

SGS



BH-05

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	UD-01	Depth (m): 3.00-4.00
Can No.		108
Weight of Wet Soil + Can (gm)		268.30
Weight of Dry Soil + can (gm)		201.29
Weight of Can (gm)		25.86
Moisture Content (%)		38.20
Description		Lean CLAY, CL

Sample No.:	UD-02	Depth (m): 7.00-8.00
Can No.		96
Weight of Wet Soil + Can (gm)		274.50
Weight of Dry Soil + can (gm)		202.66
Weight of Can (gm)		12.09
Moisture Content (%)		37.70
Description		Lean CLAY, CL

Sample No.:	UD-03	Depth (m): 11.00-12.00
Can No.		205
Weight of Wet Soil + Can (gm)		227.60
Weight of Dry Soil + can (gm)		182.55
Weight of Can (gm)		26.05
Moisture Content (%)		28.79
Description		Lean CLAY, CL

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-11	Depth (m): 14.00-14.45
Can No.		204
Weight of Wet Soil + Can (gm)		243.79
Weight of Dry Soil + can (gm)		190.26
Weight of Can (gm)		25.68
Moisture Content (%)		32.53
Description		SILT with Sand, ML

Sample No.:	SPT-14	Depth (m): 17.00-17.45
Can No.		408
Weight of Wet Soil + Can (gm)		225.68
Weight of Dry Soil + can (gm)		191.30
Weight of Can (gm)		24.91
Moisture Content (%)		20.66
Description		Silty fine SAND, SM

Sample No.:	SPT-18	Depth (m): 21.00-21.45
Can No.		446
Weight of Wet Soil + Can (gm)		230.34
Weight of Dry Soil + can (gm)		190.69
Weight of Can (gm)		11.54
Moisture Content (%)		22.13
Description		Sandy SILT, ML

Geotechnical Investigation for Matarbari Project

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BH No.: BH-05

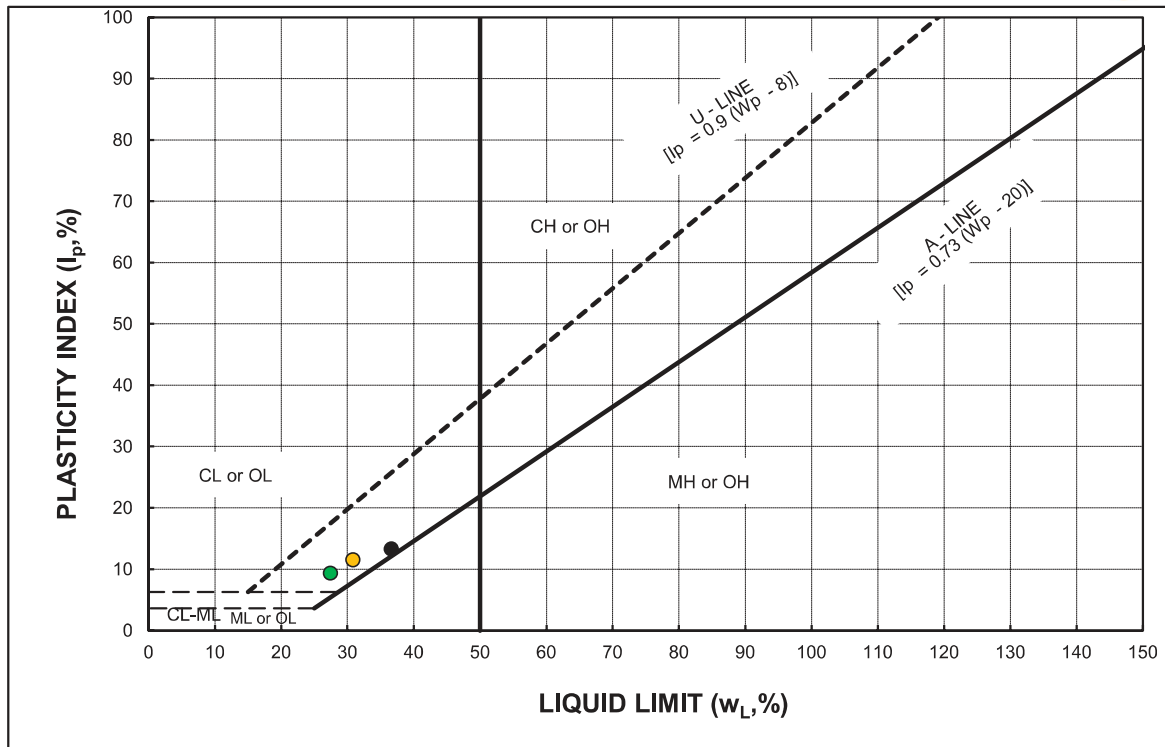
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 02-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	UD-01	3.00-4.00	36.60	23.29	13.31		Lean CLAY, CL
●	UD-02	7.00-8.00	30.80	19.26	11.54		Lean CLAY, CL
●	UD-03	11.00-12.00	27.40	18.02	9.38		Lean CLAY, CL
●	SPT-14	17.00-17.45	*	*	*		The sample is nonplastic
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05

*Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 15-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

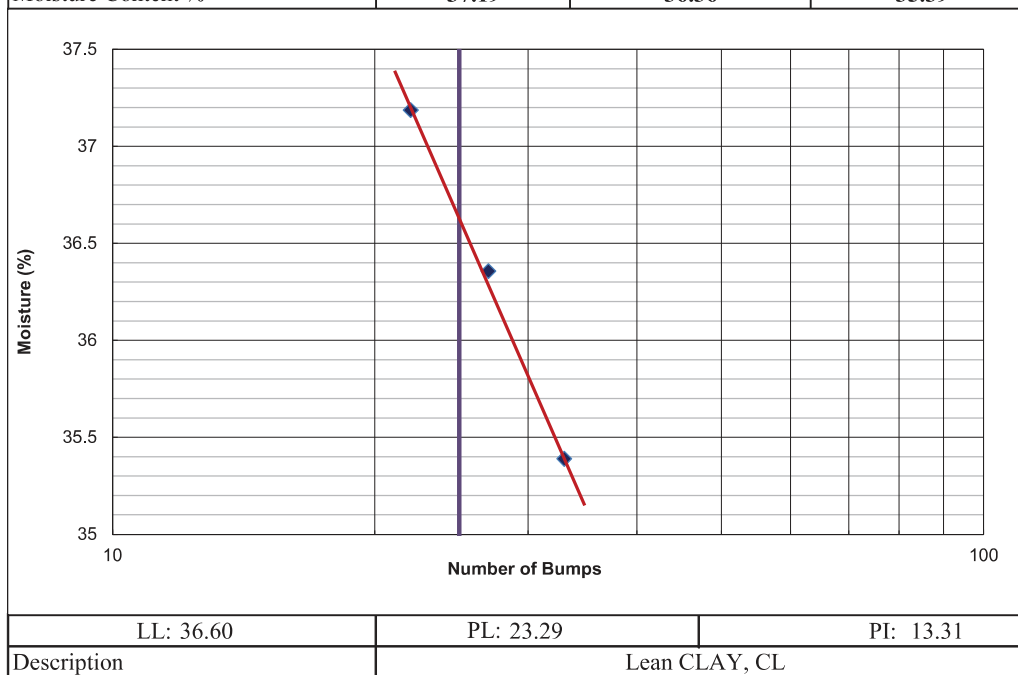
Sample No: UD-01

BH No.: BH-05

Sample Depth: 3.00-4.00

Plastic Limit Test		
Container No.	366	26
Weight of can (gm)	8.64	8.63
Wet weight of soil + can (gm)	31.12	31.14
Dry Weight of soil + can (gm)	26.89	26.87
Moisture Content %	23.18	23.41
Average	23.29	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	27	33
Container No.	329	479	335
Weight of can (gm)	9.42	9.22	9.29
Wet weight of soil + can (gm)	28.64	26.96	26.2
Dry Weight of soil + can (gm)	23.43	22.23	21.78
Moisture Content %	37.19	36.36	35.39



Tested by: Rayhan

Date: 15-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

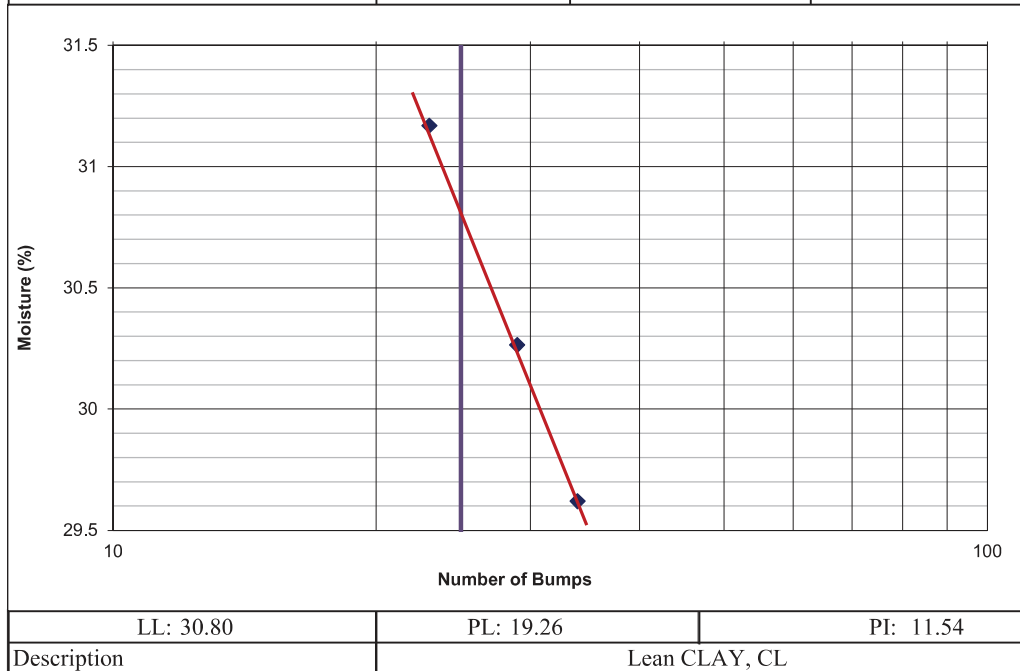
Sample No.: UD-02

BH No.: BH-05

Sample Depth: 7.00-8.00

Plastic Limit Test		
Container No.	345	339
Weight of can (gm)	8.99	8.94
Wet weight of soil + can (gm)	33.97	33.99
Dry Weight of soil + can (gm)	29.95	29.93
Moisture Content %	19.18	19.34
Average	19.26	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	34
Container No.	331	330	321
Weight of can (gm)	9.86	9.1	9.13
Wet weight of soil + can (gm)	30.06	28.34	27.51
Dry Weight of soil + can (gm)	25.26	23.87	23.31
Moisture Content %	31.17	30.26	29.62



Tested by: Rayhan
Date: 15-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

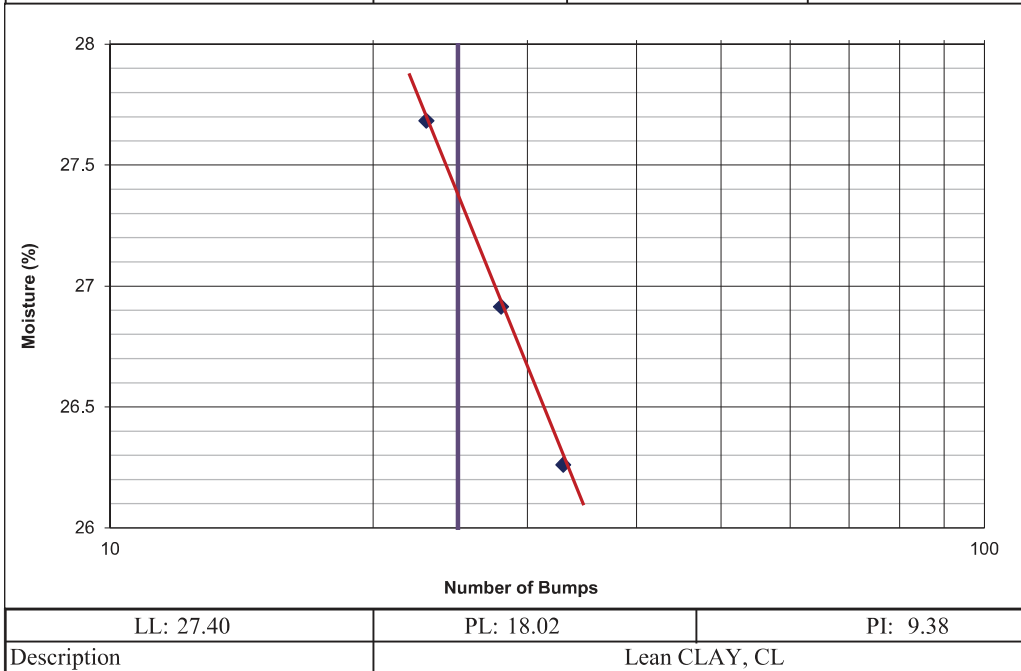
Sample No.: UD-03

BH No.: BH-05

Sample Depth.: 11.00-12.00

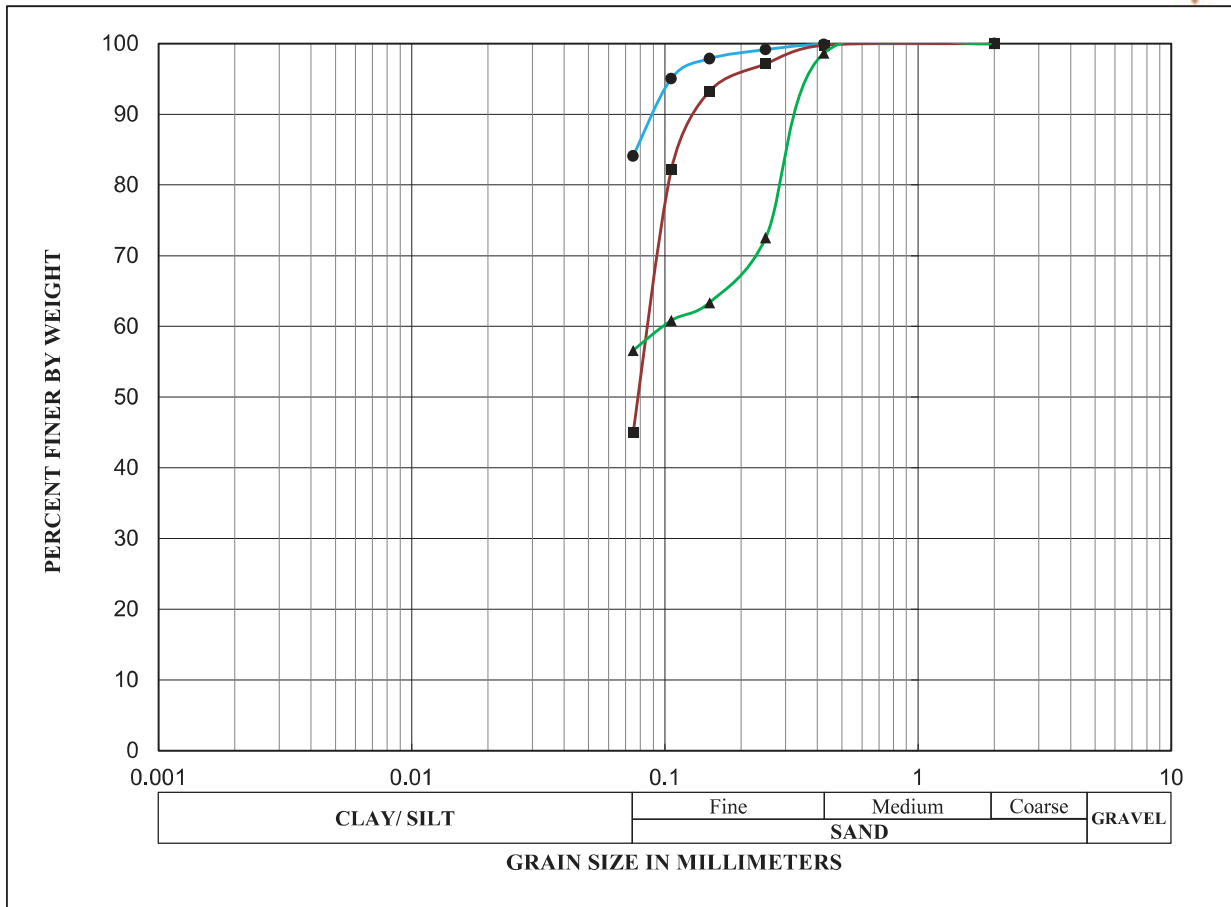
Plastic Limit Test		
Container No.	418	333
Weight of can (gm)	6.98	6.93
Wet weight of soil + can (gm)	36.74	36.76
Dry Weight of soil + can (gm)	32.21	32.19
Moisture Content %	17.95	18.09
Average	18.02	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	33
Container No.	315	312	462
Weight of can (gm)	13.3	13.33	12.29
Wet weight of soil + can (gm)	37.33	35.54	34.07
Dry Weight of soil + can (gm)	32.12	30.83	29.54
Moisture Content %	27.68	26.91	26.26



Tested by: Rayhan
Date: 15-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● SPT-11	14.00-14.45	SILT with Sand, ML						
■ SPT-14	17.00-17.45	Silty fine SAND, SM						
▲ SPT-18	21.00-21.45	Sandy SILT, ML						
●								
■								
▲								

Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
							%Fine	%Meidum	%Coarse	
● SPT-11	14.00-14.45	0.054	0.045	0.027	0.009	0.00	15.78	0.12	0.00	84.10
■ SPT-14	17.00-17.45	0.088	0.079	0.050	0.017	0.00	54.78	0.22	0.00	45.00
▲ SPT-18	21.00-21.45	0.100	0.066	0.040	0.013	0.00	42.02	1.36	0.00	56.62
●										
■										
▲										

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-01	Depth(m)	3.00-4.00
Pyknometer No.		19
Mass of bottle + soil + water: M_3	gm	124.09
Mass of bottle + soil: M_2	gm	72.45
Mass of bottle + water: M_4	gm	105.04
Mass of bottle: M_1	gm	42.41
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	32.59
Mass of water used: $M_3 - M_2$	gm	51.64
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	10.99
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-02	Depth(m)	7.00-8.00
Pyknometer No.		18
Mass of bottle + soil + water: M_3	gm	118.77
Mass of bottle + soil: M_2	gm	73.82
Mass of bottle + water: M_4	gm	99.79
Mass of bottle: M_1	gm	43.85
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	25.97
Mass of water used: $M_3 - M_2$	gm	44.95
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	10.99
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.72

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-11	Depth(m)	14.00-14.45
Pyknometer No.		20
Mass of bottle + soil + water: M_3	gm	118.26
Mass of bottle + soil: M_2	gm	73.80
Mass of bottle + water: M_4	gm	99.33
Mass of bottle: M_1	gm	43.82
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	25.53
Mass of water used: $M_3 - M_2$	gm	44.46
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.05
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.71

Geotechnical Investigation for Matarbari Project

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Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 1-10.4.21 *


SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

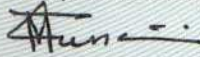
Countersigned by :

f


Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Test performed by :


 25.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-18	Depth(m)	21.00-21.45
Pyknometer No.		6
Mass of bottle + soil + water: M_3	gm	94.09
Mass of bottle + soil: M_2	gm	55.21
Mass of bottle + water: M_4	gm	75.23
Mass of bottle: M_1	gm	25.22
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	20.02
Mass of water used: $M_3 - M_2$	gm	38.88
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.13
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	3.00-4.00
Weight of soil	gm	160.50
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.86
Dry Density	(g/cm ³)	1.35
Void Ratio		1.03
Moisture Content	%	38.20
Specific Gravity	(g/cm ³)	2.73

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

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Date: 16-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-02	Depth (m):	7.00-8.00
Weight of soil	gm	157.80
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.83
Dry Density	(g/cm ³)	1.33
Void Ratio		1.05
Moisture Content	%	37.70
Specific Gravity	(g/cm ³)	2.72

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-03	Depth (m):	11.00-12.00
Weight of soil	gm	163.80
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.90
Dry Density	(g/cm ³)	1.48
Void Ratio		0.88
Moisture Content	%	28.79
Specific Gravity	(g/cm ³)	2.77

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-05

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)


Tested by: Rayhan
Date: 03-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

Total Stress Triaxial Compression

Unconfined Compression

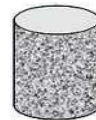
Summary Report

<p>Sample Details</p>  <p><i>sketch showing specimen location in original sample</i></p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Depth</td> <td colspan="3">3.00-4.00</td> </tr> <tr> <td>Description</td> <td colspan="3">Lean CLAY,CL</td> </tr> <tr> <td>Type</td> <td colspan="3">UD</td> </tr> <tr> <td>Initial Sample Length</td> <td>L_0</td> <td>(mm)</td> <td>76.0</td> </tr> <tr> <td>Initial Sample Diameter</td> <td>D_0</td> <td>(mm)</td> <td>38.0</td> </tr> <tr> <td>Initial Sample Weight</td> <td>W_0</td> <td>(gr)</td> <td>160.5</td> </tr> <tr> <td>Bulk Density</td> <td>ρ_0</td> <td>(Mg/m³)</td> <td>1.86</td> </tr> <tr> <td>Particle Density</td> <td>ρ_s</td> <td>(Mg/m³)</td> <td>2.73</td> </tr> </table>	Depth	3.00-4.00			Description	Lean CLAY,CL			Type	UD			Initial Sample Length	L_0	(mm)	76.0	Initial Sample Diameter	D_0	(mm)	38.0	Initial Sample Weight	W_0	(gr)	160.5	Bulk Density	ρ_0	(Mg/m ³)	1.86	Particle Density	ρ_s	(Mg/m ³)	2.73
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Bulk Density	ρ_0	(Mg/m ³)	1.86																														
Particle Density	ρ_s	(Mg/m ³)	2.73																														


Initial Conditions			
Strain Rate	m_s	(mm/min)	0.76000
MembraneThickness	m_b	(mm)	0.00
Displacement Input	L_{IP}	(mm)	CH 7
Load Input	N_{IP}	(N)	CH 2
Initial Moisture	ω_i	(%)	39
Initial Dry Density	ρ_{d0}	(Mg/m ³)	1.34
Initial Voids Ratio	e_0	.	1.04
Initial Degree of Saturation	S_o	(%)	100

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$	(kPa)	48.04
Strain At Max Stress	ϵ_f	(%)	13.53
Final Moisture	ω_f	(%)	39
Final Dry Density	ρ_{df}	(Mg/m ³)	1.34
Final Voids Ratio	e_f	.	1.04
Final Degree of Saturation	S_f	(%)	100.0

Notes



Failure Sketch
(surface inclination)

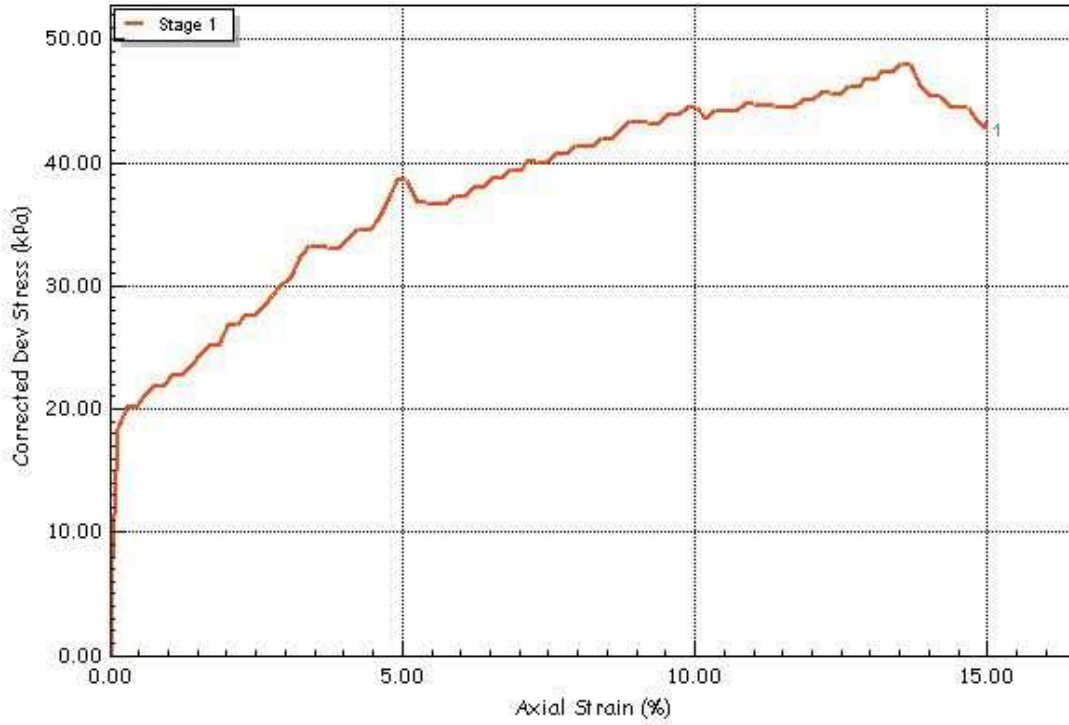
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	Database:	.\SQLEXPRESS \ GIE-D	Test Date	3/16/2021
	Site Reference		Borehole	BH-05
	Jobfile	UCT	Sample	UD-01
Client	SGS	Depth	3.00-4.00	
Operator	R. Islam	Checked	Aminul	Approved T. Islam


GIE

Total Stress Triaxial Compression

Unconfined Compression

Test Results Plots




	Test Method D 2166/D2166M-13		Test Name UCT		
	Database: .\SQLEXPRESS \ GIE-D		Test Date 3/16/2021		
	Site Reference		Borehole BH-05		
	Jobfile UCT		Sample UD-01		
Client SGS		Depth 3.00-4.00			
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

GIE

Total Stress Triaxial Compression

Unconfined Compression

Summary Report

<p>Sample Details</p>  <p><i>sketch showing specimen location in original sample</i></p>	Depth Description Type	7.00-8.00 Lean CLAY. CL UD	
	Initial Sample Length Initial Sample Diameter Initial Sample Weight Bulk Density Particle Density	L ₀ D ₀ W ₀ ρ ₀ ρ _s	(mm) (mm) (gr) (Mg/m ³) (Mg/m ³) 76.0 38.0 157.8 1.83 2.72


Initial Conditions			
Strain Rate	m _s	(mm/min)	0.76000
MembraneThickness	m _b	(mm)	0.00
Displacement Input	L _{IP}	(mm)	CH 7
Load Input	N _{IP}	(N)	CH 2
Initial Moisture	ω _i %	(%)	38
Initial Dry Density	ρ _{d0}	(Mg/m ³)	1.33
Initial Voids Ratio	e ₀	.	1.04
Initial Degree of Saturation	S _o	(%)	98

Final Conditions			
Max Deviator Stress	(σ ₁ - σ ₃) _f	(kPa)	58.23
Strain At Max Stress	ε _f %	(%)	10.76
Final Moisture	ω _f %	(%)	38
Final Dry Density	ρ _{df}	(Mg/m ³)	1.33
Final Voids Ratio	e _f	.	1.04
Final Degree of Saturation	S _f	(%)	98.0

Notes



Failure Sketch
(surface inclination)

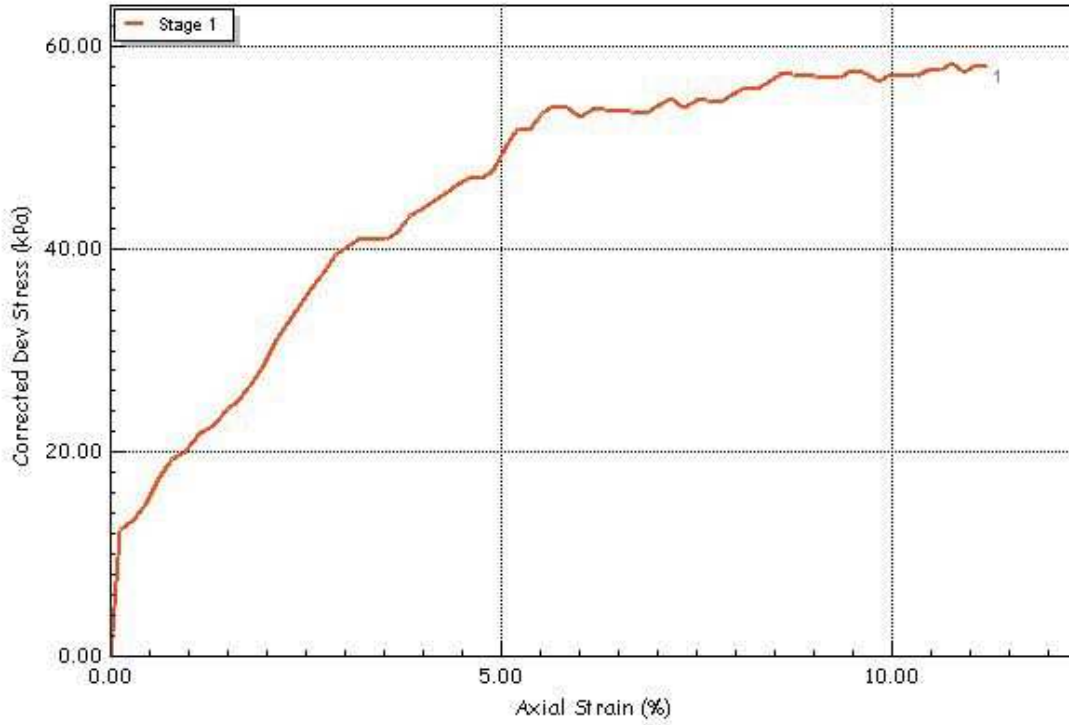
	Test Method D 2166/D2166M-13 Database: .\SQLEXPRESS \ GIE-D	Test Name UCT Test Date 3/11/2021		
	Site Reference Jobfile UCT Client SGS	Borehole BH-05 Sample UD-02 Depth 7.00-8.00		
	Operator R. Islam	Checked Aminul	Approved T. Islam	


GIE

Total Stress Triaxial Compression

Unconfined Compression

Test Results Plots

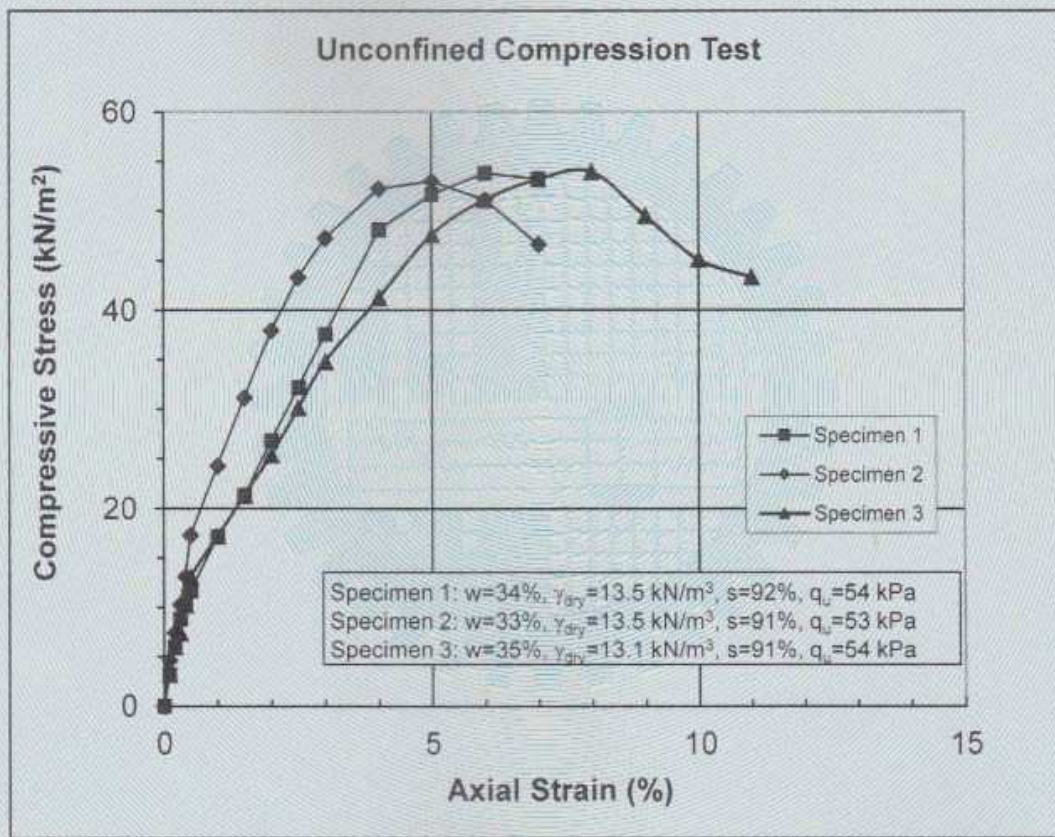


	Test Method D 2166/D2166M-13		Test Name UCT		
	Database: \SQLEXPRESS \ GIE-D		Test Date 3/11/2021		
	Site Reference		Borehole BH-05		
	Jobfile UCT		Sample UD-02		
Client SGS		Depth 7.00-8.00			
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

GIE



BRTC No.: 110-231613/20-21/CE dated 11.3.21			
Client : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka			
Ref : SGS/Phase-2/SI/090321 dated 9.3.21			
Project : Geotechnical Investigation at Matarbari			
Soil description : Grey silty clay			
Test Method:	ASTM	Date of Test:	31.3.21-5.4.21
BH No. :	5	Sample ID :	UD-3
		Depth:	11-12 m
		Location:	Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition.

Countersigned by :

majabil

Dr. A.B.M. Badruzzaman

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.



Specific Gravity= 2.77

Test performed by :

Tahmeed M. Al-Hussaini
8.5.21

Dr. Tahmeed M. Al-Hussaini

Professor

Department of Civil Engineering
BUET, Dhaka - 1000.

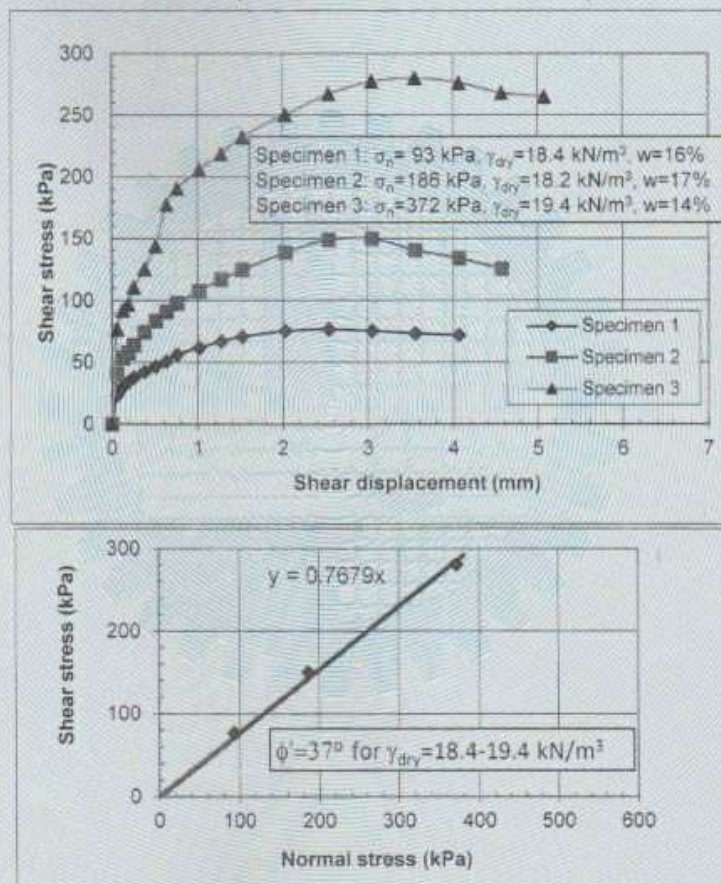




GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand, trace clay	Location: Matarbari	
Bore-Hole: 5	Sample: 14	Depth: 17-17.45 m
Date of Test: 28.3.21-7.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.
 Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.



Countersigned by :

Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.


Test performed by :

Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.

Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	21.00-21.45				
 <i>sketch showing specimen location in original sample</i>	Description	Sandy SILT				
	Type	Disturbed Soil				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	152.7	152.7	152.7	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	2.12	2.12	2.12	
	Particle Density	ρ _s (Mg/m ³)	2.69	2.69	2.69	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	200	400	800
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i (%)	22	22	22
Initial Dry Density	ρ _{di} (Mg/m ³)	1.74	1.74	1.74
Initial Voids Ratio	e _i	0.545	0.545	0.545
Initial Degree of Saturation	S _i (%)	100.0	100.0	100.0
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f (%)	36	36	36
Final Dry Density	ρ _{df} (Mg/m ³)	5.48	5.94	6.25
Final Voids Ratio	e _f	0.540	0.314	0.249
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0
Peak Shear Stress	(kPa)	136.3	267.1	558.6
Hoz Displacement	L _H (mm)	12.000	12.000	11.970
Vertical Displacement	L _V (mm)	0.070	0.290	0.600

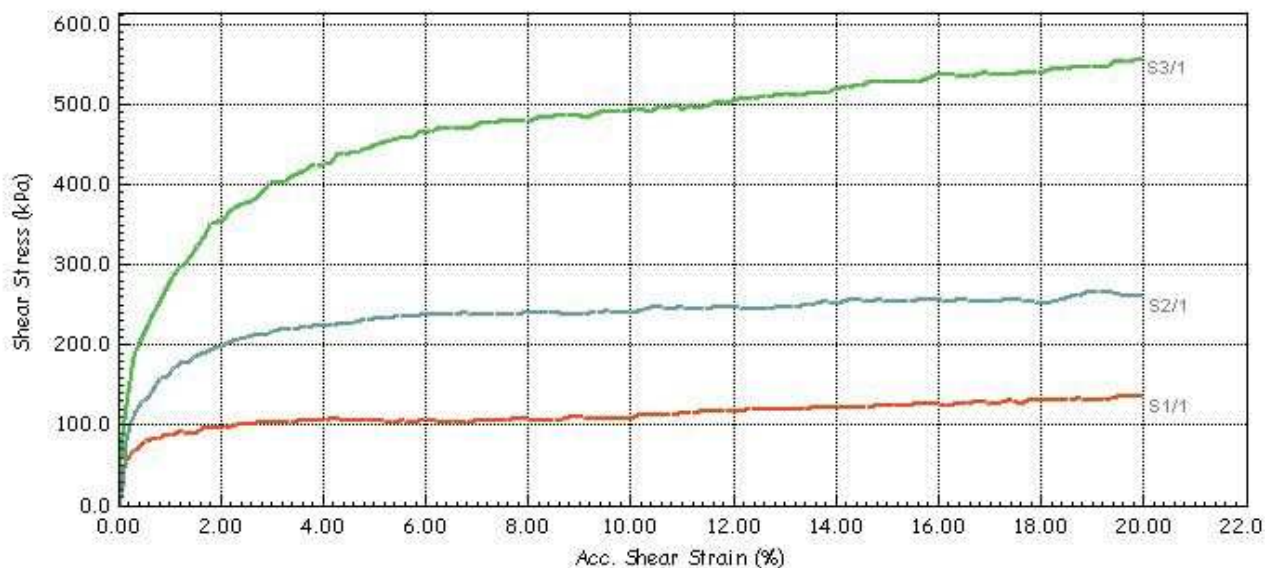
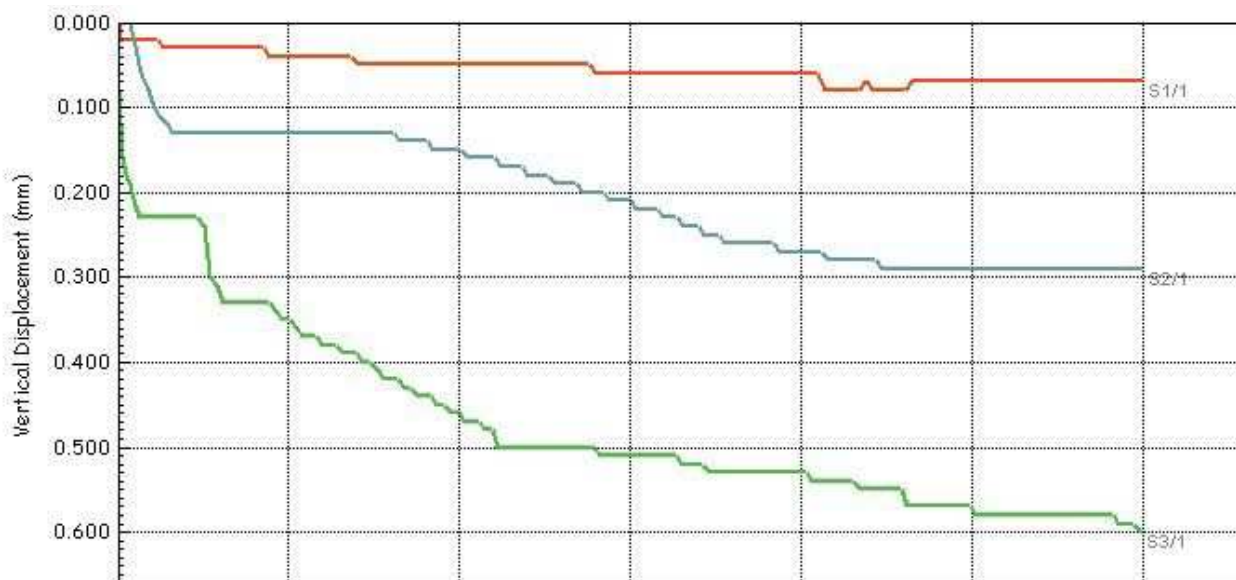
GIE


	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/23/2021
	Jobfile	Direct Shear Test	Sample	SPT-18
Client	SGS	Borehole	BH-05	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method	ASTM D 3080-04	Test Name	Direct Shear	
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D	
	Jobfile	Direct Shear Test	Test Date	3/23/2021	
	Client	SGS	Sample	SPT-18	
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

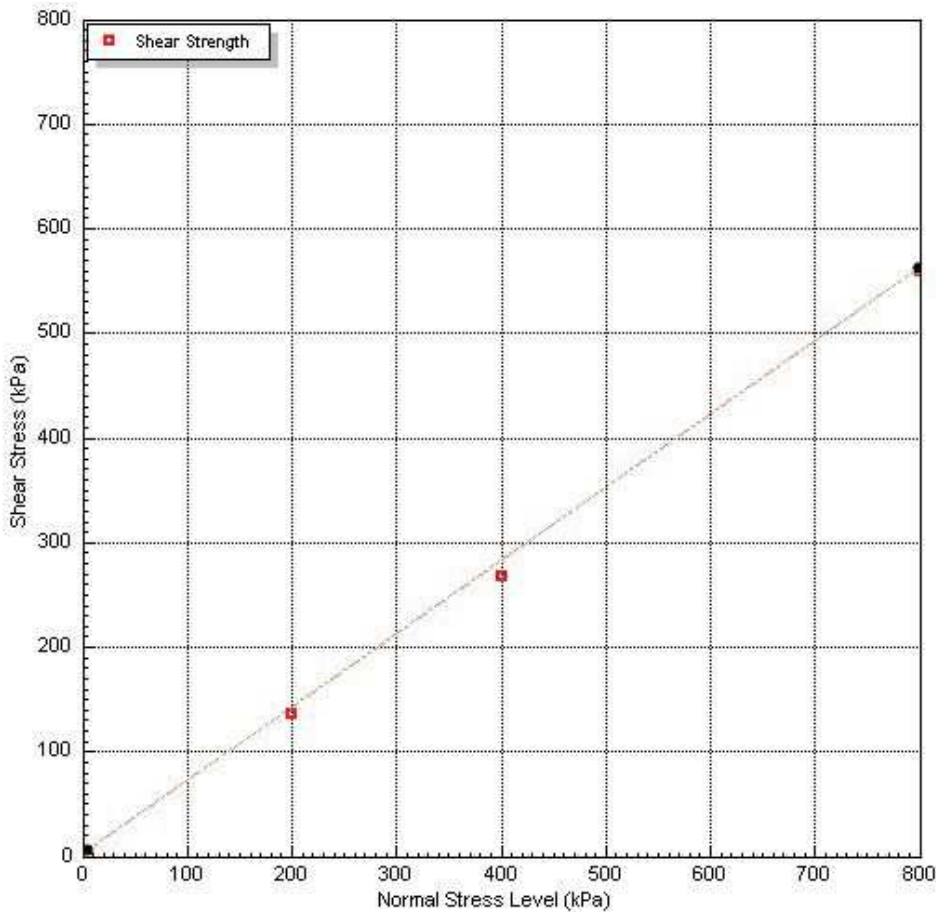
GIE

Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	36	36	36
Final Dry Density	ρ_{df} (Mg/m ³)	5.48	5.94	6.25
Final Voids Ratio	e_f	0.540	0.314	0.249
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	3.28		
Angle of Shearing Resistance	ϕ	35.1		
Notes				




	Test Method	ASTM D 3080-04	Test Name	Direct Shear	
			Database:	.\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date	3/23/2021	
	Jobfile	Direct Shear Test	Sample	SPT-18	
	Client	SGS	Borehole	BH-05	
	Operator	R. Islam	Checked	Aminul	Approved

GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

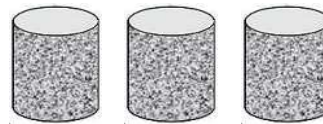
Summary Report

Sample Details			Spm. 1	2	3
 <p style="font-size: small;">sketch showing specimen location in original sample</p>	Depth	3.00-4.00			
	Type	UD			
	Initial Sample Length	L ₀ (mm)	76.0	76.0	76.0
	Initial Sample Diameter	D ₀ (mm)	38.0	38.0	38.0
	Initial Sample Weight	W ₀ (gr)	153.0	153.2	153.8
	Bulk Density	ρ ₀ (Mg/m ³)	1.78	1.78	1.78
	Particle Density	ρ _s (Mg/m ³)	2.73	2.73	2.73


Initial Conditions			Spm. 1	2	3
Specimen					
Initial Cell Pressure	σ ₃ (kPa)		35	70	140
Strain Rate	m _s (mm/min)		0.76000	0.76000	0.76000
Membrane Thickness	m _b (mm)		0.02	0.02	0.02
Displacement Input	L _{IP} (mm)		CH 7	CH 7	CH 7
Load Input	N _{IP} (N)		CH 2	CH 2	CH 2
Initial Moisture	ω _i % (%)		39	39	39
Initial Dry Density	ρ _{d0} (Mg/m ³)		1.28	1.28	1.28
Initial Voids Ratio	e ₀ .		1.14	1.13	1.13
Initial Degree of Saturation	S _o (%)		93	94	94

Final Conditions			Spm. 1	2	3
Max Deviator Stress	(σ ₁ - σ ₃) _f (kPa)		39.68	40.62	49.17
Membrane Correction	m _c (kPa)		38.662	43.799	42.802
Strain At Max Stress	ε _f % (%)		5.37	8.49	6.95
Shear Strength	c _u (kPa)		19.84	20.31	24.58
Final Moisture	ω _f % (%)		40	40	39
Final Dry Density	ρ _{df} (Mg/m ³)		1.27	1.27	1.28
Final Voids Ratio	e _f .		1.15	1.15	1.13
Final Degree of Saturation	S _f (%)		94.4	94.6	94.5

Notes



Failure Sketch
(surface inclination)

	Test Method	D 2850-03A (2007)	Test Name	UU	
	Database:	.\SQLEXPRESS \ GIE-D	Test Date	3/22/2021	
	Site Reference		Borehole	BH-05	
	Jobfile	UU	Sample	UD-01	
	Client	SGS	Depth	3.00-4.00	
	Operator	R. Islam	Checked	Aminul	Approved

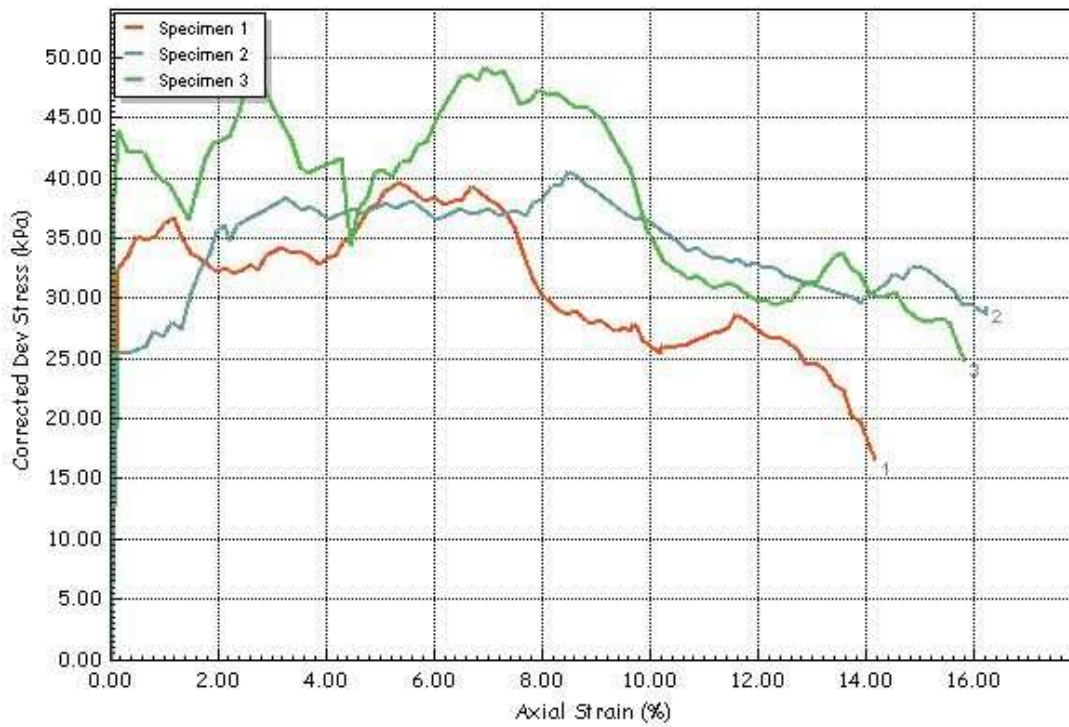
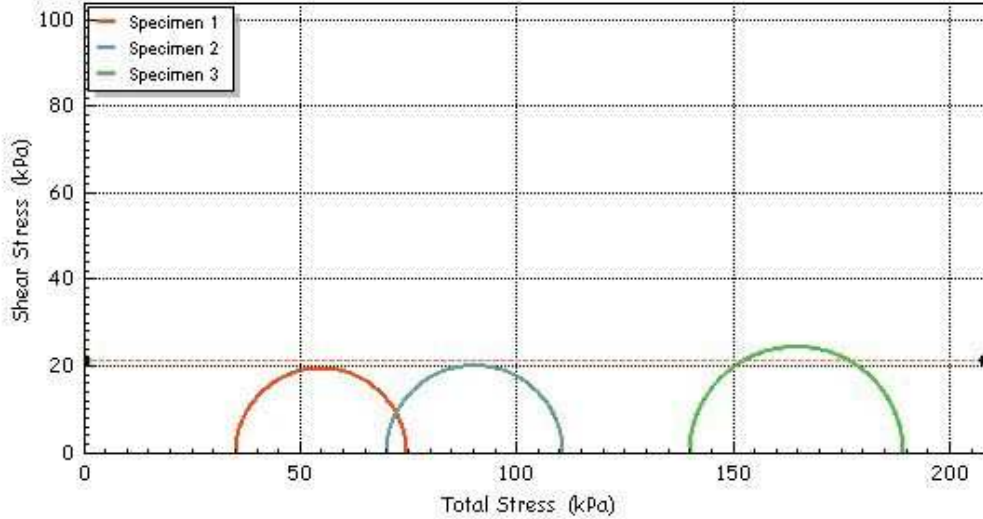
GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

Test Results Plots

Cohesion Level	c	(kPa)	21.3
Friction Angle	ϕ	(deg)	0.0




	Test Method	D 2850-03A (2007)		Test Name	UU	
	Database:	.\SQLEXPRESS \ GIE-D		Test Date	3/22/2021	
	Site Reference			Borehole	BH-05	
	Jobfile	UU		Sample	UD-01	
	Client	SGS		Depth	3.00-4.00	
	Operator	R. Islam	Checked	Aminul	Approved	T. Islam

GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

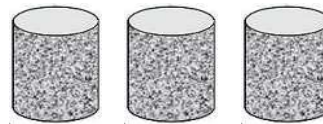
Summary Report

Sample Details	Depth	7.00-8.00				
 <i>sketch showing specimen location in original sample</i>	Type	UD				
			Spm. 1	2	3	
	Initial Sample Length	L ₀ (mm)	76.0	76.0	76.0	
	Initial Sample Diameter	D ₀ (mm)	38.0	38.0	38.0	
	Initial Sample Weight	W ₀ (gr)	159.0	159.3	159.8	
	Bulk Density	ρ ₀ (Mg/m ³)	1.84	1.85	1.85	
	Particle Density	ρ _s (Mg/m ³)	2.72	2.72	2.72	


Initial Conditions		Spm. 1	2	3
Specimen				
Initial Cell Pressure	σ ₃ (kPa)	75	150	300
Strain Rate	m _s (mm/min)	0.76000	0.76000	0.76000
Membrane Thickness	m _b (mm)	0.02	0.02	0.02
Displacement Input	L _{IP} (mm)	CH 7	CH 7	CH 7
Load Input	N _{IP} (N)	CH 2	CH 2	CH 2
Initial Moisture	ω _i % (%)	38	38	38
Initial Dry Density	ρ _{d0} (Mg/m ³)	1.33	1.34	1.34
Initial Voids Ratio	e ₀ .	1.04	1.04	1.03
Initial Degree of Saturation	S _o (%)	100	100	100

Final Conditions		Spm. 1	2	3
Max Deviator Stress	(σ ₁ - σ ₃) _f (kPa)	49.58	52.13	61.45
Membrane Correction	m _c (kPa)	36.574	40.760	40.760
Strain At Max Stress	ε _f % (%)	4.43	4.91	5.58
Shear Strength	c _U (kPa)	24.79	26.07	30.72
Final Moisture	ω _f % (%)	39	39	39
Final Dry Density	ρ _{df} (Mg/m ³)	1.32	1.33	1.33
Final Voids Ratio	e _f .	1.05	1.05	1.04
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0

Notes



Failure Sketch
(surface inclination)

	Test Method	D 2850-03A (2007)	Test Name	UU	
	Database:	.\SQLEXPRESS \ GIE-D	Test Date	3/11/2021	
	Site Reference		Borehole	BH-05	
	Jobfile	UU	Sample	UD-02	
	Client	SGS	Depth	7.00-8.00	
	Operator	R. Islam	Checked	Aminul	Approved

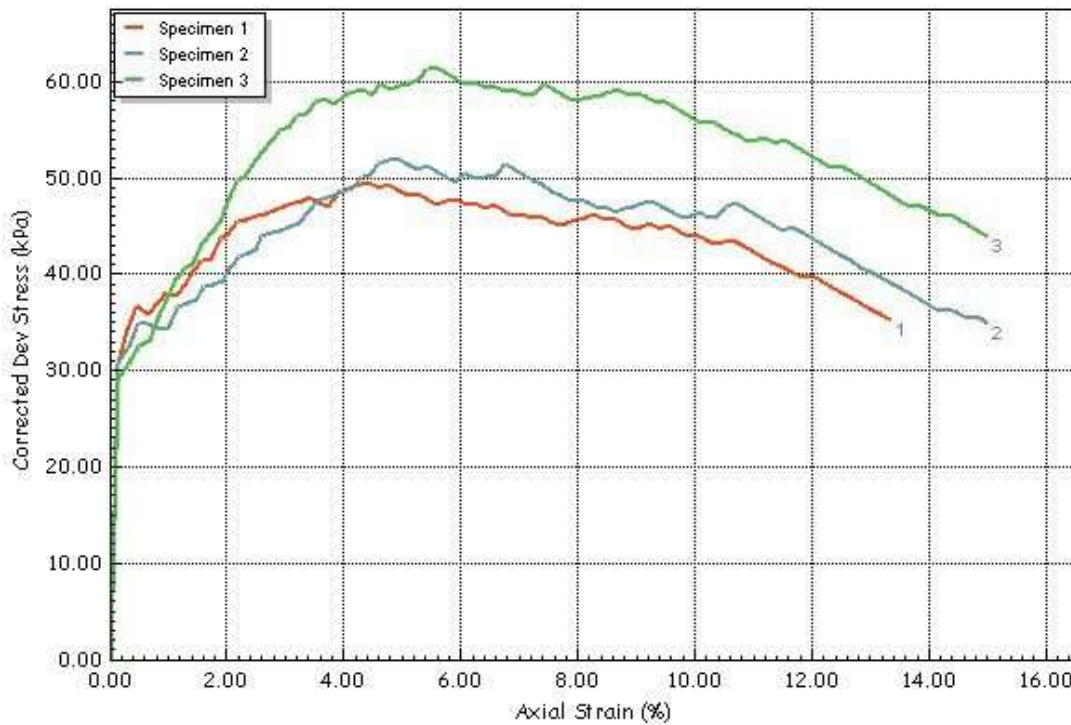
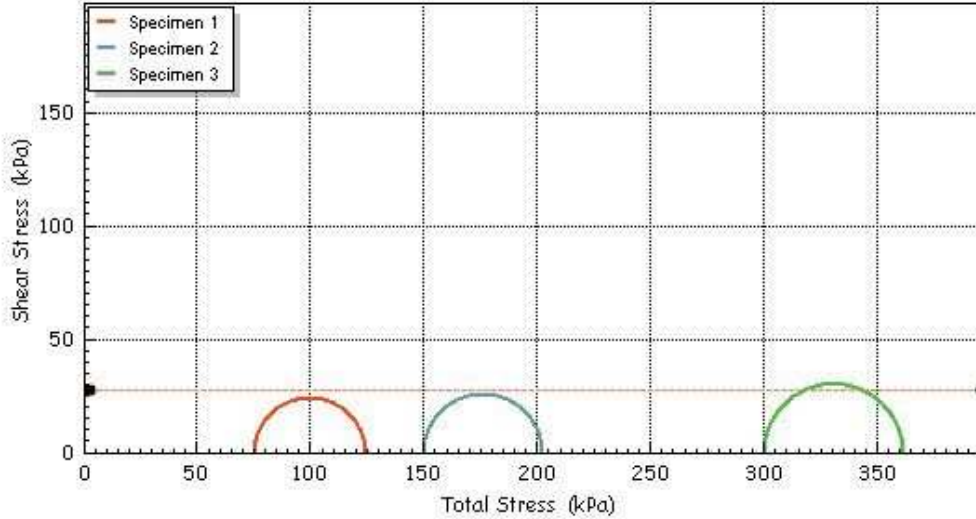
GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

Test Results Plots

Cohesion Level	c	(kPa)	27.2
Friction Angle	ϕ	(deg)	0.0



	Test Method	D 2850-03A (2007)		Test Name	UU	
	Database:	.\SQLEXPRESS \ GIE-D		Test Date	3/11/2021	
	Site Reference			Borehole	BH-05	
	Jobfile	UU		Sample	UD-02	
	Client	SGS		Depth	7.00-8.00	
	Operator	R. Islam	Checked	Aminul	Approved	T. Islam

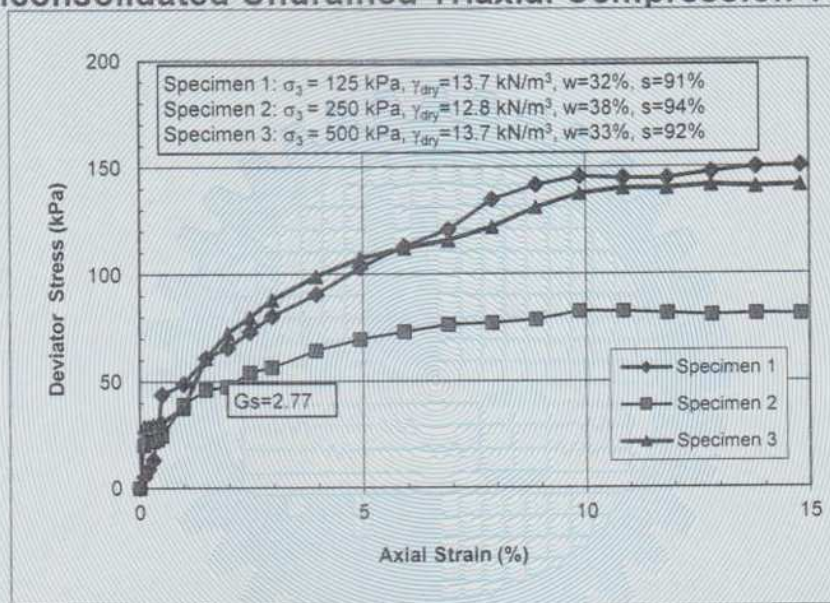
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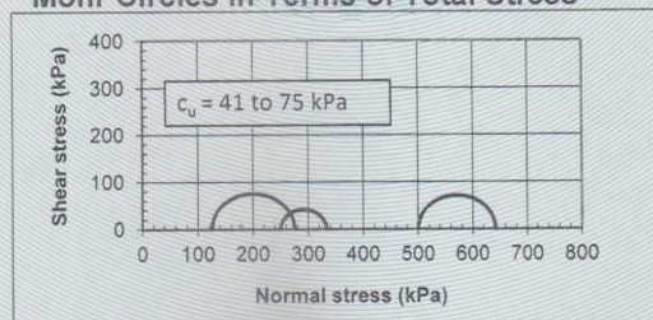
GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey soft silty clay	Test Method: ASTM	
B.H. No.: 5	Sample: UD-3	Depth: 11-12 m
Location: Matarbari	Date of Test: 23.5.21-24.5.21	

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading. Specimen 2 has lower soil density and much lower shear strength.

Countersigned by :

Dr. A.B.M. Badruzzaman
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

Dr. Tahmeed M. Al-Hussaini
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.





Project : SIBD2105
 Client - Location : Geotechnical Investigation for Matarbari Project
 Boring No : BH-05
 Sample No : UD-01
 Depth (m) : 3.00-4.00
 Soil Description : Lean CLAY, CL

Moisture Content Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 145.80	140.78
Wt. of Ring + Dry Soil, gm	= 124.95	124.95
Weight of Water, gm	= 20.85	15.83
Weight of Container, gm	= 69.47	69.47
Weight of Dry Soil, gm	= 55.48	55.48
Water Content, %	= 37.6	28.5

Unit Weight Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 145.80	140.78
Weight of Ring, gm	= 69.47	69.47
Weight of Wet Soil, gm	= 76.33	71.31
Height of Sample, cm	= 2	1.768
Diameter of Sample, cm	= 5	5
Volume of Sample, cm ³	= 39.27	34.71
Unit Wet Weight, kN/m ³	= 19.1	20.2
Unit Dry Weight, kN/m ³	= 13.9	15.7

Specific Gravity = 2.73
 Initial Void Ratio = 0.932
 Degree of Saturation, % = 100.0
 Room Temperature, °C = 24.0
 Temp. correction factor = 0.91
 Initial Transducer Reading = 8.65
 Effective Overburden Pressure =
 Preconsolidation Pressure = 77
 Compression Index (Cc) = 0.2200

15.66-34.09

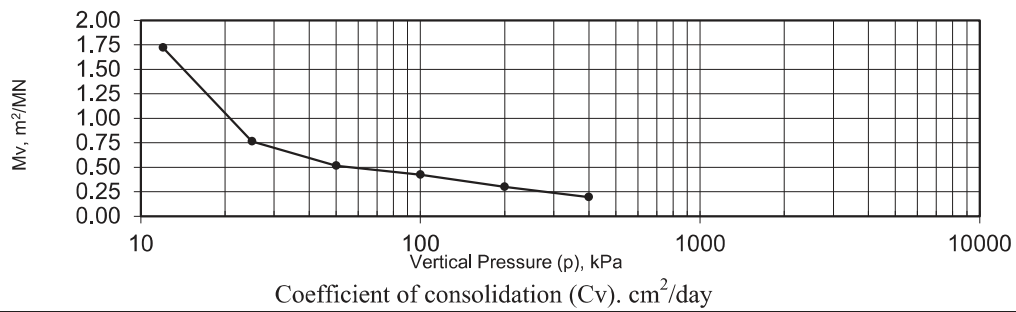
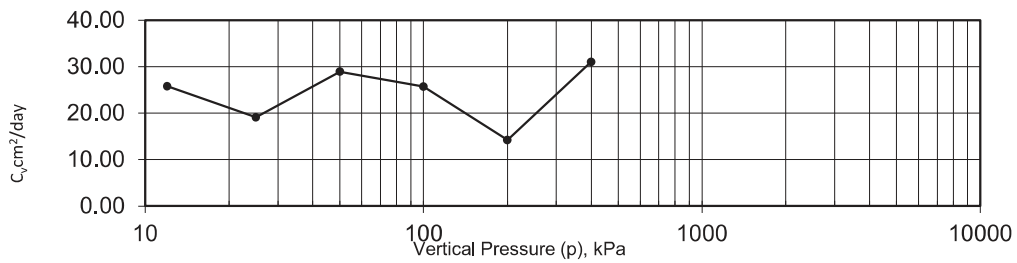
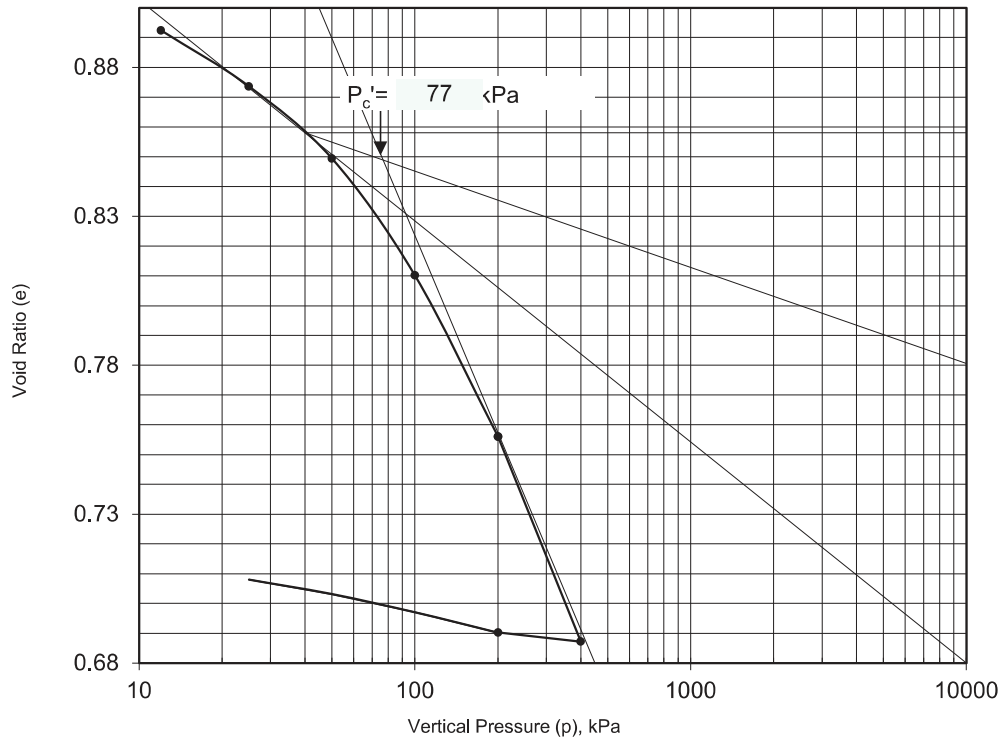
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v (cm ² /day)	c _v (20°C) (cm ² /day)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	8.240	0.001	0.413	0.892	41.538	28.341	25.790	1.721	13.802
2	25	8.045	0.001	0.608	0.874	55.479	21.009	19.118	0.766	4.553
3	50	7.792	0.004	0.858	0.849	35.875	31.751	28.894	0.516	4.634
4	100	7.380	0.010	1.264	0.810	38.958	28.252	25.709	0.424	3.392
5	200	6.812	0.017	1.825	0.756	66.719	15.665	14.255	0.299	1.327
6	400	6.090	0.027	2.537	0.687	28.580	34.090	31.022	0.196	1.890
7	200	6.125	0.023	2.506	0.690				0.009	
8	100	6.200	0.019	2.435	0.697				0.041	
9	50	6.266	0.016	2.372	0.703				0.072	
10	25	6.317	0.015	2.322	0.708				0.113	

Tested By: Rayhan

Checked & Approved By: T. Islam

Date: 24-03-2021

Date: 28-03-2021



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-05
 Sample : UD-01
 Depth (m) : 3.00-4.00



Ground Instrumentation & Engineering Pte Ltd



Project : SIBD2105
 Client - Location : Geotechnical Investigation for Matarbari Project
 Boring No : BH-05
 Sample No : UD-02
 Depth (m) : 7.00-8.00
 Soil Description : Lean CLAY, CL

Moisture Content Determination

	Initial	Final
Wt. of Ring + Wet Soil, gm	= 142.90	139.89
Wt. of Ring + Dry Soil, gm	= 122.01	122.01
Weight of Water, gm	= 20.89	17.88
Weight of Container, gm	= 69.52	69.52
Weight of Dry Soil, gm	= 52.49	52.49
Water Content, %	= 39.8	34.1

Unit Weight Determination

	Initial	Final
Wt. of Ring + Wet Soil, gm	= 142.90	139.89
Weight of Ring, gm	= 69.52	69.52
Weight of Wet Soil, gm	= 73.38	70.37
Height of Sample, cm	= 2	1.812
Diameter of Sample, cm	= 5	5
Volume of Sample, cm ³	= 39.27	35.58
Unit Wet Weight, kN/m ³	= 18.3	19.4
Unit Dry Weight, kN/m ³	= 13.1	14.5

Specific Gravity = 2.72
 Initial Void Ratio = 1.035
 Degree of Saturation, % = 100.0
 Room Temperature, °C = 24.0
 Temp. correction factor = 0.91
 Initial Transducer Reading = 8.22
 Effective Overburden Pressure =
 Preconsolidation Pressure = 100
 Compression Index (Cc) = 0.2664

21.75-341.09

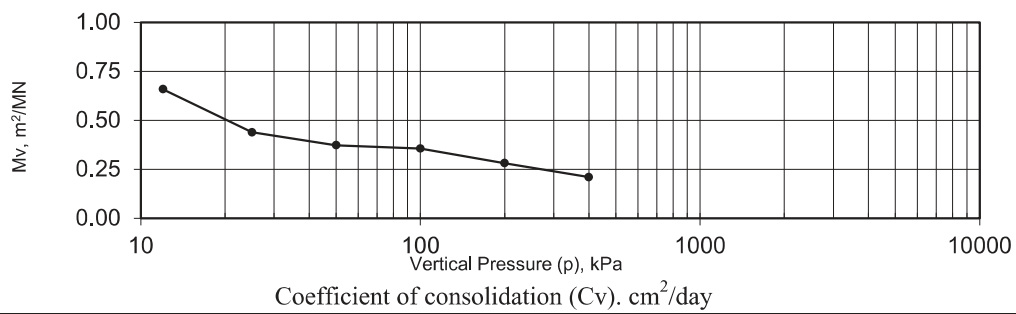
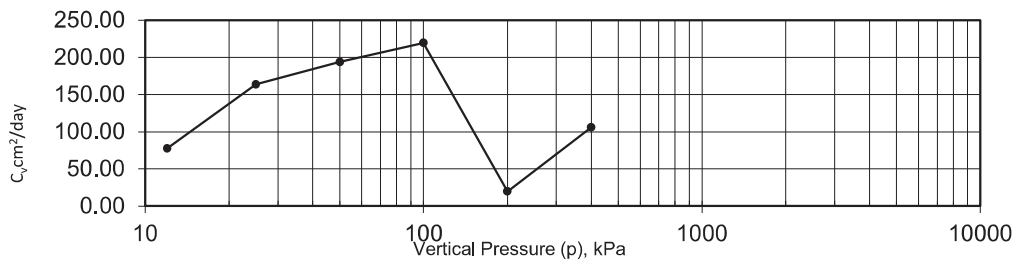
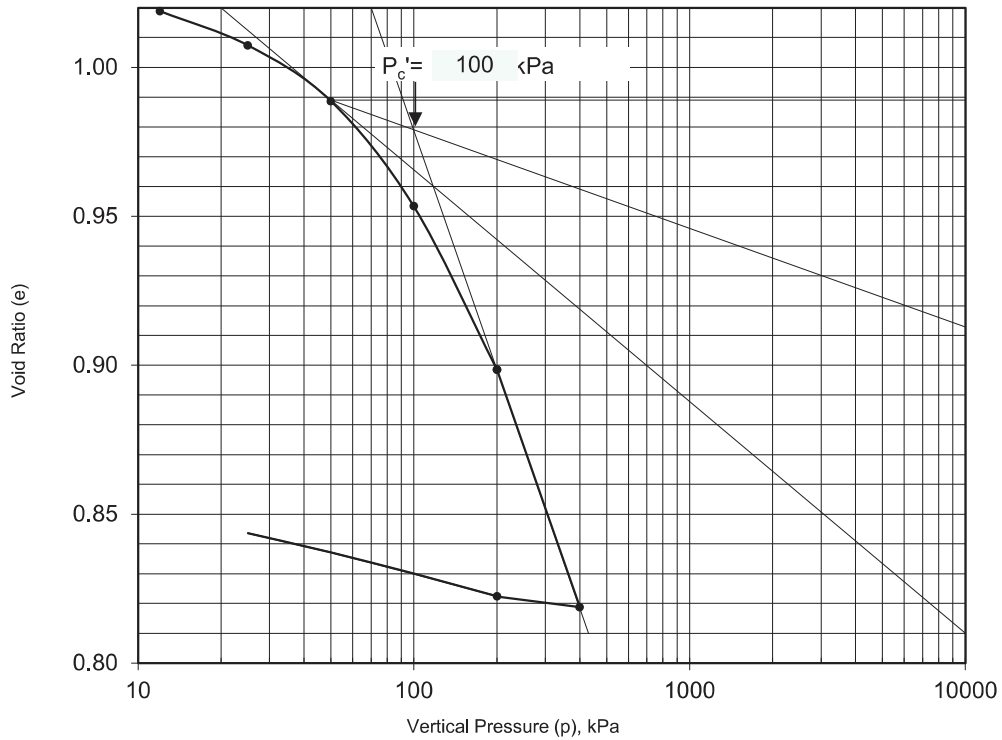
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v (cm ² /day)	c _v (20°C) (cm ² /day)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	8.059	0.001	0.158	1.019	14.142	85.425	77.737	0.658	15.916
2	25	7.946	0.001	0.271	1.007	6.674	179.984	163.785	0.438	22.314
3	50	7.762	0.001	0.455	0.989	5.551	213.160	193.975	0.373	22.505
4	100	7.412	0.004	0.802	0.953	4.776	241.095	219.396	0.355	24.228
5	200	6.869	0.008	1.341	0.898	50.552	21.748	19.791	0.281	1.728
6	400	6.079	0.015	2.124	0.819	8.816	116.148	105.695	0.210	6.897
7	200	6.119	0.010	2.089	0.822				0.010	
8	100	6.198	0.006	2.014	0.830				0.042	
9	50	6.272	0.002	1.944	0.837				0.078	
10	25	6.335	0.002	1.881	0.844				0.140	

Tested By: Rayhan

Date: 24-03-2021

Checked & Approved By: T. Islam


Date: 28-03-2021



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-05
 Sample : UD-02
 Depth (m) : 7.00-8.00

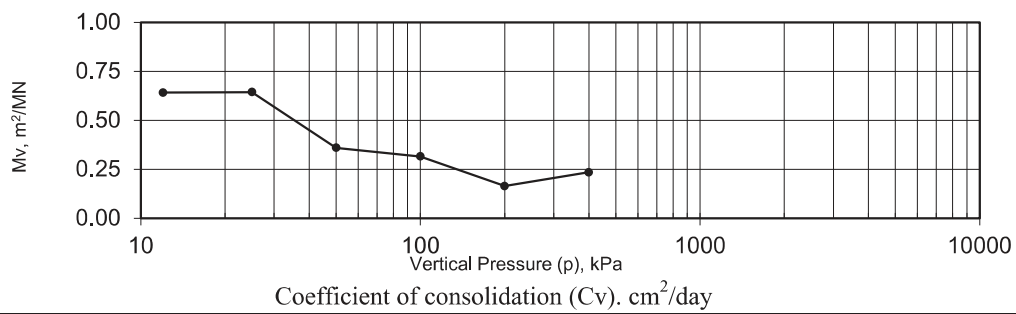
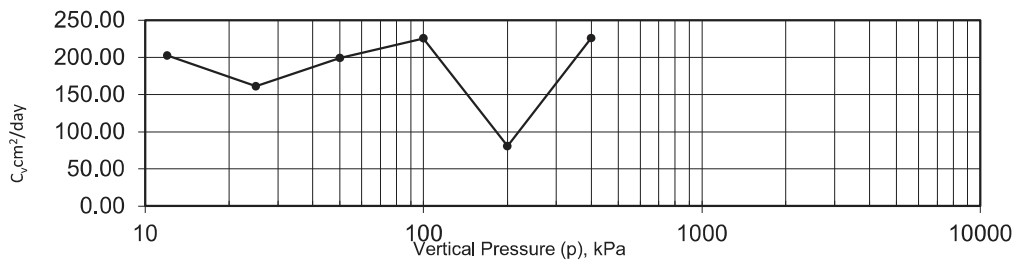
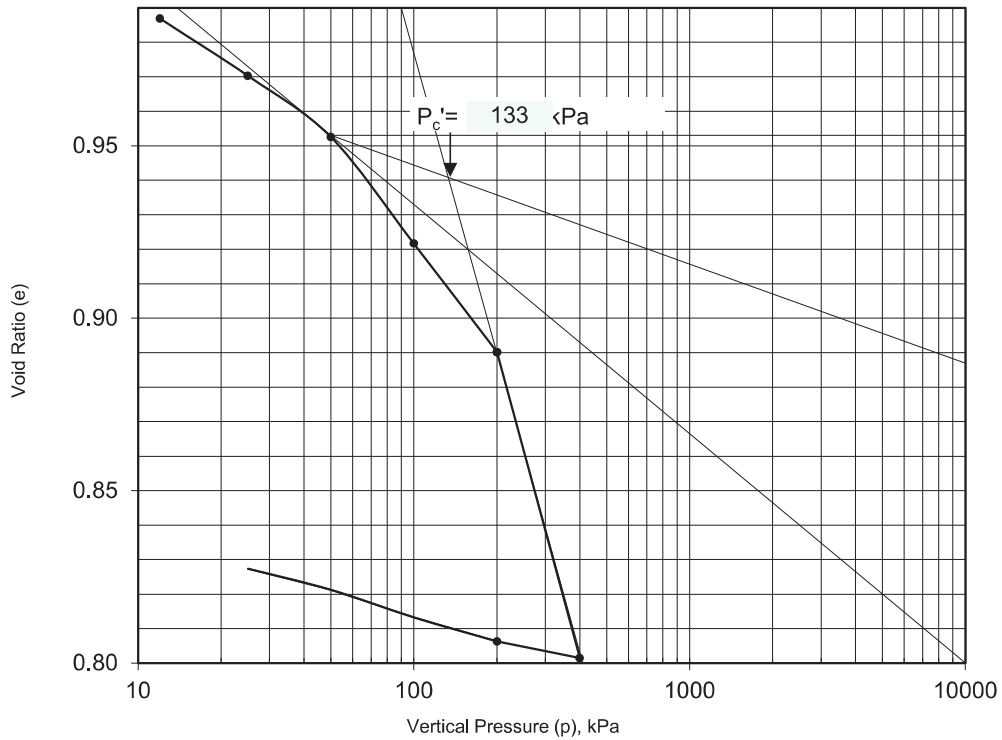


Ground Instrumentation & Engineering Pte Ltd

Ground Instrumentation & Engineering Pte Ltd		OEDOMETER TEST RESULTS ASTM D2435/D2435M - 11								
Project		: SIBD2105								
Client - Location		: Geotechnical Investigation for Matarbari Project								
Boring No		: BH-05								
Sample No		: UD-03								
Depth (m)		: 11.00-12.00								
Soil Description		: Lean CLAY, CL								
<u>Moisture Content Determination</u>										
		<u>Initial</u>	<u>Final</u>							
Wt. of Ring + Wet Soil, gm	=	142.30	139.17							
Wt. of Ring + Dry Soil, gm	=	122.67	122.67							
Weight of Water, gm	=	19.63	16.50							
Weight of Container, gm	=	69.52	69.52							
Weight of Dry Soil, gm	=	53.15	53.15							
Water Content, %	=	36.9	31.0							
<u>Unit Weight Determination</u>										
		<u>Initial</u>	<u>Final</u>							
Wt. of Ring + Wet Soil, gm	=	142.30	139.17							
Weight of Ring, gm	=	69.52	69.52							
Weight of Wet Soil, gm	=	72.78	69.65							
Height of Sample, cm	=	2	1.825							
Diameter of Sample, cm	=	5	5							
Volume of Sample, cm ³	=	39.27	35.84							
Unit Wet Weight, kN/m ³	=	18.2	19.1							
Unit Dry Weight, kN/m ³	=	13.3	14.5							
Specific Gravity	=	2.71								
Initial Void Ratio	=	1.002								
Degree of Saturation, %	=	99.9								
Room Temperature, °C	=	24.0								
Temp. correction factor	=	0.91								
Initial Transducer Reading	=	8.42								
Effective Overburden Pressure	=									
Preconsolidation Pressure	=	133								
Compression Index (Cc)	=	0.2885								
88-74-2435-11										
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t₉₀ (min)	c_v (cm²/day)	c_v(20°C) (cm²/day)	m_v (m²/MN)	k x 10⁻⁹ (m/s)
1	12	8.269	0.001	0.154	0.987	5.432	222.491	202.467	0.642	40.404
2	25	8.103	0.001	0.320	0.970	6.763	177.212	161.263	0.643	32.269
3	50	7.926	0.001	0.497	0.953	5.385	218.713	199.029	0.360	22.268
4	100	7.615	0.004	0.805	0.922	4.632	248.013	225.692	0.316	22.169
5	200	7.296	0.008	1.120	0.890	12.532	88.741	80.754	0.164	4.121
6	400	6.403	0.015	2.006	0.801	4.204	248.110	225.780	0.235	16.476
7	200	6.456	0.010	1.958	0.806				0.013	
8	100	6.530	0.006	1.888	0.813				0.039	
9	50	6.614	0.002	1.808	0.821				0.088	
10	25	6.675	0.002	1.747	0.827				0.134	
Tested By: Rayhan		Checked & Approved By: T. Islam								
Date: 24-03-2021		Date: 28-03-2021								

ASTM D2435/D2435M - 11

Cc= 0.288516



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-05
 Sample : UD-03
 Depth (m) : 11.00-12.00



Ground Instrumentation & Engineering Pte Ltd

GEOTECHNICAL AND MATERIAL LABORATORY
Ground Instrumentation & Engineering
Pte.Ltd. House-7 Road-12, Dhaka 1230

LABORATORY COMPACTION TEST DATA
(Dry Density- Moisture Content Relationship)
 ASTM D1557

Date: 29/03/2021

Project : Geotechnical Investigation for Matarbari, ID-SIBD-2105

Client : SGS

Test Pit No. : BH-05

Sample Depth : 1.00 m

Method: Standard Proctor (using 2.5 kg rammer)

Volume of Mould: 950 cm³

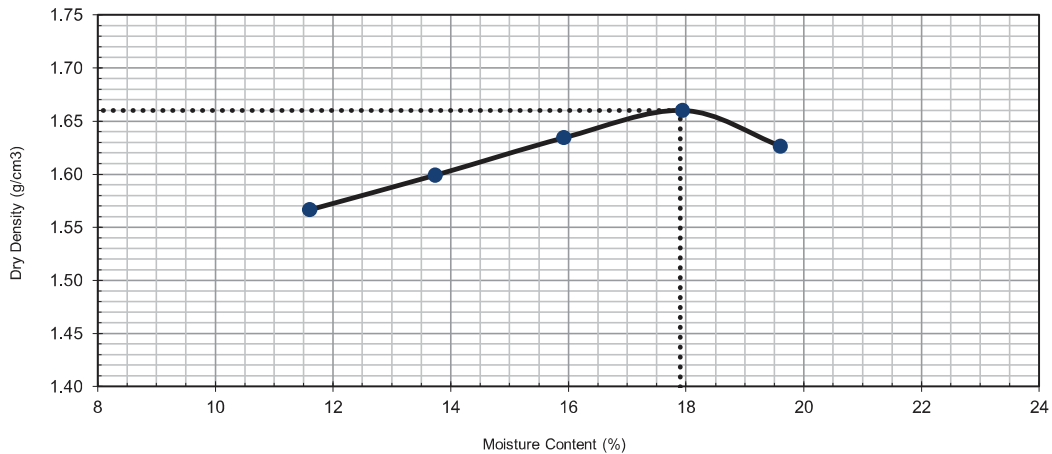
Test No.:		1	2	3	4	5
Mass of Mould+ Base+Compacted Materials (m2)	g	5321	5388	5460	5520	5508
Mass of Mould+ Base(m1)	g	3660	3660	3660	3660	3660
mass of Compacted Materials(m2-m1)	g	1661	1728	1800	1860	1848
Bulk Density, $\rho = \frac{m2 - m1}{vol. of mold}$	g/cm ³	1.748	1.819	1.895	1.958	1.945
Moisture Content (w)	%	11.61	13.75	15.93	17.95	19.61
Dry Density, $\rho_d = \frac{100\rho}{100 + w}$	g/cm ³	1.567	1.599	1.634	1.660	1.626

MOISTURE CONTENT

Test No.:		1	2	3	4	5					
Container No.:		B-142	B-145	B-69	B-07	B-54	B-59	B-138	B-106	B-05	B-116
Mass of container + wet soil	g	61.6	70.5	57.7	60.87	79.53	75.39	80.82	82.81	104	83.28
mass of container + dry soil	g	58.5	67.0	53.68	56.76	73.28	69.5	72.48	74.22	92.2	74.2
Mass of Water	g	3.19	3.46	3.99	4.11	6.25	5.85	8.34	8.59	11.82	9.05
Mass of Container	g	31.27	36.91	24.41	27.11	33.8	33.05	26.97	25.32	32.83	27.34
Mass of Dry Soil	g	27.2	30.12	29.27	29.65	39.48	36.49	45.51	48.9	59.32	46.89
Moisture Content	%	11.74	11.49	13.63	13.86	15.83	16.03	18.33	17.57	19.93	19.30
Average Moisture Content	%	11.6	13.7	15.9	17.9	19.6					

Maximum Dry Density	1.660	g/cm ³
Optimum Moisture Content	17.9	%

Fig. : Dry Density vs Moisture Content Curve



SGS



BH-06

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-06	Depth (m): 6.00-6.45
Can No.		485
Weight of Wet Soil + Can (gm)		223.46
Weight of Dry Soil + can (gm)		194.08
Weight of Can (gm)		26.82
Moisture Content (%)		17.57
Description		Fine-medium SAND with Silt, SP-SM

Sample No.:	UD-01	Depth (m): 8.00-9.00
Can No.		360
Weight of Wet Soil + Can (gm)		302.70
Weight of Dry Soil + can (gm)		228.99
Weight of Can (gm)		13.31
Moisture Content (%)		34.18
Description		Lean CLAY, CL

Sample No.:	UD-03	Depth (m): 14.00-15.00
Can No.		98
Weight of Wet Soil + Can (gm)		201.80
Weight of Dry Soil + can (gm)		153.07
Weight of Can (gm)		15.99
Moisture Content (%)		35.55
Description		Lean CLAY, CL

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 10-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-18	Depth (m): 21.00-21.45
Can No.		204
Weight of Wet Soil + Can (gm)		213.29
Weight of Dry Soil + can (gm)		174.33
Weight of Can (gm)		25.68
Moisture Content (%)		26.21
Description		Sandy SILT, ML

Sample No.:	SPT-23	Depth (m): 26.00-26.45
Can No.		202
Weight of Wet Soil + Can (gm)		189.19
Weight of Dry Soil + can (gm)		157.57
Weight of Can (gm)		24.49
Moisture Content (%)		23.76
Description		SILT with traces of Sand, ML

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

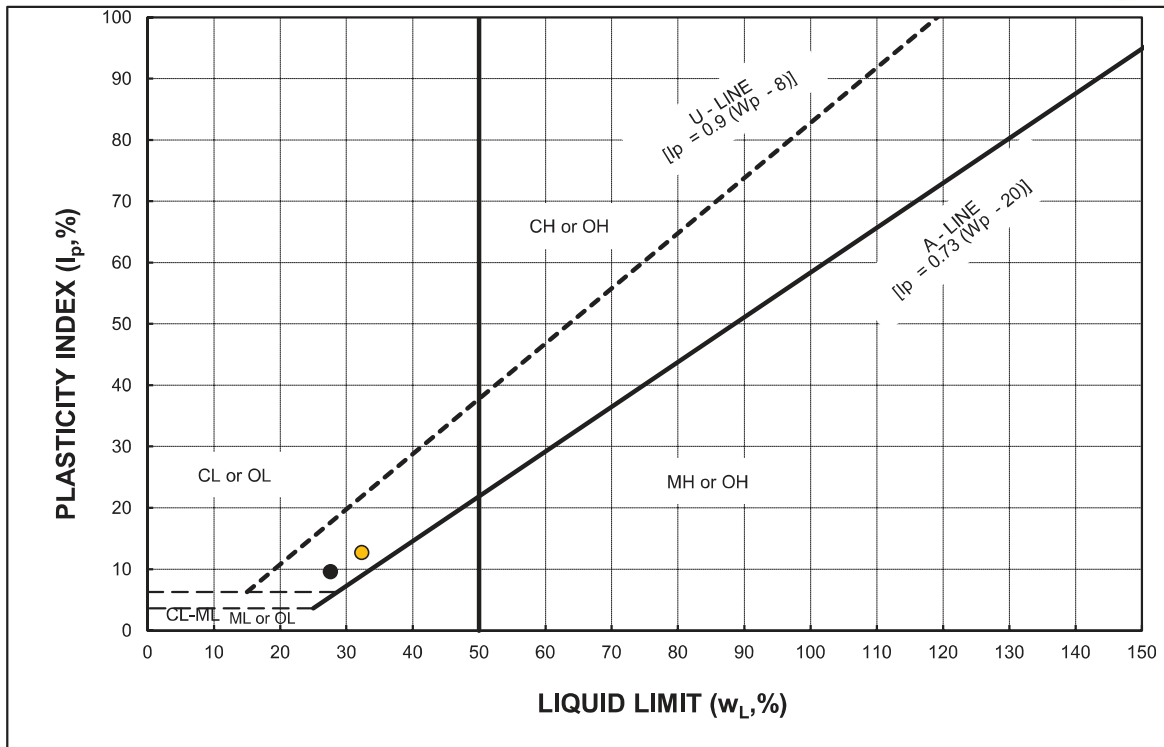
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 10-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	UD-01	8.00-9.00	27.60	17.97	9.63		Lean CLAY, CL
●	UD-03	14.00-15.00	32.30	19.58	12.72		Lean CLAY, CL
●							
●							
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05
 *Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
 Date: 11-03-2021

Checked by: Suvashis Paul
 Date: 16-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

Sample No: UD-01

BH No.: BH-06

Sample Depth: 8.00-9.00

Plastic Limit Test		
Container No.	339	54
Weight of can (gm)	8.94	8.8
Wet weight of soil + can (gm)	37.09	37.11
Dry Weight of soil + can (gm)	32.81	32.79
Moisture Content %	17.93	18.01
Average	17.97	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	29	34
Container No.	333	325	324
Weight of can (gm)	6.93	7.2	9.73
Wet weight of soil + can (gm)	30.72	30.38	29.47
Dry Weight of soil + can (gm)	25.54	25.42	25.31
Moisture Content %	27.83	27.22	26.70



Description	Lean CLAY, CL	
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Tested by: Rayhan
Date: 11-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

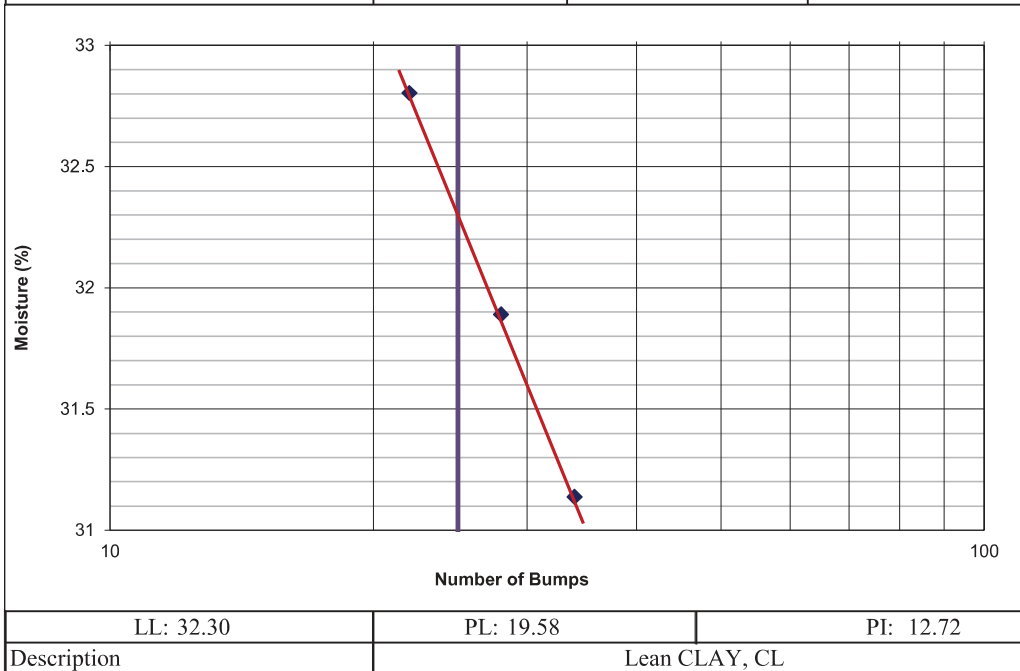
Sample No.: UD-03

BH No.: BH-06

Sample Depth: 14.00-15.00

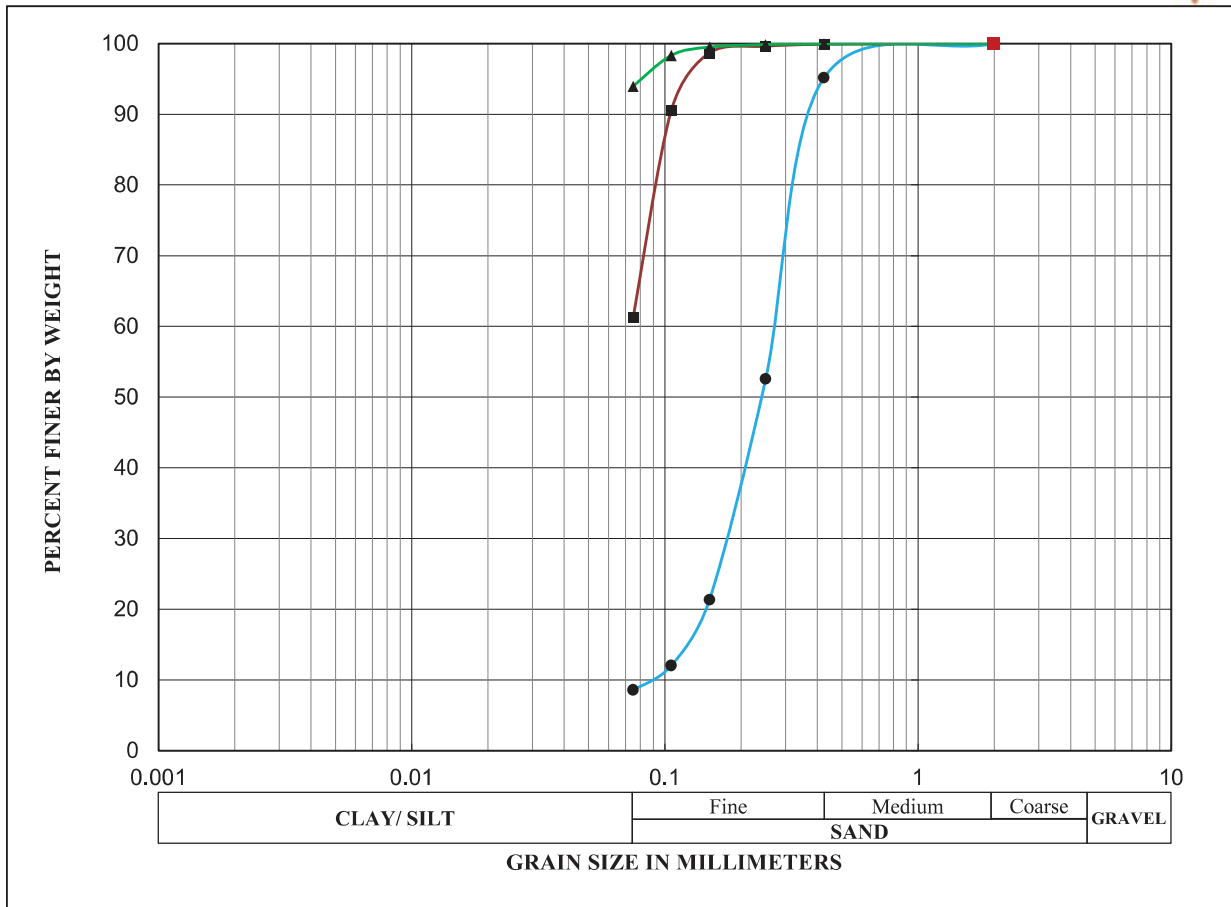
Plastic Limit Test		
Container No.	342	56
Weight of can (gm)	8.21	8.1
Wet weight of soil + can (gm)	35.32	35.34
Dry Weight of soil + can (gm)	30.89	30.87
Moisture Content %	19.53	19.63
Average	19.58	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	28	34
Container No.	334	444	431
Weight of can (gm)	9.9	4.19	4.15
Wet weight of soil + can (gm)	29.98	24.91	23.86
Dry Weight of soil + can (gm)	25.02	19.9	19.18
Moisture Content %	32.80	31.89	31.14



Tested by: Rayhan
Date: 11-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-06	6.00-6.45	Fine-medium SAND with Silt, SP-SM					3.20	1.28
■	SPT-18	21.00-21.45	Sandy SILT, ML						
▲	SPT-23	26.00-26.45	SILT with traces of Sand, ML						
●									
■									
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Meidum	%Coarse	
●	SPT-06	6.00-6.45	0.280	0.242	0.178	0.088	0.00	86.58	4.84	0.00	8.58
■	SPT-18	21.00-21.45	0.073	0.061	0.037	0.012	0.00	38.58	0.12	0.00	61.30
▲	SPT-23	26.00-26.45	0.048	0.040	0.024	0.008	0.00	5.98	0.06	0.00	93.96
●											
■											
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

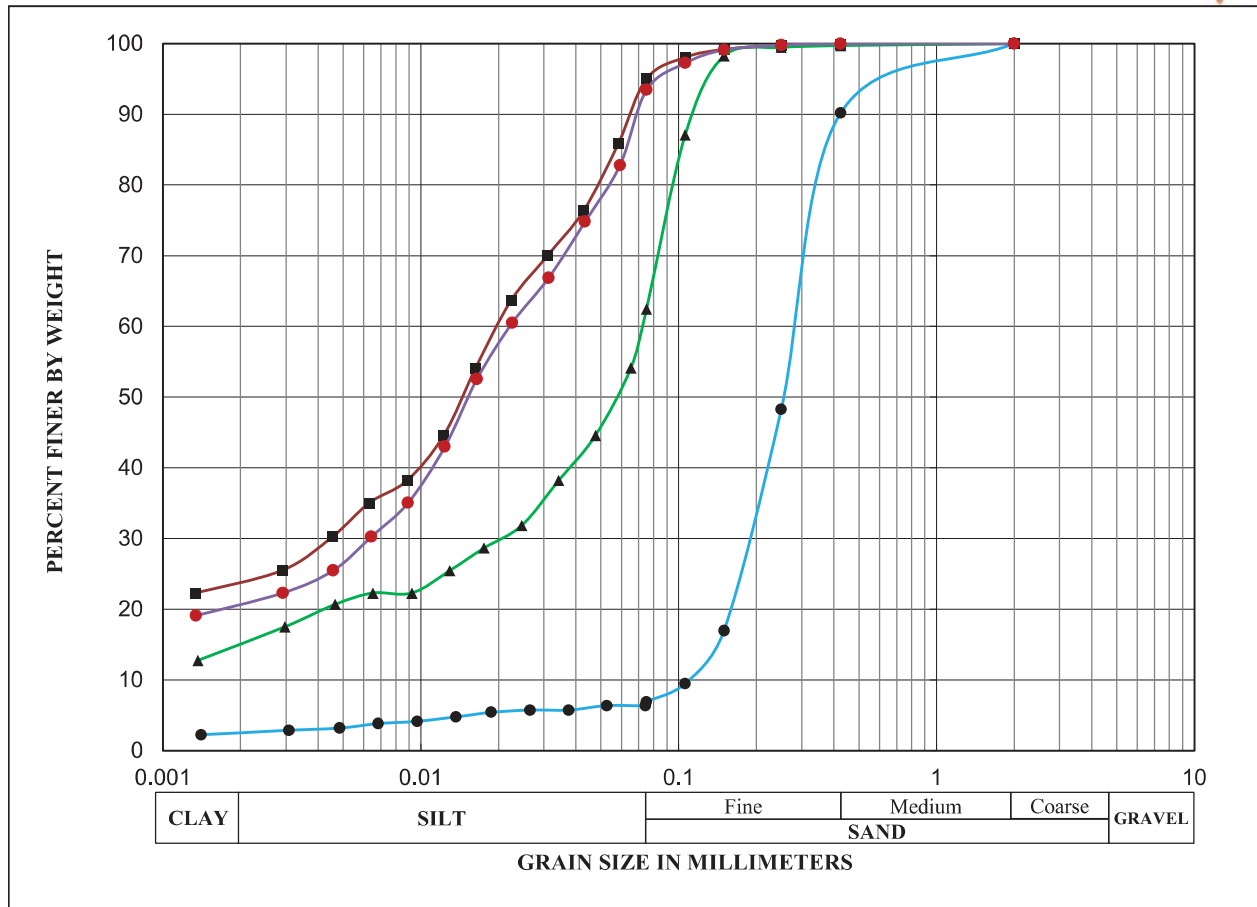
Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 13-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-06	Depth(m)	6.00-6.45
Pyknometer No.		4
Mass of bottle + soil + water: M_3	gm	118.61
Mass of bottle + soil: M_2	gm	73.92
Mass of bottle + water: M_4	gm	99.90
Mass of bottle: M_1	gm	43.88
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	25.98
Mass of water used: $M_3 - M_2$	gm	44.69
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.33
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 13-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



UD-01	Depth(m)	8.00-9.00
Pyknometer No.		11
Mass of bottle + soil + water: M_3	gm	96.83
Mass of bottle + soil: M_2	gm	57.71
Mass of bottle + water: M_4	gm	77.89
Mass of bottle: M_1	gm	27.74
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	20.19
Mass of water used: $M_3 - M_2$	gm	39.12
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.03
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.71

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 13-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-18	Depth(m)	21.00-21.45
Pyknometer No.		11
Mass of bottle + soil + water: M_3	gm	96.74
Mass of bottle + soil: M_2	gm	57.72
Mass of bottle + water: M_4	gm	77.89
Mass of bottle: M_1	gm	27.74
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	20.18
Mass of water used: $M_3 - M_2$	gm	39.02
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.13
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 13-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 1-10.4.21 *


SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	1	2	3.0	4.0	5.0	6.0
Depth (m)	14-14.5	25-25.45	4-4.5	17-17.45	17-17.45	26-26.45
Sample No.	12.0	23.0	4.0	15.0	14.0	23.0
Soil Type	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand	Grey silty sand
Wt. of bottle+water+ soil, gm	371.6	375.3	373.4	371.6	380.1	396.4
Temperature (°C)	30.5	30.0	30.5	30.5	30.5	30.0
Wt. of bottle+water, gm	340.0	343.7	342.1	340.4	348.8	365.1
Wt. of soil, gm	49.8	49.2	49.9	49.3	49.7	48.6
Specific Gravity	2.72	2.78	2.67	2.71	2.69	2.80

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

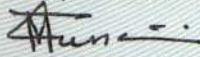
Countersigned by :

f


Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Test performed by :

 25.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.





**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	8.00-9.00
Weight of soil	gm	160.40
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.86
Dry Density	(g/cm ³)	1.39
Void Ratio		0.96
Moisture Content	%	34.18
Specific Gravity	(g/cm ³)	2.71

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 13-03-2021

Checked by: Suvashis Paul

Date: 16-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-03	Depth (m):	14.00-15.00
Weight of soil	gm	163.20
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.89
Dry Density	(g/cm ³)	1.40
Void Ratio		1.00
Moisture Content	%	35.55
Specific Gravity	(g/cm ³)	2.79

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-06

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)


Tested by: Rayhan
Date: 13-03-2021

Checked by: Suvashis Paul
Date: 16-03-2021

Total Stress Triaxial Compression

Unconfined Compression

Summary Report

<p>Sample Details</p>  <p><i>sketch showing specimen location in original sample</i></p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Depth</td> <td colspan="3">8.00-9.00</td> </tr> <tr> <td>Description</td> <td colspan="3">Lean CLAY, CL</td> </tr> <tr> <td>Type</td> <td colspan="3">UD</td> </tr> <tr> <td>Initial Sample Length</td> <td>L_0</td> <td>(mm)</td> <td>76.0</td> </tr> <tr> <td>Initial Sample Diameter</td> <td>D_0</td> <td>(mm)</td> <td>38.0</td> </tr> <tr> <td>Initial Sample Weight</td> <td>W_0</td> <td>(gr)</td> <td>160.4</td> </tr> <tr> <td>Bulk Density</td> <td>ρ_0</td> <td>(Mg/m³)</td> <td>1.86</td> </tr> <tr> <td>Particle Density</td> <td>ρ_s</td> <td>(Mg/m³)</td> <td>2.71</td> </tr> </table>	Depth	8.00-9.00			Description	Lean CLAY, CL			Type	UD			Initial Sample Length	L_0	(mm)	76.0	Initial Sample Diameter	D_0	(mm)	38.0	Initial Sample Weight	W_0	(gr)	160.4	Bulk Density	ρ_0	(Mg/m ³)	1.86	Particle Density	ρ_s	(Mg/m ³)	2.71
Depth	8.00-9.00																																
Description	Lean CLAY, CL																																
Type	UD																																
Initial Sample Length	L_0	(mm)	76.0																														
Initial Sample Diameter	D_0	(mm)	38.0																														
Initial Sample Weight	W_0	(gr)	160.4																														
Bulk Density	ρ_0	(Mg/m ³)	1.86																														
Particle Density	ρ_s	(Mg/m ³)	2.71																														


Initial Conditions			
Strain Rate	m_s	(mm/min)	0.76000
Membrane Thickness	m_b	(mm)	0.00
Displacement Input	L_{IP}	(mm)	CH 7
Load Input	N_{IP}	(N)	CH 2
Initial Moisture	ω_i	(%)	34
Initial Dry Density	ρ_{d0}	(Mg/m ³)	1.39
Initial Voids Ratio	e_0	.	0.95
Initial Degree of Saturation	S_o	(%)	97

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$	(kPa)	60.84
Strain At Max Stress	ϵ_f	(%)	10.39
Final Moisture	ω_f	(%)	34
Final Dry Density	ρ_{df}	(Mg/m ³)	1.39
Final Voids Ratio	e_f	.	0.95
Final Degree of Saturation	S_f	(%)	97.1

Notes



Failure Sketch
(surface inclination)

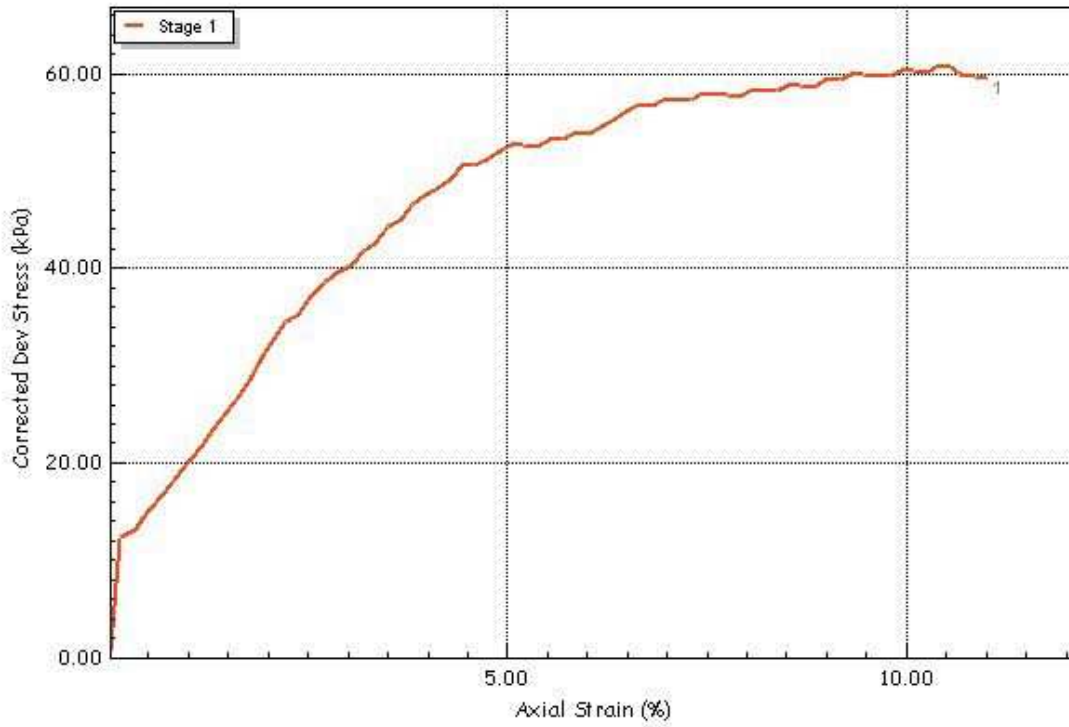
	Test Method	D 2166/D2166M-13	Test Name	UCT
	Database:	.\SQLEXPRESS \ GIE-D	Test Date	3/11/2021
	Site Reference		Borehole	BH-06
	Jobfile	UCT	Sample	UD-01
Client	SGS	Depth	8.00-9.00	
Operator	R. Islam	Checked	Aminul	Approved T. Islam


GIE

Total Stress Triaxial Compression

Unconfined Compression

Test Results Plots



	Test Method D 2166/D2166M-13		Test Name UCT		
	Database: .\SQLEXPRESS \ GIE-D		Test Date 3/11/2021		
	Site Reference		Borehole BH-06		
	Jobfile UCT		Sample UD-01		
Client SGS		Depth 8.00-9.00			
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

GIE

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



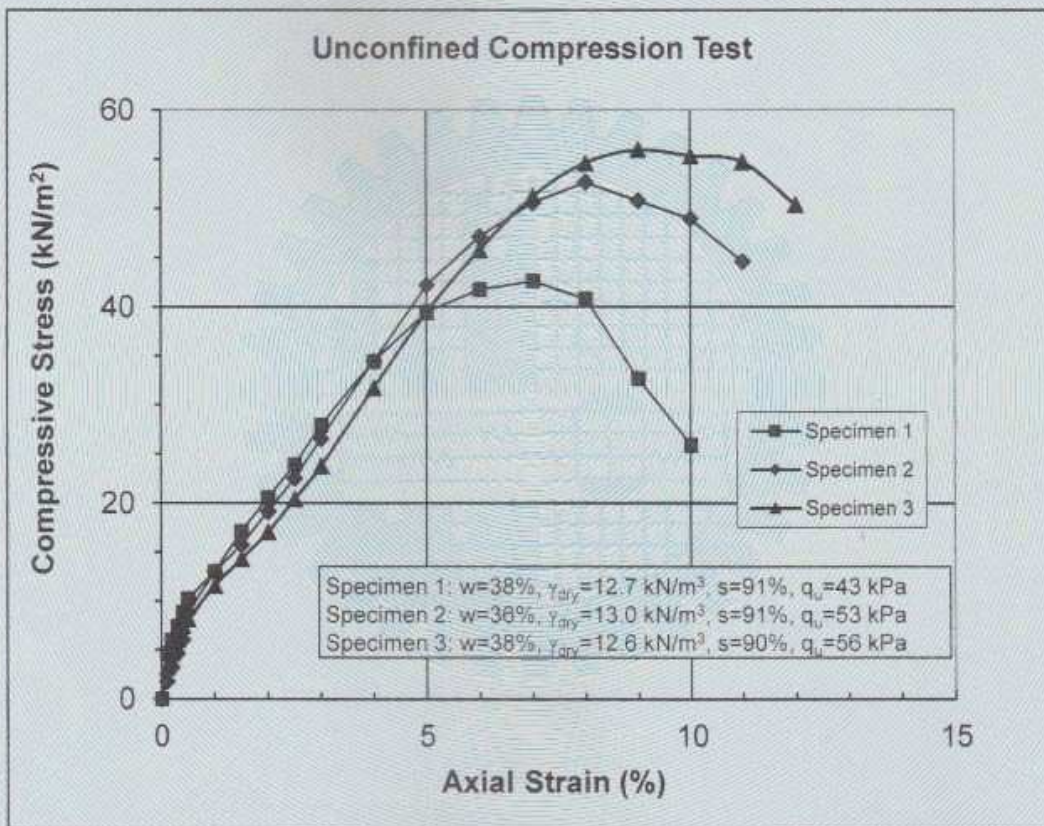
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Client : Manager, Environment Health & Safety, SGS Bangladesh Ltd, Bir Uttam CR Datta Road, Dhaka		
Ref : SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay		
Test Method:	ASTM	Date of Test: 31.3.21-5.4.21
BH No. :	6	Sample ID : UD-3
		Depth: 14-15 m
		Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition:

Specific Gravity= 2.79

Countersigned by:

Dr. A.B.M. Badruzzaman

Dr. A.B.M. Badruzzaman
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.



Test performed by:

Dr. Tahmeed M. Al-Hussaini
8.5.21

Dr. Tahmeed M. Al-Hussaini
Professor
Department of Civil Engineering
BUET, Dhaka - 1000.




BRTC BUET

BUETCE 0272385

Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	6.00-6.45				
 <i>sketch showing specimen location in original sample</i>	Description	Fine-medium SAND				
	Type	Disturbed Soil				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	142.4	142.4	142.4	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	1.98	1.98	1.98	
	Particle Density	ρ _s (Mg/m ³)	2.65	2.65	2.65	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	50	100	200
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i % (%)	17	17	17
Initial Dry Density	ρ _{di} (Mg/m ³)	1.68	1.69	1.68
Initial Voids Ratio	e _i .	0.574	0.568	0.574
Initial Degree of Saturation	S _i (%)	80.7	79.5	80.8
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f % (%)	19	18	19
Final Dry Density	ρ _{df} (Mg/m ³)	1.73	1.74	1.71
Final Voids Ratio	e _f .	0.536	0.524	0.553
Final Degree of Saturation	S _f (%)	92.3	91.8	89.4
Peak Shear Stress	(kPa)	41.4	83.5	166.3
Hoz Displacement	L _H (mm)	12.000	12.000	12.000
Vertical Displacement	L _V (mm)	-0.150	-0.030	-0.160

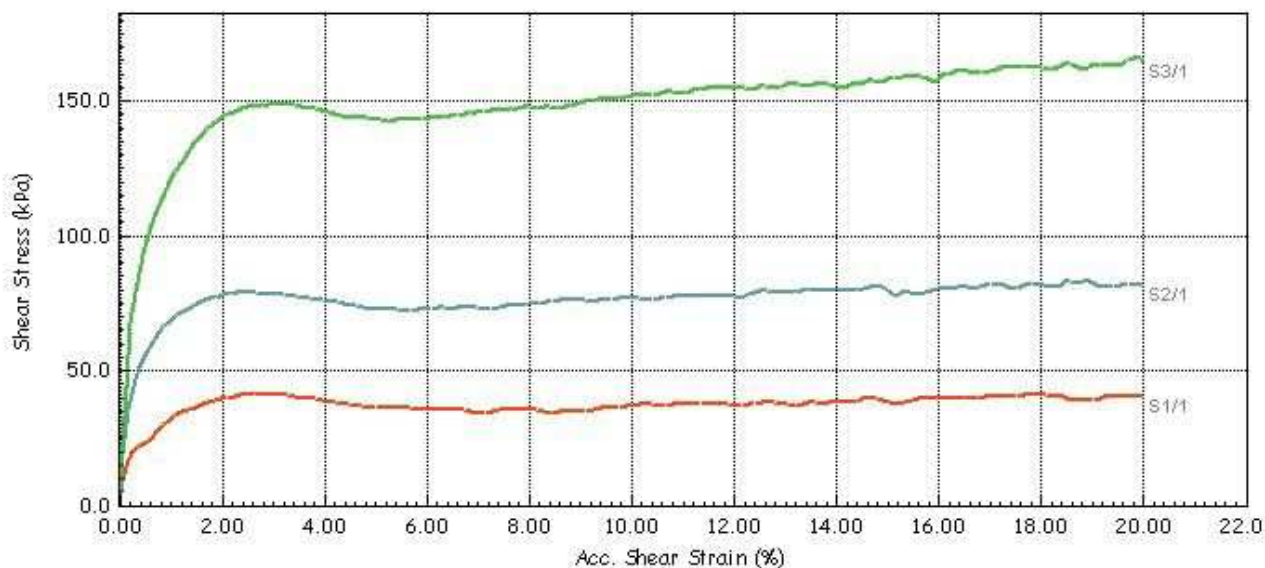
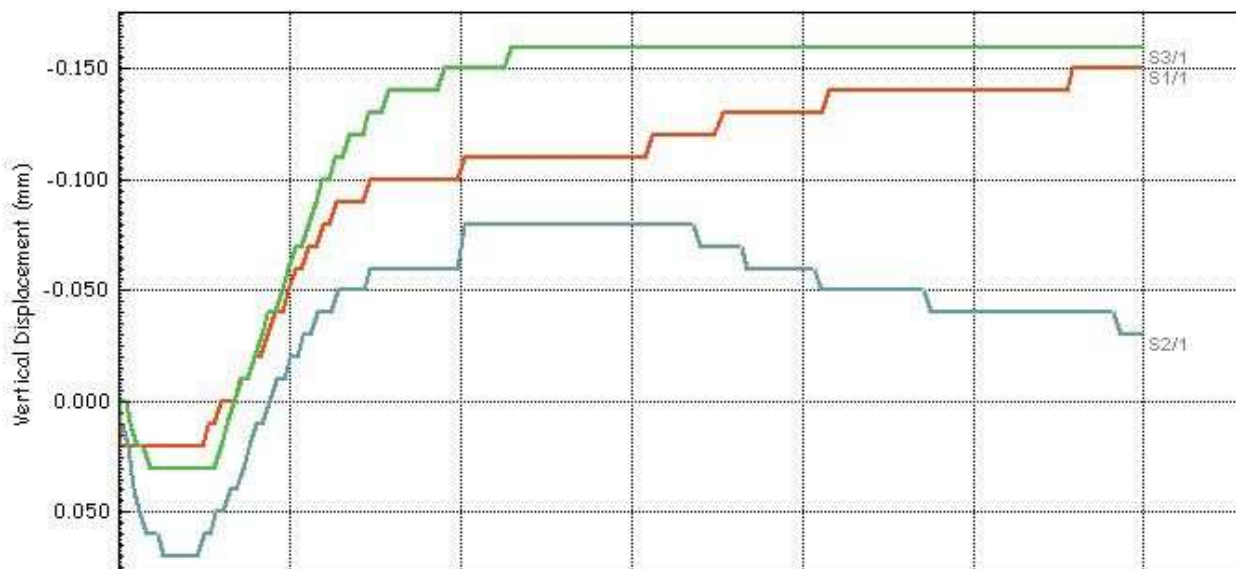
GIE


	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/21/2021
	Jobfile	Direct Shear Test	Sample	SPT-06
Client	SGS	Borehole	BH-06	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/21/2021	
	Jobfile Direct Shear Test		Sample SPT-06	
Client SGS		Borehole BH-06		
Operator R. Islam	Checked	Aminul	Approved	T. Islam

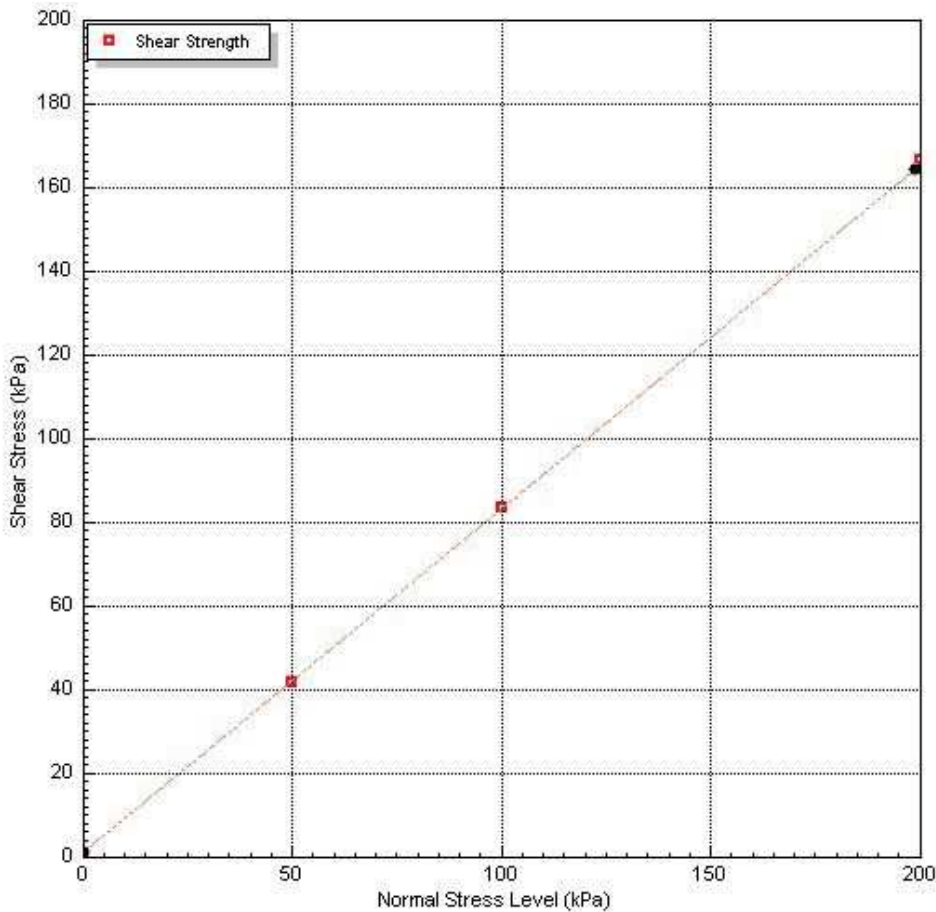
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Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	19	18	19
Final Dry Density	ρ_{df} (Mg/m ³)	1.73	1.74	1.71
Final Voids Ratio	e_f	0.536	0.524	0.553
Final Degree of Saturation	S_f (%)	92.3	91.8	89.4
Apparent cohesion	c (kPa)	0.72		
Angle of Shearing Resistance	ϕ	39.4		
Notes				




	Test Method	ASTM D 3080-04	Test Name	Direct Shear
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	3/21/2021
	Client	SGS	Sample	SPT-06
	Operator	R. Islam	Borehole	BH-06
	Checked	Aminul	Approved	T. Islam

GIE

Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	21.00-21.45				
 <i>sketch showing specimen location in original sample</i>	Description	Sandy SILT, Disturbed Soil				
	Type					
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	136.5	136.5	136.5	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	1.90	1.90	1.90	
	Particle Density	ρ _s (Mg/m ³)	2.69	2.69	2.69	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	200	400	800
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i % (%)	27	27	27
Initial Dry Density	ρ _{di} (Mg/m ³)	1.50	1.50	1.50
Initial Voids Ratio	e _i .	0.795	0.795	0.795
Initial Degree of Saturation	S _i (%)	89.7	89.7	89.7
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f % (%)	28	28	27
Final Dry Density	ρ _{df} (Mg/m ³)	1.57	1.60	1.69
Final Voids Ratio	e _f .	0.703	0.677	0.585
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0
Peak Shear Stress	(kPa)	100.0	217.5	428.1
Hoz Displacement	L _H (mm)	12.000	12.000	8.610
Vertical Displacement	L _V (mm)	0.150	0.270	0.180

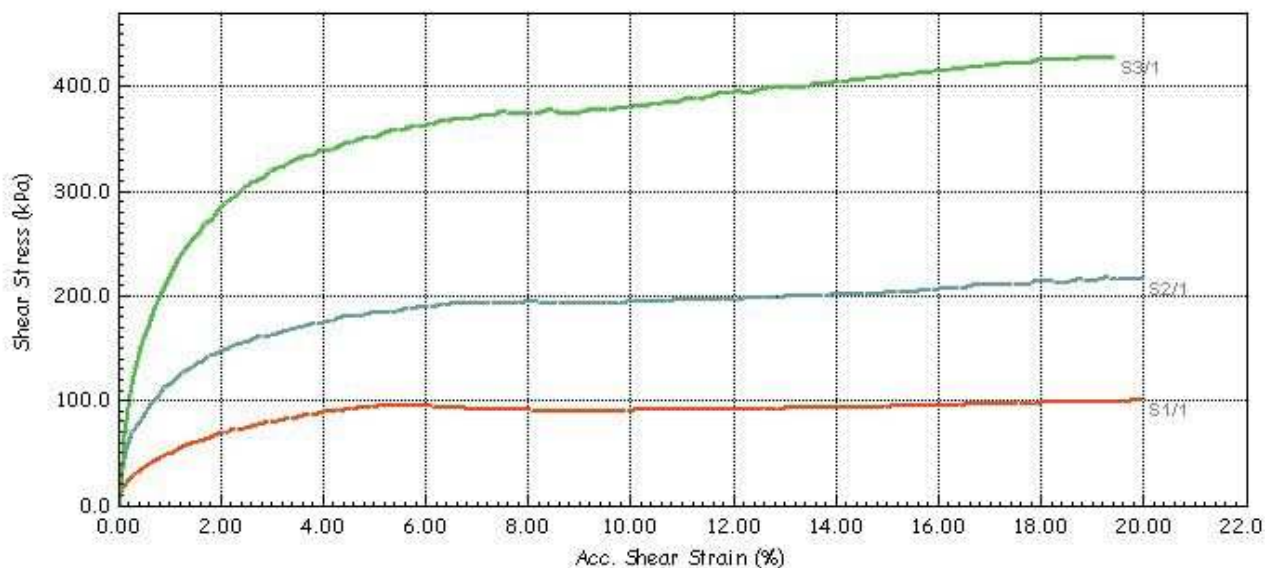
GIE

	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/21/2021
	Jobfile	Direct Shear Test	Sample	SPT-18
Client	SGS	Borehole	BH-06	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method	ASTM D 3080-04	Test Name	Direct Shear	
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D	
	Jobfile	Direct Shear Test	Test Date	3/21/2021	
	Client	SGS	Sample	SPT-18	
			Borehole	BH-06	
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

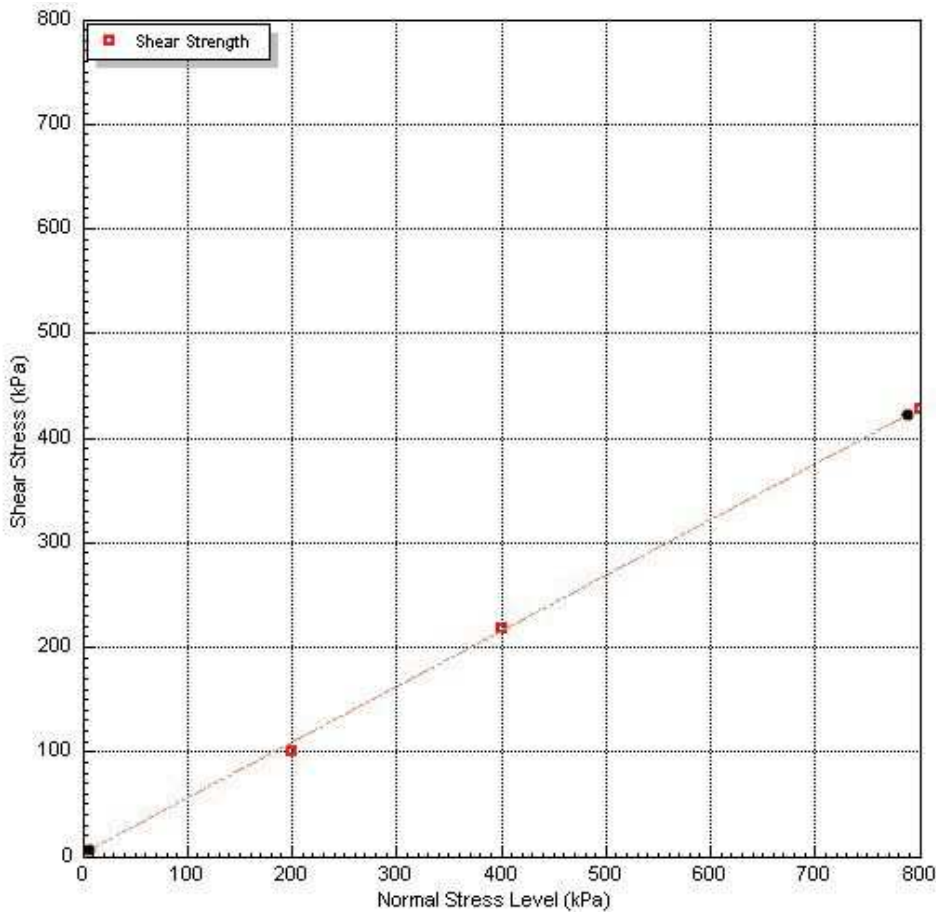
GIE

Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	28	28	27
Final Dry Density	ρ_{df} (Mg/m ³)	1.57	1.60	1.69
Final Voids Ratio	e_f	0.703	0.677	0.585
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	3.24		
Angle of Shearing Resistance	ϕ	28.0		
Notes				



	Test Method	ASTM D 3080-04	Test Name	Direct Shear
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	3/21/2021
	Client	SGS	Sample	SPT-18
			Borehole	BH-06
Operator	R. Islam	Checked	Aminul	Approved T. Islam

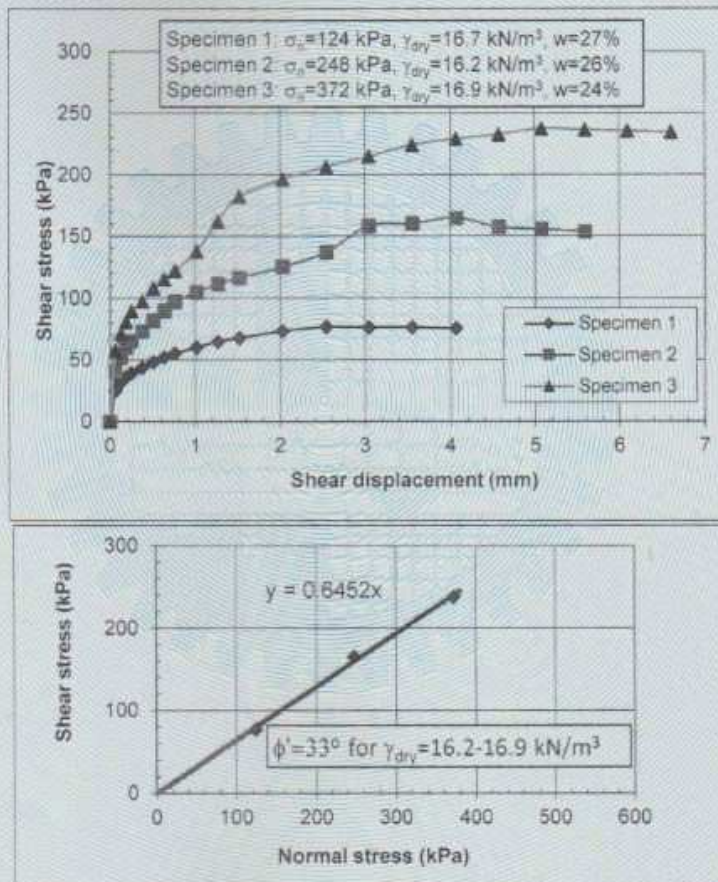
GIE



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand, trace clay	Location: Matarbari	
Bore-Hole: 6	Sample: 23	Depth: 26-26.45 m
Date of Test: 1.4.21-13.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.
 Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.

Countersigned by :

Dr. A.B.M. Badruzzaman
Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by :


Dr. Tahmeed M. Al-Hussaini
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

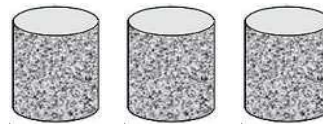
Summary Report

Sample Details	Depth	8.00-9.00				
 <p style="font-size: small;">sketch showing specimen location in original sample</p>	Type	UD				
			Spm. 1	2	3	
	Initial Sample Length	L ₀ (mm)	76.0	76.0	76.0	
	Initial Sample Diameter	D ₀ (mm)	38.0	38.0	38.0	
	Initial Sample Weight	W ₀ (gr)	158.5	158.1	158.5	
	Bulk Density	ρ ₀ (Mg/m ³)	1.84	1.83	1.84	
	Particle Density	ρ _s (Mg/m ³)	2.71	2.71	2.71	


Initial Conditions	Spm. 1 2 3			
Specimen				
Initial Cell Pressure	σ ₃ (kPa)	75	150	300
Strain Rate	m _s (mm/min)	0.76000	0.76000	0.76000
Membrane Thickness	m _b (mm)	0.02	0.02	0.02
Displacement Input	L _{IP} (mm)	CH 7	CH 7	CH 7
Load Input	N _{IP} (N)	CH 2	CH 2	CH 2
Initial Moisture	ω _i % (%)	34	34	34
Initial Dry Density	ρ _{d0} (Mg/m ³)	1.38	1.37	1.38
Initial Voids Ratio	e ₀ .	0.97	0.97	0.97
Initial Degree of Saturation	S _o (%)	94	94	94

Final Conditions	Spm. 1 2 3			
Max Deviator Stress	(σ ₁ - σ ₃) _f (kPa)	41.10	50.90	57.99
Membrane Correction	m _c (kPa)	31.545	40.760	33.923
Strain At Max Stress	ε _f % (%)	3.45	7.86	5.38
Shear Strength	c _U (kPa)	20.55	25.45	28.99
Final Moisture	ω _f % (%)	35	35	35
Final Dry Density	ρ _{df} (Mg/m ³)	1.37	1.36	1.37
Final Voids Ratio	e _f .	0.98	0.99	0.98
Final Degree of Saturation	S _f (%)	95.2	94.7	95.2

Notes



Failure Sketch
(surface inclination)

	Test Method	D 2850-03A (2007)	Test Name	UU
	Database:	.\SQLEXPRESS \ GIE-D	Test Date	3/11/2021
	Site Reference		Borehole	BH-06
	Jobfile	UU	Sample	UD-01
Client	SGS	Depth	8.00-9.00	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

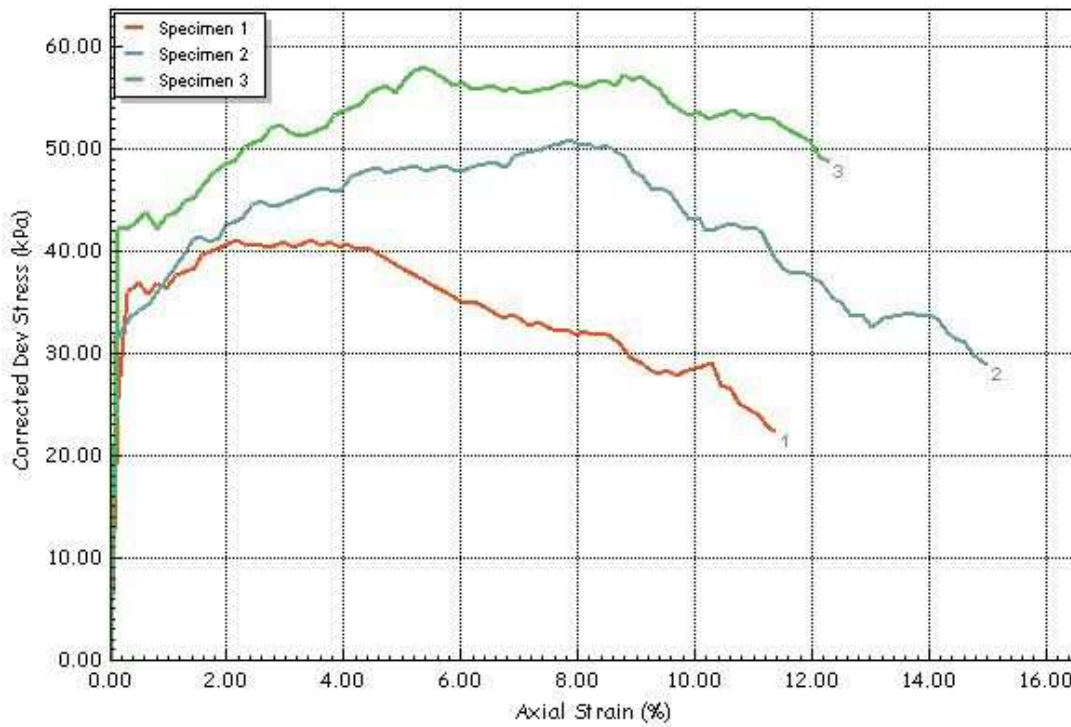
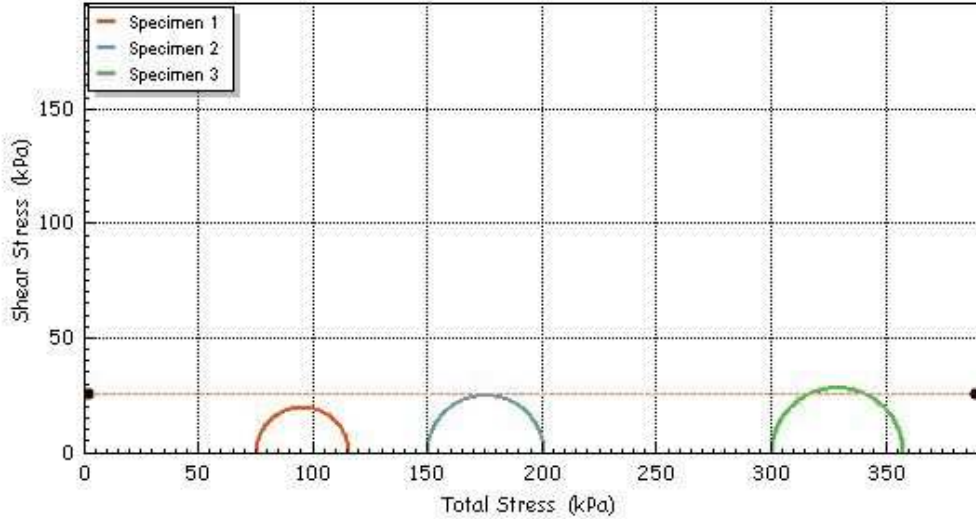
GIE

Total Stress Triaxial Compression

Unconsolidated Undrained (Multiple Specimen)

Test Results Plots

Cohesion Level	c	(kPa)	25.3
Friction Angle	ϕ	(deg)	0.0



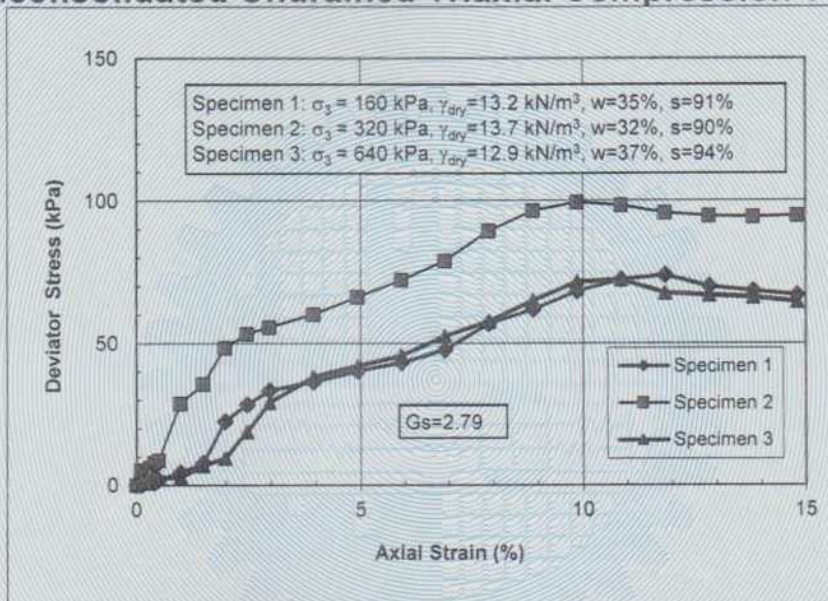
	Test Method	D 2850-03A (2007)		Test Name	UU		
	Database:	.\SQLEXPRESS \ GIE-D		Test Date	3/11/2021		
	Site Reference			Borehole	BH-06		
	Jobfile	UU		Sample	UD-01		
	Client	SGS		Depth	8.00-9.00		
	Operator	R. Islam	Checked	Aminul	Approved	T. Islam	

GIE

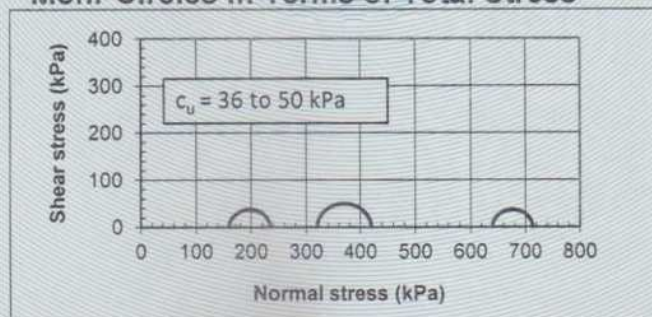


BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay	Test Method: ASTM	
B.H. No.: 6	Sample: UD-3	Depth: 14-15 m
Location: Matarbari	Date of Test: 24.5.21-26.5.21	

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading.

Countersigned by :

Dr. A.B.M. Badruzzaman
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

3.6.21

Dr. Tahmeed M. Al-Hussaini
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.





Project : SIBD2105
 Client - Location : Geotechnical Investigation for Matarbari Project
 Boring No : BH-06
 Sample No : UD-01
 Depth (m) : 8.00-9.00
 Soil Description : Lean CLAY, CL

Moisture Content Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 144.40	140.60
Wt. of Ring + Dry Soil, gm	= 124.18	124.18
Weight of Water, gm	= 20.22	16.42
Weight of Container, gm	= 69.56	69.56
Weight of Dry Soil, gm	= 54.62	54.62
Water Content, %	= 37.0	30.1

Unit Weight Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 144.40	140.60
Weight of Ring, gm	= 69.56	69.56
Weight of Wet Soil, gm	= 74.84	71.04
Height of Sample, cm	= 2	1.806
Diameter of Sample, cm	= 5	5
Volume of Sample, cm ³	= 39.27	35.46
Unit Wet Weight, kN/m ³	= 18.7	19.7
Unit Dry Weight, kN/m ³	= 13.6	15.1

Specific Gravity = 2.71
 Initial Void Ratio = 0.948
 Degree of Saturation, % = 100.0
 Room Temperature, °C = 24.0
 Temp. correction factor = 0.91
 Initial Transducer Reading = 8.25
 Effective Overburden Pressure =
 Preconsolidation Pressure = 100
 Compression Index (Cc) = 0.2442

22.09.2021

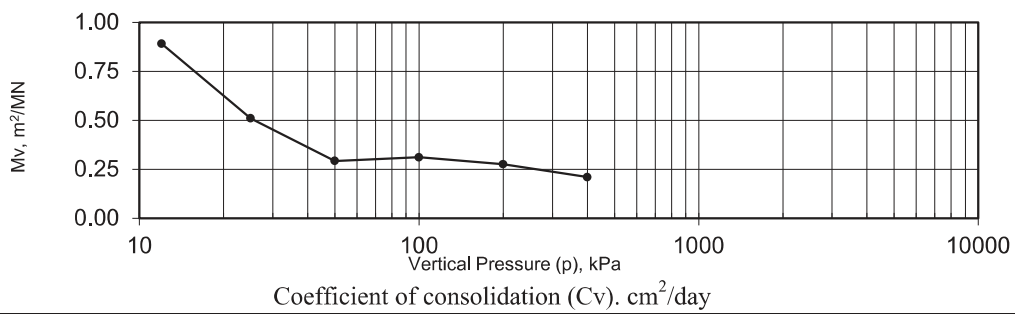
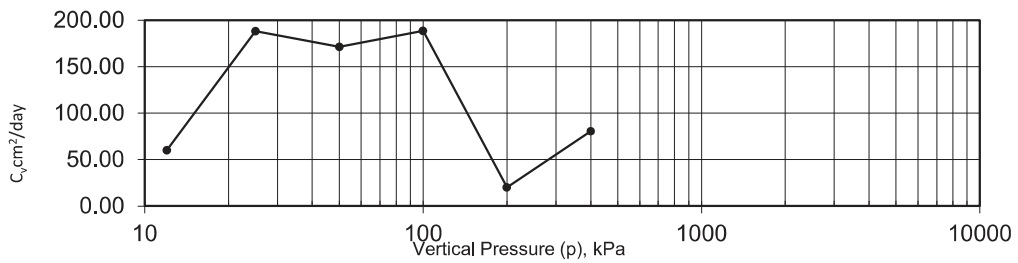
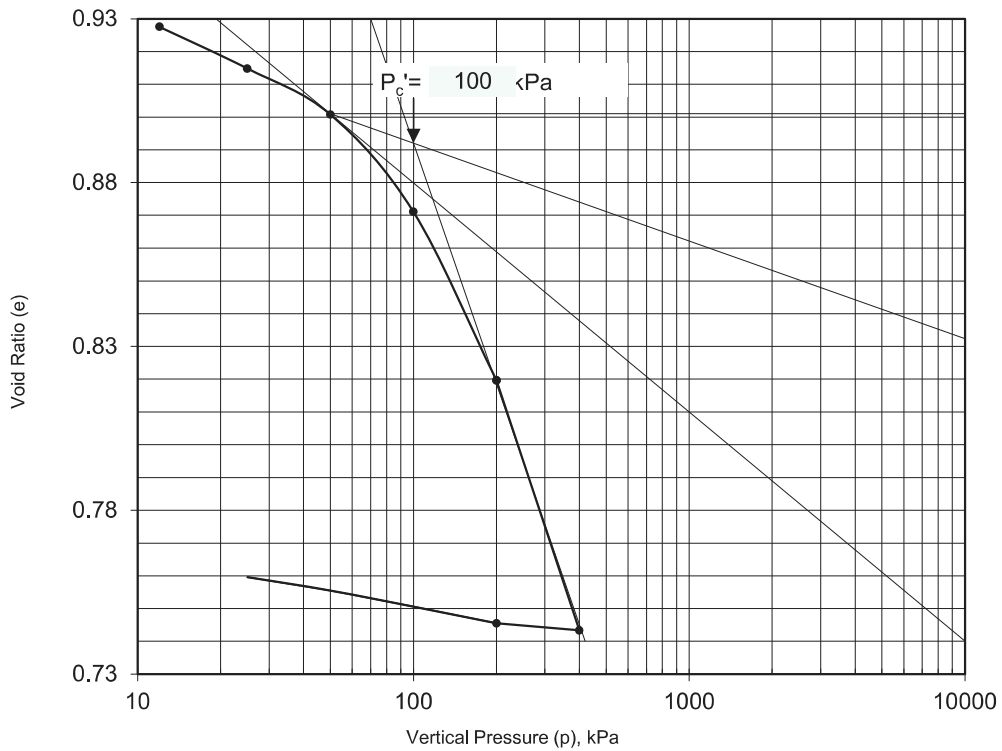
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v (cm ² /day)	c _v (20°C) (cm ² /day)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	8.034	0.001	0.214	0.928	18.237	65.870	59.942	0.892	16.622
2	25	7.903	0.001	0.345	0.915	5.764	207.032	188.399	0.509	29.841
3	50	7.759	0.001	0.489	0.901	6.249	188.310	171.362	0.293	15.618
4	100	7.452	0.004	0.793	0.871	5.548	207.279	188.624	0.312	18.280
5	200	6.920	0.008	1.321	0.820	49.840	22.093	20.104	0.275	1.719
6	400	6.129	0.015	2.105	0.743	11.592	88.522	80.555	0.210	5.258
7	200	6.156	0.010	2.083	0.745				0.006	
8	100	6.213	0.006	2.030	0.751				0.030	
9	50	6.267	0.002	1.980	0.756				0.056	
10	25	6.309	0.002	1.938	0.760				0.093	

Tested By: Rayhan

Checked & Approved By: T. Islam

Date: 25-03-2021

Date: 29-03-2021



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-06
 Sample : UD-01
 Depth (m) : 8.00-9.00





Project : SIBD2105
 Client - Location : Geotechnical Investigation for Matarbari Project
 Boring No : BH-06
 Sample No : UD-03
 Depth (m) : 14.00-15.00
 Soil Description : Lean CLAY, CL

Moisture Content Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 140.95	140.9
Wt. of Ring + Dry Soil, gm	= 123.54	123.54
Weight of Water, gm	= 17.41	17.36
Weight of Container, gm	= 69.56	69.56
Weight of Dry Soil, gm	= 53.98	53.98
Water Content, %	= 32.3	32.2

Unit Weight Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 140.95	140.9
Weight of Ring, gm	= 69.56	69.56
Weight of Wet Soil, gm	= 71.39	71.34
Height of Sample, cm	= 2	1.860
Diameter of Sample, cm	= 5	5
Volume of Sample, cm ³	= 39.27	36.52
Unit Wet Weight, kN/m ³	= 17.8	19.2
Unit Dry Weight, kN/m ³	= 13.5	14.5

Specific Gravity = 2.73
 Initial Void Ratio = 0.986
 Degree of Saturation, % = 89.3
 Room Temperature, °C = 24.0
 Temp. correction factor = 0.91
 Initial Transducer Reading = 8.94
 Effective Overburden Pressure =
 Preconsolidation Pressure = 111
 Compression Index (Cc) = 0.2056

88.34-403.07

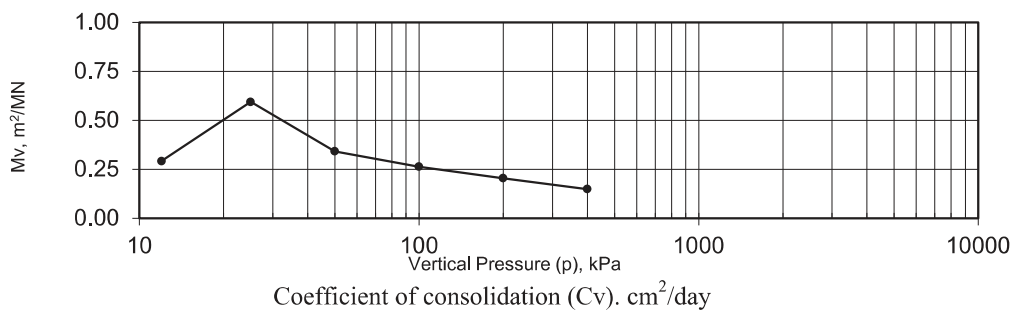
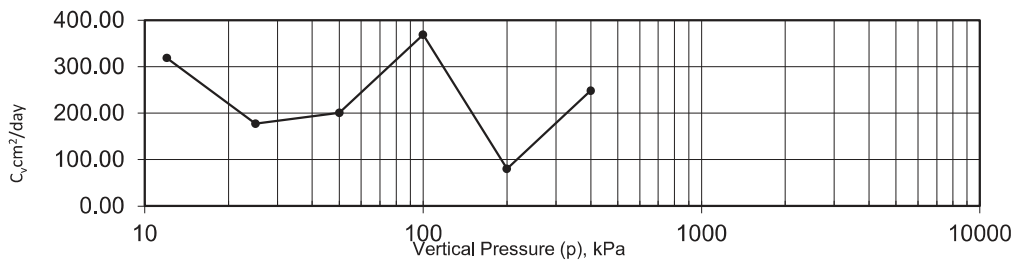
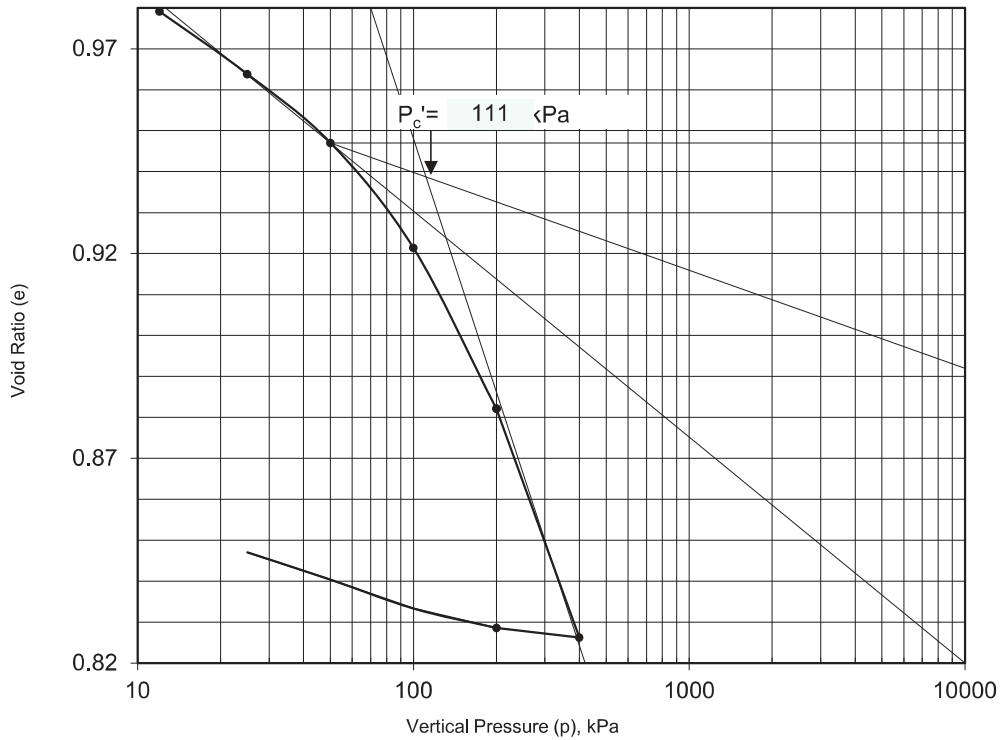
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v ('cm ² /day)	c _v (20°C) ('cm ² /day)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	8.864	0.001	0.070	0.979	3.483	349.935	318.441	0.292	28.885
2	25	8.710	0.001	0.224	0.964	6.214	194.629	177.112	0.594	32.740
3	50	8.541	0.001	0.393	0.947	5.397	220.461	200.619	0.342	21.328
4	100	8.280	0.004	0.651	0.921	2.874	405.068	368.612	0.263	30.169
5	200	7.880	0.008	1.047	0.882	12.739	88.343	80.392	0.205	5.117
6	400	7.311	0.015	1.609	0.826	3.918	273.051	248.476	0.148	11.457
7	200	7.339	0.010	1.586	0.829				0.006	
8	100	7.391	0.006	1.538	0.833				0.026	
9	50	7.466	0.002	1.467	0.840				0.077	
10	25	7.533	0.002	1.400	0.847				0.145	

Tested By: Rayhan

Checked & Approved By: T. Islam

Date: 22-03-2021

Date: 26-03-2021



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-06
 Sample : UD-03
 Depth (m) : 14.00-15.00



SGS



BH-07

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-03	Depth (m): 3.00-3.45
Can No.		210
Weight of Wet Soil + Can (gm)		233.12
Weight of Dry Soil + can (gm)		203.55
Weight of Can (gm)		26.05
Moisture Content (%)		16.66
Description		Fine-medium SAND with Silt, SP-SM

Sample No.:	SPT-06	Depth (m): 6.00-6.45
Can No.		205
Weight of Wet Soil + Can (gm)		179.88
Weight of Dry Soil + can (gm)		151.65
Weight of Can (gm)		26.05
Moisture Content (%)		22.48
Description		Sandy lean CLAY, CL

Sample No.:	SPT-07	Depth (m): 7.00-7.45
Can No.		404
Weight of Wet Soil + Can (gm)		98.33
Weight of Dry Soil + can (gm)		82.23
Weight of Can (gm)		25.00
Moisture Content (%)		28.13
Description		Lean CLAY, CL

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	UD-01	Depth (m): 9.00-10.00
Can No.		48
Weight of Wet Soil + Can (gm)		181.60
Weight of Dry Soil + can (gm)		142.29
Weight of Can (gm)		13.55
Moisture Content (%)		30.53
Description		Lean CLAY with Sand, CL

Sample No.:	SPT-13	Depth (m): 14.00-14.45
Can No.		485
Weight of Wet Soil + Can (gm)		223.49
Weight of Dry Soil + can (gm)		193.17
Weight of Can (gm)		26.82
Moisture Content (%)		18.23
Description		Silty fine-medium SAND, SM

Sample No.:	SPT-15	Depth (m): 16.00-16.45
Can No.		206
Weight of Wet Soil + Can (gm)		191.04
Weight of Dry Soil + can (gm)		158.13
Weight of Can (gm)		23.52
Moisture Content (%)		24.45
Description		Silty fine SAND, SM

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-17	Depth (m): 18.00-18.45
Can No.		406
Weight of Wet Soil + Can (gm)		173.55
Weight of Dry Soil + can (gm)		147.87
Weight of Can (gm)		26.78
Moisture Content (%)		21.21
Description		Silty fine SAND, SM

Sample No.:	MZ-01	Depth (m): 21.00-22.00
Can No.		102
Weight of Wet Soil + Can (gm)		207.00
Weight of Dry Soil + can (gm)		175.78
Weight of Can (gm)		13.85
Moisture Content (%)		19.28
Description		Fine SAND with Silt, SP-SM

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

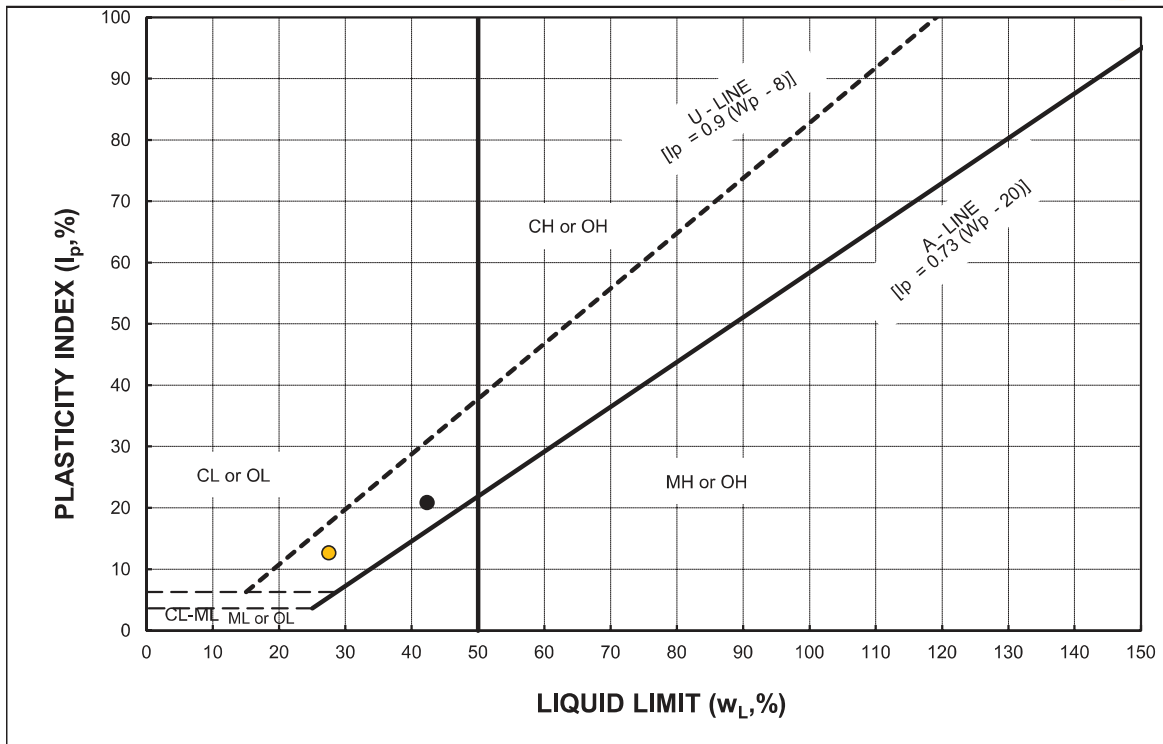
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 03-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	SPT-07	7.00-7.45	42.30	21.40	20.90		Lean CLAY, CL
●	UD-01	9.00-10.00	27.50	14.85	12.65		Lean CLAY, CL
●							
●							
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05
 *Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH	Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH	Inorganic clays of high plasticity, fat clays, etc.
OL	Organic silts and organic silty clays of low plasticity.	OH	Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
 Date: 04-03-2021

Checked by: Suvashis Paul
 Date: 09-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

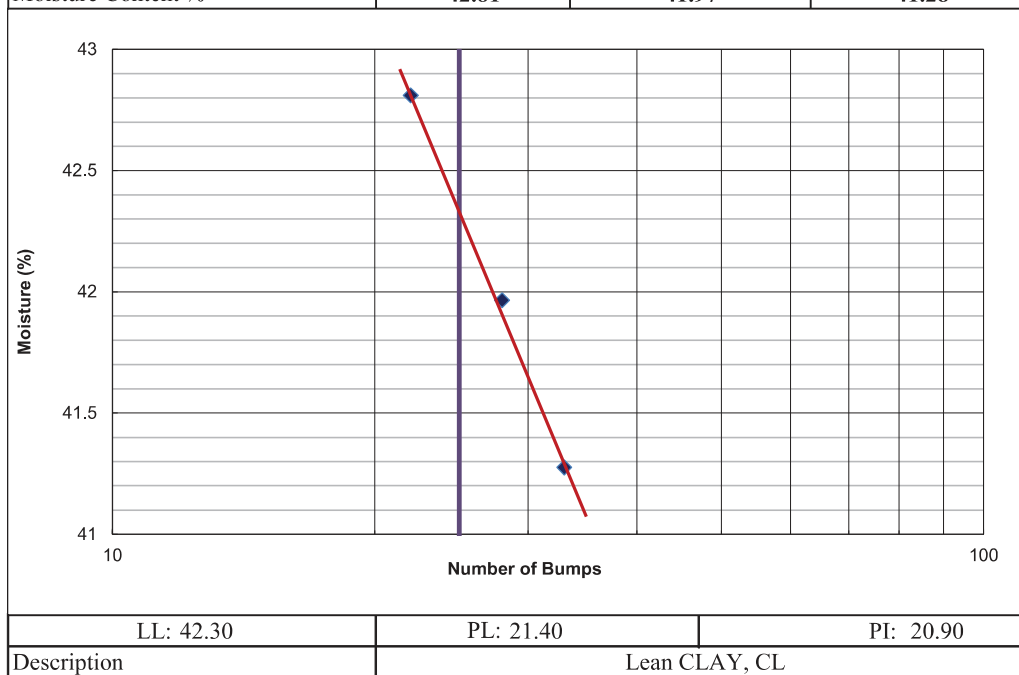
Sample No: SPT-07

BH No.: BH-07

Sample Depth: 7.00-7.45

Plastic Limit Test		
Container No.	333	416
Weight of can (gm)	6.93	6.72
Wet weight of soil + can (gm)	30.41	30.43
Dry Weight of soil + can (gm)	26.27	26.25
Moisture Content %	21.41	21.40
Average	21.40	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	28	33
Container No.	477	324	322
Weight of can (gm)	3.77	9.73	7.55
Wet weight of soil + can (gm)	29.59	27.93	25.93
Dry Weight of soil + can (gm)	21.85	22.55	20.56
Moisture Content %	42.81	41.97	41.28



Tested by: Rayhan

Date: 04-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

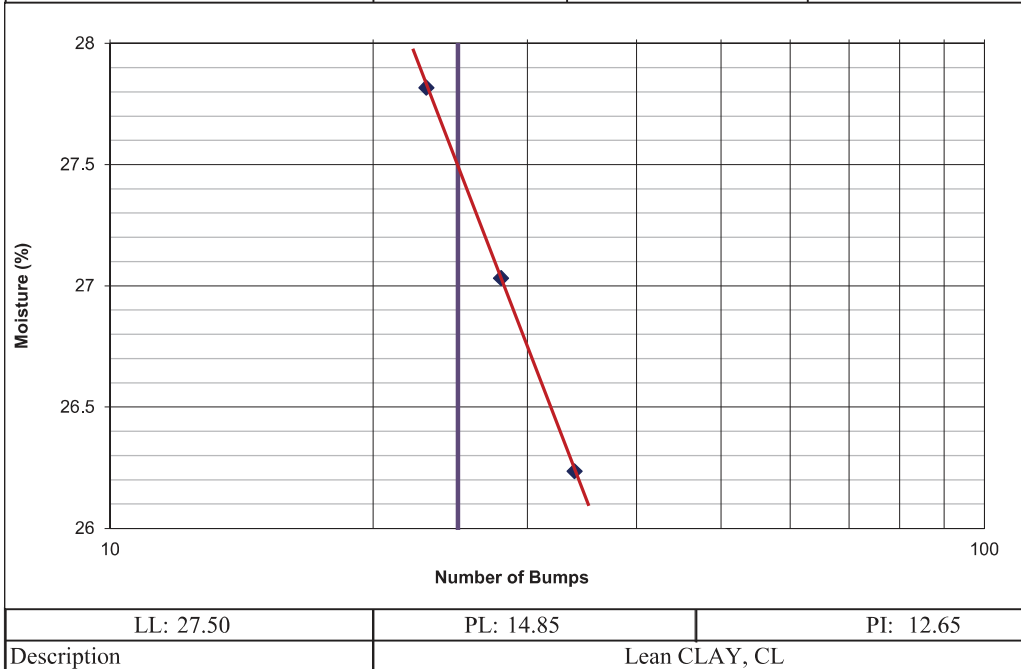
Sample No.: UD-01

BH No.: BH-07

Sample Depth: 9.00-10.00

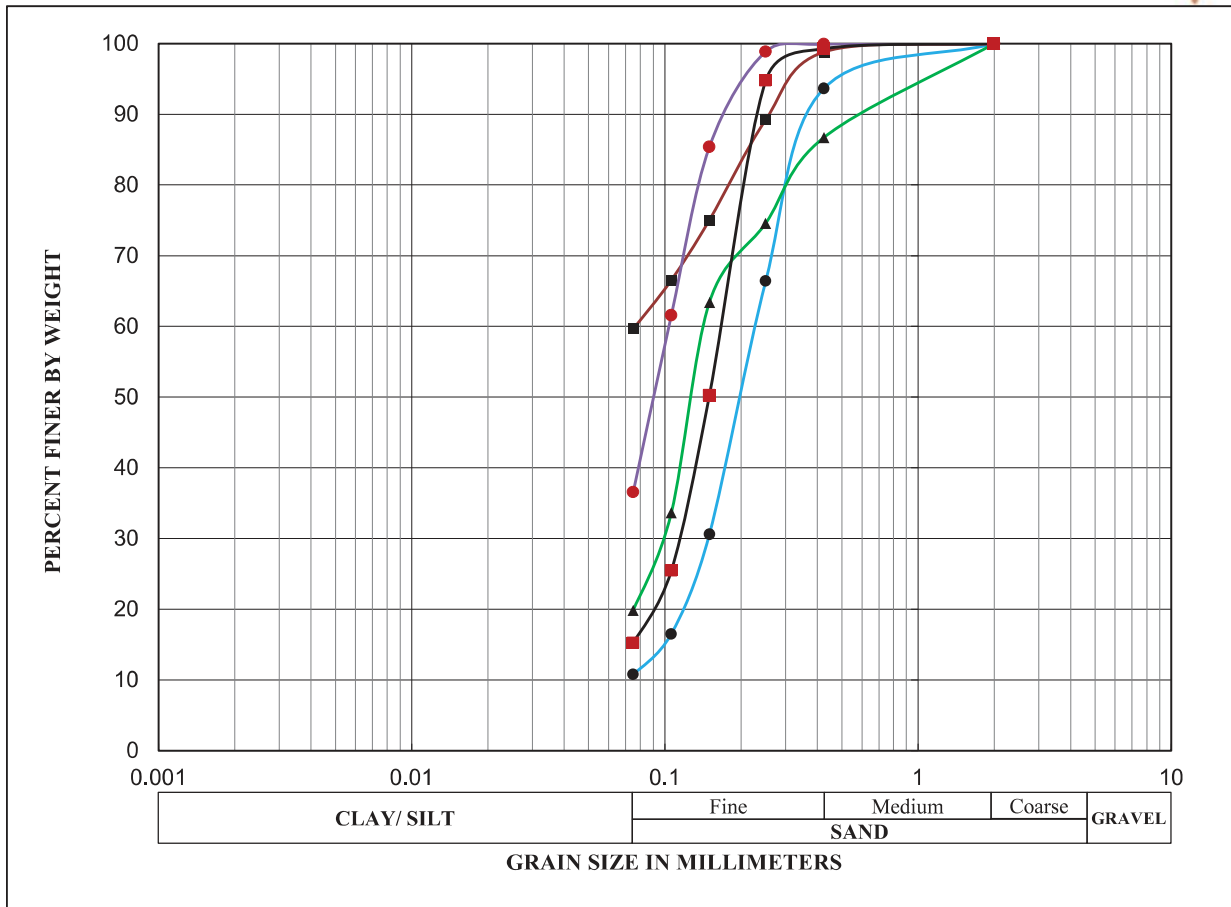
Plastic Limit Test		
Container No.	339	54
Weight of can (gm)	8.94	8.8
Wet weight of soil + can (gm)	36.86	36.88
Dry Weight of soil + can (gm)	33.26	33.24
Moisture Content %	14.80	14.89
Average	14.85	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	34
Container No.	438	319	329
Weight of can (gm)	4.07	9.25	9.42
Wet weight of soil + can (gm)	31.18	28.94	25.78
Dry Weight of soil + can (gm)	25.28	24.75	22.38
Moisture Content %	27.82	27.03	26.23



Tested by: Rayhan
Date: 04-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-03	3.00-3.45	Fine-medium SAND with Silt, SP-SM					3.33	1.36
■	SPT-06	6.00-6.45	Sandy lean CLAY, CL						
▲	SPT-13	14.00-14.45	Silty fine-medium SAND, SM						
●	SPT-15	16.00-16.45	Silty fine SAND, SM						
■	SPT-17	18.00-18.45	Silty fine SAND, SM						
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Medium	%Coarse	
●	SPT-03	3.00-3.45	0.232	0.204	0.148	0.070	0.00	82.90	6.34	0.00	10.76
■	SPT-06	6.00-6.45	0.077	0.063	0.038	0.013	0.00	39.16	1.20	0.00	59.64
▲	SPT-13	14.00-14.45	0.145	0.130	0.098	0.038	0.00	66.88	13.28	0.00	19.84
●	SPT-15	16.00-16.45	0.104	0.092	0.062	0.021	0.00	63.32	0.12	0.00	36.56
■	SPT-17	18.00-18.45	0.172	0.150	0.114	0.049	0.00	84.06	0.72	0.00	15.22
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

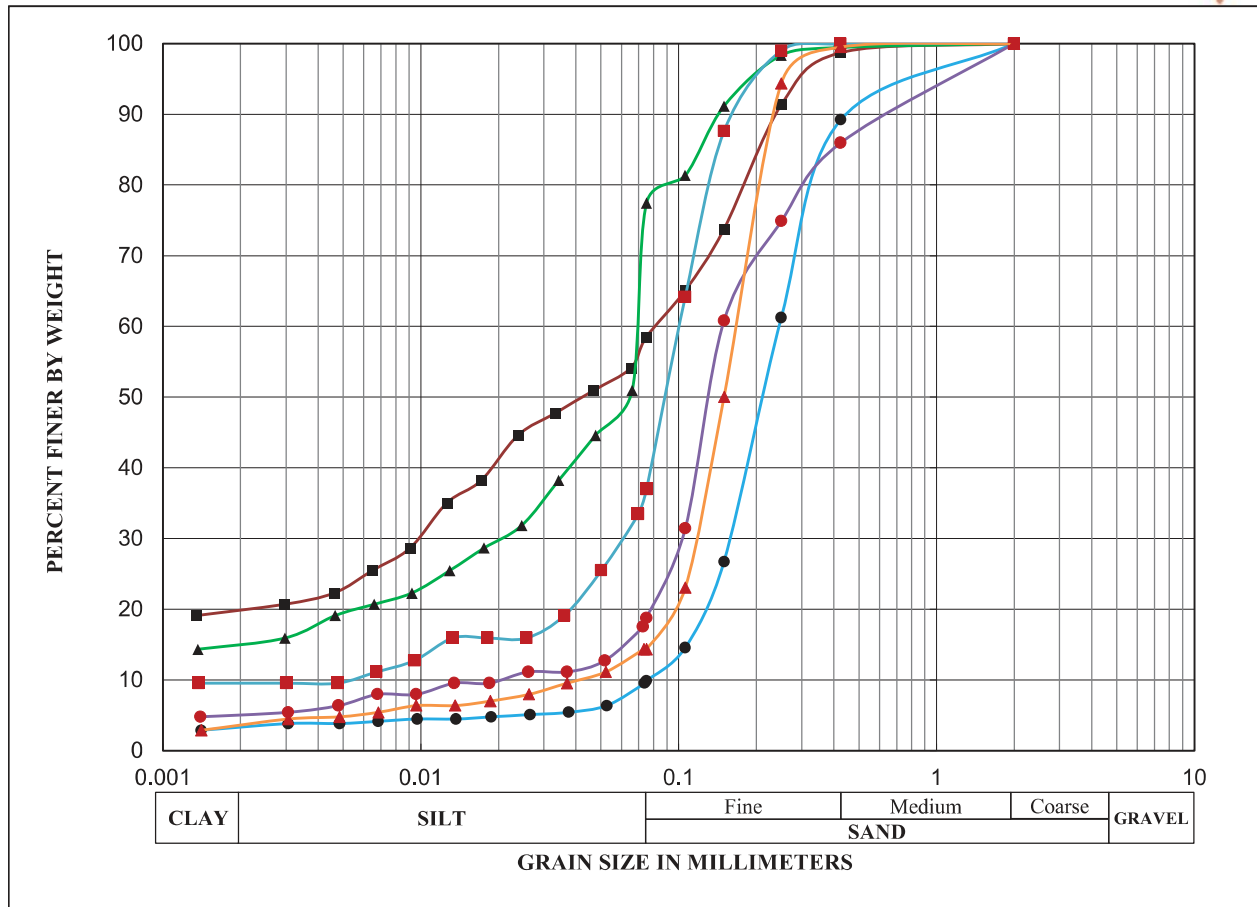
Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● SPT-03	3.00-3.45	Fine-medium SAND with Silt, SP-SM					3.25	1.36
■ SPT-06	6.00-6.45	Sandy lean CLAY, CL						
▲ UD-01	9.00-10.00	Lean CLAY with Sand, CL						
● SPT-13	14.00-14.45	Silty fine-medium SAND, SM						
■ SPT-15	16.00-16.45	Silty fine SAND, SM						
▲ SPT-17	18.00-18.45	Silty fine SAND, SM						

Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
							%Fine	%Medium	%Coarse		
● SPT-03	3.00-3.45	0.246	0.217	0.160	0.076	0.00	79.34	10.78	0.00	7.01	2.87
■ SPT-06	6.00-6.45	0.082	0.043	0.010	0.001	0.00	40.20	1.30	0.00	39.40	19.10
▲ UD-01	9.00-10.00	0.069	0.063	0.021	0.001	0.00	21.98	0.56	0.00	63.13	14.33
● SPT-13	14.00-14.45	0.149	0.134	0.103	0.021	0.00	67.20	14.04	0.00	13.98	4.78
■ SPT-15	16.00-16.45	0.101	0.090	0.061	0.005	0.00	62.96	0.08	0.00	27.41	9.55
▲ SPT-17	18.00-18.45	0.173	0.150	0.117	0.041	0.00	85.18	0.50	0.00	11.45	2.87

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

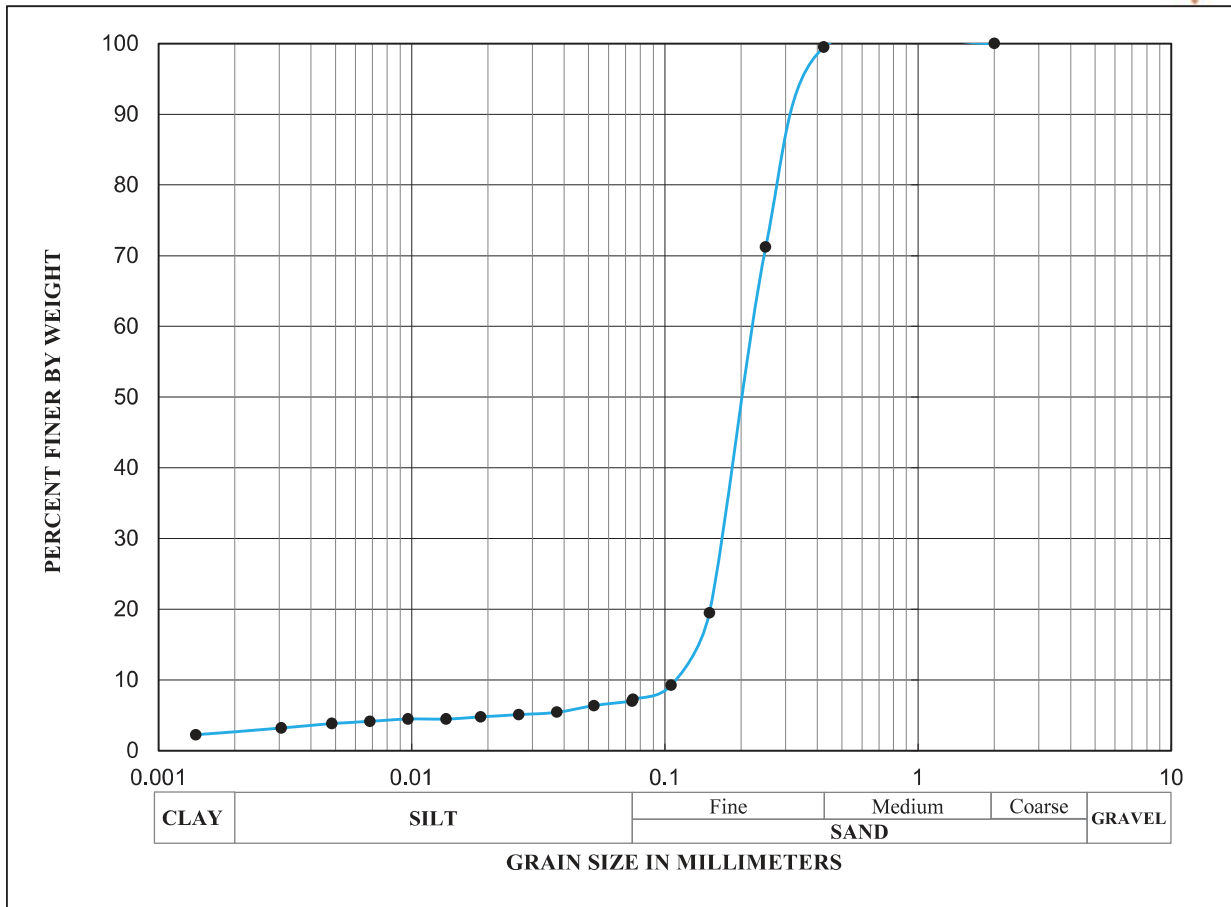
Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 07-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● MZ-01	21.00-22.00	Fine SAND with Silt, SP-SM					2.09	1.16
■								
▲								
●								
■								
▲								

Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
							%Fine	%Meidum	%Coarse		
● MZ-01	21.00-22.00	0.228	0.209	0.170	0.109	0.00	92.24	0.50	0.00	5.03	2.23
■											
▲											
●											
■											
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 07-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-03	Depth(m)	3.00-3.45
Pyknometer No.		1
Mass of bottle + soil + water: M_3	gm	118.71
Mass of bottle + soil: M_2	gm	74.04
Mass of bottle + water: M_4	gm	99.99
Mass of bottle: M_1	gm	44.00
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	25.95
Mass of water used: $M_3 - M_2$	gm	44.67
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.32
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-06	Depth(m)	6.00-6.45
Pyknometer No.		2
Mass of bottle + soil + water: M_3	gm	117.23
Mass of bottle + soil: M_2	gm	74.10
Mass of bottle + water: M_4	gm	98.41
Mass of bottle: M_1	gm	44.13
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	24.31
Mass of water used: $M_3 - M_2$	gm	43.13
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.15
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 06-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-13	Depth(m)	14.00-14.45
Pyknometer No.		8
Mass of bottle + soil + water: M_3	gm	91.23
Mass of bottle + soil: M_2	gm	51.19
Mass of bottle + water: M_4	gm	72.48
Mass of bottle: M_1	gm	21.14
Mass of soil: $M_2 - M_1$	gm	30.05
Mass of water in full bottle: $M_4 - M_2$	gm	21.29
Mass of water used: $M_3 - M_2$	gm	40.04
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.30
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.66

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 06-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-15	Depth(m)	16.00-16.45
Pyknometer No.		3
Mass of bottle + soil + water: M_3	gm	117.68
Mass of bottle + soil: M_2	gm	74.51
Mass of bottle + water: M_4	gm	98.92
Mass of bottle: M_1	gm	44.52
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	24.41
Mass of water used: $M_3 - M_2$	gm	43.17
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.23
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 06-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 10-13.4.21

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	7	8	---	---	---	---
Depth (m)	18-18.45	21-21.45	---	---	---	---
Sample No.	17.0	21.0	---	---	---	---
Soil Type	Grey silty sand	Grey silty sand	---	---	---	---
Wt. of bottle+water+soil, gm	373.4	373.1	---	---	---	---
Temperature (°C)	31.0	30.0	---	---	---	---
Wt. of bottle+water, gm	342.2	341.9	---	---	---	---
Wt. of soil, gm	49.8	49.6	---	---	---	---
Specific Gravity	2.67	2.68	---	---	---	---

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

Countersigned by :

f

Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Test performed by :

25.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



MZ-01	Depth(m)	21.00-22.00
Pyknometer No.		17
Mass of bottle + soil + water: M_3	gm	123.93
Mass of bottle + soil: M_2	gm	71.88
Mass of bottle + water: M_4	gm	105.23
Mass of bottle: M_1	gm	41.89
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	33.36
Mass of water used: $M_3 - M_2$	gm	52.05
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.29
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 06-03-2021

Checked by: Suvashis Paul

Date: 09-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

UD-01	Depth (m):	9.00-10.00
Weight of soil	gm	163.40
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.90
Dry Density	(g/cm ³)	1.45
Void Ratio		0.91
Moisture Content	%	30.53
Specific Gravity	(g/cm ³)	2.77

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021



**UNIT WEIGHT / BULK DENSITY
VOID RATIO**



Ground Instrumentation
& Engineering Pte Ltd

MZ-01	Depth (m):	21.00-22.00
Weight of soil	gm	169.00
Height	mm	76
Diameter	mm	38
Volume	mm ³	86193
Bulk Density	(g/cm ³)	1.96
Dry Density	(g/cm ³)	1.64
Void Ratio		0.61
Moisture Content	%	19.28
Specific Gravity	(g/cm ³)	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-07

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 09-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



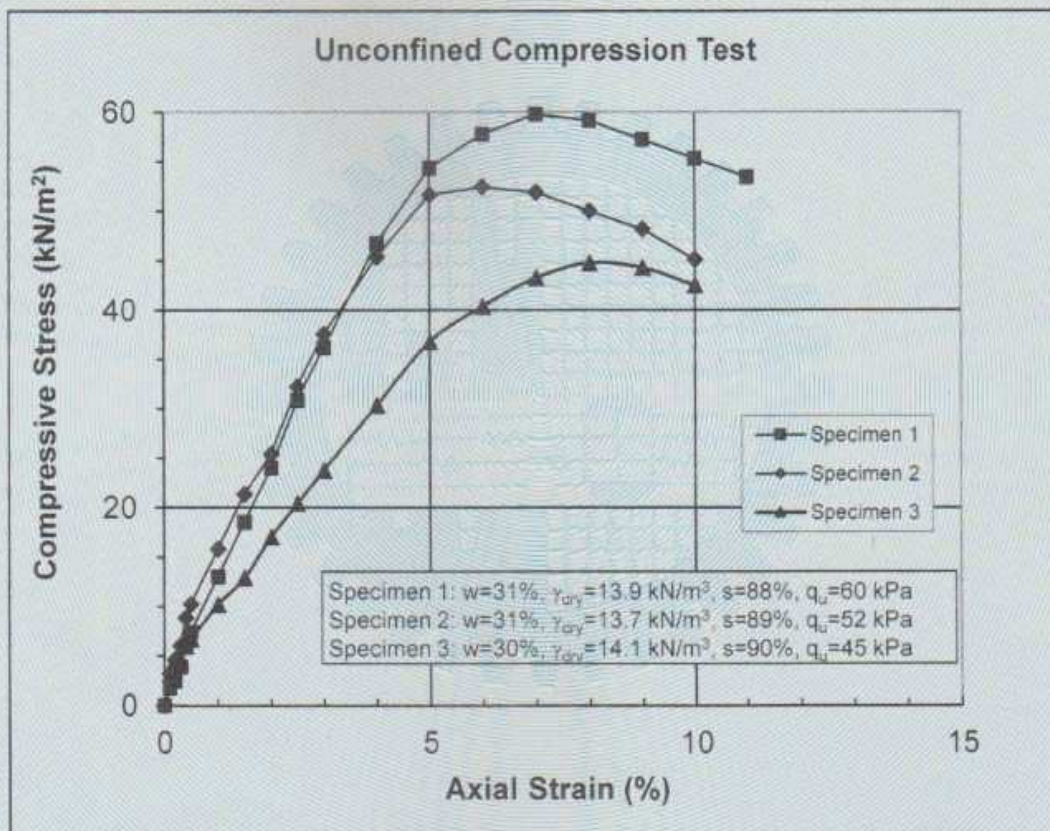
DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE dated 11.3.21		
Client : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref : SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil description : Grey silty clay		
Test Method: ASTM		Date of Test: 31.3.21-5.4.21
BH No. : 7	Sample ID : UD-1	Depth: 9-10 m
		Location: Matarbari



Note: Samples as supplied to us in sampler tubes have been tested in our laboratory. BRTC, BUET does not have any responsibility as to the representative character of the sample. Initial water content, dry density, degree of saturation and unconfined compressive strength is reported.

Sample was received in unsealed condition.

Specific Gravity= 2.77

Countersigned by :

f. majah
Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by :

Ahmed
 8.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.




BRTC BUET

BUETCE 0 2 7 2 3 8 6

Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	3.00-3.45				
 <i>sketch showing specimen location in original sample</i>	Description	Fine-medium sand				
	Type	Disturbed Soil				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	130.2	130.2	130.2	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	1.81	1.81	1.81	
	Particle Density	ρ _s (Mg/m ³)	2.67	2.67	2.67	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	50	100	200
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i % (%)	17	17	17
Initial Dry Density	ρ _{di} (Mg/m ³)	1.54	1.54	1.54
Initial Voids Ratio	e _i .	0.729	0.729	0.729
Initial Degree of Saturation	S _i (%)	62.6	62.6	62.6
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f % (%)	18	18	17
Final Dry Density	ρ _{df} (Mg/m ³)	1.62	1.62	1.75
Final Voids Ratio	e _f .	0.645	0.584	0.471
Final Degree of Saturation	S _f (%)	72.6	80.2	97.0
Peak Shear Stress	(kPa)	36.0	67.8	130.7
Hoz Displacement	L _H (mm)	12.000	12.000	12.000
Vertical Displacement	L _V (mm)	0.200	0.240	0.330

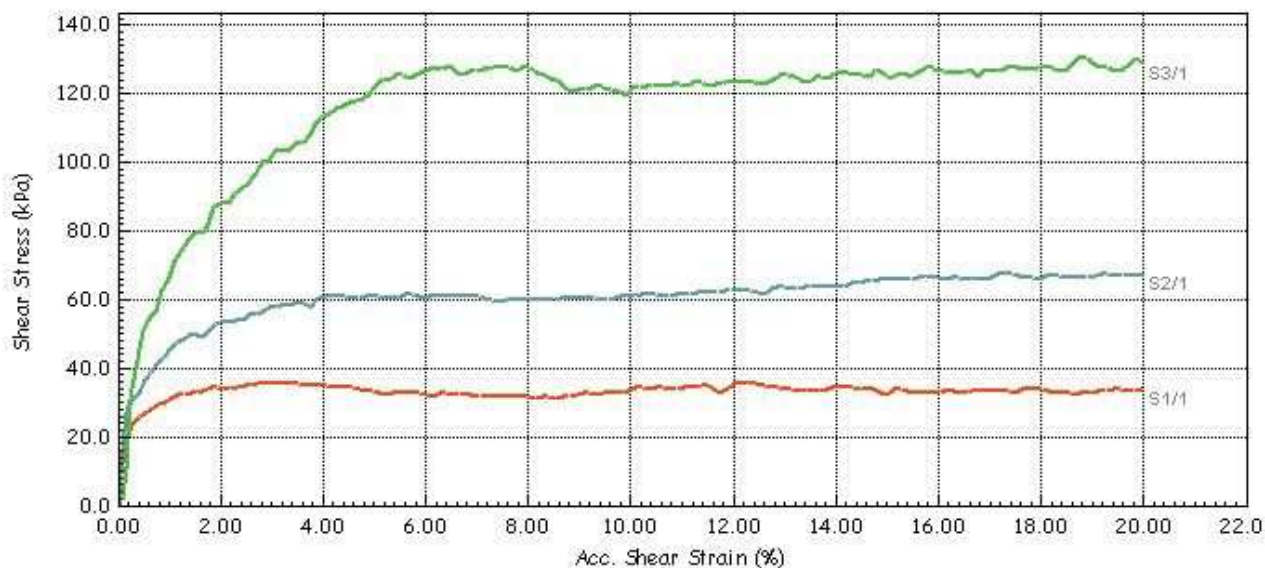
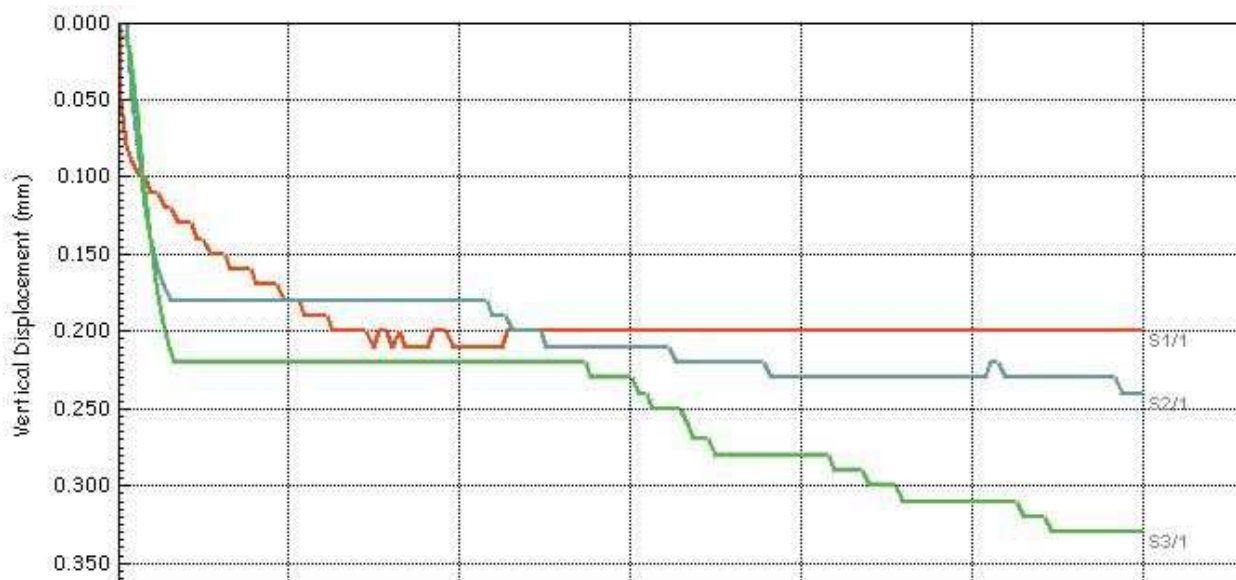
GIE


	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/24/2021
	Jobfile	Direct Shear Test	Sample	SPT-03
Client	SGS	Borehole	BH-07	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/24/2021	
	Jobfile Direct Shear Test		Sample SPT-03	
Client SGS		Borehole BH-07		
Operator R. Islam	Checked	Aminul	Approved	T. Islam

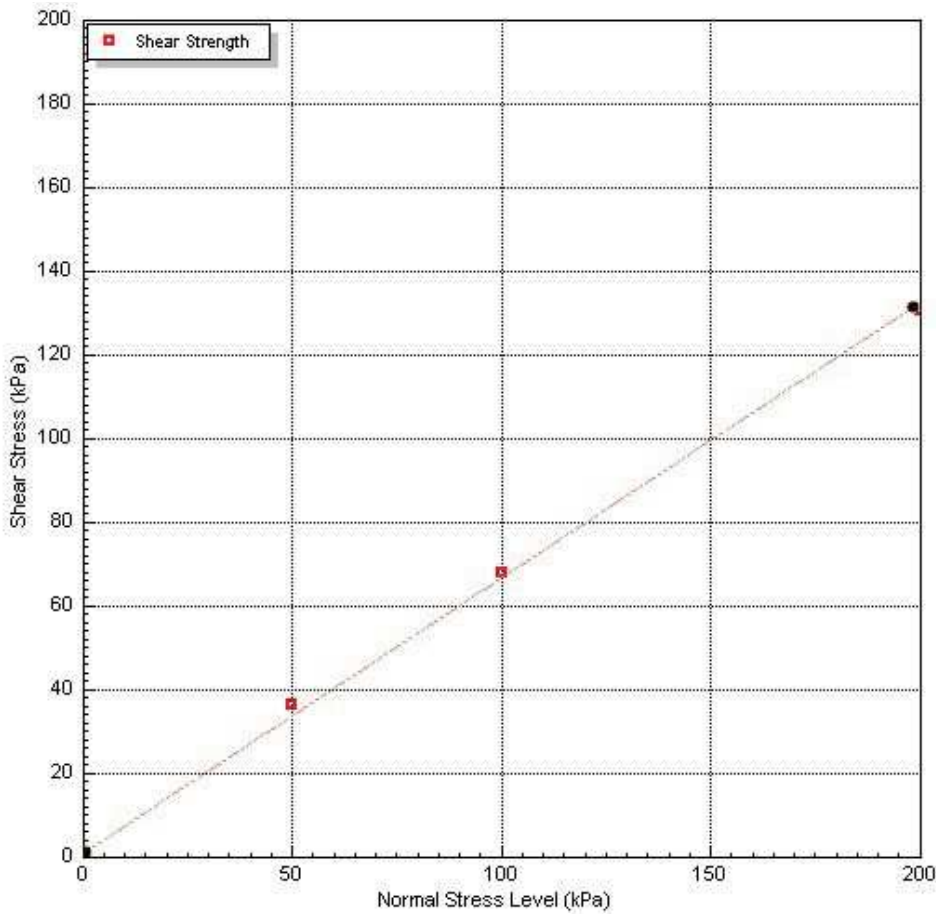
GIE

Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	18	18	17
Final Dry Density	ρ_{df} (Mg/m ³)	1.62	1.62	1.75
Final Voids Ratio	e_f	0.645	0.584	0.471
Final Degree of Saturation	S_f (%)	72.6	80.2	97.0
Apparent cohesion	c (kPa)	0.51		
Angle of Shearing Resistance	ϕ	33.4		
Notes				



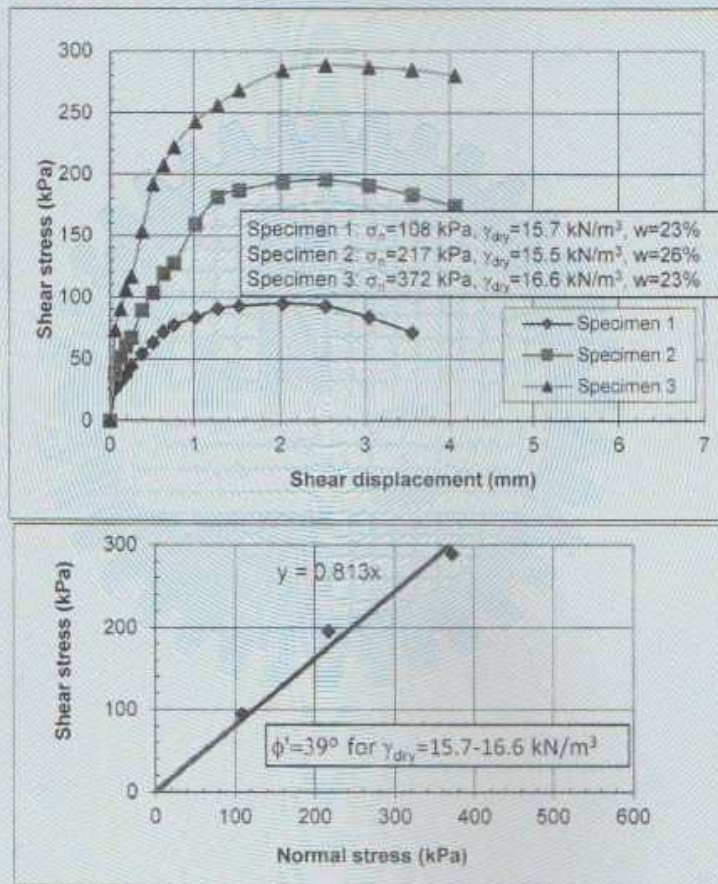
	Test Method	ASTM D 3080-04	Test Name	Direct Shear	
			Database:	.\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date	3/24/2021	
	Jobfile	Direct Shear Test	Sample	SPT-03	
	Client	SGS	Borehole	BH-07	
	Operator	R. Islam	Checked	Aminul	Approved

GIE



BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand	Location: Matarbari	
Bore-Hole: 7	Sample: 17	Depth: 18-18.45 m
Date of Test: 8.4.21-12.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition.
 Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.

Countersigned by :

[Signature]
Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by :


[Signature] 9.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	21.00-22.00				
 <i>Sketch showing specimen location in original sample</i>	Description	Silty fine SAND with silt, SP-SM				
	Type	Mazier				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	152.6	152.6	152.6	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	2.12	2.12	2.12	
	Particle Density	ρ _s (Mg/m ³)	2.65	2.65	2.65	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	225	450	900
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i (%)	19	19	19
Initial Dry Density	ρ _{di} (Mg/m ³)	1.78	1.78	1.78
Initial Voids Ratio	e _i	0.492	0.492	0.492
Initial Degree of Saturation	S _i (%)	100.0	100.0	100.0
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f (%)	19	20	20
Final Dry Density	ρ _{df} (Mg/m ³)	1.82	1.86	1.89
Final Voids Ratio	e _f	0.482	0.446	0.426
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0
Peak Shear Stress	(kPa)	157.7	318.1	622.7
Hoz Displacement	L _H (mm)	12.000	12.000	12.000
Vertical Displacement	L _V (mm)	-0.270	-0.040	0.080

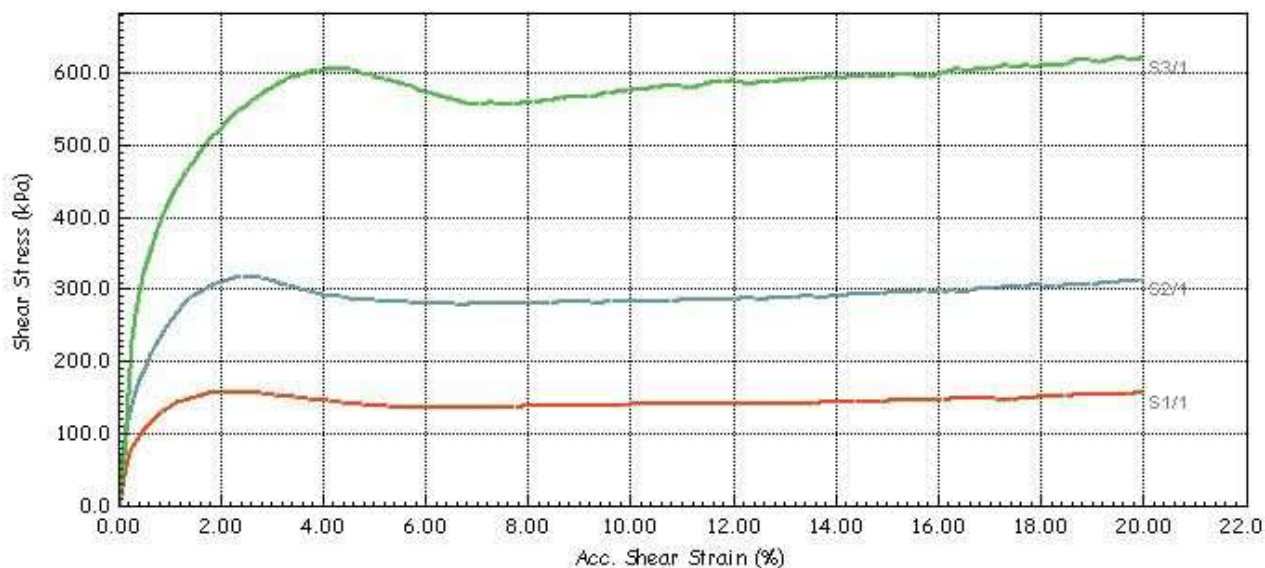
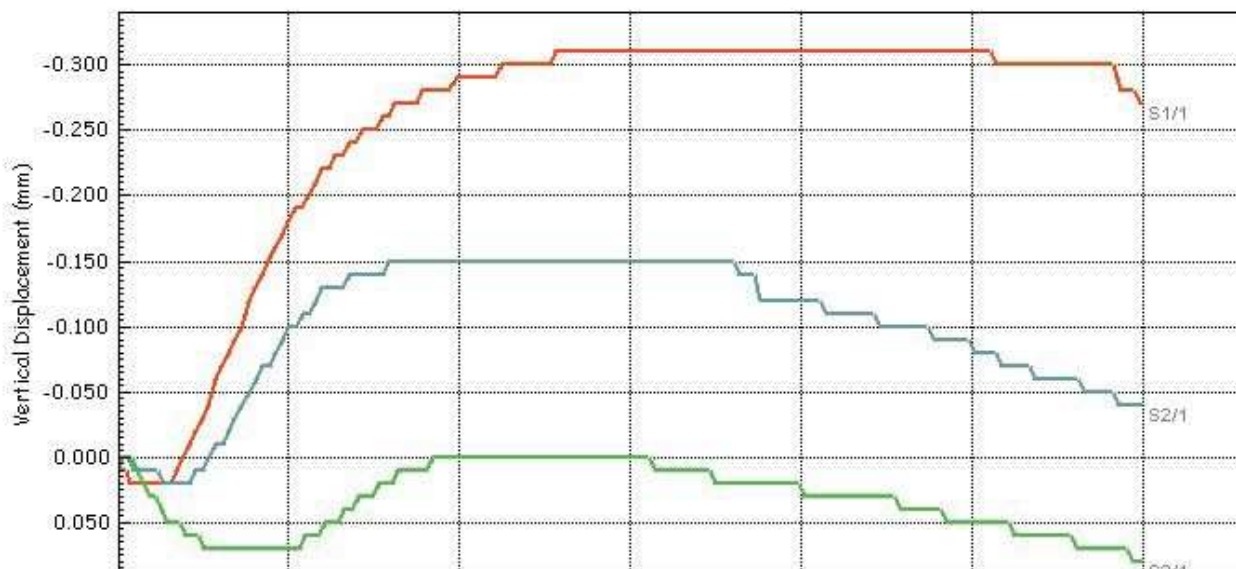
GIE


	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/25/2021
	Jobfile	Direct Shear Test	Sample	Mazier-01
Client	SGS	Borehole	BH-07	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method	ASTM D 3080-04	Test Name	Direct Shear	
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D	
	Jobfile	Direct Shear Test	Test Date	3/25/2021	
	Client	SGS	Sample	Mazier-01	
Operator	R. Islam	Checked	Aminul	Approved	T. Islam

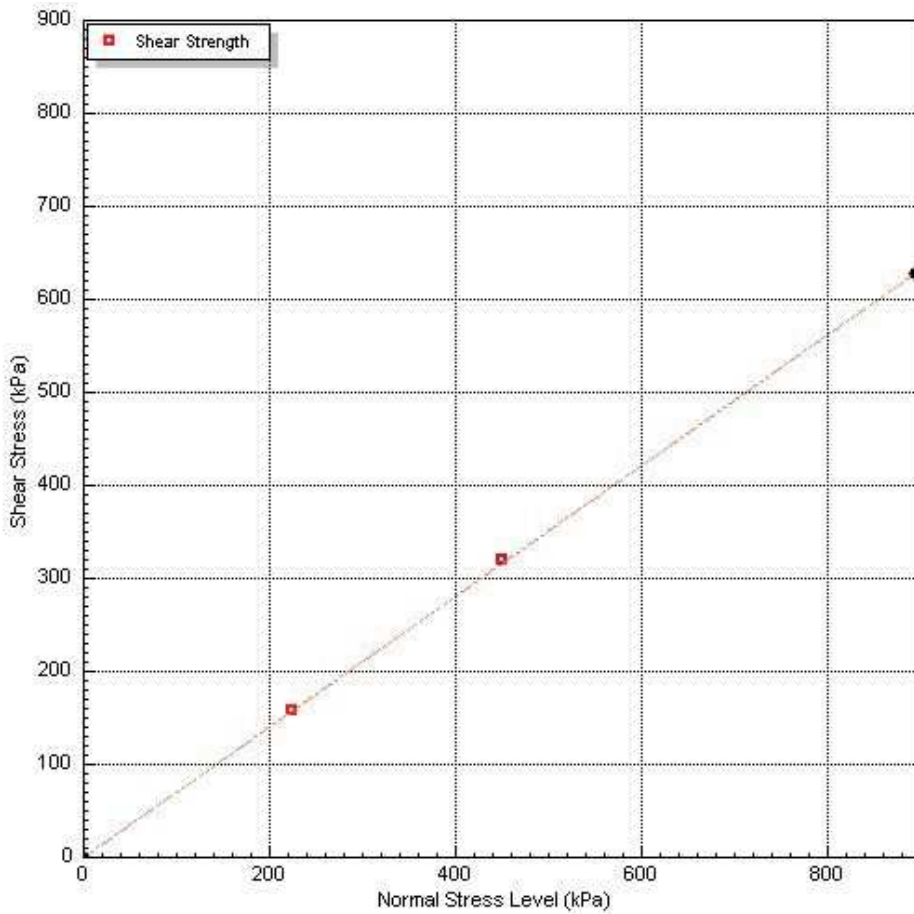
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Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	19	20	20
Final Dry Density	ρ_{df} (Mg/m ³)	1.82	1.86	1.89
Final Voids Ratio	e_f	0.482	0.446	0.426
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	0.00		
Angle of Shearing Resistance	ϕ	35.1		
Notes				



	Test Method	ASTM D 3080-04	Test Name	Direct Shear
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	3/25/2021
	Client	SGS	Sample	Mazier-01
	Operator	R. Islam	Borehole	BH-07
	Checked	Aminul	Approved	T. Islam

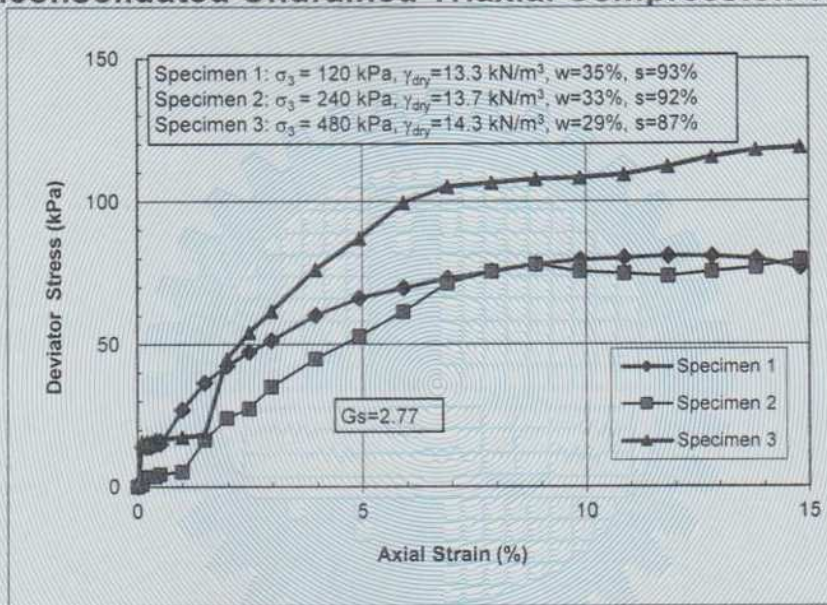
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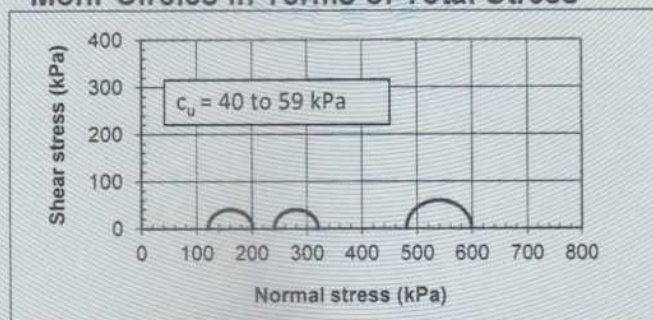
GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21	
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka	
Ref: SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Soil description : Grey silty clay, trace fine sand	Test Method: ASTM
B.H. No.: 7	Sample: UD-1
Depth: 9-10 m	
Location: Matarbari	Date of Test: 26.5.21-28.5.21

Unconsolidated Undrained Triaxial Compression Test



Mohr Circles in Terms of Total Stress



Remarks: Initial dry density, water content and degree of saturation is indicated. All specimens were subjected to saturation prior to loading. Differences in soil density may be noted.

Countersigned by :

Dr. A.B.M. Badruzzaman
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.

Test performed by :

Dr. Tahmeed M. Al-Hussaini
Professor, Dept. of Civil Engineering
BUET, Dhaka - 1000.



Project : SIBD2105
 Client - Location : Geotechnical Investigation for Matarbari Project
 Boring No : BH-07
 Sample No : UD-01
 Depth (m) : 9.00-10.00
 Soil Description : Lean CLAY with SAND, CL

Moisture Content Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 146.40	143.98
Wt. of Ring + Dry Soil, gm	= 128.00	128.00
Weight of Water, gm	= 18.40	15.98
Weight of Container, gm	= 69.56	69.56
Weight of Dry Soil, gm	= 58.44	58.44
Water Content, %	= 31.5	27.3

Unit Weight Determination

	<u>Initial</u>	<u>Final</u>
Wt. of Ring + Wet Soil, gm	= 146.40	143.98
Weight of Ring, gm	= 69.56	69.56
Weight of Wet Soil, gm	= 76.84	74.42
Height of Sample, cm	= 2	1.856
Diameter of Sample, cm	= 5	5
Volume of Sample, cm ³	= 39.27	36.45
Unit Wet Weight, kN/m ³	= 19.2	20.0
Unit Dry Weight, kN/m ³	= 14.6	15.7

Specific Gravity = 2.71
 Initial Void Ratio = 0.821
 Degree of Saturation, % = 100.0
 Room Temperature, °C = 24.0
 Temp. correction factor = 0.91
 Initial Transducer Reading = 9.73
 Effective Overburden Pressure =
 Preconsolidation Pressure = 62
 Compression Index (Cc) = 0.1377

46.75-208.36

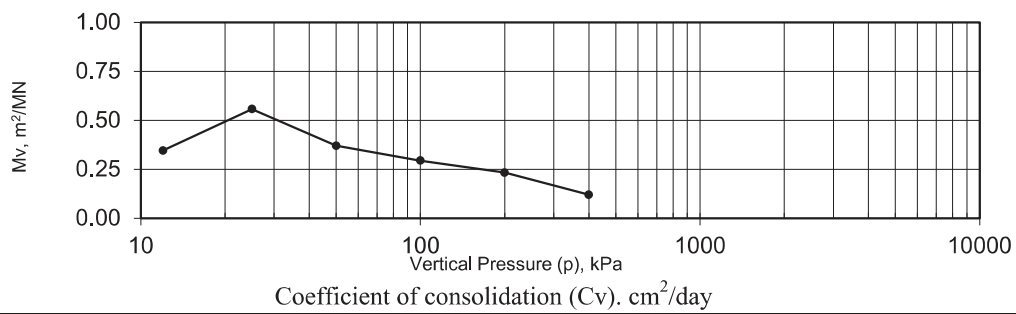
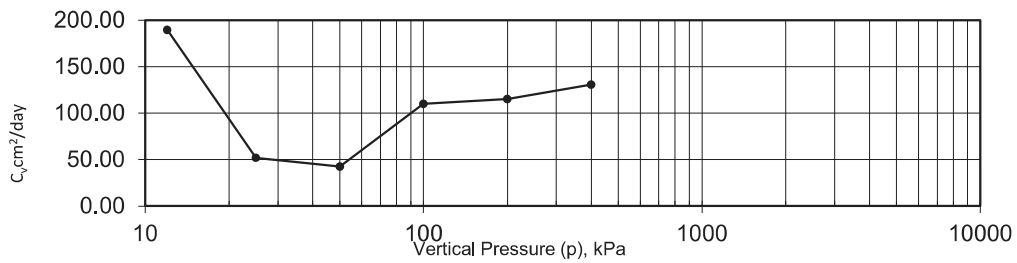
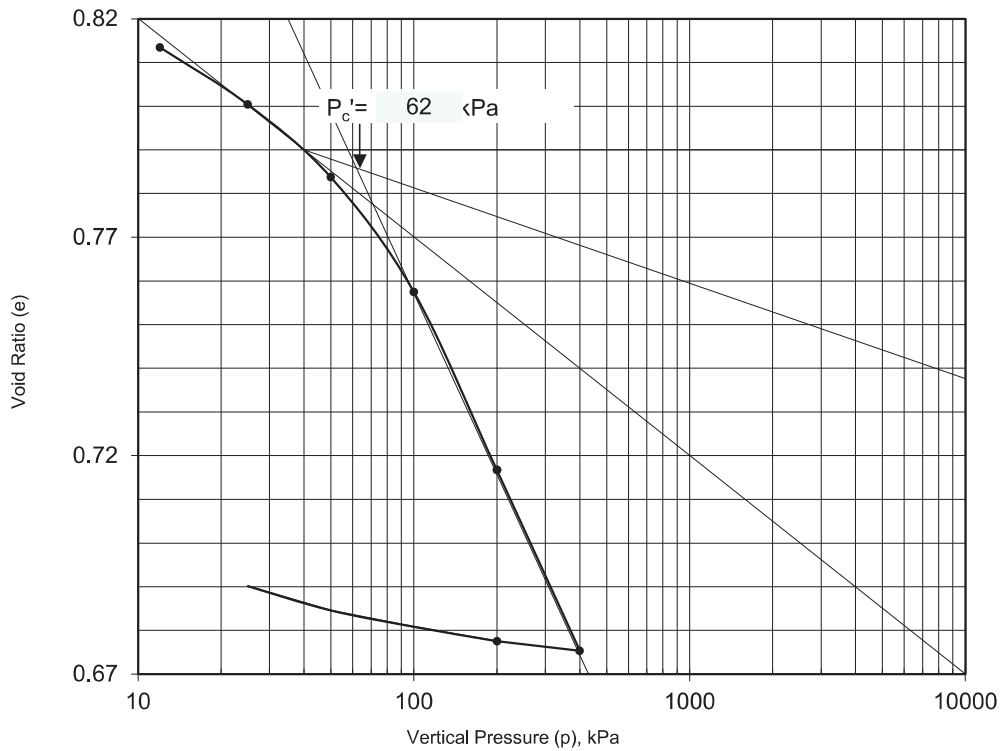
Inc. No.	Load, p (kPa)	Transducer Reading (div)	Machine Corr. (div)	Change in Height (mm)	e Void Ratio	t ₉₀ (min)	c _v (cm ² /day)	c _v (20°C) (cm ² /day)	m _v (m ² /MN)	k x 10 ⁻⁹ (m/s)
1	12	9.646	0.001	0.083	0.813	5.842	208.359	189.607	0.346	20.393
2	25	9.502	0.001	0.227	0.800	21.176	57.067	51.931	0.556	8.982
3	50	9.319	0.001	0.410	0.784	25.423	46.754	42.546	0.370	4.898
4	100	9.028	0.004	0.698	0.757	9.610	120.743	109.876	0.294	10.047
5	200	8.576	0.008	1.146	0.717	8.833	126.440	115.060	0.232	8.305
6	400	8.115	0.015	1.600	0.675	7.415	143.582	130.660	0.120	4.892
7	200	8.144	0.010	1.576	0.678				0.007	
8	100	8.184	0.006	1.540	0.681				0.020	
9	50	8.229	0.002	1.499	0.685				0.044	
10	25	8.290	0.002	1.438	0.690				0.132	

Tested By: Rayhan

Date: 30-03-2021

Checked & Approved By: T. Islam

Date: 03-04-2021



Job No. : SIBD2105
 Project : Geotechnical Investigation for Matarbari Project
 Location : Matarbari, Power Plant Area
 Borehole : BH-07
 Sample : UD-01
 Depth (m) : 9.00-10.00



Ground Instrumentation & Engineering Pte Ltd

GEOTECHNICAL AND MATERIAL LABORATORY
Ground Instrumentation & Engineering
Pte.Ltd. House-7 Road-12, Dhaka 1230

LABORATORY COMPACTION TEST DATA
(Dry Density- Moisture Content Relationship)
 ASTM D1557

Date: 29/03/2021

Project : Geotechnical Investigation for Matarbari, ID-SIBD-2105

Client : SGS

Test Pit No. : BH-07

Sample Depth : 1.00 m

Method: Standard Proctor (using 2.5 kg rammer)

Volume of Mould: 950 cm³

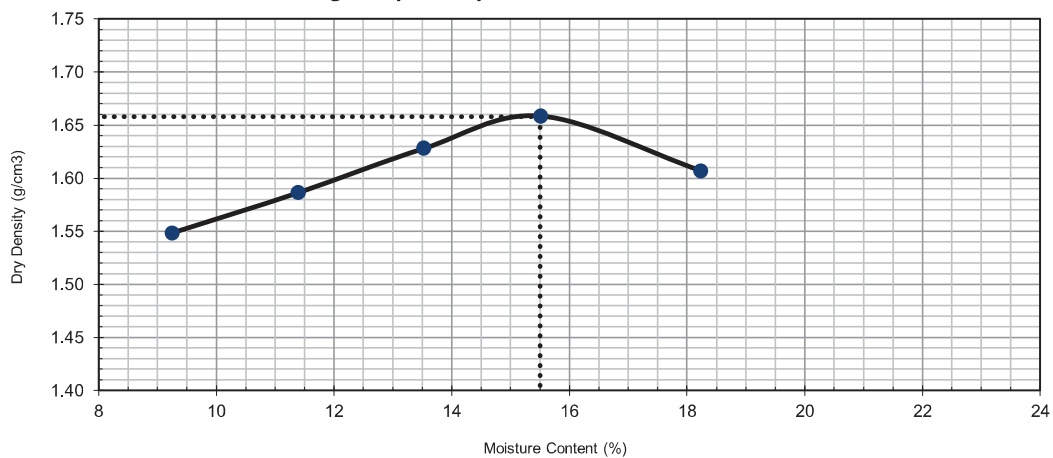
Test No.:		1	2	3	4	5
Mass of Mould+ Base+Compacted Materials (m2)	g	5267	5339	5416	5480	5465
Mass of Mould+ Base(m1)	g	3660	3660	3660	3660	3660
mass of Compacted Materials(m2-m1)	g	1607	1679	1756	1820	1805
Bulk Density, $\rho = \frac{m2 - m1}{vol. of mold}$	g/cm ³	1.692	1.767	1.848	1.916	1.900
Moisture Content (w)	%	9.25	11.40	13.53	15.52	18.24
Dry Density, $\rho_d = \frac{100\rho}{100 + w}$	g/cm ³	1.548	1.587	1.628	1.658	1.607

MOISTURE CONTENT

Test No.:		1		2		3		4		5	
Container No.:		B-11	B-40	B-36	B-77	B-68	B-49	B-58	B-92	B-112	B-14
Mass of container + wet soil	g	60.1	72.4	73.5	84.31	74.63	97.29	94.26	87.95	72.86	108.6
mass of container + dry soil	g	57.3	69.5	68.58	78.15	68.61	89.0	85.81	79.46	64.9	96.8
Mass of Water	g	2.78	2.9	4.9	6.16	6.02	8.32	8.45	8.49	7.94	11.81
Mass of Container	g	27.79	37.6	25.34	24.42	23.91	27.77	30.31	25.77	22.06	31
Mass of Dry Soil	g	29.5	31.92	43.24	53.73	44.7	61.2	55.5	53.69	42.86	65.77
Moisture Content	%	9.42	9.09	11.33	11.46	13.47	13.59	15.23	15.81	18.53	17.96
Average Moisture Content	%	9.3		11.4		13.5		15.5		18.2	

Maximum Dry Density	1.658	g/cm ³
Optimum Moisture Content	15.5	%

Fig. : Dry Density vs Moisture Content Curve





Ground Instrumentation &

Falling Head Permeability Test

K.H. Head Vol.2



Project ID: : SI BD2105 Project/Location: Geotechnical Investigation for Matarbari Project

Borehole No. : BH-07 Sample: MZ-01 Depth: 21.00 - 22.00 (m)

Soil Description : Fine SAND with silt, SP-SM

Method of Preparation: Undisturbed or Compacted

Diameter, D , mm	73.00	Moisture Content, %	19
Area, A , mm ²	4185.40	Bulk Density, ρ , Mg/m ³	1.94
Length, L , mm	72.15	Dry Density, ρ_D , Mg/m ³	1.63
Volume, V , mm ³	301976.36	Particle Density, ρ_s	2.65 <small>measured / assumed</small>
Voids ratio, e	0.623	Temperature, °C	25
Standpipe diameter, mm	4.70	Standpipe area, (a) mm ²	17.3

Correction Factor for test temperature corresponding to 20°C 0.890

HEIGHT ABOVE OUTLET h (mm)	TIME TAKEN t (min)	HEIGHT RATIO	COEFFICIENT OF PERMEABILITY K_v (m/s)	AVERAGE K_v AT TEST TEMPERATURE K_v (m/s)
1070	0	-	-	-
465	25.00	2.30	1.66E-07	1.77E-07
202	22.00	2.30	1.88E-07	

CORRECTED AVERAGE K_v @ 20 °C	1.58E-07
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The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. The report shall not be reproduced except in full, unless the management representative of GIE has given approval in writing.

Tested by : Faysal Checked/Approved by : Mario  Date: 16/9/21

SGS



BH-08

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-02	Depth (m): 2.00-2.45
Can No.		341
Weight of Wet Soil + Can (gm)		201.60
Weight of Dry Soil + can (gm)		174.81
Weight of Can (gm)		14.39
Moisture Content (%)		16.70
Description		Fine-medium SAND, SP

Sample No.:	SPT-05	Depth (m): 5.00-5.45
Can No.		107
Weight of Wet Soil + Can (gm)		242.06
Weight of Dry Soil + can (gm)		196.38
Weight of Can (gm)		30.93
Moisture Content (%)		27.61
Description		Lean CLAY, CL

Sample No.:	SPT-07	Depth (m): 7.00-7.45
Can No.		106
Weight of Wet Soil + Can (gm)		193.93
Weight of Dry Soil + can (gm)		148.87
Weight of Can (gm)		22.01
Moisture Content (%)		35.52
Description		Lean CLAY, CL

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 04-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-09	Depth (m): 9.00-9.45
Can No.		446
Weight of Wet Soil + Can (gm)		172.50
Weight of Dry Soil + can (gm)		144.45
Weight of Can (gm)		11.54
Moisture Content (%)		21.10
Description		Sandy lean CLAY, CL

Sample No.:	SPT-12	Depth (m): 12.00-12.45
Can No.		401
Weight of Wet Soil + Can (gm)		200.12
Weight of Dry Soil + can (gm)		164.40
Weight of Can (gm)		23.18
Moisture Content (%)		25.29
Description		Silty fine SAND, SM

Sample No.:	SPT-16	Depth (m): 16.00-16.45
Can No.		404
Weight of Wet Soil + Can (gm)		236.29
Weight of Dry Soil + can (gm)		195.61
Weight of Can (gm)		25.00
Moisture Content (%)		23.84
Description		Silty fine SAND, SM

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 04-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

Ground Instrumentation &
Engineering Pte Ltd

MOISTURE CONTENT
ASTM D2216-10



Sample No.:	SPT-21	Depth (m): 21.00-21.45
Can No.		486
Weight of Wet Soil + Can (gm)		151.57
Weight of Dry Soil + can (gm)		129.37
Weight of Can (gm)		15.04
Moisture Content (%)		19.42
Description		Fine SAND with Silt, SP-SM

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Sample No.:		Depth (m):
Can No.		
Weight of Wet Soil + Can (gm)		
Weight of Dry Soil + can (gm)		
Weight of Can (gm)		
Moisture Content (%)		
Description		

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

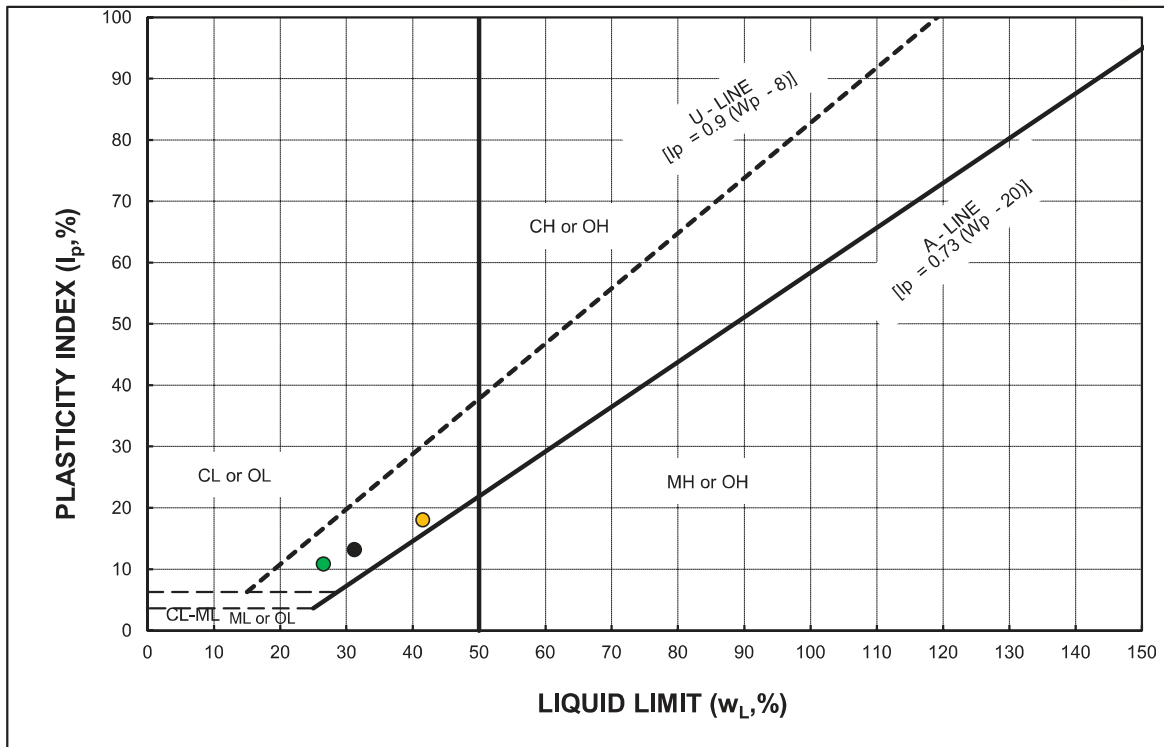
Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 04-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021



	Sample No.	Depth	W _L	W _P	I _p	Fines	Remarks
●	SPT-05	5.00-5.45	31.20	18.00	13.20		Lean CLAY, CL
●	SPT-07	7.00-7.45	41.50	23.45	18.05		Lean CLAY, CL
●	SPT-09	9.00-9.45	26.50	15.64	10.86		Lean CLAY, CL
●							
●							
●							
●							
●							
●							
○							

Note : All the above Liquid Limit tests was performed in accordance to Method A (Multi-Point) of ASTM D 4318-05
 *Hydrometer analysis were performed instead of atterberg limit and presented with the Particle Size Distribution Section

ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands, etc.	MH Inorganic silts, or diatomaceous fine sands or silts, elastic silts, etc.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, etc.	CH Inorganic clays of high plasticity, fat clays, etc.
OL Organic silts and organic silty clays of low plasticity.	OH Organic silts and organic clays of medium to high plasticity.

PLASTICITY CHART (ASTM D 2487 - 06 & D 4318 - 05)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
 Date: 06-03-2021

Checked by: Suvashis Paul
 Date: 11-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

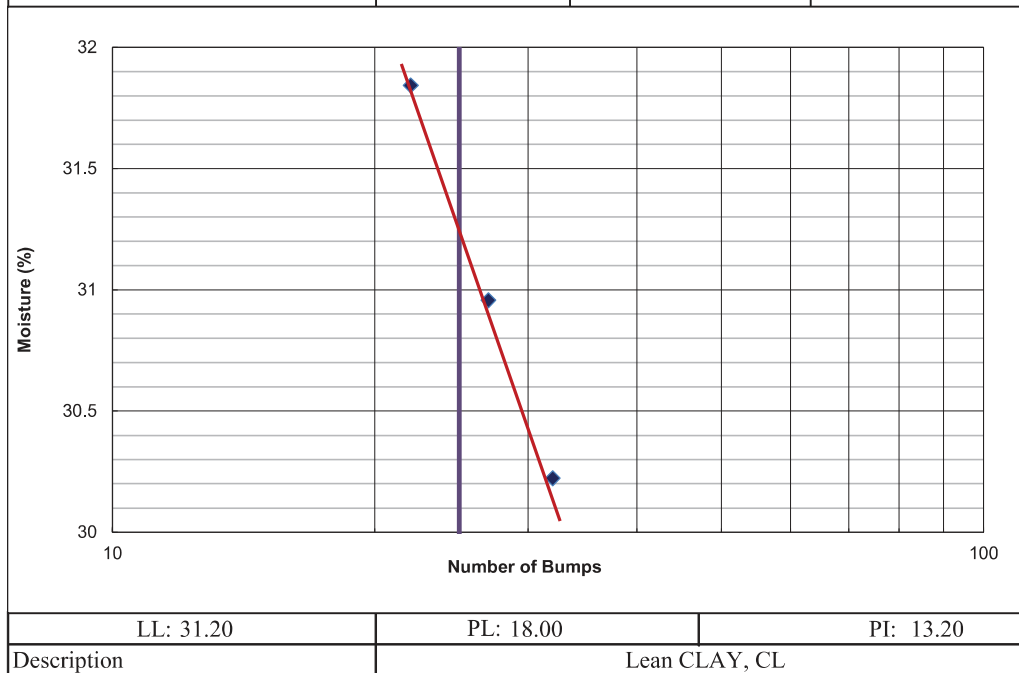
Sample No: SPT-05

BH No.: BH-08

Sample Depth: 5.00-5.45

Plastic Limit Test		
Container No.	58	326
Weight of can (gm)	8.05	7.89
Wet weight of soil + can (gm)	38.83	38.85
Dry Weight of soil + can (gm)	34.14	34.12
Moisture Content %	17.98	18.03
Average	18.00	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	27	32
Container No.	432	320	436
Weight of can (gm)	3.63	7.67	3.83
Wet weight of soil + can (gm)	28.1	27.51	26.02
Dry Weight of soil + can (gm)	22.19	22.82	20.87
Moisture Content %	31.84	30.96	30.22



Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 11-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

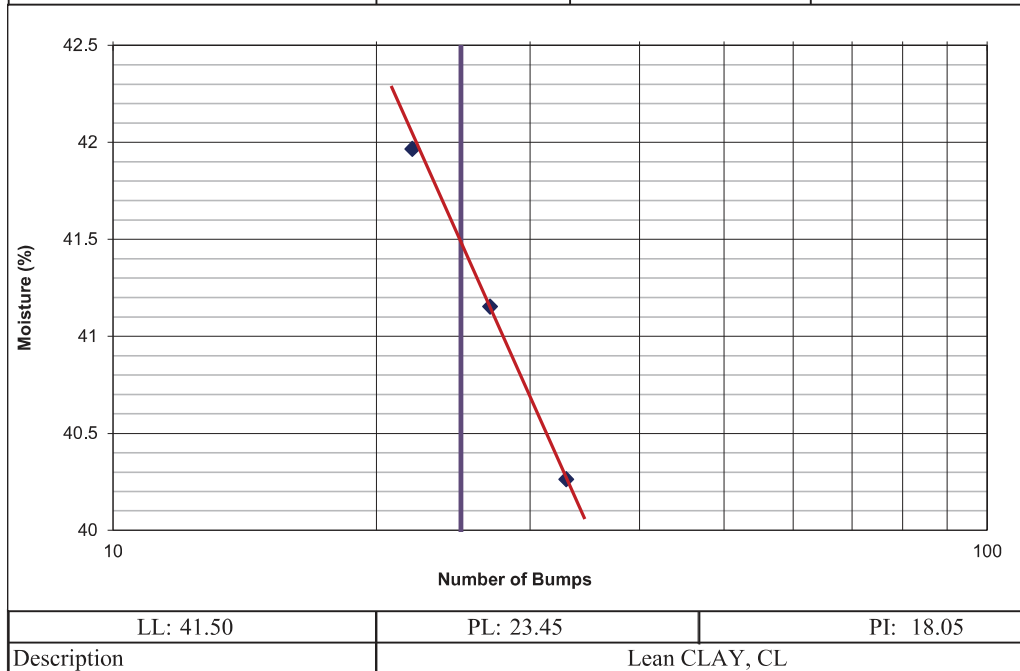
Sample No.: SPT-07

BH No.: BH-08

Sample Depth: 7.00-7.45

Plastic Limit Test		
Container No.	418	333
Weight of can (gm)	6.98	6.93
Wet weight of soil + can (gm)	33.9	33.92
Dry Weight of soil + can (gm)	28.8	28.78
Moisture Content %	23.37	23.52
Average	23.45	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	22	27	33
Container No.	329	325	332
Weight of can (gm)	9.42	7.2	7.4
Wet weight of soil + can (gm)	27.62	25.07	24.47
Dry Weight of soil + can (gm)	22.24	19.86	19.57
Moisture Content %	41.97	41.15	40.26



Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 11-03-2021

Ground Instrumentation & Engineering Pte. Ltd.



Liquid and Plastic Limits Test: ASTM D4318-10 (Casagrande Method)

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Project ID: SIBD2105

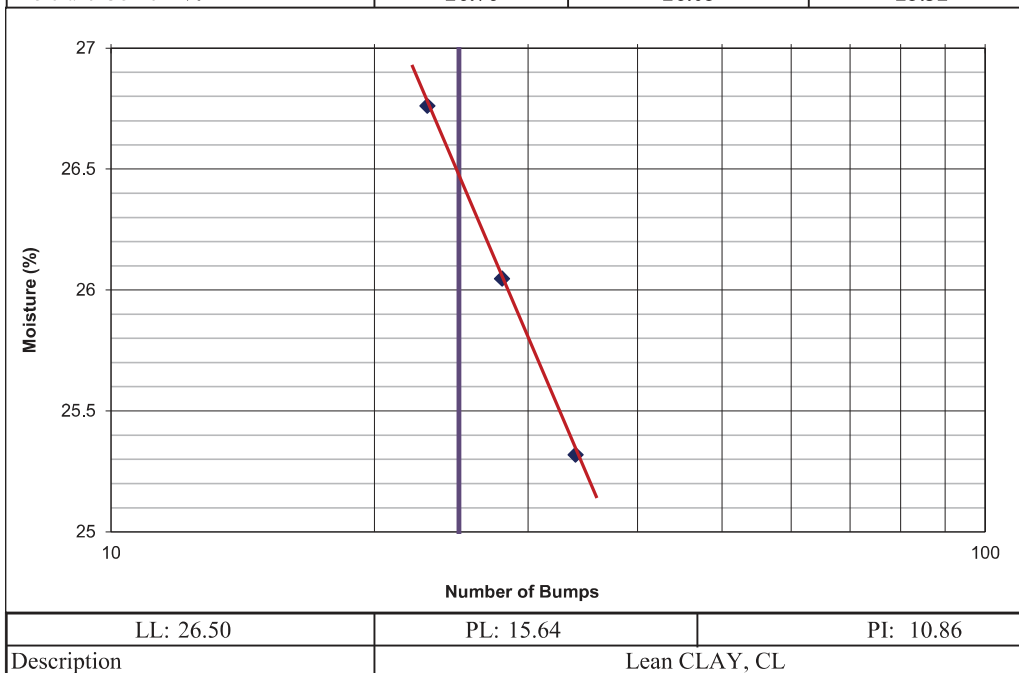
Sample No.: SPT-09

BH No.: BH-08

Sample Depth.: 9.00-9.45

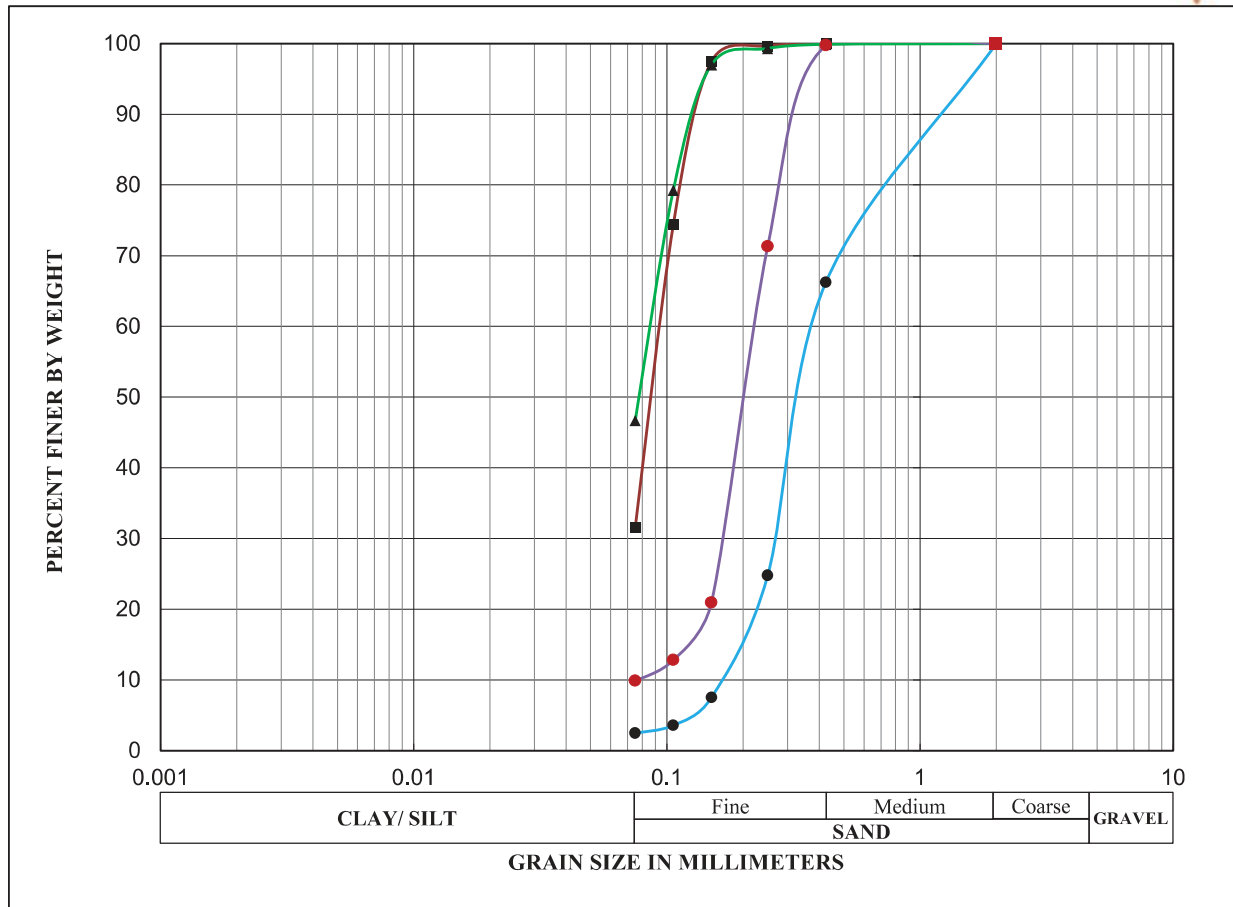
Plastic Limit Test		
Container No.	338	57
Weight of can (gm)	7.83	7.71
Wet weight of soil + can (gm)	36.16	36.18
Dry Weight of soil + can (gm)	32.34	32.32
Moisture Content %	15.59	15.68
Average	15.64	

Liquid Limit Test (Casagrande, Blow count: 20-35, ASTM Method-A- multi-pt)			
Test No	1	2	3
Number of Bumps	23	28	34
Container No.	331	333	335
Weight of can (gm)	9.86	6.93	9.29
Wet weight of soil + can (gm)	33.97	31.61	30.87
Dry Weight of soil + can (gm)	28.88	26.51	26.51
Moisture Content %	26.76	26.05	25.32



Tested by: Rayhan
Date: 06-03-2021

Checked by: Suvashis Paul
Date: 11-03-2021



	Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
●	SPT-02	2.00-2.45	Fine-medium SAND, SP					2.43	1.13
■	SPT-12	12.00-12.45	Silty fine SAND, SM						
▲	SPT-16	16.00-16.45	Silty fine SAND, SM						
●	SPT-21	21.00-21.45	Fine SAND with Silt, SP-SM					2.98	1.62
■									
▲									

	Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT/ %CLAY
								%Fine	%Meidum	%Coarse	
●	SPT-02	2.00-2.45	0.399	0.356	0.272	0.164	0.00	63.74	33.76	0.00	2.50
■	SPT-12	12.00-12.45	0.096	0.088	0.071	0.024	0.00	68.44	0.04	0.00	31.52
▲	SPT-16	16.00-16.45	0.088	0.078	0.048	0.016	0.00	53.20	0.12	0.00	46.68
●	SPT-21	21.00-21.45	0.228	0.208	0.168	0.076	0.00	89.92	0.22	0.00	9.86
■											
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

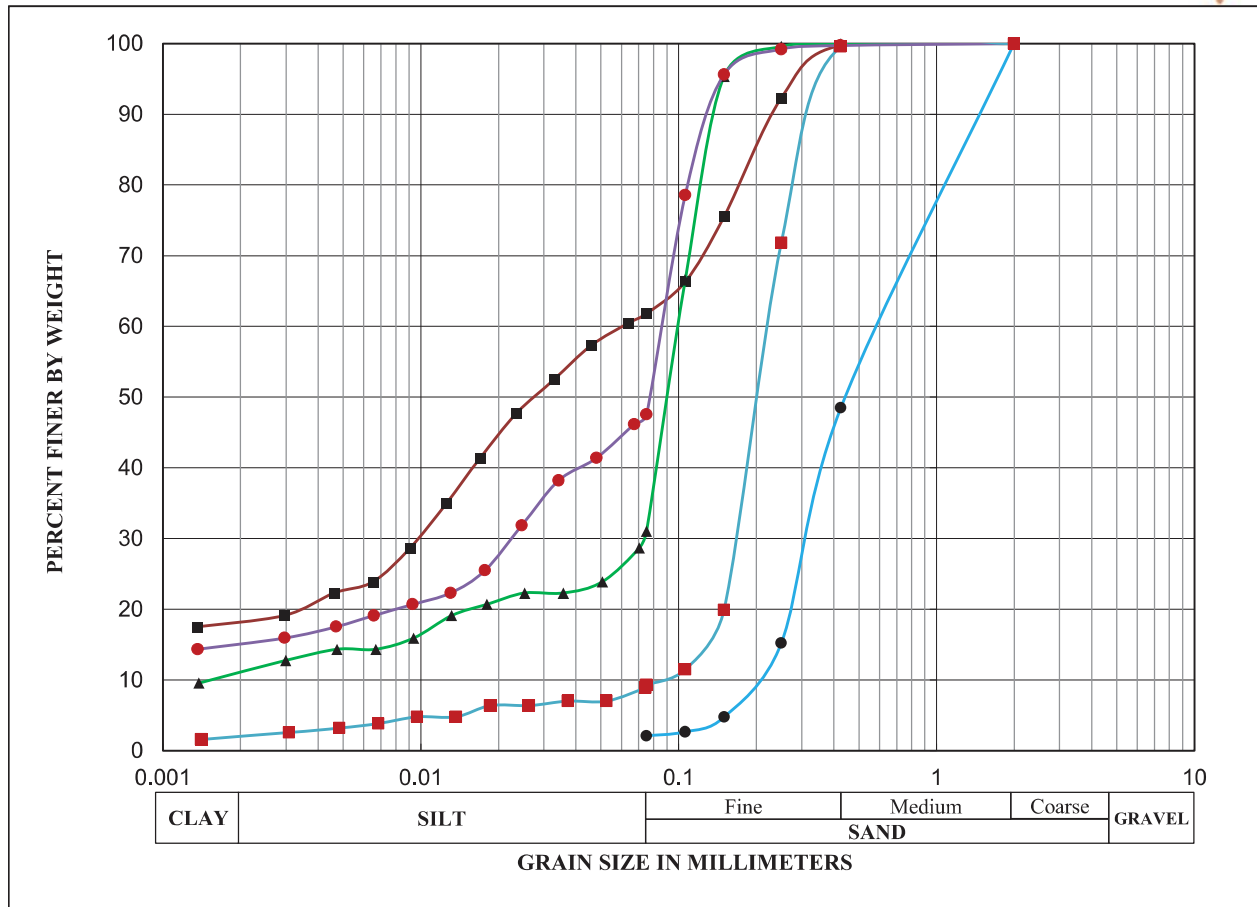
Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 08-03-2021

Checked by: Suvashis Paul
Date: 11-03-2021



Sample	Depth	Classification	W(%)	W _L	P _L	I _p	C _u	C _c
● SPT-02	2.00-2.45	Fine-medium SAND, SP					3.88	0.69
■ SPT-09	9.00-9.45	Sandy lean CLAY, CL						
▲ SPT-12	12.00-12.45	Silty fine SAND, SM						
● SPT-16	16.00-16.45	Silty fine SAND, SM						
■ SPT-21	21.00-21.45	Fine SAND with Silt, SP-SM					2.67	1.49
▲								

Sample	Depth	D60	D50	D30	D10	%Gravel	%Sand			%SILT	%CLAY
							%Fine	%Medium	%Coarse		
● SPT-02	2.00-2.45	0.777	0.471	0.328	0.200	0.00	46.38	51.52	0.00	2.10	
■ SPT-09	9.00-9.45	0.061	0.028	0.010	0.001	0.00	37.94	0.24	0.00	44.31	17.51
▲ SPT-12	12.00-12.45	0.100	0.092	0.073	0.002	0.00	68.94	0.04	0.00	21.47	9.55
● SPT-16	16.00-16.45	0.087	0.077	0.023	0.001	0.00	52.22	0.26	0.00	33.19	14.33
■ SPT-21	21.00-21.45	0.227	0.208	0.169	0.085	0.00	90.26	0.44	0.00	7.71	1.59
▲											

GRADATION CURVES (ASTM D 2487 - 06 & D 422 - 63)

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan
Date: 09-03-2021

Checked by: Suvashis Paul
Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-02	Depth(m)	2.00-2.45
Pyknometer No.		7
Mass of bottle + soil + water: M_3	gm	90.62
Mass of bottle + soil: M_2	gm	51.15
Mass of bottle + water: M_4	gm	71.90
Mass of bottle: M_1	gm	21.11
Mass of soil: $M_2 - M_1$	gm	30.04
Mass of water in full bottle: $M_4 - M_2$	gm	20.75
Mass of water used: $M_3 - M_2$	gm	39.47
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.32
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.65

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-05	Depth(m)	5.00-5.45
Pyknometer No.		11
Mass of bottle + soil + water: M_3	gm	96.82
Mass of bottle + soil: M_2	gm	57.71
Mass of bottle + water: M_4	gm	77.89
Mass of bottle: M_1	gm	27.74
Mass of soil: $M_2 - M_1$	gm	29.97
Mass of water in full bottle: $M_4 - M_2$	gm	20.19
Mass of water used: $M_3 - M_2$	gm	39.11
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.04
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.71

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-07	Depth(m)	7.00-7.45
Pyknometer No.		4
Mass of bottle + soil + water: M_3	gm	118.91
Mass of bottle + soil: M_2	gm	73.90
Mass of bottle + water: M_4	gm	99.90
Mass of bottle: M_1	gm	43.88
Mass of soil: $M_2 - M_1$	gm	30.02
Mass of water in full bottle: $M_4 - M_2$	gm	26.00
Mass of water used: $M_3 - M_2$	gm	45.01
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.01
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.72

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-09	Depth(m)	9.00-9.45
Pyknometer No.		2
Mass of bottle + soil + water: M_3	gm	117.27
Mass of bottle + soil: M_2	gm	74.11
Mass of bottle + water: M_4	gm	98.41
Mass of bottle: M_1	gm	44.13
Mass of soil: $M_2 - M_1$	gm	29.98
Mass of water in full bottle: $M_4 - M_2$	gm	24.30
Mass of water used: $M_3 - M_2$	gm	43.16
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.12
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.69

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-12	Depth(m)	12.00-12.45
Pyknometer No.		3
Mass of bottle + soil + water: M_3	gm	117.73
Mass of bottle + soil: M_2	gm	74.57
Mass of bottle + water: M_4	gm	98.92
Mass of bottle: M_1	gm	44.52
Mass of soil: $M_2 - M_1$	gm	30.05
Mass of water in full bottle: $M_4 - M_2$	gm	24.35
Mass of water used: $M_3 - M_2$	gm	43.16
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.24
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.67

Geotechnical Investigation for Matarbari Project

Client: TEPSCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

PARTICLE DENSITY
BS 1733 Part 2 Section 8
(Small Pyknometer Method)



SPT-16	Depth(m)	16.00-16.45
Pyknometer No.		1
Mass of bottle + soil + water: M_3	gm	118.81
Mass of bottle + soil: M_2	gm	73.99
Mass of bottle + water: M_4	gm	99.99
Mass of bottle: M_1	gm	44.00
Mass of soil: $M_2 - M_1$	gm	29.99
Mass of water in full bottle: $M_4 - M_2$	gm	26.00
Mass of water used: $M_3 - M_2$	gm	44.82
Volume of soil particles: $(M_4 - M_1) - (M_3 - M_2)$	ml	11.17
Particle Density: $\frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$	g/cm ³	2.68

Geotechnical Investigation for Matarbari Project

Client: TEPCO

Project ID: SIBD2105

BH No.: BH-08

Project Location: Matarbari Ultra Super Critical Coal-Fired Power Project (Phase-2)

Tested by: Rayhan

Date: 08-03-2021

Checked by: Suvashis Paul

Date: 11-03-2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)



DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No.: 110-231613/20-21/CE Dated 11.3.21	
Client : Manager, Environment, Health and Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Rd, Dhaka	
Ref : SGS/Phase-2/SI/090321 dated 9.3.21	
Project : Geotechnical Investigation at Matarbari	
Location: Matarbari	
Test Method: ASTM	Date of Test: 10-13.4.21

SPECIFIC GRAVITY DETERMINATION OF SOIL

Borehole	7	8	---	---	---	---
Depth (m)	18-18.45	21-21.45	---	---	---	---
Sample No.	17.0	21.0	---	---	---	---
Soil Type	Grey silty sand	Grey silty sand	---	---	---	---
Wt. of bottle+water+soil, gm	373.4	373.1	---	---	---	---
Temperature (°C)	31.0	30.0	---	---	---	---
Wt. of bottle+water, gm	342.2	341.9	---	---	---	---
Wt. of soil, gm	49.8	49.6	---	---	---	---
Specific Gravity	2.67	2.68	---	---	---	---

Note: Tests were conducted on samples received in unsealed condition. BRTC, BUET does not have any responsibility as to the representative character of the supplied samples.

Countersigned by :

f

[Signature]
Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Test performed by :


[Signature] 25.5.21
Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	2.00-2.45				
 <i>sketch showing specimen location in original sample</i>	Description	Fine-medium SAND				
	Type	Disturbed Soil				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	154.3	154.3	154.3	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	2.14	2.14	2.14	
	Particle Density	ρ _s (Mg/m ³)	2.65	2.65	2.65	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	50	100	200
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i % (%)	17	17	17
Initial Dry Density	ρ _{di} (Mg/m ³)	1.84	1.84	1.84
Initial Voids Ratio	e _i .	0.442	0.442	0.442
Initial Degree of Saturation	S _i (%)	99.6	99.6	99.6
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f % (%)	18	19	18
Final Dry Density	ρ _{df} (Mg/m ³)	1.88	1.92	1.85
Final Voids Ratio	e _f .	0.402	0.323	0.380
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0
Peak Shear Stress	(kPa)	31.8	61.5	123.6
Hoz Displacement	L _H (mm)	12.000	12.000	12.000
Vertical Displacement	L _V (mm)	0.160	0.390	0.190

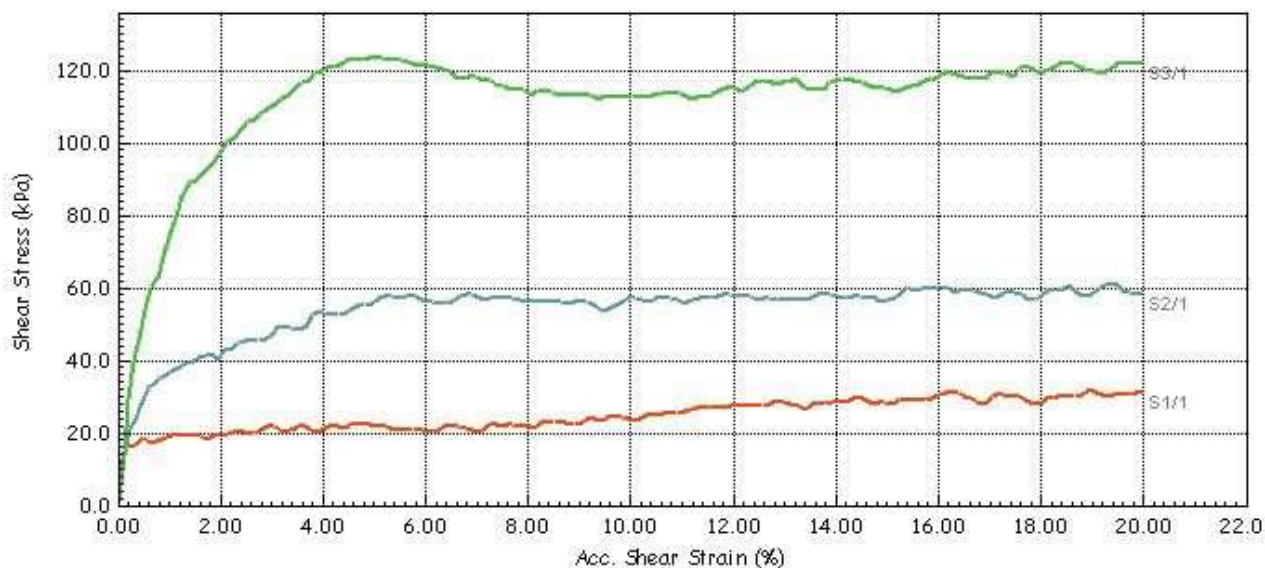
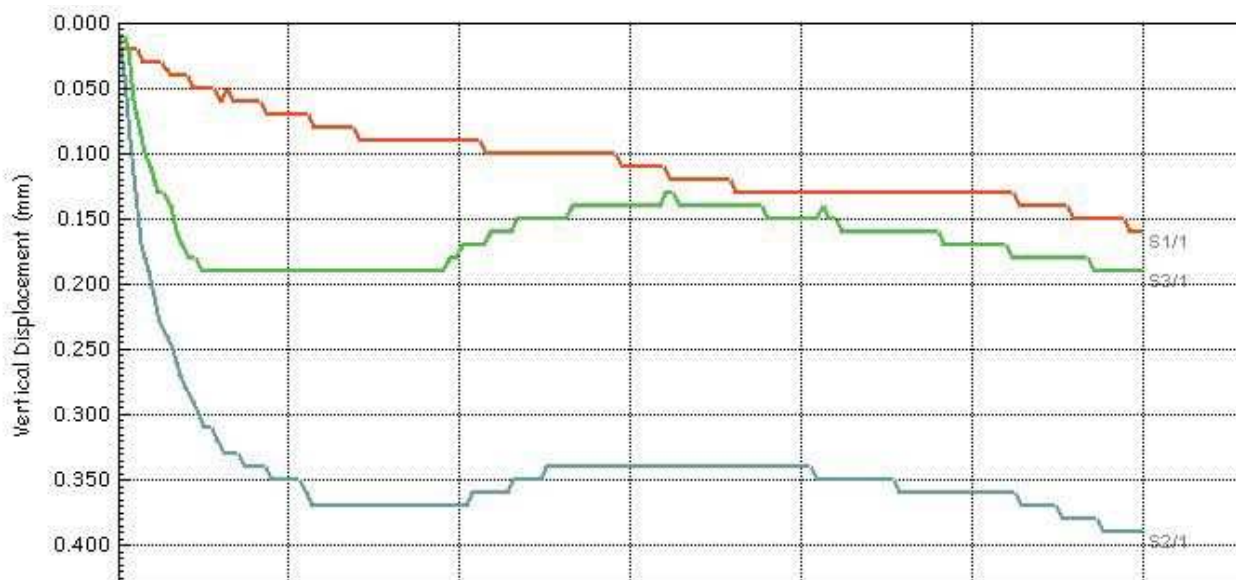
GIE


	Test Method	ASTM D 3080-04	Test Name	SPT-21
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	4/17/2021
	Jobfile	Direct Shear Test	Sample	SPT-02
Client	SGS	Borehole	BH-08	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name SPT-21	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 4/17/2021	
	Jobfile Direct Shear Test		Sample SPT-02	
Client SGS		Borehole BH-08		
Operator R. Islam	Checked	Aminul	Approved	T. Islam

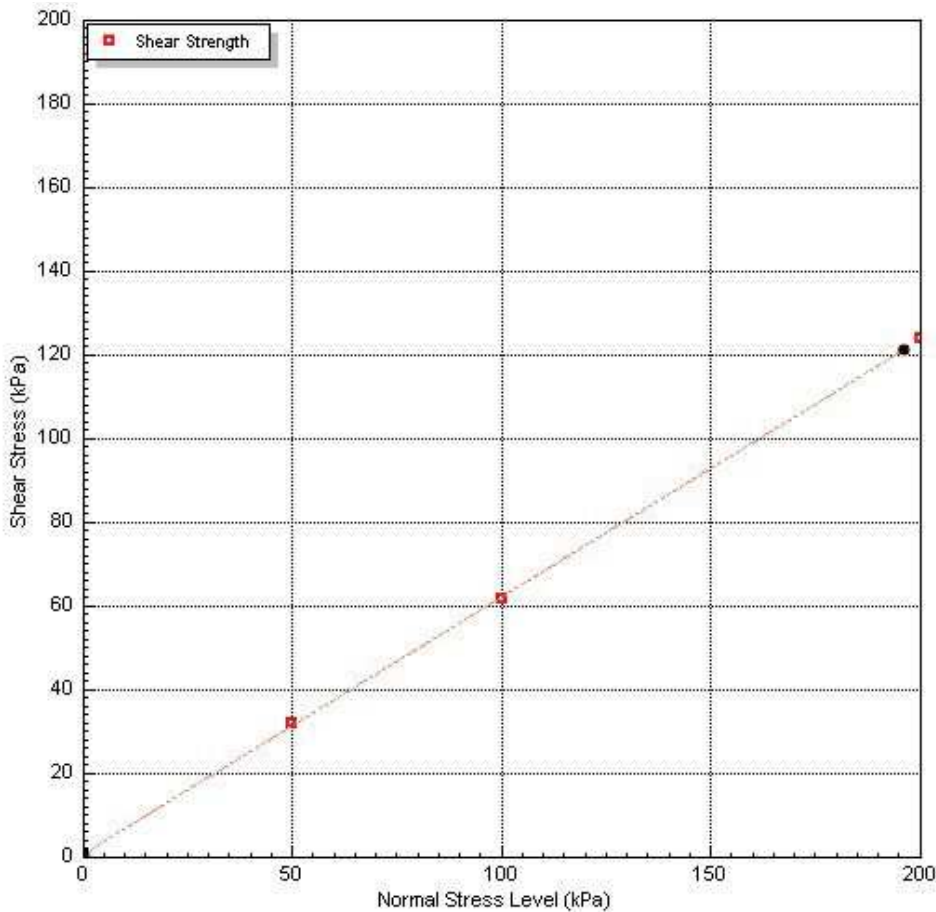
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Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	18	19	18
Final Dry Density	ρ_{df} (Mg/m ³)	1.88	1.92	1.85
Final Voids Ratio	e_f	0.402	0.323	0.380
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	0.79		
Angle of Shearing Resistance	ϕ	31.5		
Notes				




	Test Method	ASTM D 3080-04	Test Name	SPT-21
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	4/17/2021
	Client	SGS	Sample	SPT-02
	Operator	R. Islam	Borehole	BH-08
	Checked	Aminul	Approved	T. Islam

GIE

Direct Shear Tests

Direct Shearbox Test


Summary

Sample Details	Depth	16.00-16.45				
 <i>Sketch showing specimen location in original sample</i>	Description	Silty fine SAND, SM				
	Type	Disturbed Soil				
			Spm. 1	2	3	
	Initial Height	H ₀ (mm)	20.0	20.0	20.0	
	Initial Width	D ₀ (mm)	60.0	60.0	60.0	
	Initial Weight	W ₀ (gr)	142.3	142.3	142.3	
	Initial Bulk Density	ρ ₀ (Mg/m ³)	1.98	1.98	1.98	
	Particle Density	ρ _s (Mg/m ³)	2.68	2.68	2.68	

Initial Condition		Spm. 1	2	3
Normal Stress Level	(kPa)	150	300	600
Is Specimen Submersed?		Yes	Yes	Yes
Reverse Method		Motor Drive		
Hoz. Control Machine		Not Used	Not Used	Not Used
Initial Moisture	ω _i % (%)	24	24	24
Initial Dry Density	ρ _{di} (Mg/m ³)	1.60	1.60	1.60
Initial Voids Ratio	e _i .	0.679	0.679	0.679
Initial Degree of Saturation	S _i (%)	94.0	94.0	94.0
Notes				

Max Shear Stress Results		Spm. 1	2	3
Final Moisture	ω _f % (%)	26	26	25
Final Dry Density	ρ _{df} (Mg/m ³)	1.73	1.73	1.78
Final Voids Ratio	e _f .	0.548	0.394	0.351
Final Degree of Saturation	S _f (%)	100.0	100.0	100.0
Peak Shear Stress	(kPa)	124.7	232.1	459.6
Hoz Displacement	L _H (mm)	9.000	12.000	12.000
Vertical Displacement	L _V (mm)	0.160	0.350	0.470

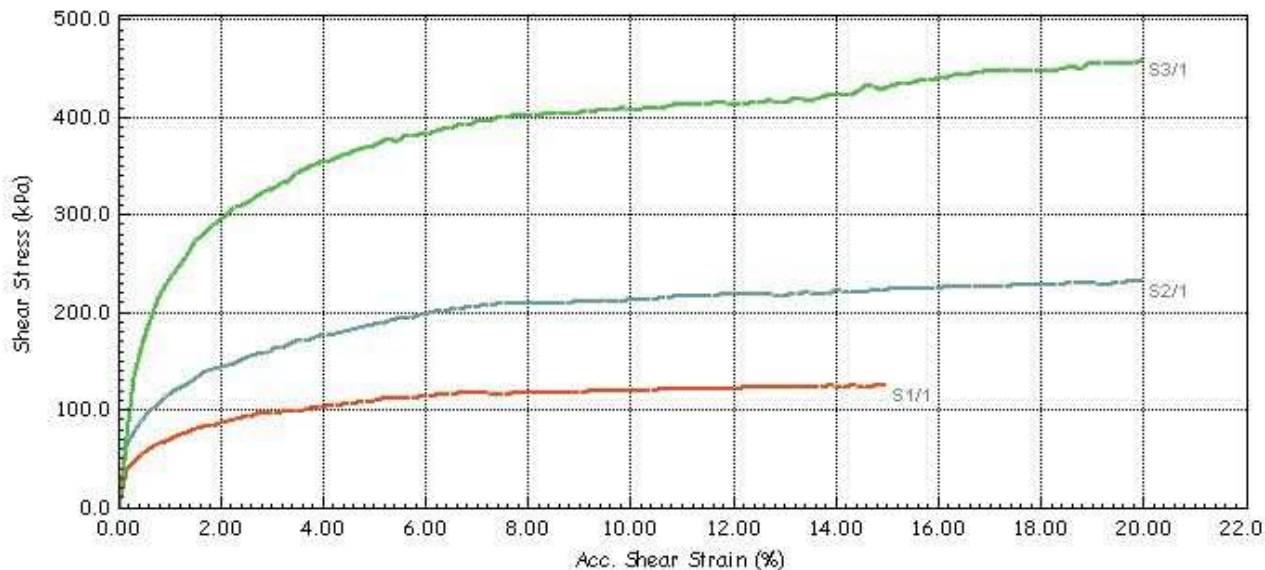
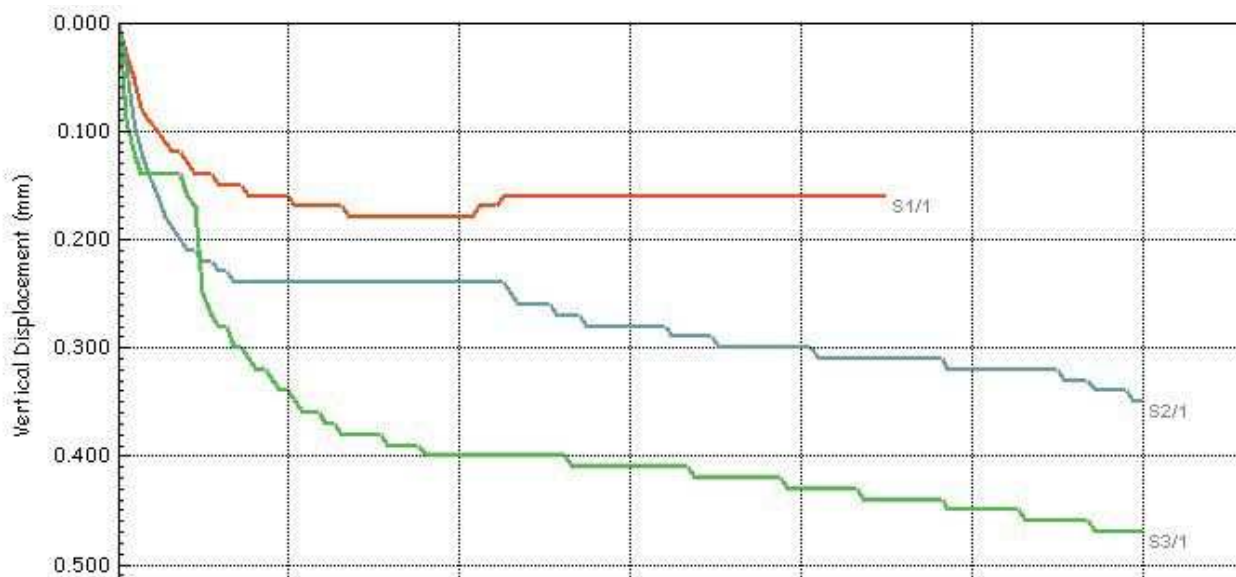
GIE


	Test Method	ASTM D 3080-04	Test Name	Direct Shear
			Database:	.\SQLEXPRESS \ GIE-D
	Site Reference		Test Date	3/28/2021
	Jobfile	Direct Shear Test	Sample	SPT-16
Client	SGS	Borehole	BH-08	
Operator	R. Islam	Checked	Aminul	Approved T. Islam

Direct Shear Tests

Direct Shearbox Test

Shear Stage



	Test Method ASTM D 3080-04		Test Name Direct Shear	
			Database: .\SQLEXPRESS \ GIE-D	
	Site Reference		Test Date 3/28/2021	
	Jobfile Direct Shear Test		Sample SPT-16	
Client SGS		Borehole BH-08		
Operator R. Islam	Checked	Aminul	Approved	T. Islam

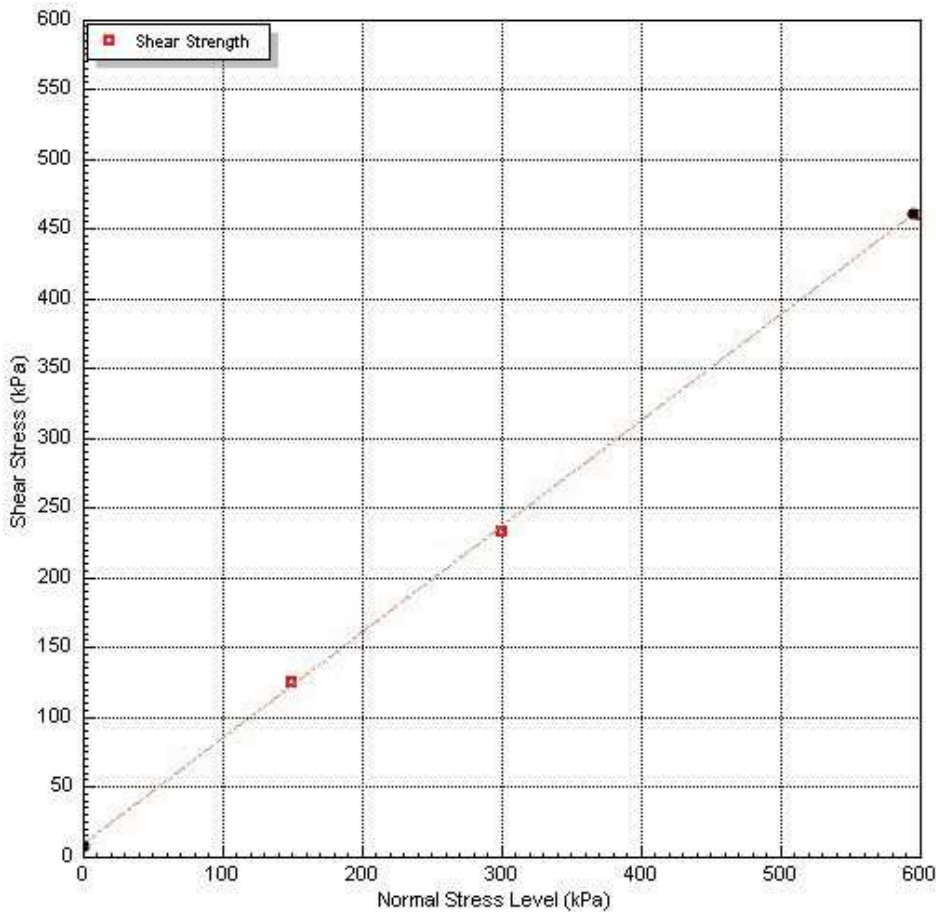
GIE

Direct Shear Tests

Direct Shearbox Test

Shear Stage

Envelope Failure Results		Spm. 1	2	3
Final Moisture	ω_f (%)	26	26	25
Final Dry Density	ρ_{df} (Mg/m ³)	1.73	1.73	1.78
Final Voids Ratio	e_f	0.548	0.394	0.351
Final Degree of Saturation	S_f (%)	100.0	100.0	100.0
Apparent cohesion	c (kPa)	9.74		
Angle of Shearing Resistance	ϕ	37.1		
Notes				



	Test Method	ASTM D 3080-04	Test Name	Direct Shear
	Site Reference		Database:	.\SQLEXPRESS \ GIE-D
	Jobfile	Direct Shear Test	Test Date	3/28/2021
	Client	SGS	Sample	SPT-16
			Borehole	BH-08
Operator	R. Islam	Checked	Aminul	Approved T. Islam

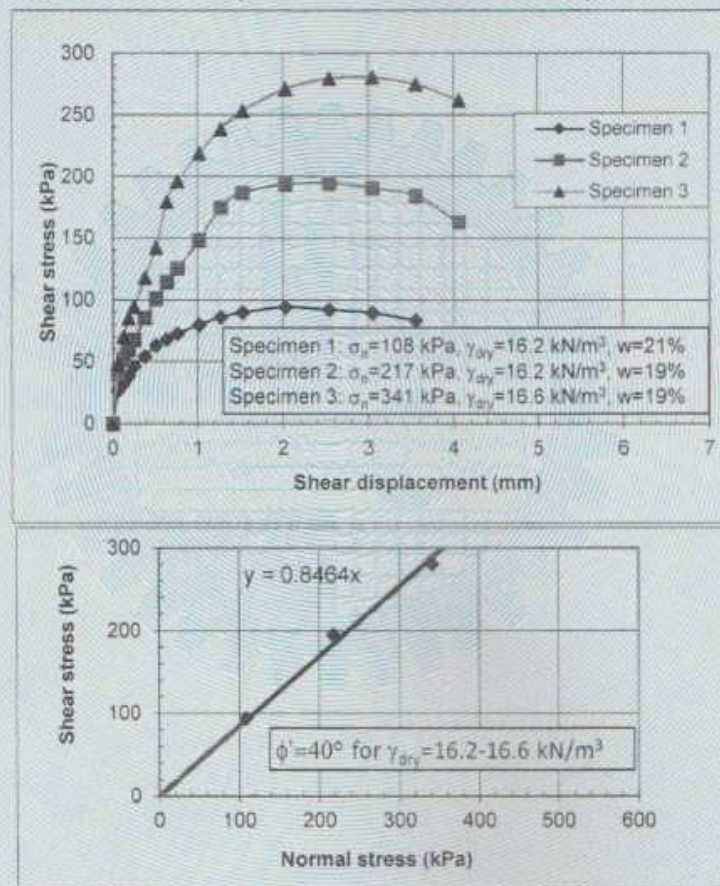
GIE



GEOTECHNICAL ENGINEERING LABORATORY

BRTC No. : 110-231613/20-21/CE dated 11.3.21		
Sent by : Manager, Environment Health & Safety, SGS Bangladesh Ltd., Bir Uttam CR Datta Road, Dhaka		
Ref: SGS/Phase-2/SI/090321 dated 9.3.21		
Project : Geotechnical Investigation at Matarbari		
Soil Description : Grey silty fine sand	Location: Matarbari	
Bore-Hole: 8	Sample: 21	Depth: 21-21.45 m
Date of Test: 8.4.21-12.4.21		

Direct Shear (Consolidated Drained) Test



Note: Sample was received in unsealed condition
 Test specimens were prepared manually from disturbed samples. The dry density specified is after application of normal load prior to shearing, the water content represents the sample after shearing.

Countersigned by :

Dr. A.B.M. Badruzzaman
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.

Test performed by :

Dr. Tahmeed M. Al-Hussaini
 Professor
 Department of Civil Engineering
 BUET, Dhaka - 1000.



APPENDIX B (iii)

Chemical Tests Results (Soil)

Soil



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 26/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-01 UD-01	
	LOR	Unit	
Depth	-	m	7.00-8.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.69
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Legend:

LOR - Limit of reporting

Remarks:

Tested by: Nadira *nadira*

Date: 26/3/2021

Approved by:

Date:

Imtiaz *Imtiaz*

26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 22/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-01 UD-01		
	LOR	Unit	
Depth	-	m	7.00-8.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.51
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Remarks:

Tested by: Nadira *nadira*
Date: 26/3/2021

Approved by: Imtiaz *Imtiaz*
Date: 26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Soil**

Sample ID

BH-01 UD-01

	LOR	Unit	
Depth	-	m	7.00-8.00
pH value	0.1	pH unit	4.3

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 26/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-02 UD-01	
	LOR	Unit	
Depth	-	m	6.00-7.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.43
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 22/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-02 UD-01		
	LOR	Unit	
Depth	-	m	6.00-7.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.27
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Soil**

Sample ID

BH-02 UD-01

	LOR	Unit	
Depth	-	m	6.00-7.00
pH value	0.1	pH unit	4.3

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Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 26/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-03 UD-02	
	LOR	Unit	
Depth	-	m	12.15-13.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.34
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 22/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-03 UD-02		
	LOR	Unit	
Depth	-	m	12.15-13.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.08
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Soil**

Sample ID

BH-03 UD-02

	LOR	Unit	
Depth	-	m	12.15-13.00
pH value	0.1	pH unit	7.0

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Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 26/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-04 UD-02	
	LOR	Unit	
Depth	-	m	9.00-10.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.36
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 22/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-04 UD-02		
	LOR	Unit	
Depth	-	m	9.00-10.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.16
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Date: 26/3/2021

Approved by: Imtiaz *Imtiaz*
Date: 26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Soil**

Sample ID

BH-04 UD-02

	LOR	Unit	
Depth	-	m	9.00-10.00
pH value	0.1	pH unit	7.5

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Date: 26/3/2021

Approved by:

Date:

Imtiaz *Imtiaz*

26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 31/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-05 UD-01	
	LOR	Unit	
Depth	-	m	3.00-4.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.46
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Legend:

LOR - Limit of reporting

Remarks:

Tested by: Nadira *nadira*

Date: 1/4/2021

Approved by:

Date:

Imtiaz *Imtiaz*

1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-05 UD-01		
	LOR	Unit	
Depth	-	m	3.00-4.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.31
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Date: 1/4/2021

Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Soil**

Sample ID

BH-05 UD-01

	LOR	Unit	
Depth	-	m	3.00-4.00
pH value	0.1	pH unit	7.4

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 31/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-06 UD-03	
	LOR	Unit	
Depth	-	m	14.00-15.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.44
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-06 UD-03		
	LOR	Unit	
Depth	-	m	14.00-15.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.45
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Soil**

Sample ID

BH-06 UD-03

	LOR	Unit	
Depth	-	m	14.00-15.00
pH value	0.1	pH unit	7.5

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Imtiaz *Imtiaz*

1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 31/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-07 UD-01	
	LOR	Unit	
Depth	-	m	9.00-10.00
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.49
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Legend:

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Remarks:

Tested by: Nadira *nadira*

Date: 1/4/2021

Approved by:

Date:

Imtiaz *Imtiaz*

1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-07 UD-01		
	LOR	Unit	
Depth	-	m	9.00-10.00
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.31
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Date: 1/4/2021

Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Soil**

Sample ID

BH-07 UD-01

	LOR	Unit	
Depth	-	m	9.00-10.00
pH value	0.1	pH unit	5.2

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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 31/3/2021

Sub-Matrix : **Soil**

Sample ID		BH-08 SPT-05	
	LOR	Unit	
Depth	-	m	5.00-5.45
Sample passing 2mm sieve	1	%	100
Chloride content (acid-extract)	0.01	%	0.43
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	-

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Date: 1/4/2021

Approved by:

Date:

Imtiaz *Imtiaz*

Date: 1/4/2021



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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Soil**

Sample ID	BH-08 SPT-05		
	LOR	Unit	
Depth	-	m	5.00-5.45
Sample passing 2mm sieve	-	%	100
Acid-soluble sulfate (as SO ₄)	0.01	%	0.41
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	-

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Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Soil**

Sample ID

BH-08 SPT-05

	LOR	Unit	
Depth	-	m	5.00-5.45
pH value	0.1	pH unit	6.8

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Remarks:

Tested by: Nadira *nadira*
Date: 1/4/2021

Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021

Water



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 18/3/2021

Sub-Matrix : **Water**

Sample ID	BH-02 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	1	%	-
Chloride content (acid-extract)	0.01	%	-
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	7.70

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Date: 26/3/2021

Approved by:

Date:

Imtiaz *Imtiaz*

26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 23/3/2021

Sub-Matrix : **Water**

Sample ID	BH-02 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	-	%	-
Acid-soluble sulfate (as SO ₄)	0.01	%	-
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	1424

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Date: 26/3/2021



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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Water**

Sample ID

BH-02 WS

	LOR	Unit	
Depth	-	m	-
pH value	0.1	pH unit	6.8

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Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 18/3/2021

Sub-Matrix : **Water**

Sample ID	BH-03 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	1	%	-
Chloride content (acid-extract)	0.01	%	-
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	8.40

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Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 23/3/2021

Sub-Matrix : **Water**

Sample ID	BH-03 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	-	%	-
Acid-soluble sulfate (as SO ₄)	0.01	%	-
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	1218

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Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Water**

Sample ID

BH-03 WS

	LOR	Unit	
Depth	-	m	-
pH value	0.1	pH unit	6.7

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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 18/3/2021

Sub-Matrix : **Water**

Sample ID	BH-04 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	1	%	-
Chloride content (acid-extract)	0.01	%	-
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	8.79

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Date: 26/3/2021

Approved by:

Date:

Imtiaz *Imtiaz*

26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 23/3/2021

Sub-Matrix : **Water**

Sample ID	BH-04 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	-	%	-
Acid-soluble sulfate (as SO ₄)	0.01	%	-
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	1597

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Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 19/3/2021

Sub-Matrix : **Water**

Sample ID

BH-04 WS

	LOR	Unit	
Depth	-	m	-
pH value	0.1	pH unit	6.7

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Date: 26/3/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 18/3/2021

Sub-Matrix : **Water**

Sample ID	BH-06 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	1	%	-
Chloride content (acid-extract)	0.01	%	-
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	7.56

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Date: 1/4/2021

Approved by:

Date:

Imtiaz *Imtiaz*

1/4/2021



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Water**

Sample ID	BH-06 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	-	%	-
Acid-soluble sulfate (as SO ₄)	0.01	%	-
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	1959

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Remarks:

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Date: 1/4/2021

Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Water**

Sample ID

BH-06 WS

	LOR	Unit	
Depth	-	m	-
pH value	0.1	pH unit	6.6

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Remarks:

Tested by: Nadira
Date: 1/4/2021

nadira

Approved by:
Date:

Imtiaz
1/4/2021

Imtiaz



Ground Instrumentation &
Engineering Pte Ltd

ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 9)
(Volhard's Method)



Chloride Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 18/3/2021

Sub-Matrix : **Water**

Sample ID	BH-07 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	1	%	-
Chloride content (acid-extract)	0.01	%	-
Chloride ion content (water-extract)		%	-
Chloride content (in groundwater)		g/l	5.91

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Remarks:

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Date: 1/4/2021

Approved by:

Date:

Imtiaz *Imtiaz*

1/4/2021



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 7)
(Gravimetric Method)



Sulfate Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 29/3/2021

Sub-Matrix : **Water**

Sample ID	BH-07 WS		
	LOR	Unit	
Depth	-	m	-
Sample passing 2mm sieve	-	%	-
Acid-soluble sulfate (as SO ₄)	0.01	%	-
Water-soluble sulfate (as SO ₄)	10	mg/l	-
Sulfate content (as SO ₄)		mg/l	362

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Remarks:

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Date: 1/4/2021

Approved by: Imtiaz *Imtiaz*
Date: 1/4/2021



Ground Instrumentation &
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ANALYTICAL RESULTS

BS 1377 : Part 3 : 2018 (Clause 12)
(Electrometric Method)



pH Test Result

Project : Geotechnical Investigation for Matarbari Project

Project No. : SIBD2105

Date performed : 1/4/2021

Sub-Matrix : **Water**

Sample ID

BH-07 WS

	LOR	Unit	
Depth	-	m	-
pH value	0.1	pH unit	6.7

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Legend:

LOR - Limit of reporting

Remarks:

Tested by: Nadira

nadira

Date: 1/4/2021

Approved by:

Imtiaz

Imtiaz

Date:

1/4/2021

APPENDIX C

SITE CLASSIFICATION

Project Name: Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)

Location: Matarbari, Maheshkhali, Cox's Bazar

Client: SGS Bangladesh Ltd./TEPSCO

Site Classification Based on SPT N Values

BH 01			BH 02			BH 03			BH 04			BH 05			BH 06			BH 07			BH 08		
Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value	Layer Thickness (m)	Field SPT N Value	Layer Thickness/N Value
1	9	0.11	1	13	0.08	1	7	0.14	1	32	0.03	1	0	-	1	2	0.50	1	17	0.06	1	13	0.08
1	48	0.02	1	9	0.11	1	42	0.02	1	27	0.04	1	2	0.50	1	3	0.33	1	18	0.06	1	5	0.20
1	27	0.04	1	10	0.10	1	40	0.03	1	13	0.08	2	16	0.13	1	5	0.20	1	11	0.09	1	1	1.00
1	26	0.04	1	6	0.17	1	9	0.11	1	0	-	1	0	-	1	3	0.33	1	10	0.10	1	19	0.05
1	4	0.25	1	6	0.17	1	22	0.05	1	0	-	1	0	-	1	12	0.08	1	34	0.03	1	2	0.50
1	5	0.20	2	3	0.67	1	5	0.20	1	2	0.50	2	0	-	1	32	0.03	1	6	0.17	1	8	0.13
2	3	0.67	2	0	-	1	5	0.20	2	0	-	1	0	-	1	6	0.17	1	7	0.14	1	4	0.25
1	5	0.20	1	3	0.33	2	5	0.40	2	5	0.40	1	2	0.50	2	0	-	1	2	0.50	1	25	0.04
2	13	0.15	1	5	0.20	1	5	0.20	1	27	0.04	2	3	0.67	2	2	1.00	2	0	-	1	3	0.33
1	5	0.20	1	7	0.14	1	8	0.13	1	17	0.06	1	2	0.50	1	2	0.50	1	8	0.13	1	29	0.03
1	34	0.03	1	22	0.05	2	22	0.09	1	22	0.05	1	7	0.14	1	3	0.33	1	35	0.03	1	22	0.05
1	20	0.05	1	22	0.05	1	25	0.04	1	6	0.17	1	5	0.20	2	6	0.33	1	15	0.07	1	24	0.04
1	21	0.05	1	20	0.05	1	26	0.04	1	10	0.10	1	5	0.20	1	13	0.08	1	41	0.02	1	31	0.03
1	15	0.07	1	21	0.05	1	20	0.05	1	12	0.08	1	20	0.05	1	50	0.02	1	45	0.02	1	23	0.04
1	23	0.04	1	15	0.07	2	22	0.09	1	22	0.05	1	32	0.03	1	50	0.02	1	24	0.04	1	37	0.03
1	29	0.03	1	22	0.05	1	50	0.02	1	26	0.04	1	50	0.02	1	27	0.04	1	27	0.04	1	32	0.03
1	13	0.08	1	22	0.05	1	37	0.03	1	24	0.04	1	50	0.02	1	6	0.17	1	50	0.02	1	33	0.03
1	15	0.07	1	23	0.04	1	13	0.08	1	42	0.02	1	50	0.02	1	22	0.05	1	50	0.02	1	50	0.02
1	50	0.02	1	38	0.03	1	50	0.02	1	50	0.02	1	50	0.02	1	11	0.09	1	50	0.02	1	50	0.02
1	50	0.02	1	50	0.02	1	38	0.03	1	50	0.02	1	50	0.02	1	16	0.06	2	50	0.04	1	50	0.02
1	45	0.02	1	50	0.02	1	50	0.02	1	50	0.02	7	50	0.14	1	50	0.02	1	50	0.02	1	50	0.02
1	50	0.02	1	50	0.02	1	50	0.02	1	50	0.02				1	50	0.02	7	50	0.14	1	50	0.02
1	50	0.02	1	50	0.02	1	50	0.02	1	50	0.02				1	50	0.02				8	50	0.16
1	50	0.02	1	50	0.02	2	50	0.04	5	50	0.10				1	50	0.02						
1	50	0.02	4	50	0.08	1	50	0.02							1	50	0.02						
1	50	0.02				1	50	0.02							2	50	0.04						
2	50	0.04																					
30		2.50	30		2.56	30		2.09	30		1.89	30		3.16	30		4.47	30		1.75	30		3.12

Borehole No.	BH-01	BH-02	BH-03	BH-04	BH-05	BH-06	BH-07	BH-08
Depth	30	30	30	30	30	30	30	30
Total (Thickness/N Value)	2.50	2.56	2.09	1.89	3.16	4.47	1.75	3.12
Total N (bar) for Individual boreholes	12.02	11.72	14.33	15.91	9.51	6.71	17.15	9.60
Average N (bar) for boreholes	12.12							
Site Class	SD							

APPENDIX D

LIQUEFACTION ANALYSIS

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)

Client: SGS Bangladesh Ltd./TEPSCO

Location: Matarbari, Maheshkhali, Cox's Bazar

Seismic Zone: 3

Borehole No: BH-01

Observed Ground Water Table (m): -

Design Ground Water Table (m): 0.00

Unit Weight of Water (kN/m³): 9.81

Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_o	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	9	18.06	18.06	8.25	26	0.70	1.00	1.00	0.75	1.84	7.88	14	20	0.992	0.395	0.212	0.536	Liquefiable
2.00	Sand	48	23.56	41.63	22.01	18	0.70	1.00	1.00	0.75	1.51	42.00	63	30	0.985	0.339	0.459	1.353	Non-Liquefiable
3.00	Sand	27	20.42	62.05	32.62	23	0.70	1.00	1.00	0.75	1.38	23.63	33	30	0.977	0.338	0.459	1.356	Non-Liquefiable
4.00	Sand	26	20.42	82.47	43.23	25	0.70	1.00	1.00	0.75	1.28	22.75	29	34	0.969	0.337	0.523	1.553	Non-Liquefiable
5.00	Sand	4	15.71	98.18	49.13	25	0.70	1.00	1.00	0.85	1.24	3.97	5	10	0.962	0.350	0.108	0.310	Liquefiable
6.00	Clay	5	18.06	116.24	57.38	86	0.70	1.00	1.00	0.95	-	5.54	6	11	0.954	0.352	0.120	0.341	Liquefiable
8.00	Clay	3	16.49	149.23	70.75	91	0.70	1.00	1.00	0.95	-	3.33	3	9	0.939	0.360	0.097	0.268	Liquefiable
9.00	Clay	5	18.06	167.30	79.01	81	0.70	1.00	1.00	0.95	-	5.54	6	11	0.931	0.359	0.120	0.334	Liquefiable
11.00	Clay	13	20.42	208.14	100.23	79	0.70	1.00	1.00	1.00	-	15.17	15	21	0.880	0.333	0.224	0.675	Liquefiable
12.00	Clay	5	18.06	226.20	108.48	82	0.70	1.00	1.00	1.00	-	5.83	6	11	0.854	0.324	0.123	0.380	Liquefiable
13.00	Sand	34	20.42	246.63	119.10	21	0.70	1.00	1.00	1.00	0.94	39.67	37	30	0.827	0.312	0.459	1.472	Non-Liquefiable
14.00	Sand	20	18.85	265.48	128.14	30	0.70	1.00	1.00	1.00	0.92	23.33	21	27	0.800	0.302	0.315	1.045	Non-Liquefiable
15.00	Sand	21	19.64	285.11	137.96	27	0.70	1.00	1.00	1.00	0.89	24.50	22	27	0.774	0.291	0.322	1.107	Non-Liquefiable
16.00	Sand	15	18.85	303.96	147.00	32	0.70	1.00	1.00	1.00	0.87	17.50	15	21	0.747	0.281	0.224	0.799	Liquefiable
17.00	Sand	23	19.64	323.60	156.83	28	0.70	1.00	1.00	1.00	0.85	26.83	23	28	0.720	0.270	0.346	1.280	Non-Liquefiable
18.00	Sand	29	20.42	344.02	167.44	24	0.70	1.00	1.00	1.00	0.83	33.83	28	33	0.693	0.259	0.462	1.782	Non-Liquefiable
19.00	Clay	13	20.42	364.44	178.05	62	0.70	1.00	1.00	1.00	-	15.17	15	21	0.667	0.248	0.225	0.906	Liquefiable
20.00	Clay	15	20.42	384.86	188.66	68	0.70	1.00	1.00	1.00	-	17.50	18	23	0.640	0.238	0.254	1.070	Non-Liquefiable
21.00	Clay	50	21.99	406.85	200.84	59	0.70	1.00	1.00	1.00	-	58.33	58	30	0.613	0.226	0.459	2.029	Non-Liquefiable
22.00	Clay	50	21.99	428.85	213.03	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.587	0.215	0.459	2.135	Non-Liquefiable
23.00	Clay	45	21.99	450.84	225.21	75	0.70	1.00	1.00	1.00	-	52.50	53	30	0.560	0.204	0.459	2.249	Non-Liquefiable
24.00	Clay	50	21.99	472.83	237.39	82	0.70	1.00	1.00	1.00	-	58.33	58	30	0.552	0.200	0.459	2.293	Non-Liquefiable
25.00	Silt	50	21.99	494.82	249.57	69	0.70	1.00	1.00	1.00	-	58.33	58	30	0.544	0.196	0.459	2.337	Non-Liquefiable
26.00	Clay	50	21.99	516.81	261.75	97	0.70	1.00	1.00	1.00	-	58.33	58	30	0.536	0.193	0.459	2.382	Non-Liquefiable
27.00	Clay	50	21.99	538.81	273.94	89	0.70	1.00	1.00	1.00	-	58.33	58	30	0.528	0.189	0.459	2.427	Non-Liquefiable
28.00	Clay	50	21.99	560.80	286.12	92	0.70	1.00	1.00	1.00	-	58.33	58	30	0.520	0.185	0.459	2.473	Non-Liquefiable
30.00	Clay	50	21.99	604.78	310.48	92	0.70	1.00	1.00	1.00	-	58.33	58	30	0.504	0.179	0.459	2.568	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)
Client: SGS Bangladesh Ltd./TEPSCO
Location: Matarbari, Maheshkhali, Cox's Bazar
Seismic Zone: 3

Borehole No: BH-02
Observed Ground Water Table (m): -
Design Ground Water Table (m): 0.00
Unit Weight of Water (kN/m³): 9.81
Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_z	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	13	18.85	18.85	9.04	5	0.70	1.00	1.00	0.75	1.81	11.38	21	21	0.992	0.377	0.222	0.591	Liquefiable
2.00	Sand	9	18.06	36.92	17.30	4	0.70	1.00	1.00	0.75	1.59	7.88	13	13	0.985	0.383	0.135	0.354	Liquefiable
3.00	Sand	10	18.06	54.98	25.55	17	0.70	1.00	1.00	0.75	1.46	8.75	13	17	0.977	0.383	0.179	0.469	Liquefiable
4.00	Clay	6	18.85	73.83	34.59	96	0.70	1.00	1.00	0.75	-	5.25	5	11	0.969	0.377	0.116	0.309	Liquefiable
5.00	Clay	6	18.85	92.68	43.63	87	0.70	1.00	1.00	0.85	-	5.95	6	11	0.962	0.372	0.124	0.334	Liquefiable
7.00	Clay	3	16.49	125.67	57.00	90	0.70	1.00	1.00	0.95	-	3.33	3	9	0.946	0.380	0.097	0.255	Liquefiable
9.00	Clay	0	14.14	153.94	65.65	99	0.70	1.00	1.00	0.95	-	0.00	0	5	0.931	0.397	0.068	0.172	Liquefiable
10.00	Clay	3	16.49	170.44	72.34	95	0.70	1.00	1.00	1.00	-	3.50	4	9	0.907	0.389	0.098	0.253	Liquefiable
11.00	Clay	5	18.06	188.50	80.59	96	0.70	1.00	1.00	1.00	-	5.83	6	11	0.880	0.375	0.123	0.327	Liquefiable
12.00	Clay	7	19.64	208.14	90.42	76	0.70	1.00	1.00	1.00	-	8.17	8	14	0.854	0.358	0.149	0.415	Liquefiable
13.00	Sand	22	19.64	227.78	100.25	31	0.70	1.00	1.00	1.00	1.00	25.67	26	31	0.827	0.342	0.353	1.032	Non-Liquefiable
14.00	Sand	22	19.64	247.41	110.07	28	0.70	1.00	1.00	1.00	0.97	25.67	25	30	0.800	0.327	0.515	1.573	Non-Liquefiable
15.00	Clay	20	20.42	267.83	120.68	64	0.70	1.00	1.00	1.00	-	23.33	23	29	0.774	0.312	0.372	1.190	Non-Liquefiable
16.00	Clay	21	20.42	288.25	131.29	62	0.70	1.00	1.00	1.00	-	24.50	25	30	0.747	0.298	0.487	1.632	Non-Liquefiable
17.00	Sand	15	18.85	307.10	140.33	35	0.70	1.00	1.00	1.00	0.89	17.50	16	21	0.720	0.287	0.229	0.797	Liquefiable
18.00	Silt	22	20.42	327.53	150.95	61	0.70	1.00	1.00	1.00	-	25.67	26	31	0.693	0.274	0.369	1.348	Non-Liquefiable
19.00	Sand	22	19.64	347.16	160.77	29	0.70	1.00	1.00	1.00	0.84	25.67	22	27	0.667	0.262	0.319	1.216	Non-Liquefiable
20.00	Clay	23	20.42	367.58	171.38	67	0.70	1.00	1.00	1.00	-	26.83	27	32	0.640	0.250	0.433	1.732	Non-Liquefiable
21.00	Sand	38	21.99	389.57	183.56	25	0.70	1.00	1.00	1.00	0.80	44.33	35	30	0.613	0.237	0.459	1.937	Non-Liquefiable
22.00	Sand	50	23.56	413.14	197.32	21	0.70	1.00	1.00	1.00	0.77	58.33	45	30	0.587	0.224	0.459	2.052	Non-Liquefiable
23.00	Sand	50	23.56	436.70	211.07	15	0.70	1.00	1.00	1.00	0.75	58.33	44	30	0.560	0.211	0.459	2.176	Non-Liquefiable
24.00	Sand	50	23.56	460.26	224.82	17	0.70	1.00	1.00	1.00	0.73	58.33	43	30	0.552	0.206	0.459	2.231	Non-Liquefiable
25.00	Sand	50	23.56	483.83	238.58	14	0.70	1.00	1.00	1.00	0.71	58.33	41	30	0.544	0.201	0.459	2.285	Non-Liquefiable
26.00	Sand	50	23.56	507.39	252.33	13	0.70	1.00	1.00	1.00	0.69	58.33	40	30	0.536	0.196	0.459	2.339	Non-Liquefiable
27.00	Sand	50	23.56	530.95	266.08	13	0.70	1.00	1.00	1.00	0.67	58.33	39	30	0.528	0.192	0.459	2.393	Non-Liquefiable
28.00	Sand	50	23.56	554.52	279.84	13	0.70	1.00	1.00	1.00	0.66	58.33	38	30	0.520	0.188	0.459	2.446	Non-Liquefiable
30.00	Sand	50	23.56	601.64	307.34	13	0.70	1.00	1.00	1.00	0.63	58.33	37	30	0.504	0.180	0.459	2.555	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)
Client: SGS Bangladesh Ltd./TEPSCO
Location: Matarbari, Maheshkhali, Cox's Bazar
Seismic Zone: 3

Borehole No: BH-03
Observed Ground Water Table (m): -
Design Ground Water Table (m): 0.00
Unit Weight of Water (kN/m³): 9.81
Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{H1}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_z	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	7	17.28	17.28	7.47	32	0.70	1.00	1.00	0.75	1.87	6.13	11	17	0.992	0.418	0.182	0.436	Liquefiable
2.00	Sand	42	22.78	40.06	20.44	9	0.70	1.00	1.00	0.75	1.53	36.75	56	30	0.985	0.351	0.459	1.306	Non-Liquefiable
3.00	Sand	40	21.99	62.05	32.62	10	0.70	1.00	1.00	0.75	1.38	35.00	48	30	0.977	0.338	0.459	1.356	Non-Liquefiable
4.00	Sand	9	18.06	80.11	40.87	4	0.70	1.00	1.00	0.75	1.30	7.88	10	10	0.969	0.346	0.111	0.321	Liquefiable
5.00	Sand	22	19.64	99.75	50.70	7	0.70	1.00	1.00	0.85	1.23	21.82	27	27	0.962	0.344	0.318	0.924	Liquefiable
6.00	Clay	5	18.06	117.81	58.95	95	0.70	1.00	1.00	0.95	-	5.54	6	11	0.954	0.347	0.120	0.345	Liquefiable
7.00	Clay	5	18.06	135.88	67.21	92	0.70	1.00	1.00	0.95	-	5.54	6	11	0.946	0.348	0.120	0.344	Liquefiable
9.00	Clay	5	18.06	172.01	83.72	93	0.70	1.00	1.00	0.95	-	5.54	6	11	0.931	0.348	0.120	0.344	Liquefiable
10.00	Clay	5	18.06	190.07	91.97	90	0.70	1.00	1.00	1.00	-	5.83	6	11	0.907	0.341	0.123	0.360	Liquefiable
11.00	Clay	8	20.42	210.50	102.59	87	0.70	1.00	1.00	1.00	-	9.33	9	15	0.880	0.329	0.161	0.489	Liquefiable
13.00	Sand	22	19.64	249.77	122.24	20	0.70	1.00	1.00	1.00	0.93	25.67	24	28	0.827	0.308	0.356	1.158	Non-Liquefiable
14.00	Sand	25	19.64	269.40	132.06	26	0.70	1.00	1.00	1.00	0.91	29.17	27	32	0.800	0.297	0.395	1.329	Non-Liquefiable
15.00	Sand	26	20.42	289.82	142.67	24	0.70	1.00	1.00	1.00	0.88	30.33	27	32	0.774	0.286	0.401	1.402	Non-Liquefiable
16.00	Sand	20	18.85	308.68	151.72	29	0.70	1.00	1.00	1.00	0.86	23.33	20	25	0.747	0.277	0.290	1.049	Non-Liquefiable
18.00	Clay	22	20.42	349.52	172.94	68	0.70	1.00	1.00	1.00	-	25.67	26	31	0.693	0.255	0.368	1.441	Non-Liquefiable
19.00	Sand	50	23.56	373.08	186.69	17	0.70	1.00	1.00	1.00	0.79	58.33	46	30	0.667	0.242	0.459	1.892	Non-Liquefiable
20.00	Sand	37	21.99	395.07	198.87	19	0.70	1.00	1.00	1.00	0.77	43.17	33	30	0.640	0.231	0.459	1.983	Non-Liquefiable
21.00	Silt	13	20.42	415.49	209.48	95	0.70	1.00	1.00	1.00	-	15.17	15	21	0.613	0.221	0.224	1.011	Non-Liquefiable
22.00	Sand	50	23.56	439.06	223.24	15	0.70	1.00	1.00	1.00	0.73	58.33	43	30	0.587	0.210	0.459	2.185	Non-Liquefiable
23.00	Sand	38	21.99	461.05	235.42	17	0.70	1.00	1.00	1.00	0.72	44.33	32	30	0.560	0.200	0.459	2.299	Non-Liquefiable
24.00	Sand	50	23.56	484.61	249.17	15	0.70	1.00	1.00	1.00	0.70	58.33	41	30	0.552	0.195	0.459	2.348	Non-Liquefiable
25.00	Sand	50	23.56	508.18	262.93	12	0.70	1.00	1.00	1.00	0.68	58.33	40	30	0.544	0.191	0.459	2.397	Non-Liquefiable
26.00	Sand	50	23.56	531.74	276.68	16	0.70	1.00	1.00	1.00	0.66	58.33	39	30	0.536	0.187	0.459	2.447	Non-Liquefiable
28.00	Sand	50	23.56	578.86	304.18	7	0.70	1.00	1.00	1.00	0.63	58.33	37	30	0.520	0.180	0.459	2.547	Non-Liquefiable
29.00	Sand	50	23.56	602.43	317.94	10	0.70	1.00	1.00	1.00	0.61	58.33	36	30	0.512	0.177	0.459	2.598	Non-Liquefiable
30.00	Sand	50	23.56	625.99	331.69	10	0.70	1.00	1.00	1.00	0.60	58.33	35	30	0.504	0.173	0.459	2.650	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)

Borehole No: BH-04

Client: SGS Bangladesh Ltd./TEPSCO

Observed Ground Water Table (m): -

Location: Matarbari, Maheshkhali, Cox's Bazar

Design Ground Water Table (m): 0.00

Seismic Zone: 3

Unit Weight of Water (kN/m³): 9.81

Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{H1}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_S	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	32	20.42	20.42	10.61	25	0.70	1.00	1.00	0.75	1.75	28.00	49	30	0.992	0.348	0.459	1.320	Non-Liquefiable
2.00	Sand	27	20.42	40.84	21.22	28	0.70	1.00	1.00	0.75	1.52	23.63	36	30	0.985	0.345	0.459	1.330	Non-Liquefiable
3.00	Sand	13	18.85	59.69	30.26	36	0.70	1.00	1.00	0.75	1.40	11.38	16	21	0.977	0.351	0.233	0.666	Liquefiable
4.00	Clay	0	14.14	73.83	34.59	98	0.70	1.00	1.00	0.75	-	0.00	0	5	0.969	0.377	0.068	0.182	Liquefiable
5.00	Clay	0	14.14	87.97	38.92	99	0.70	1.00	1.00	0.85	-	0.00	0	5	0.962	0.396	0.068	0.173	Liquefiable
6.00	Clay	2	15.71	103.68	44.82	95	0.70	1.00	1.00	0.95	-	2.22	2	8	0.954	0.402	0.086	0.214	Liquefiable
8.00	Clay	0	14.14	131.95	53.47	97	0.70	1.00	1.00	0.95	-	0.00	0	5	0.939	0.422	0.068	0.162	Liquefiable
10.00	Clay	5	18.06	168.08	69.98	64	0.70	1.00	1.00	1.00	-	5.83	6	11	0.907	0.396	0.124	0.312	Liquefiable
11.00	Sand	27	20.42	188.50	80.59	25	0.70	1.00	1.00	1.00	1.07	31.50	34	30	0.880	0.375	0.459	1.224	Non-Liquefiable
12.00	Sand	17	18.85	207.35	89.63	28	0.70	1.00	1.00	1.00	1.04	19.83	21	26	0.854	0.359	0.297	0.828	Liquefiable
13.00	Sand	22	19.64	226.99	99.46	24	0.70	1.00	1.00	1.00	1.00	25.67	26	31	0.827	0.343	0.286	0.834	Liquefiable
14.00	Clay	6	18.85	245.84	108.50	69	0.70	1.00	1.00	1.00	-	7.00	7	13	0.800	0.330	0.136	0.413	Liquefiable
15.00	Sand	10	18.06	263.91	116.76	32	0.70	1.00	1.00	1.00	0.95	11.67	11	17	0.774	0.318	0.178	0.560	Liquefiable
16.00	Sand	12	18.54	282.44	125.48	29	0.70	1.00	1.00	1.00	0.93	14.00	13	18	0.747	0.306	0.197	0.645	Liquefiable
17.00	Sand	22	19.64	302.08	135.31	19	0.70	1.00	1.00	1.00	0.90	25.67	23	27	0.720	0.293	0.329	1.123	Non-Liquefiable
18.00	Sand	26	20.42	322.50	145.92	15	0.70	1.00	1.00	1.00	0.88	30.33	27	30	0.693	0.279	0.428	1.536	Non-Liquefiable
19.00	Sand	24	19.64	342.13	155.74	17	0.70	1.00	1.00	1.00	0.85	28.00	24	28	0.667	0.267	0.337	1.263	Non-Liquefiable
20.00	Clay	42	21.99	364.13	167.93	98	0.70	1.00	1.00	1.00	-	49.00	49	30	0.640	0.253	0.459	1.816	Non-Liquefiable
21.00	Silt	50	21.99	386.12	180.11	67	0.70	1.00	1.00	1.00	-	58.33	58	30	0.613	0.239	0.459	1.917	Non-Liquefiable
22.00	Silt	50	21.99	408.11	192.29	65	0.70	1.00	1.00	1.00	-	58.33	58	30	0.587	0.227	0.459	2.025	Non-Liquefiable
23.00	Silt	50	21.99	430.10	204.47	62	0.70	1.00	1.00	1.00	-	58.33	58	30	0.560	0.214	0.459	2.140	Non-Liquefiable
24.00	Silt	50	21.99	452.10	216.66	59	0.70	1.00	1.00	1.00	-	58.33	58	30	0.552	0.210	0.459	2.188	Non-Liquefiable
25.00	Silt	50	21.99	474.09	228.84	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.544	0.205	0.459	2.237	Non-Liquefiable
26.00	Silt	50	21.99	496.08	241.02	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.536	0.201	0.459	2.285	Non-Liquefiable
27.00	Silt	50	21.99	518.07	253.20	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.528	0.197	0.459	2.333	Non-Liquefiable
28.00	Silt	50	21.99	540.06	265.38	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.520	0.193	0.459	2.382	Non-Liquefiable
30.00	Silt	50	21.99	584.05	289.75	60	0.70	1.00	1.00	1.00	-	58.33	58	30	0.504	0.185	0.459	2.481	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)

Client: SGS Bangladesh Ltd./TEPSCO

Location: Matarbari, Maheshkhali, Cox's Bazar

Seismic Zone: 3

Borehole No: BH-05

Observed Ground Water Table (m): -

Design Ground Water Table (m): 0.00

Unit Weight of Water (kN/m³): 9.81

Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_o	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Clay	0	14.14	14.14	4.33	96	0.70	1.00	1.00	0.75	-	0.00	0	5	0.992	0.590	0.068	0.116	Liquefiable
2.00	Clay	2	15.71	29.85	10.23	98	0.70	1.00	1.00	0.75	-	1.75	2	7	0.985	0.523	0.082	0.157	Liquefiable
4.00	Sand	16	18.85	67.55	28.31	47	0.70	1.00	1.00	0.75	1.42	14.00	20	26	0.969	0.421	0.292	0.693	Liquefiable
5.00	Clay	0	14.14	81.69	32.64	98	0.70	1.00	1.00	0.85	-	0.00	0	5	0.962	0.438	0.068	0.156	Liquefiable
6.00	Clay	0	14.14	95.82	36.96	97	0.70	1.00	1.00	0.95	-	0.00	0	5	0.954	0.450	0.068	0.152	Liquefiable
8.00	Clay	0	14.14	124.10	45.62	99	0.70	1.00	1.00	0.95	-	0.00	0	5	0.939	0.465	0.068	0.147	Liquefiable
9.00	Silt	0	14.14	138.24	49.95	99	0.70	1.00	1.00	0.95	-	0.00	0	5	0.931	0.469	0.068	0.146	Liquefiable
10.00	Clay	2	15.71	153.94	55.84	98	0.70	1.00	1.00	1.00	-	2.33	2	8	0.907	0.455	0.087	0.191	Liquefiable
12.00	Silt	3	16.49	186.93	69.21	97	0.70	1.00	1.00	1.00	-	3.50	4	9	0.854	0.420	0.098	0.234	Liquefiable
13.00	Silt	2	15.71	202.64	75.11	98	0.70	1.00	1.00	1.00	-	2.33	2	8	0.827	0.406	0.087	0.214	Liquefiable
14.00	Silt	7	19.64	222.28	84.94	84	0.70	1.00	1.00	1.00	-	8.17	8	14	0.800	0.381	0.148	0.389	Liquefiable
15.00	Silt	5	18.06	240.34	93.19	39	0.70	1.00	1.00	1.00	-	5.83	6	11	0.774	0.363	0.123	0.340	Liquefiable
16.00	Sand	5	16.49	256.84	99.88	46	0.70	1.00	1.00	1.00	1.00	5.83	6	11	0.747	0.350	0.124	0.355	Liquefiable
17.00	Sand	20	18.85	275.69	108.92	45	0.70	1.00	1.00	1.00	0.97	23.33	23	28	0.720	0.332	0.352	1.060	Non-Liquefiable
18.00	Sand	32	20.42	296.11	119.53	29	0.70	1.00	1.00	1.00	0.94	37.33	35	30	0.693	0.313	0.459	1.467	Non-Liquefiable
19.00	Silt	50	21.99	318.10	131.71	68	0.70	1.00	1.00	1.00	-	58.33	58	30	0.667	0.293	0.459	1.566	Non-Liquefiable
20.00	Silt	50	21.99	340.09	143.89	62	0.70	1.00	1.00	1.00	-	58.33	58	30	0.640	0.275	0.459	1.666	Non-Liquefiable
21.00	Silt	50	21.99	362.08	156.07	57	0.70	1.00	1.00	1.00	-	58.33	58	30	0.613	0.259	0.459	1.772	Non-Liquefiable
22.00	Silt	50	21.99	384.08	168.26	58	0.70	1.00	1.00	1.00	-	58.33	58	30	0.587	0.244	0.459	1.883	Non-Liquefiable
23.00	Silt	50	21.99	406.07	180.44	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.560	0.229	0.459	2.001	Non-Liquefiable
24.00	Silt	50	21.99	428.06	192.62	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.552	0.223	0.459	2.055	Non-Liquefiable
25.00	Silt	50	21.99	450.05	204.80	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.544	0.218	0.459	2.109	Non-Liquefiable
26.00	Silt	50	21.99	472.05	216.99	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.536	0.212	0.459	2.162	Non-Liquefiable
27.00	Silt	50	21.99	494.04	229.17	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.528	0.207	0.459	2.215	Non-Liquefiable
28.00	Silt	50	21.99	516.03	241.35	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.520	0.202	0.459	2.267	Non-Liquefiable
29.00	Silt	50	21.99	538.02	253.53	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.512	0.198	0.459	2.320	Non-Liquefiable
30.00	Silt	50	21.99	560.01	265.71	56	0.70	1.00	1.00	1.00	-	58.33	58	30	0.504	0.193	0.459	2.373	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)
Client: SGS Bangladesh Ltd./TEPSCO
Location: Matarbari, Maheshkhali, Cox's Bazar
Seismic Zone: 3

Borehole No: BH-06
Observed Ground Water Table (m): -
Design Ground Water Table (m): 0.00
Unit Weight of Water (kN/m³): 9.81
Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_o	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	2	14.92	14.92	5.11	36	0.70	1.00	1.00	0.75	2.00	1.75	3	9	0.992	0.527	0.099	0.187	Liquefiable
2.00	Sand	3	15.71	30.63	11.01	32	0.70	1.00	1.00	0.75	1.74	2.63	5	10	0.985	0.499	0.109	0.218	Liquefiable
3.00	Sand	5	16.49	47.13	17.70	29	0.70	1.00	1.00	0.75	1.58	4.38	7	12	0.977	0.474	0.132	0.280	Liquefiable
4.00	Sand	3	15.71	62.83	23.59	30	0.70	1.00	1.00	0.75	1.48	2.63	4	9	0.969	0.470	0.101	0.215	Liquefiable
5.00	Sand	12	18.54	81.37	32.32	25	0.70	1.00	1.00	0.85	1.38	11.90	16	21	0.962	0.441	0.234	0.530	Liquefiable
6.00	Sand	32	20.42	101.79	42.93	9	0.70	1.00	1.00	0.95	1.28	35.47	46	30	0.954	0.412	0.459	1.114	Non-Liquefiable
7.00	Clay	6	18.85	120.64	51.97	87	0.70	1.00	1.00	0.95	-	6.65	7	12	0.946	0.400	0.132	0.330	Liquefiable
9.00	Clay	0	14.14	148.92	60.63	99	0.70	1.00	1.00	0.95	-	0.00	0	5	0.931	0.416	0.068	0.164	Liquefiable
11.00	Clay	2	15.71	180.34	72.43	95	0.70	1.00	1.00	1.00	-	2.33	2	8	0.880	0.399	0.087	0.218	Liquefiable
12.00	Clay	2	15.71	196.04	78.32	93	0.70	1.00	1.00	1.00	-	2.33	2	8	0.854	0.389	0.087	0.224	Liquefiable
13.00	Clay	3	16.49	212.54	85.01	95	0.70	1.00	1.00	1.00	-	3.50	4	9	0.827	0.376	0.098	0.261	Liquefiable
15.00	Clay	6	18.85	250.24	103.09	92	0.70	1.00	1.00	1.00	-	7.00	7	13	0.774	0.342	0.135	0.396	Liquefiable
16.00	Sand	13	18.85	269.09	112.13	25	0.70	1.00	1.00	1.00	0.96	15.17	15	20	0.747	0.326	0.213	0.652	Liquefiable
17.00	Sand	50	23.56	292.65	125.88	12	0.70	1.00	1.00	1.00	0.92	58.33	54	30	0.720	0.305	0.459	1.506	Non-Liquefiable
18.00	Sand	50	23.56	316.22	139.64	9	0.70	1.00	1.00	1.00	0.89	58.33	52	30	0.693	0.286	0.459	1.605	Non-Liquefiable
19.00	Sand	27	20.42	336.64	150.25	17	0.70	1.00	1.00	1.00	0.87	31.50	27	31	0.667	0.272	0.356	1.309	Non-Liquefiable
20.00	Sand	6	16.49	353.13	156.93	22	0.70	1.00	1.00	1.00	0.85	7.00	6	11	0.640	0.262	0.116	0.443	Liquefiable
21.00	Silt	22	20.42	373.55	167.54	61	0.70	1.00	1.00	1.00	-	25.67	26	31	0.613	0.249	0.369	1.483	Non-Liquefiable
22.00	Silt	11	20.42	393.97	178.15	66	0.70	1.00	1.00	1.00	-	12.83	13	18	0.587	0.236	0.199	0.842	Liquefiable
23.00	Silt	16	20.42	414.39	188.76	59	0.70	1.00	1.00	1.00	-	18.67	19	24	0.560	0.224	0.271	1.213	Non-Liquefiable
24.00	Silt	50	21.99	436.39	200.95	68	0.70	1.00	1.00	1.00	-	58.33	58	30	0.552	0.218	0.459	2.103	Non-Liquefiable
25.00	Silt	50	21.99	458.38	213.13	71	0.70	1.00	1.00	1.00	-	58.33	58	30	0.544	0.213	0.459	2.155	Non-Liquefiable
26.00	Silt	50	21.99	480.37	225.31	94	0.70	1.00	1.00	1.00	-	58.33	58	30	0.536	0.208	0.459	2.206	Non-Liquefiable
27.00	Silt	50	21.99	502.36	237.49	83	0.70	1.00	1.00	1.00	-	58.33	58	30	0.528	0.203	0.459	2.257	Non-Liquefiable
28.00	Silt	50	21.99	524.35	249.67	69	0.70	1.00	1.00	1.00	-	58.33	58	30	0.520	0.199	0.459	2.308	Non-Liquefiable
29.00	Silt	50	21.99	546.35	261.86	69	0.70	1.00	1.00	1.00	-	58.33	58	30	0.512	0.194	0.459	2.360	Non-Liquefiable
30.00	Silt	50	21.99	568.34	274.04	69	0.70	1.00	1.00	1.00	-	58.33	58	30	0.504	0.190	0.459	2.412	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)
Client: SGS Bangladesh Ltd./TEPSCO
Location: Matarbari, Maheshkhali, Cox's Bazar
Seismic Zone: 3

Borehole No: BH-07
Observed Ground Water Table (m): -
Design Ground Water Table (m): 0.00
Unit Weight of Water (kN/m³): 9.81
Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_s	Rod length correction, C_R	Overburden Correction, C_{γ}	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	17	18.85	18.85	9.04	9	0.70	1.00	1.00	0.75	1.81	14.88	27	28	0.992	0.377	0.332	0.883	Liquefiable
2.00	Sand	18	18.85	37.70	18.08	8	0.70	1.00	1.00	0.75	1.57	15.75	25	25	0.985	0.374	0.285	0.763	Liquefiable
3.00	Sand	11	18.06	55.77	26.34	11	0.70	1.00	1.00	0.75	1.45	9.63	14	16	0.977	0.377	0.168	0.446	Liquefiable
4.00	Sand	10	18.06	73.83	34.59	15	0.70	1.00	1.00	0.75	1.36	8.75	12	15	0.969	0.377	0.164	0.435	Liquefiable
5.00	Sand	34	20.42	94.25	45.20	17	0.70	1.00	1.00	0.85	1.27	33.72	43	30	0.962	0.365	0.459	1.257	Non-Liquefiable
6.00	Clay	6	18.85	113.10	54.24	60	0.70	1.00	1.00	0.95	-	6.65	7	12	0.954	0.362	0.133	0.366	Liquefiable
7.00	Clay	7	19.64	132.74	64.07	68	0.70	1.00	1.00	0.95	-	7.76	8	13	0.946	0.357	0.144	0.405	Liquefiable
8.00	Clay	2	15.71	148.45	69.97	87	0.70	1.00	1.00	0.95	-	2.22	2	8	0.939	0.363	0.086	0.238	Liquefiable
10.00	Clay	0	14.14	176.72	78.62	77	0.70	1.00	1.00	1.00	-	0.00	0	6	0.907	0.371	0.069	0.186	Liquefiable
11.00	Sand	8	17.28	194.00	86.09	29	0.70	1.00	1.00	1.00	1.05	9.33	10	15	0.880	0.361	0.164	0.453	Liquefiable
12.00	Sand	35	20.42	214.42	96.70	18	0.70	1.00	1.00	1.00	1.01	40.83	41	30	0.854	0.344	0.459	1.332	Non-Liquefiable
13.00	Sand	15	18.85	233.27	105.74	25	0.70	1.00	1.00	1.00	0.98	17.50	17	22	0.827	0.332	0.244	0.734	Liquefiable
14.00	Sand	41	22.78	256.05	118.71	20	0.70	1.00	1.00	1.00	0.94	47.83	45	30	0.800	0.314	0.459	1.460	Non-Liquefiable
15.00	Sand	45	22.78	278.83	131.68	16	0.70	1.00	1.00	1.00	0.91	52.50	48	30	0.774	0.298	0.459	1.539	Non-Liquefiable
16.00	Sand	24	19.64	298.46	141.50	37	0.70	1.00	1.00	1.00	0.89	28.00	25	30	0.747	0.287	0.834	2.908	Non-Liquefiable
17.00	Sand	27	20.42	318.89	152.12	19	0.70	1.00	1.00	1.00	0.86	31.50	27	31	0.720	0.275	0.381	1.388	Non-Liquefiable
18.00	Sand	50	23.56	342.45	165.87	15	0.70	1.00	1.00	1.00	0.83	58.33	49	30	0.693	0.261	0.459	1.761	Non-Liquefiable
19.00	Sand	50	23.56	366.01	179.62	18	0.70	1.00	1.00	1.00	0.81	58.33	47	30	0.667	0.247	0.459	1.856	Non-Liquefiable
20.00	Sand	50	23.56	389.57	193.37	14	0.70	1.00	1.00	1.00	0.78	58.33	46	30	0.640	0.235	0.459	1.955	Non-Liquefiable
22.00	Sand	50	23.56	436.70	220.88	7	0.70	1.00	1.00	1.00	0.74	58.33	43	30	0.587	0.211	0.459	2.174	Non-Liquefiable
23.00	Sand	50	23.56	460.26	234.63	9	0.70	1.00	1.00	1.00	0.72	58.33	42	30	0.560	0.200	0.459	2.295	Non-Liquefiable
24.00	Sand	50	23.56	483.83	248.39	9	0.70	1.00	1.00	1.00	0.70	58.33	41	30	0.552	0.196	0.459	2.344	Non-Liquefiable
25.00	Sand	50	23.56	507.39	262.14	9	0.70	1.00	1.00	1.00	0.68	58.33	40	30	0.544	0.192	0.459	2.394	Non-Liquefiable
26.00	Sand	50	23.56	530.95	275.89	9	0.70	1.00	1.00	1.00	0.66	58.33	39	30	0.536	0.188	0.459	2.444	Non-Liquefiable
27.00	Sand	50	23.56	554.52	289.65	9	0.70	1.00	1.00	1.00	0.65	58.33	38	30	0.528	0.184	0.459	2.494	Non-Liquefiable
28.00	Sand	50	23.56	578.08	303.40	9	0.70	1.00	1.00	1.00	0.63	58.33	37	30	0.520	0.180	0.459	2.544	Non-Liquefiable
30.00	Sand	50	23.56	625.20	330.90	9	0.70	1.00	1.00	1.00	0.60	58.33	35	30	0.504	0.173	0.459	2.647	Non-Liquefiable

Liquefaction Analysis

Project : Soil Investigation Work for the Matarbari Ultra Super Critical Coal-Fired Power Plant Project (Phase-2)
Client: SGS Bangladesh Ltd./TEPSCO
Location: Matarbari, Maheshkhali, Cox's Bazar
Seismic Zone: 3

Borehole No: BH-08
Observed Ground Water Table (m): -
Design Ground Water Table (m): 0.00
Unit Weight of Water (kN/m³): 9.81
Peak ground acceleration (m/s²): 0.28 g

Depth (m)	Soil Type	Field SPT N Value	Unit Wt. of soil (kN/m ³)	Total Overburden Pressure σ_v (kN/m ²)	Effective overburden pressure σ'_v (kN/m ²)	Fine Content (%)	Hammer efficiency, E_{Ht}	Borehole diameter correction, C_B	Sampler correction, C_S	Rod length correction, C_R	Overburden Correction, C_o	Corrected SPT, $(N)_{60}$	Corrected SPT due to Overburden Pressure, $(N)_{60}$	SPT $(N)_{60}$ Conversion for Pure Sand, $(N)_{60cs}$	Stress Reduction Coefficient, r_d	Cyclic Stress Ratio (CSR)	Cyclic Resistance Ratio (CRR)	Factor of Safety, F_s	Remarks
1.00	Sand	13	18.85	18.85	9.04	10	0.70	1.00	1.00	0.75	1.81	11.38	21	22	0.992	0.377	0.236	0.627	Liquefiable
2.00	Sand	5	16.49	35.34	15.72	2	0.70	1.00	1.00	0.75	1.62	4.38	7	7	0.985	0.403	0.081	0.200	Liquefiable
3.00	Sand	1	14.14	49.48	20.05	26	0.70	1.00	1.00	0.75	1.54	0.88	1	6	0.977	0.439	0.076	0.173	Liquefiable
4.00	Sand	19	18.85	68.33	29.09	12	0.70	1.00	1.00	0.75	1.41	16.63	24	26	0.969	0.414	0.293	0.706	Liquefiable
5.00	Clay	2	15.71	84.04	34.99	87	0.70	1.00	1.00	0.85	-	1.98	2	8	0.962	0.420	0.084	0.200	Liquefiable
6.00	Clay	8	20.42	104.46	45.60	69	0.70	1.00	1.00	0.95	-	8.87	9	14	0.954	0.398	0.156	0.393	Liquefiable
7.00	Clay	4	17.28	121.74	53.07	85	0.70	1.00	1.00	0.95	-	4.43	4	10	0.946	0.395	0.108	0.274	Liquefiable
8.00	Sand	25	19.64	141.38	62.90	42	0.70	1.00	1.00	0.95	1.16	27.71	32	30	0.939	0.384	0.459	1.195	Non-Liquefiable
9.00	Clay	3	16.49	157.87	69.58	62	0.70	1.00	1.00	0.95	-	3.33	3	9	0.931	0.385	0.098	0.254	Liquefiable
10.00	Sand	29	20.42	178.29	80.19	36	0.70	1.00	1.00	1.00	1.08	33.83	36	30	0.907	0.367	0.459	1.250	Non-Liquefiable
11.00	Sand	22	19.64	197.93	90.02	38	0.70	1.00	1.00	1.00	1.04	25.67	27	32	0.880	0.352	0.421	1.195	Non-Liquefiable
12.00	Sand	24	19.64	217.56	99.84	32	0.70	1.00	1.00	1.00	1.00	28.00	28	33	0.854	0.339	0.484	1.429	Non-Liquefiable
13.00	Sand	31	20.42	237.99	110.46	25	0.70	1.00	1.00	1.00	0.97	36.17	35	30	0.827	0.324	0.459	1.415	Non-Liquefiable
14.00	Sand	23	19.64	257.62	120.28	35	0.70	1.00	1.00	1.00	0.94	26.83	25	31	0.800	0.312	0.281	0.902	Liquefiable
15.00	Sand	37	21.99	279.61	132.46	39	0.70	1.00	1.00	1.00	0.91	43.17	39	30	0.774	0.297	0.459	1.544	Non-Liquefiable
16.00	Sand	32	20.42	300.04	143.08	47	0.70	1.00	1.00	1.00	0.88	37.33	33	30	0.747	0.285	0.459	1.610	Non-Liquefiable
17.00	Sand	33	20.42	320.46	153.69	36	0.70	1.00	1.00	1.00	0.86	38.50	33	30	0.720	0.273	0.459	1.679	Non-Liquefiable
18.00	Sand	50	23.56	344.02	167.44	15	0.70	1.00	1.00	1.00	0.83	58.33	48	30	0.693	0.259	0.459	1.769	Non-Liquefiable
19.00	Sand	50	23.56	367.58	181.19	13	0.70	1.00	1.00	1.00	0.80	58.33	47	30	0.667	0.246	0.459	1.864	Non-Liquefiable
20.00	Sand	50	23.56	391.15	194.95	9	0.70	1.00	1.00	1.00	0.78	58.33	45	30	0.640	0.234	0.459	1.963	Non-Liquefiable
21.00	Sand	50	23.56	414.71	208.70	10	0.70	1.00	1.00	1.00	0.76	58.33	44	30	0.613	0.222	0.459	2.068	Non-Liquefiable
22.00	Sand	50	23.56	438.27	222.45	12	0.70	1.00	1.00	1.00	0.73	58.33	43	30	0.587	0.210	0.459	2.181	Non-Liquefiable
25.00	Sand	50	23.56	508.96	263.71	12	0.70	1.00	1.00	1.00	0.68	58.33	40	30	0.544	0.191	0.459	2.401	Non-Liquefiable
26.00	Sand	50	23.56	532.52	277.46	12	0.70	1.00	1.00	1.00	0.66	58.33	39	30	0.536	0.187	0.459	2.450	Non-Liquefiable
27.00	Sand	50	23.56	556.09	291.22	12	0.70	1.00	1.00	1.00	0.64	58.33	38	30	0.528	0.183	0.459	2.500	Non-Liquefiable
28.00	Sand	50	23.56	579.65	304.97	12	0.70	1.00	1.00	1.00	0.63	58.33	37	30	0.520	0.180	0.459	2.550	Non-Liquefiable
30.00	Sand	50	23.56	626.78	332.48	12	0.70	1.00	1.00	1.00	0.60	58.33	35	30	0.504	0.173	0.459	2.653	Non-Liquefiable