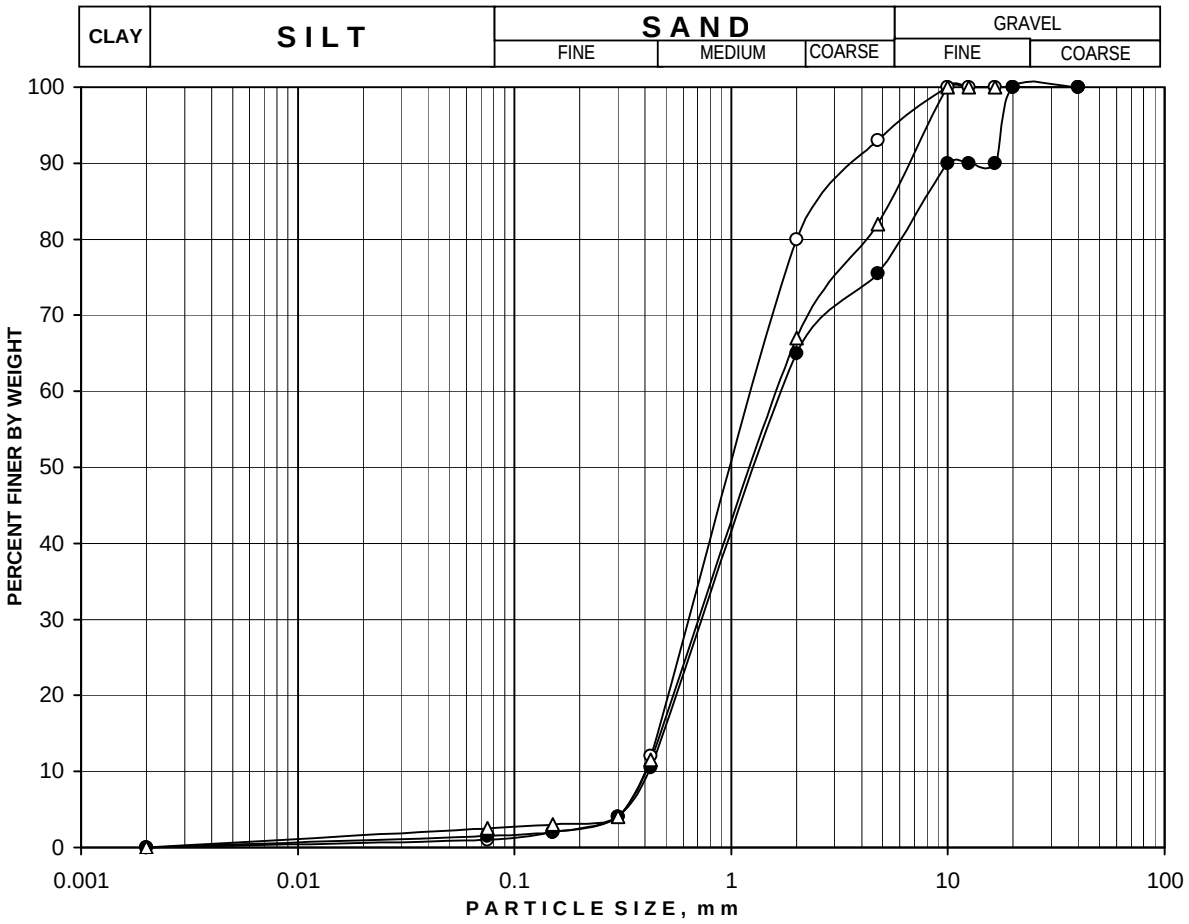

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	4	42.00	Gravelly Coarse to Medium Sand (SP)	7.00	92.00	1.00	0.00
●	4	45.00	Gravelly Coarse to Medium Sand (SP)	25.00	74.00	1.00	0.00
△	4	48.00	Gravelly Coarse to Medium Sand (SP)	18.00	80.00	2.00	0.00

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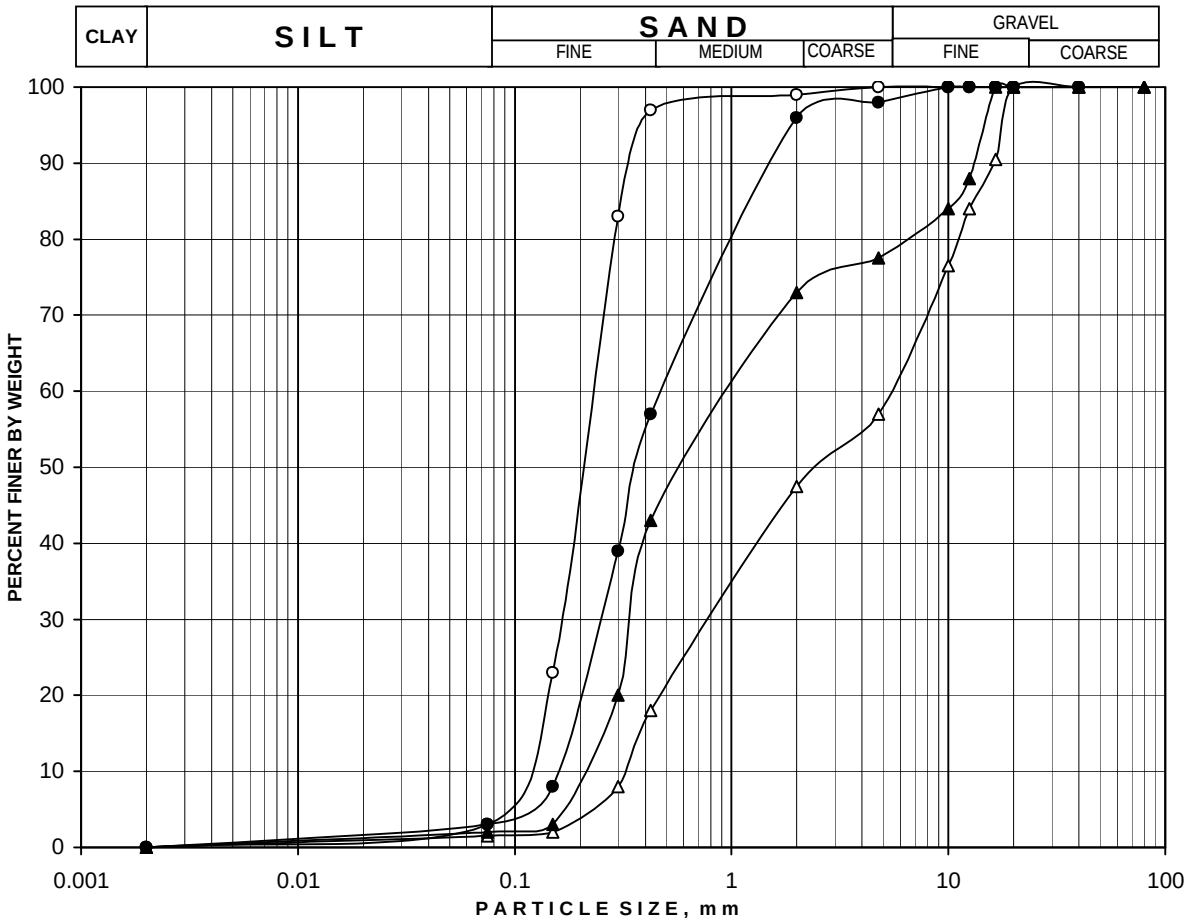

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	5	0.00 - 1.00	Fine Sand (SP)	0.00	97.00	3.00	0.00
●	5	3.00	Medium to Fine Sand (SP)	2.00	95.00	3.00	0.00
△	5	6.00	Gravelly Fine to Medium Sand (SP)	43.00	56.00	1.00	0.00
▲	5	9.00	Gravelly Medium to Fine Sand (SP)	23.00	75.00	2.00	0.00

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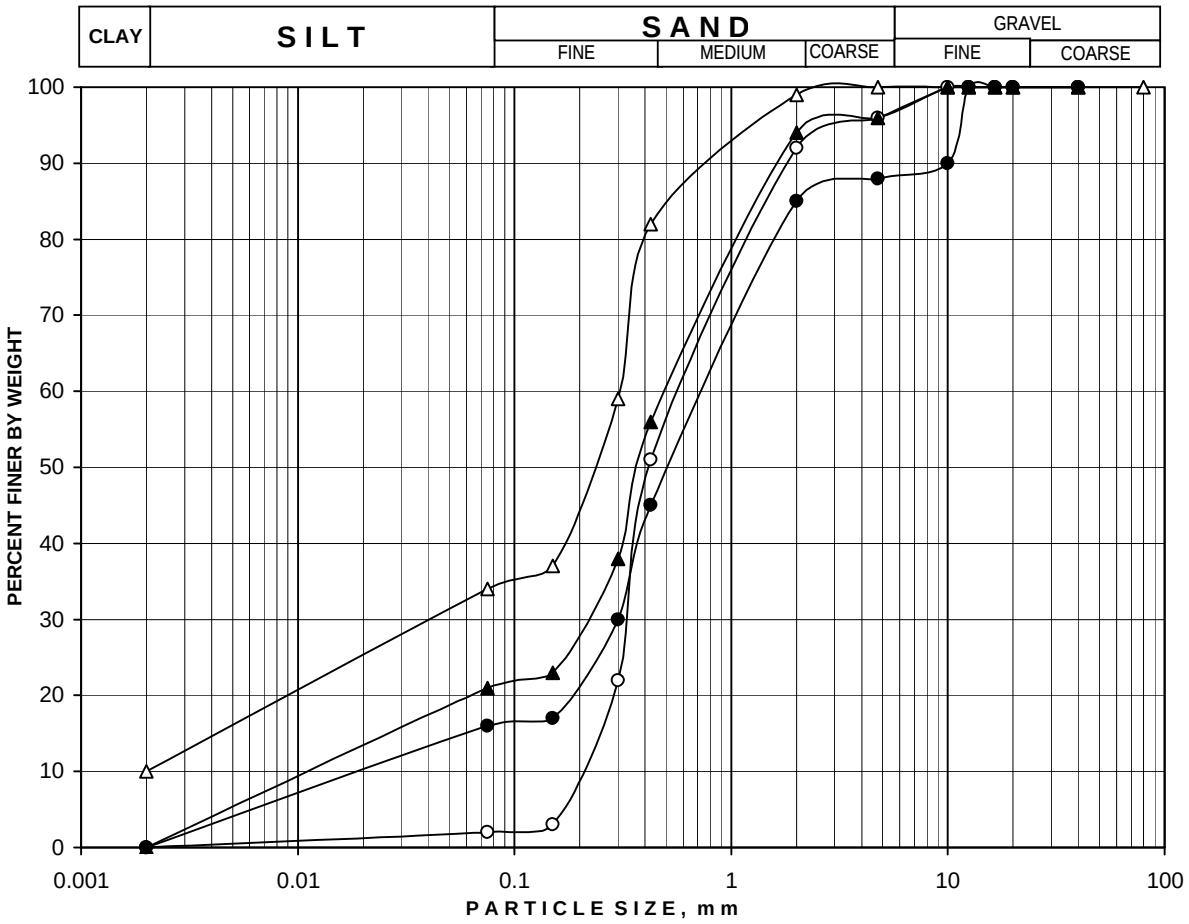

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	5	12.00	Medium to Fine Sand (SP)	4.00	94.00	2.00	0.00
●	5	15.00	Gravelly Silty Sand (SM)	12.00	72.00	16.00	0.00
△	5	16.50	Clayey Silty Sand of low plasticity (SC)	0.00	66.00	24.00	10.00
▲	5	18.00	Silty Sand (SM)	4.00	75.00	21.00	0.00

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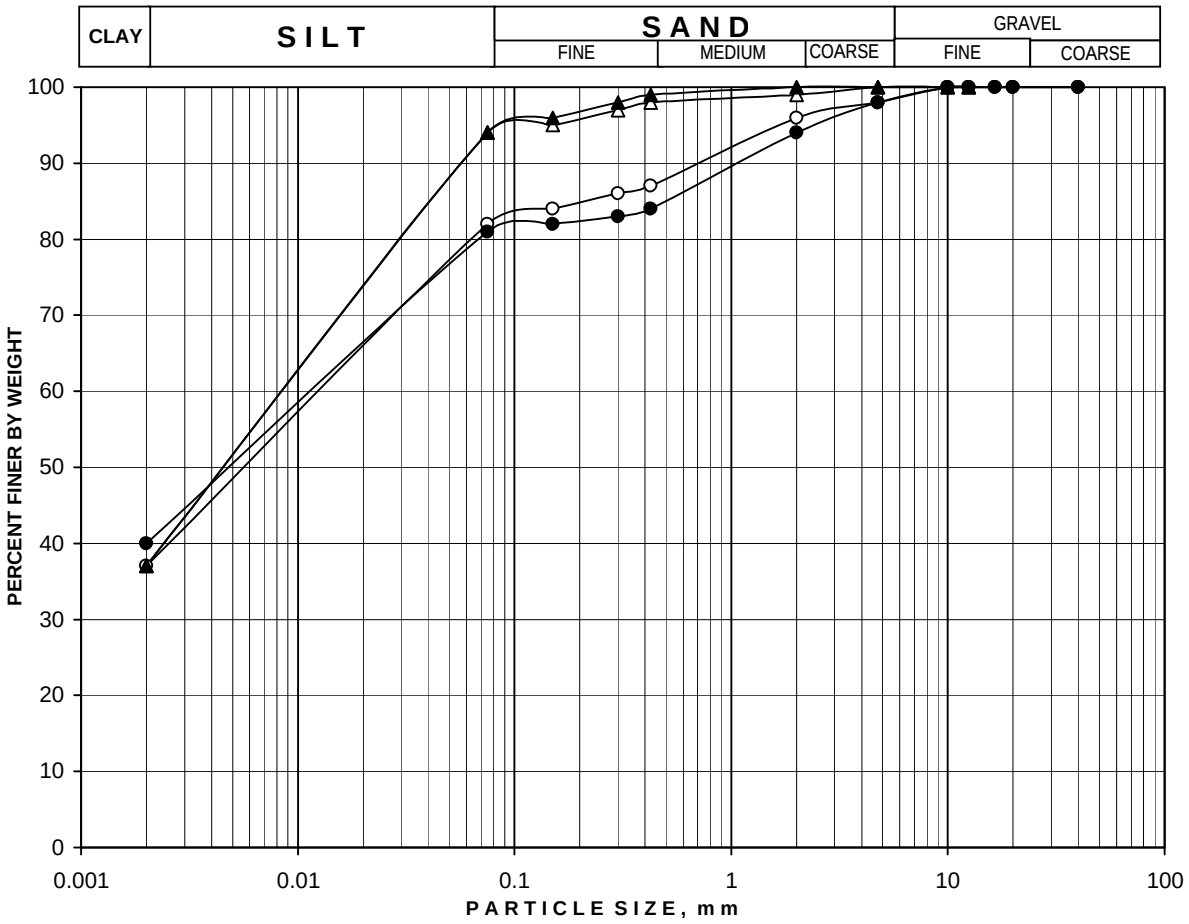

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	5	21.00	Silty Clay of high plasticity (CH)	2.00	16.00	45.00	37.00
●	5	25.50	Silty Clay of high plasticity (CH)	2.00	17.00	41.00	40.00
△	5	30.00	Silty Clay of high plasticity (CH)	0.00	6.00	57.00	37.00
▲	5	34.50	Silty Clay of high plasticity (CH)	0.00	6.00	57.00	37.00

INDIAN GEOTECHNICAL SERVICES

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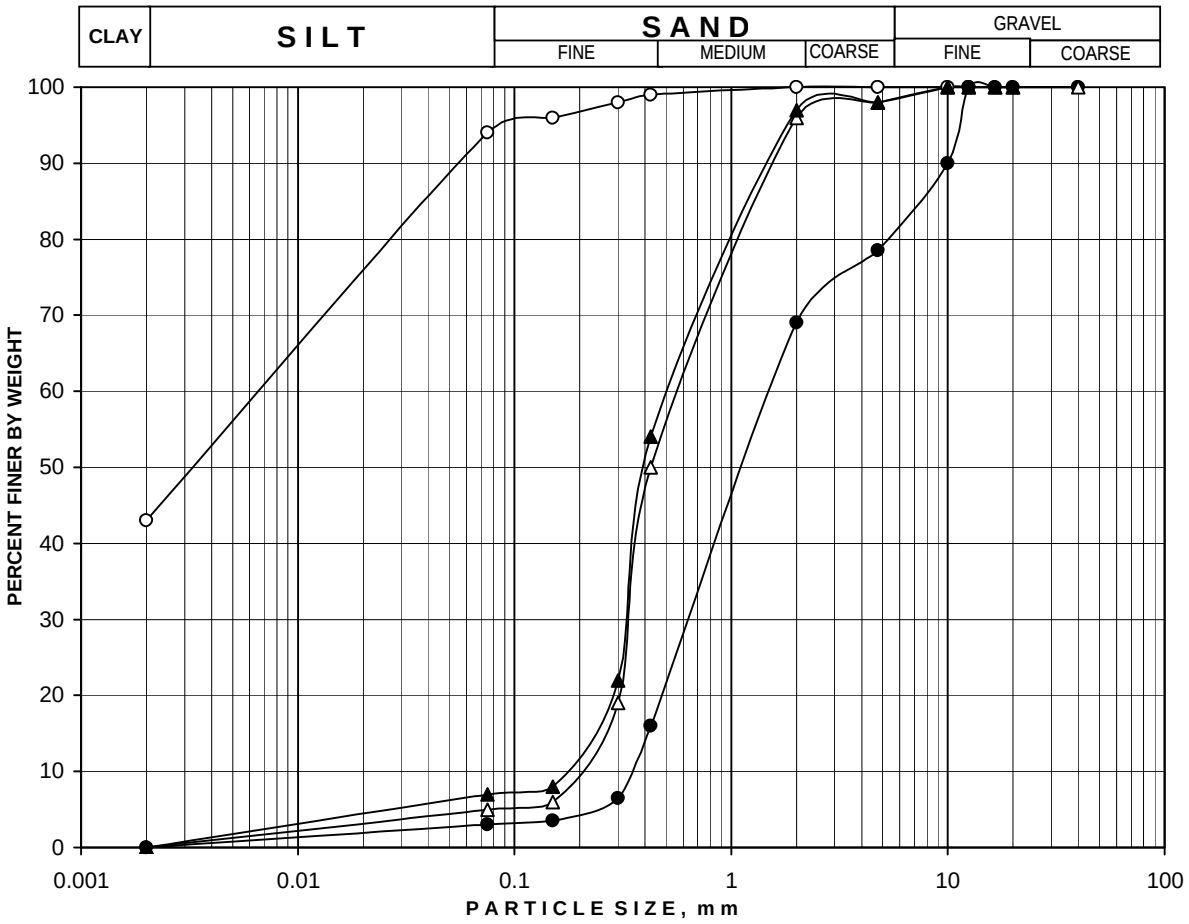

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	5	39.00	Silty Clay of high plasticity (CH)	0.00	6.00	51.00	43.00
●	5	42.00	Gravelly Fine to Medium Sand (SP)	22.00	75.00	3.00	0.00
△	5	45.00	Medium to Fine Sand (SP-SM)	2.00	93.00	5.00	0.00
▲	5	48.00	Medium to Fine Sand (SP-SM)	2.00	91.00	7.00	0.00

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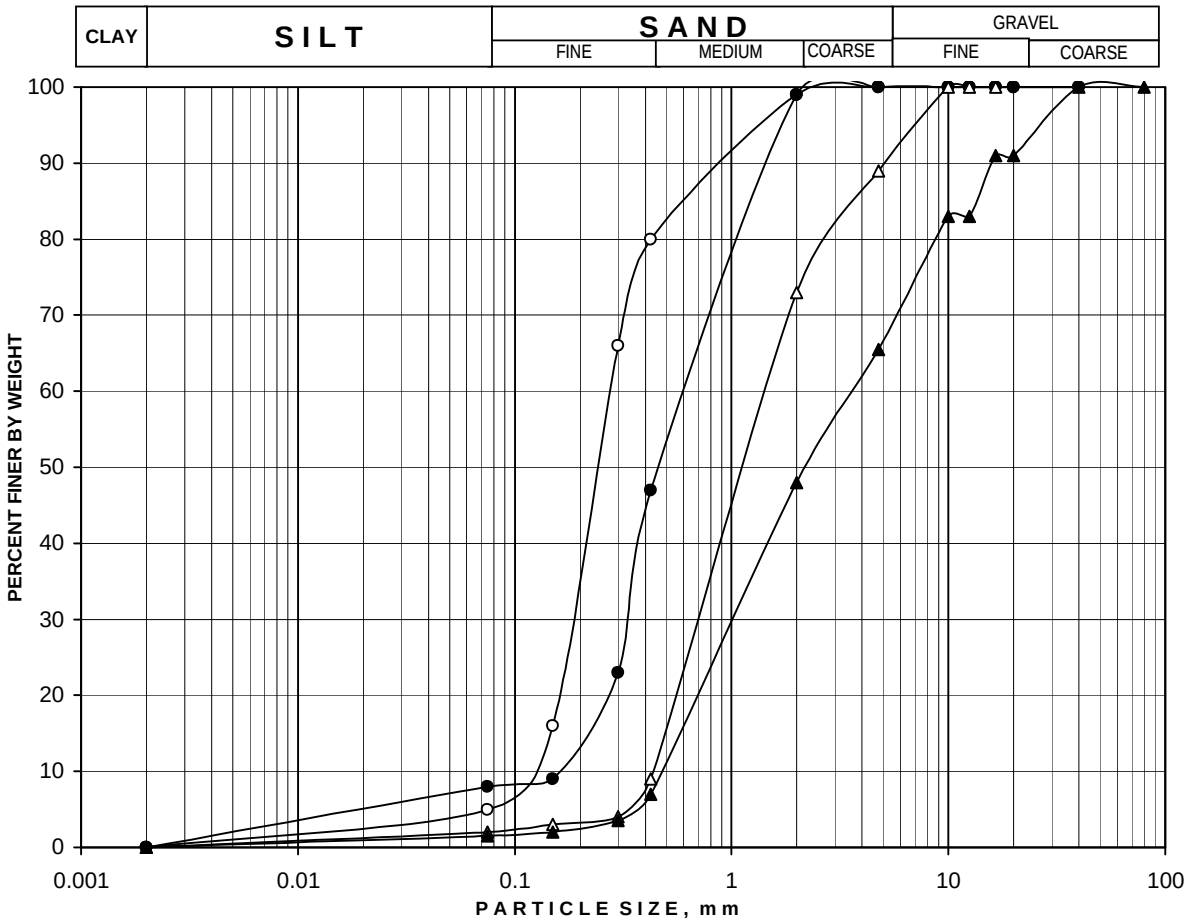

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	6	0.00 - 1.00	Medium to Fine Sand (SP-SM)	0.00	95.00	5.00	0.00
●	6	3.00	Fine to Medium Sand (SP-SM)	0.00	92.00	8.00	0.00
△	6	6.00	Gravelly Coarse to Medium Sand (SP)	11.00	87.00	2.00	0.00
▲	6	9.00	Gravelly Coarse to Medium Sand (SP)	35.00	64.00	1.00	0.00

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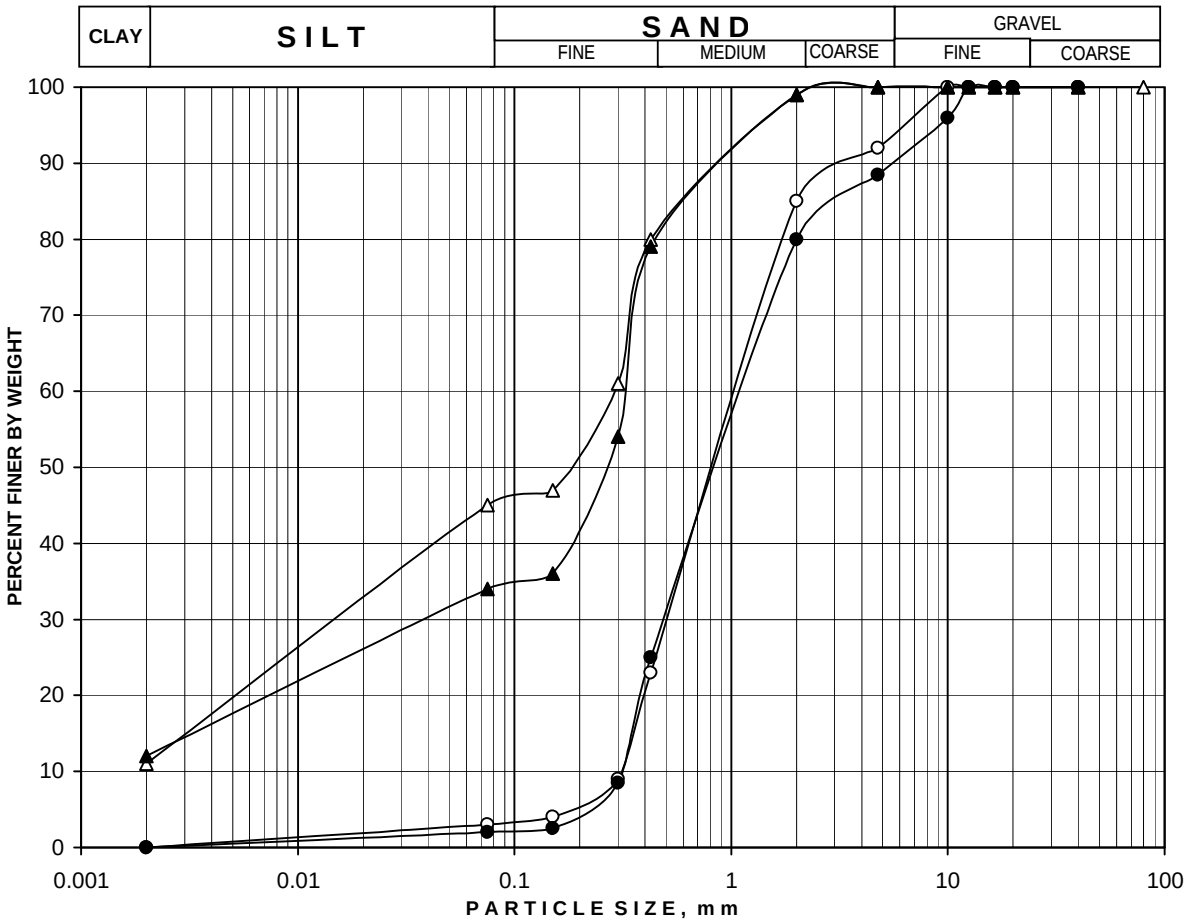

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	6	12.00	Gravelly Fine to Medium Sand (SP)	8.00	89.00	3.00	0.00
●	6	15.00	Gravelly Fine to Medium Sand (SP)	12.00	86.00	2.00	0.00
△	6	16.50	Clayey Silty Sand of low plasticity (SC)	0.00	55.00	34.00	11.00
▲	6	18.00	Clayey Silty Sand of low plasticity (SC)	0.00	66.00	22.00	12.00

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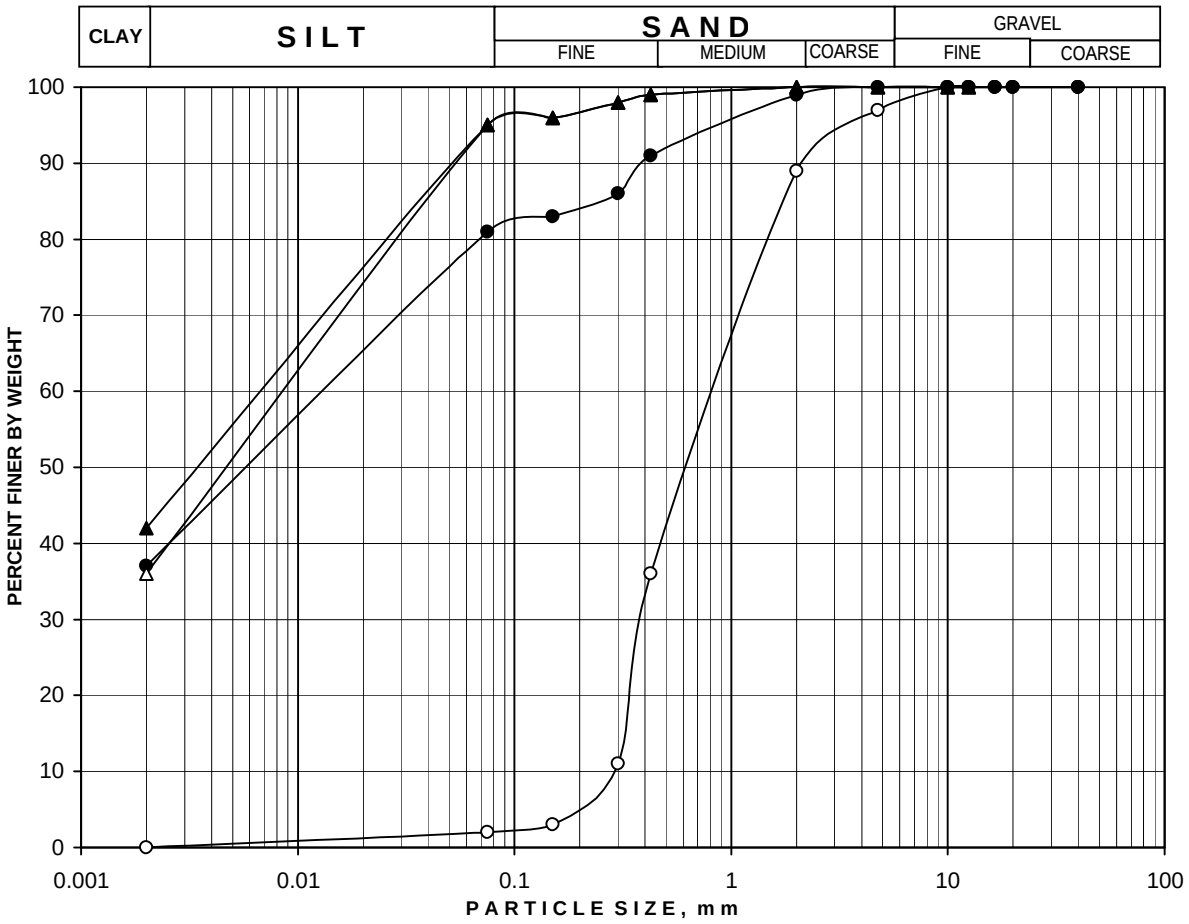

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	6	21.00	Fine to Medium Sand (SP)	3.00	95.00	2.00	0.00
●	6	22.50	Silty Clay of high plasticity (CH)	0.00	19.00	44.00	37.00
△	6	27.00	Silty Clay of high plasticity (CH)	0.00	5.00	59.00	36.00
▲	6	31.50	Silty Clay of high plasticity (CH)	0.00	5.00	53.00	42.00

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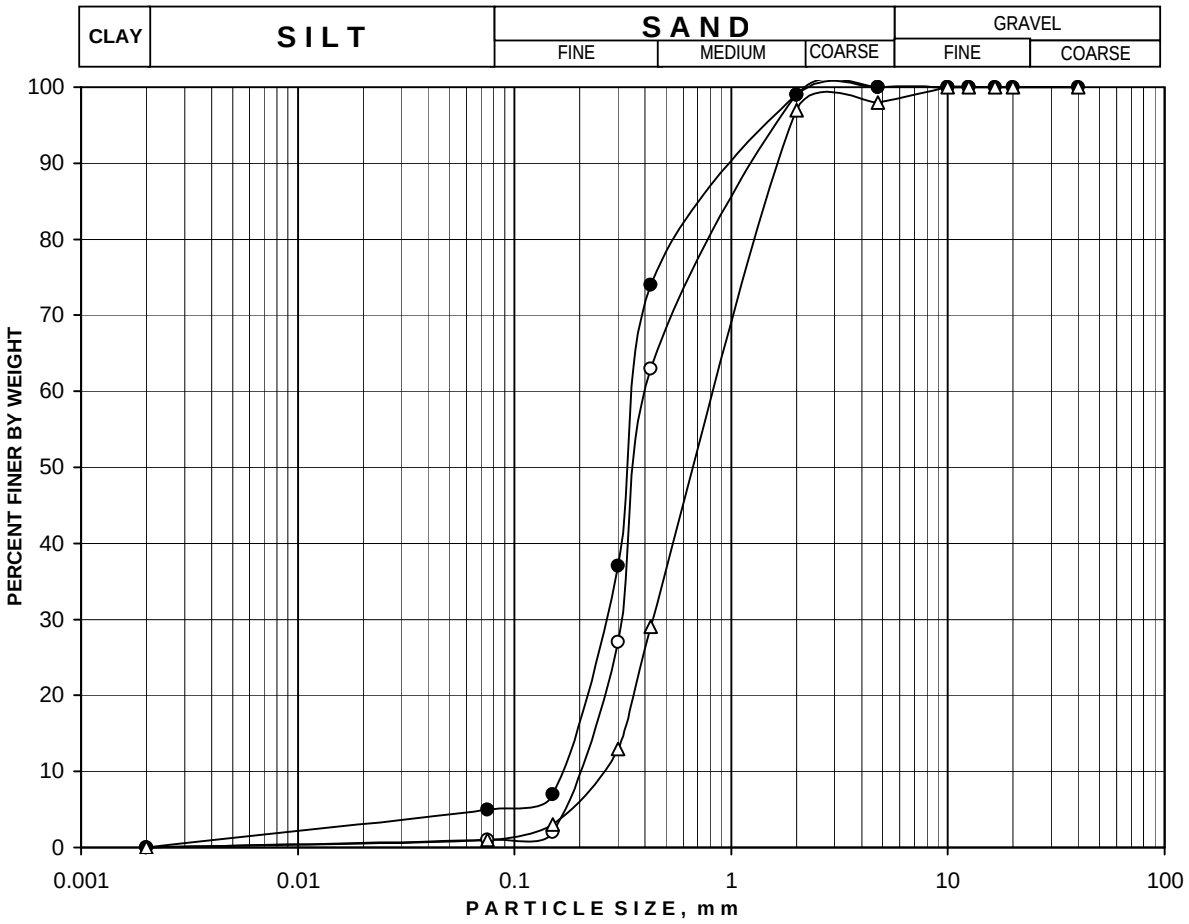

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	6	36.00	Medium to Fine Sand (SP)	0.00	99.00	1.00	0.00
●	6	39.00	Medium to Fine Sand (SP-SM)	0.00	95.00	5.00	0.00
△	6	42.00	Fine to Medium Sand (SP)	2.00	97.00	1.00	0.00

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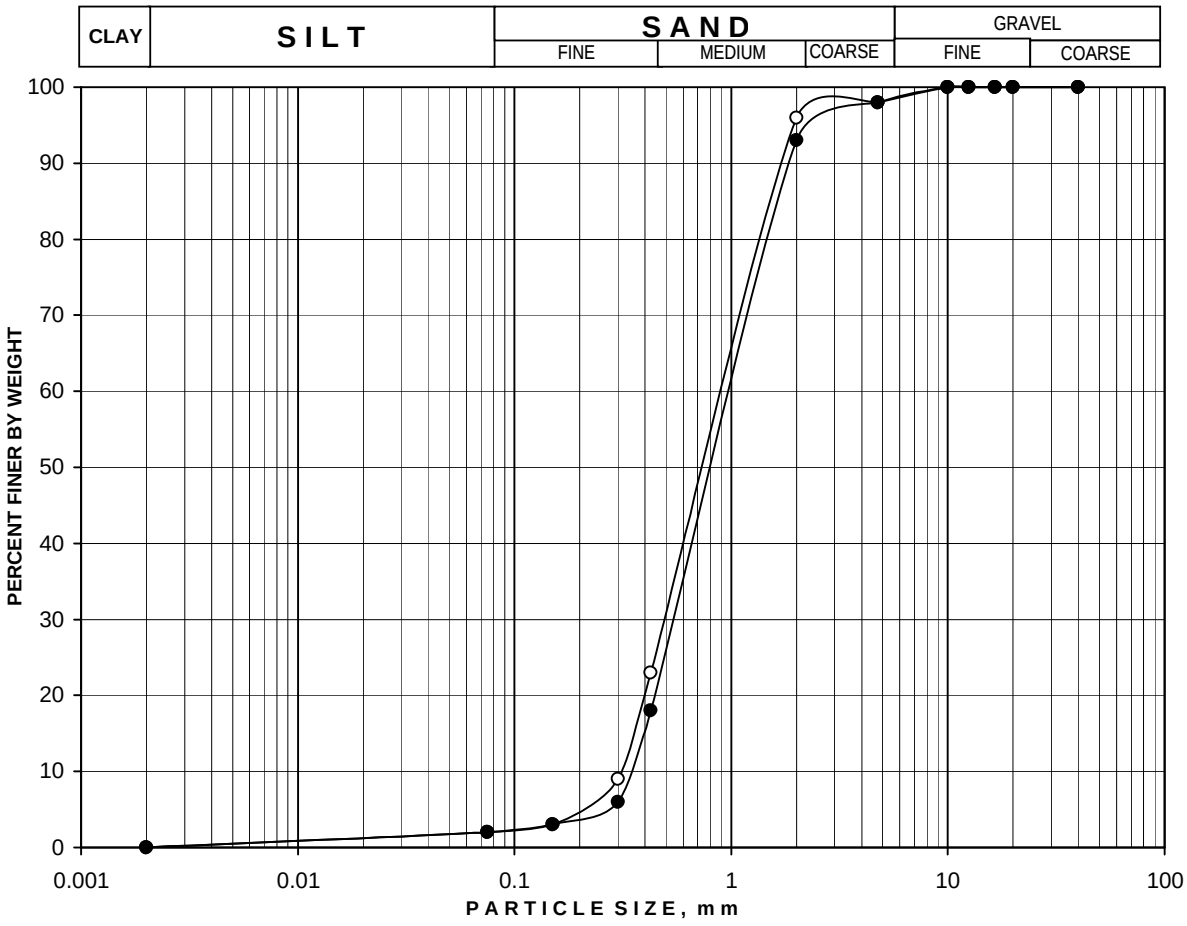

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	6	45.00	Fine to Medium Sand (SP)	2.00	96.00	2.00	0.00
●	6	48.00	Fine to Medium Sand (SP)	2.00	96.00	2.00	0.00

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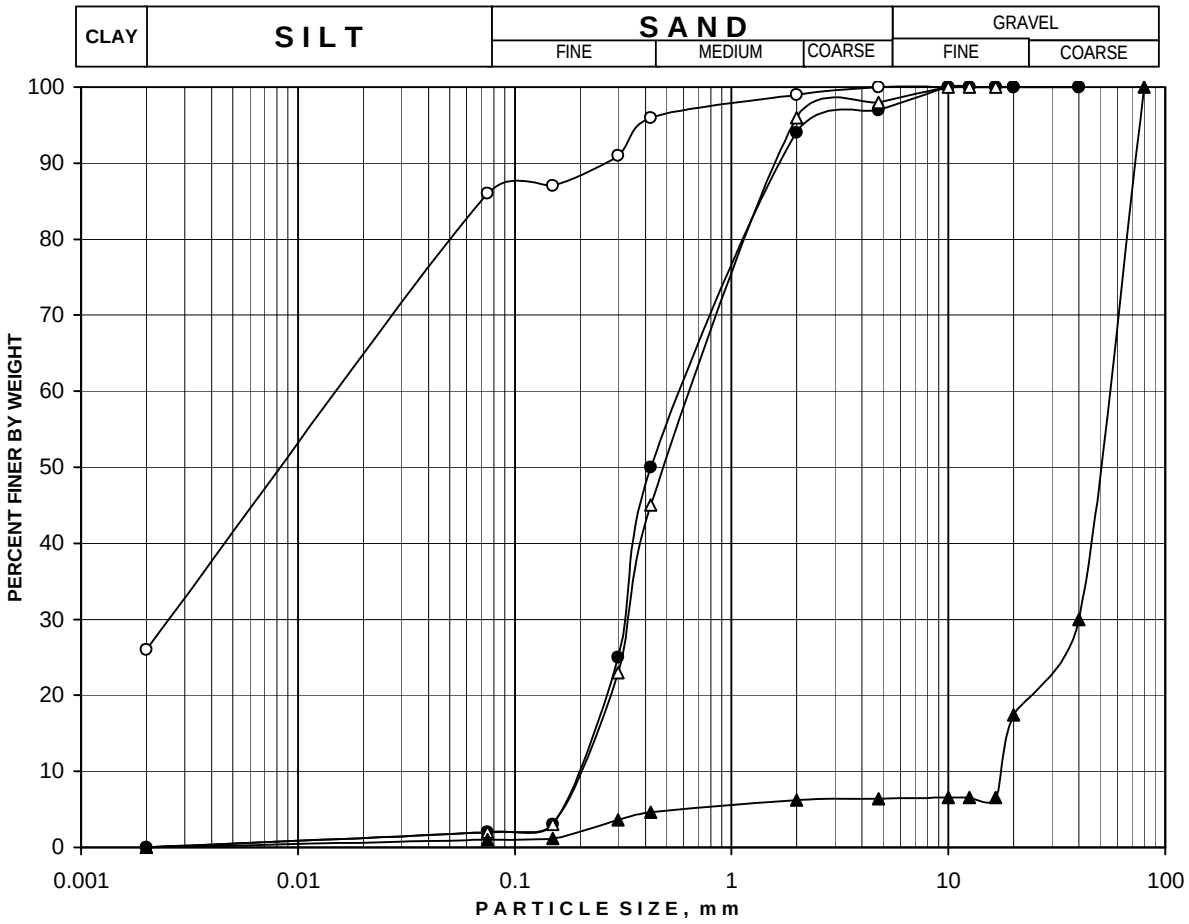

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	0.00 - 1.00	Clayey Silt of medium plasticity (CI)	0.00	14.00	60.00	26.00
●	7	1.50	Fine to Medium Sand with gravels(SP)	3.00	95.00	2.00	0.00
△	7	3.00	Fine to Medium Sand with gravels(SP)	2.00	96.00	2.00	0.00
▲	7	5.50	Sandy Gravels (GP)	94.00	5.00	1.00	0.00

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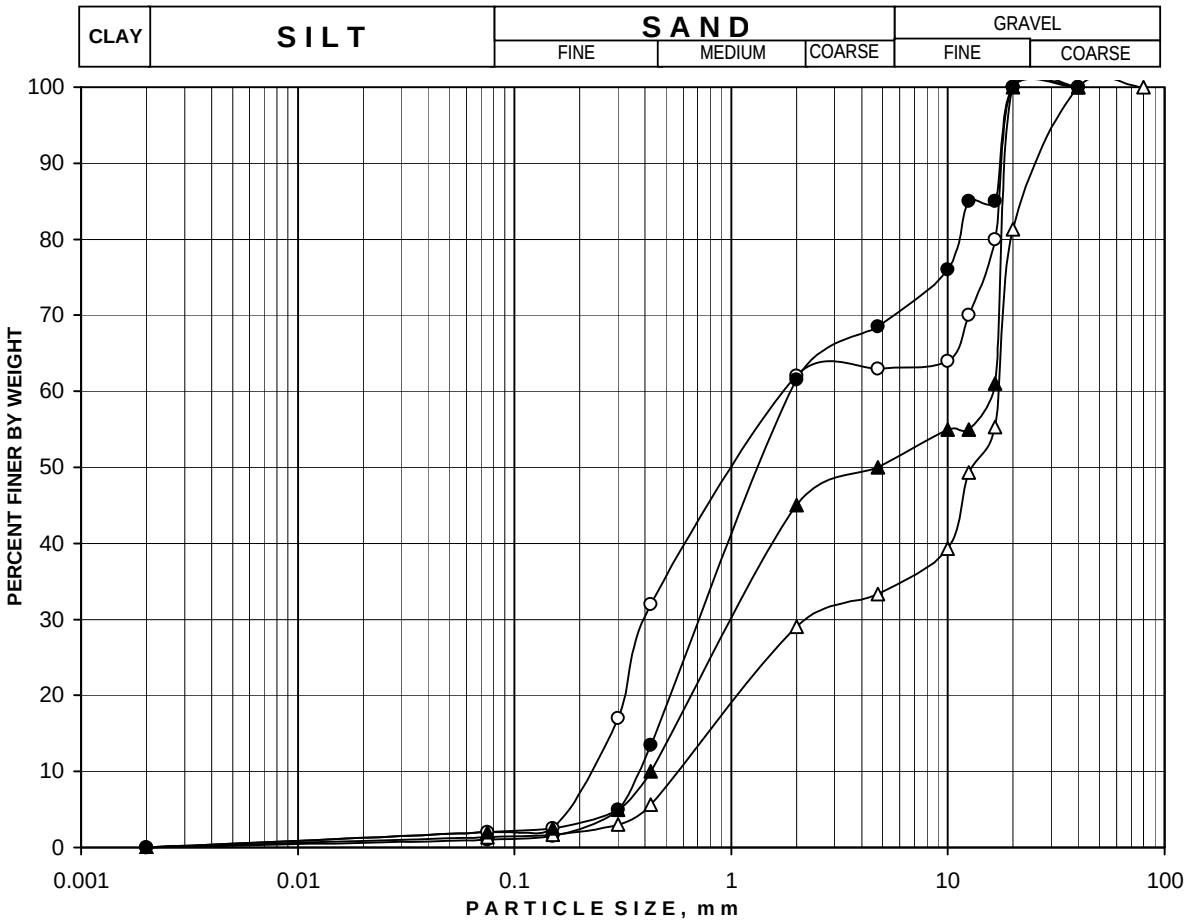

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	6.00	Gravelly Fine to Medium Sand (SP)	37.00	61.00	2.00	0.00
●	7	7.50	Gravelly Fine to Medium Sand (SP)	32.00	67.00	1.00	0.00
△	7	8.50	Sandy Gravels (GP-SP)	67.00	32.00	1.00	0.00
▲	7	9.00	Sandy Gravels (GP-SP)	50.00	48.00	2.00	0.00

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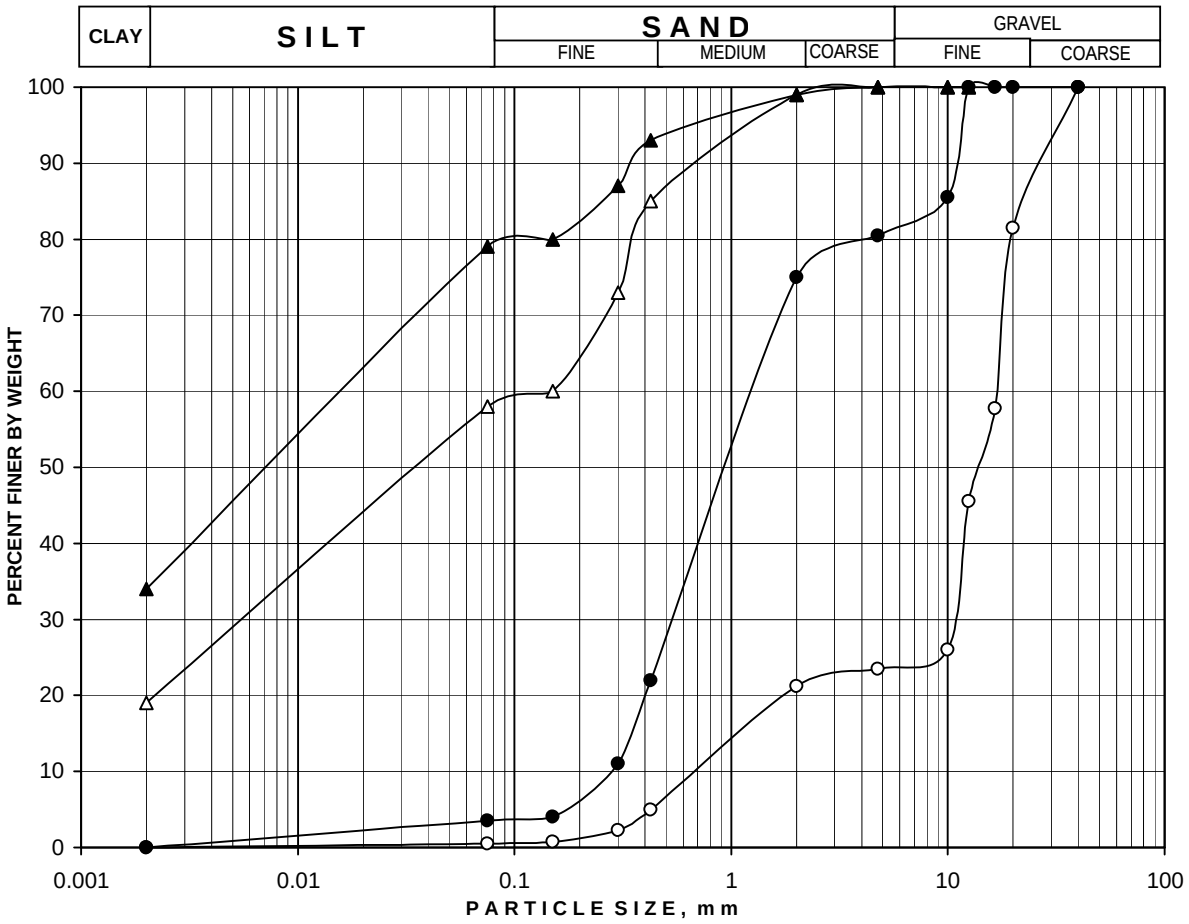

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	11.50	Sandy Gravels (GP)	77.00	22.00	1.00	0.00
●	7	12.00	Gravelly Fine to Medium Sand (SP)	20.00	76.00	4.00	0.00
△	7	15.00	Clayey Sandy Silt / Sandy Clayey Silt of medium plasticity (CI)	0.00	42.00	39.00	19.00
▲	7	19.50	Clayey Sandy Silt / Sandy Clayey Silt of medium plasticity (CI)	0.00	21.00	45.00	34.00

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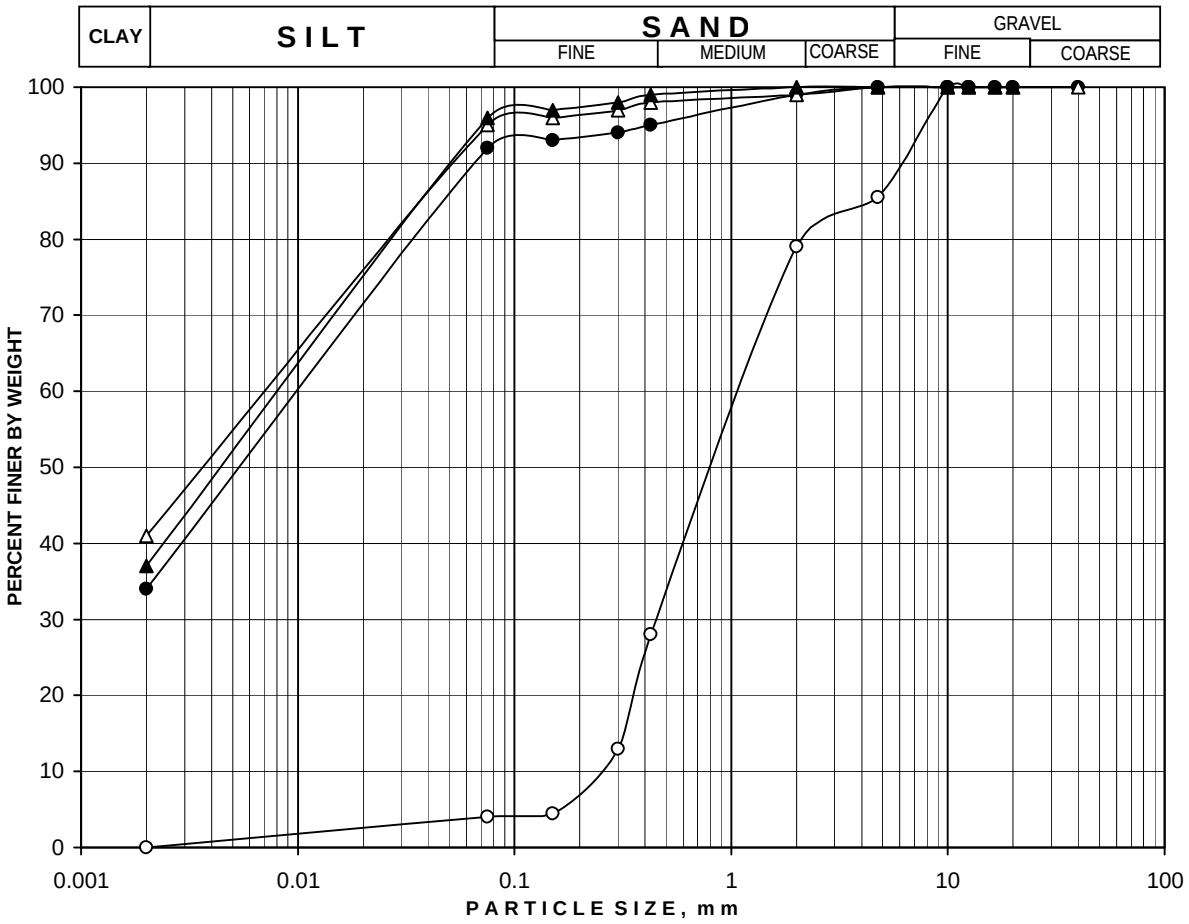

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	21.00	Gravelly Fine to Medium Sand (SP)	15.00	81.00	4.00	0.00
●	7	24.00	Clayey Silt of medium plasticity (CI)	0.00	8.00	58.00	34.00
△	7	28.50	Silty Clay of high plasticity (CH)	0.00	5.00	54.00	41.00
▲	7	33.00	Silty Clay of high plasticity (CH)	0.00	4.00	59.00	37.00

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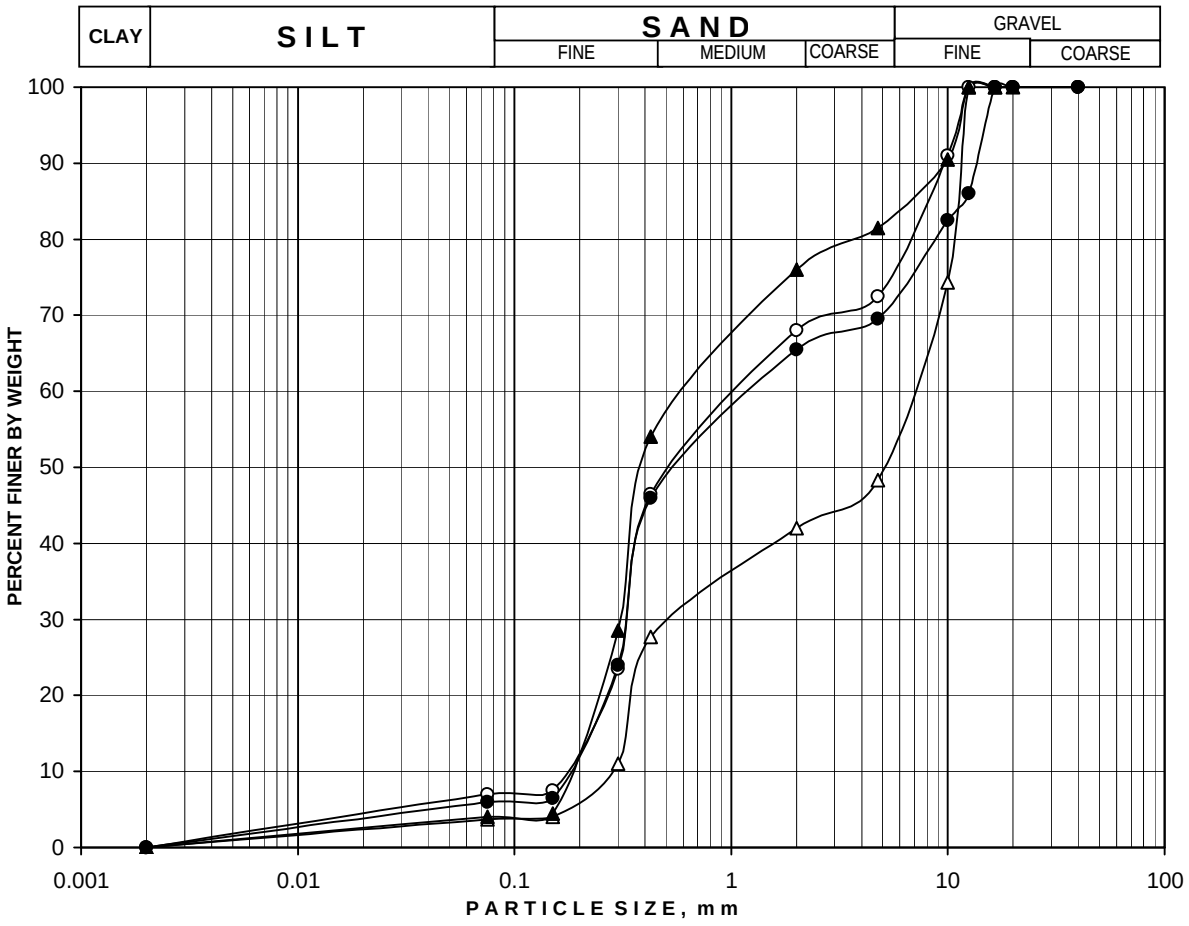

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	34.50	Gravelly Fine to Medium Sand (SP SM)	28.00	65.00	7.00	0.00
●	7	37.50	Gravelly Fine to Medium Sand (SP SM)	31.00	63.00	6.00	0.00
△	7	39.00	Sandy Gravels (GP-SP)	52.00	44.00	4.00	0.00
▲	7	40.50	Gravelly Medium to Fine Sand (SP)	19.00	77.00	4.00	0.00

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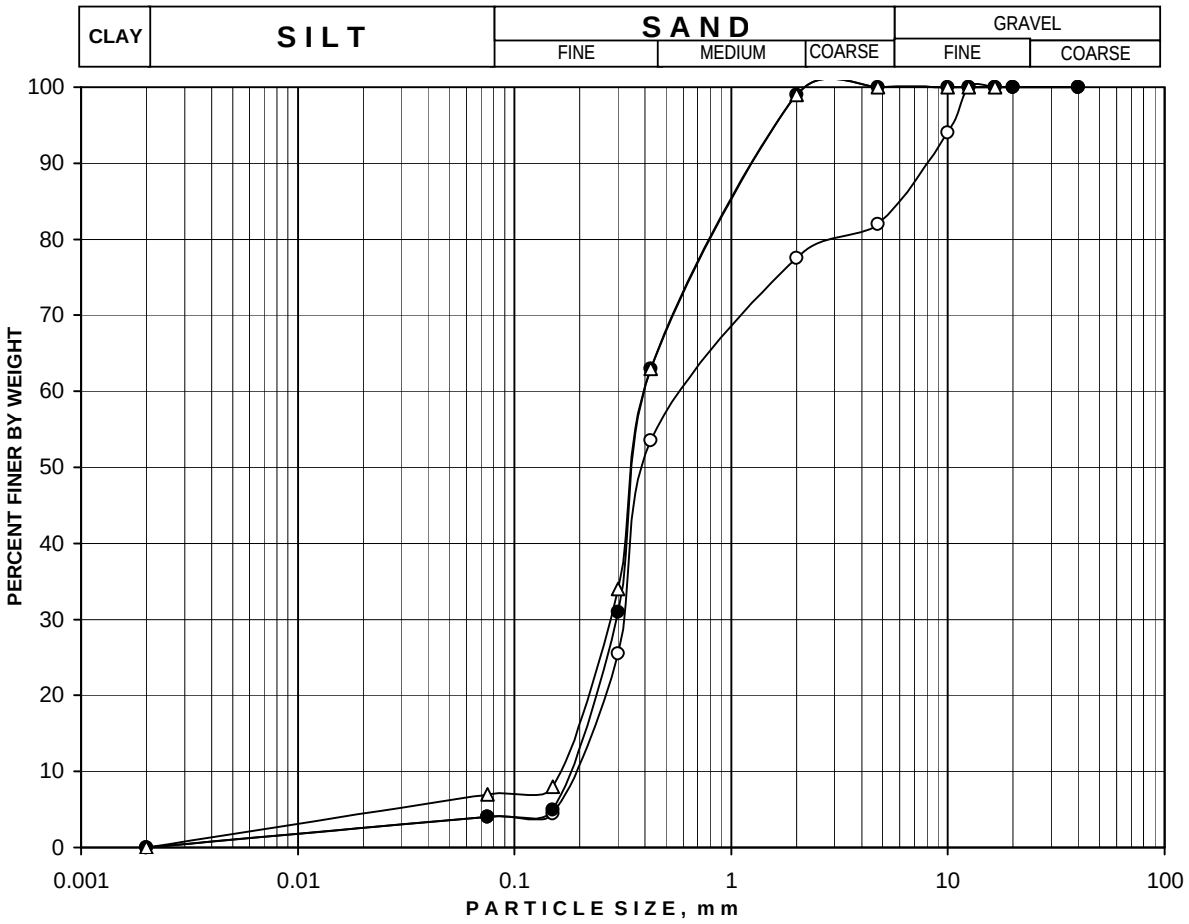

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	7	42.00	Gravelly Medium to Fine Sand (SP)	18.00	78.00	4.00	0.00
●	7	45.00	Medium to Fine Sand (SP)	0.00	96.00	4.00	0.00
△	7	48.00	Gravelly Medium to Fine Sand (SP SM)	0.00	93.00	7.00	0.00

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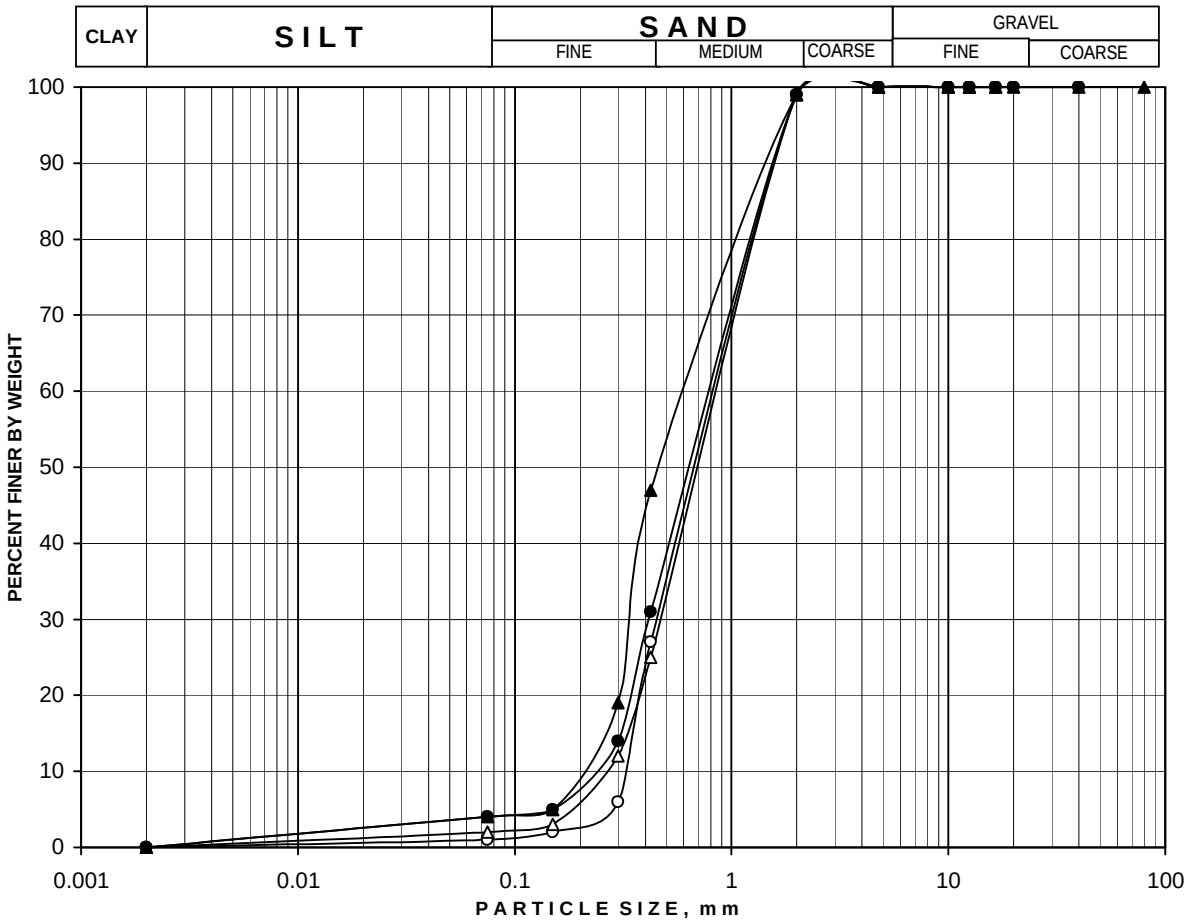

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	8	0.00 - 1.00	Fine to Medium Sand (SP)	0.00	99.00	1.00	0.00
●	8	3.00	Fine to Medium Sand (SP)	0.00	96.00	4.00	0.00
△	8	6.00	Fine to Medium Sand (SP)	0.00	98.00	2.00	0.00
▲	8	9.00	Fine to Medium Sand (SP)	0.00	96.00	4.00	0.00

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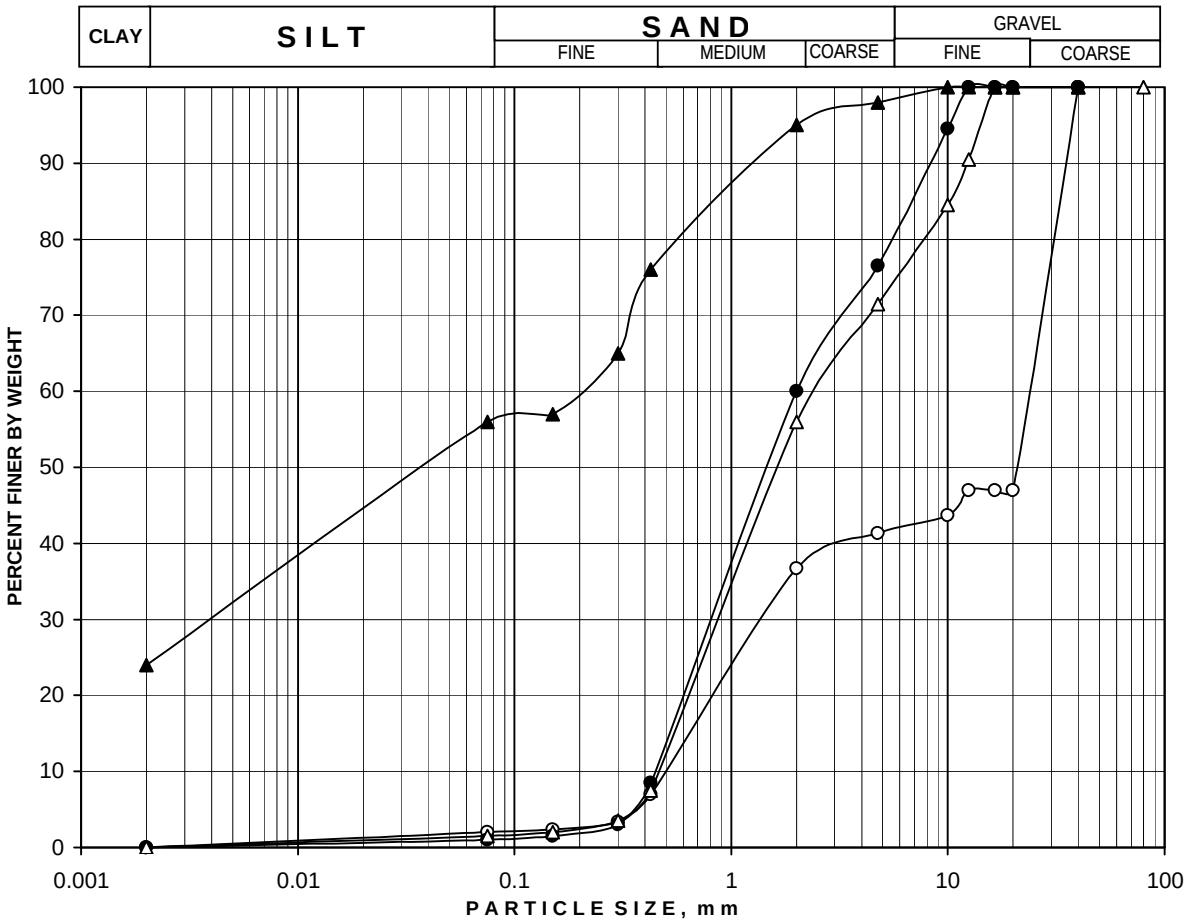

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	8	11.50	Sandy Gravels (GP-SP)	59.00	39.00	2.00	0.00
●	8	12.00	Gravelly Coarse to Medium Sand (SP)	24.00	75.00	1.00	0.00
△	8	15.00	Gravelly Coarse to Medium Sand (SP)	29.00	70.00	1.00	0.00
▲	8	16.50	Clayey Sandy Silt / Clayey Silt of medium plasticity (CI)	2.00	42.00	32.00	24.00

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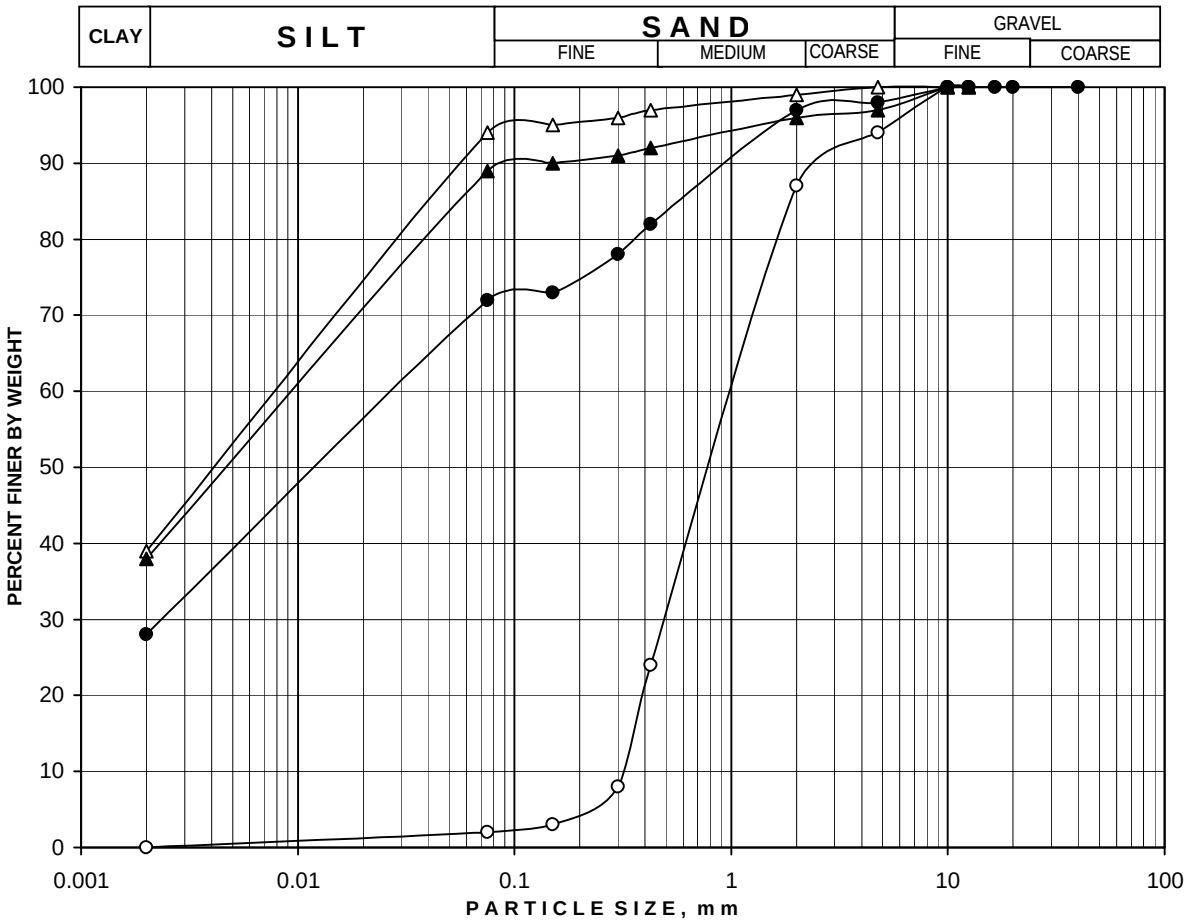

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	8	21.00	Fine to Medium Sand (SP)	6.00	92.00	2.00	0.00
●	8	22.50	Sandy Clayey Silt / Clayey Silt of medium plasticity (CI)	2.00	26.00	44.00	28.00
△	8	27.00	Silty Clay of high plasticity (CH)	0.00	6.00	55.00	39.00
▲	8	31.50	Silty Clay of high plasticity (CH)	3.00	8.00	51.00	38.00

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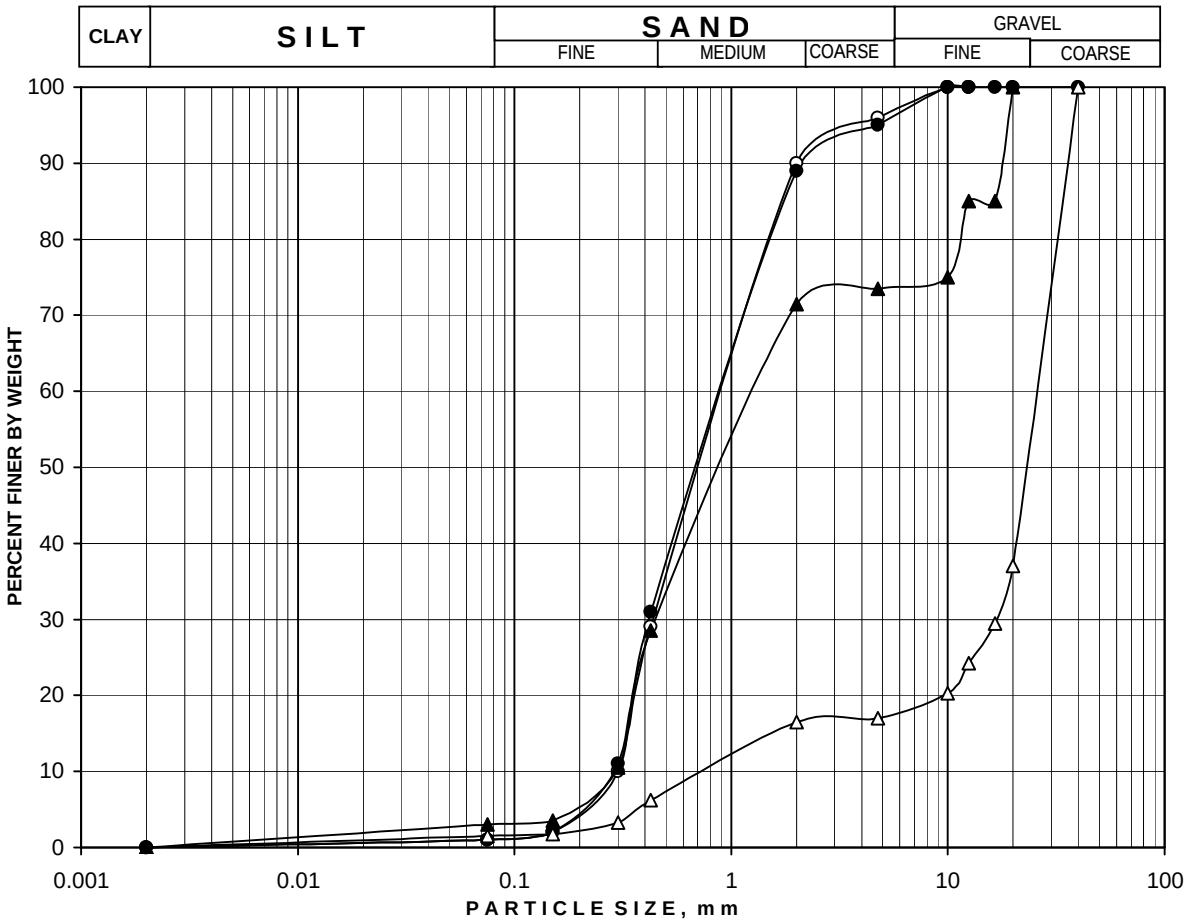

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	8	36.00	Fine to Medium Sand (SP)	4.00	95.00	1.00	0.00
●	8	39.00	Fine to Medium Sand (SP)	5.00	94.00	1.00	0.00
△	8	41.50	Sandy Gravels (GP)	83.00	15.00	2.00	0.00
▲	8	42.00	Gravelly Fine to Medium Sand (SP)	27.00	70.00	3.00	0.00

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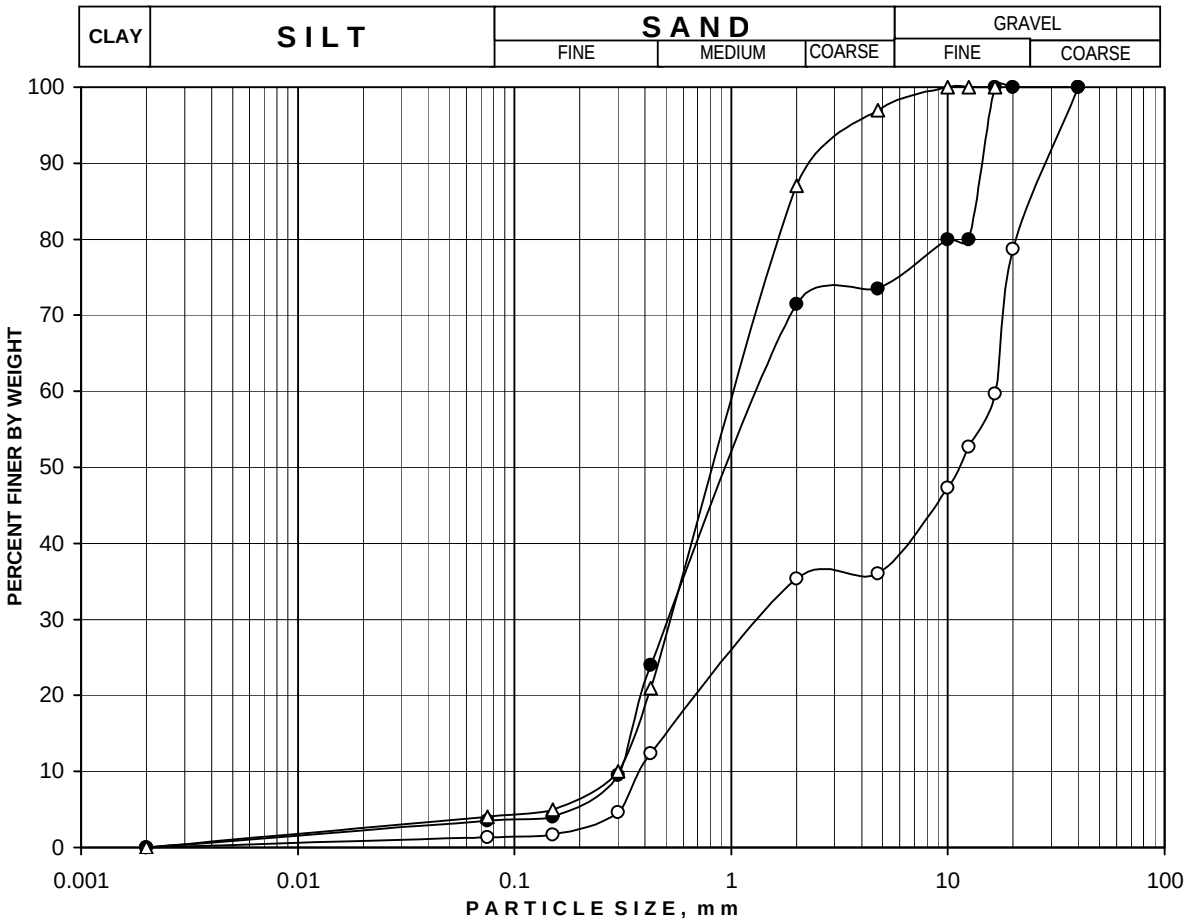

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	8	44.50	Sandy Gravels (GP-SP)	64.00	35.00	1.00	0.00
●	8	45.00	Gravelly Fine to Medium Sand (SP)	27.00	69.00	4.00	0.00
△	8	48.00	Fine to Medium Sand (SP)	3.00	93.00	4.00	0.00

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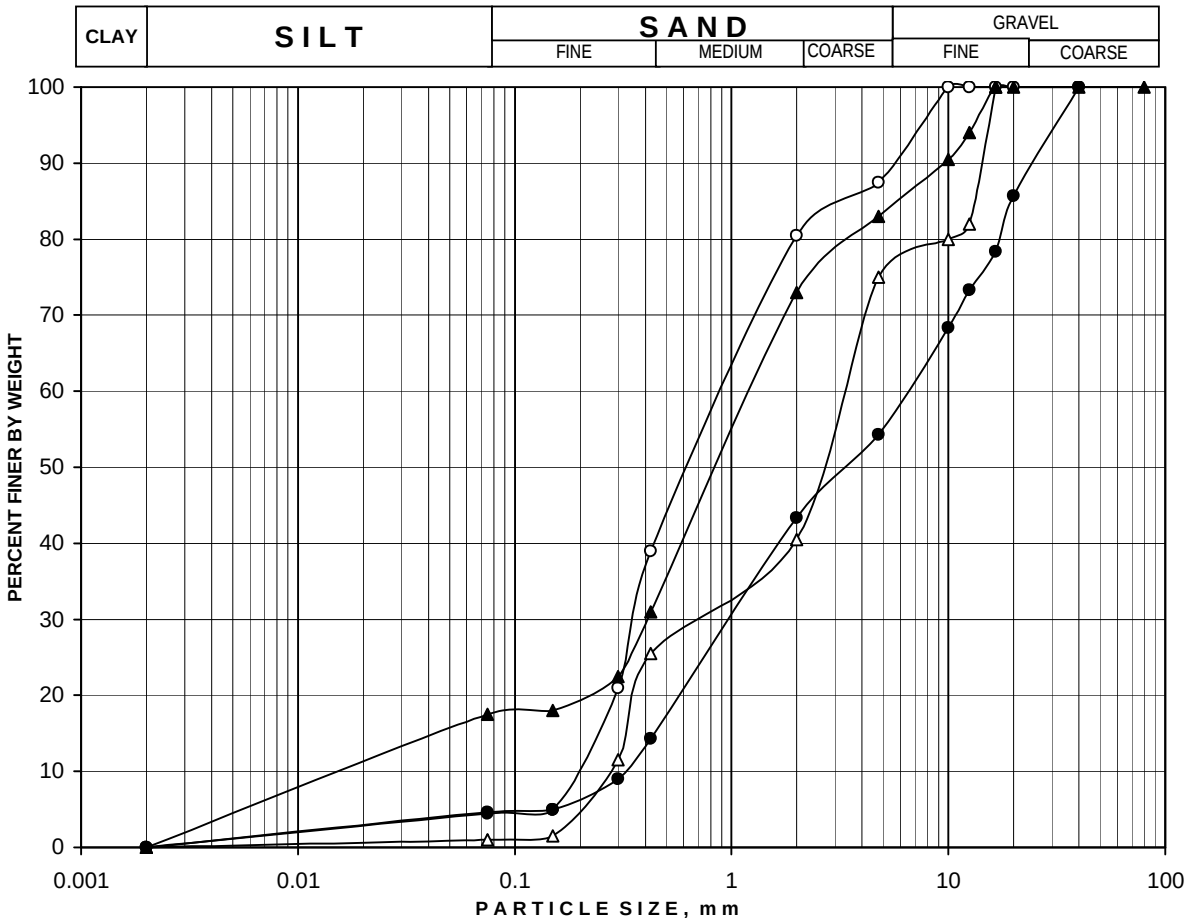
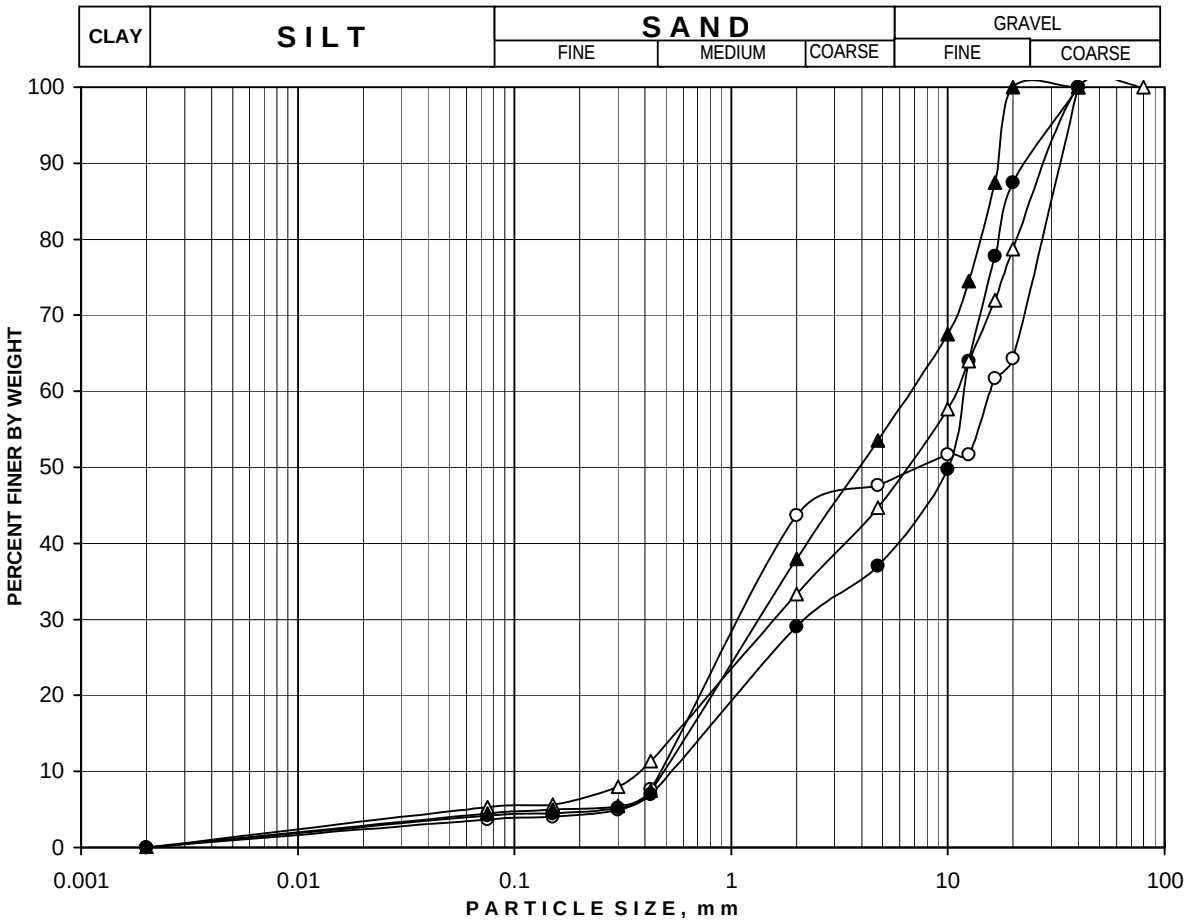
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	9	0.00 - 1.00	Gravelly Fine to Medium Sand (SP)	13.00	83.00	4.00	0.00
●	9	1.50	Gravelly Coarse to Medium Sand (SP-SM)	46.00	49.00	5.00	0.00
△	9	3.00	Gravelly Coarse to Fine Sand (SP)	25.00	74.00	1.00	0.00
▲	9	6.00	Silty Sand with gravels (SM)	17.00	66.00	17.00	0.00

INDIAN GEOTECHNICAL SERVICES

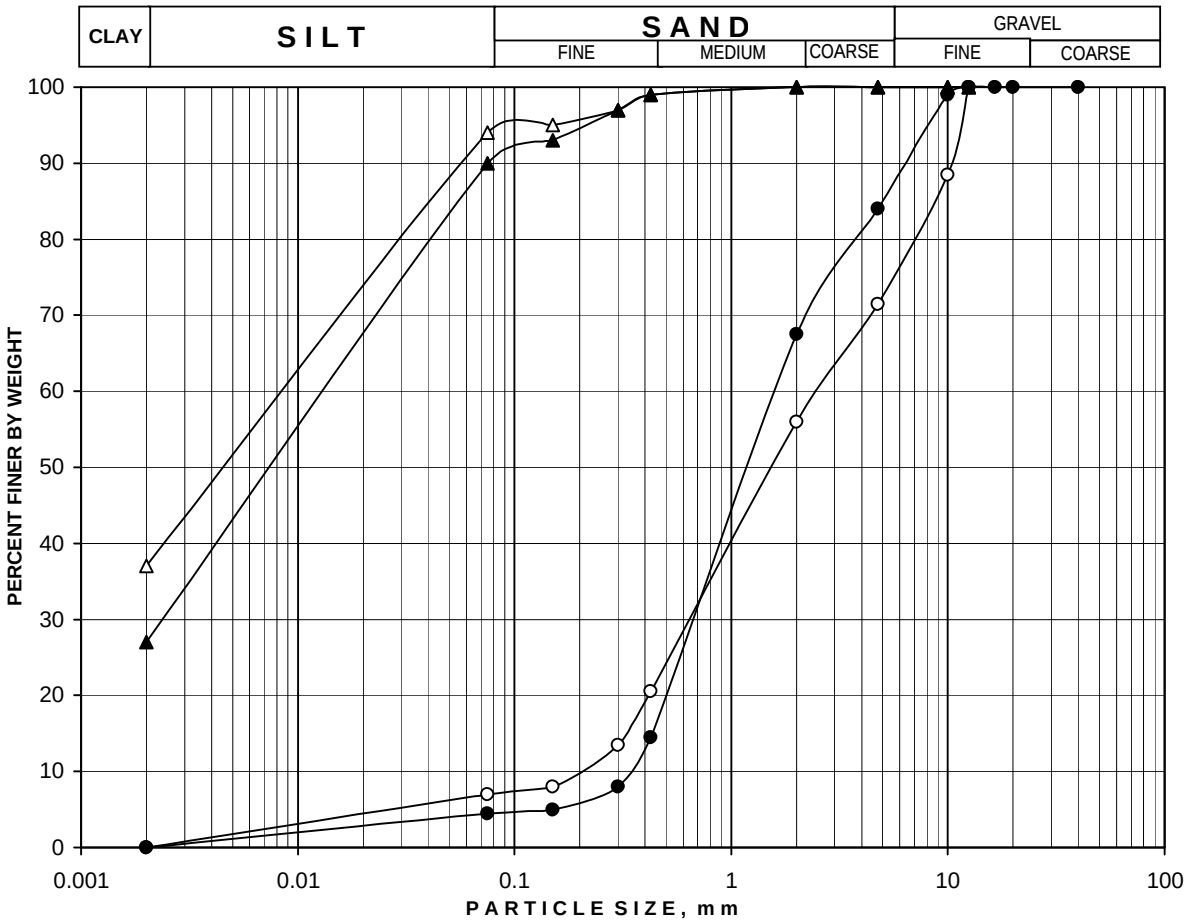
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	9	9.00	Sandy Gravels (GP-GP)	52.00	44.00	4.00	0.00
●	9	12.00	Sandy Gravels (GP)	63.00	33.00	4.00	0.00
△	9	15.00	Sandy Gravels (GP-GM)	55.00	40.00	5.00	0.00
▲	9	18.00	Gravelly Coarse to Medium Sand (SP-GP)	47.00	49.00	4.00	0.00

INDIAN GEOTECHNICAL SERVICES

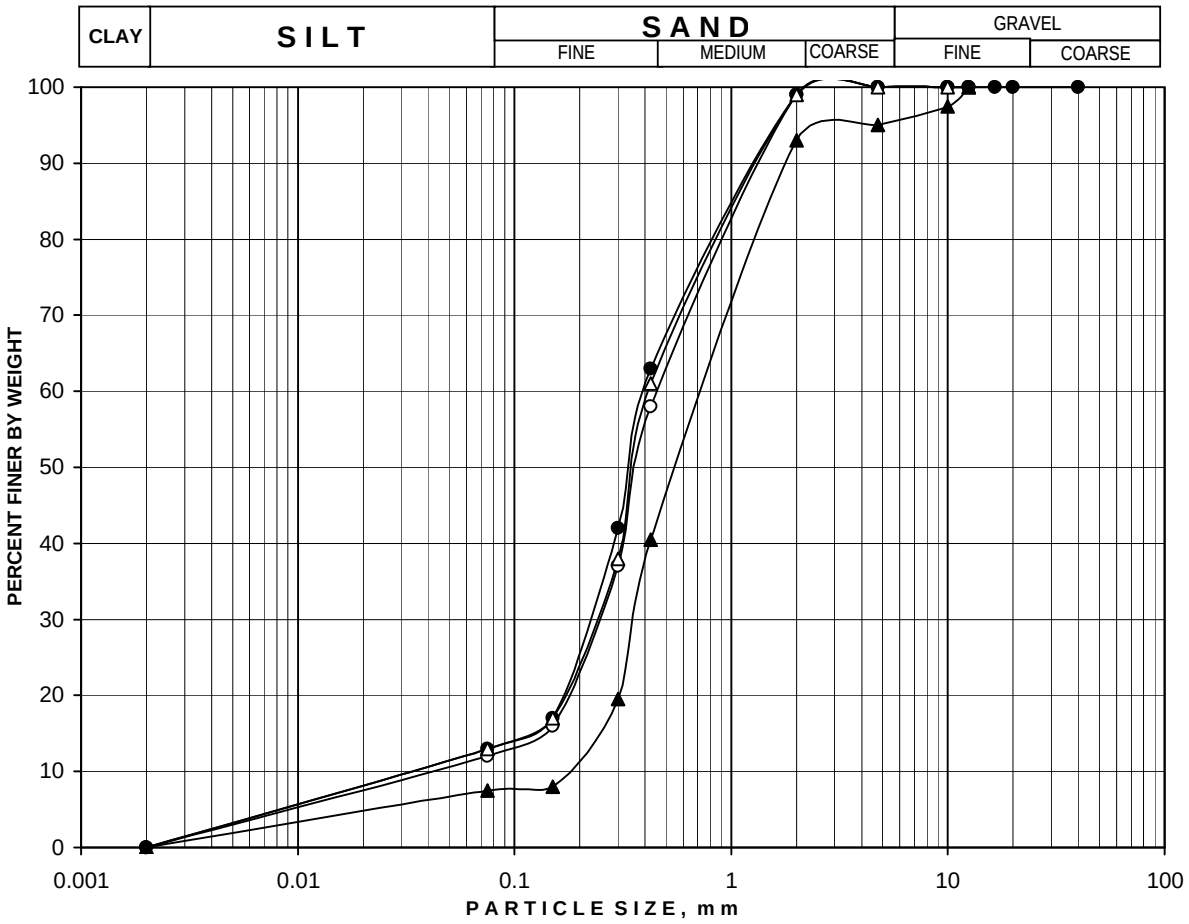
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	9	21.00	Gravelly Coarse to Medium Sand (SP-SM)	29.00	64.00	7.00	0.00
●	9	24.00	Gravelly Coarse to Medium Sand (SP)	16.00	80.00	4.00	0.00
△	9	27.00	Silty Clay of high plasticity (CH)	0.00	6.00	57.00	37.00
▲	9	31.50	Clayey Silt of medium plasticity (CI)	0.00	10.00	63.00	27.00

INDIAN GEOTECHNICAL SERVICES

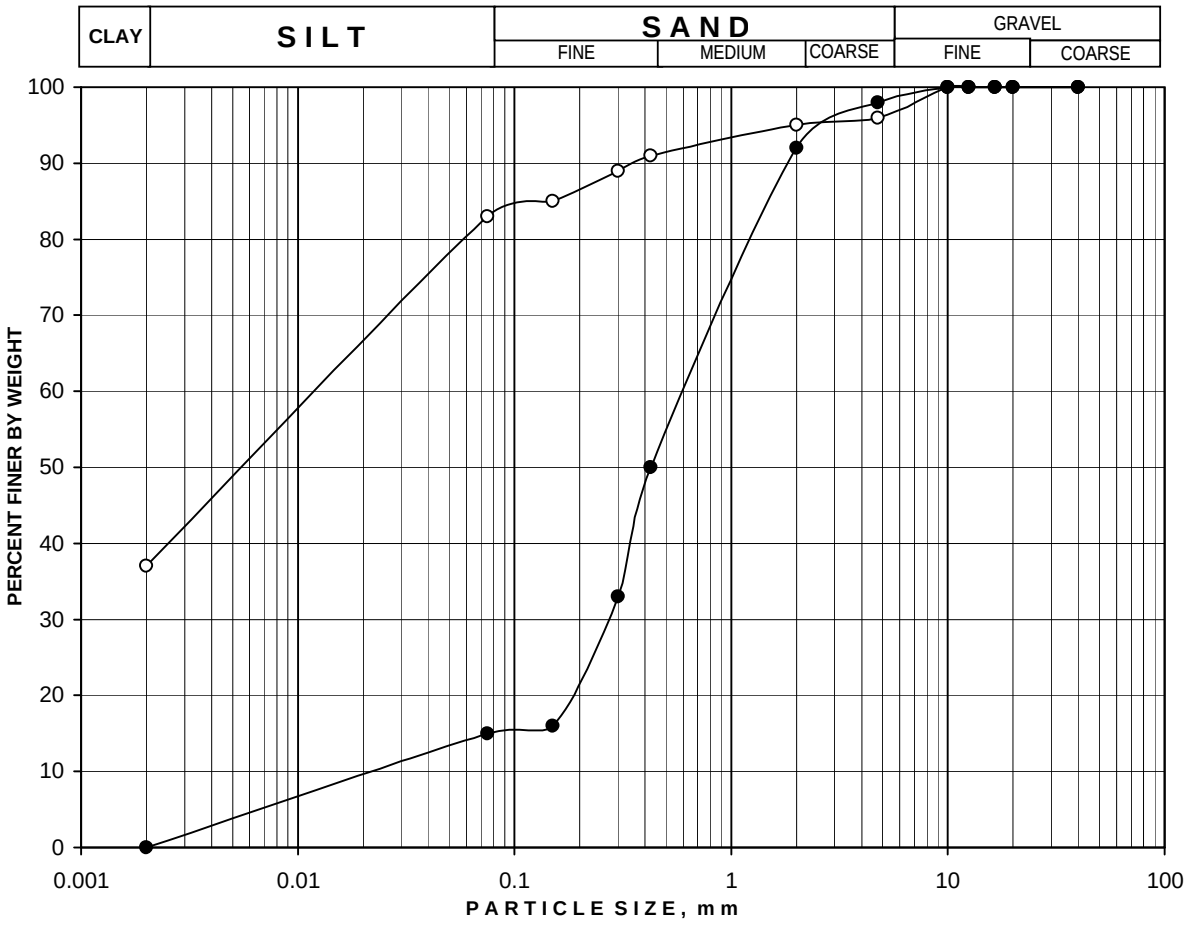
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	9	34.50	Fine to Medium Sand (SP-SM)	0.00	88.00	12.00	0.00
●	9	37.50	Silty Sand (SM)	0.00	87.00	13.00	0.00
△	9	40.50	Silty Sand (SM)	0.00	87.00	13.00	0.00
▲	9	42.00	Medium to Fine Sand (SP-SM)	5.00	88.00	7.00	0.00

INDIAN GEOTECHNICAL SERVICES

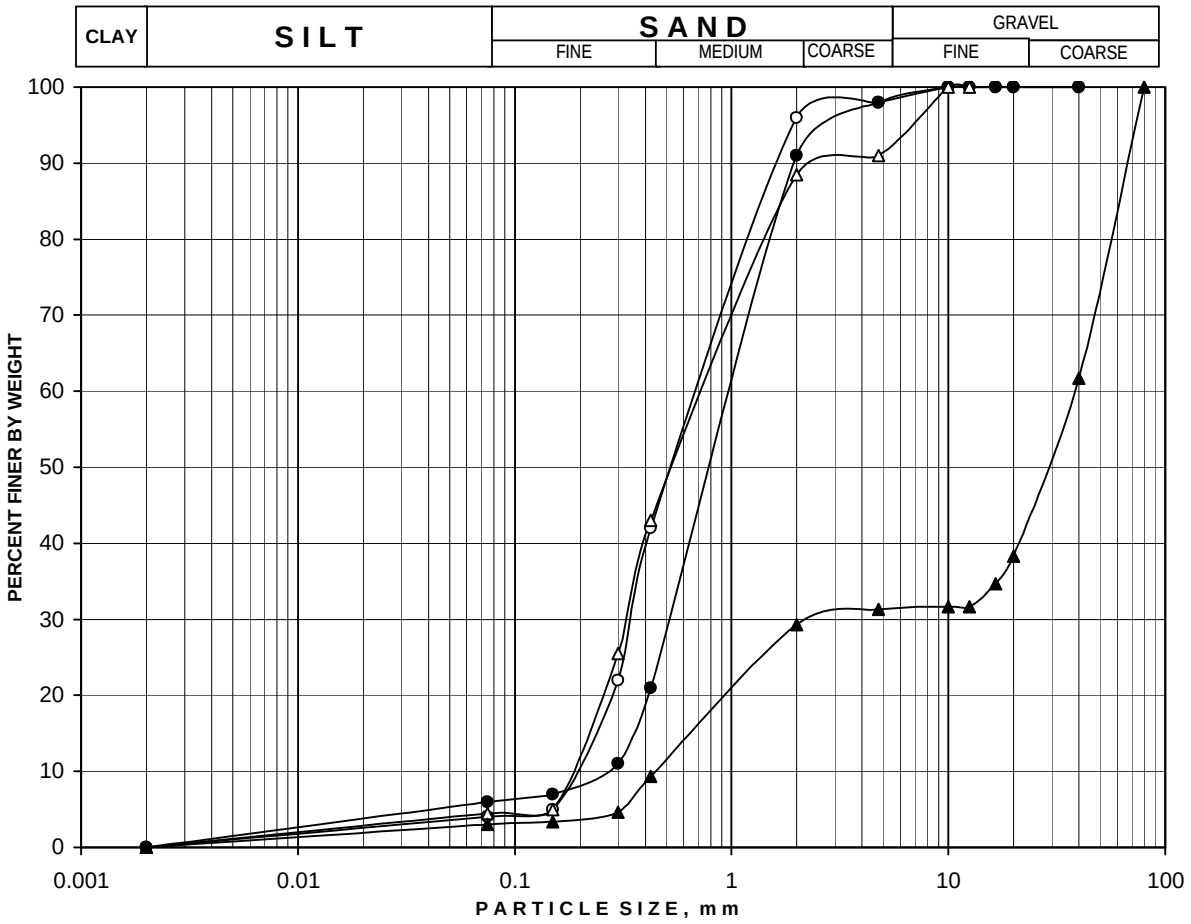
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	9	45.00	Silty Clay of high plasticity (CH)	4.00	13.00	46.00	37.00
●	9	48.00	Silty Sand (SM)	2.00	83.00	15.00	0.00

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	0.00 - 1.00	Fine to Medium Sand (SP)	2.00	94.00	4.00	0.00
●	10	3.00	Fine to Medium Sand (SP-SM)	2.00	92.00	6.00	0.00
△	10	6.00	Fine to Medium Sand (SP)	9.00	87.00	4.00	0.00
▲	10	8.50	Sandy Gravels (GP)	69.00	28.00	3.00	0.00

INDIAN GEOTECHNICAL SERVICES

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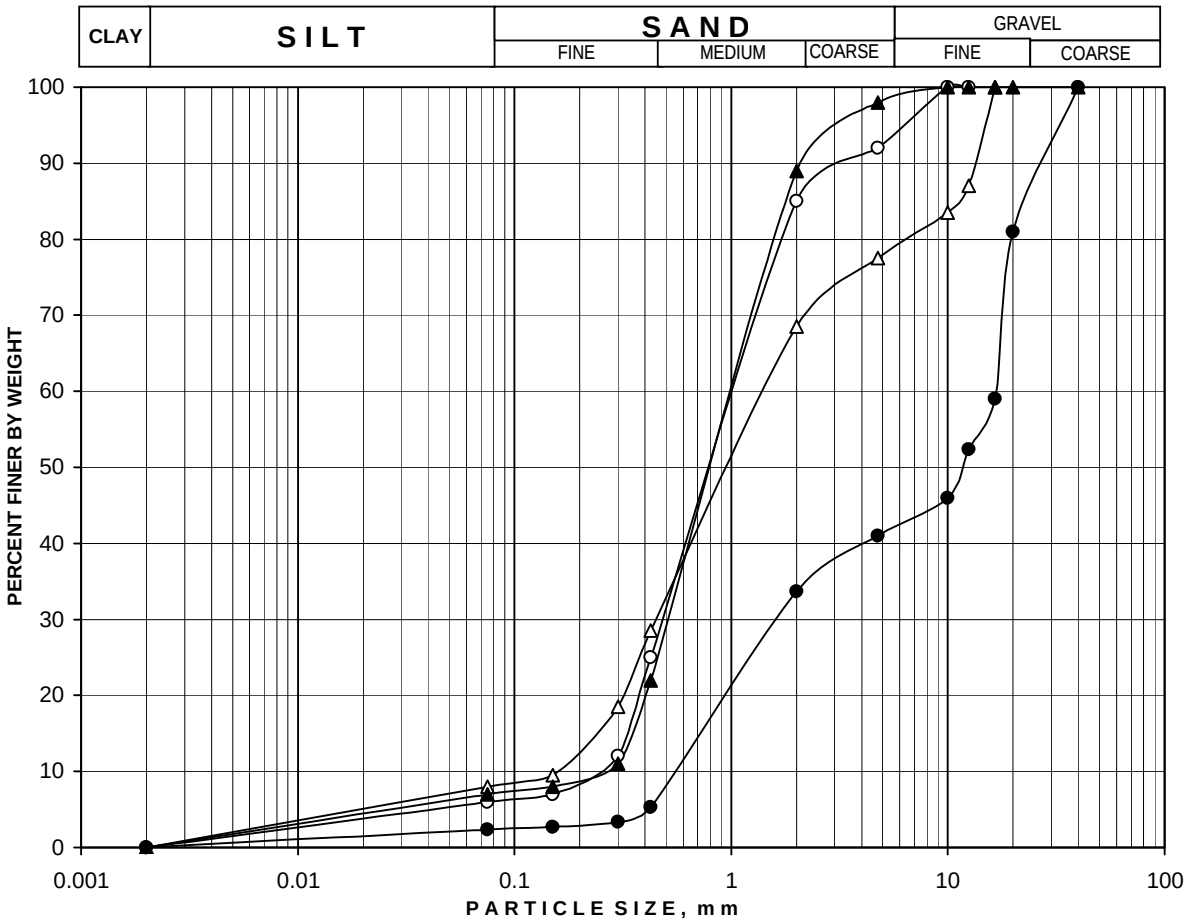
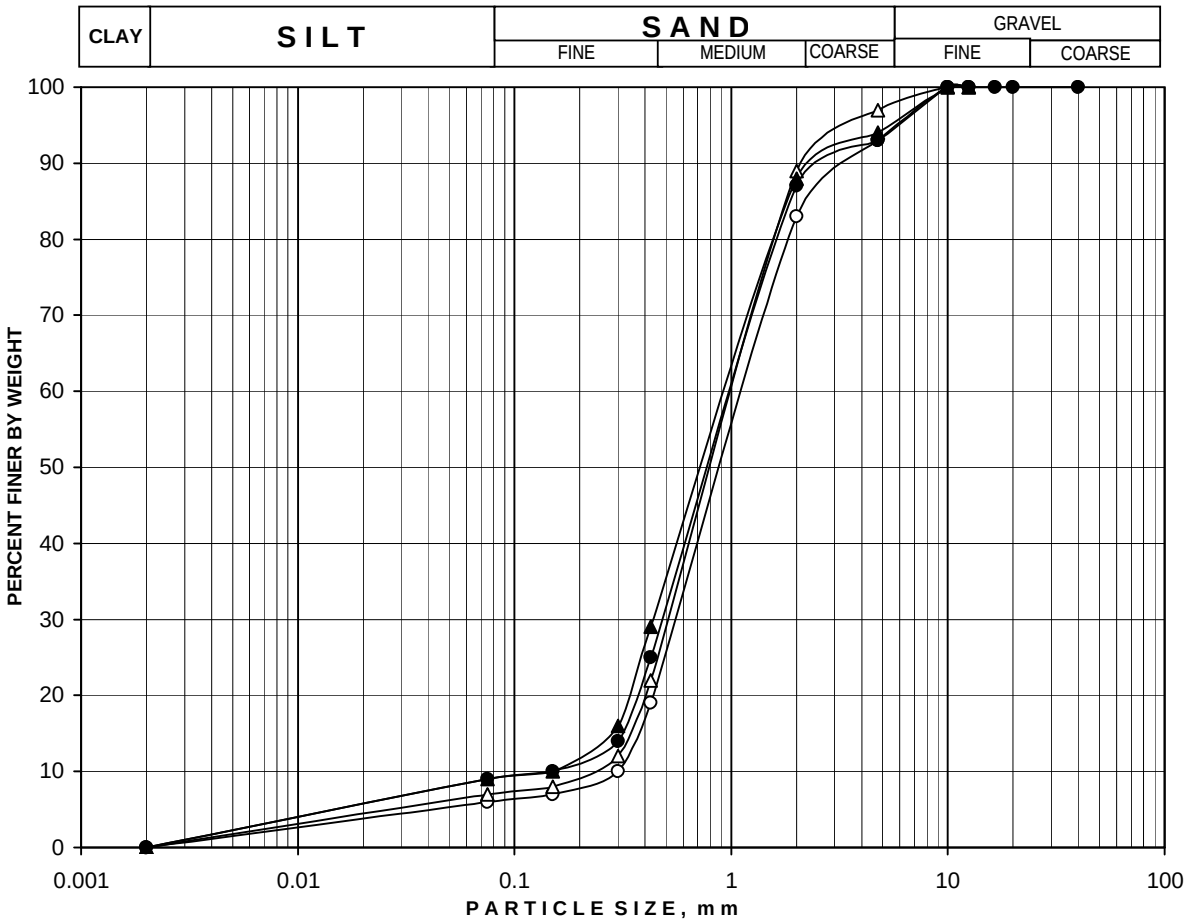


Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	9.00	Fine to Medium Sand (SP-SM)	8.00	86.00	6.00	0.00
●	10	11.50	Sandy Gravels (GP-SP)	59.00	39.00	2.00	0.00
△	10	12.00	Fine to Medium Sand with gravels (SP-SM)	23.00	69.00	8.00	0.00
▲	10	15.00	Fine to Medium Sand (SP-SM)	2.00	91.00	7.00	0.00

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	18.00	Coarse to Fine Sand (SP-SM)	7.00	87.00	6.00	0.00
●	10	19.50	Fine to Medium Sand (SP-SM)	7.00	84.00	9.00	0.00
△	10	22.50	Fine to Medium Sand (SP-SM)	3.00	90.00	7.00	0.00
▲	10	25.50	Fine to Medium Sand (SP-SM)	6.00	85.00	9.00	0.00

INDIAN GEOTECHNICAL SERVICES

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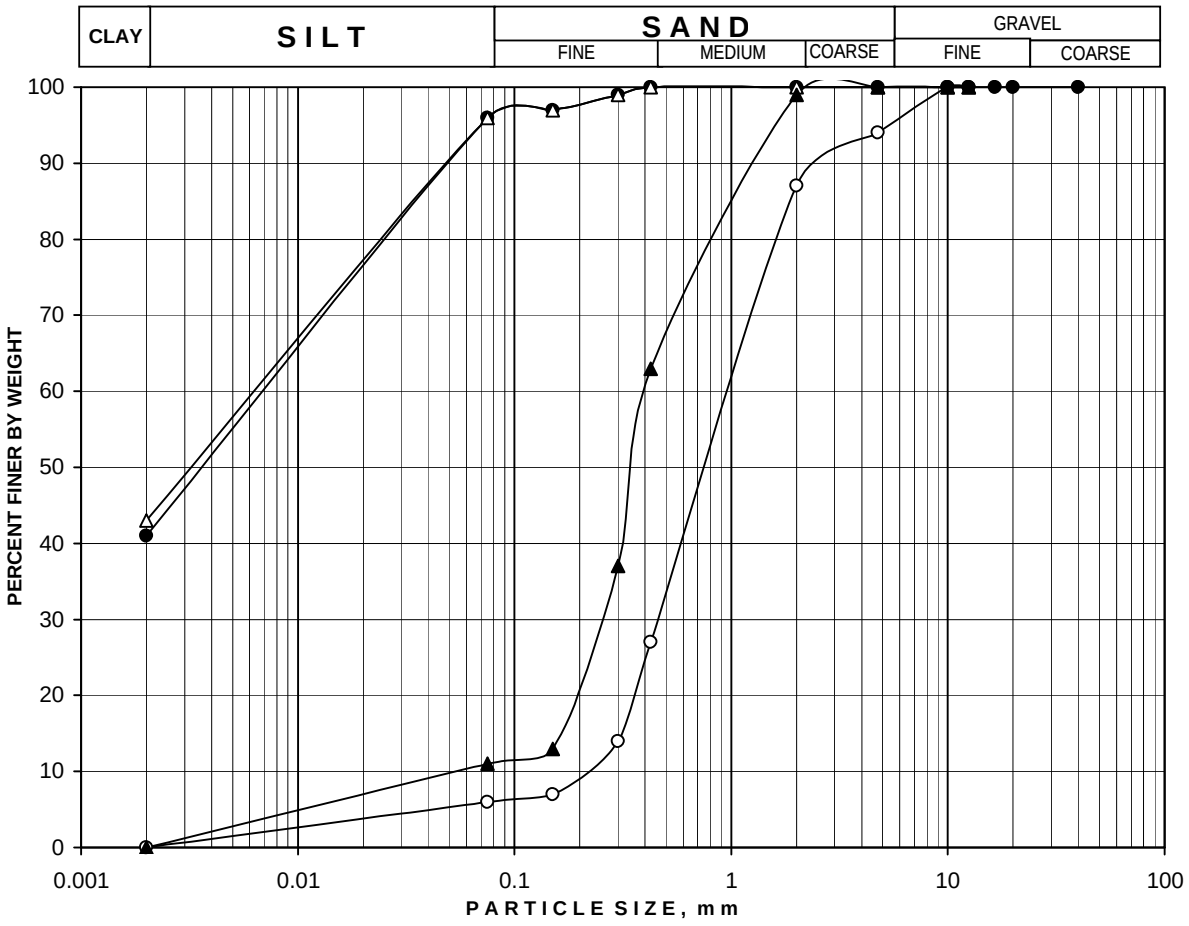
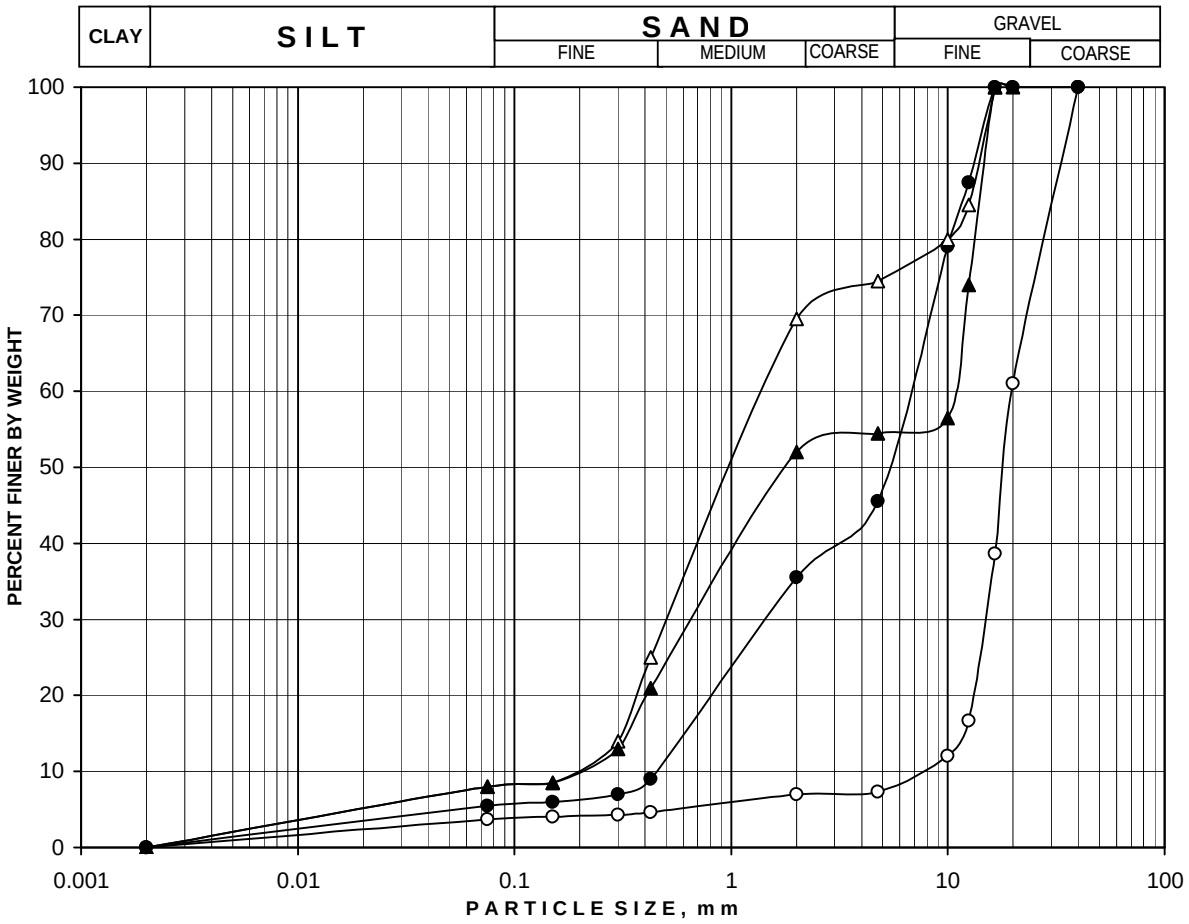


Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	28.50	Fine to Medium Sand (SP-SM)	6.00	88.00	6.00	0.00
●	10	31.50	Silty Clay of high plasticity (CH)	0.00	4.00	55.00	41.00
△	10	34.50	Silty Clay of high plasticity (CH)	0.00	4.00	53.00	43.00
▲	10	36.00	Medium to Fine Sand (SP-SM)	0.00	89.00	11.00	0.00

INDIAN GEOTECHNICAL SERVICES

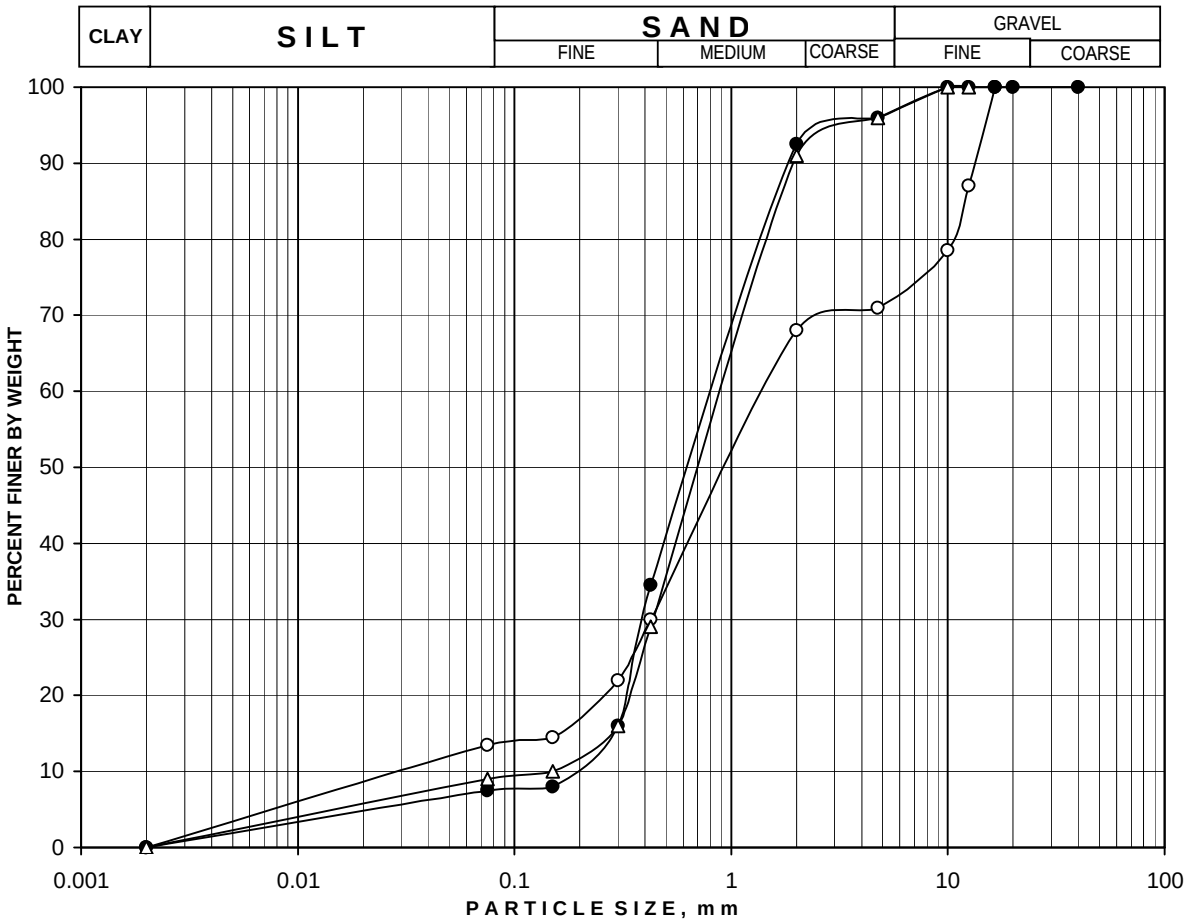
PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	38.50	Sandy Gravels (GP)	93.00	3.00	4.00	0.00
●	10	39.00	Sandy Gravels (GP-GM)	55.00	40.00	5.00	0.00
△	10	40.50	Fine to Medium Sand with gravels (SP-SM)	26.00	66.00	8.00	0.00
▲	10	42.00	Fine to Medium Sand with gravels (SP-SM-GP)	46.00	46.00	8.00	0.00

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	10	45.00	Silty Sand with gravels (SM)	29.00	58.00	13.00	0.00
●	10	46.50	Fine to Medium Sand (SP-SM)	4.00	89.00	7.00	0.00
△	10	50.00	Fine to Medium Sand (SP-SM)	4.00	87.00	9.00	0.00

INDIAN GEOTECHNICAL SERVICES

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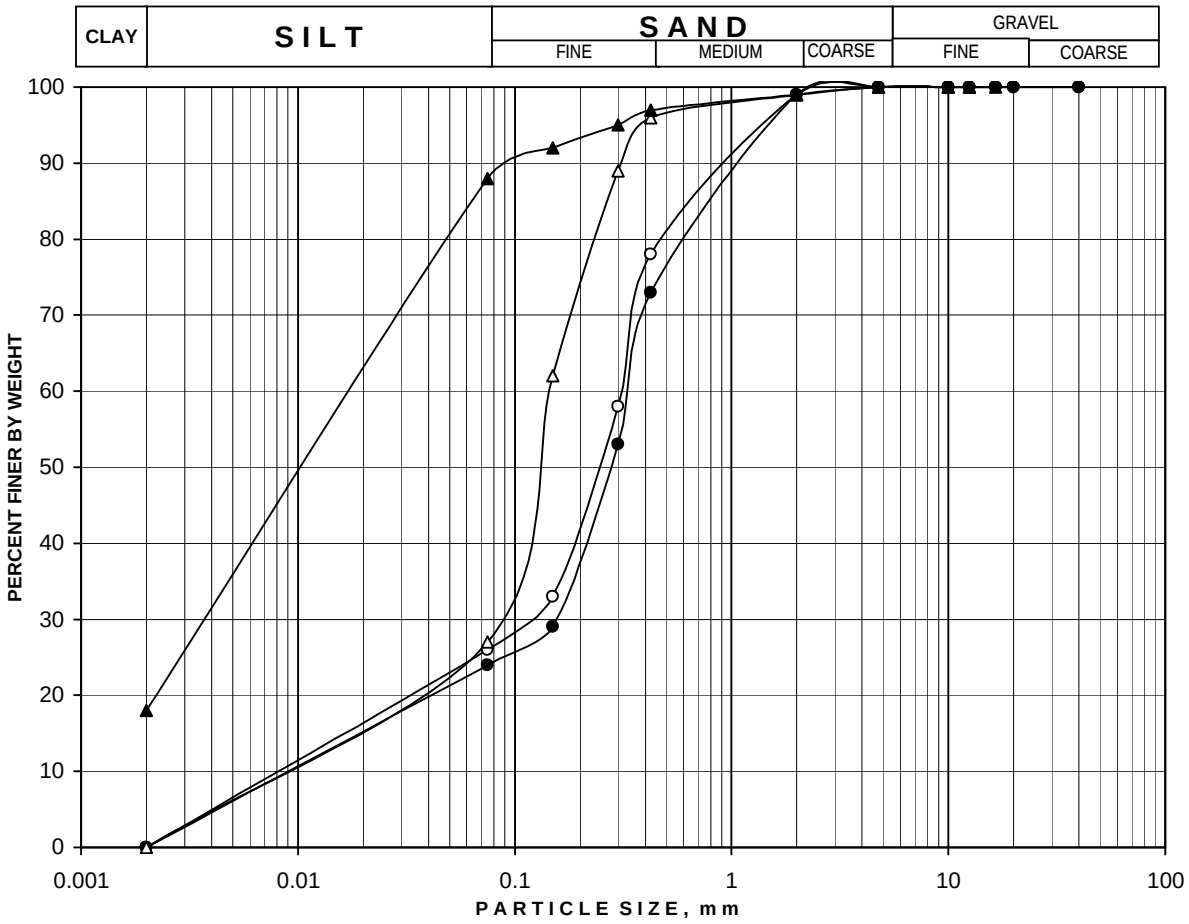

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	0.00 - 1.00	Filled Up Soil (Road Materials)	0.00	74.00	26.00	0.00
●	11	1.50	Silty Sand (SM)	0.00	76.00	24.00	0.00
△	11	2.50	Silty Sand (SM)	0.00	73.00	27.00	0.00
▲	11	3.00	Clayey Sandy Silt of low plasticity (CL)	0.00	12.00	70.00	18.00

INDIAN GEOTECHNICAL SERVICES

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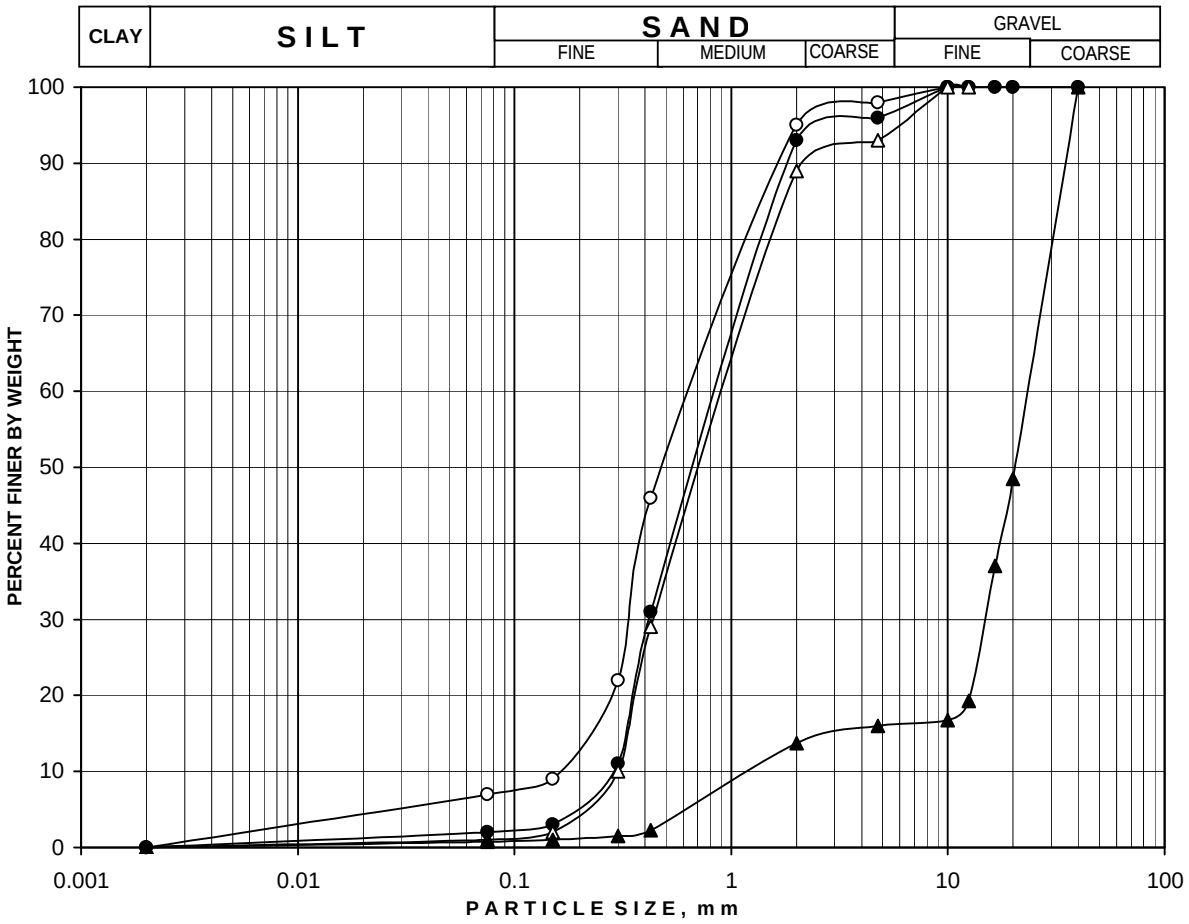

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	6.00	Fine to Medium Sand Sand (SP-SM)	2.00	91.00	7.00	0.00
●	11	9.00	Fine to Medium Sand Sand (SP)	4.00	94.00	2.00	0.00
△	11	12.00	Fine to Medium Sand Sand (SP)	7.00	92.00	1.00	0.00
▲	11	14.50	Sandy Gravels (GP)	84.00	15.00	1.00	0.00

INDIAN GEOTECHNICAL SERVICES

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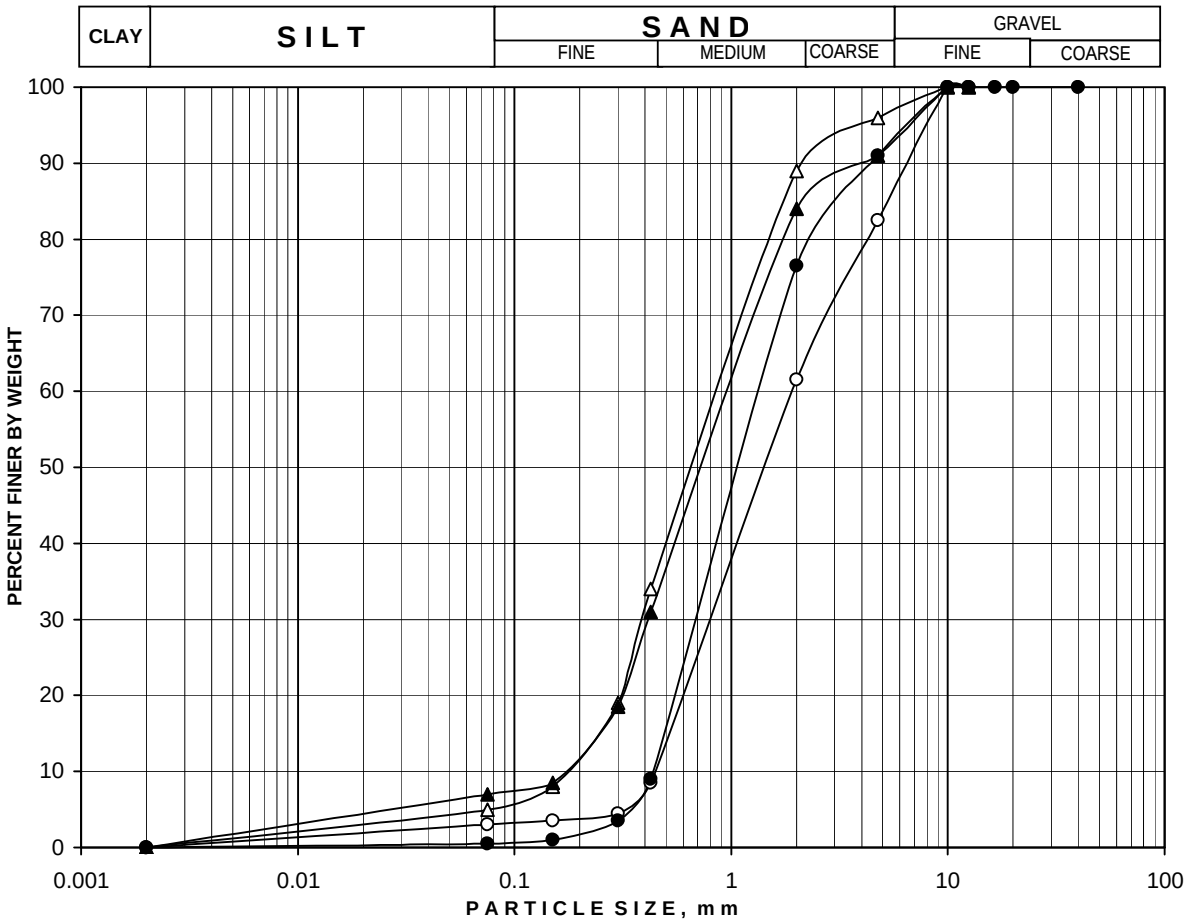

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	15.00	Coarse to Medium Sand with gravels(SP)	18.00	79.00	3.00	0.00
●	11	18.00	Coarse to Medium Sand (SP)	9.00	90.00	1.00	0.00
△	11	19.50	Fine to Medium Sand (SP SM)	4.00	91.00	5.00	0.00
▲	11	21.00	Fine to Medium Sand (SP SM)	9.00	84.00	7.00	0.00

INDIAN GEOTECHNICAL SERVICES

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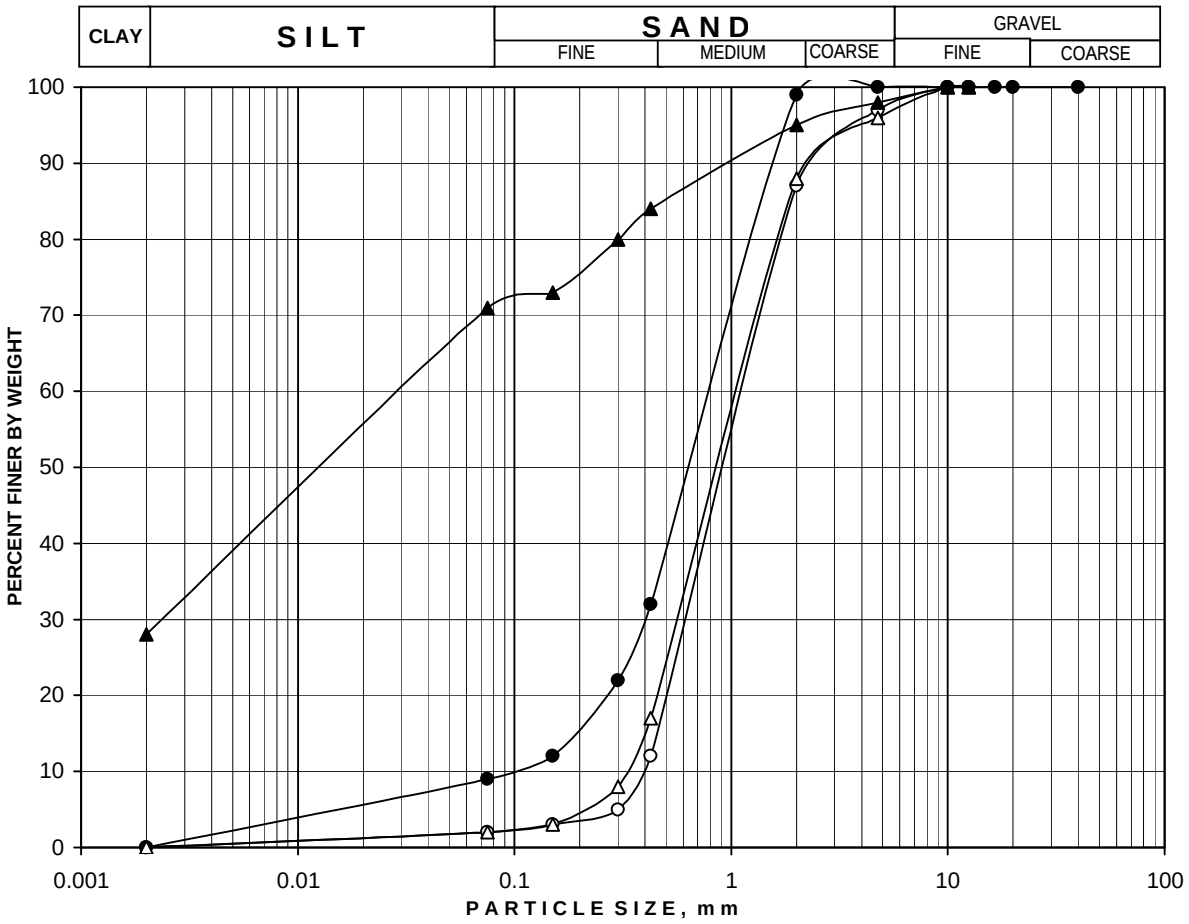

Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	24.00	Fine to Medium Sand (SP)	3.00	95.00	2.00	0.00
●	11	27.00	Fine to Medium Sand (SP SM)	0.00	91.00	9.00	0.00
△	11	28.50	Fine to Medium Sand (SP)	4.00	94.00	2.00	0.00
▲	11	30.00	Sandy Clayey Silt / Silty Clay of medium plasticity (CI)	2.00	27.00	43.00	28.00

INDIAN GEOTECHNICAL SERVICES

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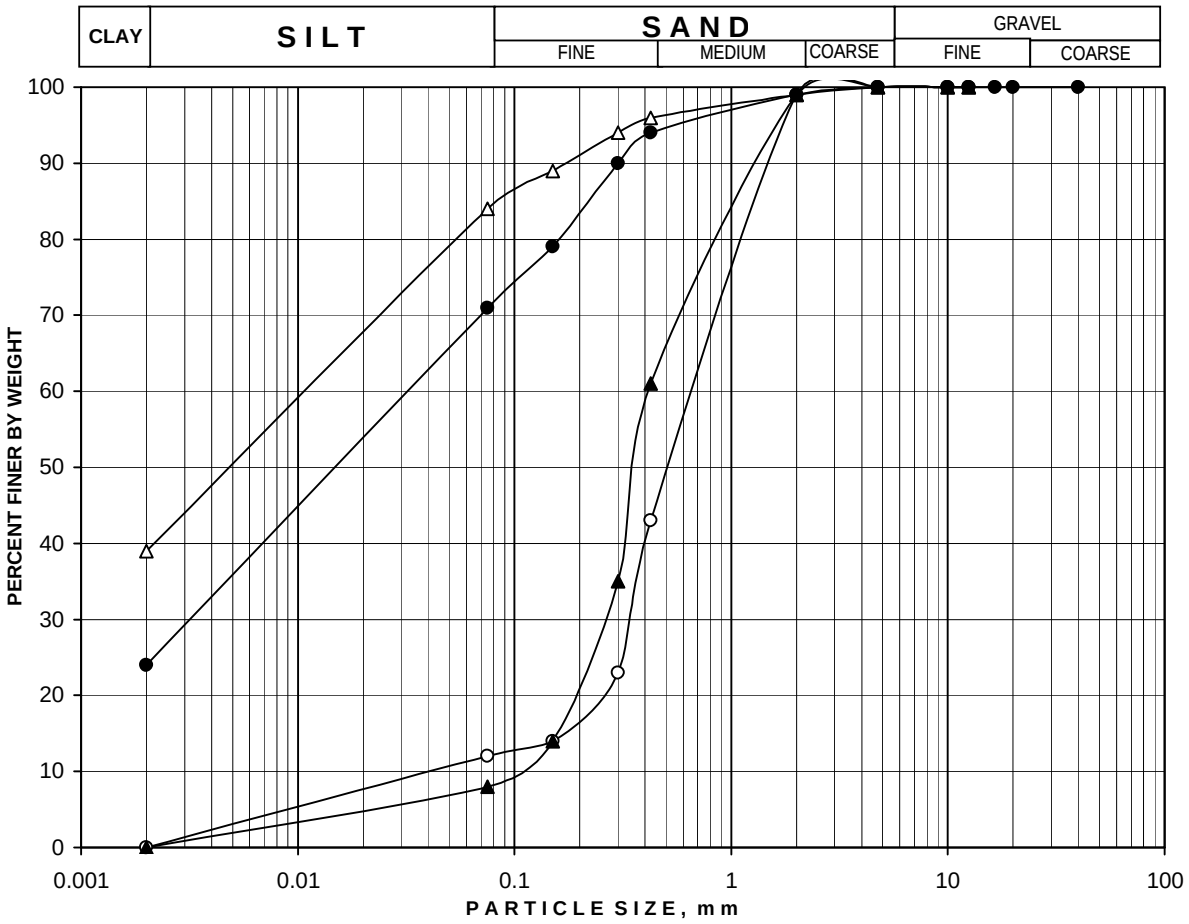
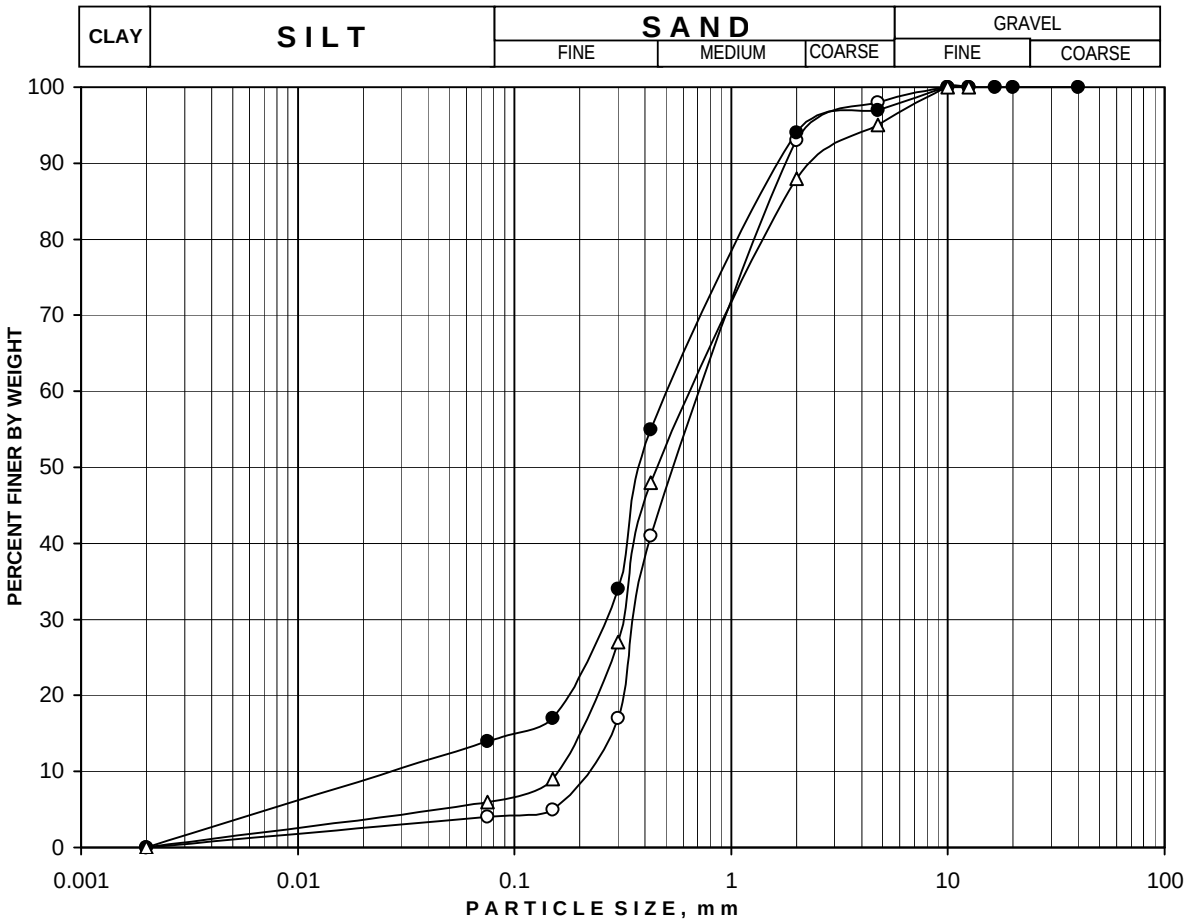


Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	31.50	Fine to Medium Sand (SP)	0.00	88.00	12.00	0.00
●	11	34.50	Clayey Sandy Silt / Silty Clay of medium plasticity (CI)	0.00	29.00	47.00	24.00
△	11	36.00	Silty Clay with sand of high plasticity (CH)	0.00	16.00	45.00	39.00
▲	11	39.00	Medium to Fine Sand (SP-SM)	0.00	92.00	8.00	0.00

INDIAN GEOTECHNICAL SERVICES

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR



Symbol	BH No.	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
○	11	42.00	Fine to Medium Sand Sand (SP)	2.00	94.00	4.00	0.00
●	11	45.00	Silty Sand (SM)	3.00	83.00	14.00	0.00
△	11	48.00	Fine to Medium Sand Sand (SP-SM)	5.00	89.00	6.00	0.00

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 1

DEPTH : 0.00 - 2.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	2.00	1.2125	2.425	0.119	**0.607**
0.300	5.00	0.3625	1.813		
0.150	4.00	0.225	0.900		
0.075	1.00	0.1125	0.113		
PAN	87.00	0.038	3.263		
	100.00		11.888		

DEPTH : 2.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.750	0.000		
2.000	1.00	3.375	3.375		
0.425	1.00	1.213	1.213	0.101	**0.560**
0.300	2.00	0.363	0.725		
0.150	6.00	0.225	1.350		
0.075	1.00	0.113	0.113		
PAN	89.00	0.038	3.338		
	100.00		10.113		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	23.00	1.2125	27.888	0.495	**1.238**
0.300	30.00	0.3625	10.875		
0.150	31.00	0.225	6.975		
0.075	3.00	0.1125	0.338		
PAN	12.00	0.038	0.450		
	100.00		49.450		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 1

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	19.00	4.75	90.250		
2.000	15.00	3.375	50.625		
0.425	46.00	1.2125	55.775	2.018	**2.500**
0.300	12.00	0.3625	4.350		
0.150	3.00	0.225	0.675		
0.075	1.00	0.1125	0.113		
PAN	4.00	0.038	0.150		
	100.00		201.788		

DEPTH : 9.00 - 11.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	16.00	20	320.000		
16.500	0.00	18.25	0.000		
12.500	0.00	14.5	0.000		
10.000	0.00	11.25	0.000		
4.750	11.50	7.375	84.813		
2.000	7.50	3.375	25.313		
0.425	39.00	1.2125	47.288	4.843	**3.873**
0.300	14.00	0.3625	5.075		
0.150	7.00	0.225	1.575		
0.075	1.00	0.1125	0.113		
PAN	4.00	0.038	0.150		
	100.00		484.325		

DEPTH : 11.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
40.000	78.00	40	3120.000		
20.000	4.75	30.000	142.500		
16.500	3.75	18.250	68.438		
12.500	0.00	14.500	0.000		
10.000	0.00	11.250	0.000		
4.750	1.75	7.375	12.906		
2.000	1.00	3.375	3.375		
0.425	7.00	1.213	8.488	33.562	**10.196**
0.300	1.00	0.363	0.363		
0.150	0.25	0.225	0.056		
0.075	0.25	0.1125	0.028		
PAN	2.25	0.038	0.084		
	100.00		3356.238		

DEPTH : 12.00 - 13.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	12.00	12.5	150.000		
10.000	0.00	11.25	0.000		
4.750	18.00	7.375	132.750		
2.000	13.00	3.375	43.875		
0.425	49.50	1.2125	60.019	3.883	**3.468**
0.300	3.50	0.3625	1.269		
0.150	1.00	0.225	0.225		
0.075	0.50	0.1125	0.056		
PAN	2.50	0.038	0.094		
	100.00		388.288		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY K 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 1

DEPTH : 13.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	6.00	4.75	28.500		
2.000	12.00	3.375	40.500		
0.425	64.00	1.2125	77.600	1.508	**2.161**
0.300	10.00	0.3625	3.625		
0.150	2.00	0.225	0.450		
0.075	1.00	0.1125	0.113		
PAN	5.00	0.038	0.188		
	100.00		150.788		

DEPTH : 15.00 - 16.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	26.00	20	520.000		
16.500	0.00	18.25	0.000		
12.500	6.00	14.5	87.000		
10.000	7.00	11.25	78.750		
4.750	7.00	7.375	51.625		
2.000	4.50	3.375	15.188		
0.425	28.00	1.2125	33.950	7.907	**4.949**
0.300	8.50	0.3625	3.081		
0.150	3.00	0.225	0.675		
0.075	0.50	0.1125	0.056		
PAN	9.50	0.038	0.356		
	100.00		790.681		

DEPTH : 16.00 - 19.00 m

C = 2.60 kg/cm2 fi = <5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.225

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 1

DEPTH : 19.00 - 22.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	2.00	3.375	6.750		
0.425	28.00	1.2125	33.950	0.616	**1.381**
0.300	22.00	0.3625	7.975		
0.150	14.00	0.225	3.150		
0.075	2.00	0.1125	0.225		
PAN	30.00	0.038	1.125		
	100.00		61.550		

DEPTH : 22.00 - 24.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	13.50	12.5	168.750		
10.000	8.50	11.25	95.625		
4.750	7.00	7.375	51.625		
2.000	5.50	3.375	18.563		
0.425	25.50	1.2125	30.919	3.707	**3.388**
0.300	8.00	0.3625	2.900		
0.150	5.50	0.225	1.238		
0.075	0.50	0.1125	0.056		
PAN	26.00	0.038	0.975		
	100.00		370.650		

DEPTH : 24.00 - 30.00 m

C = 2.28 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.020

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 2

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	14.00	1.2125	16.975	0.429	**1.153**
0.300	30.00	0.3625	10.875		
0.150	50.00	0.225	11.250		
0.075	3.00	0.1125	0.338		
PAN	2.00	0.038	0.075		
	100.00		42.888		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	3.00	4.750	14.250		
2.000	2.00	3.375	6.750		
0.425	64.00	1.213	77.600	1.061	**1.813**
0.300	16.00	0.363	5.800		
0.150	5.00	0.225	1.125		
0.075	3.00	0.113	0.338		
PAN	7.00	0.038	0.263		
	100.00		106.125		

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	2.00	3.375	6.750		
0.425	21.00	1.2125	25.463	0.496	**1.240**
0.300	15.00	0.3625	5.438		
0.150	10.00	0.225	2.250		
0.075	2.00	0.1125	0.225		
PAN	48.00	0.038	1.800		
	100.00		49.625		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 2

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	22.00	4.75	104.500		
2.000	16.00	3.375	54.000		
0.425	48.00	1.2125	58.200	2.205	**2.614**
0.300	9.00	0.3625	3.263		
0.150	2.00	0.225	0.450		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		220.525		

DEPTH : 12.00 - 13.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	7.00	3.375	23.625		
0.425	72.00	1.2125	87.300	1.345	**2.041**
0.300	11.00	0.3625	3.988		
0.150	2.00	0.225	0.450		
0.075	1.00	0.1125	0.113		
PAN	3.00	0.038	0.113		
	100.00		134.475		

DEPTH : 13.00 - 16.00 m

C = 1.35 kg/cm2 fi = <5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 3.783

DEPTH : 16.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	39.00	1.2125	47.288	0.602	**1.366**
0.300	17.00	0.3625	6.163		
0.150	14.00	0.225	3.150		
0.075	2.00	0.1125	0.225		
PAN	27.00	0.038	1.013		
	100.00		60.200		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 2

DEPTH : 18.00 - 19.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	22.00	4.75	104.500		
2.000	5.00	3.375	16.875		
0.425	58.00	1.2125	70.325	1.959	**2.463**
0.300	10.00	0.3625	3.625		
0.150	2.00	0.225	0.450		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		195.888		

DEPTH : 19.00 - 28.00 m

C = 2.38 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.085

DEPTH : 28.00 - 33.00 m

C = 2.00 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.828

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 3

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	4.00	3.375	13.500		
0.425	66.00	1.2125	80.025	1.111	**1.855**
0.300	18.00	0.3625	6.525		
0.150	6.00	0.225	1.350		
0.075	1.00	0.1125	0.113		
PAN	3.00	0.038	0.113		
	100.00		111.125		

DEPTH : 3.00 - 5.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.750	9.500		
2.000	4.00	3.375	13.500		
0.425	66.00	1.213	80.025	1.109	**1.854**
0.300	18.00	0.363	6.525		
0.150	5.00	0.225	1.125		
0.075	1.00	0.113	0.113		
PAN	4.00	0.038	0.150		
	100.00		110.938		

DEPTH : 5.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	38.50	20	770.000		
16.500	4.50	18.25	82.125		
12.500	0.00	14.5	0.000		
10.000	0.00	11.25	0.000		
4.750	2.50	7.375	18.438		
2.000	6.00	3.375	20.250		
0.425	36.50	1.2125	44.256	9.380	**5.390**
0.300	6.50	0.3625	2.356		
0.150	2.00	0.225	0.450		
0.075	0.50	0.1125	0.056		
PAN	3.00	0.038	0.113		
	100.00		938.044		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 3

DEPTH : 6.00 - 9.00 m

C = 1.26 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.245

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	12.50	20	250.000		
16.500	0.00	18.25	0.000		
12.500	0.00	14.5	0.000		
10.000	0.00	11.25	0.000		
4.750	6.00	7.375	44.250		
2.000	10.00	3.375	33.750		
0.425	56.50	1.2125	68.506	4.005	**3.522**
0.300	9.00	0.3625	3.263		
0.150	2.50	0.225	0.563		
0.075	0.50	0.1125	0.056		
PAN	3.00	0.038	0.113		
	100.00		400.500		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 3

DEPTH : 12.00 - 16.00 m

C = 1.50 kg/cm2 fi = 5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 3.893

DEPTH : 16.00 - 19.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	8.00	4.750	38.000		
2.000	10.00	3.375	33.750		
0.425	58.00	1.213	70.325	1.485	**2.145**
0.300	14.00	0.363	5.075		
0.150	5.00	0.225	1.125		
0.075	1.00	0.113	0.113		
PAN	4.00	0.038	0.150		
	100.00		148.538		

DEPTH : 19.00 - 28.00 m

C = 2.33 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.053

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 4

DEPTH : 0.00 - 1.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	6.00	4.75	28.500		
2.000	1.00	3.375	3.375		
0.425	20.00	1.2125	24.250	0.686	**1.457**
0.300	19.00	0.3625	6.888		
0.150	18.00	0.225	4.050		
0.075	2.00	0.1125	0.225		
PAN	34.00	0.038	1.275		
	100.00		68.563		

DEPTH : 1.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	20.00	1.2125	24.250	0.463	**1.197**
0.300	26.00	0.3625	9.425		
0.150	35.00	0.225	7.875		
0.075	9.00	0.1125	1.013		
PAN	9.00	0.038	0.338		
	100.00		46.275		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	22.00	1.2125	26.675	0.480	**1.219**
0.300	24.00	0.3625	8.700		
0.150	35.00	0.225	7.875		
0.075	9.00	0.1125	1.013		
PAN	9.00	0.038	0.338		
	100.00		47.975		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 4

DEPTH : 6.00 - 7.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	14.00	12.5	175.000		
10.000	17.00	11.25	191.250		
4.750	29.00	7.375	213.875		
2.000	14.50	3.375	48.938		
0.425	21.00	1.2125	25.463	6.555	**4.506**
0.300	2.00	0.3625	0.725		
0.150	0.50	0.225	0.113		
0.075	0.50	0.1125	0.056		
PAN	1.50	0.038	0.056		
	100.00		655.475		

DEPTH : 7.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	16.00	20	320.000		
16.500	19.00	18.25	346.750		
12.500	13.00	14.5	188.500		
10.000	10.00	11.25	112.500		
4.750	14.50	7.375	106.938		
2.000	8.00	3.375	27.000		
0.425	14.00	1.2125	16.975	11.197	**5.889**
0.300	2.00	0.3625	0.725		
0.150	0.50	0.225	0.113		
0.075	0.50	0.1125	0.056		
PAN	2.50	0.038	0.094		
	100.00		1119.650		

DEPTH : 9.00 - 10.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	9.00	10	90.000		
4.750	13.00	7.375	95.875		
2.000	12.50	3.375	42.188		
0.425	51.00	1.2125	61.838	2.939	**3.017**
0.300	8.50	0.3625	3.081		
0.150	3.50	0.225	0.788		
0.075	0.50	0.1125	0.056		
PAN	2.00	0.038	0.075		
	100.00		293.900		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 4

DEPTH : 10.00 - 13.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	14.50	10	145.000		
4.750	26.50	7.375	195.438		
2.000	26.50	3.375	89.438		
0.425	28.00	1.2125	33.950	4.649	**3.795**
0.300	2.00	0.3625	0.725		
0.150	1.00	0.225	0.225		
0.075	0.50	0.1125	0.056		
PAN	1.00	0.038	0.038		
	100.00		464.869		

DEPTH : 13.00 - 14.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	4.00	10	40.000		
4.750	14.00	7.375	103.250		
2.000	25.50	3.375	86.063		
0.425	41.50	1.2125	50.319	2.837	**2.965**
0.300	8.50	0.3625	3.081		
0.150	4.00	0.225	0.900		
0.075	0.50	0.1125	0.056		
PAN	2.00	0.038	0.075		
	100.00		283.744		

DEPTH : 14.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	16.00	20	320.000		
16.500	12.50	18.25	228.125		
12.500	15.00	14.5	217.500		
10.000	5.00	11.25	56.250		
4.750	17.00	7.375	125.375		
2.000	8.50	3.375	28.688		
0.425	15.00	1.2125	18.188	9.963	**5.555**
0.300	3.50	0.3625	1.269		
0.150	3.00	0.225	0.675		
0.075	0.50	0.1125	0.056		
PAN	4.00	0.038	0.150		
	100.00		996.275		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 4

DEPTH : 15.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	2.00	3.375	6.750		
0.425	19.00	1.2125	23.038	0.519	**1.268**
0.300	19.00	0.3625	6.888		
0.150	18.00	0.225	4.050		
0.075	2.00	0.1125	0.225		
PAN	38.00	0.038	1.425		
	100.00		51.875		

DEPTH : 18.00 - 21.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	9.00	4.75	42.750		
2.000	2.00	3.375	6.750		
0.425	16.00	1.2125	19.400	0.800	**1.574**
0.300	16.00	0.3625	5.800		
0.150	16.00	0.225	3.600		
0.075	2.00	0.1125	0.225		
PAN	39.00	0.038	1.463		
	100.00		79.988		

DEPTH : 21.00 - 24.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	5.00	4.75	23.750		
2.000	2.00	3.375	6.750		
0.425	31.00	1.2125	37.588	0.776	**1.551**
0.300	14.00	0.3625	5.075		
0.150	13.00	0.225	2.925		
0.075	3.00	0.1125	0.338		
PAN	32.00	0.038	1.200		
	100.00		77.625		

DEPTH : 24.00 - 31.00 m

C = 2.25 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.000

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 5

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	2.00	1.2125	2.425	0.267	**0.910**
0.300	14.00	0.3625	5.075		
0.150	60.00	0.225	13.500		
0.075	20.00	0.1125	2.250		
PAN	3.00	0.038	0.113		
	100.00		26.738		

DEPTH : 3.00 - 5.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.750	9.500		
2.000	2.00	3.375	6.750		
0.425	39.00	1.213	47.288	0.777	**1.552**
0.300	18.00	0.363	6.525		
0.150	31.00	0.225	6.975		
0.075	5.00	0.113	0.563		
PAN	3.00	0.038	0.113		
	100.00		77.713		

DEPTH : 5.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
16.500	9.50	16.5	156.750		
12.500	6.50	14.5	94.250		
10.000	7.50	11.25	84.375		
4.750	19.50	7.375	143.813		
2.000	9.50	3.375	32.063		
0.425	29.50	1.2125	35.769	5.521	**4.135**
0.300	10.00	0.3625	3.625		
0.150	6.00	0.225	1.350		
0.075	0.50	0.1125	0.056		
PAN	1.50	0.038	0.056		
	100.00		552.106		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 5

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	12.00	12.5	150.000		
10.000	4.00	11.25	45.000		
4.750	6.50	7.375	47.938		
2.000	4.50	3.375	15.188		
0.425	30.00	1.2125	36.375	3.069	**3.083**
0.300	23.00	0.3625	8.338		
0.150	17.00	0.225	3.825		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		306.850		

DEPTH : 12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	4.00	3.375	13.500		
0.425	41.00	1.2125	49.713	0.972	**1.735**
0.300	29.00	0.3625	10.513		
0.150	19.00	0.225	4.275		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		97.188		

DEPTH : 15.00 - 16.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	10.00	10	100.000		
4.750	2.00	7.375	14.750		
2.000	3.00	3.375	10.125		
0.425	40.00	1.2125	48.500	1.825	**2.377**
0.300	15.00	0.3625	5.438		
0.150	13.00	0.225	2.925		
0.075	1.00	0.1125	0.113		
PAN	16.00	0.038	0.600		
	100.00		182.450		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 5

DEPTH : 16.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	17.00	1.2125	20.613	0.389	**1.098**
0.300	23.00	0.3625	8.338		
0.150	22.00	0.225	4.950		
0.075	3.00	0.1125	0.338		
PAN	34.00	0.038	1.275		
	100.00		38.888		

DEPTH : 18.00 - 21.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	2.00	3.375	6.750		
0.425	38.00	1.2125	46.075	0.827	**1.601**
0.300	18.00	0.3625	6.525		
0.150	15.00	0.225	3.375		
0.075	2.00	0.1125	0.225		
PAN	21.00	0.038	0.788		
	100.00		82.738		

DEPTH : 21.00 - 30.00 m

C = 2.20 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.966

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 6

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	19.00	1.2125	23.038	0.442	**1.170**
0.300	14.00	0.3625	5.075		
0.150	50.00	0.225	11.250		
0.075	11.00	0.1125	1.238		
PAN	5.00	0.038	0.188		
	100.00		44.163		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.750	0.000		
2.000	1.00	3.375	3.375		
0.425	52.00	1.213	63.050	0.787	**1.561**
0.300	24.00	0.363	8.700		
0.150	14.00	0.225	3.150		
0.075	1.00	0.113	0.113		
PAN	8.00	0.038	0.300		
	100.00		78.688		

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	11.00	4.75	52.250		
2.000	16.00	3.375	54.000		
0.425	64.00	1.2125	77.600	1.860	**2.400**
0.300	5.00	0.3625	1.813		
0.150	1.00	0.225	0.225		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		186.000		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 6

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	9.00	20	180.000		
16.500	0.00	18.25	0.000		
12.500	8.00	14.5	116.000		
10.000	0.00	11.25	0.000		
4.750	17.50	7.375	129.063		
2.000	17.50	3.375	59.063		
0.425	41.00	1.2125	49.713	5.356	**4.073**
0.300	3.50	0.3625	1.269		
0.150	1.50	0.225	0.338		
0.075	0.50	0.1125	0.056		
PAN	1.50	0.038	0.056		
	100.00		535.556		

DEPTH : 12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	8.00	4.75	38.000		
2.000	7.00	3.375	23.625		
0.425	62.00	1.2125	75.175	1.432	**2.106**
0.300	14.00	0.3625	5.075		
0.150	5.00	0.225	1.125		
0.075	1.00	0.1125	0.113		
PAN	3.00	0.038	0.113		
	100.00		143.225		

DEPTH : 15.00 - 16.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	4.00	10	40.000		
4.750	7.50	7.375	55.313		
2.000	8.50	3.375	28.688		
0.425	55.00	1.2125	66.688	1.982	**2.477**
0.300	16.50	0.3625	5.981		
0.150	6.00	0.225	1.350		
0.075	0.50	0.1125	0.056		
PAN	2.00	0.038	0.075		
	100.00		198.150		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 6

DEPTH : 16.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	19.00	1.2125	23.038	0.384	**1.090**
0.300	19.00	0.3625	6.888		
0.150	14.00	0.225	3.150		
0.075	2.00	0.1125	0.225		
PAN	45.00	0.038	1.688		
	100.00		38.363		

DEPTH : 18.00 - 21.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	20.00	1.2125	24.250	0.422	**1.144**
0.300	25.00	0.3625	9.063		
0.150	18.00	0.225	4.050		
0.075	2.00	0.1125	0.225		
PAN	34.00	0.038	1.275		
	100.00		42.238		

DEPTH : 21.00 - 22.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	3.00	4.75	14.250		
2.000	8.00	3.375	27.000		
0.425	53.00	1.2125	64.263	1.166	**1.900**
0.300	25.00	0.3625	9.063		
0.150	8.00	0.225	1.800		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		116.563		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 6

DEPTH : 22.00 - 31.00 m

C = 2.05 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.864

DEPTH : 31.00 - 35.00 m

C = 2.18 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.953

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 7

DEPTH : 0.00 - 1.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	3.00	1.2125	3.638	0.131	**0.636**
0.300	5.00	0.3625	1.813		
0.150	4.00	0.225	0.900		
0.075	1.00	0.1125	0.113		
PAN	86.00	0.038	3.225		
	100.00		13.063		

DEPTH : 1.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	3.00	4.750	14.250		
2.000	3.00	3.375	10.125		
0.425	44.00	1.213	53.350	0.919	**1.687**
0.300	25.00	0.363	9.063		
0.150	22.00	0.225	4.950		
0.075	1.00	0.113	0.113		
PAN	2.00	0.038	0.075		
	100.00		91.925		

DEPTH : 3.00 - 5.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	2.00	3.375	6.750		
0.425	51.00	1.2125	61.838	0.907	**1.676**
0.300	22.00	0.3625	7.975		
0.150	20.00	0.225	4.500		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		90.675		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 7

DEPTH : 5.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
40.000	70.00	40	2800.000		
20.000	12.60	30	378.000		
16.500	10.80	18.25	197.100		
12.500	0.00	14.5	0.000		
10.000	0.00	11.25	0.000		
4.750	0.20	7.375	1.475		
2.000	0.20	3.375	0.675		
0.425	1.60	1.2125	1.940	33.802	**10.232**
0.300	1.00	0.3625	0.363		
0.150	2.40	0.225	0.540		
0.075	0.20	0.1125	0.023		
PAN	1.00	0.038	0.038		
	100.00		3380.153		

DEPTH : 6.00 - 7.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
16.500	20.00	16.5	330.000		
12.500	10.00	14.5	145.000		
10.000	6.00	11.25	67.500		
4.750	1.00	7.375	7.375		
2.000	1.00	3.375	3.375		
0.425	30.00	1.2125	36.375	5.985	**4.306**
0.300	15.00	0.3625	5.438		
0.150	14.50	0.225	3.263		
0.075	0.50	0.1125	0.056		
PAN	2.00	0.038	0.075		
	100.00		598.456		

DEPTH : 7.00 - 8.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
16.500	15.00	16.5	247.500		
12.500	0.00	14.5	0.000		
10.000	9.00	11.25	101.250		
4.750	7.50	7.375	55.313		
2.000	7.00	3.375	23.625		
0.425	48.00	1.2125	58.200	4.899	**3.895**
0.300	8.50	0.3625	3.081		
0.150	3.50	0.225	0.788		
0.075	0.50	0.1125	0.056		
PAN	1.00	0.038	0.038		
	100.00		489.850		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHR ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 7

DEPTH : 8.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	18.67	20	373.333		
16.500	26.00	18.25	474.500		
12.500	6.00	14.5	87.000		
10.000	10.00	11.25	112.500		
4.750	6.00	7.375	44.250		
2.000	4.33	3.375	14.625		
0.425	23.33	1.2125	28.292	11.359	**5.932**
0.300	2.67	0.3625	0.967		
0.150	1.33	0.225	0.300		
0.075	0.33	0.1125	0.038		
PAN	1.33	0.038	0.050		
	100.00		1135.854		

DEPTH : 9.00 - 11.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
16.500	39.00	16.5	643.500		
12.500	6.00	14.5	87.000		
10.000	0.00	11.25	0.000		
4.750	5.00	7.375	36.875		
2.000	5.00	3.375	16.875		
0.425	35.00	1.2125	42.438	8.292	**5.068**
0.300	5.00	0.3625	1.813		
0.150	2.50	0.225	0.563		
0.075	0.50	0.1125	0.056		
PAN	2.00	0.038	0.075		
	100.00		829.194		

DEPTH : 11.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	18.50	20	370.000		
16.500	23.75	18.25	433.438		
12.500	12.25	14.5	177.625		
10.000	19.50	11.25	219.375		
4.750	2.50	7.375	18.438		
2.000	2.25	3.375	7.594		
0.425	16.25	1.2125	19.703	12.476	**6.216**
0.300	2.75	0.3625	0.997		
0.150	1.50	0.225	0.338		
0.075	0.25	0.1125	0.028		
PAN	0.50	0.038	0.019		
	100.00		1247.553		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 7

DEPTH : 12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	14.50	10	145.000		
4.750	5.00	7.375	36.875		
2.000	5.50	3.375	18.563		
0.425	53.00	1.2125	64.263	2.705	**2.894**
0.300	11.00	0.3625	3.988		
0.150	7.00	0.225	1.575		
0.075	0.50	0.1125	0.056		
PAN	3.50	0.038	0.131		
	100.00		270.450		

DEPTH : 15.00 - 20.00 m

C = 1.60 kg/cm2 fi = <5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.530

DEPTH : 20.00 - 24.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	14.50	4.75	68.875		
2.000	6.50	3.375	21.938		
0.425	51.00	1.2125	61.838	1.602	**2.228**
0.300	15.00	0.3625	5.438		
0.150	8.50	0.225	1.913		
0.075	0.50	0.1125	0.056		
PAN	4.00	0.038	0.150		
	100.00		160.206		

DEPTH : 24.00 - 28.00 m

C = 2.23 kg/cm2 fi = 6 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.363

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 8

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	72.00	1.2125	87.300	0.993	**1.754**
0.300	21.00	0.3625	7.613		
0.150	4.00	0.225	0.900		
0.075	1.00	0.1125	0.113		
PAN	1.00	0.038	0.038		
	100.00		99.338		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.750	0.000		
2.000	1.00	3.375	3.375		
0.425	68.00	1.213	82.450	0.943	**1.709**
0.300	17.00	0.363	6.163		
0.150	9.00	0.225	2.025		
0.075	1.00	0.113	0.113		
PAN	4.00	0.038	0.150		
	100.00		94.275		

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	74.00	1.2125	89.725	1.000	**1.760**
0.300	13.00	0.3625	4.713		
0.150	9.00	0.225	2.025		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		99.950		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 8

DEPTH : 9.00 - 11.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	52.00	1.2125	63.050	0.800	**1.574**
0.300	28.00	0.3625	10.150		
0.150	14.00	0.225	3.150		
0.075	1.00	0.1125	0.113		
PAN	4.00	0.038	0.150		
	100.00		79.988		

DEPTH : 11.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	53.00	20	1060.000		
16.500	0.00	18.25	0.000		
12.500	0.00	14.5	0.000		
10.000	3.33	11.25	37.500		
4.750	2.33	7.375	17.208		
2.000	4.67	3.375	15.750		
0.425	29.67	1.2125	35.971	11.681	**6.015**
0.300	3.67	0.3625	1.329		
0.150	1.00	0.225	0.225		
0.075	0.33	0.1125	0.038		
PAN	2.00	0.038	0.075		
	100.00		1168.096		

DEPTH :12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	5.50	10	55.000		
4.750	18.00	7.375	132.750		
2.000	16.50	3.375	55.688		
0.425	51.50	1.2125	62.444	3.083	**3.090**
0.300	5.50	0.3625	1.994		
0.150	1.50	0.225	0.338		
0.075	0.50	0.1125	0.056		
PAN	1.00	0.038	0.038		
	100.00		308.306		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 8

DEPTH : 15.00 - 16.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	9.50	12.5	118.750		
10.000	6.00	11.25	67.500		
4.750	13.00	7.375	95.875		
2.000	15.50	3.375	52.313		
0.425	48.50	1.2125	58.806	3.951	**3.499**
0.300	4.00	0.3625	1.450		
0.150	1.50	0.225	0.338		
0.075	0.50	0.1125	0.056		
PAN	1.50	0.038	0.056		
	100.00		395.144		

DEPTH : 16.00 - 21.00 m

C = 1.80 kg/cm2 fi = <5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.683

DEPTH : 21.00 - 22.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	6.00	4.75	28.500		
2.000	7.00	3.375	23.625		
0.425	63.00	1.2125	76.388	1.356	**2.050**
0.300	16.00	0.3625	5.800		
0.150	5.00	0.225	1.125		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		135.625		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 8

DEPTH : 22.00 - 27.00 m

C = 2.05 kg/cm2 fi = 5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.864

DEPTH : 27.00 - 35.00 m

C = 2.28 kg/cm2 fi = <5 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 5.020

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION O EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 9

DEPTH : 0.00 - 1.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	12.50	4.75	59.375		
2.000	7.00	3.375	23.625		
0.425	41.50	1.2125	50.319	1.437	**2.110**
0.300	18.00	0.3625	6.525		
0.150	16.00	0.225	3.600		
0.075	0.50	0.1125	0.056		
PAN	4.50	0.038	0.169		
	100.00		143.669		

DEPTH : 1.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	14.33	20	286.667		
16.500	7.33	18.25	133.833		
12.500	5.00	14.5	72.500		
10.000	5.00	11.25	56.250		
4.750	14.00	7.375	103.250		
2.000	11.00	3.375	37.125		
0.425	29.00	1.2125	35.163	7.278	**4.748**
0.300	5.33	0.3625	1.933		
0.150	4.00	0.225	0.900		
0.075	0.33	0.1125	0.038		
PAN	4.67	0.038	0.175		
	100.00		727.833		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	18.00	12.5	225.000		
10.000	2.00	11.25	22.500		
4.750	5.00	7.375	36.875		
2.000	34.50	3.375	116.438		
0.425	15.00	1.2125	18.188	4.264	**3.634**
0.300	14.00	0.3625	5.075		
0.150	10.00	0.225	2.250		
0.075	0.50	0.1125	0.056		
PAN	1.00	0.038	0.038		
	100.00		426.419		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHR ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 9

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	6.00	12.5	75.000		
10.000	3.50	11.25	39.375		
4.750	7.50	7.375	55.313		
2.000	10.00	3.375	33.750		
0.425	42.00	1.2125	50.925	2.592	**2.833**
0.300	8.50	0.3625	3.081		
0.150	4.50	0.225	1.013		
0.075	0.50	0.1125	0.056		
PAN	17.50	0.038	0.656		
	100.00		259.169		

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	35.67	20	713.333		
16.500	2.67	18.25	48.667		
12.500	10.00	14.5	145.000		
10.000	0.00	11.25	0.000		
4.750	4.00	7.375	29.500		
2.000	4.00	3.375	13.500		
0.425	36.00	1.2125	43.650	9.950	**5.552**
0.300	2.67	0.3625	0.967		
0.150	1.00	0.225	0.225		
0.075	0.33	0.1125	0.038		
PAN	3.67	0.038	0.138		
	100.00		995.017		

DEPTH : 12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	12.50	20	250.000		
16.500	9.75	18.25	177.938		
12.500	13.75	14.5	199.375		
10.000	14.25	11.25	160.313		
4.750	12.75	7.375	94.031		
2.000	8.00	3.375	27.000		
0.425	22.00	1.2125	26.675	9.363	**5.385**
0.300	1.75	0.3625	0.634		
0.150	0.75	0.225	0.169		
0.075	0.25	0.1125	0.028		
PAN	4.25	0.038	0.159		
	100.00		936.322		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 9

DEPTH : 15.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	21.33	20	426.667		
16.500	6.67	18.25	121.667		
12.500	8.00	14.5	116.000		
10.000	6.33	11.25	71.250		
4.750	13.00	7.375	95.875		
2.000	11.33	3.375	38.250		
0.425	22.00	1.2125	26.675	8.984	**5.275**
0.300	3.33	0.3625	1.208		
0.150	2.33	0.225	0.525		
0.075	0.33	0.1125	0.038		
PAN	5.33	0.038	0.200		
	100.00		898.354		

DEPTH : 18.00 - 21.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
16.500	12.50	16.5	206.250		
12.500	13.00	14.5	188.500		
10.000	7.00	11.25	78.750		
4.750	14.00	7.375	103.250		
2.000	15.50	3.375	52.313		
0.425	30.50	1.2125	36.981	6.671	**4.546**
0.300	2.00	0.3625	0.725		
0.150	0.50	0.225	0.113		
0.075	0.50	0.1125	0.056		
PAN	4.50	0.038	0.169		
	100.00		667.106		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 9

DEPTH : 21.00 - 24.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	11.50	10	115.000		
4.750	17.00	7.375	125.375		
2.000	15.50	3.375	52.313		
0.425	35.50	1.2125	43.044	3.399	**3.245**
0.300	7.00	0.3625	2.538		
0.150	5.50	0.225	1.238		
0.075	1.00	0.1125	0.113		
PAN	7.00	0.038	0.263		
	100.00		339.881		

DEPTH : 24.00 - 27.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
10.000	1.00	10	10.000		
4.750	15.00	7.375	110.625		
2.000	16.50	3.375	55.688		
0.425	53.00	1.2125	64.263	2.438	**2.748**
0.300	6.50	0.3625	2.356		
0.150	3.00	0.225	0.675		
0.075	0.50	0.1125	0.056		
PAN	4.50	0.038	0.169		
	100.00		243.831		

DEPTH : 27.00 - 31.00 m

C = 1.85 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.720

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 10

DEPTH : 0.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	2.00	3.375	6.750		
0.425	54.00	1.2125	65.475	0.931	**1.698**
0.300	20.00	0.3625	7.250		
0.150	17.00	0.225	3.825		
0.075	1.00	0.1125	0.113		
PAN	4.00	0.038	0.150		
	100.00		93.063		

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.750	9.500		
2.000	7.00	3.375	23.625		
0.425	70.00	1.213	84.875	1.229	**1.951**
0.300	10.00	0.363	3.625		
0.150	4.00	0.225	0.900		
0.075	1.00	0.113	0.113		
PAN	6.00	0.038	0.225		
	100.00		122.863		

DEPTH : 6.00 - 8.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	9.00	4.75	42.750		
2.000	2.50	3.375	8.438		
0.425	45.50	1.2125	55.169	1.174	**1.907**
0.300	17.50	0.3625	6.344		
0.150	20.50	0.225	4.613		
0.075	0.50	0.1125	0.056		
PAN	4.50	0.038	0.169		
	100.00		117.369		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHR ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 10

DEPTH : 8.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
40.000	38.33	40	1533.333		
20.000	23.33	30	700.000		
16.500	3.67	18.25	66.917		
12.500	3.00	14.5	43.500		
10.000	0.00	11.25	0.000		
4.750	0.33	7.375	2.458		
2.000	2.00	3.375	6.750		
0.425	20.00	1.2125	24.250	23.794	**8.585**
0.300	4.67	0.3625	1.692		
0.150	1.33	0.225	0.300		
0.075	0.33	0.1125	0.038		
PAN	3.00	0.038	0.113		
	100.00		2379.350		

DEPTH : 9.00 - 11.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	8.00	4.75	38.000		
2.000	7.00	3.375	23.625		
0.425	60.00	1.2125	72.750	1.406	**2.087**
0.300	13.00	0.3625	4.713		
0.150	5.00	0.225	1.125		
0.075	1.00	0.1125	0.113		
PAN	6.00	0.038	0.225		
	100.00		140.550		

DEPTH : 11.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	19.00	20	380.000		
16.500	22.00	18.25	401.500		
12.500	6.67	14.5	96.667		
10.000	6.33	11.25	71.250		
4.750	5.00	7.375	36.875		
2.000	7.33	3.375	24.750		
0.425	28.33	1.2125	34.354	10.464	**5.693**
0.300	2.00	0.3625	0.725		
0.150	0.67	0.225	0.150		
0.075	0.33	0.1125	0.038		
PAN	2.33	0.038	0.088		
	100.00		1046.396		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 10

DEPTH : 12.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
12.500	13.00	12.5	162.500		
10.000	3.50	11.25	39.375		
4.750	6.00	7.375	44.250		
2.000	9.00	3.375	30.375		
0.425	40.00	1.2125	48.500	3.311	**3.203**
0.300	10.00	0.3625	3.625		
0.150	9.00	0.225	2.025		
0.075	1.50	0.1125	0.169		
PAN	8.00	0.038	0.300		
	100.00		331.119		

DEPTH : 15.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	9.00	3.375	30.375		
0.425	67.00	1.2125	81.238	1.262	**1.977**
0.300	11.00	0.3625	3.988		
0.150	3.00	0.225	0.675		
0.075	1.00	0.1125	0.113		
PAN	7.00	0.038	0.263		
	100.00		126.150		

DEPTH : 18.00 - 19.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	7.00	4.75	33.250		
2.000	10.00	3.375	33.750		
0.425	64.00	1.2125	77.600	1.489	**2.147**
0.300	9.00	0.3625	3.263		
0.150	3.00	0.225	0.675		
0.075	1.00	0.1125	0.113		
PAN	6.00	0.038	0.225		
	100.00		148.875		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 10

DEPTH : 19.00 - 22.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	7.00	4.75	33.250		
2.000	6.00	3.375	20.250		
0.425	62.00	1.2125	75.175	1.340	**2.037**
0.300	11.00	0.3625	3.988		
0.150	4.00	0.225	0.900		
0.075	1.00	0.1125	0.113		
PAN	9.00	0.038	0.338		
	100.00		134.013		

DEPTH : 22.00 - 25.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	3.00	4.75	14.250		
2.000	8.00	3.375	27.000		
0.425	67.00	1.2125	81.238	1.274	**1.986**
0.300	10.00	0.3625	3.625		
0.150	4.00	0.225	0.900		
0.075	1.00	0.1125	0.113		
PAN	7.00	0.038	0.263		
	100.00		127.388		

DEPTH : 25.00 - 28.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	6.00	4.75	28.500		
2.000	6.00	3.375	20.250		
0.425	59.00	1.2125	71.538	1.268	**1.982**
0.300	13.00	0.3625	4.713		
0.150	6.00	0.225	1.350		
0.075	1.00	0.1125	0.113		
PAN	9.00	0.038	0.338		
	100.00		126.800		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 10

DEPTH : 28.00 - 31.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	6.00	4.75	28.500		
2.000	7.00	3.375	23.625		
0.425	60.00	1.2125	72.750	1.315	**2.018**
0.300	13.00	0.3625	4.713		
0.150	7.00	0.225	1.575		
0.075	1.00	0.1125	0.113		
PAN	6.00	0.038	0.225		
	100.00		131.500		

DEPTH : 31.00 - 36.00 m

C = 2.15 kg/cm2 fi = 4 degree

Ksf = f (1 + sqrt (c))

f = 1.5 for fi > 10 and <15

f = 1.75 for fi > 5 and <10

f = 2.0 for fi <5

Silt Factor = 4.933

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 11

DEPTH : 0.00 - 1.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	21.00	1.2125	25.463	0.435	**1.160**
0.300	20.00	0.3625	7.250		
0.150	25.00	0.225	5.625		
0.075	7.00	0.1125	0.788		
PAN	26.00	0.038	0.975		
	100.00		43.475		

DEPTH : 1.00 - 2.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.750	0.000		
2.000	1.00	3.375	3.375		
0.425	26.00	1.213	31.525	0.490	**1.232**
0.300	20.00	0.363	7.250		
0.150	24.00	0.225	5.400		
0.075	5.00	0.113	0.563		
PAN	24.00	0.038	0.900		
	100.00		49.013		

DEPTH : 2.00 - 3.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	3.00	1.2125	3.638	0.196	**0.778**
0.300	7.00	0.3625	2.538		
0.150	27.00	0.225	6.075		
0.075	35.00	0.1125	3.938		
PAN	27.00	0.038	1.013		
	100.00		19.563		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 11

DEPTH : 3.00 - 6.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	2.00	1.2125	2.425	0.110	**0.582**
0.300	2.00	0.3625	0.725		
0.150	3.00	0.225	0.675		
0.075	4.00	0.1125	0.450		
PAN	88.00	0.038	3.300		
	100.00		10.950		

DEPTH : 6.00 - 9.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	2.00	4.75	9.500		
2.000	3.00	3.375	10.125		
0.425	49.00	1.2125	59.413	0.912	**1.680**
0.300	24.00	0.3625	8.700		
0.150	13.00	0.225	2.925		
0.075	2.00	0.1125	0.225		
PAN	7.00	0.038	0.263		
	100.00		91.150		

DEPTH : 9.00 - 12.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	3.00	3.375	10.125		
0.425	62.00	1.2125	75.175	1.135	**1.875**
0.300	20.00	0.3625	7.250		
0.150	8.00	0.225	1.800		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		113.538		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 11

DEPTH : 12.00 - 14.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	7.00	4.75	33.250		
2.000	4.00	3.375	13.500		
0.425	60.00	1.2125	72.750	1.283	**1.994**
0.300	19.00	0.3625	6.888		
0.150	8.00	0.225	1.800		
0.075	1.00	0.1125	0.113		
PAN	1.00	0.038	0.038		
	100.00		128.338		

DEPTH : 14.00 - 15.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
20.000	51.50	20	1030.000		
16.500	11.50	18.25	209.875		
12.500	17.75	14.5	257.375		
10.000	2.50	11.25	28.125		
4.750	0.75	7.375	5.531		
2.000	2.25	3.375	7.594		
0.425	11.50	1.2125	13.944	15.529	**6.936**
0.300	0.75	0.3625	0.272		
0.150	0.50	0.225	0.113		
0.075	0.25	0.1125	0.028		
PAN	0.75	0.038	0.028		
	100.00		1552.884		

DEPTH : 15.00 - 18.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	17.50	4.75	83.125		
2.000	21.00	3.375	70.875		
0.425	53.00	1.2125	64.263	2.201	**2.611**
0.300	4.00	0.3625	1.450		
0.150	1.00	0.225	0.225		
0.075	0.50	0.1125	0.056		
PAN	3.00	0.038	0.113		
	100.00		220.106		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 11

DEPTH : 18.00 - 19.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	9.00	4.75	42.750		
2.000	14.50	3.375	48.938		
0.425	67.50	1.2125	81.844	1.762	**2.336**
0.300	5.50	0.3625	1.994		
0.150	2.50	0.225	0.563		
0.075	0.50	0.1125	0.056		
PAN	0.50	0.038	0.019		
	100.00		176.163		

DEPTH : 19.00 - 21.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	7.00	3.375	23.625		
0.425	55.00	1.2125	66.688	1.178	**1.910**
0.300	15.00	0.3625	5.438		
0.150	11.00	0.225	2.475		
0.075	3.00	0.1125	0.338		
PAN	5.00	0.038	0.188		
	100.00		117.750		

DEPTH : 21.00 - 24.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	9.00	4.75	42.750		
2.000	7.00	3.375	23.625		
0.425	53.00	1.2125	64.263	1.379	**2.066**
0.300	12.50	0.3625	4.531		
0.150	10.00	0.225	2.250		
0.075	1.50	0.1125	0.169		
PAN	7.00	0.038	0.263		
	100.00		137.850		

INDIAN GEOTECHNICAL SERVICES

DETERMINATION OF SILT FACTOR

PROJECT : GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF IMPORTANT DFCC BRIDGE ACROSS RIVER SONE (APPX LENGTH 3.06 KMS AND TENTATIVE SPAN 93x30.48m) ON NORTH SIDE OF NEW IR SONE BRIDGE FOR DOUBLE TRACK OF DFCC RAILWAY LINE BETWEEN SONE NAGAR (RLY KM 549.043) AND DEHRI-ON-SONE (RLY KM 554.806) RAILWAY STATIONS ON MUGHALSARAI - SONE NAGAR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

BORE HOLE NO. : 11

DEPTH : 24.00 - 27.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	3.00	4.75	14.250		
2.000	10.00	3.375	33.750		
0.425	75.00	1.2125	90.938	1.421	**2.098**
0.300	7.00	0.3625	2.538		
0.150	2.00	0.225	0.450		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		142.113		

DEPTH : 27.00 - 28.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	0.00	4.75	0.000		
2.000	1.00	3.375	3.375		
0.425	67.00	1.2125	81.238	0.912	**1.680**
0.300	10.00	0.3625	3.625		
0.150	10.00	0.225	2.250		
0.075	3.00	0.1125	0.338		
PAN	9.00	0.038	0.338		
	100.00		91.163		

DEPTH : 28.00 - 30.00 m

SIEVE SIZE (mm)	PERCENTAGE RETAINED	AVERAGE SIZE OF SIEVE	2 X 3	MEAN DIAMETER (Dm), mm	SILT FACTOR, f
1	2	3	4	4/100	
4.750	4.00	4.75	19.000		
2.000	8.00	3.375	27.000		
0.425	71.00	1.2125	86.088	1.367	**2.057**
0.300	9.00	0.3625	3.263		
0.150	5.00	0.225	1.125		
0.075	1.00	0.1125	0.113		
PAN	2.00	0.038	0.075		
	100.00		136.663		

Design of Pile Foundation at Pier

Estimation of Vertical Compressive Load Bearing Capacity of "Concrete Pile"

[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure	River Bridge	Structure No	-	Location (Chainage in km)	Sone River Bridge	Based on Bore Hole	BH - 5		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Factor of Safety for Shaft Friction	2.5	River or Stream Bed Level / Ground Level (m)	99.570	Ground Water Level (m)	99.570	Pile Cut - off Level (m)	97.770
Pile Diameter (mm)	1200	Earth Pressure Coefficient, K_o	1.0	Factor of Safety for Base Resistance	2.5	Scour Level (m)	77.274	Pile Cap Top Level (m)	99.570	Pile Tip Level (m)	51.770

Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip $'q_{dp}'$ (t/m^2)	Bearing Capacity Factors			Ultimate Base Resistance, $P_{pu} = A_p * (c.N_c + q.N_q + 0.5.\gamma.B.N_\gamma)$					Ultimate Shaft Friction, $P_{su} = (\Sigma(K_s.P_{dl}.Tan\delta).A_{si} + \alpha.c.A_s)$						Total Ultimate Capacity, P_u $[P_u = (P_{pu} + P_{su})]$ (Tonnes)	Self Weight of Pile, W_p (Tonnes)	Total Safe Capacity, P_s $P_s = [(P_{pu} / FOS + P_{su} / FOS) - W_p / FOS]$ (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
										N_c	N_q	N_γ	A_p (m^2)	$c.N_c$	$q.N_q$	$0.5.\gamma.B.N_\gamma$	P_{pu} (tonnes)	Effective Over-burden Pressure at c.g of the layer $'P_{dl}'$ (t/m^2)	A_{si} (m^2)	$(K_s.P_{dl}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_{si}$	P_{su}					
1	Scourable	77.274	77.274	0.00																					34.8		0.00	20.50
2	Hard Clayey Silt / Silty Clay	77.274	58.570	18.70	22.50	0.0	0.0	1.00	18.00	9.00	1.00	0.00	1.13	202.50	18.00	0.00	249.38	9.35	70.51	0.00	0.30	475.96	475.96	725.3	66.5	263.5	18.70	39.2
3	Dense Sand	58.570	55.770	2.80	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	10.56	87.59	0.00	0.00	563.55	1296.4	71.3	490.1	21.50	42.0
4	Dense Sand	55.770	53.770	2.00	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	7.54	62.57	0.00	0.00	626.12	1359.0	74.6	513.7	23.50	44.0
5	Dense Sand	53.770	51.770	2.00	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	7.54	62.57	0.00	0.00	688.68	1421.5	78.0	537.4	25.50	46.0

Design of Pile Foundation at Pier
Estimation of Vertical Tensile / Uplift Capacity of "Concrete Pile"
[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure & Chainage	River Bridge	River or Stream Bed Level / Ground Level (m)	99.570	Based on Bore Hole	BH - 5
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Scour Level (m)	77.274	Ground Water Level (m)	99.570
Pile Diameter (mm)	1200	Earth Pressure Coefficient, K_s	1.0	Factor of Safety on Uplift Load	2.5	Pile Cap Top Level (m)	99.570

										Ultimate Shaft Friction in Tensile / Uplift Condition, $P_{su} = (1/2).(\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s)$										
Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip 'q_{tip}' (t/m^2)	Effective Over-burden Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_s$	P_{su}	Self Weight of Pile, W_p (Tonnes)	Total Ultimate Capacity, P_u [P_u = (Wp + P_{su})] (Tonnes)	Total Safe Capacity, P_s P_s = [P_{su} / FOS + W_p / FOS] (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
1	Scourable	77.274	77.274	0.00	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.8	34.8	13.9	0.00	20.50
2	Hard Clayey Silt / Silty Clay	77.274	58.570	18.70	22.50	0.0	0.0	1.00	18.00	9.35	70.51	0.00	0.30	475.96	333.17	66.5	399.7	159.9	18.70	39.20
3	Dense Sand	58.570	55.770	2.80	0.00	33.0	24.8	1.00	18.00	18.00	10.56	87.59	0.00	0.00	394.49	71.3	465.7	186.3	21.50	42.00
4	Dense Sand	55.770	53.770	2.00	0.00	33.0	24.8	1.00	18.00	18.00	7.54	62.57	0.00	0.00	438.28	74.6	512.9	205.2	23.50	44.00
5	Dense Sand	53.770	51.770	2.00	0.00	33.0	24.8	1.00	18.00	18.00	7.54	62.57	0.00	0.00	482.08	78.0	560.1	224.0	25.50	46.00

Lateral Load Capacity of Pile
[As per IS : 2911(Part 1/Sec 2):2010, Second Revision and IRC : 78]

Project Name :	Major DFCC River Bridge over Sone	**Str. No. / Str. Name :**	Sone River Bridge
Related Bore Hole :	BH - 5	**Chainage (km) :**	--

A) PILE DETAILS :

1)	Type of Pile	=	Bored Cast- in-Situ		
2)	Diameter of Pile **(D)**	=	120	cm	
3)	Existing Ground Level	=	99.57	m	
4)	Pile Cut-off Level	=	97.770	m	
5)	Maximum Scour / Liquefiable Level / Soft Soil	=	77.274	m	
6)	Minimum Length of Pile to be long pile	=	34.000		
7)	Pile Tip Level	=	63.770	m	
8)	Grade of Concrete **(M)**	=	M 35		
9)	Moment of Inertia of Pile **(I)**	=	10178760.20	cm^4	
10)	Pile Modulus of Elasticity **(E)**	=	315000	kg/cm^2	As per IRC : 21 - 2000, Clause No. 303.1, Table 9
11)	Pile length above scour / liquefiable level **(L_1)**	=	2049.6	cm	

B) SOIL PARAMETERS :

1)	Soil Type (Clay/ Silt/ Sand)	=	Clay		Nature of Prominant / Major Soil Strata along the Pile Shaft
2)	Cohesion of Soil **(c)**	=	2.25	kg/cm^2	
3)	Unconfined compressive strength of Soil **(s_u)**	=	4.5	kg/cm^2	
4)	Modulus of subgrade reaction for cohesive soil, k_1	=	7.3	kg/cm^3	
4)	In-situ Effective Unit Weight of Soil **(γ)**	=	0.001	kg/cm^3	
5)	Angle of Shear Resistance of Soil **(ϕ)**	=	0	deg.	
6)	Angle of Shear Resistance of Soil **(ϕ)**	=	0.000	rad.	
7)	Average corrected "N" value	=	50.0		
8)	Compactness of strata	=	-		
9)	Preconsolidation Pressure for Clayey Starta **(p_c)**	=	-	kg/cm^2	
10)	Initial Overburden Pressure **(p_0)**	=	1.70	kg/cm^2	
11)	State of Consolidation (N.C./ P.C.)	=	P.C.		
12)	Condition of Soil w.r.t. G.W.T (Submerged/ Dry)	=	Submerged		

C) OTHER PARAMETERS :

1)	Co-efficient of modulus variation for granular soil **(n_h)**	=	-	MN/m^3	As per "Table **3** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Modulus of Subgrade Reaction for Cohesive Soil **(k_1)**	=	7.30	kg/cm^3	As per "Table **4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
3)	Modulus of horizontal subgrade reaction $K = [(k_1*0.3/1.5*B)]$	=	1.217	kg/cm^3	
4)	Stiffness Factor for P.C. Cohesive Soil (R)	=	384.9578	cm	
5)	Stiffness Factor for N.C.clay and NonCohesive Soil (T)	=	0	m	
6)	Embedded Pile Length **(L_e)**	=	13.50	m	**OK as Long Flexible Pile**
7)	L_1 / R or L_1 / T	=	5.324		

Determination of Depth of Fixity

For FIXED Head Pile

1)	For Fixed Headed Pile : L_f / R or L_f / T	=	1.46		As per "**Fig. 4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Depth of Fixity for fixed headed pile **(L_{ffx})**	=	562.04	m	
3)	Depth of Fixity w.r.t. Pile Cap Bottom (Lffx = Lf + L1)		2611.64	m	

Determination of Lateral Load Capacity

1)	Pile Head Deflection at Pile Cut-off Level **(δ)**	=	4.20	cm	As Per The Allowable Limit
2)	Lateral Load Capacity for fixed headed pile **(Q_{fx})**	=	9.08	ton	
	Lateral Load Capacity of FIXED Head Pile		9.00	ton	

Design of Pile Foundation at Pier

Estimation of Vertical Compressive Load Bearing Capacity of "Concrete Pile"

[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure	River Bridge	Structure No	-	Location (Chainage in km)	Sone River Bridge	Based on Bore Hole	BH - 5
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Factor of Safety for Shaft Friction	2.5	River or Stream Bed Level / Ground Level (m)	99.570	Ground Water Level (m)	99.570
Pile Diameter (mm)	1500	Earth Pressure Coefficient, K_o	1.0	Factor of Safety for Base Resistance	2.5	Scour Level (m)	77.274	Pile Cap Top Level (m)	99.570

Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip 'q_{dp}' (t/m^2)	Bearing Capacity Factors			Ultimate Base Resistance, $P_{pu} = A_p * (c.N_c + q.N_q + 0.5.\gamma.B.N_\gamma)$					Ultimate Shaft Friction, $P_{su} = \Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s$						Total Ultimate Capacity, P_u [$P_u = (P_{pu} + P_{su})$] (Tonnes)	Self Weight of Pile, W_p (Tonnes)	Total Safe Capacity, P_s $P_s = [(P_{pu} / FOS + P_{su} / FOS) - W_p / FOS]$ (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
										N_c	N_q	N_γ	A_p (m^2)	$c.N_c$	$q.N_q$	$0.5.\gamma.B.N_\gamma$	P_{pu} (tonnes)	Effective Over-burden Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_{si}$	P_{su}					
1	Scourable	77.274	77.274	0.00																				53.0		0.00	20.00
2	Hard Clayey Silt / Silty Clay	77.274	58.570	18.70	22.50	0.0	0.0	1.00	18.70	9.00	1.00	0.00	1.77	202.50	18.70	0.00	390.90	9.35	88.14	0.00	0.30	594.95	594.95	985.8	102.6	353.3	18.70	38.7
3	Dense Sand	58.570	55.270	3.30	0.00	33.0	24.8	1.00	22.00	9.00	34.86	34.19	1.77	0.00	767.06	25.64	1400.82	20.35	15.55	145.92	0.00	0.00	740.87	2141.7	111.3	812.1	22.00	42.0
4	Dense Sand	55.270	53.270	2.00	0.00	33.0	24.8	1.00	22.50	9.00	34.86	34.19	1.77	0.00	784.35	25.64	1431.37	22.50	9.42	97.76	0.00	0.00	838.63	2270.0	116.6	861.3	24.00	44.0
5	Dense Sand	53.270	51.270	2.00	0.00	33.0	24.8	1.00	22.50	9.00	34.86	34.19	1.77	0.00	784.35	25.64	1431.37	22.50	9.42	97.76	0.00	0.00	936.39	2367.8	121.9	898.3	26.00	46.0

Design of Pile Foundation at Pier
Estimation of Vertical Tensile / Uplift Capacity of "Concrete Pile"
[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure & Chainage	River Bridge	River or Stream Bed Level / Ground Level (m)	99.570	Based on Bore Hole	BH - 5
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Scour Level (m)	77.274	Ground Water Level (m)	99.570
Pile Diameter (mm)	1500	Earth Pressure Coefficient, K_s	1.0	Factor of Safety on Uplift Load	2.5	Pile Cap Top Level (m)	99.570

										Ultimate Shaft Friction in Tensile / Uplift Condition, $P_{su} = (1/2).(\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s)$										
Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip 'q_{tip}' (t/m^2)	Effective Over-burden Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_s$	P_{su}	Self Weight of Pile, W_p (Tonnes)	Total Ultimate Capacity, P_u [P_u = (Wp + P_{su})] (Tonnes)	Total Safe Capacity, P_s P_s = [P_{su} / FOS + W_p / FOS] (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
1	Scourable	77.274	77.274	0.00	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.0	53.0		0.00	20.00
2	Hard Clayey Silt / Silty Clay	77.274	58.570	18.70	22.50	0.0	0.0	1.00	18.70	9.35	88.14	0.00	0.30	594.95	416.46	102.6	519.0		18.70	38.70
3	Dense Sand	58.570	55.270	3.30	0.00	33.0	24.8	1.00	22.00	20.35	15.55	145.92	0.00	0.00	518.61	111.3	629.9	252.0	22.00	42.00
4	Dense Sand	55.270	53.270	2.00	0.00	33.0	24.8	1.00	22.50	22.50	9.42	97.76	0.00	0.00	587.04	116.6	703.7	281.5	24.00	44.00
5	Dense Sand	53.270	51.270	2.00	0.00	33.0	24.8	1.00	22.50	22.50	9.42	97.76	0.00	0.00	655.47	121.9	777.4	311.0	26.00	46.00

Lateral Load Capacity of Pile
[As per IS : 2911(Part 1/Sec 2):2010, Second Revision and IRC : 78]

Project Name :	Major DFCC River Bridge over Sone	**Str. No. / Str. Name :**	Sone River Bridge
Related Bore Hole :	BH - 5	**Chainage (km) :**	--

A)	**PILE DETAILS :**				
1)	Type of Pile	=	Bored Cast- in-Situ		
2)	Diameter of Pile **(D)**	=	150	cm	
3)	Existing Ground Level	=	99.57	m	
4)	Pile Cut-off Level	=	97.270	m	
5)	Maximum Scour / Liquefiable Level / Soft Soil	=	77.274	m	
6)	Minimum Length of Pile to be long pile	=	35.000		
7)	Pile Tip Level	=	62.270	m	
8)	Grade of Concrete **(M)**	=	M 35		
9)	Moment of Inertia of Pile **(I)**	=	24850488.76	cm^4	
10)	Pile Modulus of Elasticity **(E)**	=	315000	kg/cm^2	As per IRC : 21 - 2000, Clause No. 303.1, Table 9
11)	Pile length above scour / liquefiable level **(L_1)**	=	1999.6	cm	
B)	**SOIL PARAMETERS :**				
1)	Soil Type (Clay/ Silt/ Sand)	=	Clay		Nature of Prominant / Major Soil Strata along the Pile Shaft
2)	Cohesion of Soil **(c)**	=	2.25	kg/cm^2	
3)	Unconfined compressive strength of Soil **(s_u)**	=	4.5	kg/cm^2	
4)	Modulus of subgrade reaction for cohesive soil, k_1	=	7.3	kg/cm^3	
4)	In-situ Effective Unit Weight of Soil **(γ)**	=	0.001	kg/cm^3	
5)	Angle of Shear Resistance of Soil **(ϕ)**	=	0	deg.	
6)	Angle of Shear Resistance of Soil **(ϕ)**	=	0.000	rad.	
7)	Average corrected "N" value	=	50.0		
8)	Compactness of strata	=	-		
9)	Preconsolidation Pressure for Clayey Starta **(p_c)**	=	-	kg/cm^2	
10)	Initial Overburden Pressure **(p_0)**	=	1.75	kg/cm^2	
11)	State of Consolidation (N.C./ P.C.)	=	P.C.		
12)	Condition of Soil w.r.t. G.W.T (Submerged/ Dry)	=	Submerged		
C)	**OTHER PARAMETERS :**				
1)	Co-efficient of modulus variation for granular soil **(n_h)**	=	-	MN/m^3	As per "Table **3** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Modulus of Subgrade Reaction for Cohesive Soil **(k_1)**	=	7.30	kg/cm^3	As per "Table **4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
3)	Modulus of horizontal subgrade reaction K = [(k_1*0.3/1.5*B)]	=	0.973	kg/cm^3	
4)	Stiffness Factor for P.C. Cohesive Soil (R)	=	481.1973	cm	
5)	Stiffness Factor for N.C.clay and NonCohesive Soil (T)	=	0	m	
6)	Embedded Pile Length **(L_e)**	=	15.00	m	**Not OK as Long Flexible Pile**
7)	L_1 / R or L_1 / T	=	4.155		

Determination of Depth of Fixity

For FIXED Head Pile

1)	For Fixed Headed Pile : L_f / R or L_f / T	=	1.48		As per "**Fig. 4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Depth of Fixity for fixed headed pile **(L_{ffx})**	=	712.17	m	
3)	Depth of Fixity w.r.t. Pile Cap Bottom (Lffx = Lf + L1)		2711.77	m	

Determination of Lateral Load Capacity

1)	Pile Head Deflection at Pile Cut-off Level **(δ)**	=	2.93	cm	As Per The Allowable Limit
2)	Lateral Load Capacity for fixed headed pile **(Q_{fx})**	=	13.80	ton	
	Lateral Load Capacity of FIXED Head Pile		13.00	ton	

Design of Pile Foundation at AButment

Estimation of Vertical Compressive Load Bearing Capacity of "Concrete Pile"

[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure	River Bridge	Structure No	-	Location (Chainage in km)	Sone River Bridge	Based on Bore Hole	BH - 11
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Factor of Safety for Shaft Friction	2.5	River or Stream Bed Level / Ground Level (m)	102.380	Ground Water Level (m)	102.380
Pile Diameter (mm)	1200	Earth Pressure Coefficient, K_s	1.0	Factor of Safety for Base Resistance	2.5	Scour Level (m)	86.837	Pile Cap Top Level (m)	102.380

Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip $'q_{tip}'$ (t/m^2)	Bearing Capacity Factors			Ultimate Base Resistance, $P_{pu} = A_p * (c.N_c + q.N_q + 0.5\gamma.B.N_\gamma)$					Ultimate Shaft Friction, $P_{su} = (\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_{si})$						Total Ultimate Capacity, P_u $[P_u = (P_{pu} + P_{su})]$ (Tonnes)	Self Weight of Pile, W_p (Tonnes)	Total Safe Capacity, P_s $P_s = [(P_{pu} / FOS + P_{su} / FOS) - W_p / FOS]$ (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
										N_c	N_q	N_γ	A_p (m^2)	$c.N_c$	$q.N_q$	$0.5\gamma.B.N_\gamma$	P_{pu} (tonnes)	Effective Over-burden Pressure at c.g of the layer $'P_{di}'$ (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_{si}$	P_{su}					
1	Scourable	86.837	86.837	0.00															0.00	0.00					23.3		0.00	13.7
2	Dense Gravelly Sand / Sandy Gravel	86.837	78.380	8.46	0.00	33.0	24.8	1.00	8.46	9.00	34.86	34.19	1.13	0.00	294.81	20.51	356.62	4.23	31.88	62.15	0.00	0.00	62.15	418.8	37.7		8.46	22.2
3	Dense Gravelly Sand / Sandy Gravel	78.380	72.380	6.00	0.00	33.0	24.8	1.00	14.46	9.00	34.86	34.19	1.13	0.00	503.97	20.51	593.18	11.46	22.62	119.47	0.00	0.00	181.62	774.8	47.8		14.46	28.2
4	Hard Clayey Silt / Silty Clay	72.380	71.380	1.00	18.00	0.0	0.0	1.00	15.46	9.00	1.00	0.00	1.13	162.00	15.46	0.00	200.70	14.96	3.77	0.00	0.30	20.36	201.98	402.7	49.5		15.46	29.2
5	Dense Fine to Medium Sand	71.380	68.380	3.00	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	16.96	11.31	88.41	0.00	0.00	290.39	1023.3	54.6		18.46	32.2
6	Hard Clayey Silt / Silty Clay	68.380	66.380	2.00	15.50	0.0	0.0	1.00	18.00	9.00	1.00	0.00	1.13	139.50	18.00	0.00	178.13	18.00	7.54	0.00	0.30	35.06	325.45	503.6	58.0		20.46	34.2
7	Hard Clayey Silt / Silty Clay	66.380	63.380	3.00	20.00	0.0	0.0	1.00	18.00	9.00	1.00	0.00	1.13	180.00	18.00	0.00	223.93	18.00	11.31	0.00	0.30	67.86	393.31	617.2	63.1		23.46	37.2
8	Dense Sand	63.380	62.380	1.00	0.00	32.0	24.0	1.00	18.00	9.00	28.88	30.22	1.13	0.00	519.84	18.13	608.43	18.00	3.77	30.21	0.00	0.00	423.52	1032.0	64.8	386.9	24.46	38.2
9	Dense Sand	62.380	60.580	1.80	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	6.79	56.31	0.00	0.00	479.83	1212.7	67.9	457.9	26.26	40.0
10	Dense Sand	60.580	58.580	2.00	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	7.54	62.57	0.00	0.00	542.40	1275.3	71.3	481.6	28.26	42.0
11	Dense Sand	58.580	56.580	2.00	0.00	33.0	24.8	1.00	18.00	9.00	34.86	34.19	1.13	0.00	627.48	20.51	732.86	18.00	7.54	62.57	0.00	0.00	604.96	1337.8	74.6	505.3	30.26	44.0

Design of Pile Foundation at Abutment
Estimation of Vertical Tensile / Uplift Capacity of "Concrete Pile"
[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure & Chainage	River Bridge	River or Stream Bed Level / Ground Level (m)	102.380	Based on Bore Hole	BH - 11
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Scour Level (m)	86.837	Ground Water Level (m)	102.380
Pile Diameter (mm)	1200	Earth Pressure Coefficient, K_s	1.0	Factor of Safety on Uplift Load	2.5	Pile Cap Top Level (m)	102.380

										Ultimate Shaft Friction in Tensile / Uplift Condition, $P_{su} = (1/2).(\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s)$										
Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip 'q_{tip}' (t/m^2)	Effective Over-burden Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_s$	P_{su}	Self Weight of Pile, W_p (Tonnes)	Total Ultimate Capacity, P_u [P_u = (Wp + P_{su})] (Tonnes)	Total Safe Capacity, P_s P_s = [P_{su} / FOS + W_p / FOS] (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
1	Scourable	86.837	86.837	0.00	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.3	23.3		0.00	13.74
2	Dense Gravelly Sand / Sandy Gravel	86.837	78.380	8.46	0.00	33.0	24.8	1.00	8.46	4.23	31.88	62.15	0.00	0.00	43.50	37.7	81.2		8.46	22.20
3	Dense Gravelly Sand / Sandy Gravel	78.380	72.380	6.00	0.00	33.0	24.8	1.00	14.46	11.46	22.62	119.47	0.00	0.00	127.13	47.8	175.0		14.46	28.20
4	Hard Clayey Silt / Silty Clay	72.380	71.380	1.00	18.00	0.0	0.0	1.00	15.46	14.96	3.77	0.00	0.30	20.36	141.38	49.5	190.9		15.46	29.20
5	Dense Fine to Medium Sand	71.380	68.380	3.00	0.00	33.0	24.8	1.00	18.00	16.96	11.31	88.41	0.00	0.00	203.27	54.6	257.9		18.46	32.20
6	Hard Clayey Silt / Silty Clay	68.380	66.380	2.00	15.50	0.0	0.0	1.00	18.00	18.00	7.54	0.00	0.30	35.06	227.81	58.0	285.8		20.46	34.20
7	Hard Clayey Silt / Silty Clay	66.380	63.380	3.00	20.00	0.0	0.0	1.00	18.00	18.00	11.31	0.00	0.30	67.86	275.32	63.1	338.4		23.46	37.20
8	Dense Sand	63.380	62.380	1.00	0.00	32.0	24.0	1.00	18.00	18.00	3.77	30.21	0.00	0.00	296.46	64.8	361.3		24.46	38.20
9	Dense Sand	62.380	60.580	1.80	0.00	33.0	24.8	1.00	18.00	18.00	6.79	56.31	0.00	0.00	335.88	67.9	403.7	161.5	26.26	40.00
10	Dense Sand	60.580	58.580	2.00	0.00	33.0	24.8	1.00	18.00	18.00	7.54	62.57	0.00	0.00	379.68	71.3	450.9	180.4	28.26	42.00
11	Dense Sand	58.580	56.580	2.00	0.00	33.0	24.8	1.00	18.00	18.00	7.54	62.57	0.00	0.00	423.47	74.6	498.1	199.2	30.26	44.00

Lateral Load Capacity of Pile
[As per IS : 2911(Part 1/Sec 2):2010, Second revision and IRC : 78]

Project Name :	Major DFCC River Bridge over Sone	**Str. No. / Str. Name :**	Sone River Bridge
Related Bore Hole :	BH - 11	**Chainage (km) :**	-

A)	**PILE DETAILS :**				
1)	Type of Pile	=	Bored Cast- in-Situ		
2)	Diameter of Pile **(D)**	=	120	cm	
3)	Existing Ground Level	=	102.380	m	
4)	Pile Cut-off Level	=	100.580	m	15.543
5)	Maximum Scour Level / Loose / Soft soil	=	86.837	m	
6)	Minimum Length of Pile to be long pile	=	29.000	m	
7)	Pile Tip Level	=	71.580	m	
8)	Grade of Concrete **(M)**	=	M 35		
9)	Moment of Inertia of Pile **(I)**	=	10178760.20	cm^4	
10)	Pile Modulus of Elasticity **(E)**	=	315000	kg/cm^2	As per IRC : 21 - 2000, Clause No. 303.1, Table 9
11)	Pile length above G.L **(L_1)**	=	1374.3	cm	
B)	**SOIL PARAMETERS :**				
1)	Soil Type (Clay/ Silt/ Sand)	=	Sand		Nature of Prominant / Major Soil Strata along the Pile Shaft
2)	Cohesion of Soil **(c)**	=	0	kg/cm^2	
3)	Unconfined compressive strength of Soil **(s_u)**	=	0	kg/cm^2	
4)	In-situ Effective Unit Weight of Soil **(γ)**	=	0.001	kg/cm^3	
5)	Angle of Shear Resistance of Soil **(ϕ)**	=	33		
6)	Angle of Shear Resistance of Soil **(ϕ)**	=	0.576	deg.	
7)	Average corrected "N" value	=	28		
8)	Compactness of strata	=	Medium		
9)	Preconsolidation Pressure for Clayey Starta **(p_c)**	=	-		
10)	Initial Overburden Pressure **(p_0)**	=	1.45	kg/cm^2	
11)	State of Consolidation (N.C./ P.C.)	=	-	kg/cm^2	
12)	Condition of Soil w.r.t. G.W.T (Submerged/ Dry)	=	Submerged		
C)	**OTHER PARAMETERS :**				
1)	Modulus of Subgrade Reaction for granular soil (n_h)	=	0.40	kg/cm^3	As per "Table **3** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Modulus of Subgrade Reaction for Cohesive Soil **(k_1)**	=	-	kg/cm^3	As per "Table **4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
3)	Stiffness Factor for P.C. Cohesive Soil (R)	=	0	m	
4)	Stiffness Factor for N.C.clay and NonCohesive Soil (T)	=	381.03	cm	
5)	Embedded Pile Length **(L_e)**	=	15.26	m	**OK as Long Flexible Pile**
6)	L_1 / R or L_1 / T	=	3.607		
	Determination of Depth of Fixity				
1)	For Fixed Headed Pile : L_f / R or L_f / T	=	1.87		As per "**Fig. 2** in Appendix C under Amendment No. 3" of IS:2911(Part I/Sec 2)
2)	Depth of Fixity for fixed head pile **(L_f)**	=	712.53	cm	
3)	Depth of Fixity w.r.t. Pile Cap Bottom **($L_{ffx} = L_f + L_1$)**	=	2086.83	cm	
	Determination of Lateral Load Capacity				
1)	Pile Head Deflection at Pile Cut-off Level **(δ)**	=	1.85	cm	
2)	Lateral Load Capacity for fixed headed pile **(Q_{fx})**	=	7.84	ton	As Per The Allowable Limit
	Recommended Lateral Load Capacity of Pile	=	**7.5**	ton	

Design of Pile Foundation at Abutment

Estimation of Vertical Compressive Load Bearing Capacity of "Concrete Pile"

[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure	River Bridge	Structure No	-	Location (Chainage in km)	Sone River Bridge
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Factor of Safety for Shaft Friction	2.5	River or Stream Bed Level / Ground Level (m)	102.380
Pile Diameter (mm)	1500	Earth Pressure Coefficient, K_s	1.0	Factor of Safety for Base Resistance	2.5	Scour Level (m)	86.837

Based on Bore Hole	BH - 11						
Ground Water Level (m)	102.380	Pile Cut - off Level (m)	100.080				
Pile Cap Top Level (m)	102.380	Pile Tip Level (m)	56.080				

Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip $'q_{tip}'$ (t/m^2)	Bearing Capacity Factors			Ultimate Base Resistance, $P_{pu} = A_p * (c.N_c + q.N_q + 0.5.\gamma.B.N_\gamma)$					Ultimate Shaft Friction, $P_{su} = (\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s)$						Total Ultimate Capacity, P_u $[P_u = (P_{pu} + P_{su})]$ (Tonnes)	Self Weight of Pile, W_p (Tonnes)	Total Safe Capacity, P_s $P_s = [(P_{pu} / FOS + P_{su} / FOS) - W_p / FOS]$ (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
										N_c	N_q	N_γ	A_p (m^2)	$c.N_c$	$q.N_q$	$0.5.\gamma.B.N_\gamma$	P_{pu} (tonnes)	Effective Over-burden Pressure at c.g of the layer $'P_{di}'$ (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_{si}$	P_{su}					
1	Scourable	86.837	86.837	0.00			0.0												0.00	0.00					35.1		0.00	13.2
2	Dense Gravelly Sand / Sandy Gravel	86.837	78.380	8.46	0.00	33.0	24.8	1.00	8.46	9.00	34.86	34.19	1.77	0.00	294.81	25.64	566.29	4.23	39.85	77.69	0.00	0.00	77.69	644.0	57.5		8.46	21.7
3	Dense Gravelly Sand / Sandy Gravel	78.380	72.380	6.00	0.00	34.0	25.5	1.00	14.46	9.00	42.08	41.06	1.77	0.00	608.35	30.80	1129.46	11.46	28.27	154.51	0.00	0.00	232.20	1361.7	73.4		14.46	27.7
4	Hard Clayey Silt / Silty Clay	72.380	71.380	1.00	18.00	0.0	0.0	1.00	15.46	9.00	1.00	0.00	1.77	162.00	15.46	0.00	313.59	14.96	4.71	0.00	0.30	25.45	257.65	571.2	76.1		15.46	28.7
5	Dense Fine to Medium Sand	71.380	68.380	3.00	0.00	33.0	24.8	1.00	18.46	9.00	34.86	34.19	1.77	0.00	643.41	25.64	1182.32	16.96	14.14	110.51	0.00	0.00	368.16	1550.5	84.0		18.46	31.7
6	Hard Clayey Silt / Silty Clay	68.380	66.380	2.00	15.50	0.0	0.0	1.00	20.46	9.00	1.00	0.00	1.77	139.50	20.46	0.00	282.67	19.46	9.42	0.00	0.30	43.83	411.98	694.7	89.3		20.46	33.7
7	Hard Clayey Silt / Silty Clay	66.380	63.380	3.00	20.00	0.0	0.0	1.00	22.50	9.00	1.00	0.00	1.77	180.00	22.50	0.00	357.85	21.96	14.14	0.00	0.30	84.82	496.81	854.7	97.3		23.46	36.7
8	Dense Sand	63.380	62.380	1.00	0.00	32.0	24.0	1.00	22.50	9.00	28.88	30.22	1.77	0.00	649.80	22.67	1188.34	22.50	4.71	47.21	0.00	0.00	544.01	1732.4	99.9	653.0	24.46	37.7
9	Dense Sand	62.380	60.080	2.30	0.00	33.0	24.8	1.00	22.50	9.00	34.86	34.19	1.77	0.00	784.35	25.64	1431.37	22.50	10.84	112.42	0.00	0.00	656.44	2087.8	106.0	792.7	26.76	40.0
10	Dense Sand	60.080	58.080	2.00	0.00	33.0	24.8	1.00	22.50	9.00	34.86	34.19	1.77	0.00	784.35	25.64	1431.37	22.50	9.42	97.76	0.00	0.00	754.20	2185.6	111.3	829.7	28.76	42.0
11	Dense Sand	58.080	56.080	2.00	0.00	33.0	24.8	1.00	22.50	9.00	34.86	34.19	1.77	0.00	784.35	25.64	1431.37	22.50	9.42	97.76	0.00	0.00	851.96	2283.3	116.6	866.7	30.76	44.0

Design of Pile Foundation at Abutment
Estimation of Vertical Tensile / Uplift Capacity of "Concrete Pile"
[As per IS : 2911(Part 1) and IRC : 78]

Name of Project	DFCC CORRIDOR	Type of Structure & Chainage	River Bridge	River or Stream Bed Level / Ground Level (m)	102.380	Based on Bore Hole	BH - 11
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of Pile with Vertical Axis (deg)	0	Scour Level (m)	86.837	Ground Water Level (m)	102.380
Pile Diameter (mm)	1500	Earth Pressure Coefficient, K_s	1.0	Factor of Safety on Uplift Load	2.5	Pile Cap Top Level (m)	102.380

										Ultimate Shaft Friction in Tensile / Uplift Condition, $P_{su} = (1/2).(\Sigma(K_s.P_{di}.Tan\delta).A_{si} + \alpha.c.A_s)$									
Layer No	Type of SubSoil Layer	RL of Layer Top	RL of Layer Bottom	Thickness of Layer (m)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)	Angle of Wall Friction, δ (deg)	Total / Submerged Unit Weight of Soil (t/m^3)	Effective Over-burden Pressure at Pile Tip 'q_{tip}' (t/m^2)	Effective Over-burden Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s.P_{di}.Tan\delta).A_{si}$	Adhesion Factior, α	$\alpha.c.A_s$	P_{su}	Self Weight of Pile, W_p (Tonnes)	Total Ultimate Capacity, P_u [P_u = (Wp + P_{su})] (Tonnes)	Total Safe Capacity, P_s P_s = [P_{su} / FOS + W_p / FOS] (Tonnes)	Pile Length below MSL (m)	Pile Length below COL (m)
1	Scourable	86.837	86.837	0.00	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.1	35.1		0.00	13.24
2	Dense Gravelly Sand / Sandy Gravel	86.837	78.380	8.46	0.00	33.0	24.8	1.00	8.46	4.23	39.85	77.69	0.00	0.00	54.38	57.5	111.9		8.46	21.70
3	Dense Gravelly Sand / Sandy Gravel	78.380	72.380	6.00	0.00	34.0	25.5	1.00	14.46	11.46	28.27	154.51	0.00	0.00	162.54	73.4	236.0		14.46	27.70
4	Hard Clayey Silt / Silty Clay	72.380	71.380	1.00	18.00	0.0	0.0	1.00	15.46	14.96	4.71	0.00	0.30	25.45	180.35	76.1	256.4		15.46	28.70
5	Dense Fine to Medium Sand	71.380	68.380	3.00	0.00	33.0	24.8	1.00	18.46	16.96	14.14	110.51	0.00	0.00	257.71	84.0	341.7		18.46	31.70
6	Hard Clayey Silt / Silty Clay	68.380	66.380	2.00	15.50	0.0	0.0	1.00	20.46	19.46	9.42	0.00	0.30	43.83	288.39	89.3	377.7		20.46	33.70
7	Hard Clayey Silt / Silty Clay	66.380	63.380	3.00	20.00	0.0	0.0	1.00	22.50	21.96	14.14	0.00	0.30	84.82	347.77	97.3	445.0		23.46	36.70
8	Dense Sand	63.380	62.380	1.00	0.00	32.0	24.0	1.00	22.50	22.50	4.71	47.21	0.00	0.00	380.81	99.9	480.7		24.46	37.70
9	Dense Sand	62.380	60.080	2.30	0.00	33.0	24.8	1.00	22.50	22.50	10.84	112.42	0.00	0.00	459.51	106.0	565.5	226.2	26.76	40.00
10	Dense Sand	60.080	58.080	2.00	0.00	33.0	24.8	1.00	22.50	22.50	9.42	97.76	0.00	0.00	527.94	111.3	639.3	255.7	28.76	42.00
11	Dense Sand	58.080	56.080	2.00	0.00	33.0	24.8	1.00	22.50	22.50	9.42	97.76	0.00	0.00	596.37	116.6	713.0	285.2	30.76	44.00

Lateral Load Capacity of Pile
[As per IS : 2911(Part 1/Sec 2):2010, Second revision and IRC : 78]

Project Name :	Major DFCC River Bridge over Sone	**Str. No. / Str. Name :**	Sone River Bridge
Related Bore Hole :	BH - 11	**Chainage (km) :**	-

A)	**PILE DETAILS :**				
1)	Type of Pile	=	Bored Cast- in-Situ		
2)	Diameter of Pile **(D)**	=	150	cm	
3)	Existing Ground Level	=	102.380	m	
4)	Pile Cut-off Level	=	100.080	m	
5)	Maximum Scour Level / Loose / Soft soil	=	86.837	m	
6)	Minimum Length of Pile to be long pile	=	32.000	m	
7)	Pile Tip Level	=	68.080	m	
8)	Grade of Concrete **(M)**	=	M 35		
9)	Moment of Inertia of Pile **(I)**	=	24850488.76	cm^4	
10)	Pile Modulus of Elasticity **(E)**	=	315000	kg/cm^2	As per IRC : 21 - 2000, Clause No. 303.1, Table 9
11)	Pile length above G.L **(L_1)**	=	1324.3	cm	
B)	**SOIL PARAMETERS :**				
1)	Soil Type (Clay/ Silt/ Sand)	=	Sand		Nature of Prominant / Major Soil Strata along the Pile Shaft
2)	Cohesion of Soil **(c)**	=	0	kg/cm^2	
3)	Unconfined compressive strength of Soil **(s_u)**	=	0	kg/cm^2	
4)	In-situ Effective Unit Weight of Soil **(γ)**	=	0.001	kg/cm^3	
5)	Angle of Shear Resistance of Soil **(ϕ)**	=	33		
6)	Angle of Shear Resistance of Soil **(ϕ)**	=	0.576	deg.	
7)	Average corrected "N" value	=	28		
8)	Compactness of strata	=	Medium		
9)	Preconsolidation Pressure for Clayey Starta **(p_c)**	=	-		
10)	Initial Overburden Pressure **(p_0)**	=	1.60	kg/cm^2	
11)	State of Consolidation (N.C./ P.C.)	=	-	kg/cm^2	
12)	Condition of Soil w.r.t. G.W.T (Submerged/ Dry)	=	Submerged		
C)	**OTHER PARAMETERS :**				
1)	Modulus of Subgrade Reaction for granular soil (n_h)	=	0.40	kg/cm^3	As per "Table **3** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
2)	Modulus of Subgrade Reaction for Cohesive Soil **(k_1)**	=	-	kg/cm^3	As per "Table **4** in ANNEX C (Clause 6.5.2), Second Revision of IS:2911(Part I/Sec 2) - 2010"
3)	Stiffness Factor for P.C. Cohesive Soil (R)	=	0	m	
4)	Stiffness Factor for N.C.clay and NonCohesive Soil (T)	=	455.50	cm	
5)	Embedded Pile Length **(L_e)**	=	18.76	m	**OK as Long Flexible Pile**
6)	L_1 / R or L_1 / T	=	2.907		
	Determination of Depth of Fixity				
1)	For Fixed Headed Pile : L_f / R or L_f / T	=	1.89		As per "**Fig. 2** in Appendix C under Amendment No. 3" of IS:2911(Part I/Sec 2)
2)	Depth of Fixity for fixed head pile **(L_f)**	=	860.90	cm	
3)	Depth of Fixity w.r.t. Pile Cap Bottom **($L_{ffx} = L_f + L_1$)**	=	2185.20	cm	
	Determination of Lateral Load Capacity				
1)	Pile Head Deflection at Pile Cut-off Level **(δ)**	=	1.46	cm	
2)	Lateral Load Capacity for fixed headed pile **(Q_{fx})**	=	13.11	ton	As Per The Allowable Limit
	Recommended Lateral Load Capacity of Pile	=	**13.0**	ton	

Design of Well Foundation at Pier / Abutment
Estimation of Vertical Load Bearing Capacity of "Concrete Well"
[As per IS Codes, IRC 78 and IRC 45]

Project	**Construction of Important DFCC Bridge Across River Sone**
Structure	**Sone River Bridge**

Proposed Structure No.	-	Pier / Abutment No.	**A1**
Location of Structure (Chainage in "km")	-	Based on Boreholes	**BH - 1**

A) FOUNDATION SOIL PARAMETERS :

Layer No	Description of Foundation Soil Layer	RL of Layer Top (m)	RL of Layer Bottom (m)	Thickness of Layer (m)	Total Unit Weight of Soil (t/m^3)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)
1	Fill	100.080	97.080	3.00	1.80		
2	Fine Sand	97.080	94.080	3.00	1.90	0.00	30.0
3	Fine Sand	94.080	89.080	5.00	2.00	0.00	32.0
4	Fine Sand	89.080	84.080	5.00	2.00	0.00	33.0
5	Clayey Silt	84.080	81.080	3.00	2.00	2.5	30.0
6	Dense Silty Sand	81.080	76.080	5.00	2.00	0.0	33.0
7	Silty Clay	76.080	66.080	10.00	2.00	22.5	0.0
8	Dense Silty Sand	66.080	64.080	2.00	2.00	0.0	32.0
9	Dense Sand	64.080	54.080	10.00	2.00	0.0	33.0
10	Dense Clayey Sand	54.080	52.080	2.00	2.00	1.5	31.0
11	Clayey Silt	52.080	50.080	2.00	2.00	22.5	0.0

B) DETAILS OF DIFFERENT LEVELS :

1)	Proposed Finished Road Level	=		m
2)	Highest Flood Level (H.F.L.)	=	103.474	m
3)	River / Stream / Canal Bed Level	=	100.080	m
4)	Ground Water Level (G.W.L)	=	100.080	m
5)	Well Cap Top Level	=		m
6)	Maximum Scour Level	=	86.837	m
7)	Well Founding Level	=	64.000	m

C) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular		
2)	Shape of Well Foundation	=	Circular		
3)	Width or Diameter of Well Foundation **(B)**	=	10.00	m	
4)	Length or Diameter of Well Foundation **(L)**	=	10.00	m	
5)	Depth of Base of Well Foundation from Maximum Scour Level **(D)**	=	22.84	m	**OK as per IRC : 78**
6)	Depth of the G.W.L. from Channel Bed Level **(D_w)**	=	0.000	m	
7)	Angle of Inclination of Load to the Vertical **(α)**	=	0	deg.	

Load Bearing Capacity of Well Foundation shall be determined only from the End Bearing of Foundation Strata and the Side Friction along the Well Shaft shall not be considered.

D) SHEAR ZONE :

1)	Depth of Shear Zone below the Foundation Base = **[0.50*B*tan(45 + ϕ / 2)]**	=	9.02	m
2)	Level of the Bottom of Shear Zone	=	54.980	m

E) DESIGNED END BEARING SOIL PARAMETERS :

1)	Cohesion of End Bearing Soil Layer **(c_d)**	=	0.00	t/m^2
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	33.0	deg.
3)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	0.58	rad.
4)	Saturated Unit Weight of End Bearing Soil Layer **(γ_{satd})**	=	2.00	t/m^3
5)	Effective Unit Weight of End Bearing Soil Layer **(γ_{subd})**	=	1.00	t/m^3
6)	Effective Overburden Pressure at Base of Open Foundation **(q)**	=	22.84	t/m^2

F) FAILURE TYPE : **GENERAL SHEAR**

G) DESIGN ANGLE OF SHEARING RESISTANCE :

			For General Shear	For Local Shear	
1)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	33.00	Not Applicable	deg.
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	0.58	Not Applicable	rad.

H) BEARING CAPACITY FACTORS :

			For General Shear	For Local Shear
1)	N_c	=	39.73	Not Applicable
2)	N_q	=	27.34	Not Applicable
3)	N_γ	=	37.78	Not Applicable

I) SHAPE FACTORS :

1)	s_c	=	**[1+ 0.2*(B/L)]**	=	1.300
2)	s_q	=	**[1+ 0.2*(B/L)]**	=	1.200
3)	s_γ	=	**[1 - 0.4*(B/L)]**	=	0.600

J) DEPTH FACTORS :

1)	d_c =		**[1+ 0.2 * (D/B) * tan(π/4 + ϕ/2)]**	=	1.841
2)	d_q =		**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.421
3)	d_γ =		**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.421

K) INCLINATION FACTOR :

1)	i_c	=	**[1 - (α/90)]^2**	=	1.000
2)	i_q	=	**[1 - (α/90)]^2**	=	1.000
3)	i_γ	=	**[1 - (α/ϕ)]^2**	=	1.000

L) WATER TABLE FACTOR :

	W'	=	0.500	

LOAD BEARING CAPACITY

A] Equations for Estimation of Net Ultimate Bearing Capacity

1]. *General Shear Failure* --------

$$Q_{nu} = [\ cN_c s_c d_c i_c + q(N_q - 1)s_q d_q i_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

2]. *Local Shear Failure* --------

$$Q_{nu} = [\ (2/3)cN'_c s_c d_c i_c + q(N'_q - 1)s_q d_q i_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

3]. *Intermediate Shear Failure* --------

$$Q_{nu} = (1/2)\ [\ \{\ cN_c s_c d_c i_c + q(N_q - 1)s_q d_q i_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ \} +\ \{\ (2/3)cN'_c s_c d_c i_c + q(N'_q - 1)s_q d_q i_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ \}\ ]$$

B] Estimation of Net Ultimate & Net Safe Bearing Capacity

NET ULTIMATE LOAD BEARING CAPACITY **(Q_{nu})**	=	1186	t/m^2
"FACTOR OF SAFETY" AGAINST NET ULTIMATE BEARING CAPACITY **(FOS)**	=	2.5	**(As per IS 6403 & IRC 78)**
NET SAFE LOAD BEARING CAPACITY **(Q_{ns})** **[$Q_{ns} = Q_{nu}$ / FOS]**	=	475	t/m^2
NET SAFE LOAD BEARING CAPACITY (Q_{ns})	=	**65**	**t/m^2**

Estimation of Settlement for Well Foundation

Proposed Structure No.	-	Pier / Abutment No.	A1
Location of Strcuture (Chainage in "km")	-	Based on Boreholes	BH - 1

A) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular	
2)	Shape of Well Foundation	=	Circular	
3)	Width or Diameter of Well Foundation (B)	=	10.00	m
4)	Length or Diameter of Well Foundation (L)	=	10.00	m
5)	Depth of Well Base from Maximum Scour Level (D)	=	22.84	m
6)	Depth of the GWL from Channel Bed Level (D_w)	=	0.00	m
7)	Angle of Inclination of Load to the Vertical (α)	=	0	deg.
8)	Total Load at Base of Well Foundation (P)	=	65	t/m^2
9)	Location of Settlement Estimation in Foundation	=	Center	

B) END BEARING FOUNDATION SOIL PARAMETERS :

LAYER I : Dense Sand

1)	Cohesion (c_1)	=	0.00	t/m^2
2)	Angle of Shearing Resistance (ϕ_1)	=	33.0	deg.
3)	Angle of Shearing Resistance (ϕ_1)	=	0.576	rad.
4)	Saturated Unit Weight (γ_{sat1})	=	2.00	t/m^3
5)	Effective Unit Weight (γ_{sub1})	=	1.00	t/m^3
6)	Initial Effective Overburden Presure at the layer top	=	35.18	t/m^2
7)	Initial Void Ratio (e_0)	=	-	
8)	Compression Index (C_c)	=	Not Applicable	
9)	Recompression Index (C_r)	=	Not Applicable	
10)	Preconsolidation Pressure (p_c)	=	Not Applicable	t/m^2
11)	Thickness (H)	=	15.00	m
12)	Poisson's Ratio (μ)	=	0.30	
13)	Influence Factor (I_s) [Ref : 'Foundation Analysis and Design' by Bowles , pg. 306]	=	0.390	
14)	Modulus of Elasticity (E_s)	=	3000	t/m^2
15)	Odeometer Correction Factor (λ)	=	Not Applicable	

ESTIMATION OF TOTAL SETTLEMENT

A]. *Consolidation Settlement* --------

(i) **Case I: If the Clayey Soil is not Preconsolidated i.e. Normally Consolidated [$p_f > p_0 > p_c$] --------**

$$S_c = C_c*[H_c / (1+e_0)]*\log_{10} [(p + \Delta p)/p_0]$$

(ii) **Case II: If the Clayey Soil is Preconsolidated and [$p_0 < p_c < p_f$] ---------**

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10} [p_c/p_0] + C_c*[H_c / (1+e_0)]*\log_{10} [(p + \Delta_p)/p_c]$$

(ii) **Case III: If the Clayey Soil is Preconsolidated and [$p_0 < p_f < p_c$] ---------**

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10} [(p + \Delta p)/p_0]$$

B]. *Elastic (Immediate) Settlement* --------

(i) For Center

$$S_i = [\ \Delta p * (B/2) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

(ii) For Corner

$$S_i = [\ \Delta p * (B) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

C]. *Table for Estimation of Settlement --------*

Layer No.	Thickness of Layer (m)	Thickness of SubLayer (m)	Cumulative Thickness of SubLayer (m)	Initial Overburden Pressure (p_0) (t/m^2)	Increase in Pressure (Δp) (t/m^2)	Final Pressure (p_f) (t/m^2)	Consolidation Settlement (m)			Elastic Settlement (m)
							Case I	**Case II**	**Case III**	
I	15.00	1.500	1.500	35.93	64.79	100.72	N.A.	N.A.	N.A.	0.154
		1.500	3.000	37.43	60.51	97.94	N.A.	N.A.	N.A.	
		1.500	4.500	38.93	50.96	89.89	N.A.	N.A.	N.A.	
		1.500	6.000	40.43	40.32	80.75	N.A.	N.A.	N.A.	
		1.500	7.500	41.93	31.27	73.20	N.A.	N.A.	N.A.	
		1.500	9.000	43.43	24.35	67.78	N.A.	N.A.	N.A.	
		1.500	10.500	44.93	19.21	64.14	N.A.	N.A.	N.A.	
		1.500	12.000	46.43	15.40	61.83	N.A.	N.A.	N.A.	
		1.500	13.500	47.93	12.55	60.48	N.A.	N.A.	N.A.	
		1.500	15.000	49.43	10.39	59.82	N.A.	N.A.	N.A.	
	Total of Layer No. 1						0.000	0.000	0.000	0.154

D]. *Total Settlement --------*

1.] Consolidation Settlement

Total Estimated "Consolidation Settlement" before Correction	=	0.000	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.57	**(As per IS 8009 - Part II)**
Rigidity Correction Factor	=	0.80	
Total Estimated "Consolidation Settlement" after Correction	=	0.000	m

2.] Elastic (Immediate) Settlement

Total Estimated "Elastic (Immediate) Settlement" before Correction	=	0.154	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.57	
Rigidity Correction Factor	=	0.80	
Total Estimated "Elastic (Immediate) Settlement" after Correction	=	0.070	m
ESTIMATED TOTAL SETTLEMENT	=	0.070	m
ESTIMATED TOTAL SETTLEMENT	=	70	mm
AS PER IS : 1904 , ALLOWABLE SETTLEMENT	=	75	mm **O.K.**
Recommended Allowable Load Bearing Capacity for Well Foundation	**=**	**65**	**t/m^2**

Design of Well Foundation at Pier / Abutment
Estimation of Vertical Load Bearing Capacity of "Concrete Well"
[As per IS Codes, IRC 78 and IRC 45]

Project	**Construction of Important DFCC Bridge Across River Sone**
Structure	**Sone River Bridge**

Proposed Structure No.	-	Pier / Abutment No.	**Infront of P-36**
Location of Strcuture (Chainage in "km")	-	Based on Boreholes	**BH - 5**

A) FOUNDATION SOIL PARAMETERS :

Layer No	Description of Foundation Soil Layer	RL of Layer Top (m)	RL of Layer Bottom (m)	Thickness of Layer (m)	Total Unit Weight of Soil (t/m^3)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)
1	Fine Sand	99.570	96.570	3.00	1.90	0.00	30.00
2	Fine Sand	96.570	94.570	2.00	2.00	0.00	31.0
3	Fine Sand	94.570	90.570	4.00	2.00	0.00	33.0
4	Fine Sand	90.570	87.570	3.00	2.00	0.00	32.0
5	Fine Sand / Silty Sand	87.570	83.570	4.00	2.00	0.0	33.0
6	Clayey Sand	83.570	81.570	2.00	2.00	1.4	31.0
7	Dense Silty Sand	81.570	78.570	3.00	2.00	0.0	32.0
8	Hard Silty Clay	78.570	58.570	20.00	2.00	22.5	0.0
8	Dense Fine Sand	58.570	49.570	9.00	2.00	0.0	33.0

B) DETAILS OF DIFFERENT LEVELS :

1)	Proposed Finished Road Level	=		m
2)	Highest Flood Level (H.F.L.)	=	103.474	m
3)	River / Stream / Canal Bed Level	=	99.570	m
4)	Ground Water Level (G.W.L)	=	99.570	m
5)	Well Cap Top Level	=		m
6)	Maximum Scour Level	=	77.274	m
7)	Well Founding Level	=	55.000	m

C) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular		
2)	Shape of Well Foundation	=	Circular		
3)	Width or Diameter of Well Foundation **(B)**	=	10.00	m	
4)	Length or Diameter of Well Foundation **(L)**	=	10.00	m	
5)	Depth of Base of Well Foundation from Maximum Scour Level **(D)**	=	22.27	m	**OK as per IRC : 78**
6)	Depth of the G.W.L. from Channel Bed Level **(D_w)**	=	0.000	m	
7)	Angle of Inclination of Load to the Vertical **(α)**	=	0	deg.	

Load Bearing Capacity of Well Foundation shall be determined only from the End Bearing of Foundation Strata and the Side Friction along the Well Shaft shall not be considered.

D) SHEAR ZONE :

1)	Depth of Shear Zone below the Foundation Base = **[0.50*B*tan(45 + ϕ / 2)]**	=	9.21	m
2)	Level of the Bottom of Shear Zone	=	45.791	m

E) DESIGNED END BEARING SOIL PARAMETERS :

1)	Cohesion of End Bearing Soil Layer **(c_d)**	=	0.00	t/m^2
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	33.0	deg.
3)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	0.58	rad.
4)	Saturated Unit Weight of End Bearing Soil Layer **(γ_{satd})**	=	2.00	t/m^3
5)	Effective Unit Weight of End Bearing Soil Layer **(γ_{subd})**	=	1.00	t/m^3
6)	Effective Overburden Pressure at Base of Open Foundation **(q)**	=	22.27	t/m^2

F) FAILURE TYPE : **GENERAL SHEAR**

G) DESIGN ANGLE OF SHEARING RESISTANCE :

			For General Shear	For Local Shear	
1)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	33.00	Not Applicable	deg.
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	0.58	Not Applicable	rad.

H) BEARING CAPACITY FACTORS :

			For General Shear	For Local Shear
1)	N_c	=	39.73	Not Applicable
2)	N_q	=	27.34	Not Applicable
3)	N_γ	=	37.78	Not Applicable

I) SHAPE FACTORS :

1)	s_c	=	**[1+ 0.2*(B/L)]**	=	1.300
2)	s_q	=	**[1+ 0.2*(B/L)]**	=	1.200
3)	s_γ	=	**[1 - 0.4*(B/L)]**	=	0.600

J) DEPTH FACTORS :

1)	d_c =	**[1+ 0.2 * (D/B) * tan(π/4 + ϕ/2)]**	=	1.820
2)	d_q =	**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.410
3)	d_γ =	**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.410

K) INCLINATION FACTOR :

1)	i_c	=	**[1 - (α/90)]^2**	=	1.000
2)	i_q	=	**[1 - (α/90)]^2**	=	1.000
3)	i_γ	=	**[1 - (α/ϕ)]^2**	=	1.000

L) WATER TABLE FACTOR :

W'	=	0.500	

LOAD BEARING CAPACITY

A] Equations for Estimation of Net Ultimate Bearing Capacity

1]. *General Shear Failure --------*

$$Q_{nu} = [\ cN_cs_cd_ci_c + q(N_q - 1)s_qd_qi_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

2]. *Local Shear Failure --------*

$$Q_{nu} = [\ (2/3)cN'_cs_cd_ci_c + q(N'_q - 1)s_qd_qi_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

3]. *Intermediate Shear Failure --------*

$$Q_{nu} = (1/2)\ [\ \{\ cN_cs_cd_ci_c + q(N_q - 1)s_qd_qi_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ \} + \{\ (2/3)cN'_cs_cd_ci_c + q(N'_q - 1)s_qd_qi_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ \}\ ]$$

B] Estimation of Net Ultimate & Net Safe Bearing Capacity

NET ULTIMATE LOAD BEARING CAPACITY **(Q_{nu})**	=	1153	t/m^2
"FACTOR OF SAFETY" AGAINST NET ULTIMATE BEARING CAPACITY **(FOS)**	=	2.5	**(As per IS 6403 & IRC 78)**
NET SAFE LOAD BEARING CAPACITY **(Q_{ns})** **[$Q_{ns} = Q_{nu}$ / FOS]**	=	461	t/m^2
NET SAFE LOAD BEARING CAPACITY (Q_{ns})	=	**65**	**t/m^2**

Estimation of Settlement for Well Foundation

Proposed Structure No.	-	Pier / Abutment No.	Infront of P-36
Location of Strcuture (Chainage in "km")	-	Based on Boreholes	BH - 5

A) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular	
2)	Shape of Well Foundation	=	Circular	
3)	Width or Diameter of Well Foundation (B)	=	10.00	m
4)	Length or Diameter of Well Foundation (L)	=	10.00	m
5)	Depth of Well Base from Maximum Scour Level (D)	=	22.27	m
6)	Depth of the GWL from Channel Bed Level (D_w)	=	0.00	m
7)	Angle of Inclination of Load to the Vertical (α)	=	0	deg.
8)	Total Load at Base of Well Foundation (P)	=	65	t/m^2
9)	Location of Settlement Estimation in Foundation	=	Center	

B) END BEARING FOUNDATION SOIL PARAMETERS :

LAYER I : Dense Fine Sand

1)	Cohesion (c_1)	=	0.00	t/m^2
2)	Angle of Shearing Resistance (ϕ_1)	=	33.0	deg.
3)	Angle of Shearing Resistance (ϕ_1)	=	0.576	rad.
4)	Saturated Unit Weight (γ_{sat1})	=	2.00	t/m^3
5)	Effective Unit Weight (γ_{sub1})	=	1.00	t/m^3
6)	Initial Effective Overburden Presure at the layer top	=	44.27	t/m^2
7)	Initial Void Ratio (e_0)	=	-	
8)	Compression Index (C_c)	=	Not Applicable	
9)	Recompression Index (C_r)	=	Not Applicable	
10)	Preconsolidation Pressure (p_c)	=	Not Applicable	t/m^2
11)	Thickness (H)	=	15.00	m
12)	Poisson's Ratio (μ)	=	0.30	
13)	Influence Factor (I_s) [Ref : 'Foundation Analysis and Design' by Bowles , pg. 306]	=	0.390	
14)	Modulus of Elasticity (E_s)	=	3000	t/m^2
15)	Odeometer Correction Factor (λ)	=	Not Applicable	

ESTIMATION OF TOTAL SETTLEMENT

A]. *Consolidation Settlement* --------

(i) Case I: If the Clayey Soil is not Preconsolidated i.e. Normally Consolidated [$p_f > p_0 > p_c$] --------

$$S_c = C_c*[H_c / (1+e_0)]*\log_{10}[(p + \Delta p)/p_0]$$

(ii) Case II: If the Clayey Soil is Preconsolidated and [$p_0 < p_c < p_f$] ---------

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10}[p_c/p_0] + C_c*[H_c / (1+e_0)]*\log_{10}[(p + \Delta_p)/p_c]$$

(ii) Case III: If the Clayey Soil is Preconsolidated and [$p_0 < p_f < p_c$] ---------

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10}[(p + \Delta p)/p_0]$$

B]. *Elastic (Immediate) Settlement* --------

(i) For Center

$$S_i = [\ \Delta p * (B/2) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

(ii) For Corner

$$S_i = [\ \Delta p * (B) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

C]. *Table for Estimation of Settlement --------*

Layer No.	Thickness of Layer (m)	Thickness of SubLayer (m)	Cumulative Thickness of SubLayer (m)	Initial Overburden Pressure (p_0) (t/m^2)	Increase in Pressure (Δp) (t/m^2)	Final Pressure (p_f) (t/m^2)	Consolidation Settlement (m)			Elastic Settlement (m)
							Case I	**Case II**	**Case III**	
I	15.00	1.500	1.500	45.02	64.79	109.81	N.A.	N.A.	N.A.	0.154
		1.500	3.000	46.52	60.51	107.03	N.A.	N.A.	N.A.	
		1.500	4.500	48.02	50.96	98.98	N.A.	N.A.	N.A.	
		1.500	6.000	49.52	40.32	89.84	N.A.	N.A.	N.A.	
		1.500	7.500	51.02	31.27	82.29	N.A.	N.A.	N.A.	
		1.500	9.000	52.52	24.35	76.87	N.A.	N.A.	N.A.	
		1.500	10.500	54.02	19.21	73.23	N.A.	N.A.	N.A.	
		1.500	12.000	55.52	15.40	70.92	N.A.	N.A.	N.A.	
		1.500	13.500	57.02	12.55	69.57	N.A.	N.A.	N.A.	
		1.500	15.000	58.52	10.39	68.91	N.A.	N.A.	N.A.	
						Total of Layer No. 1	0.000	0.000	0.000	0.154

D]. *Total Settlement --------*

1.] Consolidation Settlement

Total Estimated "Consolidation Settlement" before Correction	=	0.000	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.57	**(As per IS 8009 - Part II)**
Rigidity Correction Factor	=	0.80	
Total Estimated "Consolidation Settlement" after Correction	=	0.000	m

2.] Elastic (Immediate) Settlement

Total Estimated "Elastic (Immediate) Settlement" before Correction	=	0.154	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.57	
Rigidity Correction Factor	=	0.80	
Total Estimated "Elastic (Immediate) Settlement" after Correction	=	0.070	m
ESTIMATED TOTAL SETTLEMENT	=	0.070	m
ESTIMATED TOTAL SETTLEMENT	=	70	mm
AS PER IS : 1904 , ALLOWABLE SETTLEMENT	=	75	mm **O.K.**
Recommended Allowable Load Bearing Capacity for Well Foundation	**=**	**65**	**t/m^2**

Design of Well Foundation at Pier / Abutment
Estimation of Vertical Load Bearing Capacity of "Concrete Well"
[As per IS Codes, IRC 78 and IRC 45]

Project	**Construction of Important DFCC Bridge Across River Sone**
Structure	**Sone River Bridge**

Proposed Structure No.	-	Pier / Abutment No.	**A2**
Location of Strcuture (Chainage in "km")	-	Based on Boreholes	**BH - 11**

A) FOUNDATION SOIL PARAMETERS :

Layer No	Description of Foundation Soil Layer	RL of Layer Top (m)	RL of Layer Bottom (m)	Thickness of Layer (m)	Total Unit Weight of Soil (t/m^3)	Cohesion, c (t/m^2)	Angle of Shearing Resistance, ϕ (deg)
1	Fill	102.380	100.880	1.50	1.80		
2	Silty Sand	100.880	99.380	1.50	1.90	0.00	30.0
3	Clayey Silt	99.380	96.380	3.00	1.90	5.50	6.0
4	Fine Sand	96.380	91.380	5.00	2.00	0.00	31.0
5	Fine Sand	91.380	88.380	3.00	2.00	0.0	32.0
6	Fine Sand	88.380	78.380	10.00	2.00	0.0	33.0
7	Fine Sand	78.380	72.380	6.00	2.00	0.0	34.0
8	Clayey Silt	72.380	71.380	1.00	2.00	18.0	0.0
9	Dense Sand	71.380	68.380	3.00	2.00	0.0	33.0
10	Clayey Silt	68.380	66.380	2.00	2.00	15.5	0.0
11	Silty Clay	66.380	63.380	3.00	2.00	20.0	0.0
12	Dense Sand	63.380	62.380	1.00	2.00	0.0	32.0
13	Dense Sand	62.380	52.380	10.00	2.00	0.0	33.0

B) DETAILS OF DIFFERENT LEVELS :

1)	Proposed Finished Road Level	=		m
2)	Highest Flood Level (H.F.L.)	=	103.474	m
3)	River / Stream / Canal Bed Level	=	102.380	m
4)	Ground Water Level (G.W.L)	=	102.380	m
5)	Well Cap Top Level	=		m
6)	Maximum Scour Level	=	86.837	m
7)	Well Founding Level	=	60.000	m

C) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular		
2)	Shape of Well Foundation	=	Circular		
3)	Width or Diameter of Well Foundation **(B)**	=	10.00	m	
4)	Length or Diameter of Well Foundation **(L)**	=	10.00	m	
5)	Depth of Base of Well Foundation from Maximum Scour Level **(D)**	=	26.84	m	**OK as per IRC : 78**
6)	Depth of the G.W.L. from Channel Bed Level **(D_w)**	=	0.000	m	
7)	Angle of Inclination of Load to the Vertical **(α)**	=	0	deg.	

Load Bearing Capacity of Well Foundation shall be determined only from the End Bearing of Foundation Strata and the Side Friction along the Well Shaft shall not be considered.

D) SHEAR ZONE :

1)	Depth of Shear Zone below the Foundation Base = **[0.50*B*tan(45 + ϕ / 2)]**	=	9.21	m
2)	Level of the Bottom of Shear Zone	=	50.791	m

E) DESIGNED END BEARING SOIL PARAMETERS :

1)	Cohesion of End Bearing Soil Layer **(c_d)**	=	0.00	t/m^2
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	33.0	deg.
3)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ_d)**	=	0.58	rad.
4)	Saturated Unit Weight of End Bearing Soil Layer **(γ_{satd})**	=	2.00	t/m^3

5)	Effective Unit Weight of End Bearing Soil Layer **(γ_{subd})**	=	1.00	t/m^3
6)	Effective Overburden Pressure at Base of Open Foundation **(q)**	=	26.84	t/m^2

F) FAILURE TYPE : **GENERAL SHEAR**

G) DESIGN ANGLE OF SHEARING RESISTANCE :

			For General Shear	For Local Shear	
1)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	33.00	Not Applicable	deg.
2)	Angle of Shearing Resistance of End Bearing Soil Layer **(ϕ)**	=	0.58	Not Applicable	rad.

H) BEARING CAPACITY FACTORS :

			For General Shear	For Local Shear
1)	N_c	=	39.73	Not Applicable
2)	N_q	=	27.34	Not Applicable
3)	N_γ	=	37.78	Not Applicable

I) SHAPE FACTORS :

1)	s_c	=	**[1+ 0.2*(B/L)]**	=	1.300
2)	s_q	=	**[1+ 0.2*(B/L)]**	=	1.200
3)	s_γ	=	**[1 - 0.4*(B/L)]**	=	0.600

J) DEPTH FACTORS :

1)	d_c =		**[1+ 0.2 * (D/B) * tan(π/4 + ϕ/2)]**	=	1.989
2)	d_q =		**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.494
3)	d_γ =		**[1+ 0.1 * (D/B) * tan(π/4+ ϕ/2)]**	=	1.494

K) INCLINATION FACTOR :

1)	i_c	=	**[1 - (α/90)]^2**	=	1.000
2)	i_q	=	**[1 - (α/90)]^2**	=	1.000
3)	i_γ	=	**[1 - (α/ϕ)]^2**	=	1.000

L) WATER TABLE FACTOR :

W'	=	0.500		

LOAD BEARING CAPACITY

A] Equations for Estimation of Net Ultimate Bearing Capacity

1]. *General Shear Failure --------*

$$Q_{nu} = [\ cN_cs_cd_ci_c + q(N_q - 1)s_qd_qi_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

2]. *Local Shear Failure --------*

$$Q_{nu} = [\ (2/3)cN'_cs_cd_ci_c + q(N'_q - 1)s_qd_qi_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ ]$$

3]. *Intermediate Shear Failure --------*

$$Q_{nu} = (1/2)\ [\ \{\ cN_cs_cd_ci_c + q(N_q - 1)s_qd_qi_q + (1/2)B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'\ \} +\ \{\ (2/3)cN'_cs_cd_ci_c + q(N'_q - 1)s_qd_qi_q + (1/2)B\gamma N'_\gamma s_\gamma d_\gamma i_\gamma W'\ \}\ ]$$

B] Estimation of Net Ultimate & Net Safe Bearing Capacity

NET ULTIMATE LOAD BEARING CAPACITY **(Q_{nu})**	=	1437	t/m^2	
"FACTOR OF SAFETY" AGAINST NET ULTIMATE BEARING CAPACITY **(FOS)**	=	2.5	**(As per IS 6403 & IRC 78)**	
NET SAFE LOAD BEARING CAPACITY **(Q_{ns})** **[$Q_{ns} = Q_{nu}$ / FOS]**	=	575	t/m^2	
NET SAFE LOAD BEARING CAPACITY (Q_{ns})	=	**65**	**t/m^2**	

Estimation of Settlement for Well Foundation

Proposed Structure No.	-	Pier / Abutment No.	A2
Location of Strcuture (Chainage in "km")	-	Based on Boreholes	BH - 11

A) STRUCTURAL PARAMETERS :

1)	Type of Well Foundation	=	Single Circular	
2)	Shape of Well Foundation	=	Circular	
3)	Width or Diameter of Well Foundation (B)	=	10.00	m
4)	Length or Diameter of Well Foundation (L)	=	10.00	m
5)	Depth of Well Base from Maximum Scour Level (D)	=	26.84	m
6)	Depth of the GWL from Channel Bed Level (D_w)	=	0.00	m
7)	Angle of Inclination of Load to the Vertical (α)	=	0	deg.
8)	Total Load at Base of Well Foundation (P)	=	65	t/m^2
9)	Location of Settlement Estimation in Foundation	=	Center	

B) END BEARING FOUNDATION SOIL PARAMETERS :

LAYER I : Dense Sand

1)	Cohesion (c_1)	=	0.00	t/m^2
2)	Angle of Shearing Resistance (ϕ_1)	=	33.0	deg.
3)	Angle of Shearing Resistance (ϕ_1)	=	0.576	rad.
4)	Saturated Unit Weight (γ_{sat1})	=	2.00	t/m^3
5)	Effective Unit Weight (γ_{sub1})	=	1.00	t/m^3
6)	Initial Effective Overburden Presure at the layer top	=	41.63	t/m^2
7)	Initial Void Ratio (e_0)	=	-	
8)	Compression Index (C_c)	=	Not Applicable	
9)	Recompression Index (C_r)	=	Not Applicable	
10)	Preconsolidation Pressure (p_c)	=	Not Applicable	t/m^2
11)	Thickness (H)	=	15.00	m
12)	Poisson's Ratio (μ)	=	0.30	
13)	Influence Factor (I_s) [Ref : 'Foundation Analysis and Design' by Bowles , pg. 306]	=	0.390	
14)	Modulus of Elasticity (E_s)	=	3000	t/m^2
15)	Odeometer Correction Factor (λ)	=	Not Applicable	

ESTIMATION OF TOTAL SETTLEMENT

A]. *Consolidation Settlement* --------

(i) Case I: If the Clayey Soil is not Preconsolidated i.e. Normally Consolidated [$p_f > p_0 > p_c$] --------

$$S_c = C_c*[H_c / (1+e_0)]*\log_{10}[(p + \Delta p)/p_0]$$

(ii) Case II: If the Clayey Soil is Preconsolidated and [$p_0 < p_c < p_f$] ---------

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10}[p_c/p_0] + C_c*[H_c / (1+e_0)]*\log_{10}[(p + \Delta_p)/p_c]$$

(ii) Case III: If the Clayey Soil is Preconsolidated and [$p_0 < p_f < p_c$] ---------

$$S_c = C_r*[H_c / (1+e_0)]*\log_{10}[(p + \Delta p)/p_0]$$

B]. *Elastic (Immediate) Settlement* --------

(i) For Center

$$S_i = [\ \Delta p * (B/2) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

(ii) For Corner

$$S_i = [\ \Delta p * (B) * ((1 - \mu^2) / E_s\ ) * m * I_s * I_F\ ]$$

C]. *Table for Estimation of Settlement --------*

Layer No.	Thickness of Layer (m)	Thickness of SubLayer (m)	Cumulative Thickness of SubLayer (m)	Initial Overburden Pressure (p_0) (t/m^2)	Increase in Pressure (Δp) (t/m^2)	Final Pressure (p_f) (t/m^2)	Consolidation Settlement (m)			Elastic Settlement (m)
							Case I	**Case II**	**Case III**	
I	15.00	1.500	1.500	42.38	64.79	107.17	N.A.	N.A.	N.A.	0.154
		1.500	3.000	43.88	60.51	104.39	N.A.	N.A.	N.A.	
		1.500	4.500	45.38	50.96	96.34	N.A.	N.A.	N.A.	
		1.500	6.000	46.88	40.32	87.20	N.A.	N.A.	N.A.	
		1.500	7.500	48.38	31.27	79.65	N.A.	N.A.	N.A.	
		1.500	9.000	49.88	24.35	74.23	N.A.	N.A.	N.A.	
		1.500	10.500	51.38	19.21	70.59	N.A.	N.A.	N.A.	
		1.500	12.000	52.88	15.40	68.28	N.A.	N.A.	N.A.	
		1.500	13.500	54.38	12.55	66.93	N.A.	N.A.	N.A.	
		1.500	15.000	55.88	10.39	66.27	N.A.	N.A.	N.A.	
						Total of Layer No. 1	0.000	0.000	0.000	0.154

D]. *Total Settlement --------*

1.] Consolidation Settlement

Total Estimated "Consolidation Settlement" before Correction	=	0.000	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.56	**(As per IS 8009 - Part II)**
Rigidity Correction Factor	=	0.80	
Total Estimated "Consolidation Settlement" after Correction	=	0.000	m

2.] Elastic (Immediate) Settlement

Total Estimated "Elastic (Immediate) Settlement" before Correction	=	0.154	m
Correction Factors --			
Depth Correction Factor **(I_F)**	=	0.56	
Rigidity Correction Factor	=	0.80	
Total Estimated "Elastic (Immediate) Settlement" after Correction	=	0.068	m
ESTIMATED TOTAL SETTLEMENT	=	0.068	m
ESTIMATED TOTAL SETTLEMENT	=	68	mm
AS PER IS : 1904 , ALLOWABLE SETTLEMENT	=	75	mm **O.K.**
Recommended Allowable Load Bearing Capacity for Well Foundation	**=**	**65**	**t/m^2**