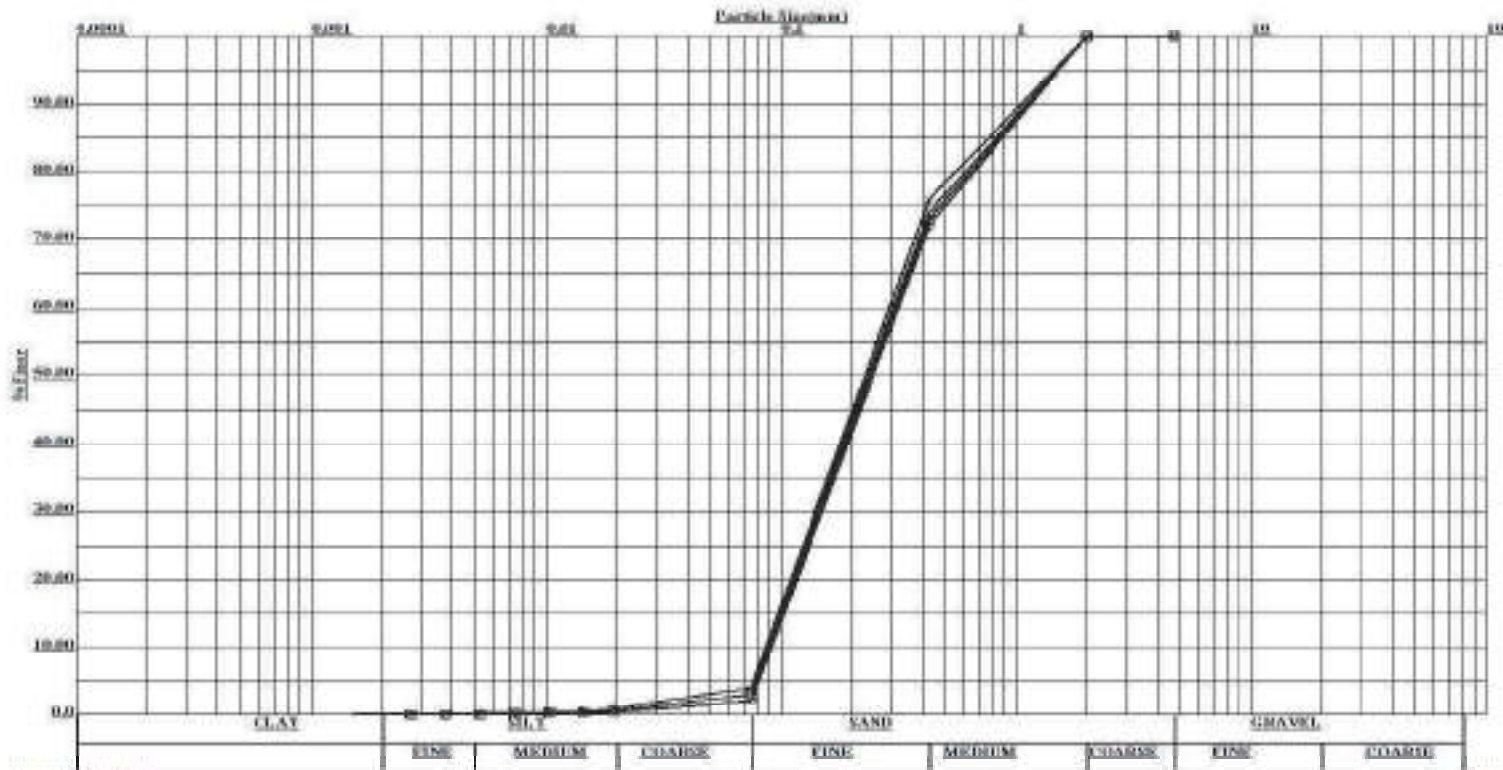


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



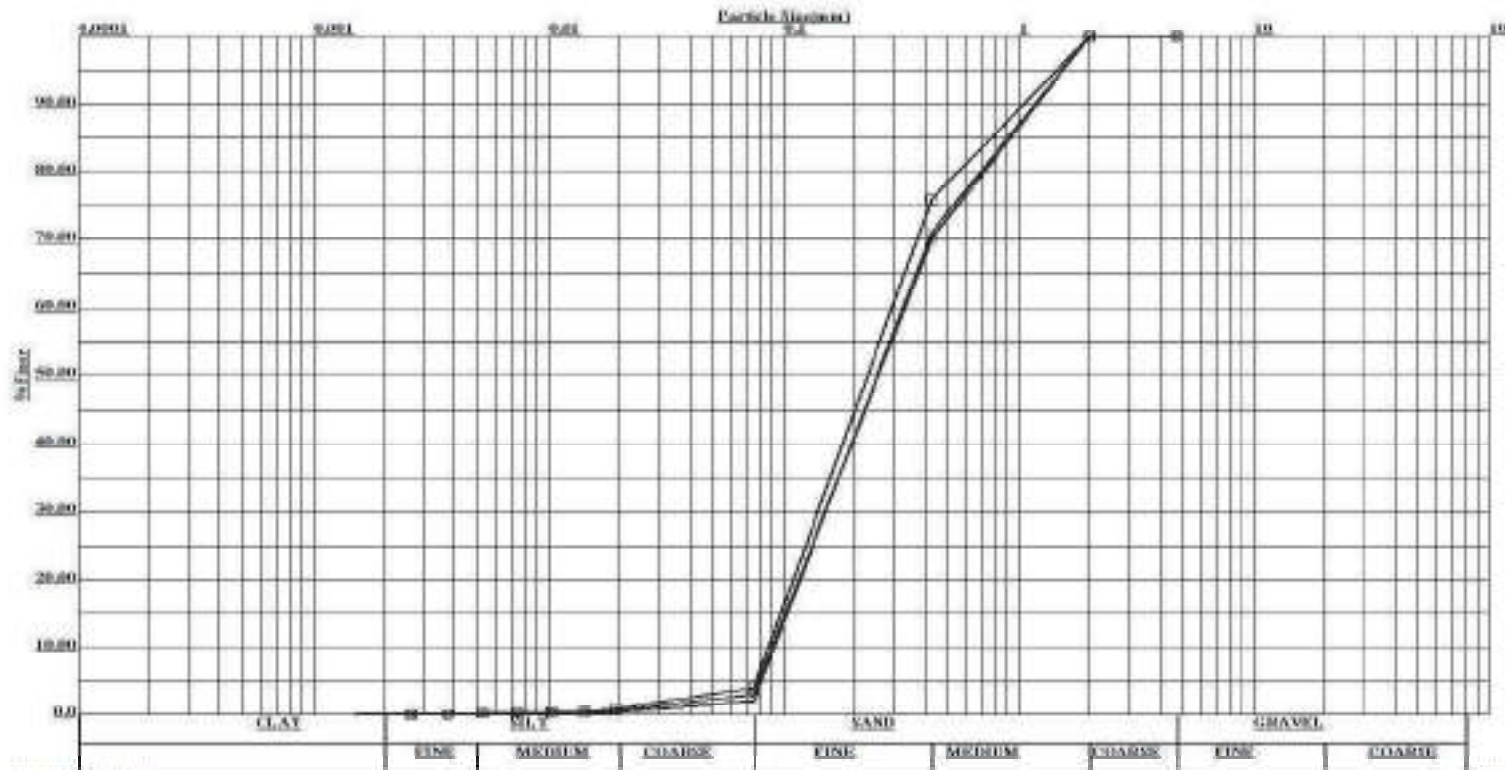
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	21.0	MEDIUM DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	96.00	4.00	0.00	3.34	0.79
○	24.0		0.00	98.00	2.00	0.00	3.45	0.78
□	27.0		0.00	97.00	3.00	0.00	3.45	0.78
◇	30.0		0.00	96.00	4.00	0.00	3.45	0.78

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



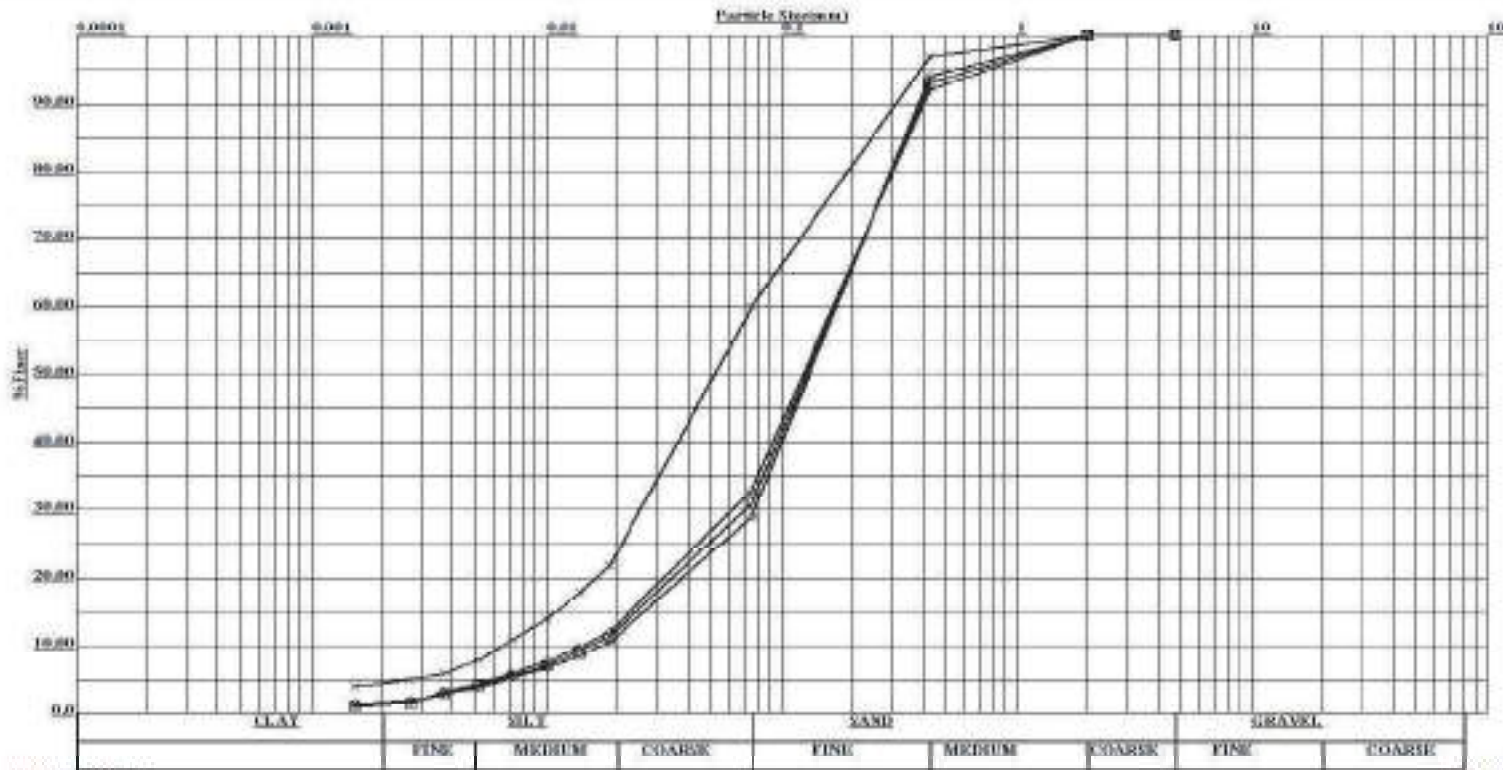
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	33.0	MEDIUM DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	98.00	2.00	0.00	3.51	0.78
○	36.0		0.00	97.00	3.00	0.00	3.65	0.77
□	39.0		0.00	96.00	4.00	0.00	3.33	0.79

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. - 03

GRAIN SIZE ANALYSIS



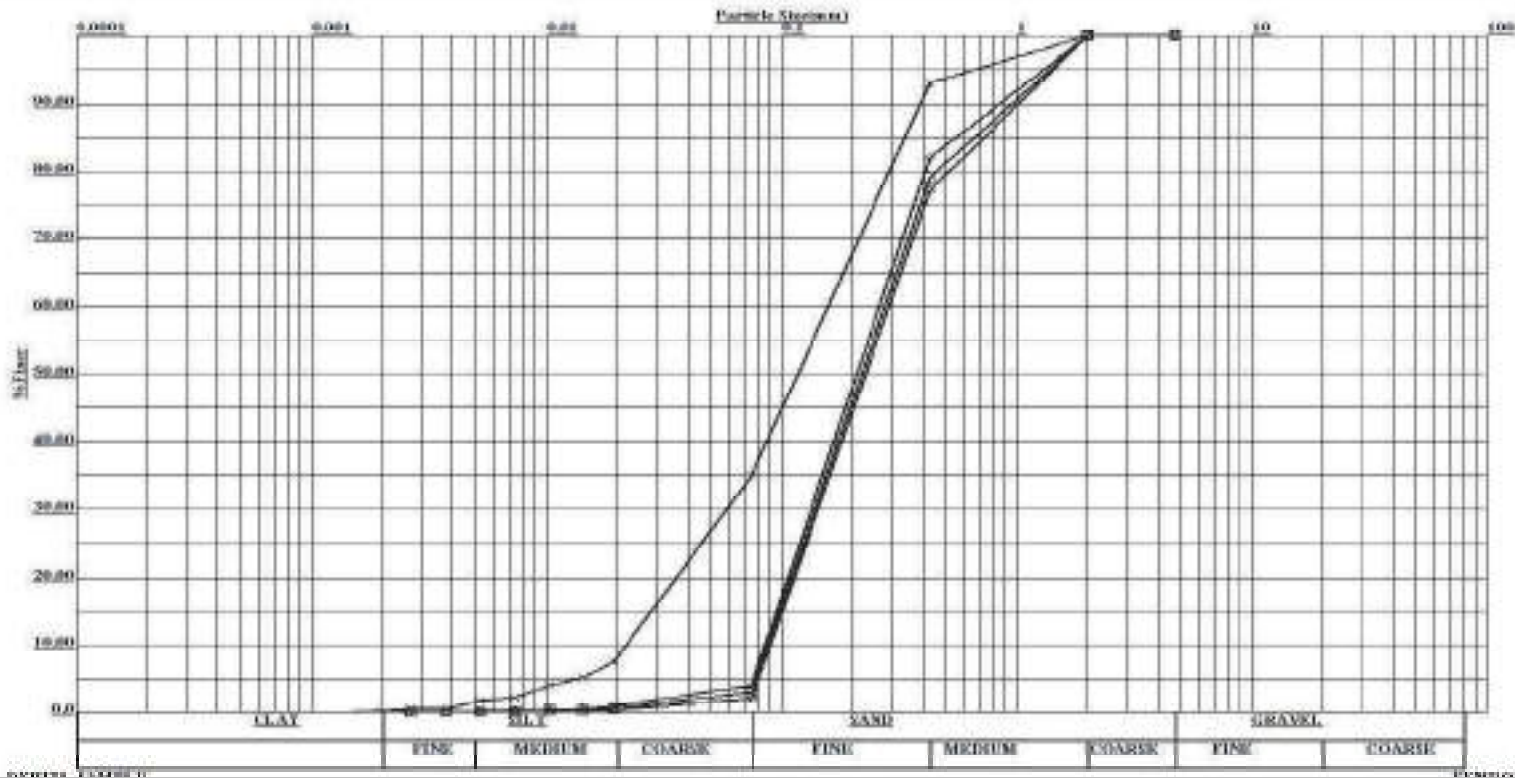
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	LOOSE , LITE BROWN, SANDY SILT(ML)	0.00	40.00	56.00	4.00	11.46	1.29
○	1.5	LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	0.00	71.00	27.00	2.00	9.96	2.01
□	3.0		0.00	69.00	30.00	1.00	10.80	1.85
◇	6.0		0.00	67.00	32.00	1.00	11.56	1.59

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. - 03

GRAIN SIZE ANALYSIS



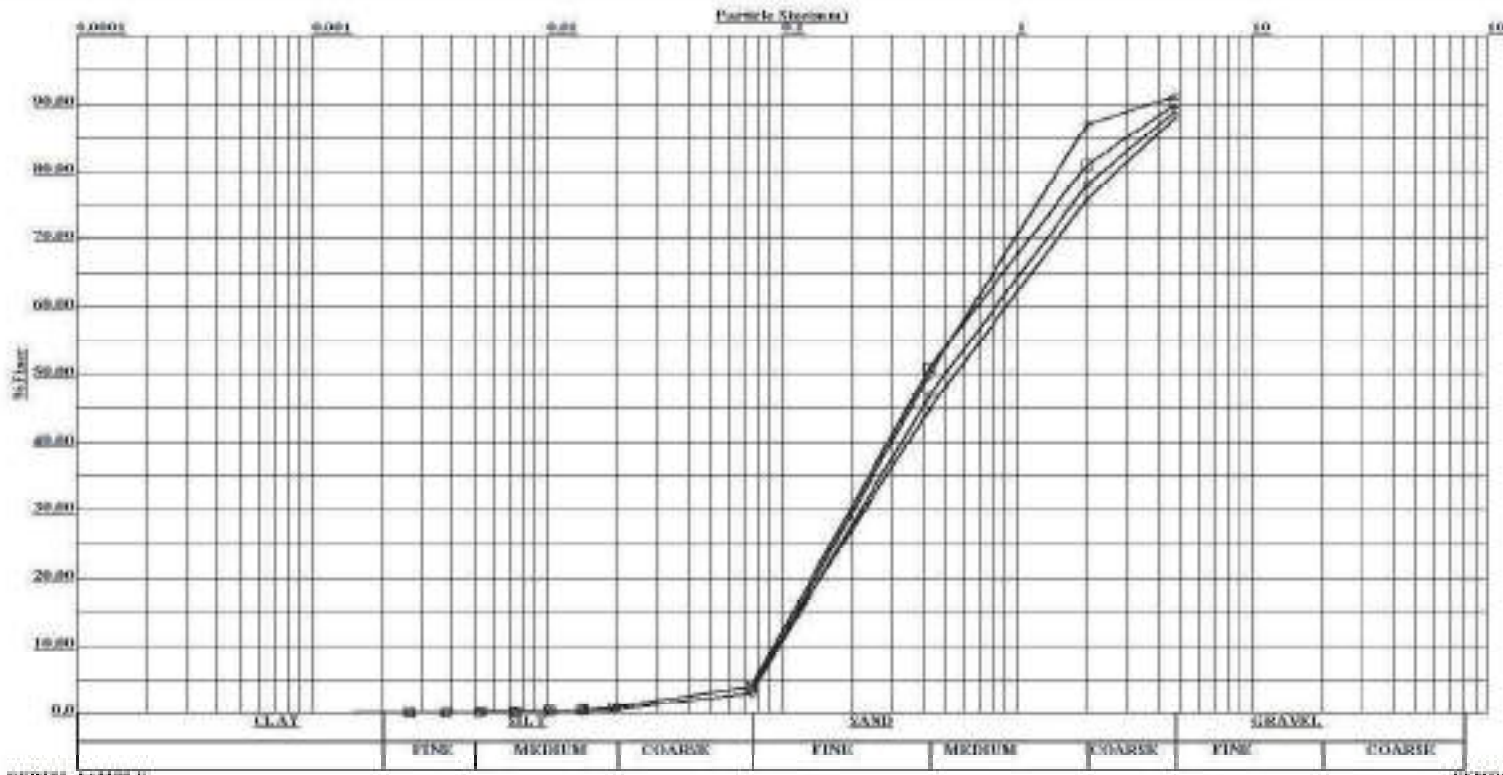
Symbol	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	C <sub>u</sub>	C <sub>c</sub>
×	9.0	LOOSE TO MEDIUM DENSE, LITE BROWN, SILTY SAND(SM)	0.00	65.00	35.00	0.00	7.20	0.99
○	12.0	MEDIUM DENSE TO VERY DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	98.00	2.00	0.00	3.18	0.79
□	15.0		0.00	97.00	3.00	0.00	3.13	0.80
◇	18.0		0.00	96.00	4.00	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. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 03

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	21.0	MEDIUM DENSE TO VERY DENSE, DARK GREY, POORLY GRADED SAND (SP)	12.00	84.00	4.00	0.00	9.30	0.58
O	24.0		11.00	86.00	3.00	0.00	8.23	0.59
□	27.0		10.00	86.00	4.00	0.00	7.23	0.61
◇	30.0		9.00	88.00	3.00	0.00	6.65	0.66

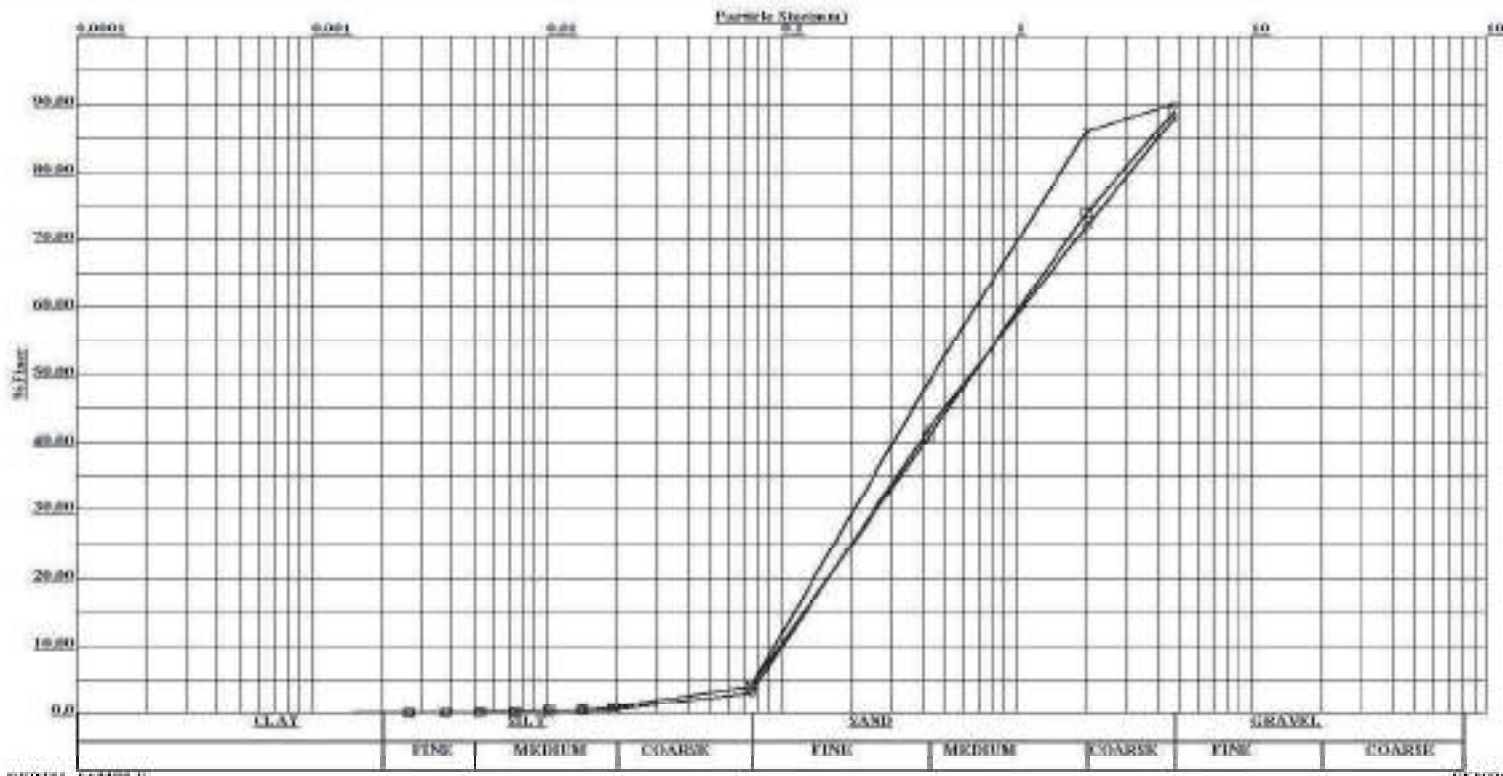


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 28  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 03

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	33.0	MEDIUM DENSE TO VERY DENSE, DARK GREY, POORLY GRADED SAND (SP)	10.00	86.00	4.00	0.00	7.13	0.66
○	36.0		12.00	85.00	3.00	0.00	10.51	0.56
□	39.0		11.00	85.00	4.00	0.00	10.43	0.63



**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- 28

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= $1.76 \times \sqrt{d_m}$	Average Cohesion Intercept - c (t/sqm)	Average Angle of Internal Friction (°)	F	Silt Factor = $\frac{K_{sf}c}{F \times (1 + \sqrt{c/10})}$	
1	BH-01	1.50	1.95	SILTY SAND	SM	0.0	0.0	0.0	8.0	40.0	21.0	31.0	0.00	0.00	0.00	5.70	12.10	2.68	1.163	0.216	0.819	-	-	-	-	-
2		6.00	6.45	SILTY SAND	SM	0.0	0.0	0.0	7.0	39.0	20.0	34.0	0.00	0.00	0.00	4.99	11.80	2.55	1.275	0.206	0.799	-	-	-	-	-
3		18.00	18.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	19.0	53.0	24.0	4.0	0.00	0.00	0.00	13.54	16.03	3.06	0.150	0.328	1.008	-	-	-	-	-



**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- 28

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 x sqrt(dm)	Average Cohesion Intercept - c (t/sqm)	Average Angle of Internal Friction (°)	F	Silt Factor = Ksfc / F x (1 + sqrt(c/10))	
1	BH-02	1.50	1.95	SILTY SAND	SM	0.0	0.0	0.0	6.0	45.0	21.0	28.0	0.00	0.00	0.00	4.28	13.61	2.68	1.050	0.216	0.818	-	-	-	-	
2		6.00	6.45	SILTY SAND	SM	0.0	0.0	0.0	7.0	41.0	21.0	31.0	0.00	0.00	0.00	4.99	12.40	2.68	1.163	0.212	0.811	-	-	-	-	
3		9.00	9.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	30.0	46.0	22.0	2.0	0.00	0.00	0.00	21.38	13.92	2.81	0.075	0.382	1.087	-	-	-	-	





**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- 28

BOREHOLE NO-03

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= $1.76 \times \sqrt{d_m}$	Average Cohesion Intercept - c (t/sqm)	Average Angle of Internal Friction (°)	F	Silt Factor = $\frac{K_{sf}c}{F \times (1 + \sqrt{c/10})}$	
1	BH-03	1.50	1.95	SANDY SILT	ML	0.0	0.0	0.0	3.0	29.0	8.0	60.0	0.00	0.00	0.00	2.14	8.77	1.02	2.250	0.142	0.663	-	-	-	-	-
2		6.00	6.45	SILTY SAND	SM	0.0	0.0	0.0	8.0	44.0	15.0	33.0	0.00	0.00	0.00	5.70	13.31	1.91	1.238	0.222	0.829	-	-	-	-	-
3		12.00	12.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	23.0	51.0	24.0	2.0	0.00	0.00	0.00	16.39	15.43	3.06	0.075	0.350	1.040	-	-	-	-	-



## NORTH EASTERN RAILWAY

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### 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)
20318.560	36	WATERWAY	MINOR	BH-01	207086	2993208	106.42

SUBMITTED BY:

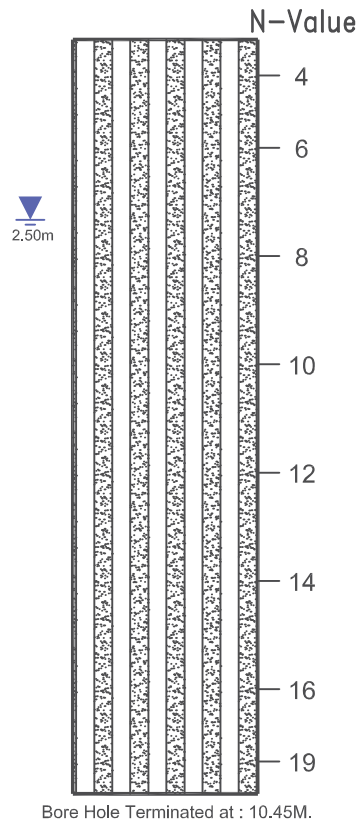


# BOREHOLE PROFILE

SECTION: CHITAUNI - MADHUBANI

BRIDGE NO.- 36

BOREHOLE NO.: BH- 01



## LEGENDS



Silty Sand (SM)



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)



### CALCULATIONS FOR CORRECTED SPT (N) VALUES

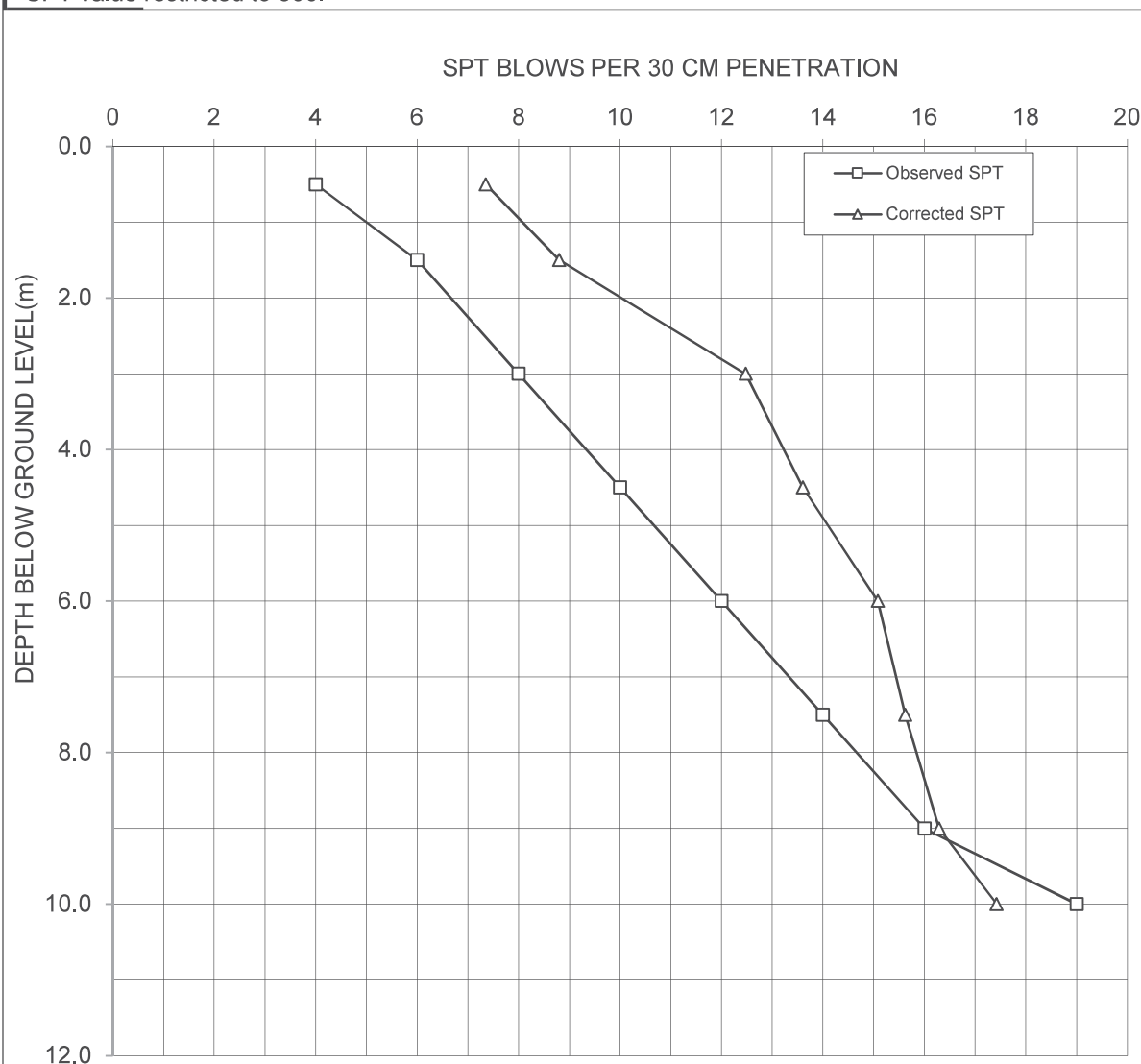
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

**BOREHOLE NO. BH- 01**

**WATER TABLE :- 2.50m**

DEPTH OF SAMPLE	TYPE OF SOIL	OBSERVED SPT 'N' VALUE	CORRECTED SPT (N') VALUE (FOR OVERBURDEN)	FINAL CORRECTED VALUE AFTER DILATANCY CORRECTION (N'')
0.50	Non Plastic	4	7	7
1.50	Non Plastic	6	9	9
3.00	Non Plastic	8	12	12
4.50	Non Plastic	10	14	14
6.00	Non Plastic	12	15	15
7.50	Non Plastic	14	16	16
9.00	Non Plastic	16	18	16
10.00	Non Plastic	19	20	17

\* 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: 36

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>	$\alpha$	$\beta$	( $N_1$ ) <sub>60cs</sub>	$CRR_M = 7.5$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
0.50	SM	4	1.62	0.62	33	IV	0.24	7.00	1.00	0.81	0.31	0.41	1.70	1.33	1.000	1.05	0.75	1.00	7.12	4.88	1.18	13.28	0.14	15.20	0.92	1.00	1.00	1.19	0.17	0.42	Liquefiable
1.50	SM	6	1.62	0.62	33	IV	0.24	7.00	0.99	2.43	0.93	0.40	1.70	1.33	1.000	1.05	0.75	1.00	10.68	4.88	1.18	17.48	0.19	21.54	0.89	1.00	1.00	1.19	0.22	0.55	Liquefiable
3.00	SM	8	2.00	1.00	35	IV	0.24	7.00	0.98	4.86	1.86	0.40	1.70	1.33	1.000	1.05	0.85	1.00	16.14	5.00	1.20	24.37	0.28	33.82	0.83	1.00	1.00	1.19	0.33	0.84	Liquefiable
4.50	SM	10	2.00	1.00	35	IV	0.24	7.00	0.97	7.86	3.36	0.35	1.70	1.33	1.000	1.05	0.95	1.00	22.55	5.00	1.20	32.06	NA	48.25	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
6.00	SM	12	2.01	1.01	36	IV	0.24	7.00	0.95	10.86	4.86	0.33	1.43	1.33	1.000	1.05	0.95	1.00	22.84	5.00	1.20	32.40	NA	48.88	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
7.50	SM	14	2.01	1.01	36	IV	0.24	7.00	0.94	13.88	6.38	0.32	1.25	1.33	1.000	1.05	0.95	1.00	23.26	5.00	1.20	32.91	NA	49.84	0.75	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
9.00	SM	16	2.04	1.04	38	IV	0.24	7.00	0.93	16.89	7.89	0.31	1.13	1.33	1.000	1.05	1	1.00	25.15	5.00	1.20	35.19	NA	54.10	0.73	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
10.00	SM	19	2.04	1.04	38	IV	0.24	7.00	0.91	18.93	8.93	0.30	1.06	1.33	1.000	1.05	1	1.00	28.08	5.00	1.20	38.69	NA	60.68	0.70	1.00	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



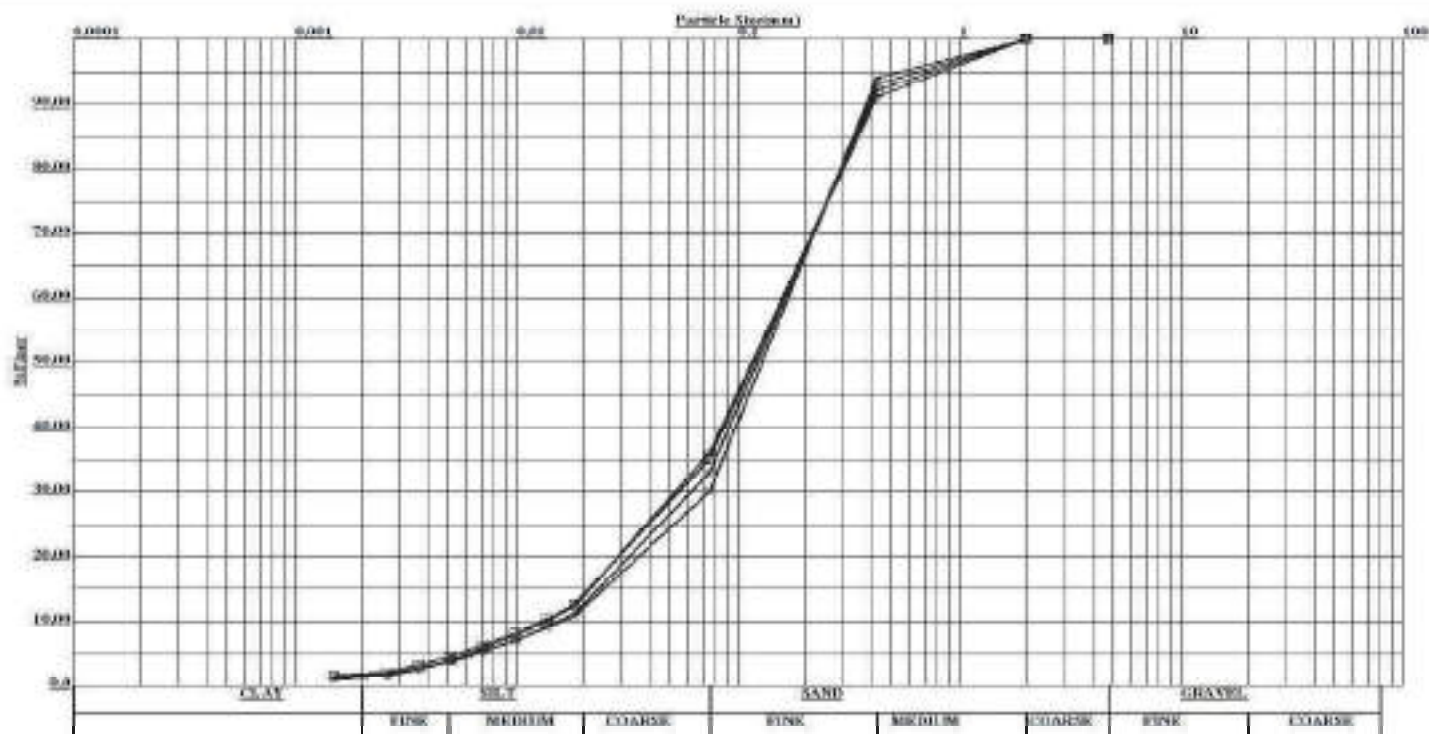
PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 36

BOREHOLE NO. - 01

SECTION:CHITAUNI TO MADHUBANI

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
x	0.0	LOSSE TO MEDIUM, LITE GREY,SILTY SAND (SM)	0.00	70.00	28.00	2.00	10.30	2.03
○	0.5		0.00	67.00	32.00	1.00	10.55	1.50
□	3.0		0.00	65.00	33.00	2.00	12.14	1.42
◇	6.0		0.00	64.00	35.00	1.00	11.53	1.25





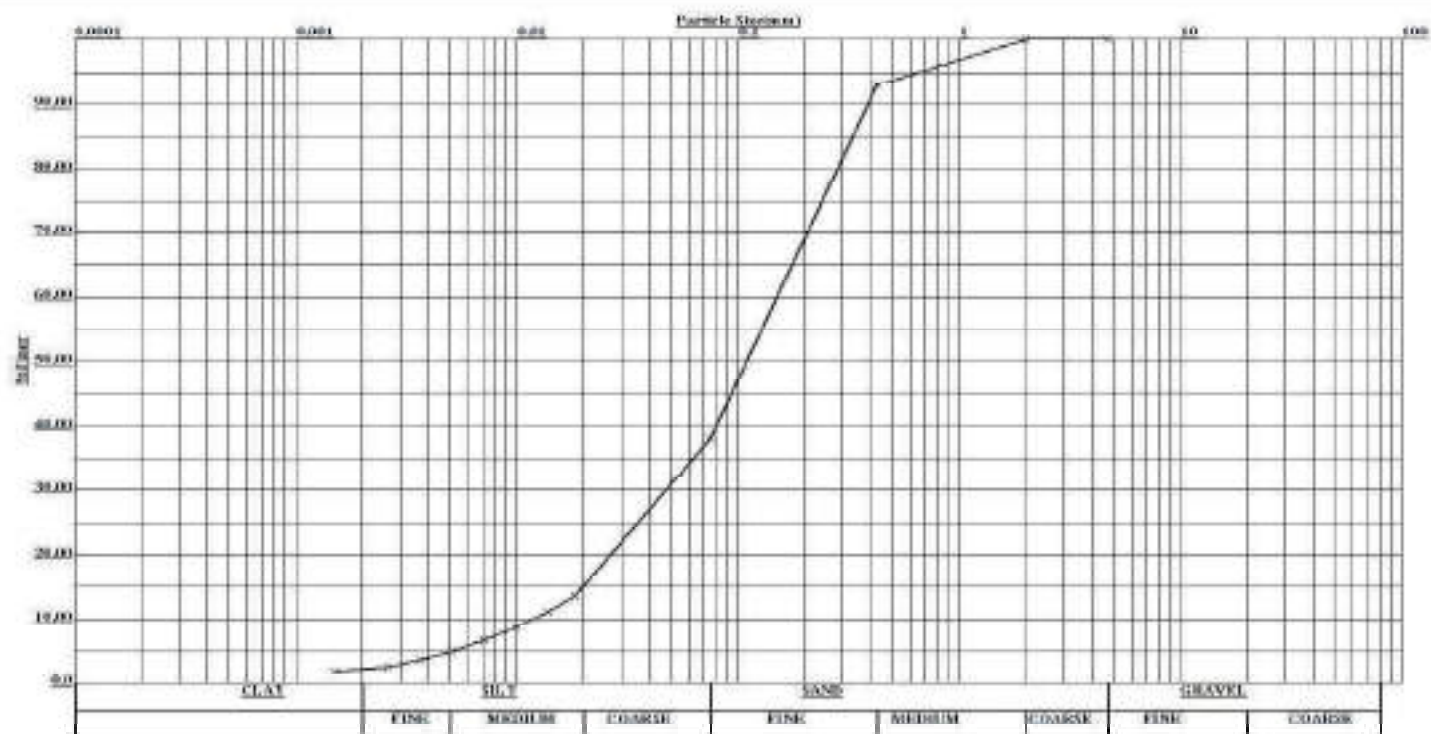
PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 36

BOREHOLE NO. - 01

SECTION:CHITAUNI TO MADHUBANI

GRAIN SIZE ANALYSIS



Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
x	9.0	LOSSE TO MEDIUM, LITE GREY,SILTY SAND (SM)	0.00	62.00	36.00	2.00	12.71	1.26

### 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. 36

BOREHOLE NO- 1

Section : CHITAUNI - 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 = K <sub>sf</sub> c = F x (1 + sqrt(c))
1	BH-1	0.50	0.95	SILTY SAND	SM	0.0	0.0	0.0	7.0	38.0	22.0	33.0	0.00	0.00	0.00	4.99	11.50	2.81	1.238	0.205	0.797	-	-	-	-
2		3.00	3.45	SILTY SAND	SM	0.0	0.0	0.0	8.0	36.0	21.0	35.0	0.00	0.00	0.00	5.70	10.89	2.68	1.313	0.206	0.798	-	-	-	-
3		6.00	6.45	SILTY SAND	SM	0.0	0.0	0.0	9.0	35.0	20.0	36.0	0.00	0.00	0.00	6.41	10.59	2.55	1.350	0.209	0.805	-	-	-	-



## 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)
26455.826	46	WATERWAY	MAJOR-BRIDGE	BH-01	209573	2988164	104.77
				BH-02	209589	2988157	104.72

SUBMITTED BY:

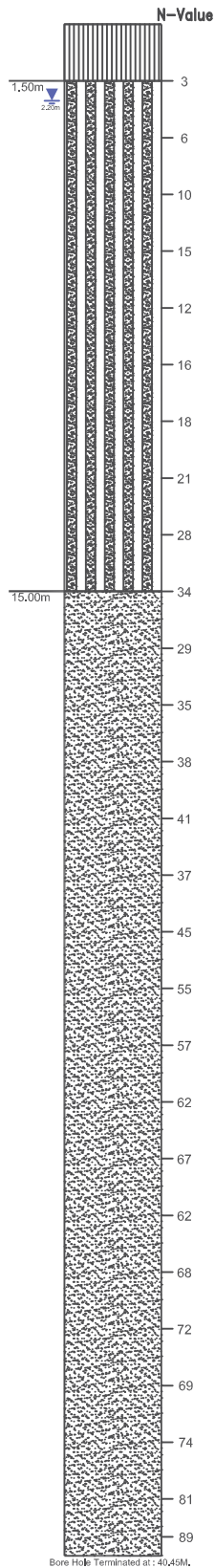
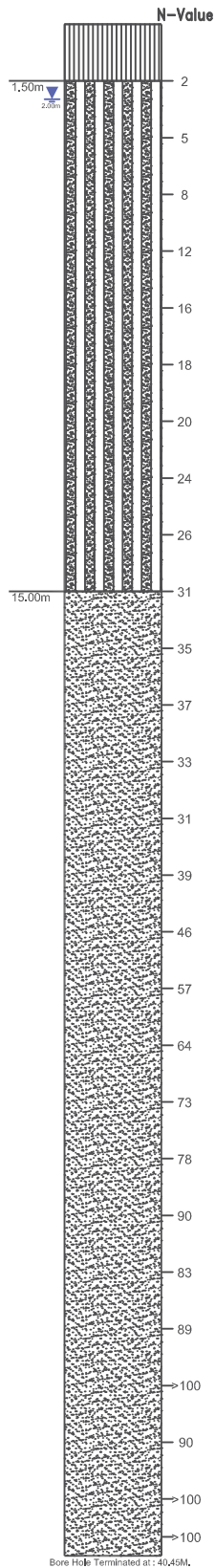


# BOREHOLE PROFILE

## SECTION: CHITAUNI TO MADHUBANI

BRIDGE NO.: 46  
BOREHOLE NO.: 01

BRIDGE NO.: 46  
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)

[illegible]

BRIDGE NO :46 BOREHOLE NO. BH- 2				GWT: 2.20 m		DATE STARTED : 18-01-2025		<div><div></div><div>aarvee associates architects engineers &amp; consultants pvt. ltd.</div></div>																										
				DATE COMPLETED : 19-01-2025		CONSOLIDATED LOGS INCLUDING LABORATORY TEST RESULTS OF SOIL																												
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/WL	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 Cc (kg/cm <sup>2</sup> )	Angle of friction (Degrees)	Compression Index(I <sub>cc</sub> )	pH										Chloride, %	Sulphate, %	pH	Chloride, mg/l	Sulphate, mg/l				
-1.00	1.0	DS	1	<div><div></div><div>2.20 m</div></div>	0.00	1.00	DS	-	-	-	<div><div></div></div>	LOOSE ,LITE BROWN,SANDY SILT(ML)	--	0.00	45.00	50.00	5.00	NON-PLASTIC				-	-	-		-	-	-	-	-	-	-	-	-
	2.0	SPT	1		1.50	1.95	3	30	3	4		--	0.00	42.00	54.00	4.00	NON-PLASTIC				-	-	-	2.53	-	-	-	-	-	-	-	-	-	
	3.0	DS	2		2.50	2.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	4.0	SPT	2		3.00	3.45	6	30	6	9		--	0.00	72.00	27.00	1.00	NON-PLASTIC				-	-	-	2.52	-	-	-	-	-	-	-	-	-	
-5.00	5.0	SPT	3		4.50	4.95	10	30	10	14		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	6.0	DS	3		5.50	5.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	7.0	SPT	4		6.00	6.45	15	30	15	17		--	0.00	68.00	30.00	2.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-	
	8.0	SPT	5		7.50	7.95	12	30	12	14		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	9.0	DS	4		8.50	8.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
-10.00	10.0	SPT	6		9.00	9.45	16	30	16	16		--	0.00	65.00	34.00	1.00	NON-PLASTIC				-	-	-	2.56	-	-	-	-	-	-	-	-	-	
	11.0	SPT	7		10.50	10.95	18	30	18	17		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12.0	DS	5		11.50	11.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	13.0	SPT	8		12.00	12.45	21	30	21	18		--	0.00	64.00	34.00	2.00	NON-PLASTIC				-	-	-	2.54	-	-	-	-	-	-	-	-	-	
	14.0	SPT	9		13.50	13.95	28	30	28	20		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
-15.00	15.0	DS	6		14.50	14.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	16.0	SPT	10		15.00	15.45	34	30	34	23		--	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-	
	17.0	SPT	11		16.50	16.95	29	30	29	20		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	18.0	DS	7		17.50	17.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	19.0	SPT	12		18.00	18.45	35	30	35	22		--	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.59	-	-	-	-	-	-	-	-	-	
-20.00	20.0	SPT	13		19.50	19.95	38	30	38	22		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	21.0	DS	8		20.50	20.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	22.0	SPT	14		21.00	21.45	41	30	41	23		--	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.60	-	-	-	-	-	-	-	-	-	
	23.0	SPT	15		22.50	22.95	37	30	37	21		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	24.0	DS	9		23.50	23.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
-25.00	25.0	SPT	16		24.00	24.45	45	30	45	24		--	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.57	-	-	-	-	-	-	-	-	-	
	26.0	SPT	17		25.50	25.95	55	30	55	27		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	27.0	DS	10		26.50	26.80		UDS SLIPPED				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	28.0	SPT	18	27.00	27.45	57	30	57	27	--	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.55	-	-	-	-	-	-	-	-	-			
	29.0	SPT	19	28.50	28.95	62	30	62	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
-30.00	30.0	DS	11	29.50	29.80		UDS SLIPPED			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	31.0	SPT	20	30.00	30.45	67	30	67	29	--	0.00	98.00	2.00	0.00	NON-PLASTIC				-	-	-	2.57	-	-	-	-	-	-	-	-	-			
	32.0	SPT	21	31.50	31.95	62	30	62	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	33.0	DS	12	32.50	32.80		UDS SLIPPED			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	34.0	SPT	22	33.00	33.45	68	30	68	28	--	0.00	97.00	3.00	0.00	NON-PLASTIC				-	-	-	2.60	-	-	-	-	-	-	-	-	-			
-35.00	35.0	SPT	23	34.50	34.95	72	30	72	29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	36.0	DS	13	35.50	35.80		UDS SLIPPED			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	37.0	SPT	24	36.00	36.45	69	30	69	27	--	0.00	98.00	2.00	0.00	NON-PLASTIC				-	-	-	2.59	-	-	-	-	-	-	-	-	-			
	38.0	SPT	25	37.50	37.95	74	30	74	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	39.0	DS	14	38.50	38.80		UDS SLIPPED			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	40.0	SPT	26	39.00	39.45	81	30	81	29	--	0.00	96.00	4.00	0.00	NON-PLASTIC				-	-	-	2.56	-	-	-	-	-	-	-	-	-			
	41.0	SPT	27	40.00	40.45	89	30	89	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
<u>CLASSIFICATION OF SOIL AS PER IS : 1498</u> 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												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)																						
												SECTION: CHITAU NI - MADHUBANI																						

### CALCULATIONS FOR CORRECTED SPT (N) VALUES

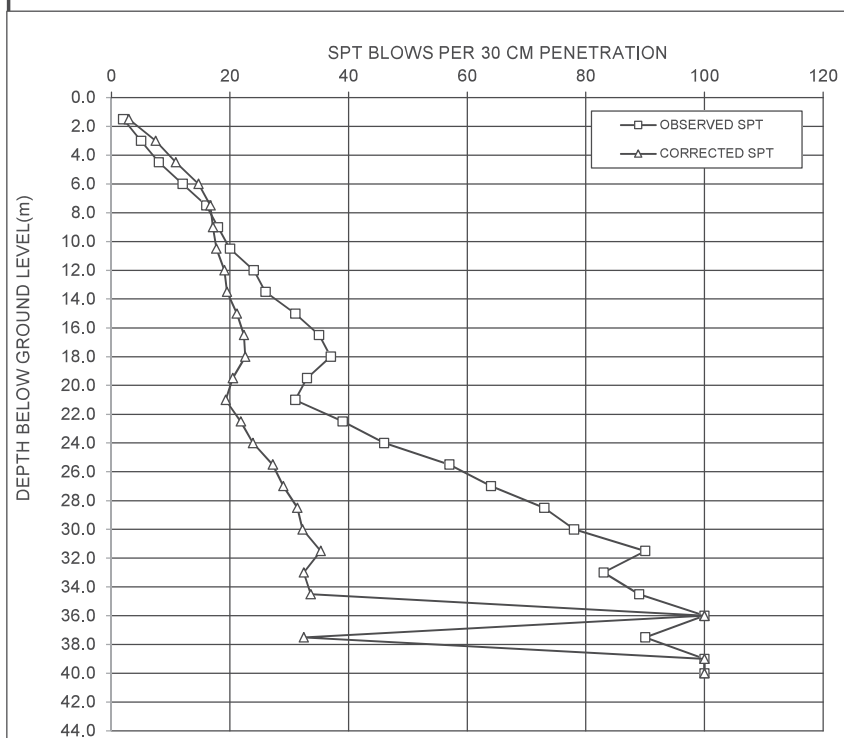
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 1

WATER TABLE - 2.00 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	2	3	3
3.00	Non Plastic	5	7	7
4.50	Non Plastic	8	11	11
6.00	Non Plastic	12	15	15
7.50	Non Plastic	16	18	17
9.00	Non Plastic	18	19	17
10.50	Non Plastic	20	20	18
12.00	Non Plastic	24	23	19
13.50	Non Plastic	26	24	20
15.00	Non Plastic	31	27	21
16.50	Non Plastic	35	30	22
18.00	Non Plastic	37	30	23
19.50	Non Plastic	33	26	21
21.00	Non Plastic	31	24	19
22.50	Non Plastic	39	29	22
24.00	Non Plastic	46	33	24
25.50	Non Plastic	57	39	27
27.00	Non Plastic	64	43	29
28.50	Non Plastic	73	48	31
30.00	Non Plastic	78	49	32
31.50	Non Plastic	90	56	35
33.00	Non Plastic	83	50	32
34.50	Non Plastic	89	52	34
36.00	Non Plastic	100	100	100
37.50	Non Plastic	90	50	32
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

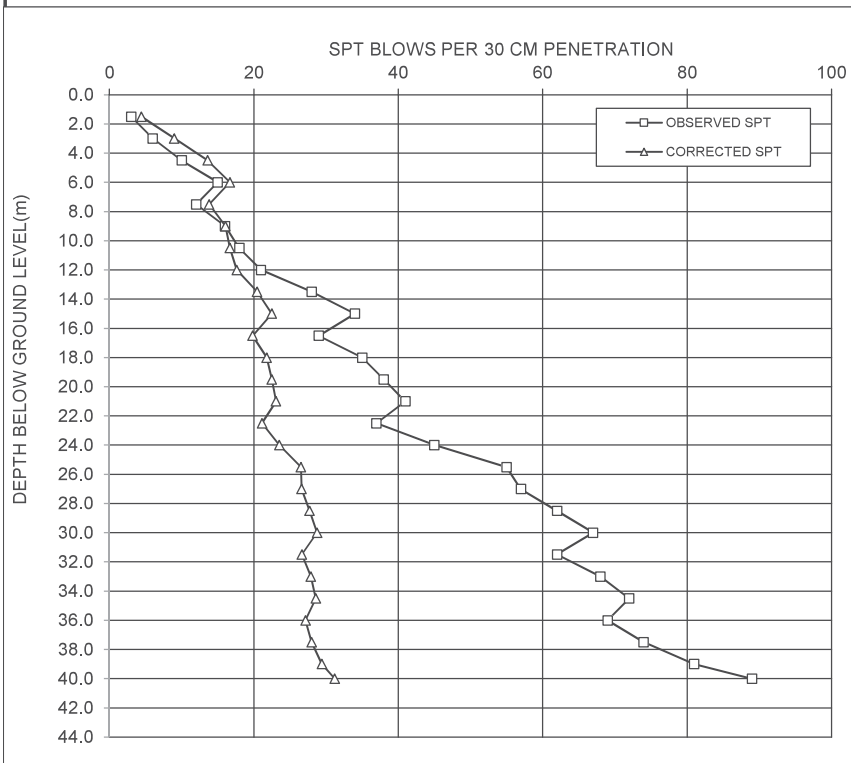
Project: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BOREHOLE NO. BH- 2

WATER TABLE -2.20 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	4	4
3.00	Non Plastic	6	9	9
4.50	Non Plastic	10	14	14
6.00	Non Plastic	15	18	17
7.50	Non Plastic	12	14	14
9.00	Non Plastic	16	17	16
10.50	Non Plastic	18	18	17
12.00	Non Plastic	21	20	18
13.50	Non Plastic	28	26	20
15.00	Non Plastic	34	30	23
16.50	Non Plastic	29	25	20
18.00	Non Plastic	35	29	22
19.50	Non Plastic	38	30	22
21.00	Non Plastic	41	31	23
22.50	Non Plastic	37	27	21
24.00	Non Plastic	45	32	24
25.50	Non Plastic	55	38	27
27.00	Non Plastic	57	38	27
28.50	Non Plastic	62	40	28
30.00	Non Plastic	67	42	29
31.50	Non Plastic	62	38	27
33.00	Non Plastic	68	41	28
34.50	Non Plastic	72	42	29
36.00	Non Plastic	69	39	27
37.50	Non Plastic	74	41	28
39.00	Non Plastic	81	44	29
40.00	Non Plastic	89	47	31

\* 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:46

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>	$\alpha$	$\beta$	( $N_1$ ) <sub>60cs</sub>	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	ML-NON PLASTIC	2	1.58	0.58	58	IV	0.24	7.00	0.99	2.37	0.87	0.42	1.70	1.33	1.000	1.05	0.75	1.00	3.56	5.00	1.20	9.27	0.11	8.90	0.96	1.00	1.00	1.19	0.13	0.30	Liquefiable
3.00	SM	5	1.91	0.91	28	IV	0.24	7.00	0.98	4.74	1.74	0.42	1.70	1.33	1.000	1.05	0.85	1.00	10.09	4.56	1.14	16.05	0.17	20.20	0.90	1.00	1.00	1.19	0.20	0.49	Liquefiable
4.50	SM	8	1.91	0.91	28	IV	0.24	7.00	0.97	7.61	3.11	0.37	1.70	1.33	1.000	1.05	0.95	1.00	18.04	4.56	1.14	25.10	0.29	38.10	0.81	1.00	1.00	1.19	0.35	0.95	Liquefiable
6.00	SM	12	2.01	1.01	32	IV	0.24	7.00	0.95	10.47	4.47	0.35	1.50	1.33	1.000	1.05	0.95	1.00	23.81	4.83	1.17	32.71	NA	51.08	0.74	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
7.50	SM	16	2.01	1.01	32	IV	0.24	7.00	0.94	13.49	5.99	0.33	1.29	1.33	1.000	1.05	0.95	1.00	27.44	4.83	1.17	36.96	NA	59.24	0.70	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
9.00	SM	18	2.02	1.02	35	IV	0.24	7.00	0.93	16.50	7.50	0.32	1.15	1.33	1.000	1.05	1	1.00	29.03	5.00	1.20	39.83	NA	62.81	0.69	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
10.50	SM	20	2.02	1.02	35	IV	0.24	7.00	0.89	19.53	9.03	0.30	1.05	1.33	1.000	1.05	1	1.00	29.39	5.00	1.20	40.27	NA	63.63	0.68	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
12.00	SM	24	2.03	1.03	36	IV	0.24	7.00	0.85	22.56	10.56	0.28	0.97	1.33	1.000	1.05	1	1.00	32.62	5.00	1.20	44.14	NA	67.62	0.66	0.98	1.00	1.19	NA	>1.0	Non Liquefiable
13.50	SM	26	2.03	1.03	36	IV	0.24	7.00	0.81	25.61	12.11	0.27	0.91	1.33	1.000	1.05	1	1.00	33.00	5.00	1.20	44.60	NA	68.00	0.66	0.94	1.00	1.19	NA	>1.0	Non Liquefiable
15.00	SP	31	2.04	1.04	3	IV	0.24	7.00	0.77	28.65	13.65	0.25	0.86	1.33	1.000	1.05	1	1.00	37.05	0.00	1.00	37.05	NA	72.05	0.64	0.89	1.00	1.19	NA	>1.0	Non Liquefiable
16.50	SP	35	2.02	1.02	3	IV	0.24	7.00	0.73	31.71	15.21	0.24	0.81	1.33	1.000	1.05	1	1.00	39.63	0.00	1.00	39.63	NA	74.63	0.63	0.86	1.00	1.19	NA	>1.0	Non Liquefiable
18.00	SP	37	2.02	1.02	4	IV	0.24	7.00	0.69	34.74	16.74	0.22	0.77	1.33	1.000	1.05	1	1.00	39.94	0.00	1.00	39.94	NA	74.94	0.63	0.82	1.00	1.19	NA	>1.0	Non Liquefiable
19.50	SP	33	2.02	1.02	4	IV	0.24	7.00	0.65	37.77	18.27	0.21	0.74	1.33	1.000	1.05	1	1.00	34.09	0.00	1.00	34.09	NA	69.09	0.65	0.81	1.00	1.19	NA	>1.0	Non Liquefiable
21.00	SP	31	2.03	1.03	3	IV	0.24	7.00	0.61	40.80	19.80	0.20	0.71	1.33	1.000	1.05	1	1.00	30.77	0.00	1.00	30.77	NA	65.77	0.67	0.80	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	43.85	21.35	0.18	0.68	1.33	1.000	1.05	1	1.00	37.28	0.00	1.00	37.28	NA	72.28	0.64	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:46

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>	$\alpha$	$\beta$	$(N_1)_{60cs}$	$CRR_{M=7.5}$	Relative Density, Dr%	f	$K_\sigma$	$K_\alpha$	MSF	CRR	FOS	Conclusion
1.50	ML-NON PLASTIC	3	1.57	0.57	58	IV	0.24	7.00	0.99	2.36	0.86	0.42	1.70	1.33	1.000	1.05	0.75	1.00	5.34	5.00	1.20	11.41	0.13	12.24	0.94	1.00	1.00	1.19	0.15	0.35	Liquefiable
3.00	SM	6	1.92	0.92	28	IV	0.24	7.00	0.98	4.71	1.71	0.42	1.70	1.33	1.000	1.05	0.85	1.00	12.11	4.56	1.14	18.34	0.20	24.74	0.88	1.00	1.00	1.19	0.23	0.56	Liquefiable
4.50	SM	10	1.92	0.92	28	IV	0.24	7.00	0.97	7.59	3.09	0.37	1.70	1.33	1.000	1.05	0.95	1.00	22.55	4.56	1.14	30.23	NA	48.25	0.76	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
6.00	SM	15	2.00	1.00	32	IV	0.24	7.00	0.95	10.47	4.47	0.35	1.50	1.33	1.000	1.05	0.95	1.00	29.76	4.83	1.17	39.68	NA	64.47	0.68	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
7.50	SM	12	2.00	1.00	32	IV	0.24	7.00	0.94	13.47	5.97	0.33	1.29	1.33	1.000	1.05	0.95	1.00	20.60	4.83	1.17	28.96	0.41	43.86	0.78	1.00	1.00	1.19	0.49	1.47	Non Liquefiable
9.00	SM	16	2.01	1.01	35	IV	0.24	7.00	0.93	16.47	7.47	0.32	1.16	1.33	1.000	1.05	1	1.00	25.85	5.00	1.20	36.02	NA	55.67	0.72	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
10.50	SM	18	2.01	1.01	35	IV	0.24	7.00	0.89	19.49	8.99	0.30	1.05	1.33	1.000	1.05	1	1.00	26.52	5.00	1.20	36.82	NA	57.17	0.71	1.00	1.00	1.19	NA	>1.0	Non Liquefiable
12.00	SM	21	2.02	1.02	36	IV	0.24	7.00	0.85	22.50	10.50	0.29	0.98	1.33	1.000	1.05	1	1.00	28.62	5.00	1.20	39.34	NA	61.89	0.69	0.99	1.00	1.19	NA	>1.0	Non Liquefiable
13.50	SM	28	2.02	1.02	36	IV	0.24	7.00	0.81	25.53	12.03	0.27	0.91	1.33	1.000	1.05	1	1.00	35.65	5.00	1.20	47.78	NA	70.65	0.65	0.94	1.00	1.19	NA	>1.0	Non Liquefiable
15.00	SP	34	2.03	1.03	3	IV	0.24	7.00	0.77	28.56	13.56	0.25	0.86	1.33	1.000	1.05	1	1.00	40.77	0.00	1.00	40.77	NA	75.77	0.62	0.89	1.00	1.19	NA	>1.0	Non Liquefiable
16.50	SP	29	2.03	1.03	3	IV	0.24	7.00	0.73	31.61	15.11	0.24	0.81	1.33	1.000	1.05	1	1.00	32.95	0.00	1.00	32.95	NA	67.95	0.66	0.87	1.00	1.19	NA	>1.0	Non Liquefiable
18.00	SP	35	2.04	1.04	4	IV	0.24	7.00	0.69	34.65	16.65	0.23	0.77	1.33	1.000	1.05	1	1.00	37.88	0.00	1.00	37.88	NA	72.88	0.64	0.83	1.00	1.19	NA	>1.0	Non Liquefiable
19.50	SP	38	2.04	1.04	4	IV	0.24	7.00	0.65	37.71	18.21	0.21	0.74	1.33	1.000	1.05	1	1.00	39.33	0.00	1.00	39.33	NA	74.33	0.63	0.80	1.00	1.19	NA	>1.0	Non Liquefiable
21.00	SP	41	2.03	1.03	3	IV	0.24	7.00	0.61	40.77	19.77	0.20	0.71	1.33	1.000	1.05	1	1.00	40.72	0.00	1.00	40.72	NA	75.72	0.62	0.77	1.00	1.19	NA	>1.0	Non Liquefiable
22.50	SP	37	2.03	1.03	3	IV	0.24	7.00	0.57	43.82	21.32	0.18	0.68	1.33	1.000	1.05	1	1.00	35.39	0.00	1.00	35.39	NA	70.39	0.65	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 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)

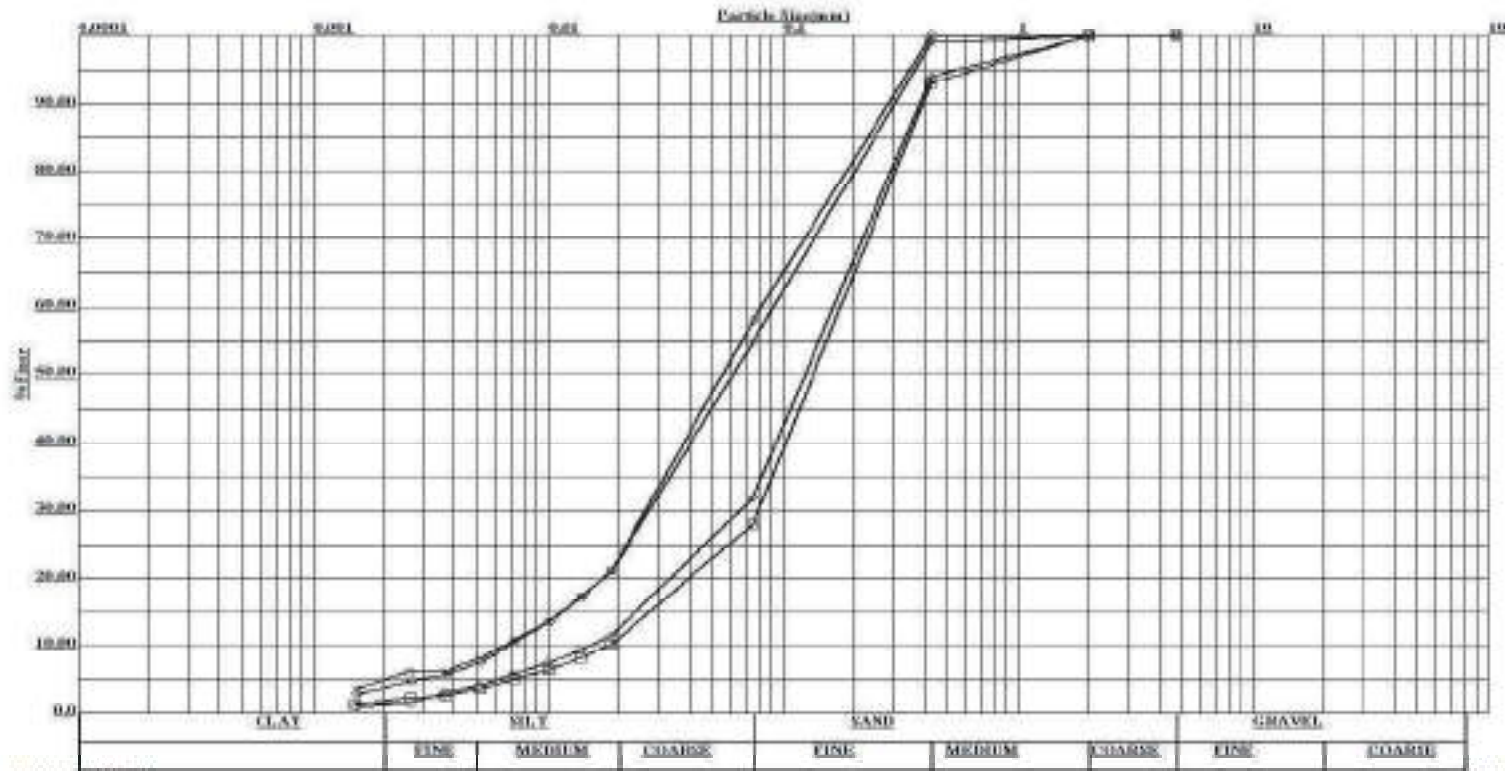
$K_\alpha$  Correction for static shear stress is required only for sloping ground

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. - 46  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



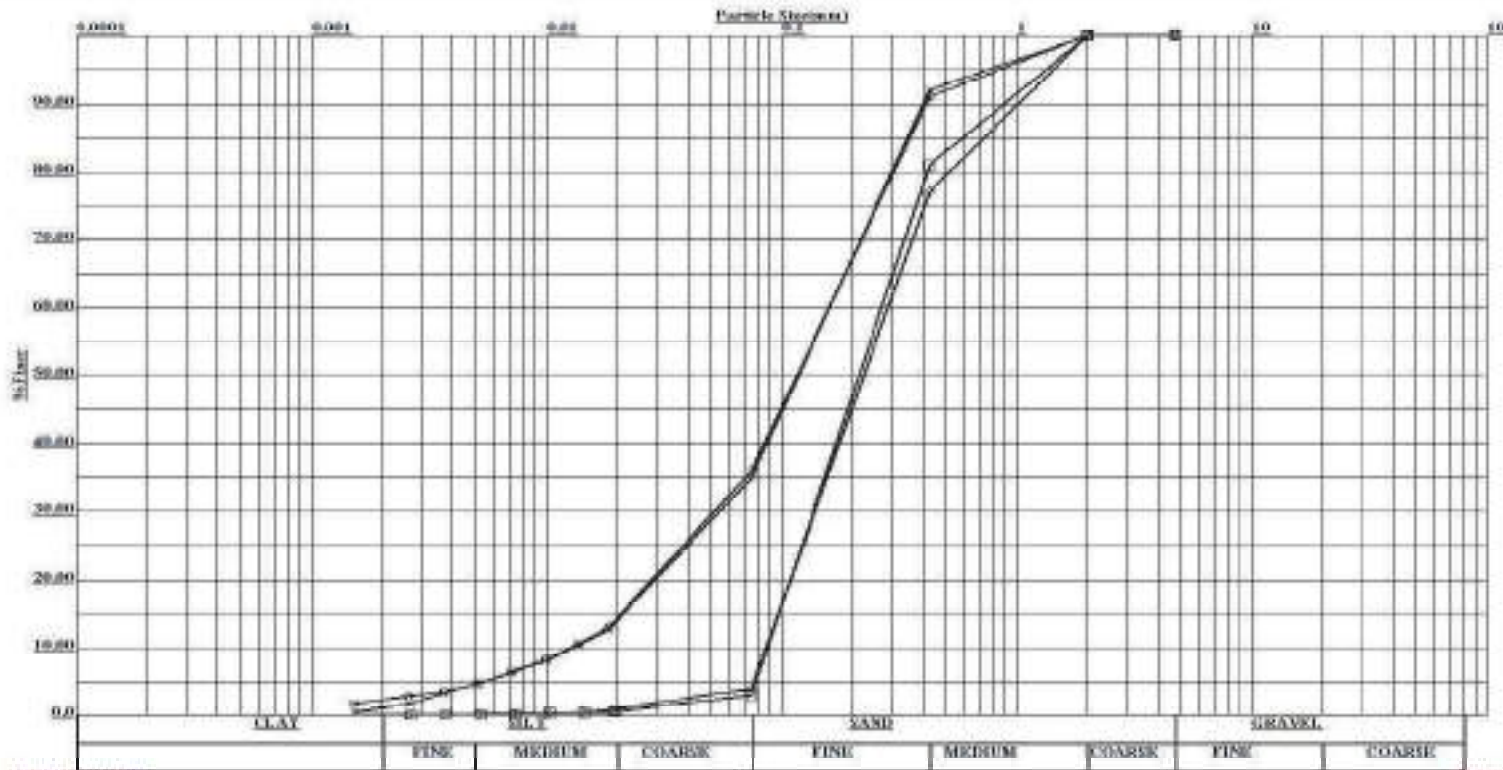
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	VERY LOOSE, LITE BROWN, SANDY SILT (ML)	0.00	45.00	50.00	5.00	14.16	1.23
○	1.5		0.00	42.00	54.00	4.00	11.97	1.23
□	3.0	LOOSE TO MEDIUM DENSE, LITE GREY, SILTY SAND (SM)	0.00	72.00	27.00	1.00	9.67	1.95
◇	6.0		0.00	68.00	30.00	2.00	10.97	1.74

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. - 46  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 01

GRAIN SIZE ANALYSIS



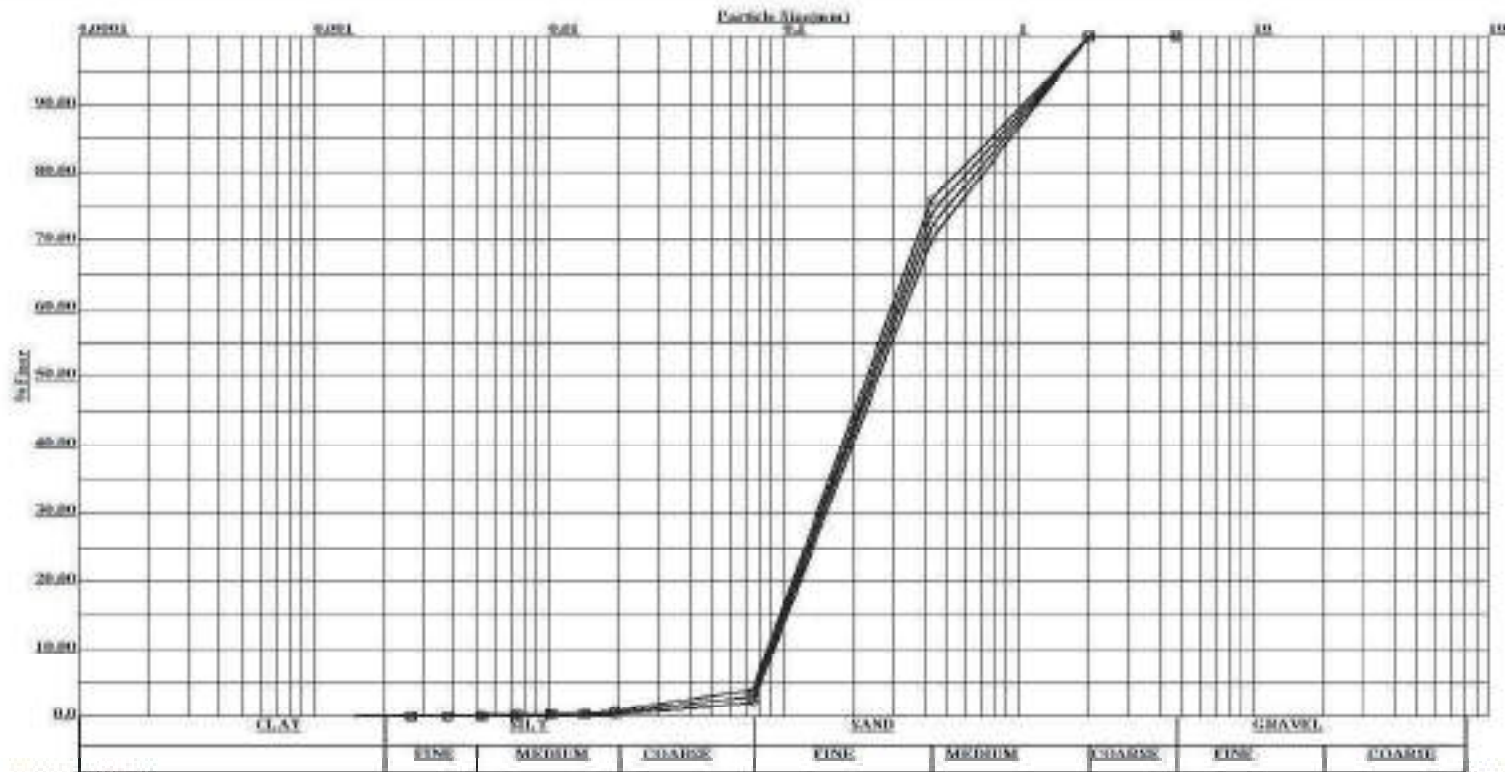
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	9.0	LOOSE TO MEDIUM DENSE, LITE GREY, SILTY SAND (SM)	0.00	65.00	34.00	1.00	12.14	1.42
○	12.0		0.00	64.00	34.00	2.00	12.57	1.33
□	15.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.04	0.80
◇	18.0		0.00	96.00	4.00	0.00	3.28	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. - 46  
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	97.00	3.00	0.00	3.39	0.78
○	24.0		0.00	96.00	4.00	0.00	3.34	0.79
□	27.0		0.00	97.00	3.00	0.00	3.51	0.78
◇	30.0		0.00	98.00	2.00	0.00	3.58	0.77

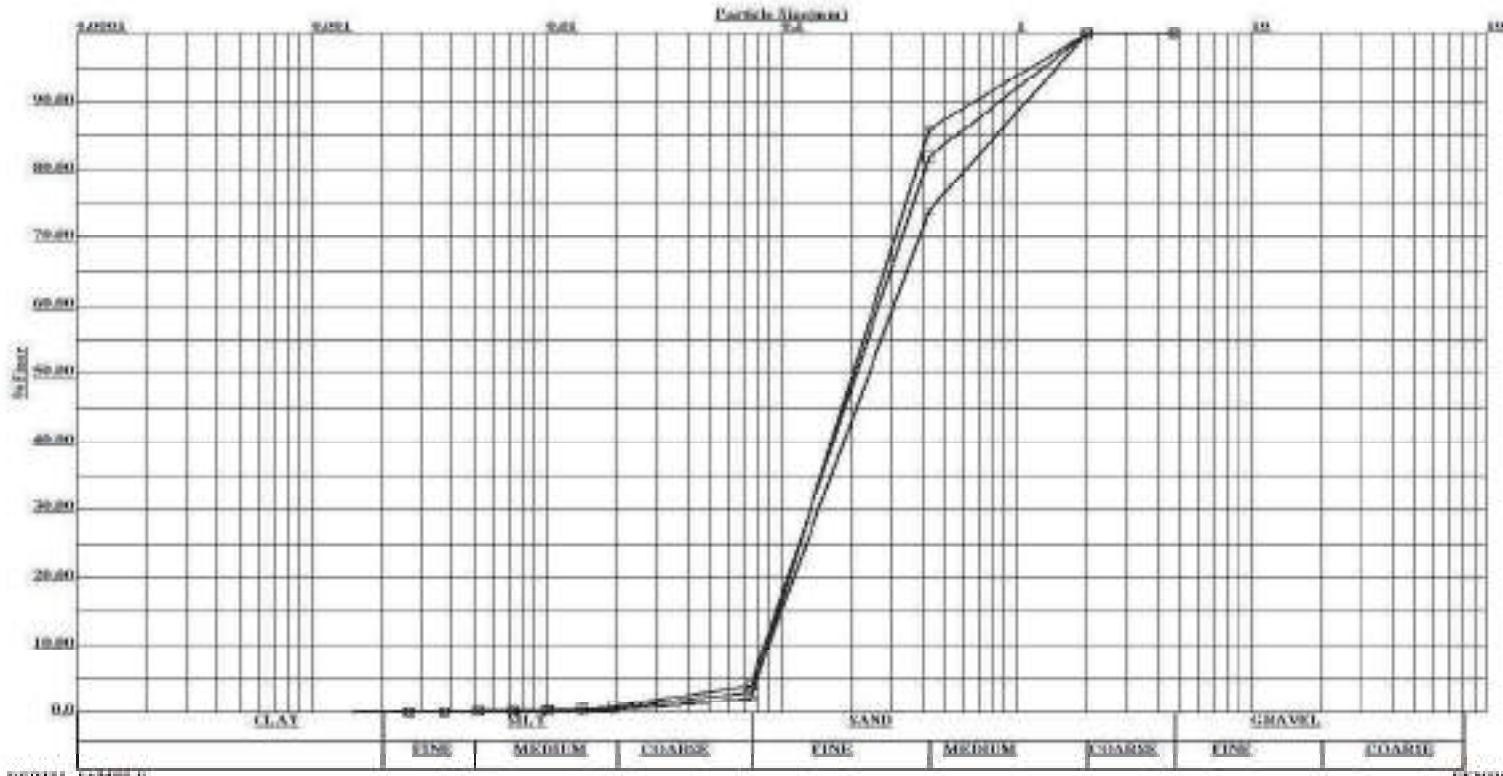


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 46  
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	97.00	3.00	0.00	3.39	0.78
o	36.0		0.00	98.00	2.00	0.00	2.81	0.81
□	39.0		0.00	96.00	4.00	0.00	3.04	0.80

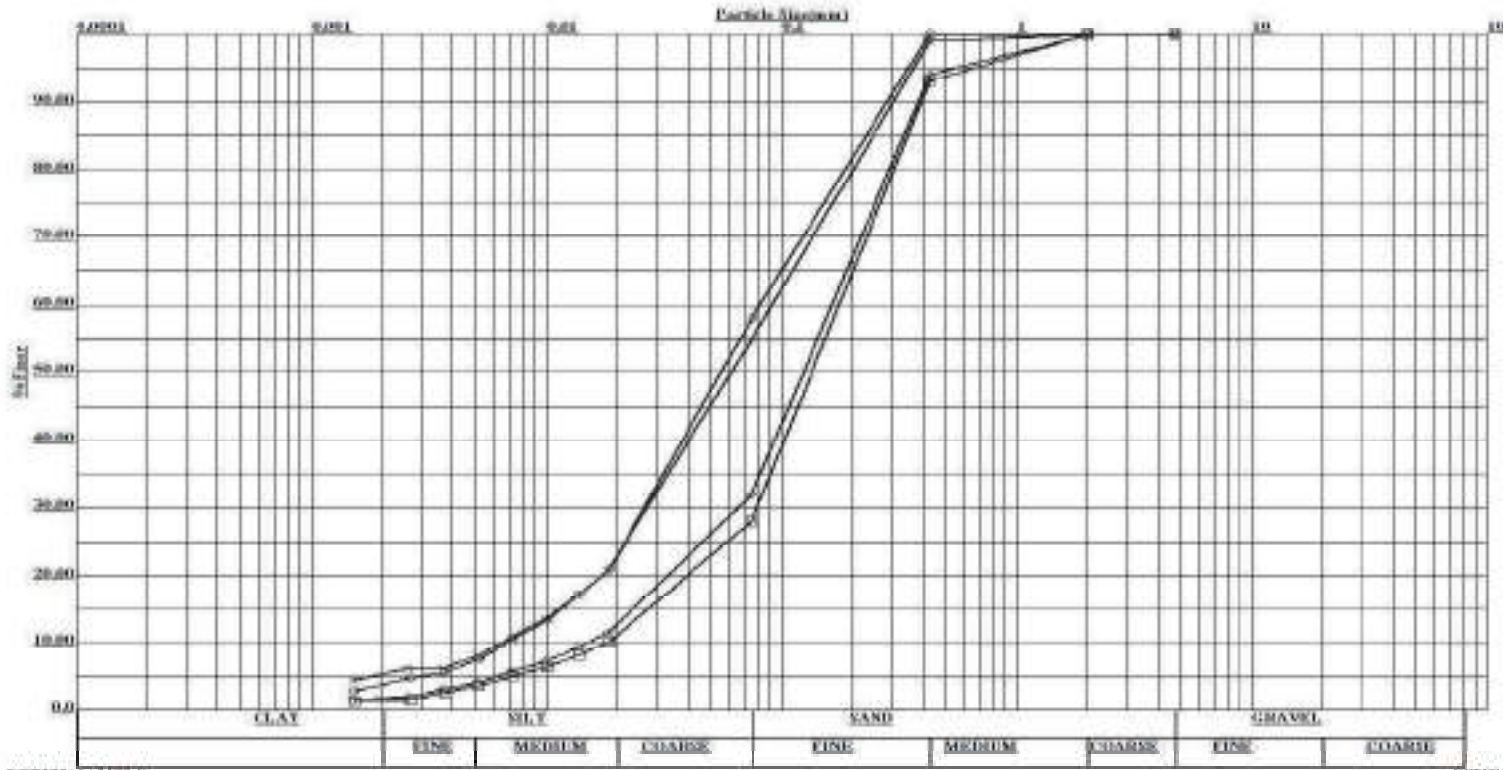


PROJECT: Final location survey for New B.G Railway line projects (770.00 km.) and Final location survey for construction of Doubling/Third line/ 3rd & 4th line (252.00 km.) of North Eastern Railway (Total 1022.00 km)

BRIDGE NO. - 46  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



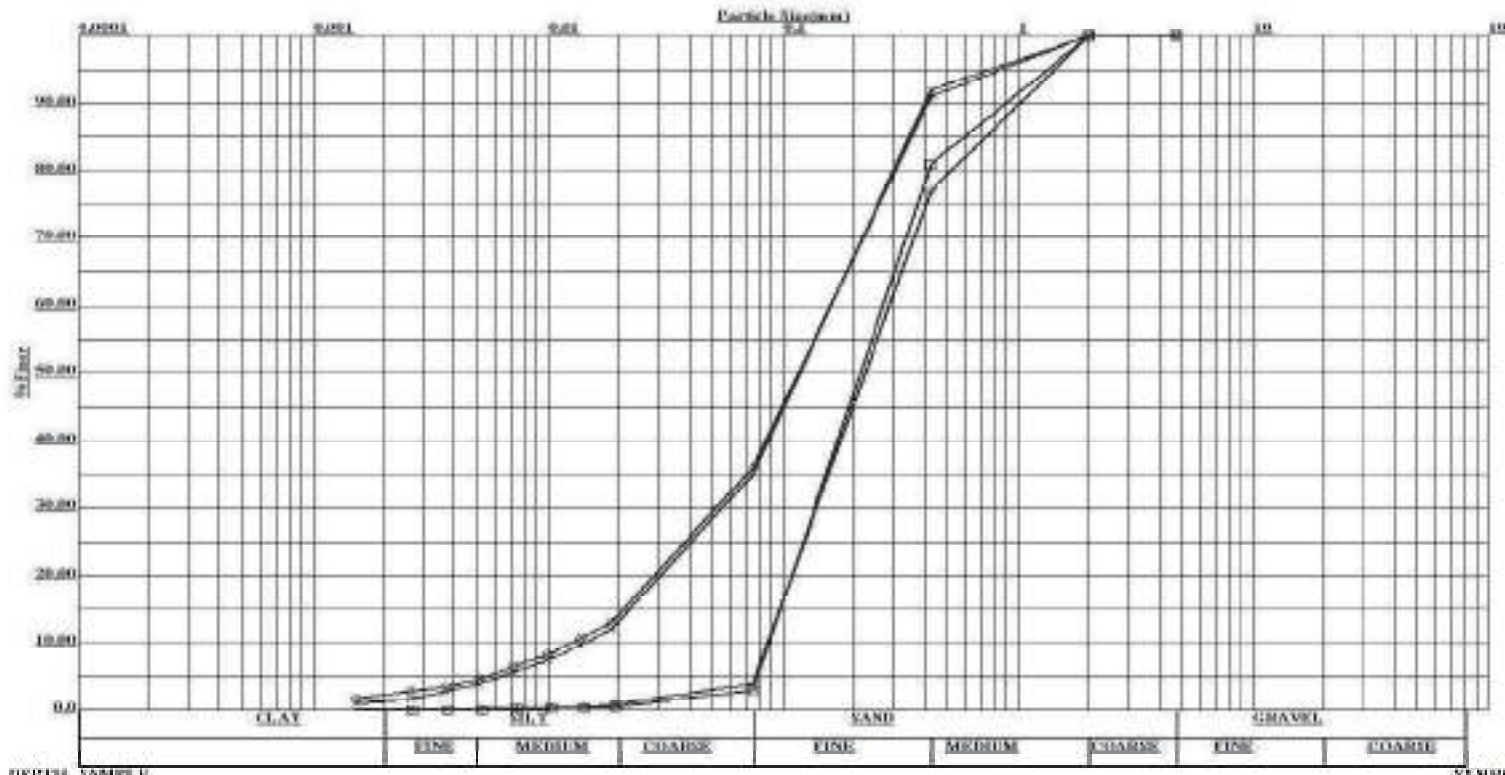
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	$C_u$	$C_c$
			(%)	(%)	(%)	(%)		
×	0.0	LOOSE ,LITE BROWN,SANDY SILT(ML)	0.00	45.00	50.00	5.00	14.16	1.23
○	1.5		0.00	42.00	54.00	4.00	11.98	1.23
□	3.0	LOOSE TO MEDUM DENSE, LITE BROWN, SILTY SAND(SM)	0.00	72.00	27.00	1.00	9.68	1.95
◇	6.0		0.00	68.00	30.00	2.00	10.97	1.74

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. - 46  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



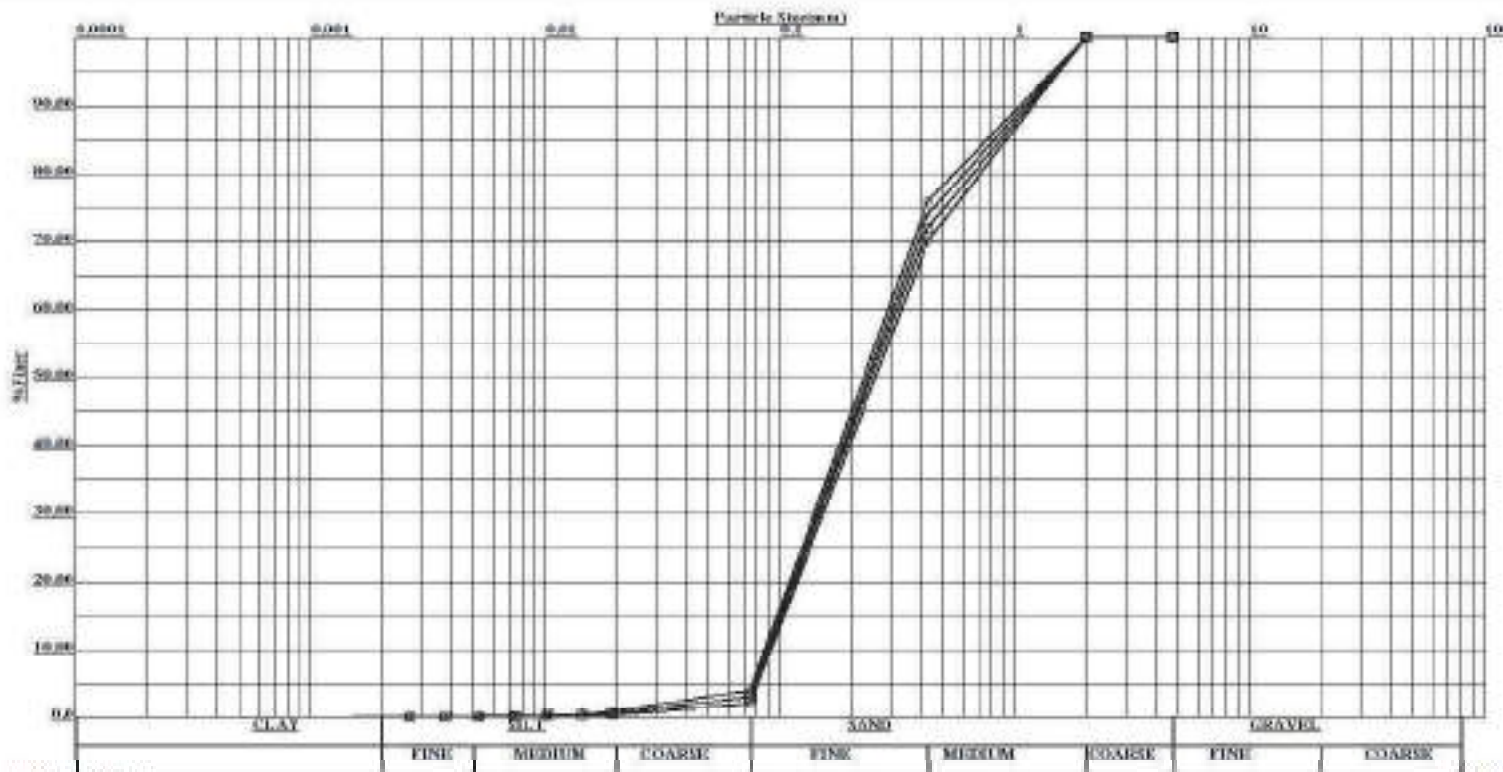
Symbol	Depth, m	Soil Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	C <sub>u</sub>	C <sub>c</sub>
×	9.0	LOOSE TO MEDUM DENSE, LITE BROWN, SILTY SAND(SM)	0.00	65.00	34.00	1.00	11.17	1.33
○	12.0		0.00	64.00	34.00	2.00	12.58	1.34
□	15.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.04	0.80
◇	18.0		0.00	96.00	4.00	0.00	3.28	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. - 46  
SECTION:CHITAUNI TO MADHUBANI

BOREHOLE NO. - 02

GRAIN SIZE ANALYSIS



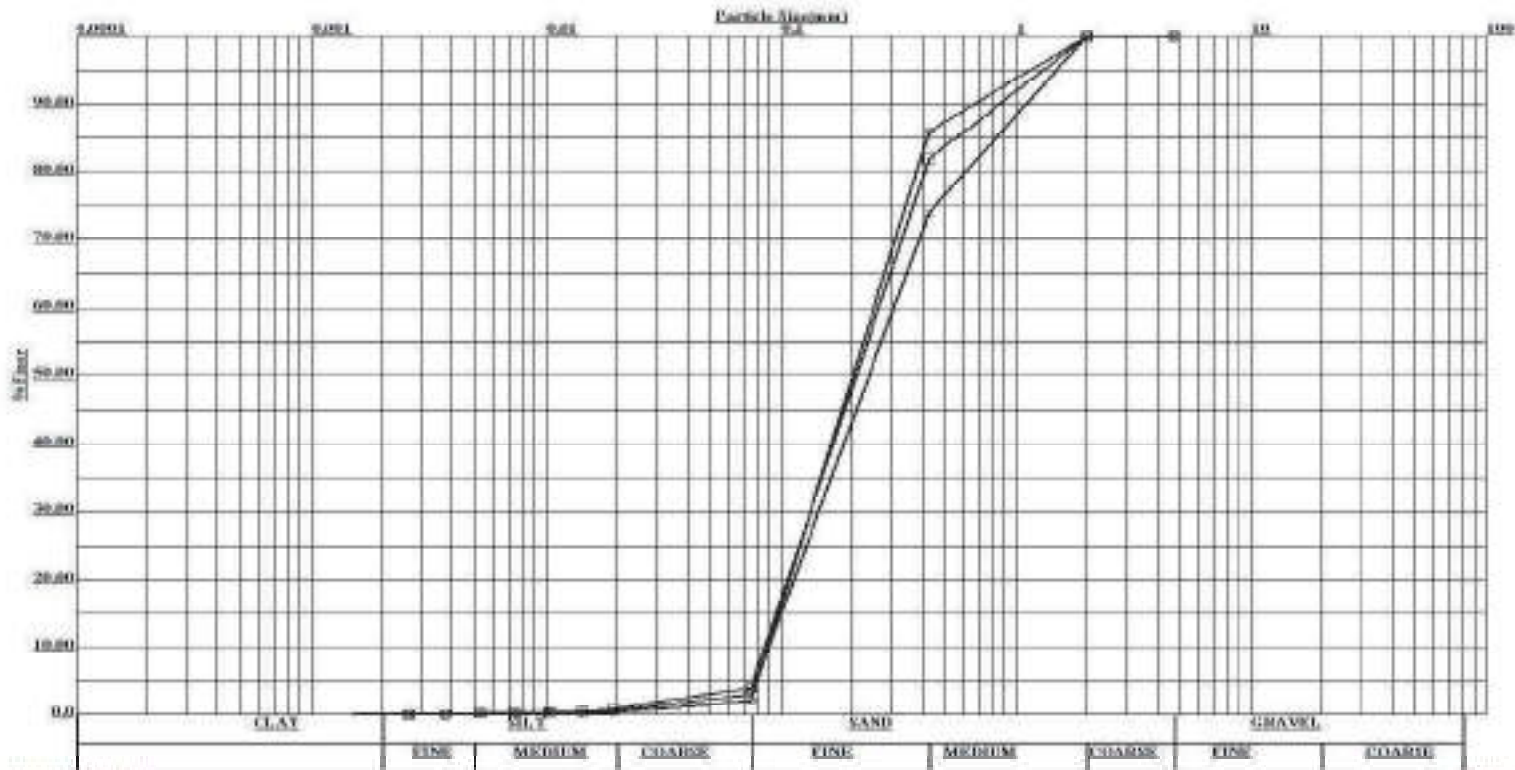
Symbol	Depth, m	Soil Description	Gravel	Sand	Silt	Clay	C <sub>u</sub>	C <sub>c</sub>
			(%)	(%)	(%)	(%)		
×	21.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.39	0.78
○	24.0		0.00	96.00	4.00	0.00	3.34	0.79
□	27.0		0.00	97.00	3.00	0.00	3.51	0.78
◇	30.0		0.00	98.00	2.00	0.00	3.58	0.77

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. - 46  
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>
			(%)	(%)	(%)	(%)		
x	33.0	MEDIUM DENSE TO DENSE, DARK GREY, POORLY GRADED SAND (SP)	0.00	97.00	3.00	0.00	3.39	0.78
o	36.0		0.00	98.00	2.00	0.00	2.81	0.81
□	39.0		0.00	96.00	4.00	0.00	3.04	0.80



**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- 46

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= $1.76 \times \sqrt{\text{d(m)}}$	Average Cohesion Intercept - c (t/sqm)	Average Angle of Internal Friction (°)	F	Silt Factor = $\frac{K_{sf}c}{F \times (1 + \sqrt{c/10})}$	
1	BH-01	1.50	1.95	SANDY SILT	ML	0.0	0.0	0.0	0.0	31.0	11.0	58.0	0.00	0.00	0.00	0.00	9.38	1.40	2.175	0.130	0.633	-	-	-	-	
2		3.00	3.45	SILTY SAND	SM	0.0	0.0	0.0	7.0	48.0	17.0	28.0	0.00	0.00	0.00	4.99	14.52	2.17	1.050	0.227	0.839	-	-	-	-	
3		15.00	15.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	19.0	53.0	25.0	3.0	0.00	0.00	0.00	13.54	16.03	3.19	0.113	0.329	1.009	-	-	-	-	



**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- 46

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= $1.76 \times \sqrt{d_m}$	Average Cohesion Intercept - c (t/sqm)	Average Angle of Internal Friction (°)	F	Silt Factor = $\frac{K_s f c}{F \times (1 + \sqrt{c/10})}$	
1	BH-02	1.50	1.95	SANDY SILT	ML	0.0	0.0	0.0	0.0	31.0	11.0	58.0	0.00	0.00	0.00	0.00	9.38	1.40	2.175	0.130	0.633	-	-	-	-	-
2		6.00	6.45	SILTY SAND	SM	0.0	0.0	0.0	6.0	40.0	22.0	32.0	0.00	0.00	0.00	4.28	12.10	2.81	1.200	0.204	0.795	-	-	-	-	-
3		18.00	18.45	POORLY GRADED SAND	SP	0.0	0.0	0.0	23.0	50.0	23.0	4.0	0.00	0.00	0.00	16.39	15.13	2.93	0.150	0.346	1.035	-	-	-	-	-