



## NORTH EASTERN RAILWAY

### FINAL LOCATION SURVEY FOR NEW B.G RAILWAY LINE PROJECTS (770.00 KM.) AND FINAL LOCATION SURVEY FOR CONSTRUCTION OF DOUBLING/THIRD LINE/ 3RD & 4TH LINE (252.00 KM.) OF NORTH EASTERN RAILWAY (TOTAL 1022.00 KM)

#### SECTION: CHITAUNI-MADHUBANI

Chainage	Br. No	Type of Crossing	Type of Bridge	Borehole No.	Easting (m)	Northing (m)	Reduced Level (m)
15383.398	26	WATERWAY	MAJOR-BRIDGE	BH-01	203428	2996384	107.17
				BH-02	203438	2996377	107.14

SUBMITTED BY:

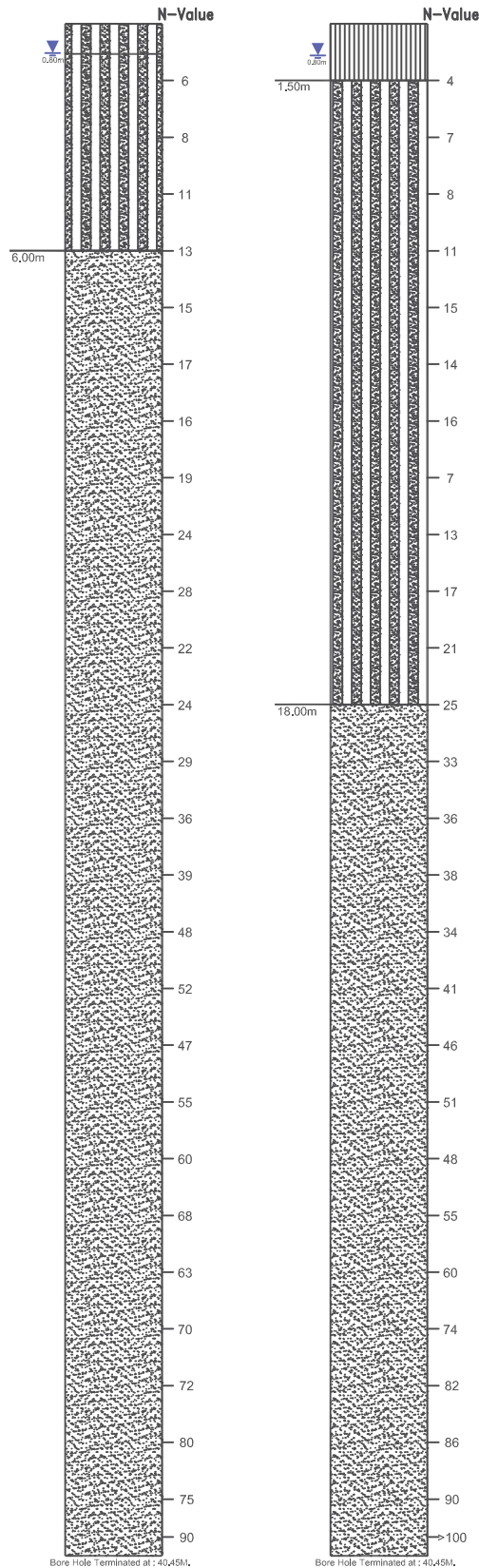


# BOREHOLE PROFILE





## SECTION: CHITAUNI TO MADHUBANI

BRIDGE NO.: 26  
BOREHOLE NO.: 01

BRIDGE NO.: 26  
BOREHOLE NO.: 02




### LEGENDS

-  SANDY-SILT (ML)
-  SILTY SAND (SM)
-  POORLY GRADED SAND (SP)
-  Ground Water Table



Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO :26				DATE STARTED :		10-01-2025		<div>aarvee associates architects engineers &amp; consultants pvt. ltd.</div>																									
BOREHOLE NO. BH- 1				GWT: 0.80 m		DATE COMPLETED :												11-01-2025															
FIELD TEST RESULTS												LABORATORY TEST RESULTS																					
ELEVATION IN METERS	DEPTH IN METERS BELOW REFERENCE	NATURE OF SAMPLING	SAMPLE REFERENCE NO.	LEVEL OF WATER TABLE / LWL	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 (gm/cc)	DRY DENSITY (gm/cc)	MOISTURE CONTENT (%)	FREESWELL INDEX (%)	SPECIFIC GRAVITY	SUBMERGED DENSITY (gm/cc)	SHEAR STRENGTH CHARACTERISTICS		CONSOLIDATION CHARACTERISTICS	Chemical Analysis Result				
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N VALUE (Recorded)	N VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)										Cohesion, C <sub>v</sub> (kg/cm <sup>2</sup> )	Angle of friction (Degrees)		Compression Index(I <sub>cc</sub> )	pH	Chloride, %	Sulphate, %	pH
-1.00	1.0	DS	1	0.80m	0.00	1.00	DS	-	-	-	MEDIUM DENSE , LITE GREY ,SILTY SAND (SM)	-	0.00	72.00	27.00	1.00	NON-PLASTIC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.0	SPT	1		1.50	1.95	6	30	6	10		-	0.00	68.00	30.00	2.00	NON-PLASTIC		-	-	-	2.52	-	-	-	-	-	-	-	-	-	-	-
	3.0	DS	2		2.50	2.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	4.0	SPT	2		3.00	3.45	8	30	8	11		-	0.00	66.00	33.00	1.00	NON-PLASTIC		-	-	-	2.53	-	-	-	-	-	-	-	-	-	-	
-5.00	5.0	SPT	3		4.50	4.95	11	30	11	14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	6.0	DS	3		5.50	5.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	7.0	SPT	4		6.00	6.45	13	30	13	15		-	0.00	97.00	3.00	0.00	NON-PLASTIC		-	-	-	2.54	-	-	-	-	-	-	-	-	-	-	
	8.0	SPT	5		7.50	7.95	15	30	15	16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	9.0	DS	4		8.50	8.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-10.00	10.0	SPT	6		9.00	9.45	17	30	17	16		-	0.00	96.00	4.00	0.00	NON-PLASTIC		-	-	-	2.55	-	-	-	-	-	-	-	-	-	-	
	11.0	SPT	7		10.50	10.95	16	30	16	15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	12.0	DS	5		11.50	11.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	13.0	SPT	8		12.00	12.45	19	30	19	16		-	0.00	97.00	3.00	0.00	NON-PLASTIC		-	-	-	2.54	-	-	-	-	-	-	-	-	-	-	
	14.0	SPT	9		13.50	13.95	24	30	24	18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-15.00	15.0	DS	6		14.50	14.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	16.0	SPT	10		15.00	15.45	28	30	28	19		-	0.00	96.00	4.00	0.00	NON-PLASTIC		-	-	-	2.56	-	-	-	-	-	-	-	-	-	-	
	17.0	SPT	11		16.50	16.95	22	30	22	17		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	18.0	DS	7		17.50	17.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	19.0	SPT	12		18.00	18.45	24	30	24	17		-	0.00	98.00	2.00	0.00	NON-PLASTIC		-	-	-	2.60	-	-	-	-	-	-	-	-	-	-	
-20.00	20.0	SPT	13		19.50	19.95	29	30	29	19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	21.0	DS	8		20.50	20.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	22.0	SPT	14		21.00	21.45	36	30	36	21		-	0.00	97.00	3.00	0.00	NON-PLASTIC		-	-	-	2.57	-	-	-	-	-	-	-	-	-	-	
	23.0	SPT	15		22.50	22.95	39	30	39	22		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	24.0	DS	9		23.50	23.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-25.00	25.0	SPT	16		24.00	24.45	48	30	48	24		-	0.00	96.00	4.00	0.00	NON-PLASTIC		-	-	-	2.56	-	-	-	-	-	-	-	-	-	-	
	26.0	SPT	17		25.50	25.95	52	30	52	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	27.0	DS	10		26.50	26.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	28.0	SPT	18		27.00	27.45	47	30	47	23		-	0.00	98.00	2.00	0.00	NON-PLASTIC		-	-	-	2.57	-	-	-	-	-	-	-	-	-	-	
	29.0	SPT	19		28.50	28.95	55	30	55	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-30.00	30.0	DS	11		29.50	29.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	31.0	SPT	20		30.00	30.45	60	30	60	26		-	0.00	97.00	3.00	0.00	NON-PLASTIC		-	-	-	2.60	-	-	-	-	-	-	-	-	-	-	
	32.0	SPT	21		31.50	31.95	68	30	68	28		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	33.0	DS	12		32.50	32.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	34.0	SPT	22		33.00	33.45	63	30	63	26		-	0.00	96.00	4.00	0.00	NON-PLASTIC		-	-	-	2.59	-	-	-	-	-	-	-	-	-	-	
-35.00	35.0	SPT	23		34.50	34.95	70	30	70	28		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	36.0	DS	13		35.50	35.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	37.0	SPT	24		36.00	36.45	72	30	72	28		-	0.00	97.00	3.00	0.00	NON-PLASTIC		-	-	-	2.57	-	-	-	-	-	-	-	-	-	-	
	38.0	SPT	25		37.50	37.95	80	30	80	29		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	39.0	DS	14		38.50	38.80	UDS SLIPPED				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-40.00	40.0	SPT	26		39.00	39.45	75	30	75	27		-	0.00	96.00	4.00	0.00	NON-PLASTIC		-	-	-	2.58	-	-	-	-	-	-	-	-	-	-	
	41.0	SPT	27		40.00	40.45	90	30	90	31		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<div>CLASSIFICATION OF SOIL AS PER IS : 1498</div> <div>ABBREVIATION USED :</div> <div>DS = DISTURBED SAMPLE, SPT = STANDARD PENETRATION TEST, UDS = UNDISTURBED SAMPLE, DST = DIRECT SHEAR TEST,</div> <div>UC : UNCONFINED COMPRESSION TEST      UU : UNCONSOLIDATED UNDRAINED TRIAXIAL TEST</div> <div>* UCS BASED ON POINT LOAD TEST</div>												<div>Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd &amp; 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)</div> <div>SECTION: CHITAUNI - MADHUBANI</div>																					

[illegible]

### CALCULATIONS FOR CORRECTED SPT (N) VALUES

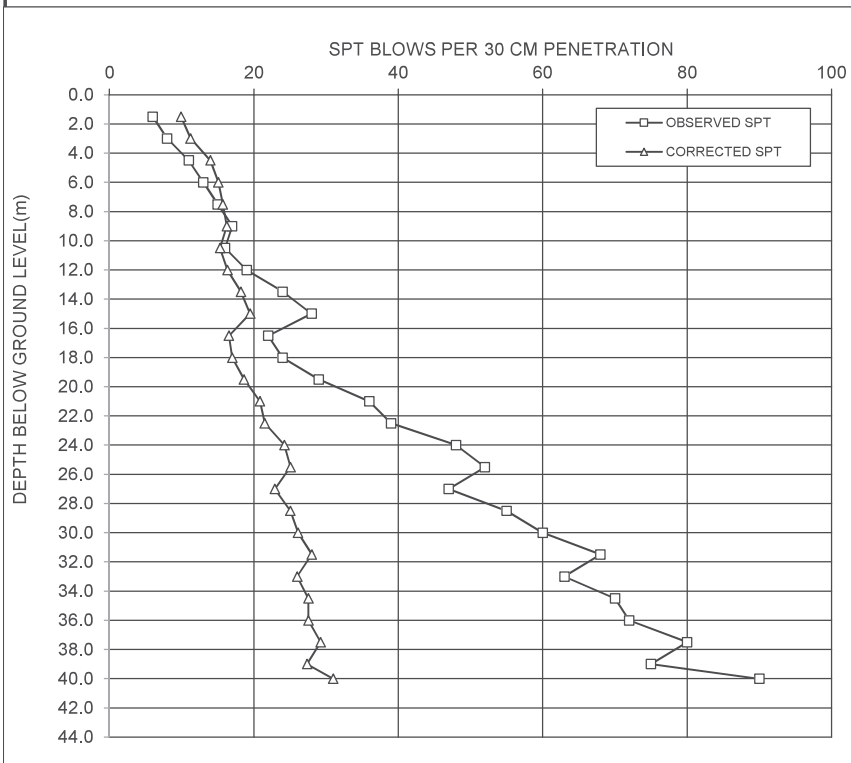
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BOREHOLE NO. BH- 1

WATER TABLE- 0.80 m

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
1.50	Non Plastic	6	10	10
3.00	Non Plastic	8	11	11
4.50	Non Plastic	11	14	14
6.00	Non Plastic	13	15	15
7.50	Non Plastic	15	16	16
9.00	Non Plastic	17	17	16
10.50	Non Plastic	16	16	15
12.00	Non Plastic	19	18	16
13.50	Non Plastic	24	21	18
15.00	Non Plastic	28	24	19
16.50	Non Plastic	22	18	17
18.00	Non Plastic	24	19	17
19.50	Non Plastic	29	22	19
21.00	Non Plastic	36	27	21
22.50	Non Plastic	39	28	22
24.00	Non Plastic	48	33	24
25.50	Non Plastic	52	35	25
27.00	Non Plastic	47	31	23
28.50	Non Plastic	55	35	25
30.00	Non Plastic	60	37	26
31.50	Non Plastic	68	41	28
33.00	Non Plastic	63	37	26
34.50	Non Plastic	70	40	28
36.00	Non Plastic	72	40	28
37.50	Non Plastic	80	43	29
39.00	Non Plastic	75	40	27
40.00	Non Plastic	90	47	31

\* SPT value restricted to 300.



### CALCULATIONS FOR CORRECTED SPT (N) VALUES

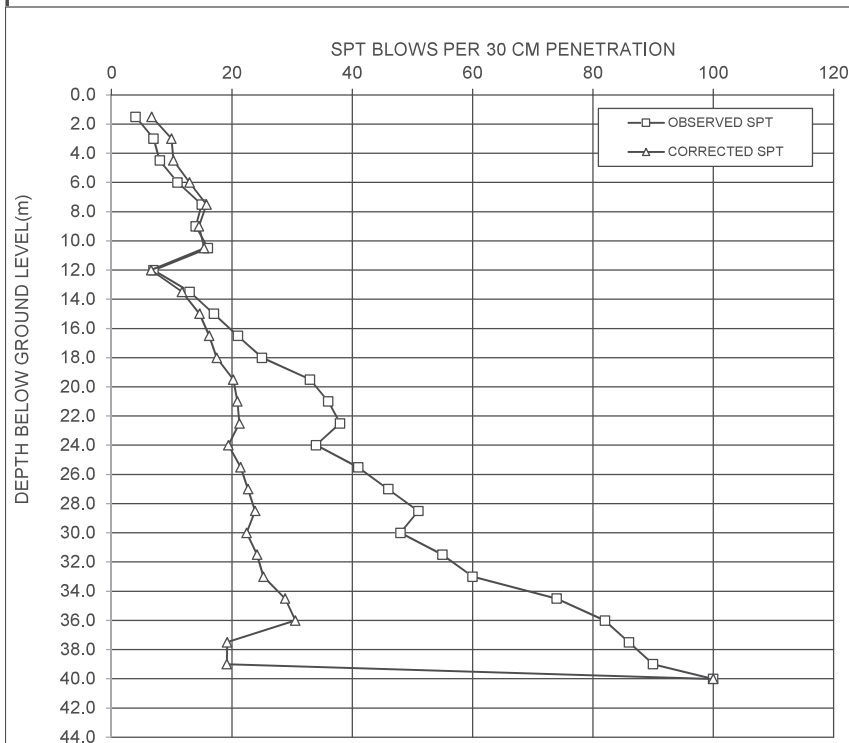
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 2

WATER TABLE -0.80 m

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
1.50	Non Plastic	4	7	7
3.00	Non Plastic	7	10	10
4.50	Non Plastic	8	10	10
6.00	Non Plastic	11	13	13
7.50	Non Plastic	15	17	16
9.00	Non Plastic	14	15	15
10.50	Non Plastic	16	16	15
12.00	Non Plastic	7	7	7
13.50	Non Plastic	13	12	12
15.00	Non Plastic	17	15	15
16.50	Non Plastic	21	17	16
18.00	Non Plastic	25	20	17
19.50	Non Plastic	33	25	20
21.00	Non Plastic	36	27	21
22.50	Non Plastic	38	28	21
24.00	Non Plastic	34	24	19
25.50	Non Plastic	41	28	21
27.00	Non Plastic	46	30	23
28.50	Non Plastic	51	33	24
30.00	Non Plastic	48	30	22
31.50	Non Plastic	55	33	24
33.00	Non Plastic	60	36	25
34.50	Non Plastic	74	43	29
36.00	Non Plastic	82	46	31
37.50	Non Plastic	86	23	19
39.00	Non Plastic	90	23	19
40.00	Non Plastic	100	100	100

\* SPT value restricted to 300.



**Typical Computation of Liquefaction Potential as per IRC:SP: 114 / IS: 1893**

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO: 26

BOREHOLE NO.

BH-01

SECTION: CHITAUUNI-MADHUBANI

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 ( % )	Earthquake Zone	Peak ground acceleration $a_{max}/g$	Earth quake magnitude (Mw)	Stress reduction coefficient (rd)	Total overburden pressure ( $\sigma_o$ ), $t/m^2$	Effective overburden ( $\sigma_o$ ), $t/m^2$	Cyclic Stress ratio (CSR)	$C_N$	CE or CHT	CH or CHW	CB or CBD	CR or CRL	CS or CSS	SPT corrected ( $N_1$ ) <sub>60</sub>	$\alpha$	$\beta$	$(N_1)_{60cs}$	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	SM	6	1.92	0.92	32	IV	0.24	7.00	0.99	2.88	1.38	0.32	1.70	1.33	1.000	1.05	0.75	1.00	10.68	4.83	1.17	17.34	0.18	21.54	0.89	1.00	1.00	1.19	0.22	0.68	Liquefiable
3.00	SM	8	2.01	1.01	34	IV	0.24	7.00	0.98	5.76	2.76	0.32	1.70	1.33	1.000	1.05	0.85	1.00	16.14	4.93	1.19	24.11	0.28	33.82	0.83	1.00	1.00	1.19	0.33	1.03	Non Liquefiable
4.50	SM	11	2.01	1.01	34	IV	0.24	7.00	0.97	8.78	4.28	0.31	1.53	1.33	1.000	1.05	0.95	1.00	22.32	4.93	1.19	31.45	NA	47.72	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
6.00	SP	13	2.02	1.02	3	IV	0.24	7.00	0.95	11.79	5.79	0.30	1.31	1.33	1.000	1.05	0.95	1.00	22.67	0.00	1.00	22.67	0.25	48.50	0.76	1.00	1.00	1.19	0.30	0.99	Liquefiable
7.50	SP	15	2.02	1.02	3	IV	0.24	7.00	0.94	14.82	7.32	0.30	1.17	1.33	1.000	1.05	0.95	1.00	23.26	0.00	1.00	23.26	0.26	49.83	0.75	1.00	1.00	1.19	0.31	1.05	Non Liquefiable
9.00	SP	17	2.03	1.03	4	IV	0.24	7.00	0.93	17.85	8.85	0.29	1.06	1.33	1.000	1.05	1	1.00	25.24	0.00	1.00	25.24	0.30	54.28	0.73	1.00	1.00	1.19	0.35	1.21	Non Liquefiable
10.50	SP	16	2.03	1.03	4	IV	0.24	7.00	0.89	20.90	10.40	0.28	0.98	1.33	1.000	1.05	1	1.00	21.92	0.00	1.00	21.92	0.24	46.81	0.77	0.99	1.00	1.19	0.28	1.02	Non Liquefiable
12.00	SP	19	2.02	1.02	3	IV	0.24	7.00	0.85	23.94	11.94	0.27	0.92	1.33	1.000	1.05	1	1.00	24.28	0.00	1.00	24.28	0.28	52.14	0.74	0.95	1.00	1.19	0.32	1.19	Non Liquefiable
13.50	SP	24	2.02	1.02	3	IV	0.24	7.00	0.81	26.97	13.47	0.25	0.86	1.33	1.000	1.05	1	1.00	28.88	0.00	1.00	28.88	0.40	62.48	0.69	0.91	1.00	1.19	0.44	1.73	Non Liquefiable
15.00	SP	28	2.01	1.01	4	IV	0.24	7.00	0.77	30.00	15.00	0.24	0.82	1.33	1.000	1.05	1	1.00	31.93	0.00	1.00	31.93	NA	66.93	0.67	0.87	1.00	1.19	NA	>1.0	Non Liquefiable
16.50	SP	22	2.01	1.01	4	IV	0.24	7.00	0.73	33.02	16.52	0.23	0.78	1.33	1.000	1.05	1	1.00	23.91	0.00	1.00	23.91	0.27	51.29	0.74	0.88	1.00	1.19	0.29	1.25	Non Liquefiable
18.00	SP	24	2.02	1.02	2	IV	0.24	7.00	0.69	36.03	18.03	0.22	0.74	1.33	1.000	1.05	1	1.00	24.96	0.00	1.00	24.96	0.29	53.66	0.73	0.85	1.00	1.19	0.30	1.37	Non Liquefiable
19.50	SP	29	2.02	1.02	2	IV	0.24	7.00	0.65	39.06	19.56	0.20	0.72	1.33	1.000	1.05	1	1.00	28.96	0.00	1.00	28.96	0.41	62.65	0.69	0.81	1.00	1.19	0.39	1.94	Non Liquefiable
21.00	SP	36	2.03	1.03	3	IV	0.24	7.00	0.61	42.09	21.09	0.19	0.69	1.33	1.000	1.05	1	1.00	34.62	0.00	1.00	34.62	NA	69.62	0.65	0.77	1.00	1.19	NA	>1.0	Non Liquefiable
22.50	SP	39	2.03	1.03	3	IV	0.24	7.00	0.57	45.14	22.64	0.18	0.66	1.33	1.000	1.05	1	1.00	36.20	0.00	1.00	36.20	NA	71.20	0.64	0.75	1.00	1.19	NA	>1.0	Non Liquefiable

Note: Values of all Parameters are as per IRC:SP: 114 / IS 1893: 2016

$C_E$  or  $C_{HT}$  (Correction for hammer energy ratio) =  $ER/60$ , ER for Rope and pully System = 80 % , Hence  $C_E = 80/60 = 1.33$

$C_H$  or  $C_{HW}$  (Correction for hammer ) = 1.00

Borehole Diameter = 150 mm , Hence  $C_B$  or  $C_{BD}$  (Correction for Borehole diameter), = 1.05

$C_S$  or  $C_{SS}$  (Correction for Standard sampler) = 1.00

$K_\sigma$  Correction for high overburden stress (for effective oberburden pressure > 10 T/m2)

$K_\alpha$  Correction for static shear stress is required only for sloping ground



**Typical Computation of Liquefaction Potential as per IRC:SP: 114 / IS: 1893**

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO: 26

BOREHOLE NO.

BH-02

SECTION: CHITAUUNI-MADHUBANI

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 ( % )	Earthquake Zone	Peak ground acceleration $a_{max}/g$	Earth quake magnitude (Mw)	Stress reduction coefficient (rd)	Total overburden pressure ( $\sigma_o$ ), $t/m^2$	Effective overburden ( $\sigma_o$ ), $t/m^2$	Cyclic Stress ratio (CSR)	$C_N$	CE or CHT	CH or CHW	CB or CBD	CR or CRL	CS or CSS	SPT corrected ( $N_1$ ) <sub>60</sub>	$\alpha$	$\beta$	( $N_1$ ) <sub>60cs</sub>	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	SM	4	1.90	0.90	29	IV	0.24	7.00	0.99	2.85	1.35	0.33	1.70	1.33	1.000	1.05	0.75	1.00	7.12	4.64	1.15	12.80	0.14	15.20	0.92	1.00	1.00	1.19	0.17	0.51	Liquefiable
3.00	SM	7	1.95	0.95	32	IV	0.24	7.00	0.98	5.70	2.70	0.32	1.70	1.33	1.000	1.05	0.85	1.00	14.13	4.83	1.17	21.37	0.23	29.28	0.85	1.00	1.00	1.19	0.28	0.86	Liquefiable
4.50	SM	8	1.95	0.95	32	IV	0.24	7.00	0.97	8.63	4.13	0.31	1.56	1.33	1.000	1.05	0.95	1.00	16.53	4.83	1.17	24.18	0.28	34.68	0.83	1.00	1.00	1.19	0.33	1.05	Non Liquefiable
6.00	SM	11	2.00	1.00	34	IV	0.24	7.00	0.95	11.55	5.55	0.31	1.34	1.33	1.000	1.05	0.95	1.00	19.59	4.93	1.19	28.21	0.38	41.58	0.79	1.00	1.00	1.19	0.45	1.45	Non Liquefiable
7.50	SM	15	2.00	1.00	34	IV	0.24	7.00	0.94	14.55	7.05	0.30	1.19	1.33	1.000	1.05	0.95	1.00	23.70	4.93	1.19	33.09	NA	50.83	0.75	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
9.00	SM	14	2.02	1.02	35	IV	0.24	7.00	0.93	17.55	8.55	0.30	1.08	1.33	1.000	1.05	1	1.00	21.14	5.00	1.20	30.37	NA	45.07	0.77	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
10.50	SM	16	2.02	1.02	35	IV	0.24	7.00	0.89	20.58	10.08	0.28	1.00	1.33	1.000	1.05	1	1.00	22.26	5.00	1.20	31.71	NA	47.57	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
12.00	SM	7	1.98	0.98	33	IV	0.24	7.00	0.85	23.61	11.61	0.27	0.93	1.33	1.000	1.05	1	1.00	9.07	4.88	1.18	15.58	0.17	18.45	0.91	0.99	1.00	1.19	0.20	0.72	Liquefiable
13.50	SM	13	1.98	0.98	33	IV	0.24	7.00	0.81	26.58	13.08	0.26	0.87	1.33	1.000	1.05	1	1.00	15.87	4.88	1.18	23.61	0.27	33.22	0.83	0.96	1.00	1.19	0.30	1.18	Non Liquefiable
15.00	SM	17	2.04	1.04	32	IV	0.24	7.00	0.77	29.55	14.55	0.25	0.83	1.33	1.000	1.05	1	1.00	19.68	4.83	1.17	27.88	0.37	41.78	0.79	0.92	1.00	1.19	0.40	1.64	Non Liquefiable
16.50	SM	21	2.04	1.04	32	IV	0.24	7.00	0.73	32.61	16.11	0.23	0.79	1.33	1.000	1.05	1	1.00	23.11	4.83	1.17	31.88	NA	49.49	0.75	0.89	1.00	1.19	NA	>1.0	Non Liquefiable
18.00	SP	25	2.03	1.03	3	IV	0.24	7.00	0.69	35.67	17.67	0.22	0.75	1.33	1.000	1.05	1	1.00	26.26	0.00	1.00	26.26	0.32	56.59	0.72	0.85	1.00	1.19	0.32	1.48	Non Liquefiable
19.50	SP	33	2.03	1.03	3	IV	0.24	7.00	0.65	38.72	19.22	0.21	0.72	1.33	1.000	1.05	1	1.00	33.25	0.00	1.00	33.25	NA	68.25	0.66	0.80	1.00	1.19	NA	>1.0	Non Liquefiable
21.00	SP	36	2.01	1.01	4	IV	0.24	7.00	0.61	41.76	20.76	0.19	0.69	1.33	1.000	1.05	1	1.00	34.89	0.00	1.00	34.89	NA	69.89	0.65	0.77	1.00	1.19	NA	>1.0	Non Liquefiable
22.50	SP	38	2.01	1.01	4	IV	0.24	7.00	0.57	44.78	22.28	0.18	0.67	1.33	1.000	1.05	1	1.00	35.56	0.00	1.00	35.56	NA	70.56	0.65	0.75	1.00	1.19	NA	>1.0	Non Liquefiable

Note: Values of all Parameters are as per IRC:SP: 114 / IS 1893: 2016

$C_E$  or  $C_{HT}$  (Correction for hammer energy ratio) = ER/60, ER for Rope and pully System = 80 % , Hence  $C_E = 80/60 = 1.33$

$C_H$  or  $C_{HW}$  (Correction for hammer ) = 1.00

Borehole Diameter = 150 mm , Hence  $C_B$  or  $C_{BD}$  (Correction for Borehole diameter), = 1.05

$C_S$  or  $C_{SS}$  (Correction for Standard sampler) = 1.00

$K_\sigma$  Correction for high overburden stress (for effective oberburden pressure>10 T/m2)

$K_\alpha$  Correction for static shear stress is required only for sloping ground

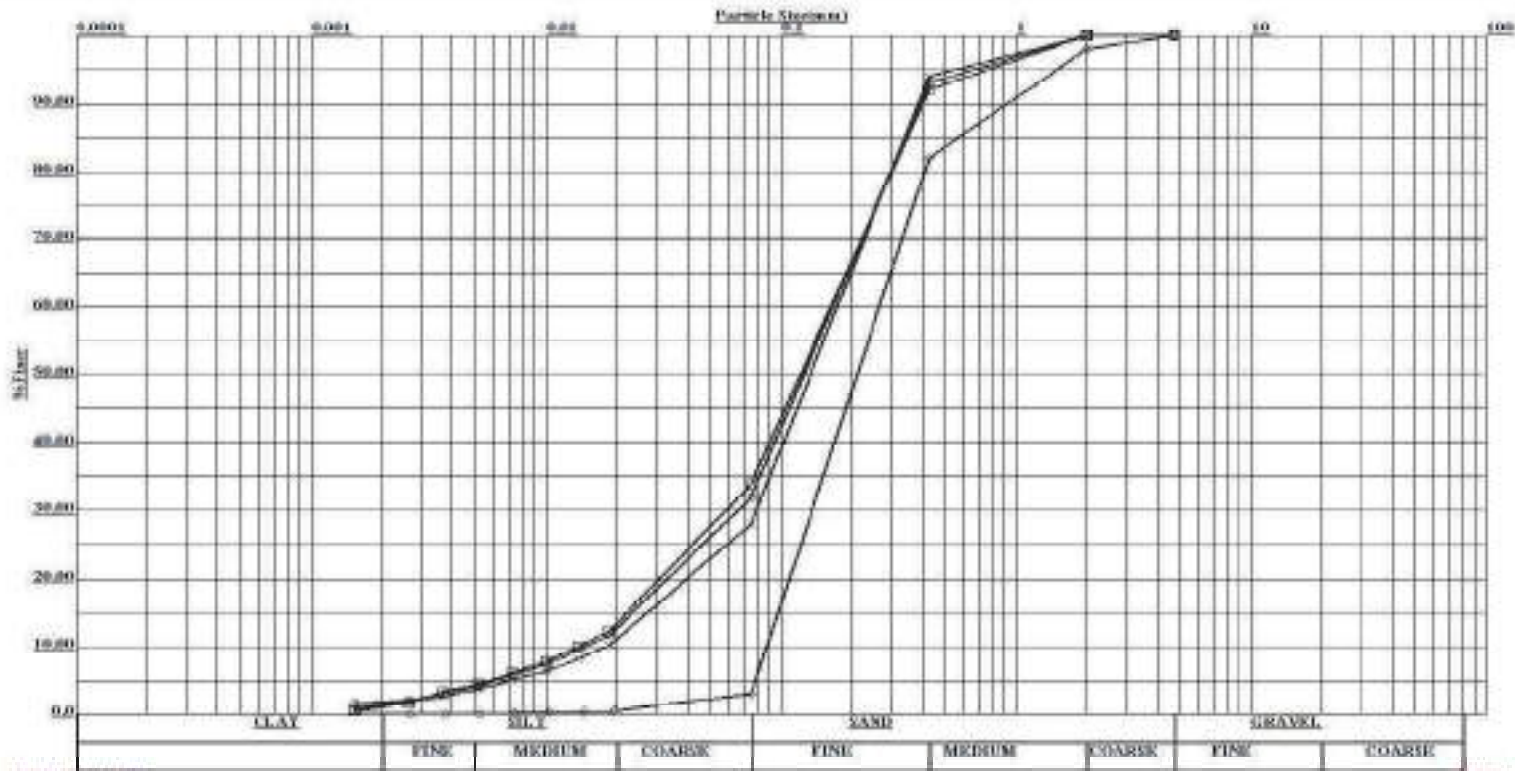


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



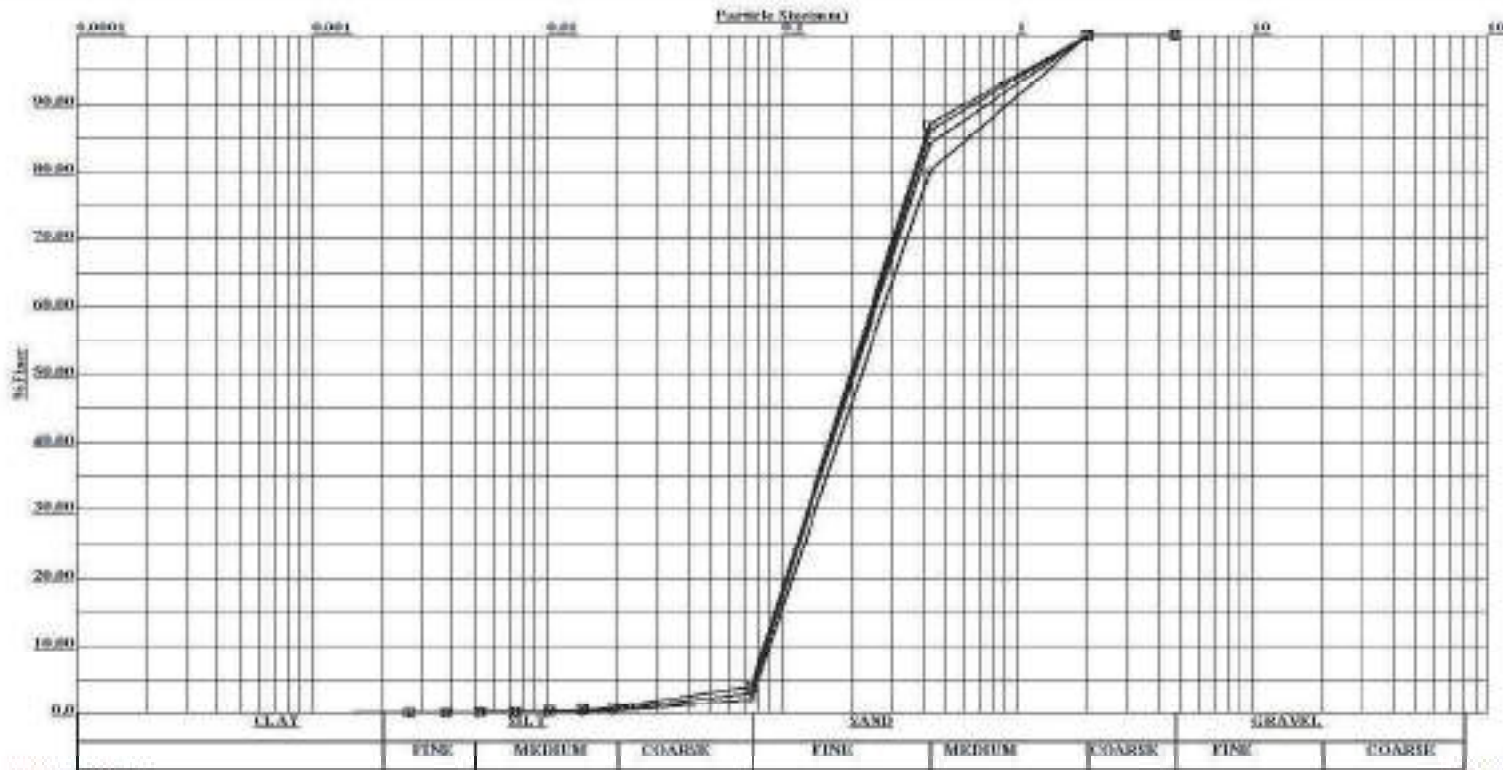
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	MEDIUM , LITE GREY ,SILTY SAND (SM)	0.00	72.00	27.00	1.00	9.55	1.97
○	1.5		0.00	68.00	30.00	2.00	11.12	1.72
□	3.0		0.00	66.00	33.00	1.00	11.84	1.50
◇	6.0	MEDIUM DENSE TO ,DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.00	0.80

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



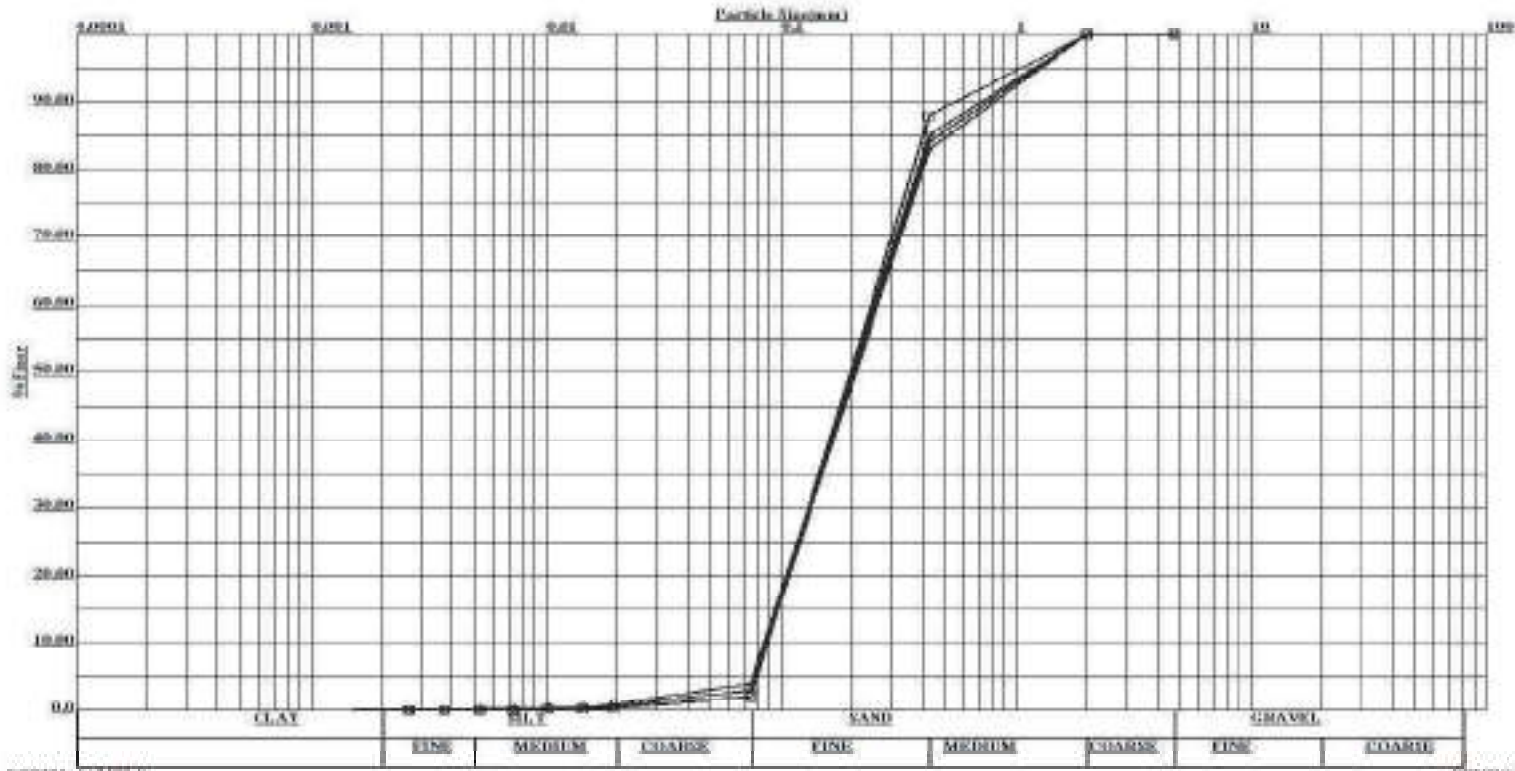
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	9.0	MEDIUM DENSE TO ,DARK GREY, POORLY GRADED SAND (SP)	0.00	96.00	4.00	0.00	2.96	0.81
○	12.0		0.00	97.00	3.00	0.00	2.84	0.81
□	15.0		0.00	96.00	4.00	0.00	2.84	0.81
◇	18.0		0.00	98.00	2.00	0.00	3.04	0.80

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. -01

GRAIN SIZE ANALYSIS



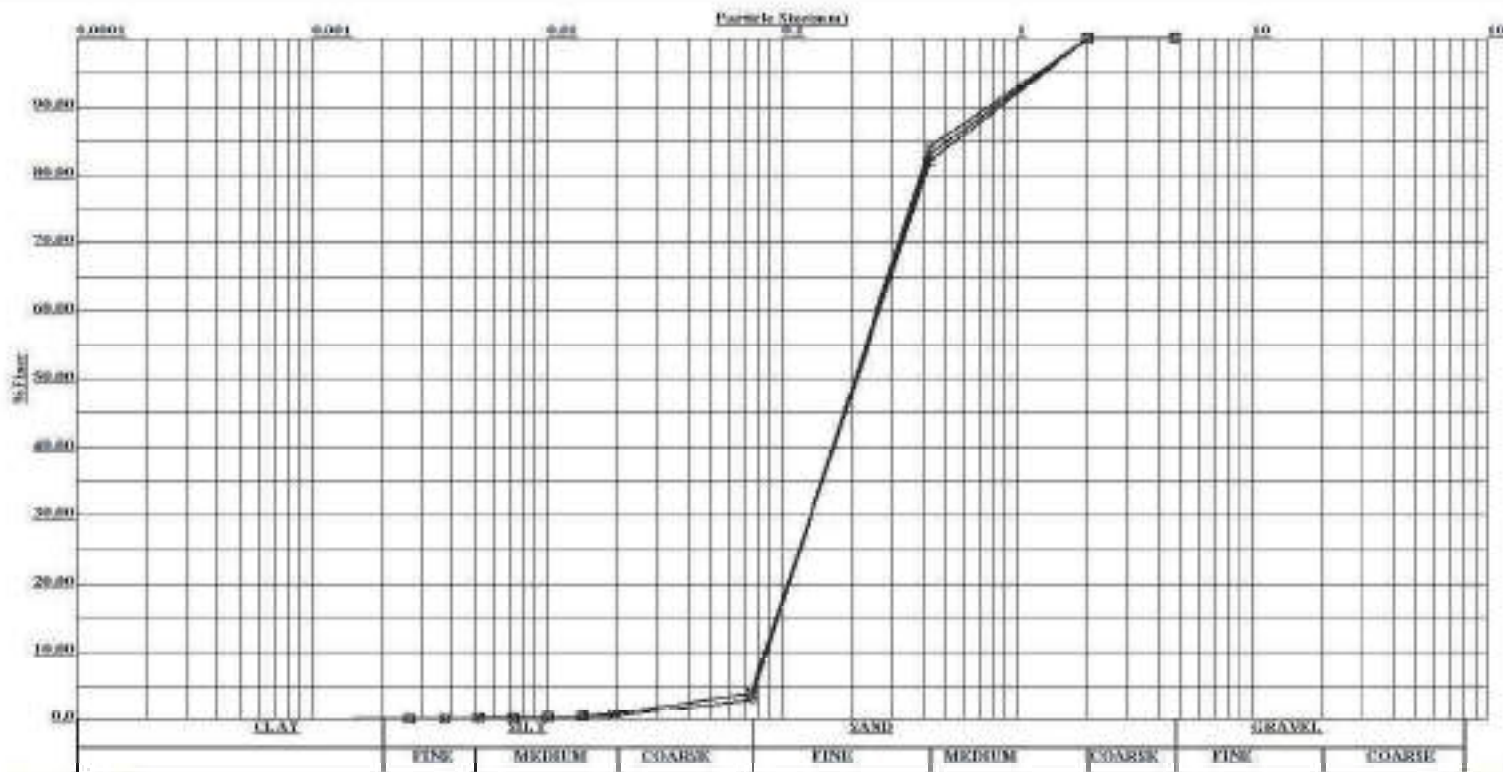
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	21.0	MEDIUM DENSE TO ,DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	2.96	0.81
○	24.0		0.00	96.00	4.00	0.00	2.92	0.81
□	27.0		0.00	98.00	2.00	0.00	2.74	0.82
◇	30.0		0.00	97.00	3.00	0.00	2.92	0.81

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS

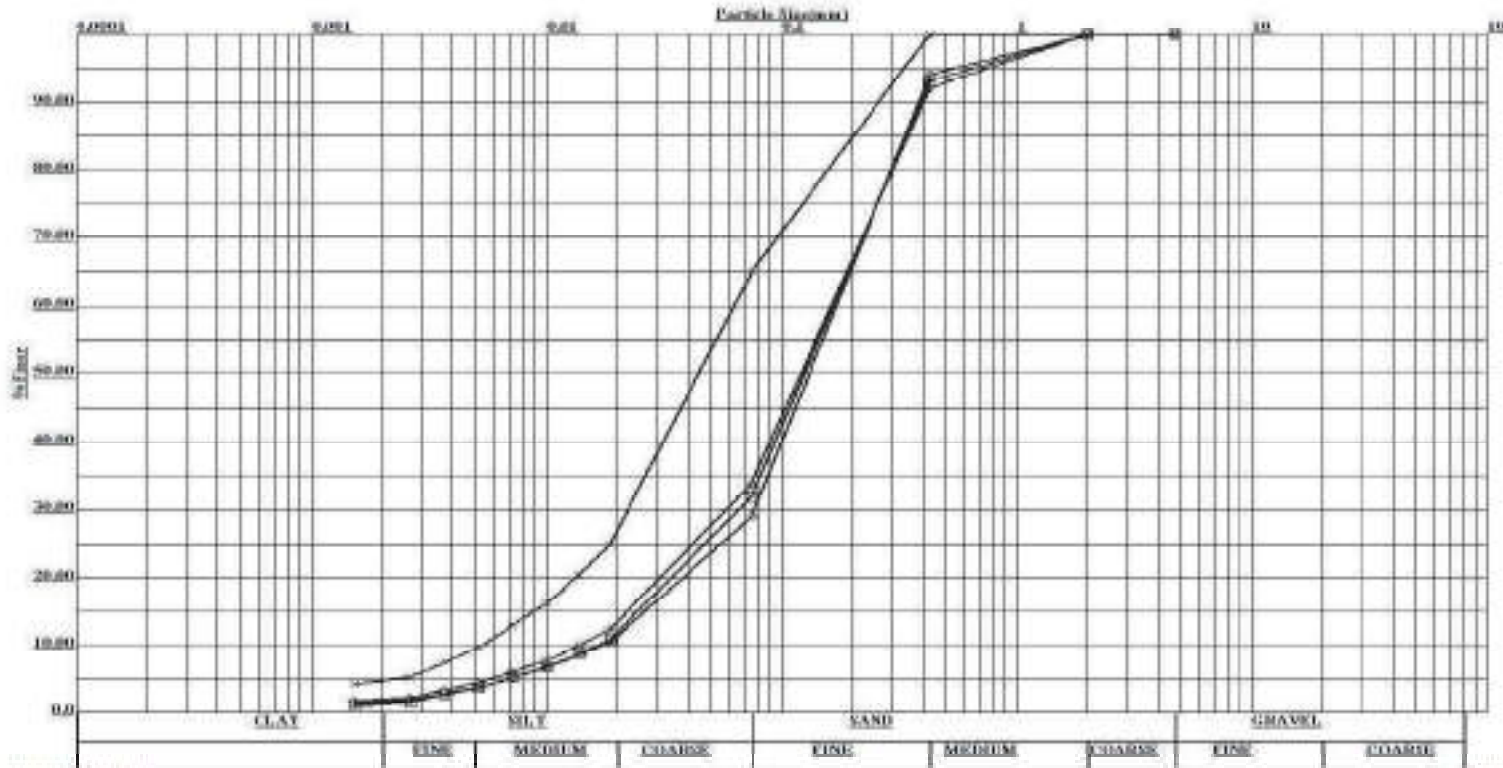


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



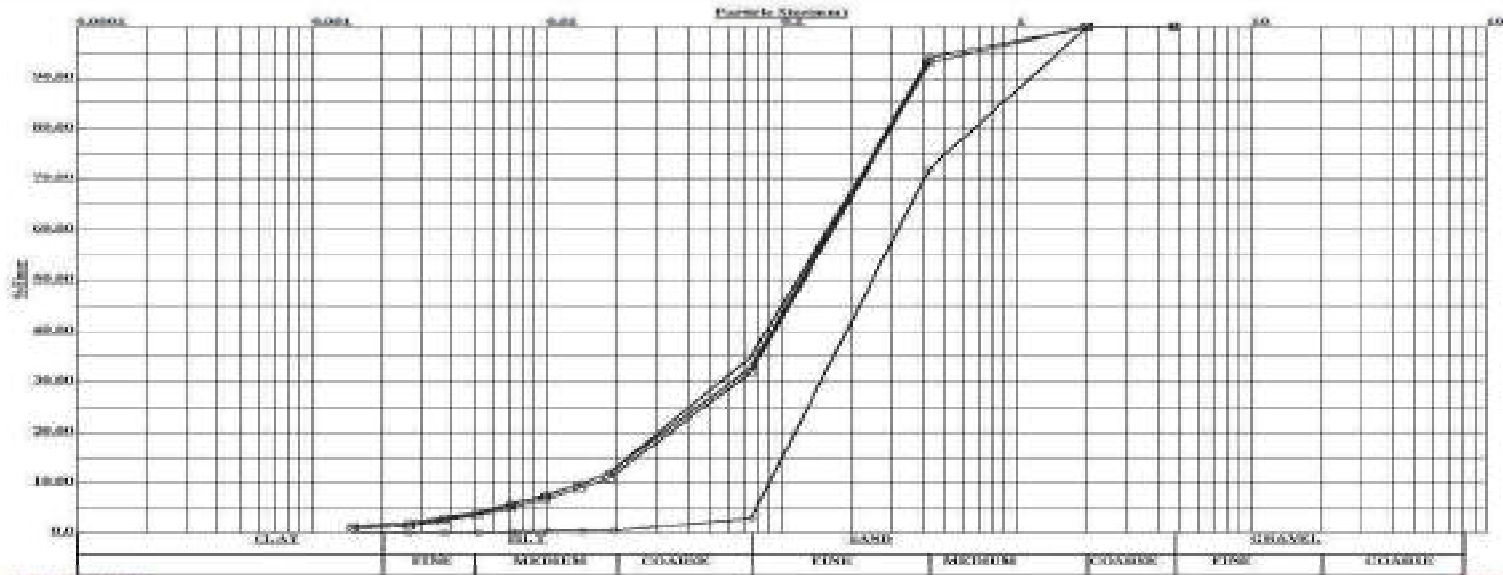
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	LOOSE, LITE BROWN, SANDY SILT (ML)	0.00	35.00	60.00	5.00	11.79	1.48
○	1.5	LOOSE TO MEDIUM DENSE, LITE GREY, SILTY SAND (SM)	0.00	71.00	27.00	2.00	9.96	2.01
□	3.0		0.00	68.00	31.00	1.00	10.28	1.60
◇	6.0		0.00	66.00	32.00	2.00	11.84	1.49

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	9.0	LOOSE TO MEDIUM DENSE, LITE GREY, SILTY SAND (SM)	0.00	65.00	34.00	1.00	11.02	1.35
○	12.0		0.00	67.00	31.00	2.00	11.27	1.63
□	15.0		0.00	68.00	31.00	1.00	10.27	1.60
◇	18.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.51	0.78

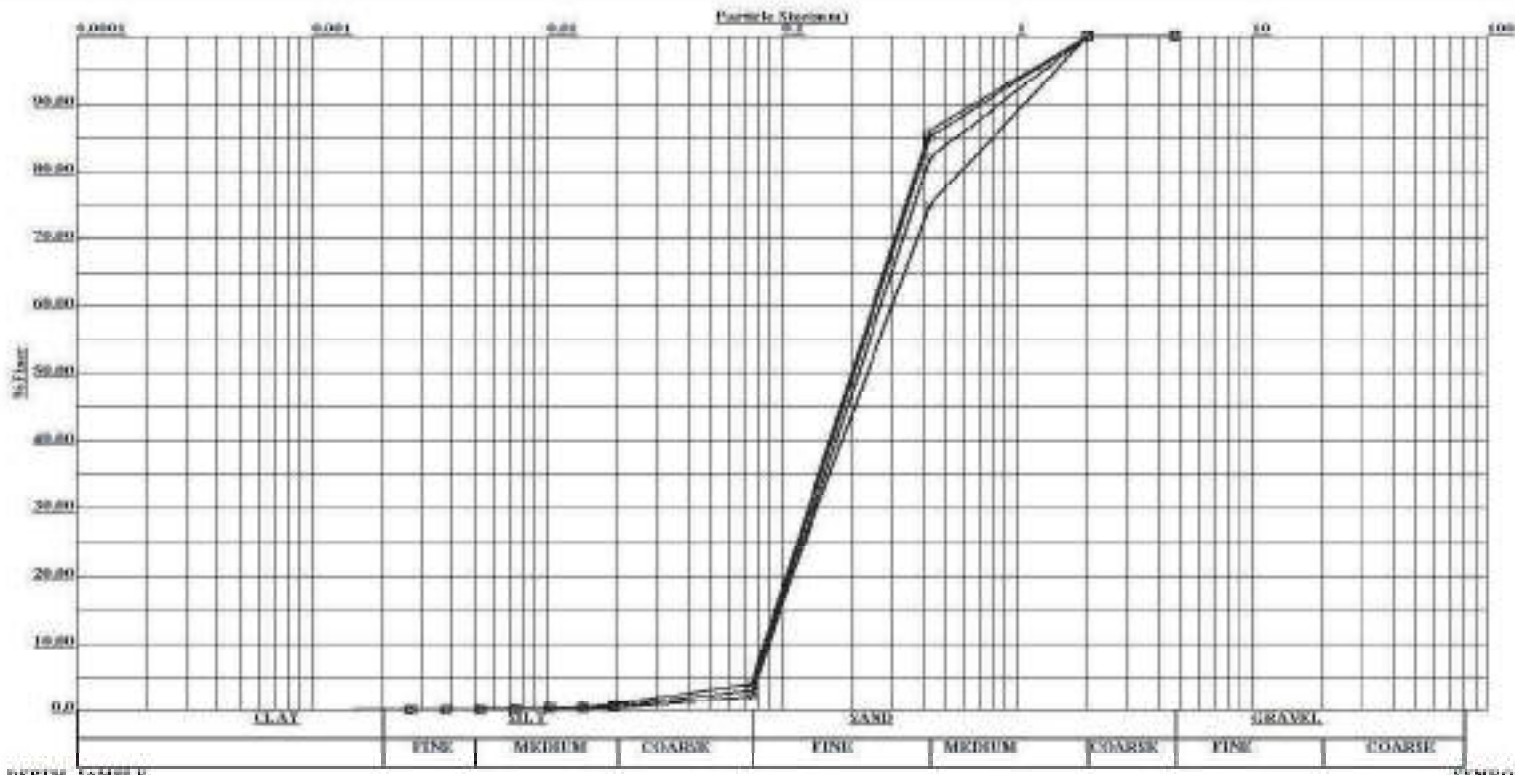


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	21.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	96.00	4.00	0.00	3.39	0.78
○	24.0		0.00	98.00	2.00	0.00	2.96	0.81
□	27.0		0.00	97.00	3.00	0.00	2.88	0.81
◇	30.0		0.00	96.00	4.00	0.00	2.88	0.81

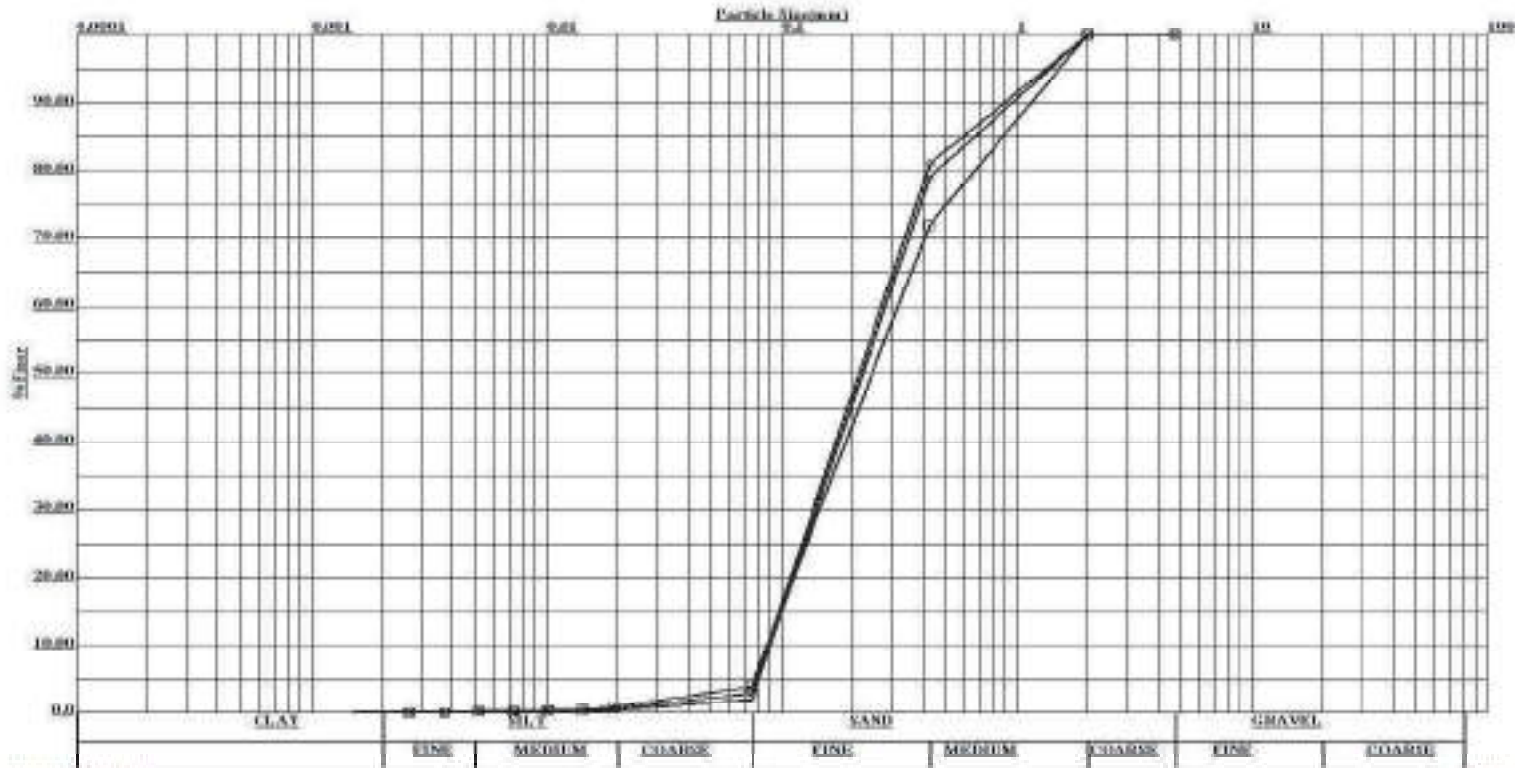


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 26  
SECTION:CHITAUNI-MADHUBANI

BOREHOLE NO. -02

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	33.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	98.00	2.00	0.00	3.08	0.80
○	36.0		0.00	97.00	3.00	0.00	3.04	0.80
□	39.0		0.00	96.00	4.00	0.00	3.58	0.77

### COMPUTATION OF WEIGHTED MEAN DIAMETER OF PARTICLES AND SILT FACTOR

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. BR-26				BOREHOLE NO-01								Section : CHITAUNI TO MADHUBANI														
Sl.No.	Borehole No.	Depth (m)		Description of the Soil Strata	IS Classification	Percentage Retained							Mean Particle Size (mm)							Sandy Strata		Clayey Soil				
		From	To			5.60 to 4.00	4.00 to 2.80	2.80 to 1.00	1.00 to 0.425	0.425 to 0.180	0.180 to 0.075	0.075 to 0	4.8	3.4	1.9	0.7125	0.3025	0.1275	0.0375	Mean Particle Size (dm)	Silt Factor in the layer= 1.76 x sqrt(dm)	Average Cohesion Intercept - c (kg/sqcm)	Average Angle of Internal Friction (°)	F	Silt Factor = $\frac{K_{sf}}{F \times (1 + \sqrt{c})}$	
1	BH-01	0.00	1.00	SILTY SAND	SM	0.0	0.0	0.0	6.0	45.0	25.0	24.00	0.00	0.00	0.00	4.28	13.61	3.19	0.900	0.220	0.825	-	-	-	-	
2		3.00	3.45			0.0	0.0	0.0	8.0	42.0	16.0	34.00	0.00	0.00	0.00	5.70	12.71	2.04	1.275	0.217	0.820	-	-	-	-	
3		6.00	6.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	18.0	47.0	32.0	3.00	0.00	0.00	0.00	12.83	14.22	4.08	0.113	0.312	0.984	-	-	-	-	
		9.00	9.45			0.0	0.0	0.0	16.0	49.0	31.0	4.00	0.00	0.00	0.00	11.40	14.82	3.95	0.150	0.303	0.969	-	-	-	-	
		12.00	12.45			0.0	0.0	0.0	14.0	48.0	35.0	3.0	0.0	0.0	0.0	9.98	14.52	4.46	0.113	0.291	0.949	-	-	-	-	
		15.00	15.45			0.0	0.0	0.0	13.0	61.0	22.0	4.0	0.0	0.0	0.0	9.3	18.5	2.8	0.15	0.31	0.975	-	-	-	-	
		18.00	18.45			0.0	0.0	0.0	20.0	42.0	36.0	2.0	0.0	0.0	0.0	14.25	12.71	4.59	0.075	0.316	0.990	-	-	-	-	
		21.00	21.45			0.0	0.0	0.0	17.0	45.0	35.0	3.0	0.0	0.0	0.0	12.1	13.6	4.5	0.11	0.30	0.969	-	-	-	-	
		27.00	27.45			0.0	0.0	0.0	12.0	49.0	37.0	2.00	0.00	0.00	0.00	8.55	14.82	4.72	0.075	0.282	0.934	-	-	-	-	

### COMPUTATION OF WEIGHTED MEAN DIAMETER OF PARTICLES AND SILT FACTOR

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. BR-26

BOREHOLE NO-02

Section : CHITAUNI TO MADHUBANI

Sl.No.	Borehole No.	Depth (m)		Description of the Soil Strata	IS Classification	Percentage Retained							Mean Particle Size (mm)							Sandy Strata		Clayey Soil				
		From	To			5.60 to 4.00	4.00 to 2.80	2.80 to 1.00	1.00 to 0.425	0.425 to 0.180	0.180 to 0.075	0.075 to 0	4.8	3.4	1.9	0.7125	0.3025	0.1275	0.0375	Mean Particle Size (dm)	Silt Factor in the layer= $1.76 \times \sqrt{\text{dm}}$	Average Cohesion Intercept - c (kg/sqcm)	Average Angle of Internal Friction ( $^{\circ}$ )	F	Silt Factor = $\frac{K_{sc}}{F \times (1 + \sqrt{c})}$	
1	BH-02	0.00	1.00	SANDY SILT	ML	0.0	0.0	0.0	0.0	27.0	8.0	65.00	0.00	0.00	0.00	0.00	8.17	1.02	2.438	0.116	0.600	-	-	-	-	-
2		3.00	3.45	SILTY SAND	SM	0.0	0.0	0.0	7.0	42.0	19.0	32.00	0.00	0.00	0.00	4.99	12.71	2.42	1.200	0.213	0.813	-	-	-	-	-
3		6.00	6.45			0.0	0.0	0.0	8.0	40.0	18.0	34.00	0.00	0.00	0.00	5.70	12.10	2.30	1.275	0.214	0.814	-	-	-	-	-
		9.00	9.45			0.0	0.0	0.0	7.0	39.0	19.0	35.00	0.00	0.00	0.00	4.99	11.80	2.42	1.313	0.205	0.797	-	-	-	-	-
		12.00	12.45			0.0	0.0	0.0	6.0	38.0	23.0	33.0	0.0	0.0	0.0	4.28	11.50	2.93	1.238	0.199	0.786	-	-	-	-	-
		15.00	15.45			0.0	0.0	0.0	7.0	42.0	19.0	32.0	0.0	0.0	0.0	5.0	12.7	2.4	1.20	0.21	0.813	-	-	-	-	-
		18.00	18.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	28.0	42.0	27.0	3.0	0.0	0.0	0.0	19.95	12.71	3.44	0.113	0.362	1.059	-	-	-	-	-
		21.00	21.45			0.0	0.0	0.0	25.0	45.0	26.0	4.0	0.0	0.0	0.0	17.8	13.6	3.3	0.15	0.35	1.040	-	-	-	-	-
		27.00	27.45			0.0	0.0	0.0	15.0	44.0	38.0	3.00	0.00	0.00	0.00	10.69	13.31	4.85	0.113	0.290	0.947	-	-	-	-	-



## NORTH EASTERN RAILWAY

### FINAL LOCATION SURVEY FOR NEW B.G RAILWAY LINE PROJECTS (770.00 KM.) AND FINAL LOCATION SURVEY FOR CONSTRUCTION OF DOUBLING/THIRD LINE/ 3RD & 4TH LINE (252.00 KM.) OF NORTH EASTERN RAILWAY (TOTAL 1022.00 KM)

#### SECTION: CHITAUNI-MADHUBANI

Chainage	Br. No	Type of Crossing	Type of Bridge	Borehole No.	Easting (m)	Northing (m)	Reduced Level (m)
16731.660	28	WEATERWAY	MAJOR-BRIDGE	BH-01	204489	2995556	106.81
				BH-02	204496	2995551	106.74
				BH-03	204503	2995545	106.80

SUBMITTED BY:



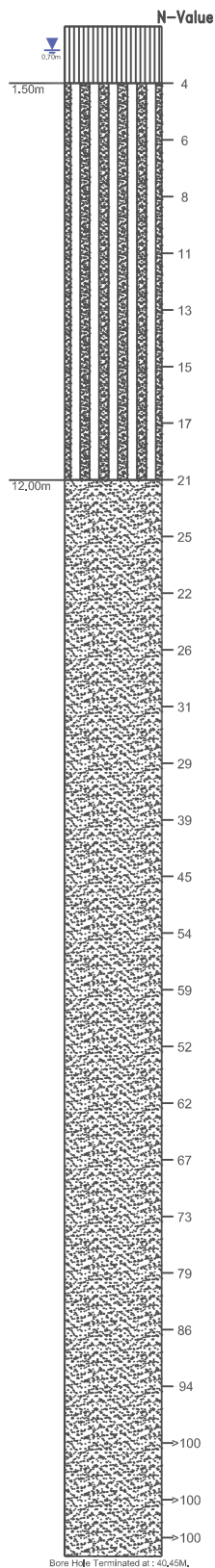
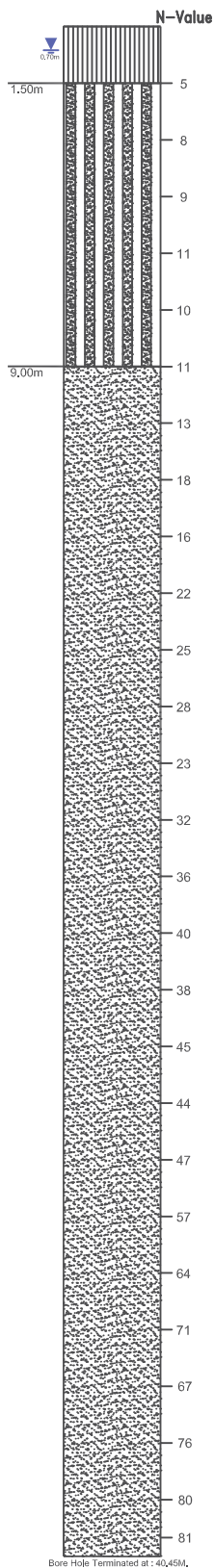
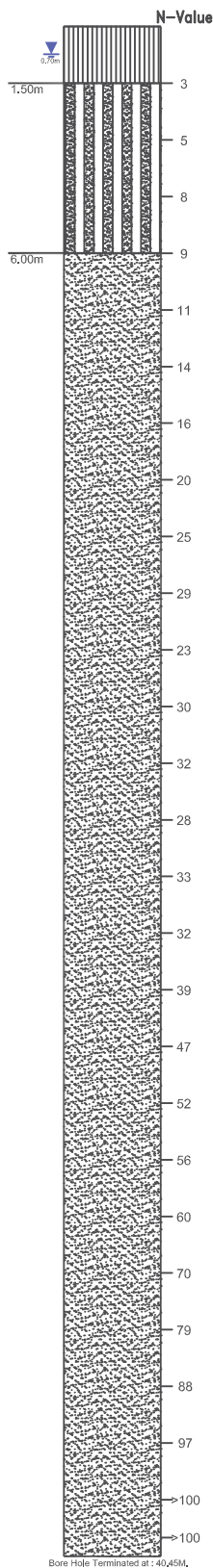
# BOREHOLE PROFILE

## SECTION: CHITAUNI TO MADHUBANI



BRIDGE NO.: 28  
BOREHOLE NO.: 01

BRIDGE NO.: 28  
BOREHOLE NO.: 02

BRIDGE NO.: 28  
BOREHOLE NO.: 03






### LEGENDS

-  SANDY-SILT (ML)
-  SILTY SAND (SM)
-  POORLY GRADED SAND (SP)
-  Ground Water Table




Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO :28 BOREHOLE NO. BH- 1										GWT: 0.70 m		DATE STARTED : 10-01-2025																				DATE COMPLETED : 12-01-2025									
FIELD TEST RESULTS												CONSOLIDATED LOGS INCLUDING LABORATORY TEST RESULTS OF SOIL																													
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 (gm /cc)	DRY DENSITY (gm/cc)	MOISTURE CONTENT (%)	FREESWELL INDEX (%)	SPECIFIC GRAVITY	SUBMERGED DENSITY (gm /cc)	SHEAR STRENGTH CHARACTERISTICS		CONSOLIDATION CHARACTERISTICS	Chemical Analysis Result												
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N VALUE (Recorded)	N VALUE (Corrected)				GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)										Cohesion, C <sub>v</sub> (kg/cm <sup>2</sup> )	Angle of friction (Degrees)		Compression Index(C <sub>c</sub> )	pH	Chloride, %	Sulphate, %	pH	Chloride, mg/l	Sulphate, mg/l						
-1.00	1.0	DS	1	 0.70 m	0.00	1.00	DS	-	-		VERY LOOSE , LITE BROWN, SANDY SILT,(ML)	-	0.00	45.00	51.00	4.00	NON-PLASTIC				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	2.0	SPT	1		1.50	1.95	3	30	3		LOOSE , LITE BROWN, SILTY SAND(SM)	-	0.00	69.00	29.00	2.00	NON-PLASTIC				-	-	-	2.53	-	-	-	-	-	-	-	-	-	-	-						
	3.0	DS	2		2.50	2.80	UDS SLIPPED					-	-	-	-	-					-	-	-	-	-	-	-	-	-	-	-	-	-								
	4.0	SPT	2		3.00	3.45	5	30	5			-	0.00	66.00	33.00	1.00	NON-PLASTIC				-	-	-	2.52	-	-	-	-	-	-	-	-	-	-	-						
-5.00	5.0	SPT	3		4.50	4.95	8	30	8			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	6.0	DS	3		5.50	5.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	7.0	SPT	4		6.00	6.45	9	30	9		MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	-	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.56	-	-	-	-	-	-	-	-	-	-	-						
	8.0	SPT	5		7.50	7.95	11	30	11			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	9.0	DS	4		8.50	8.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
-10.00	10.0	SPT	6		9.00	9.45	14	30	14			-	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-	-	-						
	11.0	SPT	7		10.50	10.95	16	30	16			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	12.0	DS	5		11.50	11.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	13.0	SPT	8		12.00	12.45	20	30	20			-	0.00	98.00	2.00	0.00	NON-PLASTIC				-	-	-	2.54	-	-	-	-	-	-	-	-	-	-	-						
	14.0	SPT	9		13.50	13.95	25	30	25			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-15.00	15.0	DS	6		14.50	14.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	16.0	SPT	10		15.00	15.45	29	30	29			-	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-	-	-						
	17.0	SPT	11		16.50	16.95	23	30	23			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	18.0	DS	7		17.50	17.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
-20.00	19.0	SPT	12		18.00	18.45	30	30	30			-	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.59	-	-	-	-	-	-	-	-	-	-	-						
	20.0	SPT	13		19.50	19.95	32	30	32			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	21.0	DS	8		20.50	20.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	22.0	SPT	14		21.00	21.45	28	30	28			-	0.00	98.00	2.00	0.00	NON-PLASTIC				-	-	-	2.60	-	-	-	-	-	-	-	-	-	-	-						
	23.0	SPT	15		22.50	22.95	33	30	33			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-25.00	24.0	DS	9		23.50	23.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	25.0	SPT	16		24.00	24.45	32	30	32			-	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.58	-	-	-	-	-	-	-	-	-	-	-						
	26.0	SPT	17		25.50	25.95	39	30	39			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	27.0	DS	10		26.50	26.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	28.0	SPT	18		27.00	27.45	47	30	47			-	0.00	98.00	2.00	0.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-	-	-						
	29.0	SPT	19		28.50	28.95	52	30	52			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-30.00	30.0	DS	11		29.50	29.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	31.0	SPT	20		30.00	30.45	56	30	56			-	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.57	-	-	-	-	-	-	-	-	-	-	-						
	32.0	SPT	21		31.50	31.95	60	30	60			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	33.0	DS	12		32.50	32.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
-35.00	34.0	SPT	22		33.00	33.45	70	30	70			-	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.60	-	-	-	-	-	-	-	-	-	-	-						
	35.0	SPT	23		34.50	34.95	79	30	79			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
	36.0	DS	13		35.50	35.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	37.0	SPT	24		36.00	36.45	88	30	88			-	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.59	-	-	-	-	-	-	-	-	-	-	-						
	38.0	SPT	25		37.50	37.95	97	30	97			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-40.00	39.0	DS	14		38.50	38.80	UDS SLIPPED					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
	40.0	SPT	26		39.00	39.45	50	1	>100			>100	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.56	-	-	-	-	-	-	-	-	-	-	-						
	41.0	SPT	27		40.00	40.45	50	1	>100			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
CLASSIFICATION OF SOIL AS PER IS : 1498												Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)																													
ABBREVIATION USED : DS = DISTURBED SAMPLE , SPT = STANDARD PENETRATION TEST, UDS = UNDISTURBED SAMPLE, DST = DIRECT SHEAR TEST, UC : UNCONFINED COMPRESSION TEST      UU : UNCONSOLIDATED UNDRAINED TRIAXIAL TEST * UCS BASED ON POINT LOAD TEST												SECTION: CHITAUUNI-MADHUBANI																													







BRIDGE NO :28						DATE STARTED : 15/01/2025		 aarvee associates architects engineers & consultants pvt. ltd.																									
BOREHOLE NO. BH- 3				GWT: 0.90 m		DATE COMPLETED : 16/01/2025																											
FIELD TEST RESULTS												CONSOLIDATED LOGS INCLUDING LABORATORY TEST RESULTS OF SOIL																					
												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 (gm /cc)	DRY DENSITY (gm/cc)	MOISTURE CONTENT (%)	FREESWELL INDEX (%)	SPECIFIC GRAVITY	SUBMERGED DENSITY (gm /cc)	SHEAR STRENGTH CHARACTERISTICS		CONSOLIDATION CHARACTERISTICS	Chemical Analysis Result				
					DEPTH IN METERS	NO. OF BLOWS	PENETRATION (CM)	N VALUE (Recorded)	N VALUE (Corrected)				Cohesion C. (kg/cm <sup>2</sup> )	Angle of friction (Degrees)	Compression Index(Cc)	pH										Chloride, %	Sulphate, %		pH	Chloride, mg/l	Sulphate, mg/l		
-1.00	1.0	DS	1		0,00	1,00	DS	-	-	-	LOOSE , LITE BROWN, SANDY SILT(ML)	--	0,00	40,00	56,00	4,00	NON-PLASTIC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2,0	SPT	1		1,50	1,95	4	30	4	7		--	0,00	71,00	27,00	2,00	NON-PLASTIC			-	-	-	2,51	-	-	-	-	-	-	-	-	-	-
	3,0	DS	2		2,50	2,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	4,0	SPT	2	3,00	3,45	6	30	6	8	--		0,00	69,00	30,00	1,00	NON-PLASTIC			-	-	-	2,52	-	-	-	-	-	-	-	-	-	-	
-5.00	5,0	SPT	3		4,50	4,95	8	30	8	10		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	6,0	DS	3		5,50	5,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	7,0	SPT	4	6,00	6,45	11	30	11	13	--		0,00	67,00	32,00	1,00	NON-PLASTIC			-	-	-	2,54	-	-	-	-	-	-	-	-	-	-	
	8,0	SPT	5		7,50	7,95	13	30	13	14		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	9,0	DS	4		8,50	8,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
-10.00	10,0	SPT	6	9,00	9,45	15	30	15	15	--		0,00	65,00	35,00	0,00	NON-PLASTIC			-	-	-	2,55	-	-	-	-	-	-	-	-	-	-	
	11,0	SPT	7		10,50	10,95	17	30	17	16		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	12,0	DS	5		11,50	11,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	13,0	SPT	8	12,00	12,45	21	30	21	17	--		0,00	98,00	2,00	0,00	NON-PLASTIC			-	-	-	2,56	-	-	-	-	-	-	-	-	-	-	
	14,0	SPT	9		13,50	13,95	25	30	25	19		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
-15.00	15,0	DS	6		14,50	14,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	16,0	SPT	10	15,00	15,45	22	30	22	17	--		0,00	97,00	3,00	0,00	NON-PLASTIC			-	-	-	2,55	-	-	-	-	-	-	-	-	-	-	
	17,0	SPT	11		16,50	16,95	26	30	26	18		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	18,0	DS	7		17,50	17,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	19,0	SPT	12	18,00	18,45	31	30	31	20	--		0,00	96,00	4,00	0,00	NON-PLASTIC			-	-	-	2,60	-	-	-	-	-	-	-	-	-	-	
-20.00	20,0	SPT	13		19,50	19,95	29	30	29	19		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	21,0	DS	8		20,50	20,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	22,0	SPT	14	21,00	21,45	39	30	39	22	--		12,00	84,00	4,00	0,00	NON-PLASTIC			-	-	-	2,59	-	-	-	-	-	-	-	-	-	-	
	23,0	SPT	15		22,50	22,95	45	30	45	24		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	24,0	DS	9		23,50	23,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
-25.00	25,0	SPT	16	24,00	24,45	54	30	54	26	--		11,00	86,00	3,00	0,00	NON-PLASTIC			-	-	-	2,58	-	-	-	-	-	-	-	-	-	-	
	26,0	SPT	17		25,50	25,95	59	30	59	27		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	27,0	DS	10		26,50	26,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	28,0	SPT	18	27,00	27,45	52	30	52	25	--		10,00	86,00	4,00	0,00	NON-PLASTIC			-	-	-	2,56	-	-	-	-	-	-	-	-	-	-	
	29,0	SPT	19		28,50	28,95	62	30	62	27		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
-30.00	30,0	DS	11		29,50	29,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	31,0	SPT	20	30,00	30,45	67	30	67	28	--		9,00	88,00	3,00	0,00	NON-PLASTIC			-	-	-	2,57	-	-	-	-	-	-	-	-	-	-	
	32,0	SPT	21		31,50	31,95	73	30	73	30		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	33,0	DS	12		32,50	32,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	34,0	SPT	22	33,00	33,45	79	30	79	31	--		10,00	86,00	4,00	0,00	NON-PLASTIC			-	-	-	2,60	-	-	-	-	-	-	-	-	-	-	
-35.00	35,0	SPT	23		34,50	34,95	86	30	86	32		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	36,0	DS	13		35,50	35,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	37,0	SPT	24	36,00	36,45	94	30	94	34	--		12,00	85,00	3,00	0,00	NON-PLASTIC			-	-	-	2,59	-	-	-	-	-	-	-	-	-	-	
	38,0	SPT	25		37,50	37,95	50	1	>100	>100		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
	39,0	DS	14		38,50	38,80	UDS SLIPPED				LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
-40.00	40,0	SPT	26	39,00	39,45	50	1	>100	>100	--		11,00	85,00	4,00	0,00	NON-PLASTIC			-	-	-	2,56	-	-	-	-	-	-	-	-	-	-	
	41,0	SPT	27		40,00	40,45	50	1	>100	>100		--	--	--	--	--				-	-	-	-	-	-	-	-	-	-	-	-	-	
CLASSIFICATION OF SOIL AS PER IS : 1498												Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)																					
ABBREVIATION USED : DS = DISTURBED SAMPLE , SPT = STANDARD PENETRATION TEST, UDS = UNDISTURBED SAMPLE, DST = DIRECT SHEAR TEST, UC : UNCONFINED COMPRESSION TEST																																	

### CALCULATIONS FOR CORRECTED SPT (N) VALUES

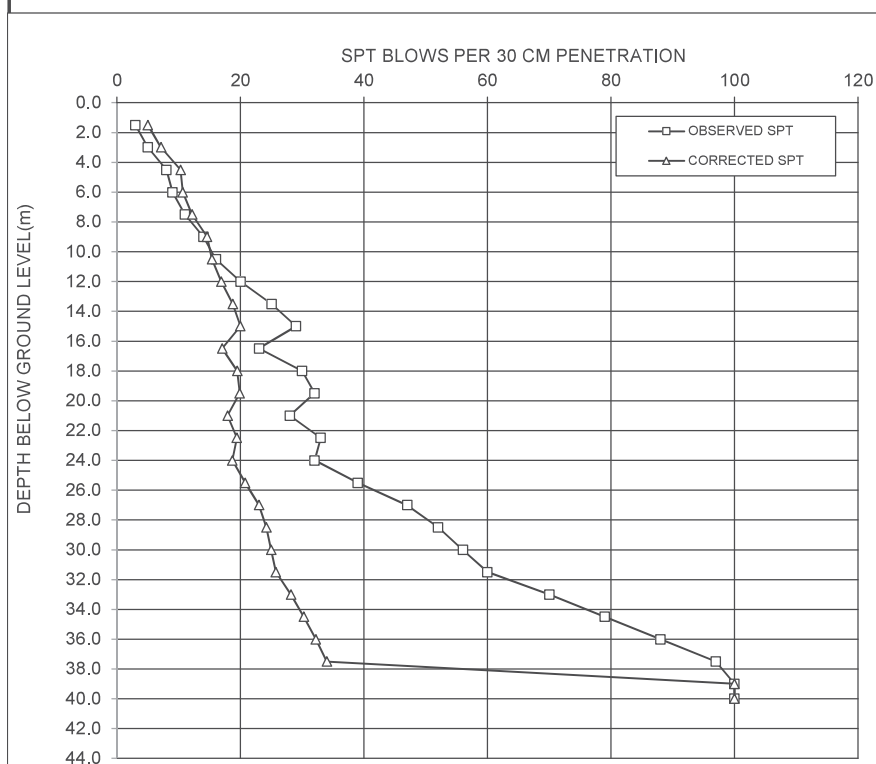
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 1

WATER TABLE - 0.70 m

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
1.50	Non Plastic	3	5	5
3.00	Non Plastic	5	7	7
4.50	Non Plastic	8	10	10
6.00	Non Plastic	9	11	11
7.50	Non Plastic	11	12	12
9.00	Non Plastic	14	15	15
10.50	Non Plastic	16	16	15
12.00	Non Plastic	20	19	17
13.50	Non Plastic	25	23	19
15.00	Non Plastic	29	25	20
16.50	Non Plastic	23	19	17
18.00	Non Plastic	30	24	19
19.50	Non Plastic	32	25	20
21.00	Non Plastic	28	21	18
22.50	Non Plastic	33	24	19
24.00	Non Plastic	32	22	19
25.50	Non Plastic	39	27	21
27.00	Non Plastic	47	31	23
28.50	Non Plastic	52	33	24
30.00	Non Plastic	56	35	25
31.50	Non Plastic	60	36	26
33.00	Non Plastic	70	41	28
34.50	Non Plastic	79	46	30
36.00	Non Plastic	88	49	32
37.50	Non Plastic	97	53	34
39.00	Non Plastic	100	100	100
40.00	Non Plastic	100	100	100

\* SPT value restricted to 300.



### CALCULATIONS FOR CORRECTED SPT (N) VALUES

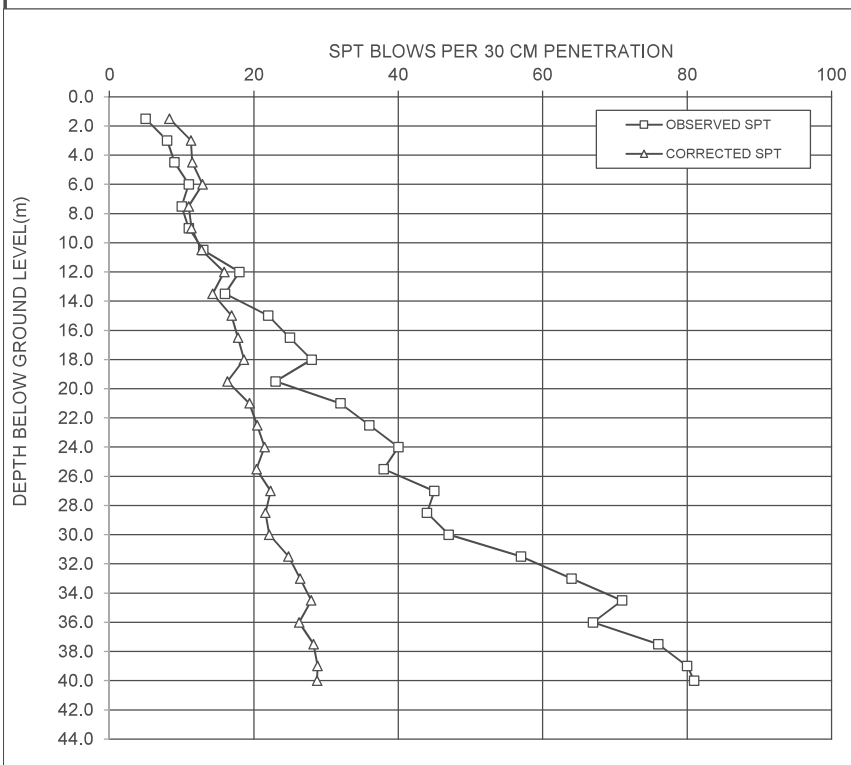
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 2

WATER TABLE IN METER(m) 0.70 m

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
1.50	Non Plastic	5	8	8
3.00	Non Plastic	8	11	11
4.50	Non Plastic	9	11	11
6.00	Non Plastic	11	13	13
7.50	Non Plastic	10	11	11
9.00	Non Plastic	11	11	11
10.50	Non Plastic	13	13	13
12.00	Non Plastic	18	17	16
13.50	Non Plastic	16	14	14
15.00	Non Plastic	22	19	17
16.50	Non Plastic	25	21	18
18.00	Non Plastic	28	22	19
19.50	Non Plastic	23	18	16
21.00	Non Plastic	32	24	19
22.50	Non Plastic	36	26	20
24.00	Non Plastic	40	28	21
25.50	Non Plastic	38	26	20
27.00	Non Plastic	45	30	22
28.50	Non Plastic	44	28	22
30.00	Non Plastic	47	29	22
31.50	Non Plastic	57	35	25
33.00	Non Plastic	64	38	26
34.50	Non Plastic	71	41	28
36.00	Non Plastic	67	38	26
37.50	Non Plastic	76	42	28
39.00	Non Plastic	80	43	29
40.00	Non Plastic	81	43	29

\* SPT value restricted to 300.



### CALCULATIONS FOR CORRECTED SPT (N) VALUES

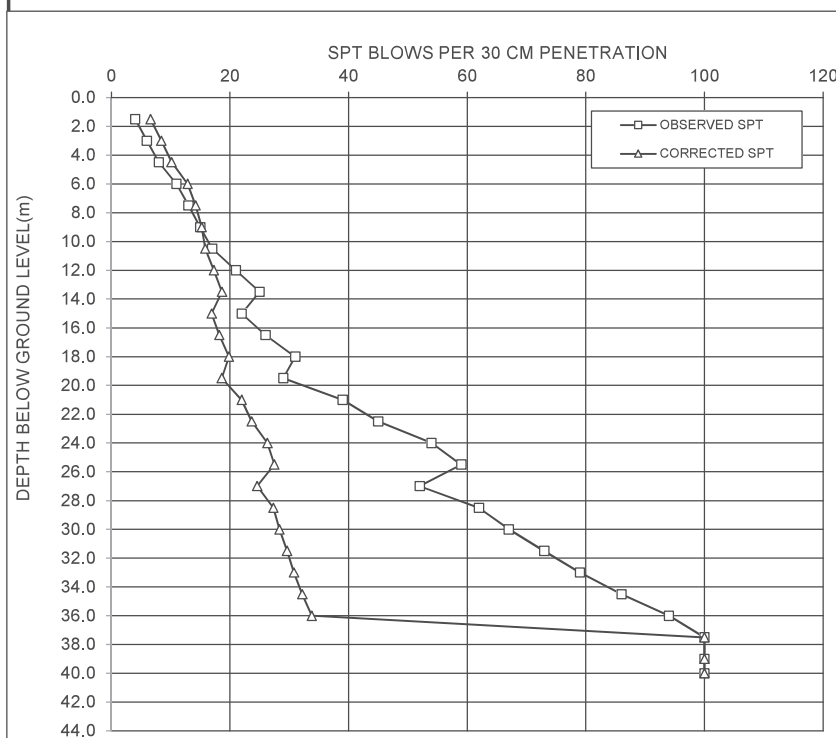
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 3

WATER TABLE- 0.90 m

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
1.50	Non Plastic	4	7	7
3.00	Non Plastic	6	8	8
4.50	Non Plastic	8	10	10
6.00	Non Plastic	11	13	13
7.50	Non Plastic	13	14	14
9.00	Non Plastic	15	15	15
10.50	Non Plastic	17	17	16
12.00	Non Plastic	21	20	17
13.50	Non Plastic	25	22	19
15.00	Non Plastic	22	19	17
16.50	Non Plastic	26	21	18
18.00	Non Plastic	31	25	20
19.50	Non Plastic	29	22	19
21.00	Non Plastic	39	29	22
22.50	Non Plastic	45	32	24
24.00	Non Plastic	54	38	26
25.50	Non Plastic	59	40	27
27.00	Non Plastic	52	34	25
28.50	Non Plastic	62	40	27
30.00	Non Plastic	67	42	28
31.50	Non Plastic	73	44	30
33.00	Non Plastic	79	47	31
34.50	Non Plastic	86	49	32
36.00	Non Plastic	94	53	34
37.50	Non Plastic	100	100	100
39.00	Non Plastic	100	100	100
40.00	Non Plastic	100	100	100

\* SPT value restricted to 300.



### Typical Computation of Liquefaction Potential as per IRC:SP: 114 / IS: 1893

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO: 28

BOREHOLE NO.

BH-01

SECTION: CHITAUNI-MADHUBANI

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 ( % )	Earthquake Zone	Peak ground acceleration $a_{max}/g$	Earth quake magnitude (Mw)	Stress reduction coefficient (rd)	Total overburden pressure ( $\sigma_o$ ), $t/m^2$	Effective overburden ( $\sigma'_o$ ), $t/m^2$	Cyclic Stress ratio (CSR)	$C_N$	CE or CHT	CH or CHW	CB or CBD	CR or CRL	CS or CSS	SPT corrected ( $N_1$ ) <sub>60</sub>	$\alpha$	$\beta$	$(N_1)_{60cs}$	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	SM	3	1.90	0.90	31	IV	0.24	7.00	0.99	2.85	1.35	0.33	1.70	1.33	1.000	1.05	0.75	1.00	5.34	4.77	1.16	10.98	0.12	12.24	0.94	1.00	1.00	1.19	0.15	0.45	Liquefiable
3.00	SM	5	1.92	0.92	34	IV	0.24	7.00	0.98	5.70	2.70	0.32	1.70	1.33	1.000	1.05	0.85	1.00	10.09	4.93	1.19	16.92	0.18	20.20	0.90	1.00	1.00	1.19	0.21	0.67	Liquefiable
4.50	SM	8	1.92	0.92	34	IV	0.24	7.00	0.97	8.58	4.08	0.32	1.57	1.33	1.000	1.05	0.95	1.00	16.62	4.93	1.19	24.68	0.29	34.89	0.83	1.00	1.00	1.19	0.34	1.08	Non Liquefiable
6.00	SP	9	2.02	1.02	3	IV	0.24	7.00	0.95	11.46	5.46	0.31	1.35	1.33	1.000	1.05	0.95	1.00	16.16	0.00	1.00	16.16	0.17	33.86	0.83	1.00	1.00	1.19	0.21	0.66	Liquefiable
7.50	SP	11	2.02	1.02	3	IV	0.24	7.00	0.94	14.49	6.99	0.30	1.20	1.33	1.000	1.05	0.95	1.00	17.45	0.00	1.00	17.45	0.19	36.77	0.82	1.00	1.00	1.19	0.22	0.73	Liquefiable
9.00	SP	14	2.01	1.01	4	IV	0.24	7.00	0.93	17.52	8.52	0.30	1.08	1.33	1.000	1.05	1	1.00	21.18	0.00	1.00	21.18	0.23	45.16	0.77	1.00	1.00	1.19	0.28	0.92	Liquefiable
10.50	SP	16	2.01	1.01	4	IV	0.24	7.00	0.89	20.54	10.04	0.29	1.00	1.33	1.000	1.05	1	1.00	22.31	0.00	1.00	22.31	0.25	47.69	0.76	1.00	1.00	1.19	0.29	1.03	Non Liquefiable
12.00	SP	20	2.02	1.02	2	IV	0.24	7.00	0.85	23.55	11.55	0.27	0.93	1.33	1.000	1.05	1	1.00	25.99	0.00	1.00	25.99	0.31	55.97	0.72	0.96	1.00	1.19	0.36	1.32	Non Liquefiable
13.50	SP	25	2.02	1.02	2	IV	0.24	7.00	0.81	26.58	13.08	0.26	0.87	1.33	1.000	1.05	1	1.00	30.53	0.00	1.00	30.53	NA	65.53	0.67	0.92	1.00	1.19	NA	>1.0	Non Liquefiable
15.00	SP	29	2.04	1.04	3	IV	0.24	7.00	0.77	29.61	14.61	0.24	0.83	1.33	1.000	1.05	1	1.00	33.51	0.00	1.00	33.51	NA	68.51	0.66	0.88	1.00	1.19	NA	>1.0	Non Liquefiable
16.50	SP	23	2.04	1.04	3	IV	0.24	7.00	0.73	32.67	16.17	0.23	0.79	1.33	1.000	1.05	1	1.00	25.26	0.00	1.00	25.26	0.30	54.33	0.73	0.88	1.00	1.19	0.31	1.35	Non Liquefiable
18.00	SP	30	2.02	1.02	4	IV	0.24	7.00	0.69	35.73	17.73	0.22	0.75	1.33	1.000	1.05	1	1.00	31.46	0.00	1.00	31.46	NA	66.46	0.67	0.83	1.00	1.19	NA	>1.0	Non Liquefiable
19.50	SP	32	2.02	1.02	4	IV	0.24	7.00	0.65	38.76	19.26	0.21	0.72	1.33	1.000	1.05	1	1.00	32.20	0.00	1.00	32.20	NA	67.20	0.66	0.80	1.00	1.19	NA	>1.0	Non Liquefiable
21.00	SP	28	2.03	1.03	2	IV	0.24	7.00	0.61	41.79	20.79	0.19	0.69	1.33	1.000	1.05	1	1.00	27.12	0.00	1.00	27.12	0.34	58.52	0.71	0.81	1.00	1.19	0.33	1.71	Non Liquefiable
22.50	SP	33	2.03	1.03	2	IV	0.24	7.00	0.57	44.84	22.34	0.18	0.67	1.33	1.000	1.05	1	1.00	30.84	0.00	1.00	30.84	NA	65.84	0.67	0.77	1.00	1.19	NA	>1.0	Non Liquefiable

Note: Values of all Parameters are as per IRC:SP: 114 / IS 1893: 2016

$C_E$  or  $C_{HT}$  (Correction for hammer energy ratio) =  $ER/60$ , ER for Rope and pulley System = 80 % , Hence  $C_E = 80/60 = 1.33$

$C_H$  or  $C_{HW}$  (Correction for hammer ) = 1.00

Borehole Diameter = 150 mm , Hence  $C_B$  or  $C_{BD}$  (Correction for Borehole diameter), = 1.05

$C_S$  or  $C_{SS}$  (Correction for Standard sampler) = 1.00

$K_\sigma$  Correction for high overburden stress (for effective oberburden pressure > 10 T/m<sup>2</sup>)

$K_\alpha$  Correction for static shear stress is required only for sloping ground

**Typical Computation of Liquefaction Potential as per IRC:SP: 114 / IS: 1893**

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO: 28

BOREHOLE NO.

BH-02

SECTION: CHITAUUNI-MADHUBANI

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 ( % )	Earthquake Zone	Peak ground acceleration $a_{max}/g$	Earth quake magnitude (Mw)	Stress reduction coefficient (rd)	Total overburden pressure ( $\sigma_o$ ), $t/m^2$	Effective overburden ( $\sigma_o$ ), $t/m^2$	Cyclic Stress ratio (CSR)	$C_N$	CE or CHT	CH or CHW	CB or CBD	CR or CRL	CS or CSS	SPT corrected ( $N_1$ ) <sub>60</sub>	$\alpha$	$\beta$	( $N_1$ ) <sub>60cs</sub>	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	SM	5	1.90	0.90	28	IV	0.24	7.00	0.99	2.85	1.35	0.33	1.70	1.33	1.000	1.05	0.75	1.00	8.90	4.56	1.14	14.69	0.16	18.17	0.91	1.00	1.00	1.19	0.19	0.58	Liquefiable
3.00	SM	8	2.00	1.00	30	IV	0.24	7.00	0.98	5.70	2.70	0.32	1.70	1.33	1.000	1.05	0.85	1.00	16.14	4.71	1.15	23.34	0.26	33.82	0.83	1.00	1.00	1.19	0.31	0.97	Liquefiable
4.50	SM	9	2.00	1.00	30	IV	0.24	7.00	0.97	8.70	4.20	0.31	1.54	1.33	1.000	1.05	0.95	1.00	18.42	4.71	1.15	25.97	0.31	38.95	0.81	1.00	1.00	1.19	0.37	1.19	Non Liquefiable
6.00	SM	11	2.01	1.01	31	IV	0.24	7.00	0.95	11.70	5.70	0.31	1.32	1.33	1.000	1.05	0.95	1.00	19.33	4.77	1.16	27.24	0.35	40.99	0.80	1.00	1.00	1.19	0.41	1.35	Non Liquefiable
7.50	SM	10	2.01	1.01	31	IV	0.24	7.00	0.94	14.72	7.22	0.30	1.18	1.33	1.000	1.05	0.95	1.00	15.62	4.77	1.16	22.93	0.26	32.64	0.84	1.00	1.00	1.19	0.31	1.02	Non Liquefiable
9.00	SP	11	2.02	1.02	2	IV	0.24	7.00	0.93	17.73	8.73	0.30	1.07	1.33	1.000	1.05	1	1.00	16.44	0.00	1.00	16.44	0.17	34.49	0.83	1.00	1.00	1.19	0.21	0.71	Liquefiable
10.50	SP	13	2.02	1.02	2	IV	0.24	7.00	0.89	20.76	10.26	0.28	0.99	1.33	1.000	1.05	1	1.00	17.92	0.00	1.00	17.92	0.19	37.83	0.81	1.00	1.00	1.19	0.23	0.80	Liquefiable
12.00	SP	18	2.03	1.03	3	IV	0.24	7.00	0.85	23.79	11.79	0.27	0.92	1.33	1.000	1.05	1	1.00	23.15	0.00	1.00	23.15	0.26	49.59	0.75	0.96	1.00	1.19	0.30	1.11	Non Liquefiable
13.50	SP	16	2.03	1.03	3	IV	0.24	7.00	0.81	26.84	13.34	0.26	0.87	1.33	1.000	1.05	1	1.00	19.35	0.00	1.00	19.35	0.21	41.04	0.79	0.94	1.00	1.19	0.23	0.91	Liquefiable
15.00	SP	22	2.02	1.02	4	IV	0.24	7.00	0.77	29.88	14.88	0.24	0.82	1.33	1.000	1.05	1	1.00	25.19	0.00	1.00	25.19	0.30	54.17	0.73	0.90	1.00	1.19	0.32	1.31	Non Liquefiable
16.50	SP	25	2.02	1.02	4	IV	0.24	7.00	0.73	32.91	16.41	0.23	0.78	1.33	1.000	1.05	1	1.00	27.25	0.00	1.00	27.25	0.35	58.82	0.71	0.86	1.00	1.19	0.36	1.55	Non Liquefiable
18.00	SP	28	2.01	1.01	3	IV	0.24	7.00	0.69	35.94	17.94	0.22	0.75	1.33	1.000	1.05	1	1.00	29.19	0.00	1.00	29.19	0.42	63.19	0.68	0.83	1.00	1.19	0.42	1.92	Non Liquefiable
19.50	SP	23	2.01	1.01	3	IV	0.24	7.00	0.65	38.96	19.46	0.20	0.72	1.33	1.000	1.05	1	1.00	23.03	0.00	1.00	23.03	0.26	49.31	0.75	0.85	1.00	1.19	0.26	1.28	Non Liquefiable
21.00	SP	32	2.02	1.02	4	IV	0.24	7.00	0.61	41.97	20.97	0.19	0.69	1.33	1.000	1.05	1	1.00	30.86	0.00	1.00	30.86	NA	65.86	0.67	0.78	1.00	1.19	NA	>1.0	Non Liquefiable
22.50	SP	36	2.02	1.02	4	IV	0.24	7.00	0.57	45.00	22.50	0.18	0.67	1.33	1.000	1.05	1	1.00	33.52	0.00	1.00	33.52	NA	68.52	0.66	0.76	1.00	1.19	NA	>1.0	Non Liquefiable

Note: Values of all Parameters are as per IRC:SP: 114 / IS 1893: 2016

$C_E$  or  $C_{HT}$  (Correction for hammer energy ratio) = ER/60, ER for Rope and pully System = 80 % , Hence  $C_E = 80/60 = 1.33$

$C_H$  or  $C_{HW}$  (Correction for hammer ) = 1.00

Borehole Diameter = 150 mm , Hence  $C_B$  or  $C_{BD}$  (Correction for Borehole diameter), = 1.05

$C_S$  or  $C_{SS}$  (Correction for Standard sampler) = 1.00

$K_\sigma$  Correction for high overburden stress (for effective oberburden pressure>10 T/m2)

$K_\alpha$  Correction for static shear stress is required only for sloping ground

**Typical Computation of Liquefaction Potential as per IRC:SP: 114 / IS: 1893**

Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO: 28

BOREHOLE NO.

BH-03

SECTION: CHITAUNI-MADHUBANI

Water table assumed for Calculation: 0.00 m

Depth below EGL, m	Type of Strata	Observed SPT Value	Saturated density (t/m <sup>3</sup> )	Submerged Density (t/m <sup>3</sup> )	Fine Content ( % )	Earthquake Zone	Peak ground acceleration $a_{max}$ /g	Earth quake magnitude (Mw)	Stress reduction coefficient (rd)	Total overburden pressure ( $\sigma_v$ ), t/m <sup>2</sup>	Effective overburden ( $\sigma'_v$ ), t/m <sup>2</sup>	Cyclic Stress ratio (CSR)	$C_N$	CE or CHT	CH or CHW	CB or CBD	CR or CRL	CS or CSS	SPT corrected ( $N_{160}$ )	$\alpha$	$\beta$	( $N_1$ ) <sub>60cs</sub>	$CRR_{N=7.5}$	Relative Density, Dr%	f	$K_v$	$K_\sigma$	MSF	CRR	FOS	Conclusion
1.50	SM	4	1.92	0.92	29	IV	0.24	7.00	0.99	2.88	1.38	0.32	1.70	1.33	1.000	1.05	0.75	1.00	7.12	4.64	1.15	12.80	0.14	15.20	0.92	1.00	1.00	1.19	0.17	0.51	Liquefiable
3.00	SM	6	2.03	1.03	31	IV	0.24	7.00	0.98	5.76	2.76	0.32	1.70	1.33	1.000	1.05	0.85	1.00	12.11	4.77	1.16	18.85	0.20	24.74	0.88	1.00	1.00	1.19	0.24	0.76	Liquefiable
4.50	SM	8	2.03	1.03	31	IV	0.24	7.00	0.97	8.81	4.31	0.31	1.52	1.33	1.000	1.05	0.95	1.00	16.18	4.77	1.16	23.58	0.27	33.90	0.83	1.00	1.00	1.19	0.32	1.03	Non Liquefiable
6.00	SM	11	2.00	1.00	33	IV	0.24	7.00	0.95	11.85	5.85	0.30	1.31	1.33	1.000	1.05	0.95	1.00	19.08	4.88	1.18	27.39	0.35	40.43	0.80	1.00	1.00	1.19	0.42	1.38	Non Liquefiable
7.50	SM	13	2.00	1.00	33	IV	0.24	7.00	0.94	14.85	7.35	0.30	1.17	1.33	1.000	1.05	0.95	1.00	20.12	4.88	1.18	28.61	0.39	42.76	0.79	1.00	1.00	1.19	0.47	1.58	Non Liquefiable
9.00	SM	15	2.01	1.01	35	IV	0.24	7.00	0.93	17.85	8.85	0.29	1.06	1.33	1.000	1.05	1	1.00	22.27	5.00	1.20	31.72	NA	47.60	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
10.50	SM	17	2.01	1.01	35	IV	0.24	7.00	0.89	20.87	10.37	0.28	0.98	1.33	1.000	1.05	1	1.00	23.32	5.00	1.20	32.98	NA	49.97	0.75	0.99	1.00	1.19	NA	>1.0	Non Liquefiable
12.00	SP	21	2.02	1.02	2	IV	0.24	7.00	0.85	23.88	11.88	0.27	0.92	1.33	1.000	1.05	1	1.00	26.91	0.00	1.00	26.91	0.34	58.04	0.71	0.95	1.00	1.19	0.38	1.42	Non Liquefiable
13.50	SP	25	2.02	1.02	2	IV	0.24	7.00	0.81	26.91	13.41	0.25	0.86	1.33	1.000	1.05	1	1.00	30.15	0.00	1.00	30.15	NA	65.15	0.67	0.91	1.00	1.19	NA	>1.0	Non Liquefiable
15.00	SP	22	2.03	1.03	3	IV	0.24	7.00	0.77	29.94	14.94	0.24	0.82	1.33	1.000	1.05	1	1.00	25.14	0.00	1.00	25.14	0.29	54.05	0.73	0.90	1.00	1.19	0.32	1.30	Non Liquefiable
16.50	SP	26	2.03	1.03	3	IV	0.24	7.00	0.73	32.99	16.49	0.23	0.78	1.33	1.000	1.05	1	1.00	28.28	0.00	1.00	28.28	0.38	61.13	0.69	0.86	1.00	1.19	0.39	1.70	Non Liquefiable
18.00	SP	31	2.02	1.02	4	IV	0.24	7.00	0.69	36.03	18.03	0.22	0.74	1.33	1.000	1.05	1	1.00	32.24	0.00	1.00	32.24	NA	67.24	0.66	0.82	1.00	1.19	NA	>1.0	Non Liquefiable
19.50	SP	29	2.20	1.20	4	IV	0.24	7.00	0.65	39.06	19.56	0.20	0.72	1.33	1.000	1.05	1	1.00	28.96	0.00	1.00	28.96	0.41	62.65	0.69	0.81	1.00	1.19	0.39	1.94	Non Liquefiable
21.00	SP	39	2.01	1.01	4	IV	0.24	7.00	0.61	42.36	21.36	0.19	0.68	1.33	1.000	1.05	1	1.00	37.27	0.00	1.00	37.27	NA	72.27	0.64	0.76	1.00	1.19	NA	>1.0	Non Liquefiable
22.50	SP	45	2.01	1.01	4	IV	0.24	7.00	0.57	45.38	22.88	0.18	0.66	1.33	1.000	1.05	1	1.00	41.55	0.00	1.00	41.55	NA	76.55	0.62	0.73	1.00	1.19	NA	>1.0	Non Liquefiable

**Note:** Values of all Parameters are as per IRC:SP: 114 / IS 1893: 2016

$C_E$  or  $C_{HT}$  (Correction for hammer energy ratio) = ER/60, ER for Rope and pulley System = 80 % , Hence  $C_E$  = 80/60 = 1.33

$C_H$  or  $C_{HW}$  (Correction for hammer) = 1.00

Borehole Diameter = 150 mm , Hence  $C_B$  or  $C_{BD}$  (Correction for Borehole diameter), = 1.05

$C_S$  or  $C_{SS}$  (Correction for Standard sampler) = 1.00

$K_\sigma$  Correction for high overburden stress (for effective oberburden pressure>10 T/m2)

$K_v$  Correction for static shear stress is required only for sloping ground

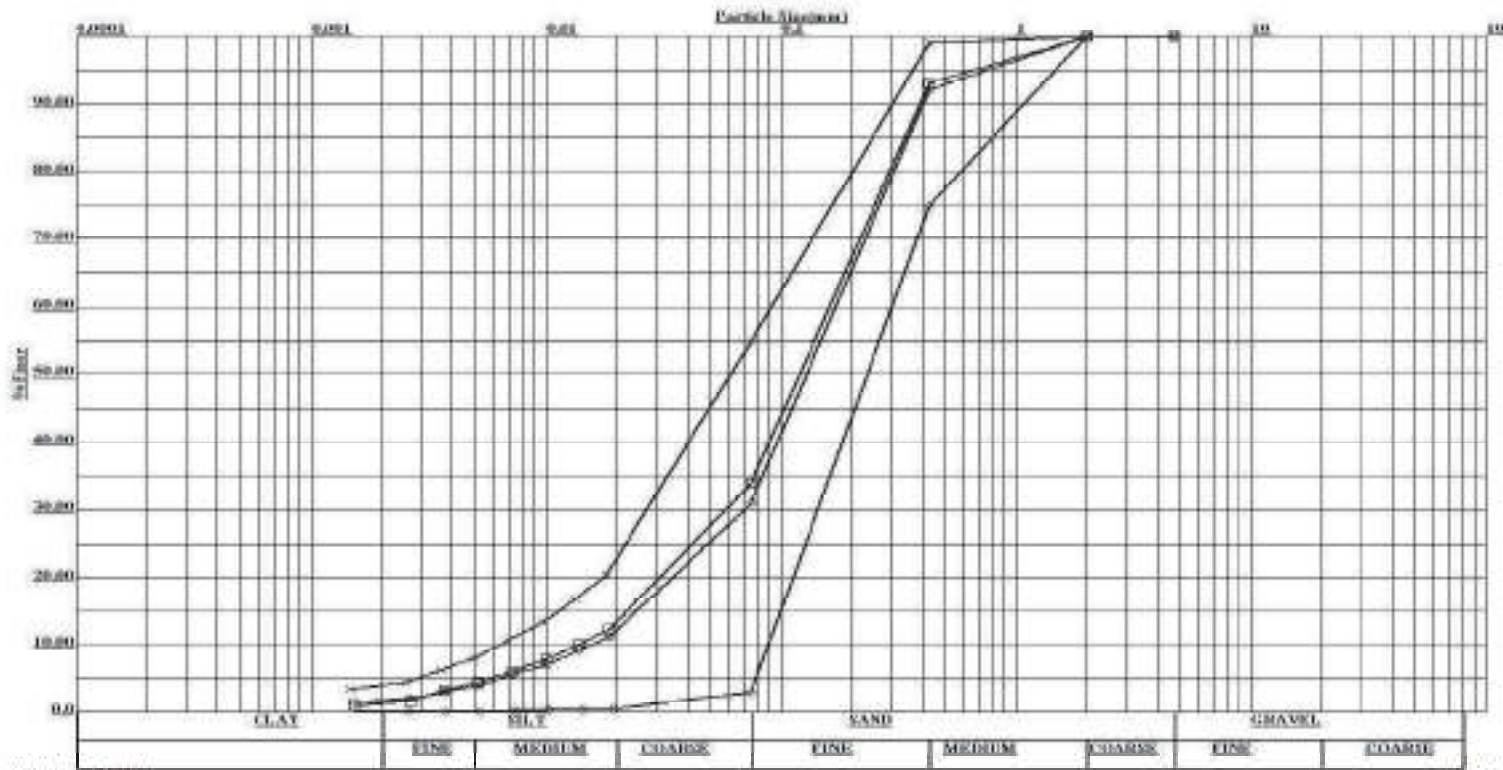


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



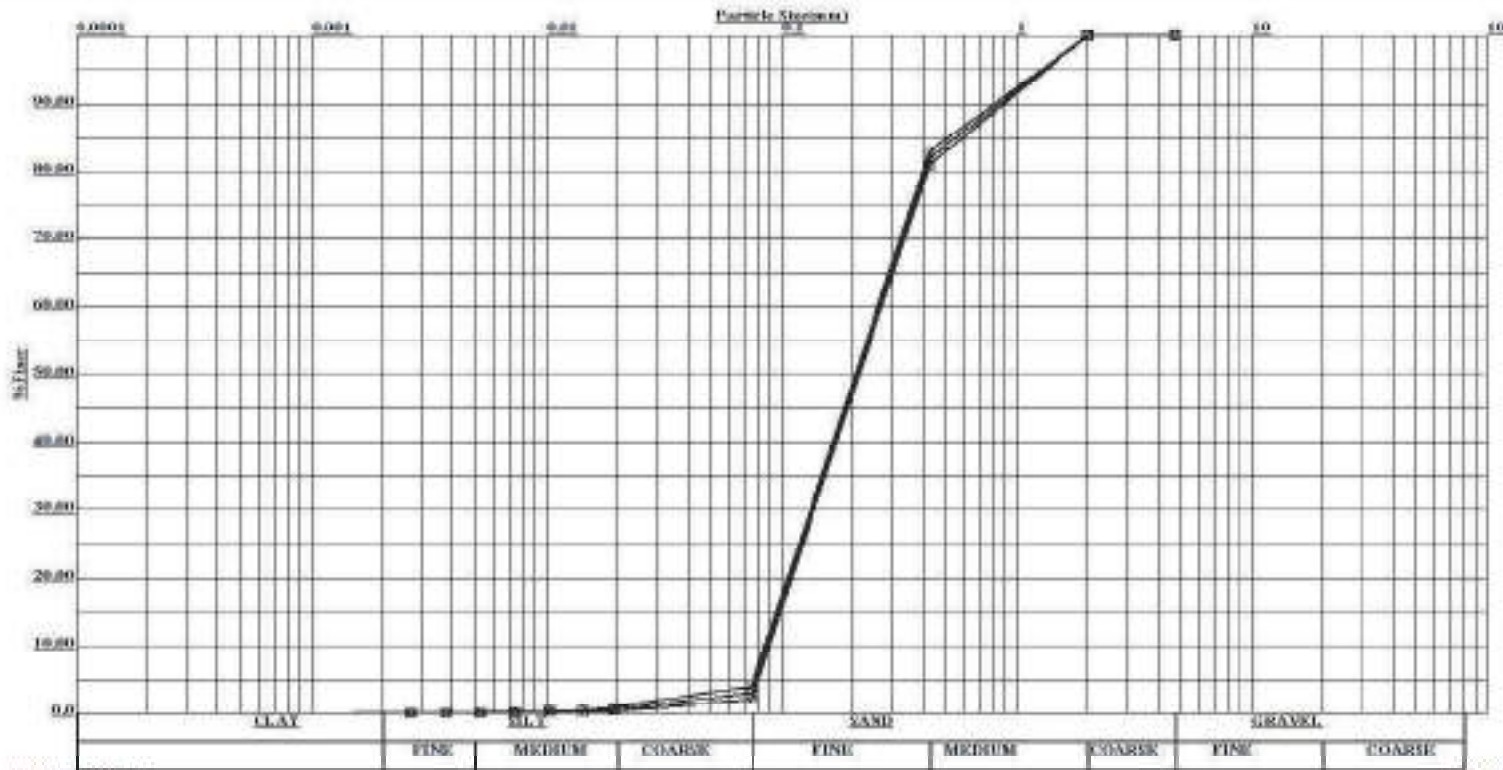
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	VERY LOOSE, LITE BROWN, SANDY SILT, (ML)	0.00	45.00	51.00	4.00	14.18	1.22
○	1.5	LOOSE, LITE BROWN, SILTY SAND (SM)	0.00	69.00	29.00	2.00	10.94	1.83
□	3.0		0.00	66.00	33.00	1.00	11.70	1.52
◇	6.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.34	0.79

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



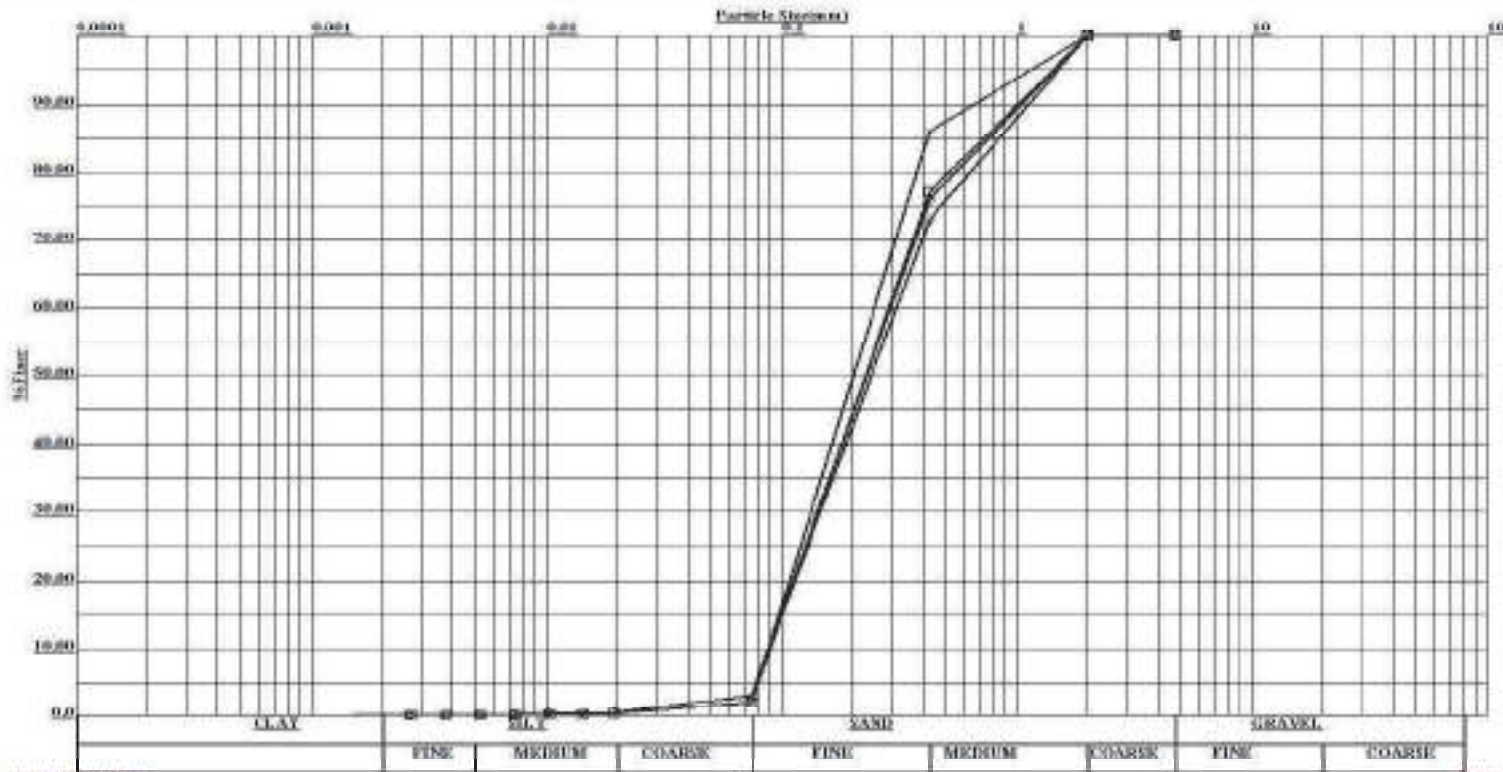
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	9.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	96.00	4.00	0.00	3.08	0.80
○	12.0		0.00	98.00	2.00	0.00	2.96	0.81
□	15.0		0.00	97.00	3.00	0.00	3.04	0.80
◇	18.0		0.00	96.00	4.00	0.00	3.00	0.80

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BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



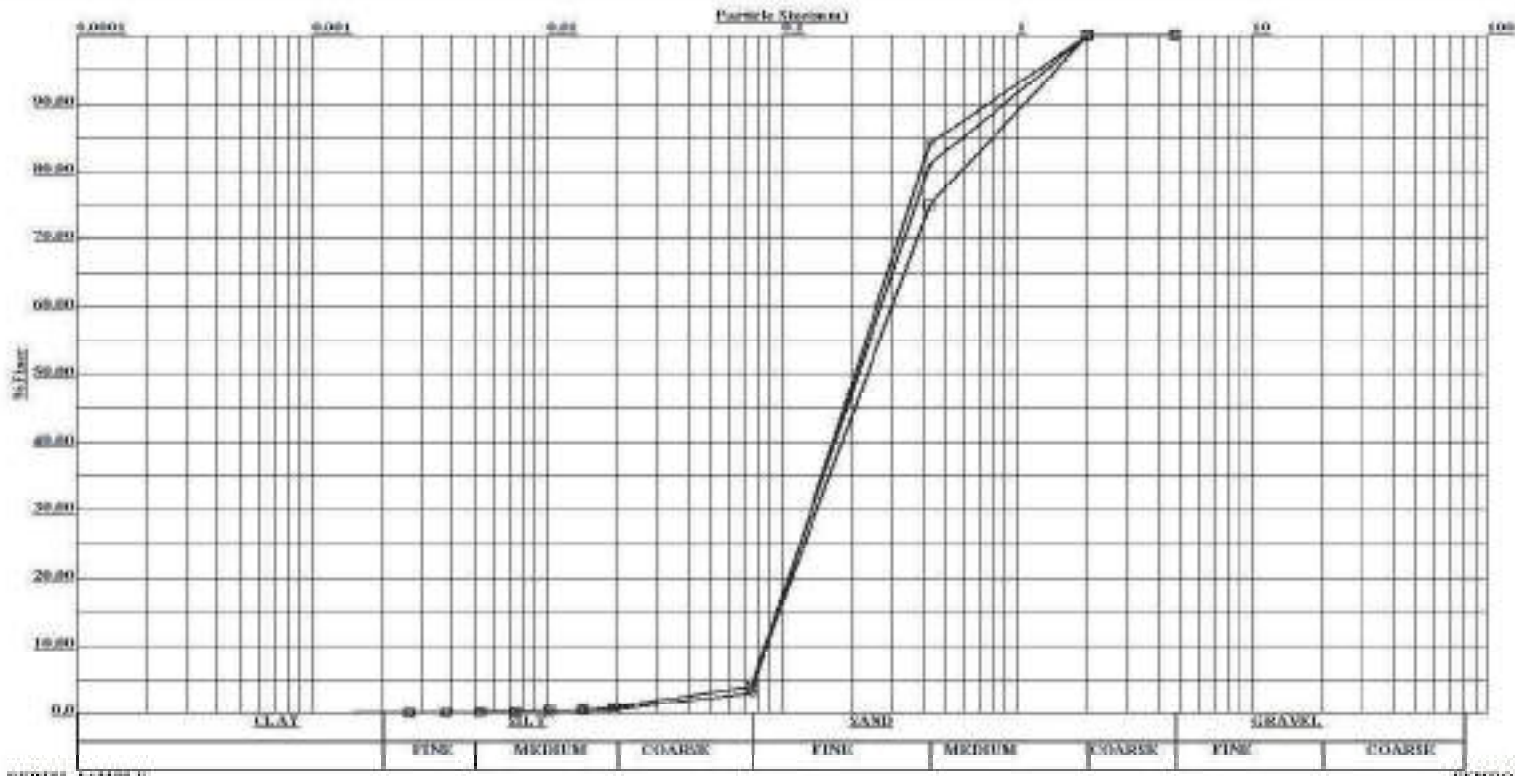
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	21.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	98.00	2.00	0.00	2.81	0.81
○	24.0		0.00	97.00	3.00	0.00	3.28	0.79
□	27.0		0.00	98.00	2.00	0.00	3.18	0.79
◇	30.0		0.00	97.00	3.00	0.00	3.45	0.78

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BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



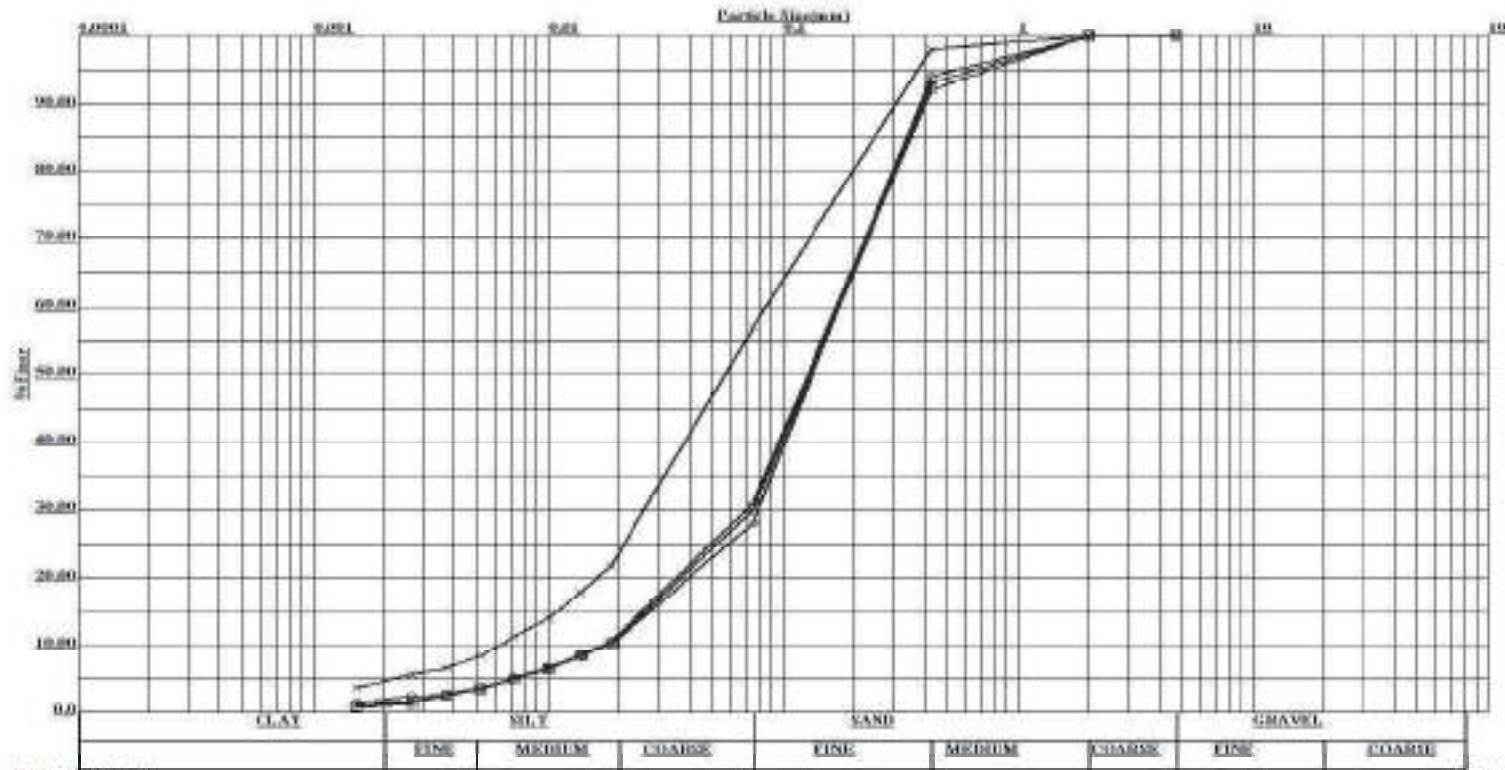
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	33.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	96.00	4.00	0.00	3.08	0.80
○	36.0		0.00	97.00	3.00	0.00	2.92	0.81
□	39.0		0.00	96.00	4.00	0.00	3.39	0.78

PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	C <sub>u</sub>	C <sub>c</sub>
×	0.0	LOOSE , LITE BROWN, SANDY SILT(ML)	0.00	43.00	52.00	5.00	13.78	1.27
○	1.5	MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	0.00	72.00	26.00	2.00	9.56	1.98
□	3.0		0.00	70.00	29.00	1.00	9.79	1.83
◇	6.0		0.00	69.00	30.00	1.00	9.97	1.72

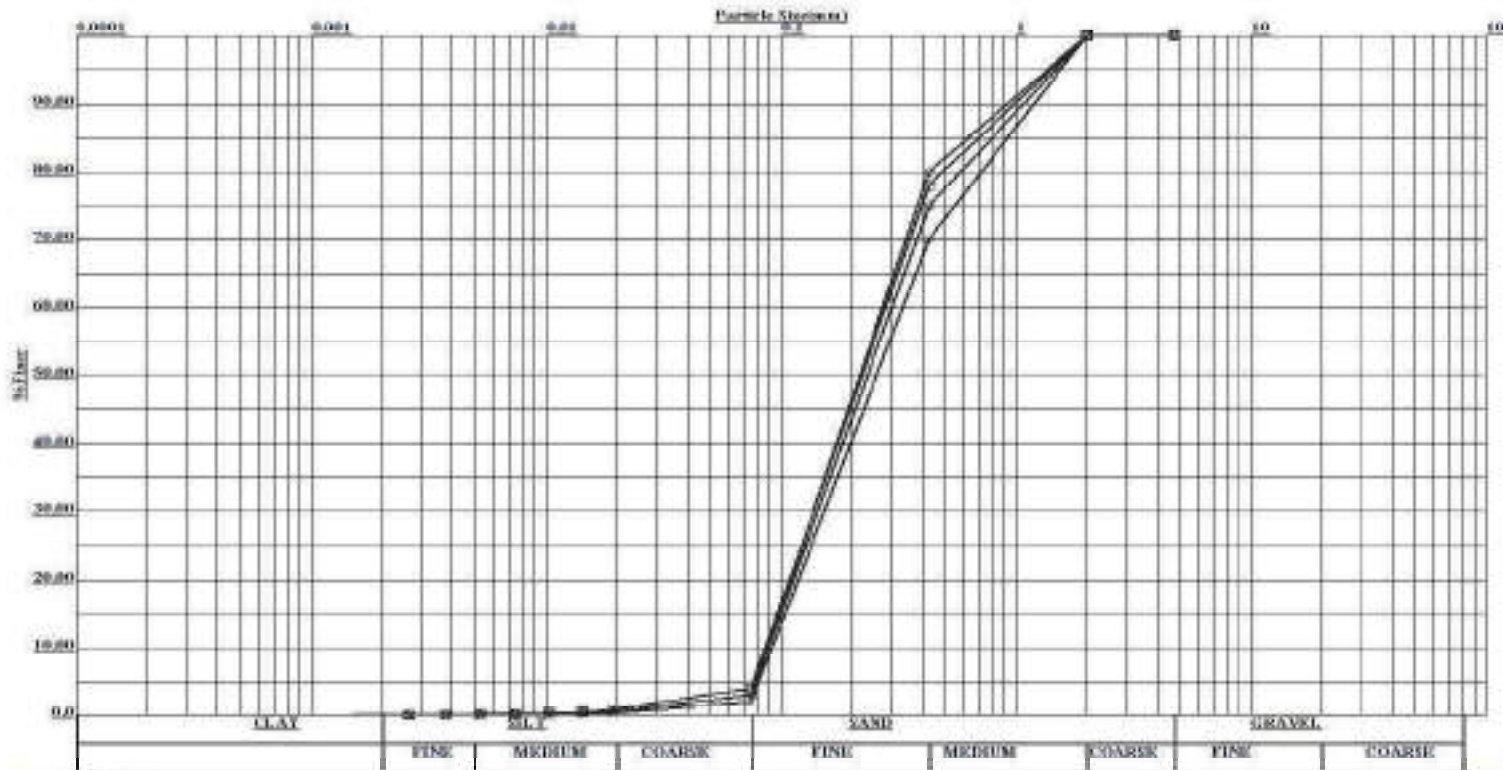


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	9.0	MEDIUM DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	98.00	2.00	0.00	3.58	0.77
○	12.0		0.00	97.00	3.00	0.00	3.34	0.79
□	15.0		0.00	96.00	4.00	0.00	3.23	0.79
◇	18.0		0.00	97.00	3.00	0.00	3.08	0.80