



SOIL TESTING REPORT

PROJECT: *Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazila and Komolnagar Upazila of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.*

- LOCATION :**
1. Barokheri, Ramgati, Lakshmipur.
 2. Ludhua Bazar, Ramgati, Lakshmipur.
 3. Kader Panditer Hat, Komolnagar, Lakshmipur.

**GEOTECHNICAL RESEARCH DIRECTORATE
SOIL MECHANICS AND GROUND WATER DIVISION**

REPORT NUMBER: SOIL – 01 (2023-2024)

FY: 2023 – 2024

RIVER RESEARCH INSTITUTE

FARIDPUR

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REPORT

1. INTRODUCTION

This report presents the results of soil tests carried out on the sub-surface soil samples collected from the locations 1. Barokheri, Upazilla- Ramgati, District- Lakshmipur.

2. Ludhua Bazar, Upazilla- Ramgati, District- Lakshmipur. 3. Kader Panditer Hat, Upazilla- Ramgati, District- Lakshmipur. in connection with Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur. In this respect 20 undisturbed and 300 disturbed soil samples were received in the laboratory on 26/06/2023 from Executive Engineer, Lakshmipur O&M Division, BDWB, Lakshmipur vide his office Memo No. RKBLK/D-1/3132, Date: 22/06/2023.

2. LABORATORY TESTINGS & RESULTS

2.1 Natural Moisture Content Test: As received moisture contents of the samples were determined and the results have been tabulated in Attachment- I & II.

2.2 Atterberg's Limit Test: Liquid limit and plastic limit of the sample was determined and the results have been shown in Attachment- II.

2.3 Grain Size Analysis: The grain Size Analysis has been carried out using sieve and hydrometer. The grain size distribution curves have been shown in Attachment- V.

2.4 Triaxial Shear Test: The test was accomplished on 16 undisturbed samples. The test was carried out on the undisturbed sample using GDS Electro-mechanical Automated Triaxial Test Equipment following unconsolidated undrained (CU) test method. Three specimens were prepared for each undisturbed sample to the cylindrical size of 3.8 cm dia × 7.6 cm long and each specimen was sheared under vertical loading velocity of 0.3 mm/min until failure occurred. Three specimens of sample were tested under 220 kPa, 440 kPa and 660 kPa radial pressures. The Mohr circle diagrams have been shown in Attachment-III and the results have been tabulated in Attachment- III.

2.5 Consolidation Test: The test was performed on 14 undisturbed sample. The specimen of the sample was trimmed to the size of 2.54 cm height × 6.35 cm diameter and the specimen was allowed to consolidate in fixed ring cell consolidometer in saturated state under six successive load increments. The six successive load increments for the four samples (H-6/U-01, H-7/U-1, H-9/U-1, H-10/U-1, H-15/U-1, H-16/U-1, H-18/U-1) were 0.25 kg/cm² to 8.00 kg/cm². For the other four samples (H-1/U-1, H-5/U-1, H-8/U-1, H-11/U-1, H-14/U-1, H-17/U-1, H-20/U-1) the six successive load increments 0.316 kg/cm² to 10.112 kg/cm².

Each load was kept on the sample for twenty-four hours to ensure complete settlement for each load. Void ratio-log pressure and Cv-log pressure curve have been shown in Attachment-IV.

2.6 Specific gravity: The test was performed on the undisturbed samples and the result has been shown in Attachment- II.

3. APPENDIX

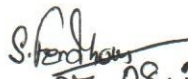
A & B: In Appendix A & B provides soil classification procedure, table and chart which are self- explanatory and may prove useful in interpreting field tests data as well as laboratory tests data.

C: Soil Testing Bill of this report no. Soil-01 (2023-24).


D: List of the personnel associated with testing works.

E: Requisition letter for the work.


Compiled by:


27.08.23
SO

Checked by:


27.08.2023
SSO

Recommended by:


27.08.2023
PSO

Approved By:


27.08.2023
Engr. Kazi Rezaul Karim
Director (Additional Charge)
Geotechnical Research Directorate
River Research Institute
Faridpur

TABLE- 1: SUMMARY OF THE TEST RESULTS OF DISTURBED SAMPLES

PROJECT: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.

Location	Hole No.	Sample no.	Sample Depth (feet)	Moisture Content (%)	Remarks
Joy Bangla Khal	1	D ₁	5	28.89	Due to shortage of samples Atterberg's Limit could not be conducted
		D ₂	10	31.70	
		D ₅	25	41.99	
Battir Khal	2	D ₁₂	60	33.28	
MP Khal-1 Sluice	3	D ₁	5	29.94	
		D ₂	10	30.65	
		D ₃	15	29.77	
		D ₁₄	70	30.19	
Kotoria Khal	4	D ₅	25	35.98	
		D ₆	30	32.13	
Patabunia Khal Sluice	5	D ₁	5	29.73	
		D ₂	10	32.44	
		D ₃	15	27.25	
Matobborhat Khal Sluice	6	D ₁₃	65	31.76	
		D ₁₄	70	26.24	
Ludhua khal (Pipe Sluice)	7	D ₁	5	27.84	
		D ₂	10	28.95	
Jarirdona Khal	8	D ₁	5	30.05	
		D ₄	20	23.45	
		D ₅	25	24.01	
		D ₆	30	30.71	
		D ₁₀	50	29.27	
Jarirdona khal sluice	9	D ₁	5	30.02	
		D ₂	10	29.14	
		D ₃	15	31.33	
Hazir khal (pipe sluice)	10	D ₁	5	32.90	
		D ₉	45	29.90	
Maleker khal sluice	11	D ₁	5	31.75	
		D ₂	10	30.14	
		D ₃	15	32.97	
		D ₄	20	32.54	
		D ₅	25	33.11	
		D ₆	30	35.75	
Munshir khal	12	D ₁	5	41.19	
Asolpara khal	13	D ₁	5	31.37	
		D ₂	10	35.40	
Kalir khal	14	D ₁	5	33.52	
Gurinder khal	15	D ₁	5	32.14	
		D ₂	10	34.54	
		D ₃	15	26.45	
		D ₆	30	25.30	
Uchkhali khal	16	D ₁	5	31.10	
		D ₂	10	34.64	

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Location	Hole No.	Sample no.	Sample Depth (feet)	Moisture Content (%)	Remarks
Char Ramiz khal	17	D ₁	5	31.70	
		D ₂	10	32.81	
		D ₃	15	27.24	
Raghunathpur sluice khal	18	D ₁	5	30.04	
		D ₂	10	36.27	
		D ₃	15	27.59	
Raghunathpur khal sluice	19	D ₁	5	33.51	
		D ₂	10	33.59	
		D ₄	20	26.15	
Malibari khal	20	D ₁	5	33.87	
		D ₂	10	33.94	

S. Gadh ~~_____~~ 

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

Location	Hole No & Sample No	Natural Moisture Content (N.M.C.) (%) and Av. N. M.C. (%)	Liquid Limit (L.L) (%)	Plasticity Index (P.I.) (%)	Unit Weight (kN/m ³)		Specific gravity. (Gs)	Triaxial Shear Test			Consolidation		Remarks
					Wet (%)	Dry at Av. MC%		Type of Test	Shearing angle, ϕ (degree)	Cohesion (c) kPa	Compression Index Cc	Max. Load kg/cm ²	
Joy Bangla Khal	H-1 UD-1	27.4 27.66 AV.-27.35	37	23	17.88	14.04 AV.- 27.35	2.675	CU	27.77	25	0.229	10.112	Triaxial test had not been carried out for the undisturbed samples UD-12, 14, 16, 20 due to shortage of required length.
Battir Khal	H-2 UD-1	28.15 24.51 AV.-26.33	39	24	18.29	14.48 AV.- 26.33		CU	22.16	12			
MP khal-I sluice	H-3 UD-1	26.38 25.95 AV.-26.17	35	21	17.47	13.84 AV.- 26.17		CU	20.01	22			
Kotoria khal	H-4 UD-1	26.14 28.25 AV.-27.20	42	22	18.48	14.53 AV.- 27.20		CU	10.32	5			
Patabunia Khal sluice	H-5 UD-1	26.70 29.95 28.48 AV.-28.38	40	25	17.29	13.47 AV.- 28.38	2.675	CU	20.01	21	0.229	10.112	

S. Khatun

M. A. H.

SUMMARY OF TEST RESULTS OF UNDISTURBED SOIL SAMPLES

Location	Hole No & Sample No	Natural Moisture Content (N.M.C.) (%) and Av.N. M.C. (%)	Liquid Limit (L.L) (%)	Plasticity Index (P.I.) (%)	Unit Weight (kN/m ³)		Specific gravity (Gs)	Triaxial Shear Test			Consolidation		Remarks
					Wet (%)	Dry at Av. MC%		Type of Test	Shearing angle, ϕ (degree)	Cohesion (c) kPa	Compression Index Cc	Max. Load kg/cm ²	
Matobborhat khal sluice	H-6 UD-1	29.99 31.25 AV.-30.62	40	25	17.96	13.75 AV- 30.62	2.675	CU	16.13	22	0.204	8	Consolation test had not been carried out for the undisturbed samples UD-2,3,4,12,13, 19 due to shortage of required length.
Ludhua khal (pipe sluice)	H-7 UD-1	28.46 32.14 26.16 AV.-28.92	40	23	17.92	13.90 AV- 28.92	2.675	CU	14.20	69	0.232	8	
Jarirdona khal	H-8 UD-1	22.13 26.74 AV-24.44	40	25	18.35	14.75 AV- 24.44		CU	18.54	32	0.237	10.112	
Jarirdona khal sluice	H-9 UD-1	28.02,29.58, 28.41 & AV.-28.67	43	15	18.60	14.46	2.675	CU	5.19	140	0.2145	8	
Hazir khal (pipe sluice)	H-10 UD-1	24.57, 32.55, 29.81 & AV.-28.98	47	22	18.67	14.74	2.675	CU	13.46	200	0.2057	8	
Maleker khal sluice	H-11 UD-1	25.84, 31.17 & AV.-28.50	46	22	17.10	13.31	2.675	CU	20.01	230	.1423	10.112	

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SUMMARY OF TEST RESULTS OF UNDISTURBED SOIL SAMPLES

Location	Hole No & Sample No	Natural Moisture Content (N.M.C.) (%) and Av.N. M.C. (%)	Liquid Limit (L.L) (%)	Plasticity Index (P.I.) (%)	Unit Weight (kN/m ³)		Specific gravity. (Gs)	Triaxial Shear Test			Consolidation		Remarks
					Wet (%)	Dry at Av. MC%		Type of Test	Shearing angle, ϕ (degree)	Cohesion (c) kPa	Compression Index Cc	Max. Load kg/cm ²	
Munshir khal	H-12 UD-1	28.33, 25.44, 25.94 & AV.-26.57	44	23	17.60	13.90							
Asolpara khal	H-13 UD-1	26.34, 35.26, 29.46 & AV.-30.35	40	15	17.35	13.31		CU	22.05	198			
Kalir khal	H-14 UD-1	27.87, 28.84, 28.77 & AV.-28.82	53	26	19.55	15.71	2.6800	CU			0.3242	10.112	
Gurinder khal	H-15 UD-1	31.62, 35.98, 33.38, & AV.-33.66	38	11	18.68	13.98	2.6678	CU	16.17	150	0.171	8	
Uchkhali khal	H-16 UD-1	26.25, 27.58, 26.49 & AV.-26.77	36	10	19.11	15.07	2.6687				0.153	8	
Char Ramij khal	H-17 UD-1	27.09, 31.89 & AV.-29.49	42	18	19.05	14.71	2.6701	CU	15.20	105	0.165	10.112	

S. Sengupta

S. Sengupta

SUMMARY OF TEST RESULTS OF UNDISTURBED SOIL SAMPLES

Location	Hole No & Sample No	Natural Moisture Content (N.M.C.) (%) and Av.N. M.C. (%)	Liquid Limit (L.L) (%)	Plasticity Index (P.I.) (%)	Unit Weight (kN/m ³)		Specific gravity. (Gs)	Triaxial Shear Test			Consolidation		Remarks
					Wet (%)	Dry at Av. MC%		Type of Test	Shearing angle, ϕ (degree)	Cohesion (c) kPa	Compression Index Cc	Max. Load kg/cm ²	
Raghunathpur sluice khal	H-18 UD-1	32.56, 31.74, 29.84 & AV.-31.38	41	21	18.55	14.12	0.158	CU	17.92	60	0.158	8	
Raghunathpur khal sluice	H-19 UD-1	28.34, 34.55, 32.48 & AV.-31.79	39	10	18.96	14.39		CU	22.12	96			
Malibari khal	H-20 UD-1	27.75, 27.71, 24.72 & AV.-26.73	44	21	19.59	15.46	0.137				0.137	10.112	

Tested by:

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Checked by:

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Approved by:

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Location: Joybangla Khal

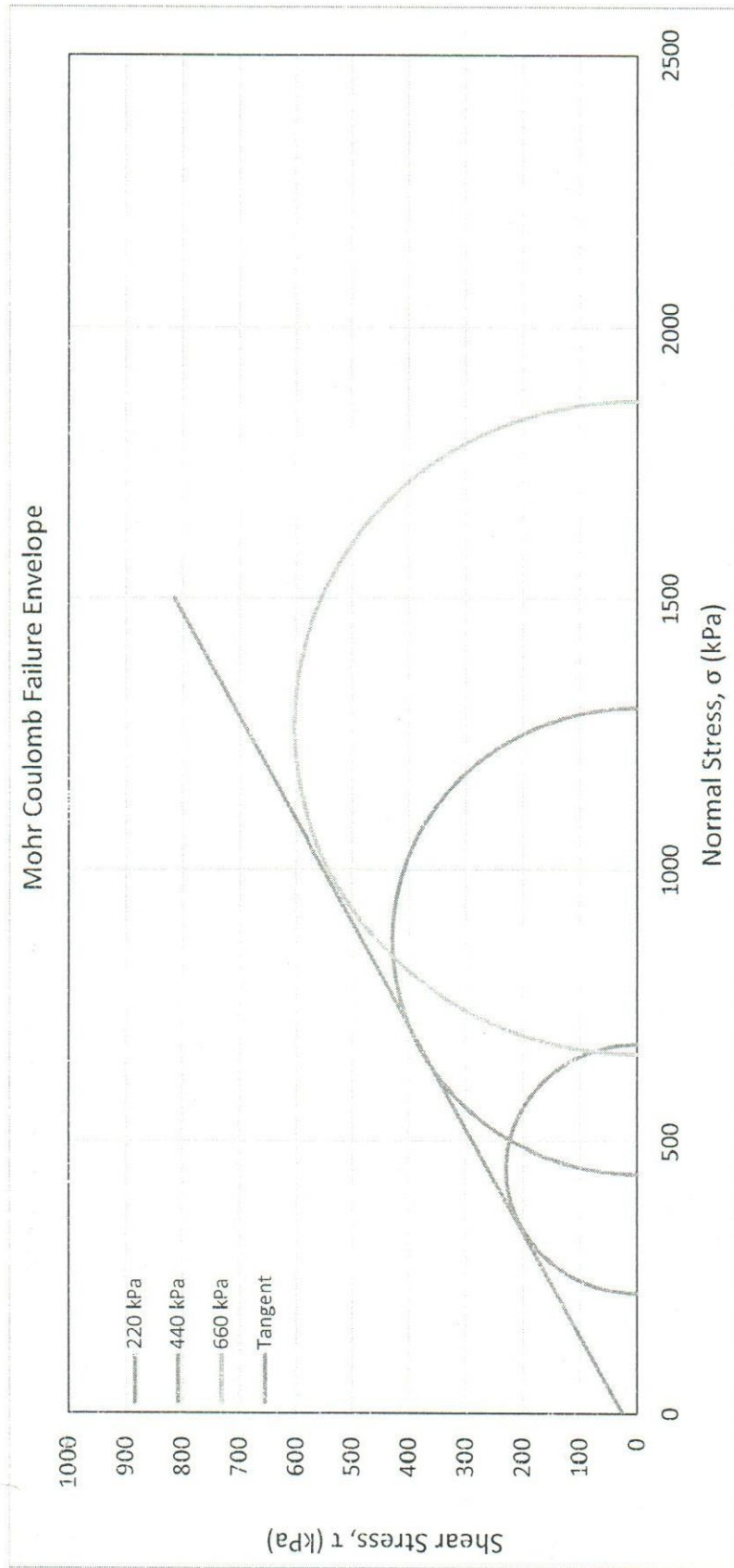
Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 25.00	Test Type: CU	Sample Size: Height-7.6 cm, Dia-3.8 cm	SP NO.	σ_3 (kPa)	σ_1 (kPa)	Strain (%)
Shearing Angle, (ϕ): 27.77°		Initial Moisture Content (%):	I	220	678	12.45
Coefficient of friction: 0.53		Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment	II	440	1298	10.25
			II	660	1865	10.32

Bore Hole No: 01

Sample No: UD-1

Depth (m):



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III



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Location: Battir Khal

Bore Hole No: 02

Sample No: UD-1

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 12.00

Shearing Angle, (φ): 22.16°

Coefficient of friction: 0.41

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

SP NO.

I

II

σ₃ (kPa)

220

440

σ₁ (kPa)

520

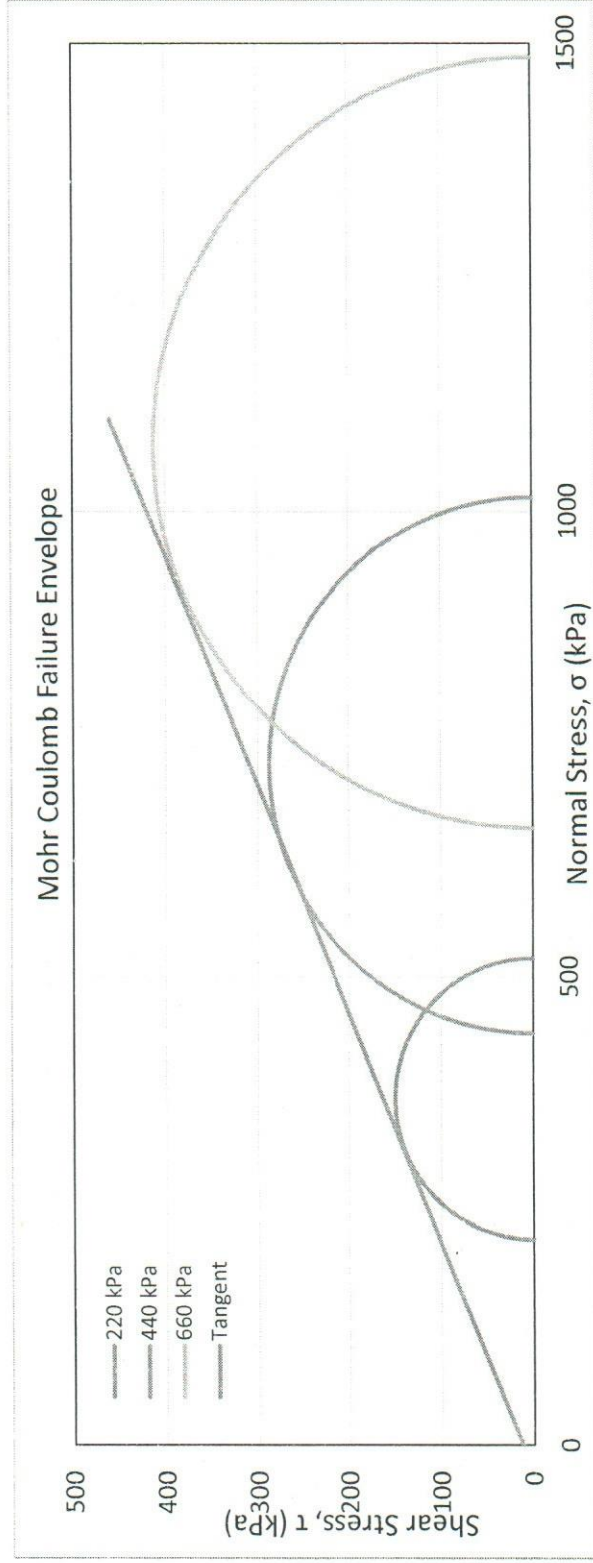
1015

Strain (%)

8.097

11.99

9.11



Tested By: *S. Kumar*

Compiled by: *S. Singh*

Checked by: *[Signature]*

Approved by: *[Signature]*

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Location: M.P. Khal-1, Sluice

Bore Hole No: 03

Sample No: UD-1

Depth (m):

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 22.00

Shearing Angle, (φ): 20.01°

Coefficient of friction: 0.53

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

Test Type:
CU

SP NO.

σ₃ (kPa)

σ₁ (kPa)

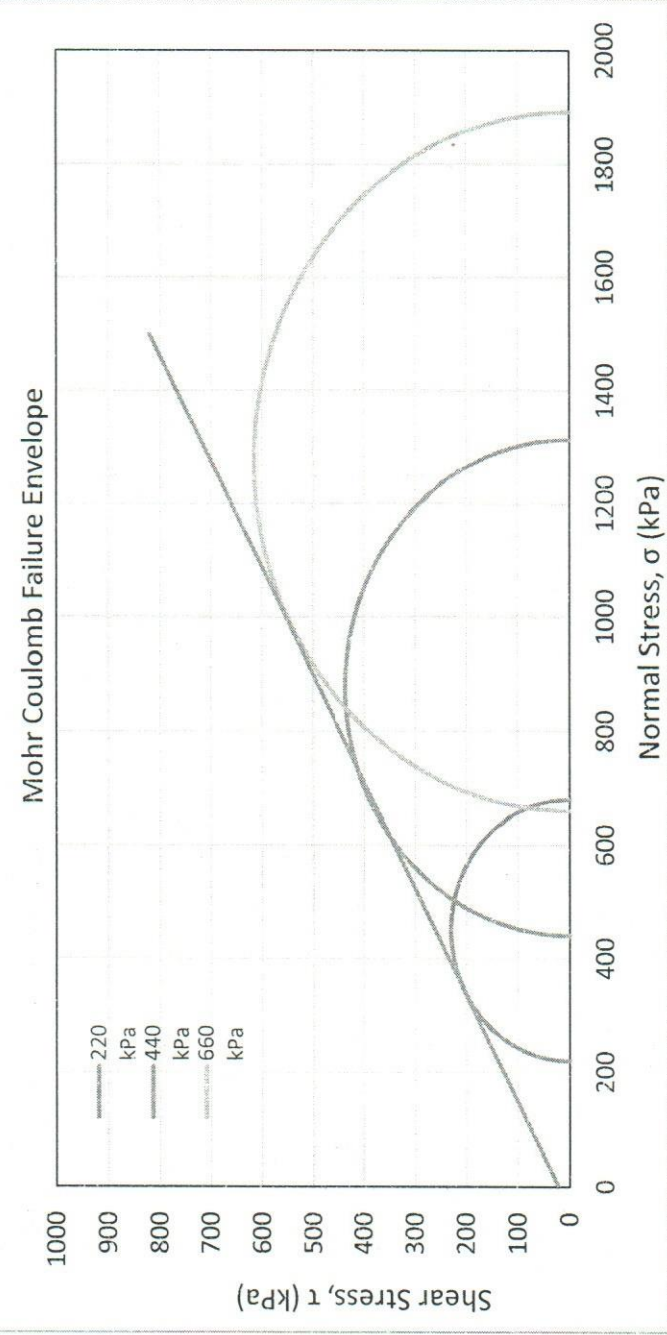
Strain (%)

SP NO.

σ₃ (kPa)

σ₁ (kPa)

Strain (%)



Tested By: *[Signature]*

Compiled by: *[Signature]*

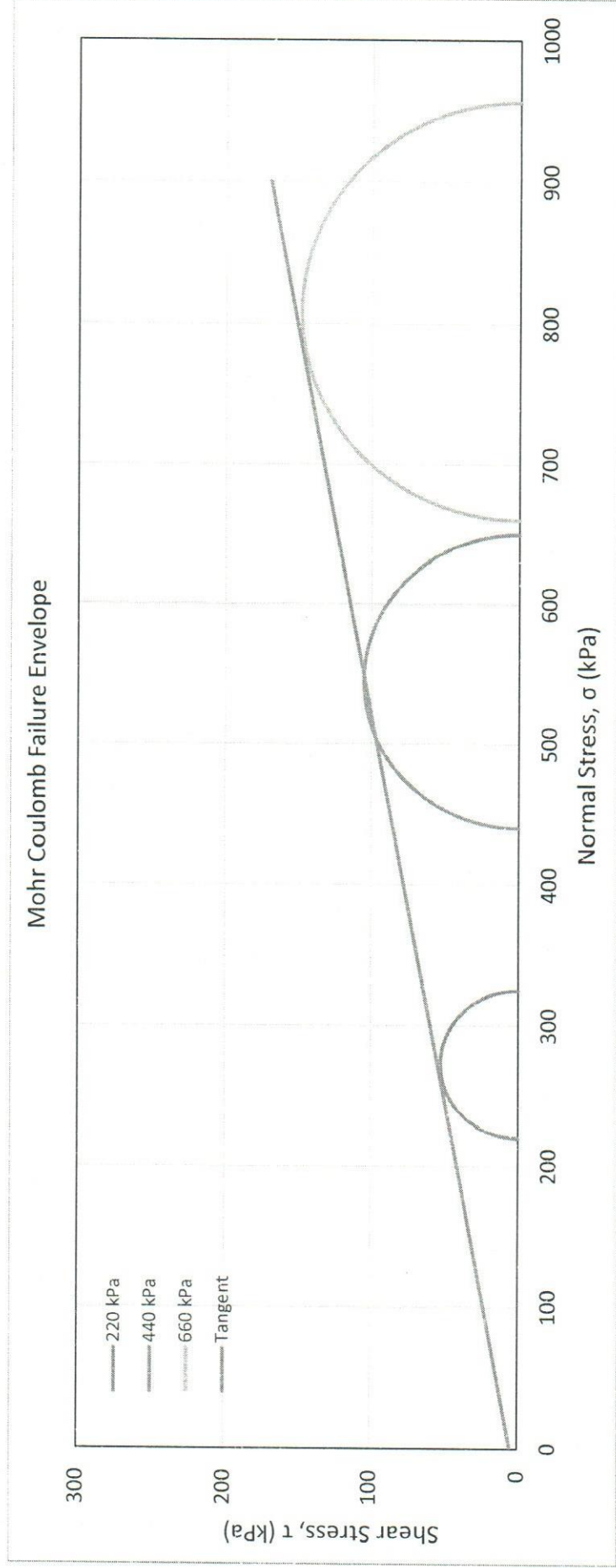
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Approved by: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.

Location: Katoria Khal		Bore Hole No: 04		Sample No: UD-1		Depth (m):	
Sample Description: CLAY, trace fine sand, medium plastic							
Cohesion, c (kPa): 5.00		Sample Size: Height-7.6 cm, Dia-3.8 cm					
Shearing Angle, (ϕ): 10.32°		Initial Moisture Content (%):					
Coefficient of friction: 0.18		Test Type: CU		SP NO.		σ_1 (kPa)	
				I		325	
				II		650	
				II		956	
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment							

Mohr Coulomb Failure Envelope



Tested By: *S. Khan*

Compiled by: *S. Khan*

Checked by: *S. Khan*

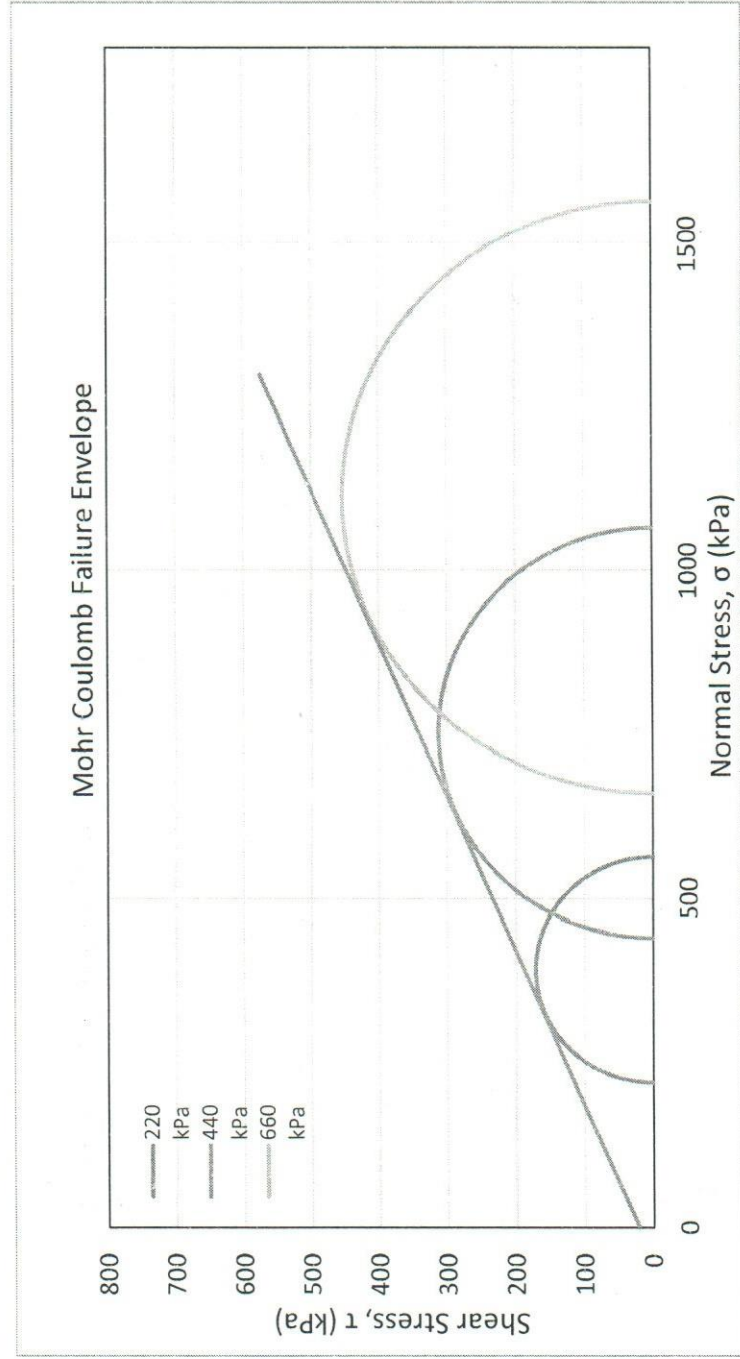
Approved by: *S. Khan*



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Location: Patabunia Khal Sluice		Sample Description: CLAY, trace fine sand, medium plastic		SP NO.		σ₁ (kPa)	
Sample Size: Height-7.6 cm, Dia-3.8 cm		Initial Moisture Content (%)		I	220	563	5.11
Test Type: CU		Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment		II	440	1065	5.98
Cohesion, c (kPa): 21.00		Shearing Angle, (φ): 23.08°		II	660	1565	6.65
Coefficient of friction: 0.43							



Tested By: *S. Kumar*

Compiled by: *S. Saha*

Checked by: *[Signature]*

Approved by: *[Signature]*



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Location: Matabborhat Khal

Bore Hole No: 06

Sample No: UD-1

Depth (m):

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 22.00

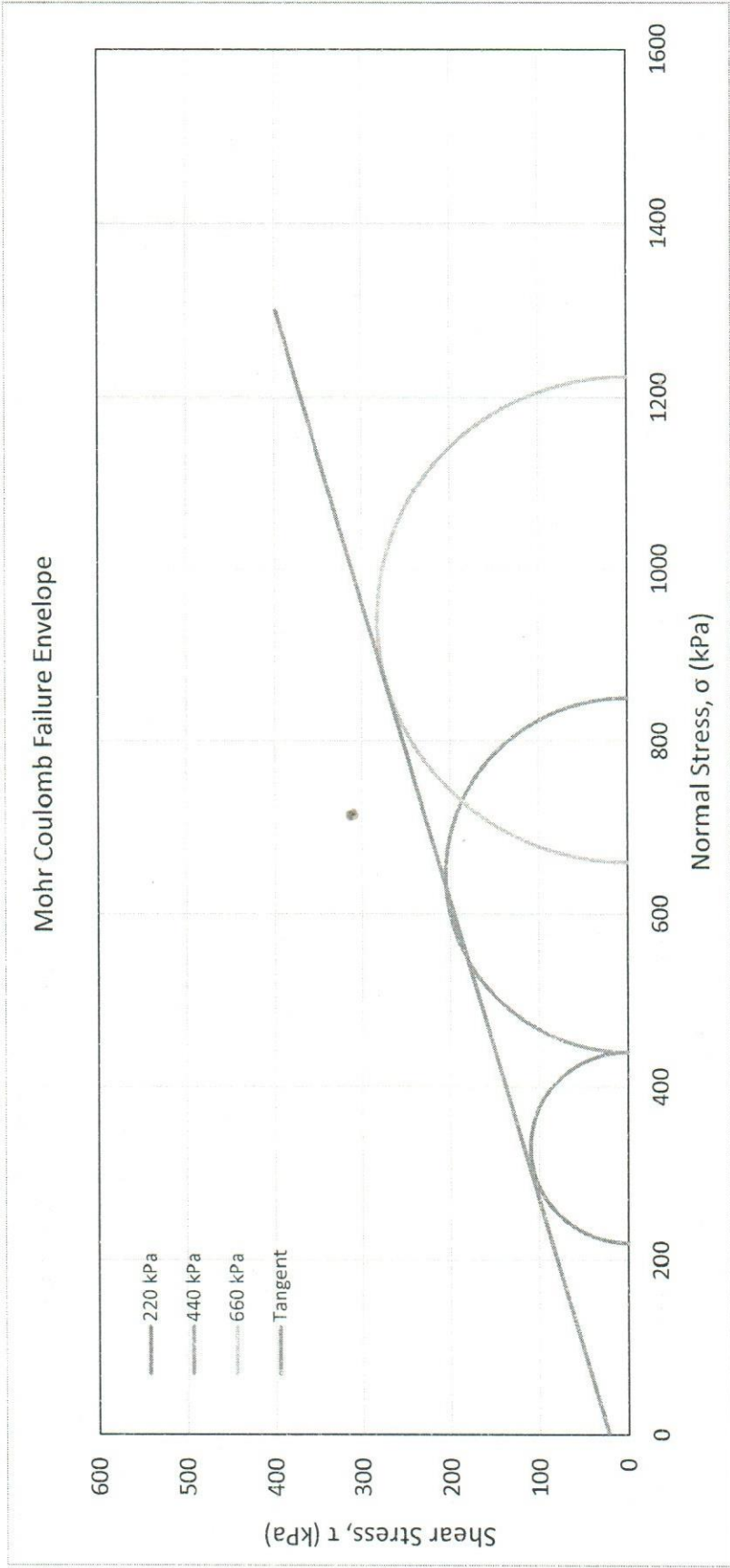
Test Type: CU

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

SP NO.	σ_3 (kPa)	σ_1 (kPa)	Strain (%)
I	220	440	7.71
II	440	850	7.59
II	660	1124	8.65



Tested By: *S. Banerjee*

Compiled by: *S. Banerjee*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III

Sheet 06 of 16



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Location: Ludhua Khal (Pipe Sluice)

Sample Description: CLAY, trace fine sand, medium plastic

Sample Size: Height-7.6 cm, Dia-3.8 cm

Test Type: CU

SP NO. I 220 σ_3 (kPa) 220 σ_1 (kPa) 545 Strain (%) 10.7

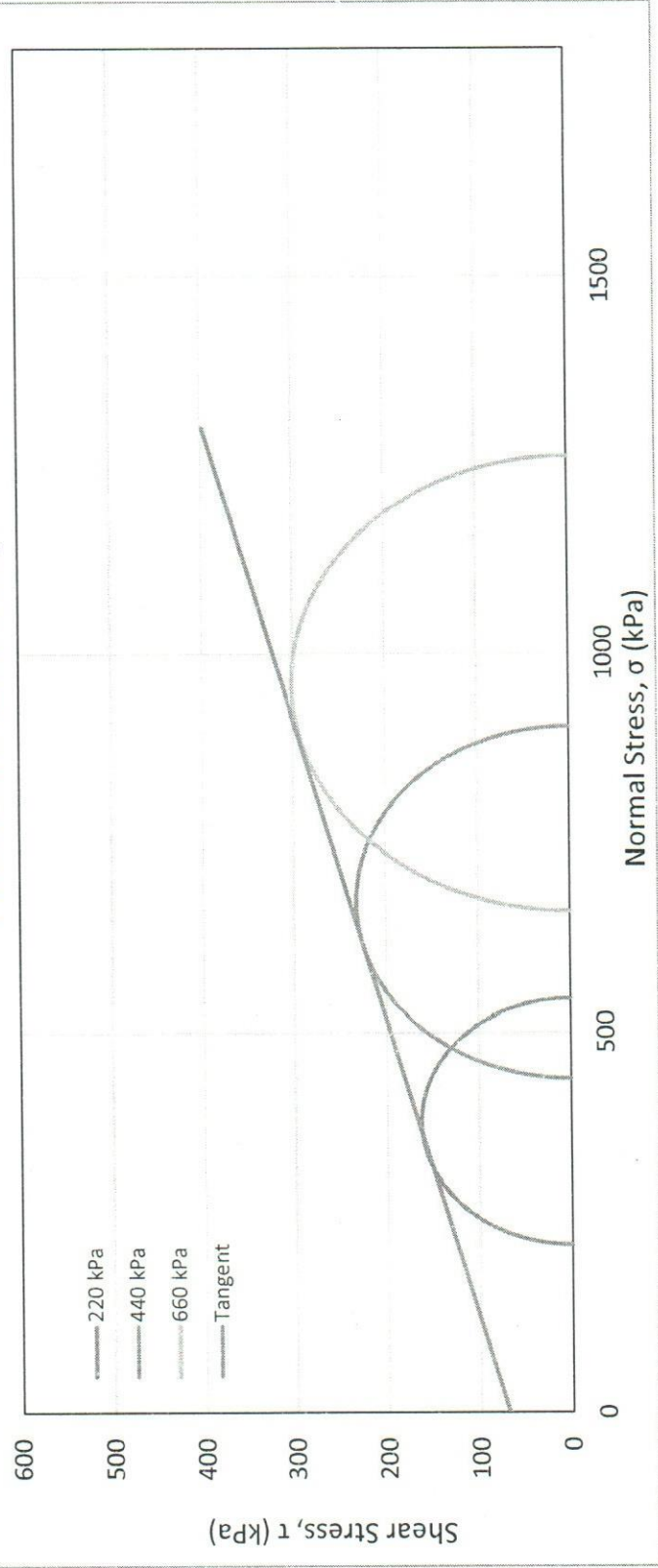
SP NO. II 440 σ_3 (kPa) 440 σ_1 (kPa) 904 Strain (%) 8.86

SP NO. II 660 σ_3 (kPa) 660 σ_1 (kPa) 1262 Strain (%) 11.82

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

Mohr Coulomb Failure Envelope



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III



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Location: Jorirdona Khal

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 32.00
Shearing Angle, (φ): 18.54°
Coefficient of friction: 0.34

Test Type:
CU

Sample Size: Height-7.6 cm, Dia-3.8 cm
Initial Moisture Content (%):
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

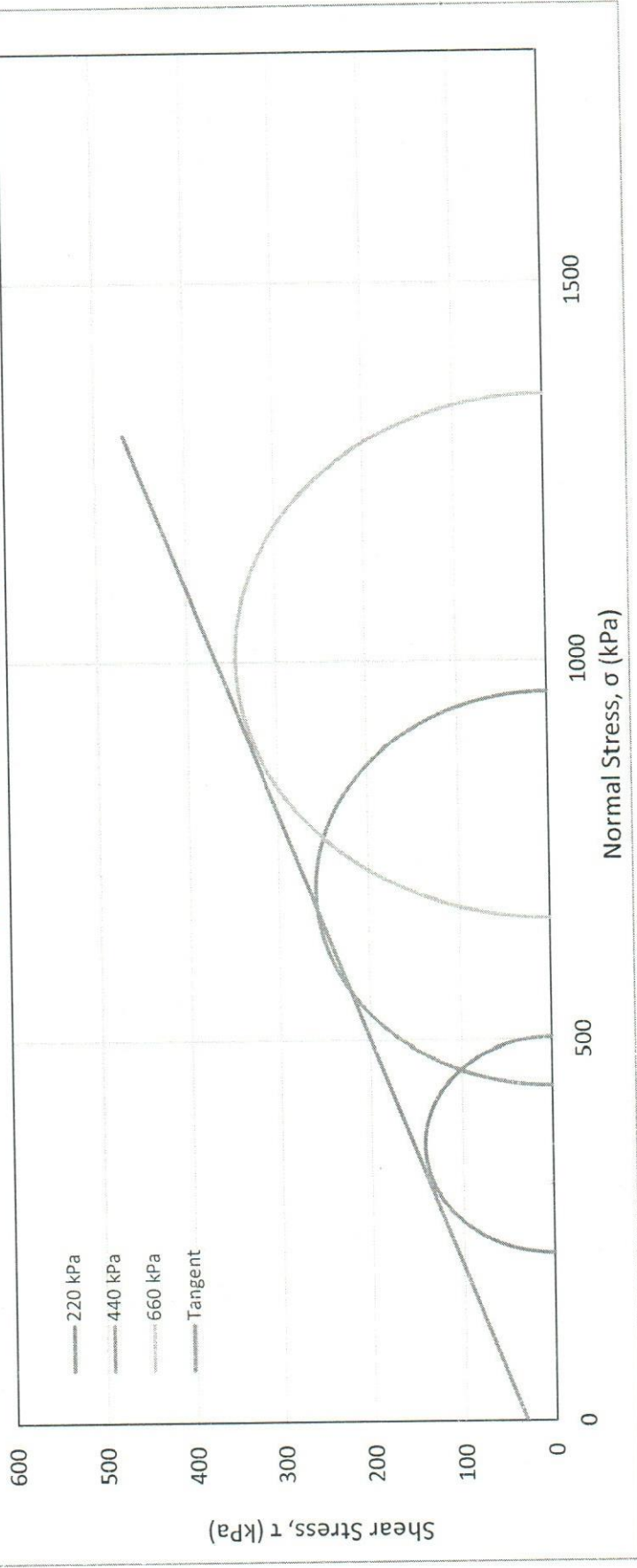
Bore Hole No: 08

Sample No: UD-1

Depth (m):

SP NO.	σ ₃ (kPa)	σ ₁ (kPa)	Strain (%)
I	220	503	6.42
II	440	958	6.92
II	660	1352	7.19

Mohr Coulomb Failure Envelope



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III



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TRIAXIAL SHEAR TEST**

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

Location: Jorirdona Khal Sluice

Bore Hole No: 09

Sample No: UD-1

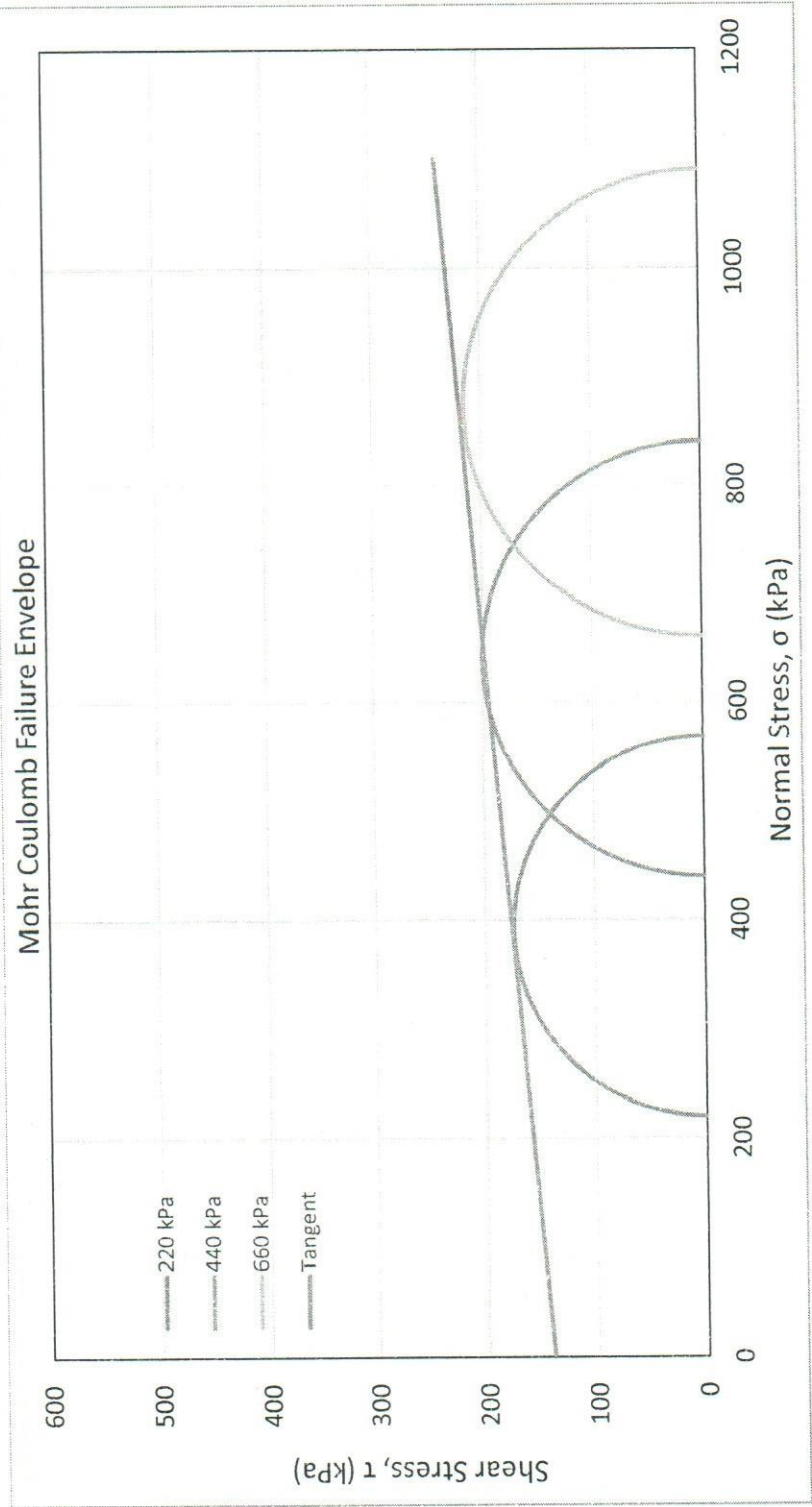
Sample Description: CLAY, trace fine sand, medium plastic

SP NO.	σ ₃ (kPa)	σ ₁ (kPa)	Strain (%)
II	440	840	5.71
II	660	1090	6.07

Sample Size: Height-7.6 cm, Dia-3.8 cm
Initial Moisture Content (%):
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

Test Type:
CU

Cohesion, c (kPa): 140.00
Shearing Angle, (φ): 5.19°
Coefficient of friction: 0.09



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III

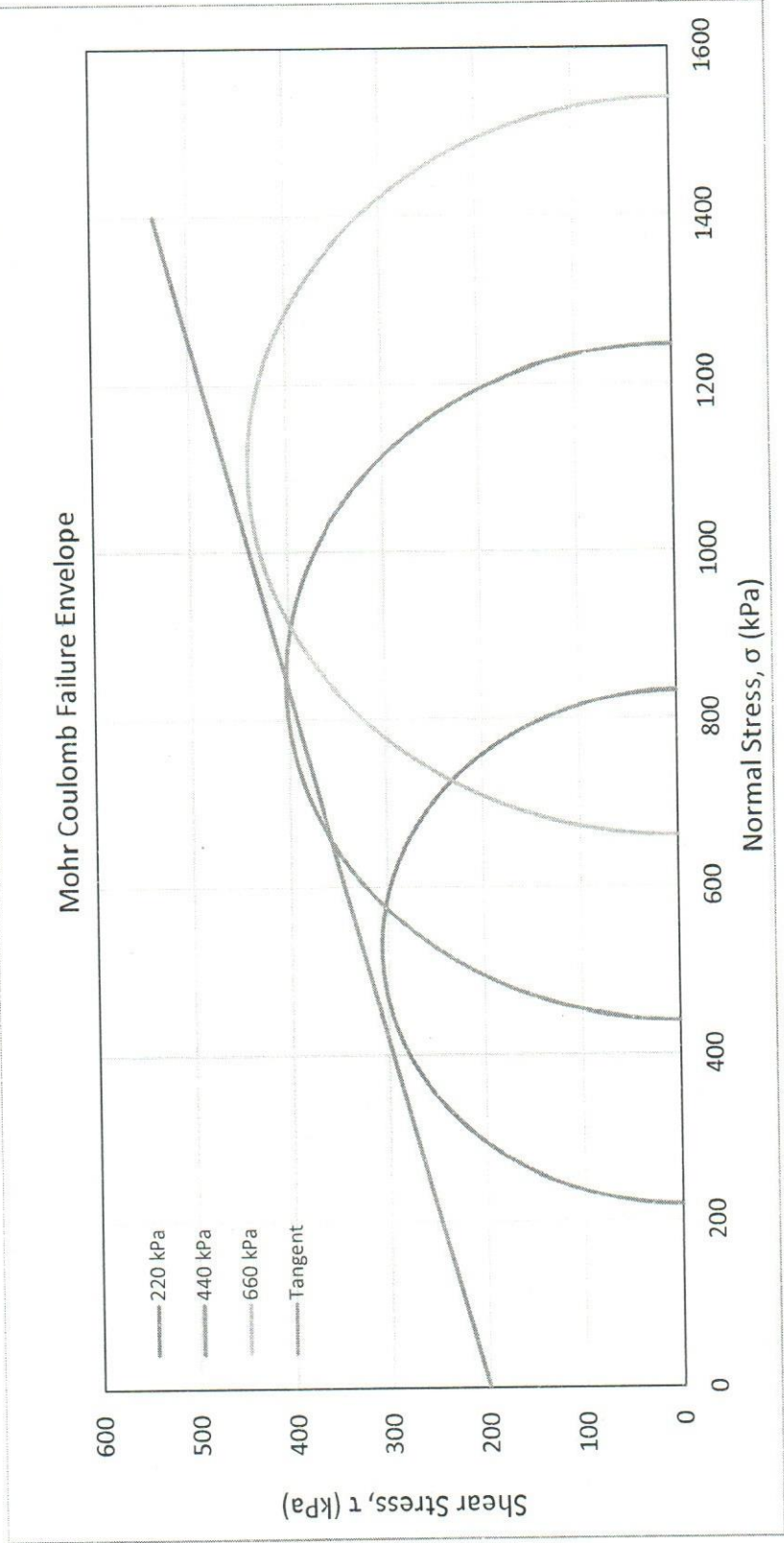


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TRIAXIAL SHEAR TEST**

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.
Location: Hajir Khal (Pipe Sluice)
Bore Hole No: 10 **Sample No:** UD-1 **Depth (m):**

Sample Description: CLAY, trace fine sand, medium plastic		Sample Size: Height-7.6 cm, Dia-3.8 cm		SP NO.	σ_3 (kPa)	σ_1 (kPa)	Strain (%)
Test Type: CU Cohesion, c (kPa): 200 Shearing Angle, (ϕ): 13.46° Coefficient of friction: 0.24	Initial Moisture Content (%): Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment	I	220	832	8.23		
		II	440	1246	11.19		
		II	660	1540	8.44		



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

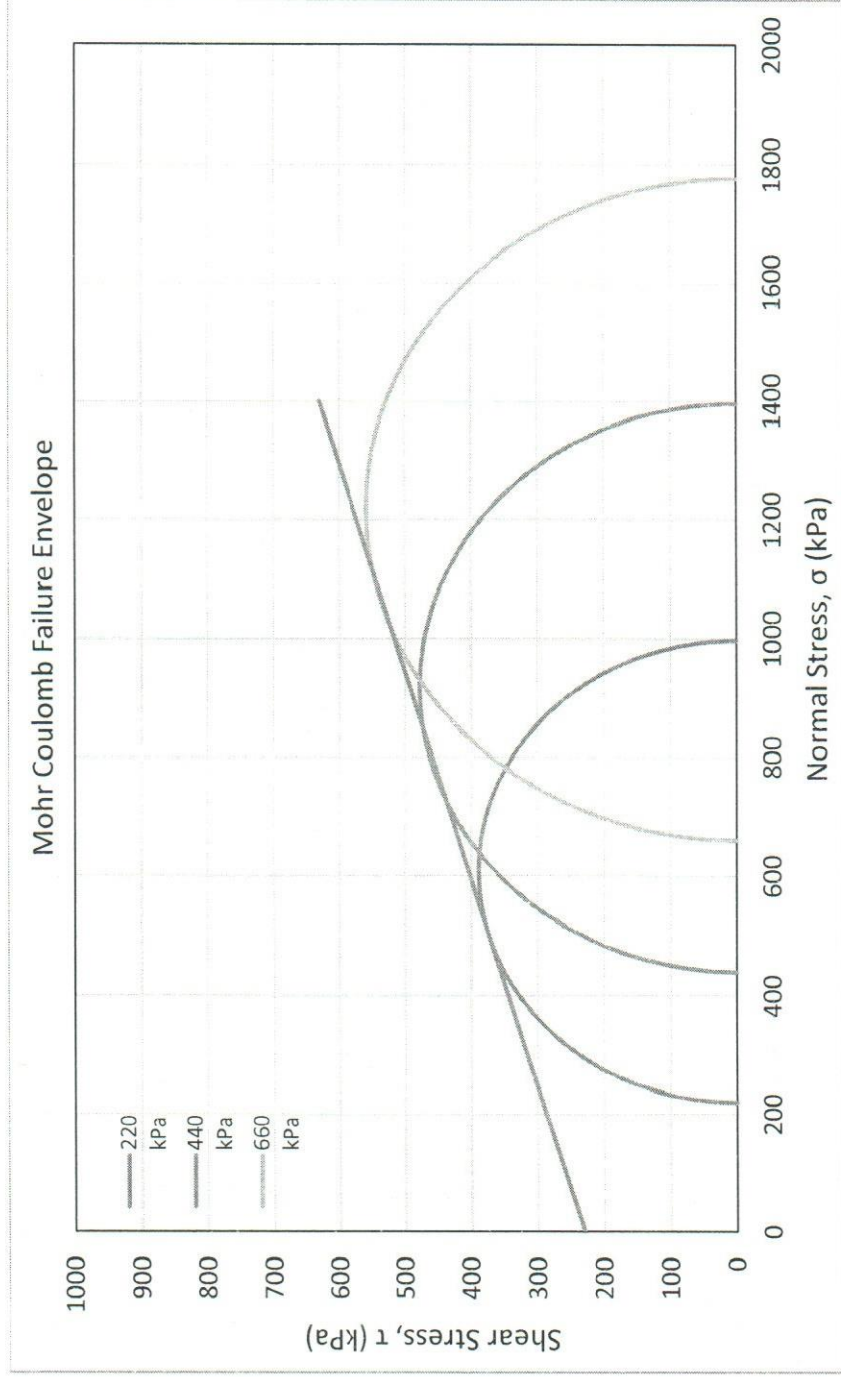
Approved by: *[Signature]*


Attachment-III

RIVER RESEARCH INSTITUTE
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TRIAXIAL SHEAR TEST

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.

Location: Maleker Khal Sluice		Bore Hole No: 11	Sample No: UD-1		Depth (m):
Sample Description: CLAY, trace fine sand, medium plastic					
Cohesion, c (kPa): 230.00	Test Type: CU	Sample Size: Height-7.6 cm, Dia-3.8 cm			
Shearing Angle, (φ): 15.95°	Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment	SP NO. I	σ₃ (kPa) 220	σ₁ (kPa) 997	Strain (%) 11.95
Coefficient of friction: 0.29		SP NO. II	σ₃ (kPa) 440	σ₁ (kPa) 1395	Strain (%) 12.21
		SP NO. II	σ₃ (kPa) 660	σ₁ (kPa) 1716	Strain (%) 13.24



Tested By: 

Compiled by: 

Checked by: 

Approved by: 

Attachment-III

**RIVER RESEARCH INSTITUTE
FARIDPUR**

TRIAXIAL SHEAR TEST

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.

Location: Asolpara Khal

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 198.00
Shearing Angle, (φ): 22.05°
Coefficient of friction: 0.41

Test Type:
CU

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

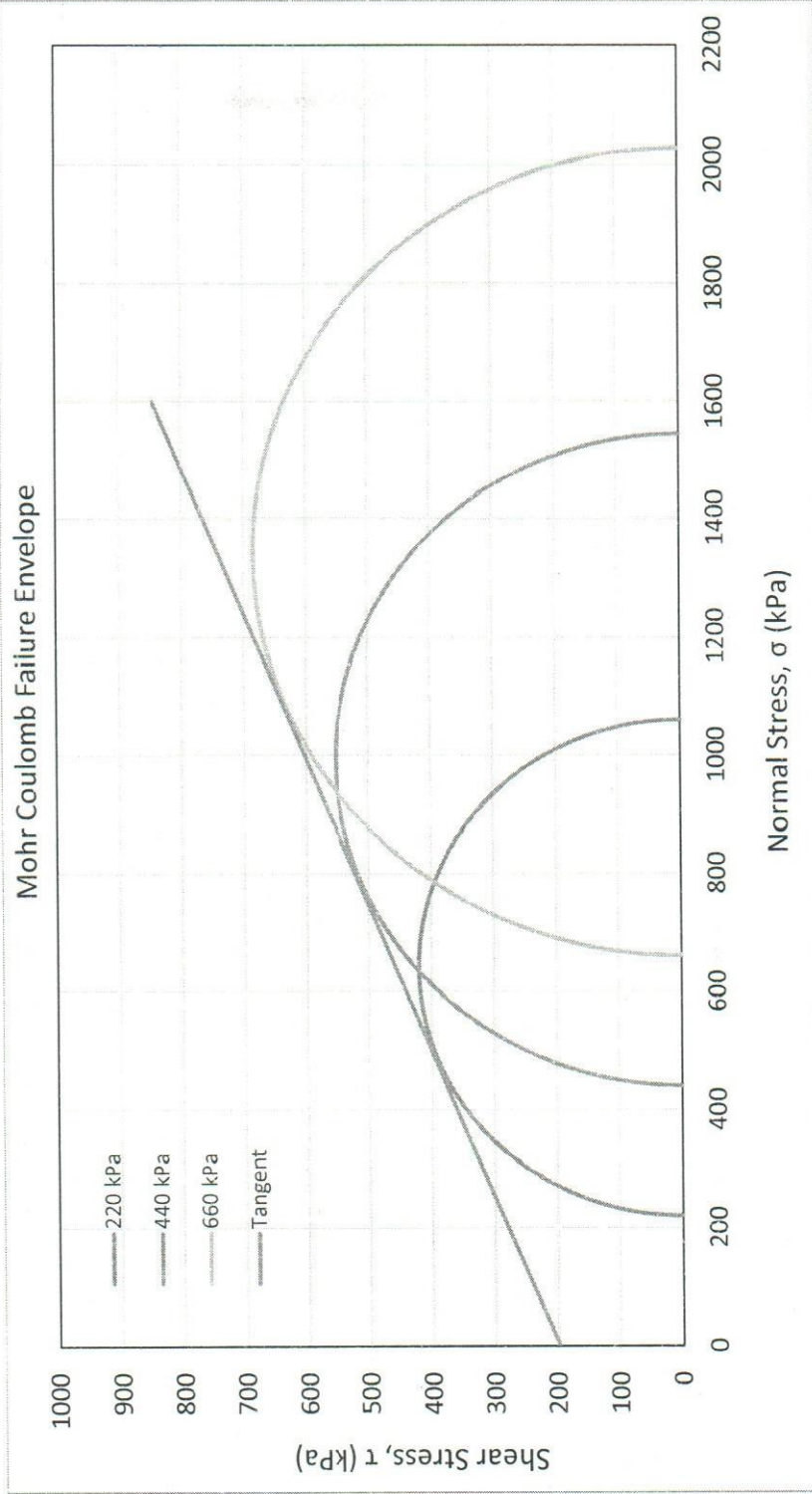
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

SP NO.	σ ₃ (kPa)	σ ₁ (kPa)	Strain (%)
I	220	1060	1015
II	440	1544	12.75
II	660	2028	11.24

Bore Hole No: 13

Sample No: UD-1

Depth (m):



Tested By: *[Signature]*

Compiled by:

[Signature]

Checked by:

[Signature]

Approved by:

Attachment-III

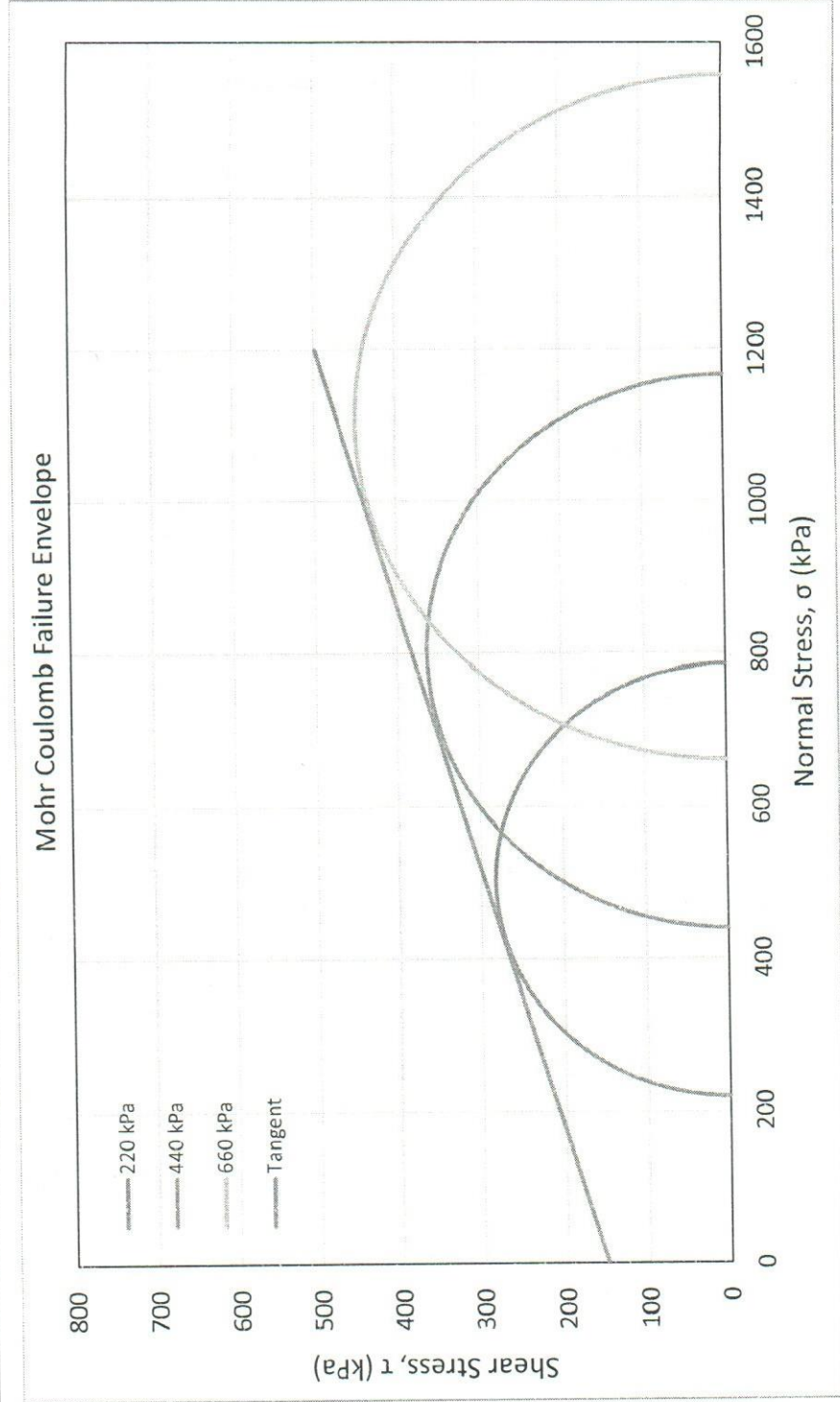


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FARIDPUR
TRIAXIAL SHEAR TEST**

River Research Institute

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.

Location: Gurindar Khal		Bore Hole No: 15		Sample No: UD-1		Depth (m):	
Sample Description: SILT, trace fine sand, medium compressive							
Sample Size: Height-7.6 cm, Dia-3.8 cm							
Initial Moisture Content (%):							
Test Type: CU		SP NO.		σ_3 (kPa)		σ_1 (kPa)	
		I		220		785	
		II		440		1167	
		II		660		1557	
Cohesion, c (kPa): 150.00							
Shearing Angle, (ϕ): 16.17°							
Coefficient of friction: 0.29							
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment							



Tested By: *S. Ghosh*

Compiled by: *S. Ghosh*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III



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TRIAXIAL SHEAR TEST

River Research Institute

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

Location: Char Ramij Khal

Sample Description: CLAY, trace fine sand, medium plastic

Test Type: CU

Cohesion, c (kPa): 105.00

Shearing Angle, (ϕ): 15.20°

Coefficient of friction: 0.27

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

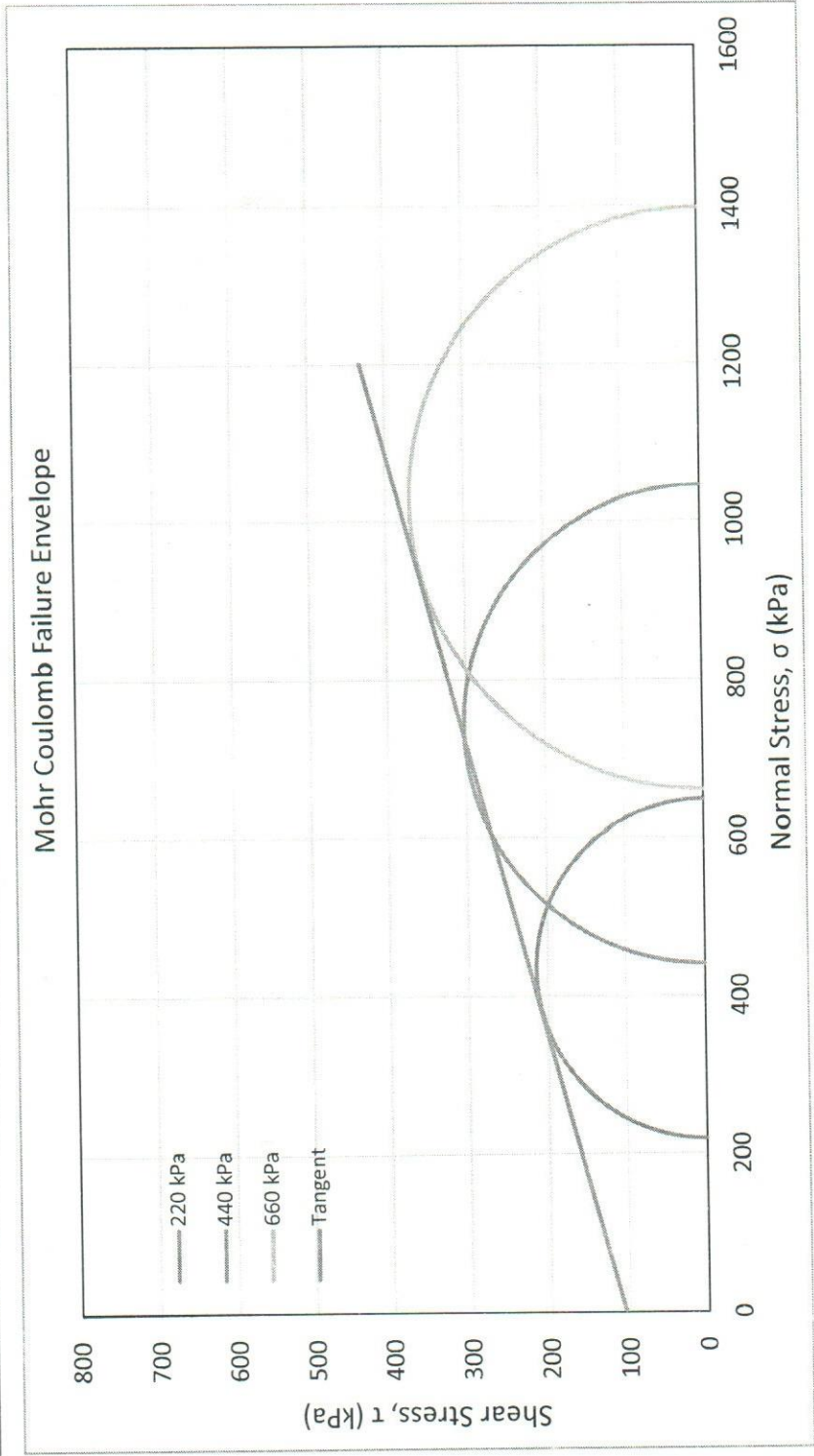
Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

SP NO.	σ_3 (kPa)	σ_1 (kPa)	Strain (%)
I	220	648	8.98
II	440	1045	9.43
II	660	1398	10.76

Bore Hole No: 17

Sample No: UD-1

Depth (m): N/A



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III

RIVER RESEARCH INSTITUTE

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Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmpur District, Lakshmpur O & M Division, BWDB, Lakshmpur.

Location: Raghunathpur Sluice Khal

Sample Description: CLAY, trace fine sand, medium plastic

Cohesion, c (kPa): 60.00

Shearing Angle, (φ): 17.92°

Coefficient of friction: 0.32

Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

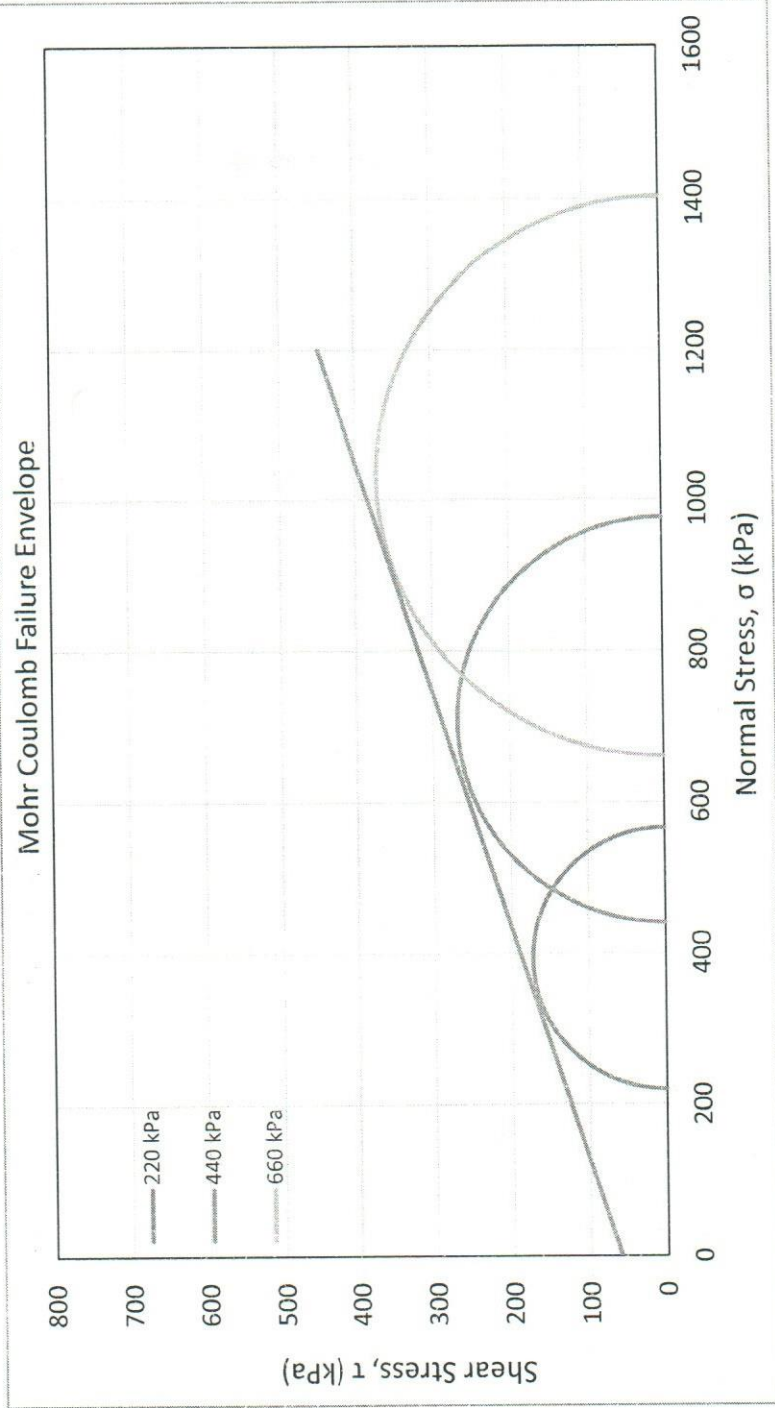
Test Type:
CU

SP NO.	σ ₃ (kPa)	σ ₁ (kPa)	Strain (%)
I	220	566	12.06
II	440	976	10.02
II	660	1403	7.71

Bore Hole No: 18

Sample No: UD-1

Depth (m):



Tested By: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved by: *[Signature]*

Attachment-III



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Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

Location: Raghunathpur Khal Sluice

Bore Hole No: 19

Sample No: UD-1

Sample Description: SILT, trace fine sand, medium compressive

Cohesion, c (kPa): 96.00
Shearing Angle, (φ): 22.12°
Coefficient of friction: 0.41

Test Type:
CU

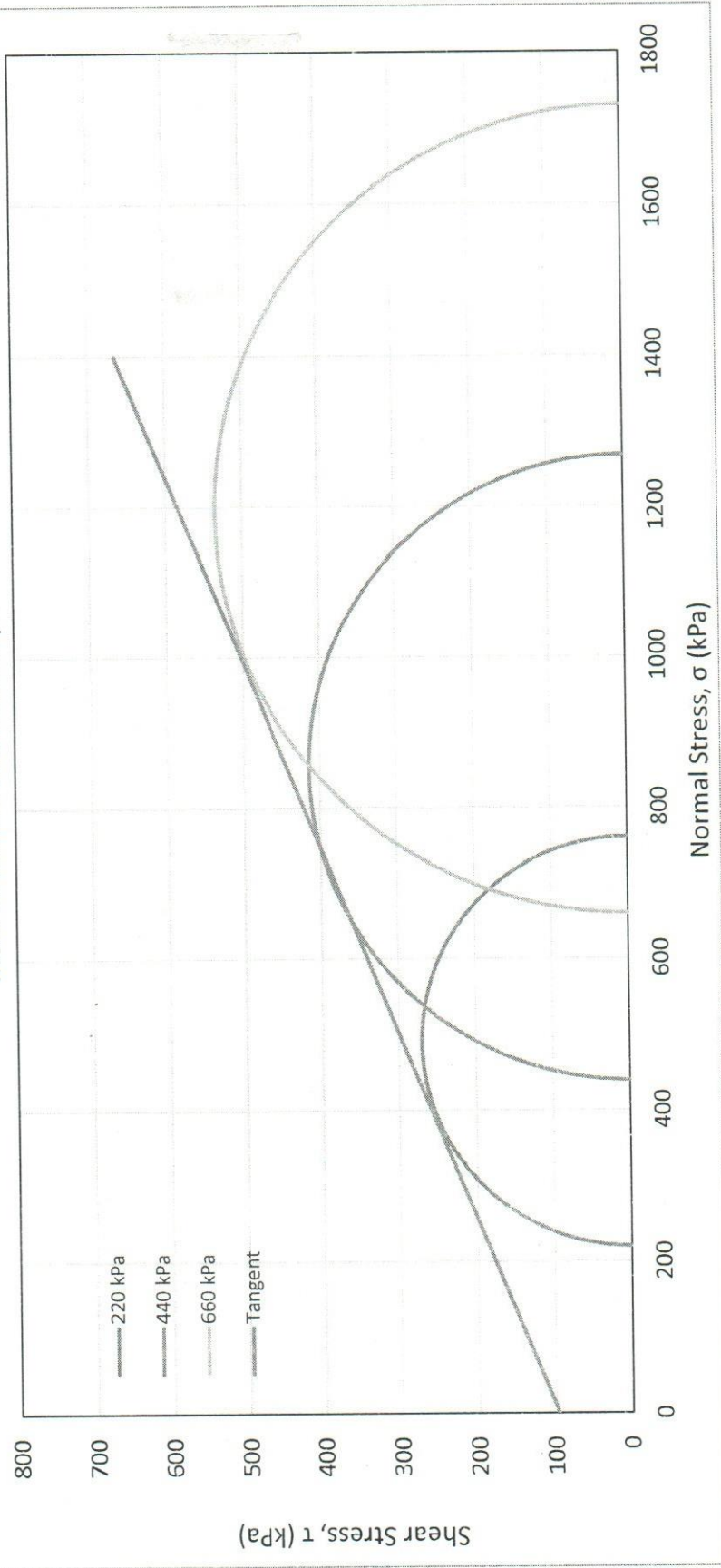
Sample Size: Height-7.6 cm, Dia-3.8 cm

Initial Moisture Content (%):

Apparatus: GDS Electro-mechanical Automated Triaxial Test Equipment

SP NO.	σ ₃ (kPa)	σ ₁ (kPa)	Strain (%)
I	220	761	10.74
II	440	1268	10.28
II	660	1730	10.09

Mohr Coulomb Failure Envelope



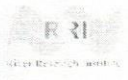
Tested By: *S. Ramo*

Compiled by: *S. Saha*

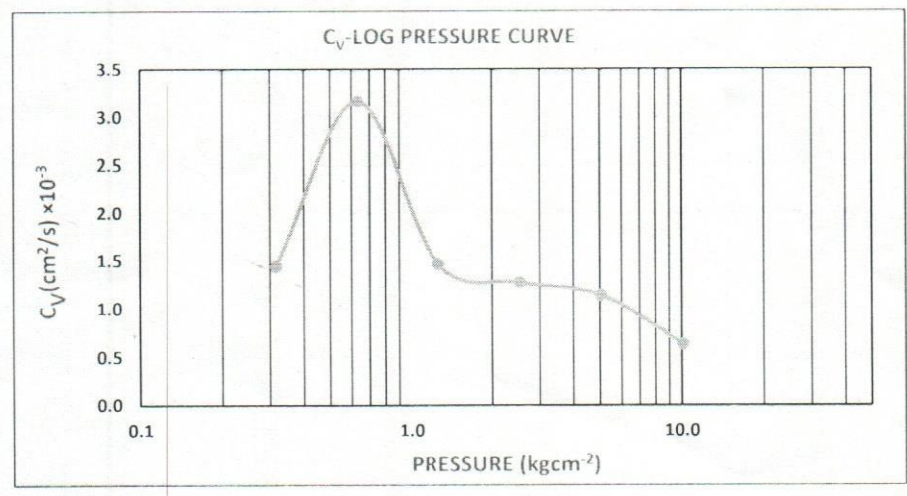
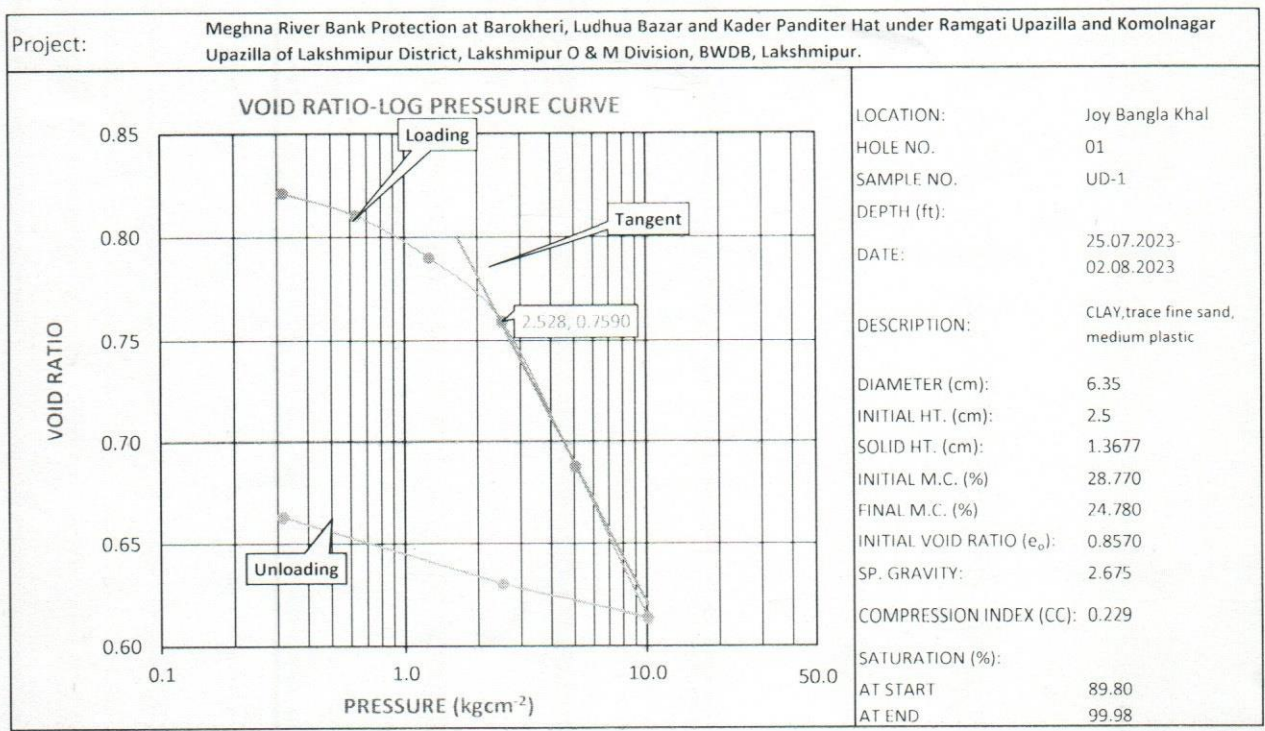
Checked by: *P. P. P.*

Approved by: *J. M.*

Attachment-III



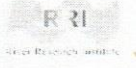
RIVER RESEARCH INSTITUTE
 SOIL MECHANICS AND GROUND WATER DIVISION
 GEOTECHNICAL RESEARCH DIRECTORATE



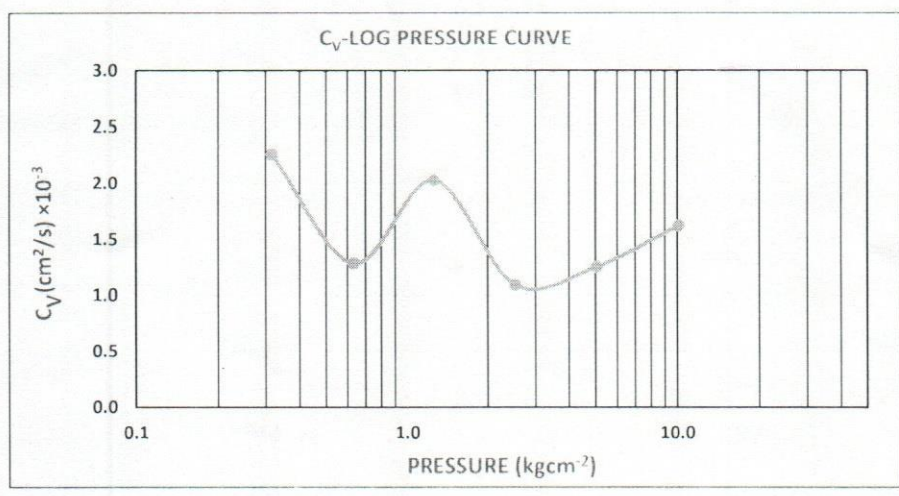
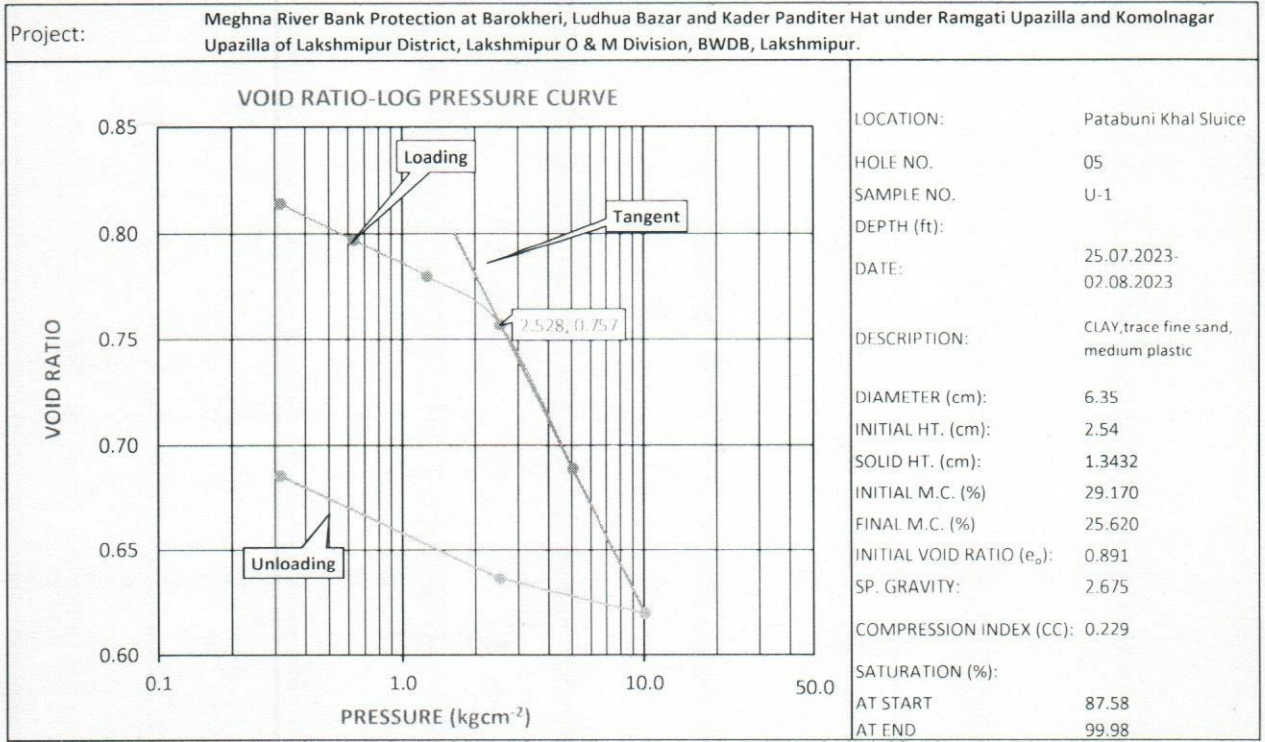
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Compiled by:

Checked by: Approved By:



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SOIL MECHANICS AND GROUND WATER DIVISION
GEOTECHNICAL RESEARCH DIRECTORATE

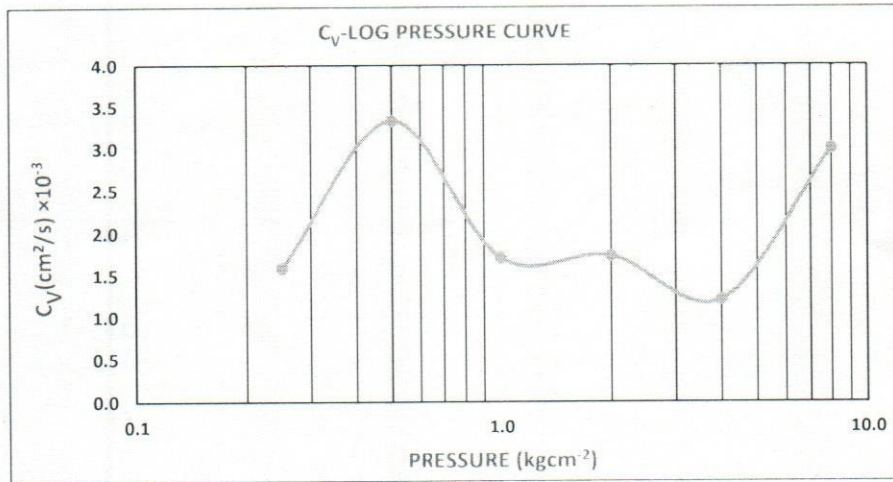
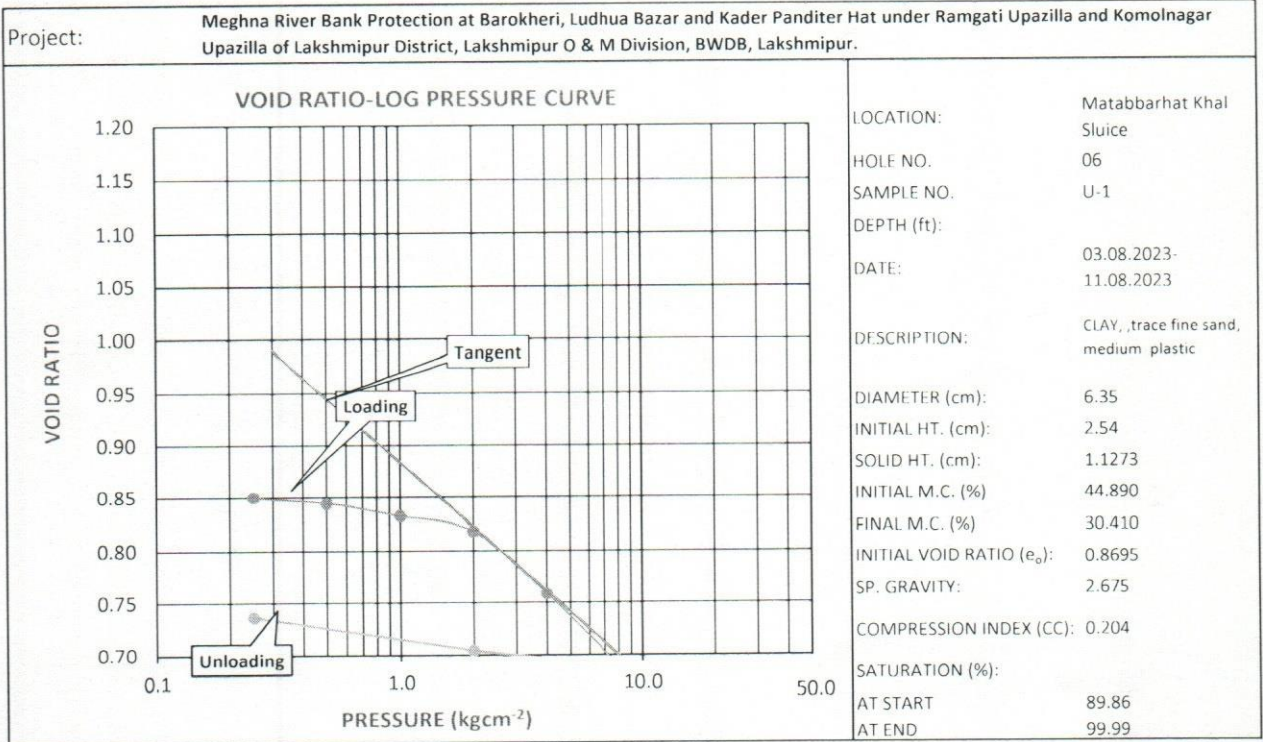



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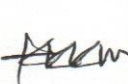
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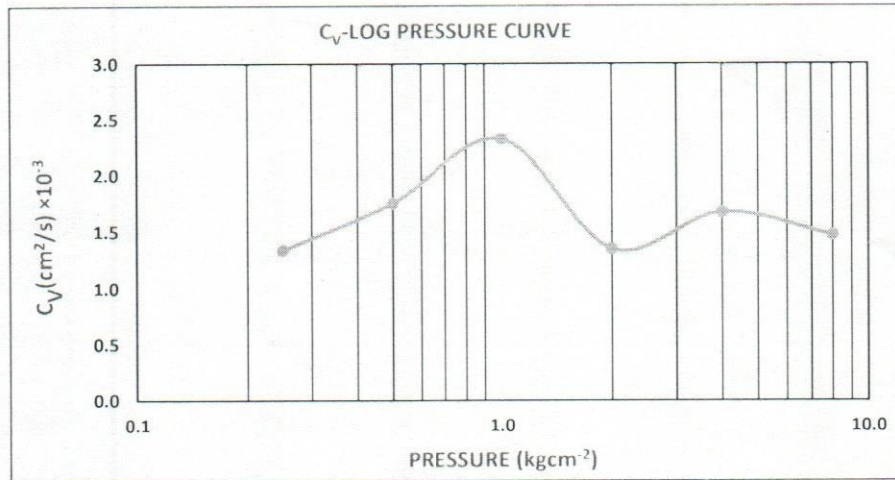
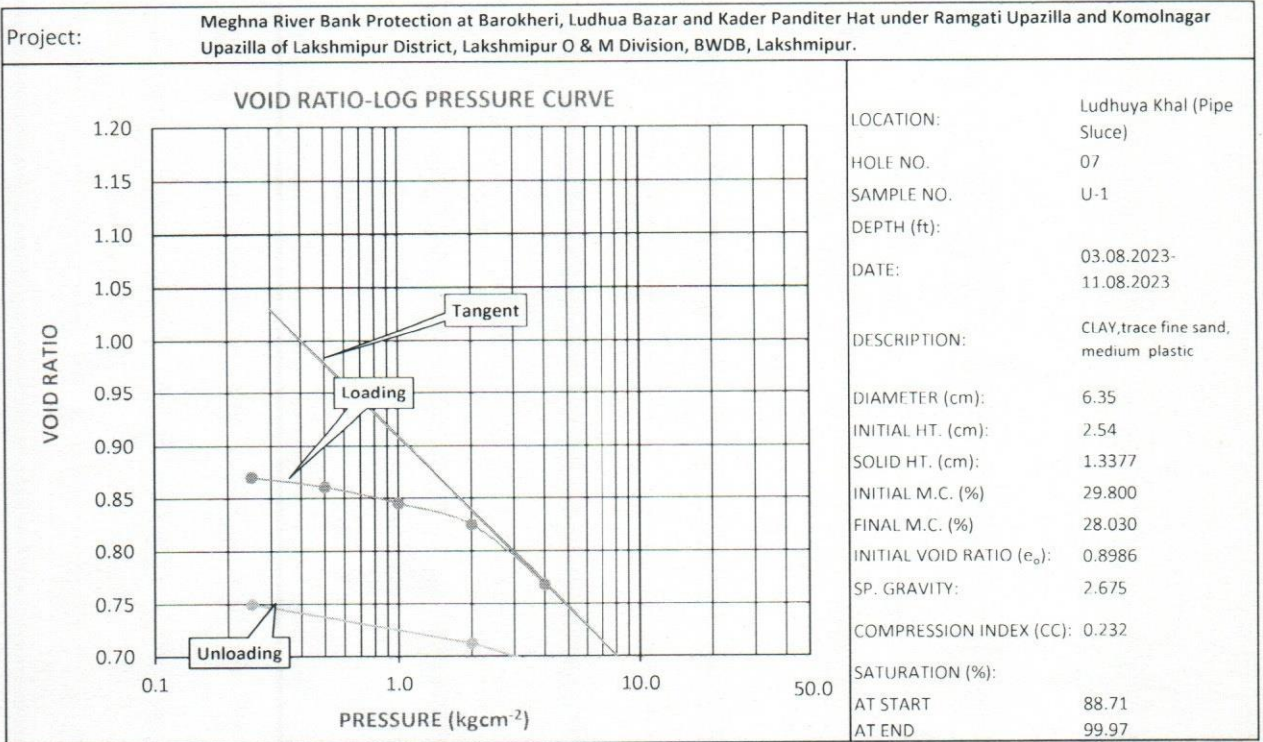


Tested by: 

Compiled by: 

Checked by: 

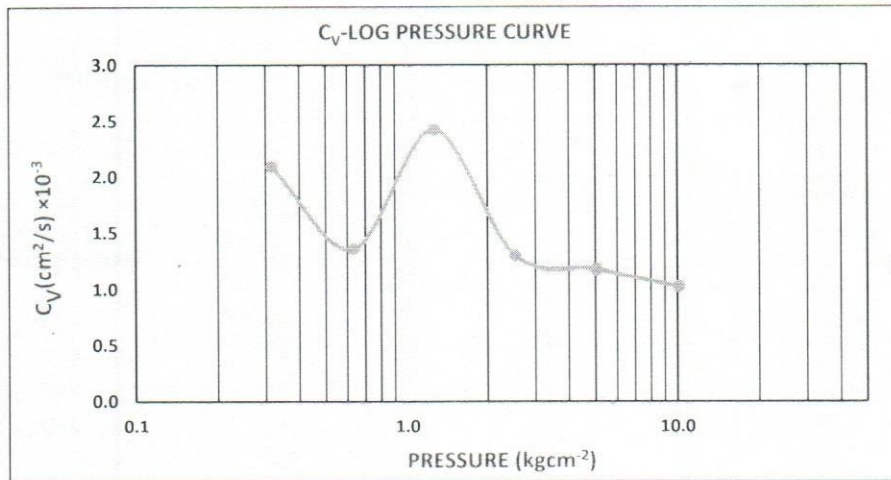
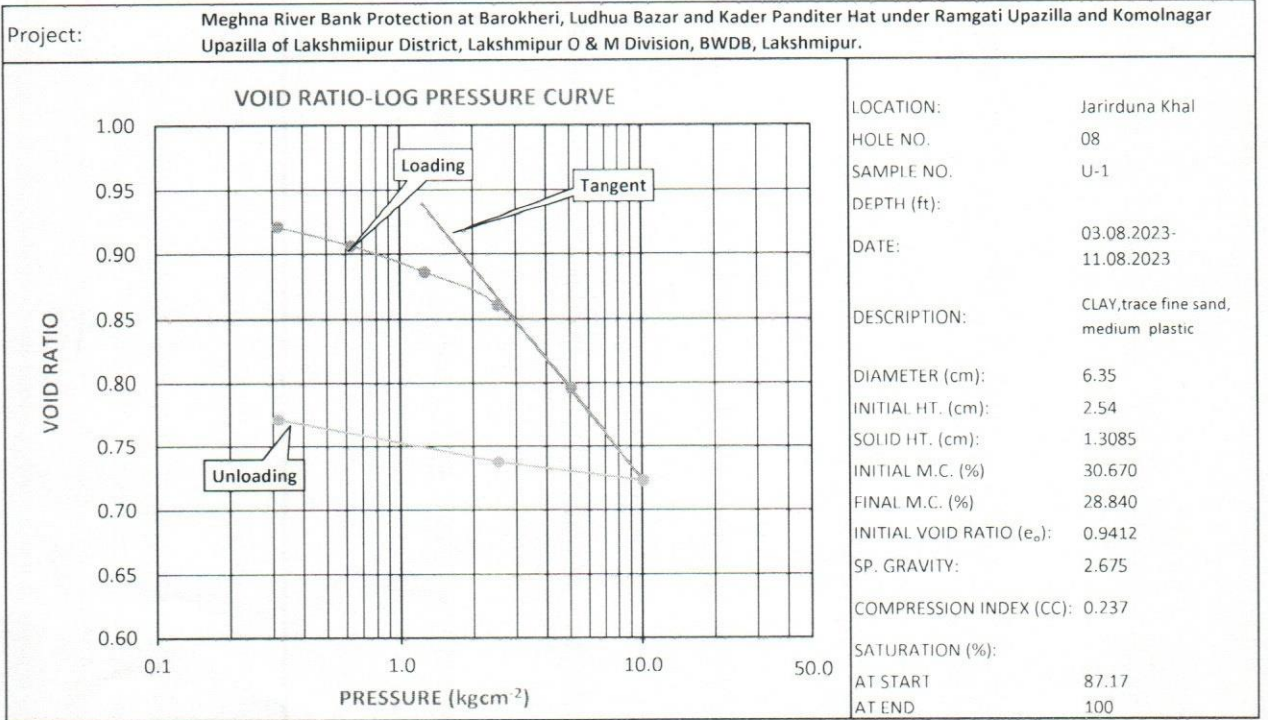
Approved By: 



Tested by: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]* Approved By: *[Signature]*



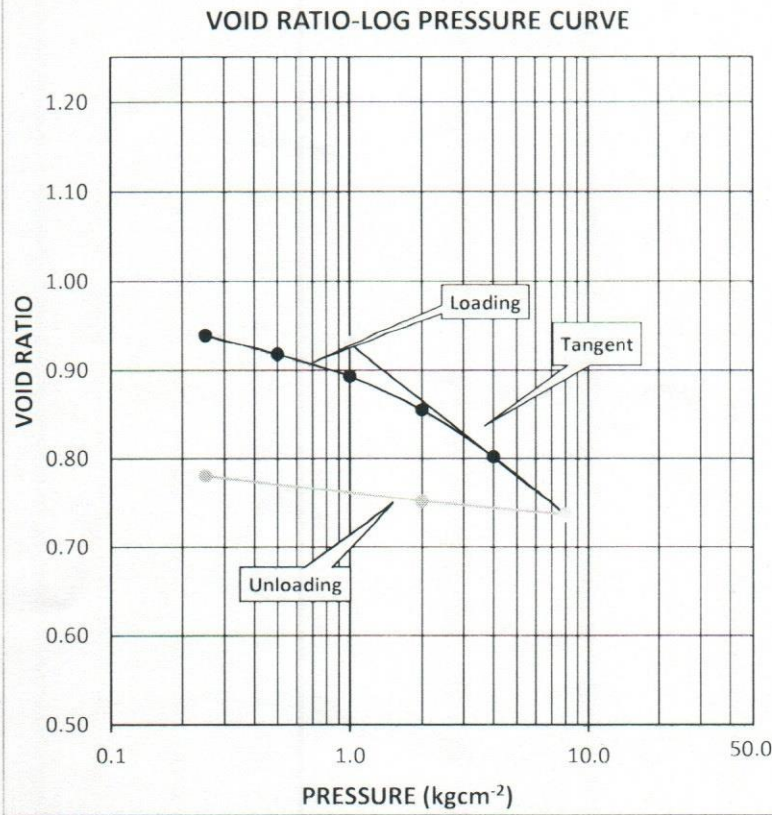
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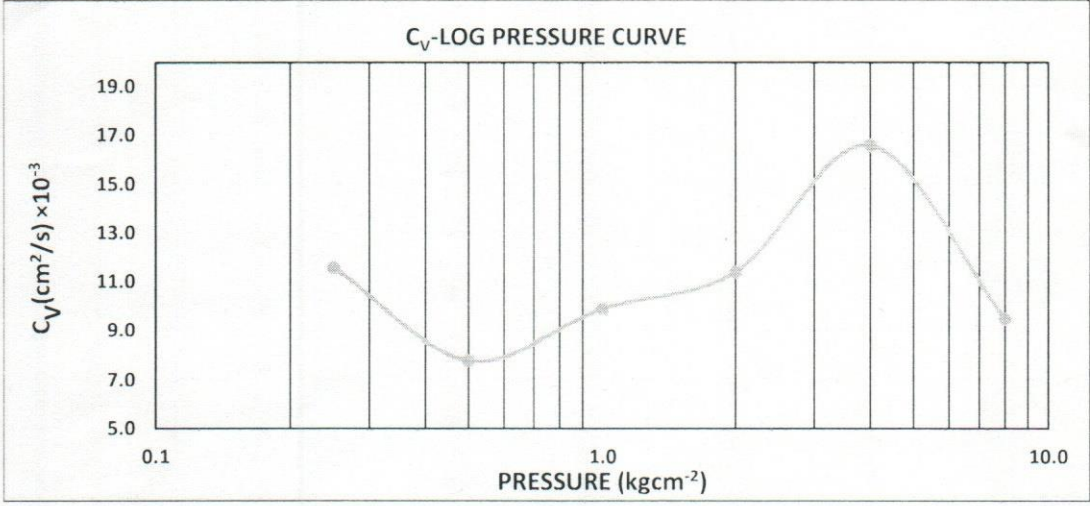
Checked by: *[Signature]*

Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

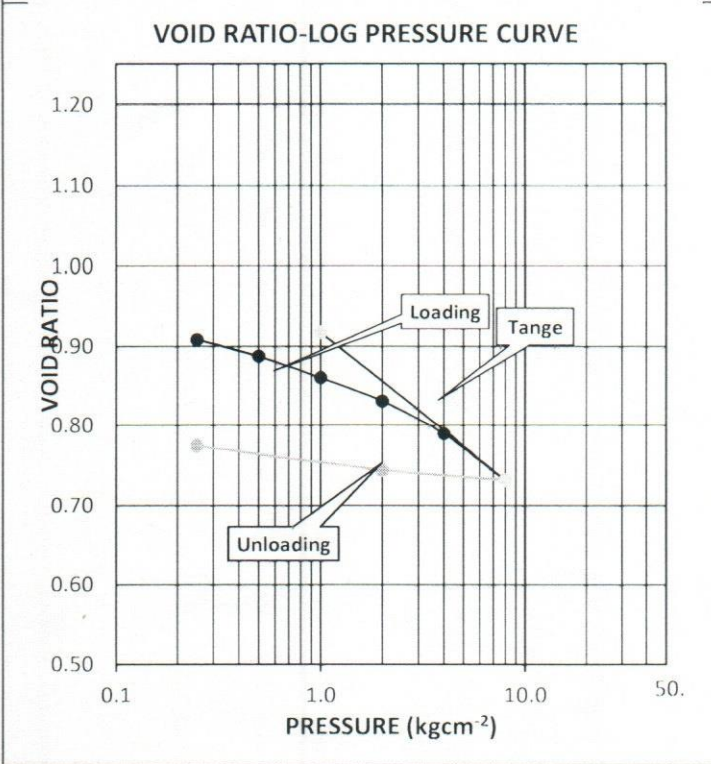


LOCATION: Jarirdona Khal sluice
 HOLE NO. 9
 SAMPLE NO. UD-1
 DEPTH (ft):
 DATE: 11.08.2023 to 20.08.2023
 DESCRIPTION: Grey moist. CLAY, trace fine sand, medium plastic.
 DIAMETER: 6.35 cm
 INITIAL HT. 2.54 cm
 SOLID HT. 1.2896
 INITIAL M.C. 32.05%
 FINAL M.C. 29.18%
 INITIAL VOID RATIO (e₀): 0.96970
 SP. GRAVITY: 2.675
 COMPRESSION INDEX (CC): 0.214
 SATURATION (%):
 AT START 88.14%
 AT END 99.99%

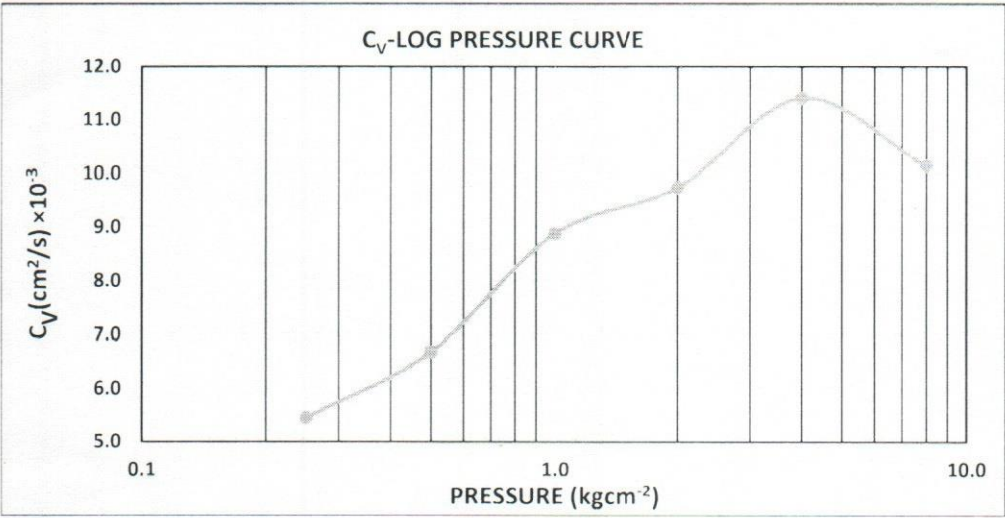


Tested by: *[Signature]* Compiled by: *[Signature]* Checked by: *[Signature]* Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

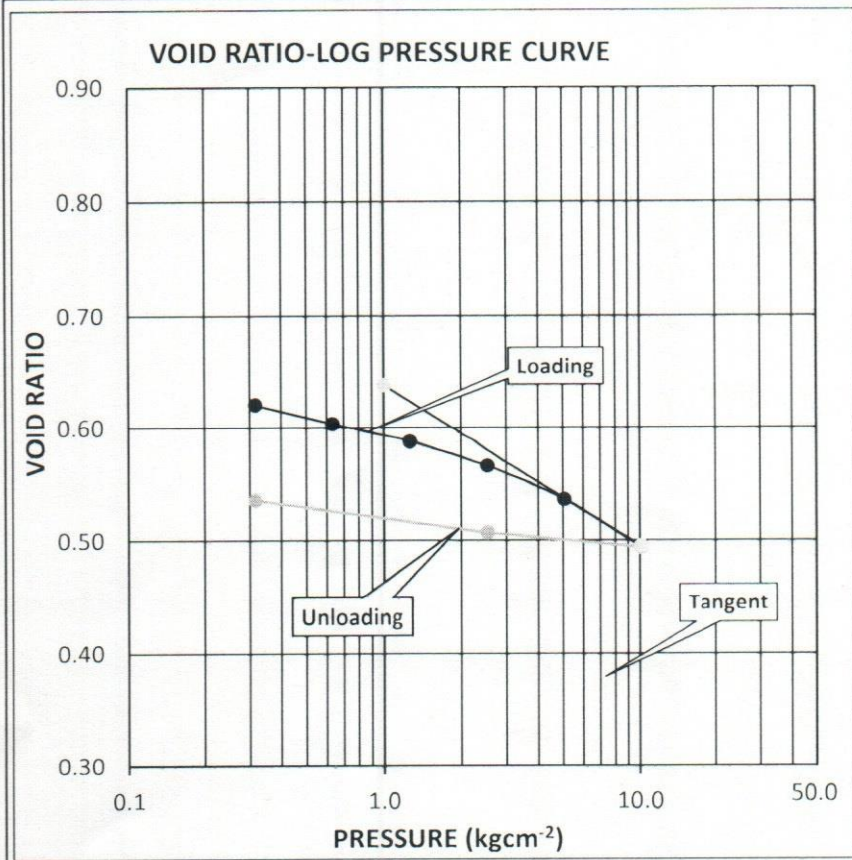


LOCATION:	Hazir khal.
HOLE NO:	10
SAMPLE NO:	UD-1
DEPTH (ft):	
DATE:	11.08.2023 to 20.08.2023
DESCRIPTION:	Grey moist. CLAY, trace fine sand, medium plastic.
DIAMETER:	6.35 cm
INITIAL HT.	2.54 cm
SOLID HT.	1.302
INITIAL M.C.	32.27%
FINAL M.C.	28.93%
INITIAL VOID RATIO (e ₀):	0.95080
SP. GRAVITY:	2.675
COMPRESSION INDEX (CC):	0.205
SATURATION (%):	
AT START	90.45%
AT END	99.95%

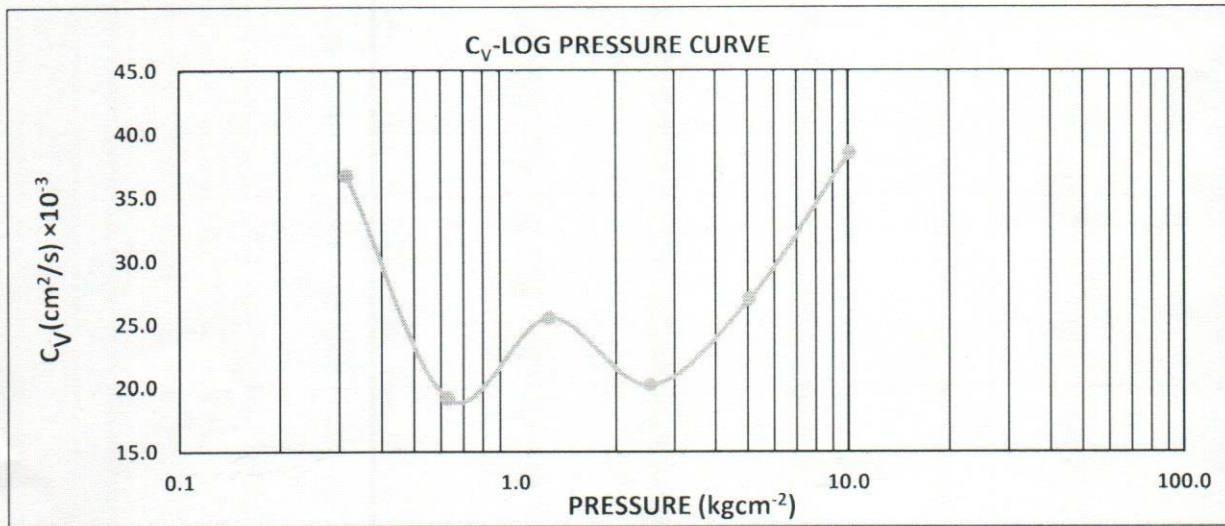


Tested by: *[Signature]* Compiled by: *[Signature]* Checked by: *[Signature]* Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



LOCATION: Malekar khal
 HOLE NO. 11
 SAMPLE NO. UD-1
 DEPTH (ft):
 DATE: 11.08.2023 to 20.08.2023
 DESCRIPTION: Grey moist. CLAY, trace fine sand, high plastic.
 DIAMETER: 6.35 cm
 INITIAL HT. 2.54 cm
 SOLID HT. 1.5157
 INITIAL M.C. 22.22%
 FINAL M.C. 20.02%
 INITIAL VOID RATIO (e₀): 0.67580
 SP. GRAVITY: 2.68
 COMPRESSION INDEX (CC): 0.142
 SATURATION (%):
 AT START 87.95%
 AT END 99.93%



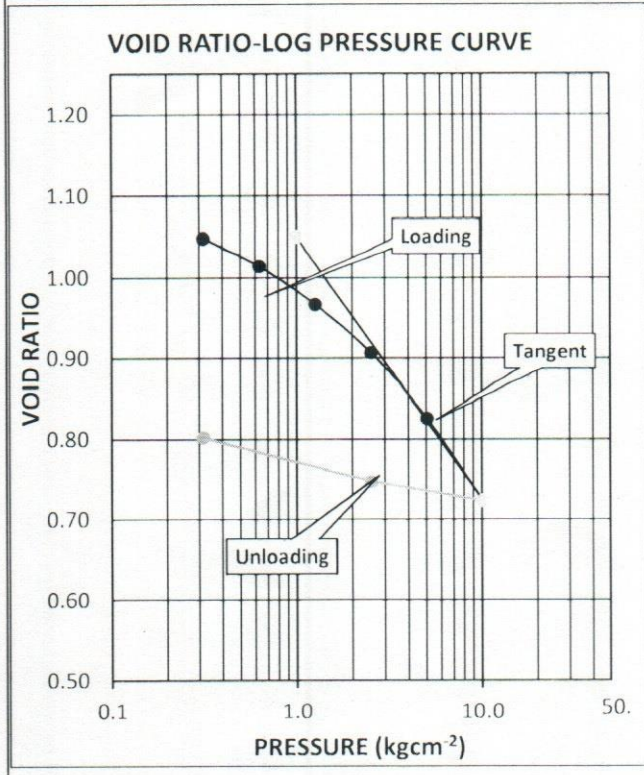
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Compiled by: *[Signature]*

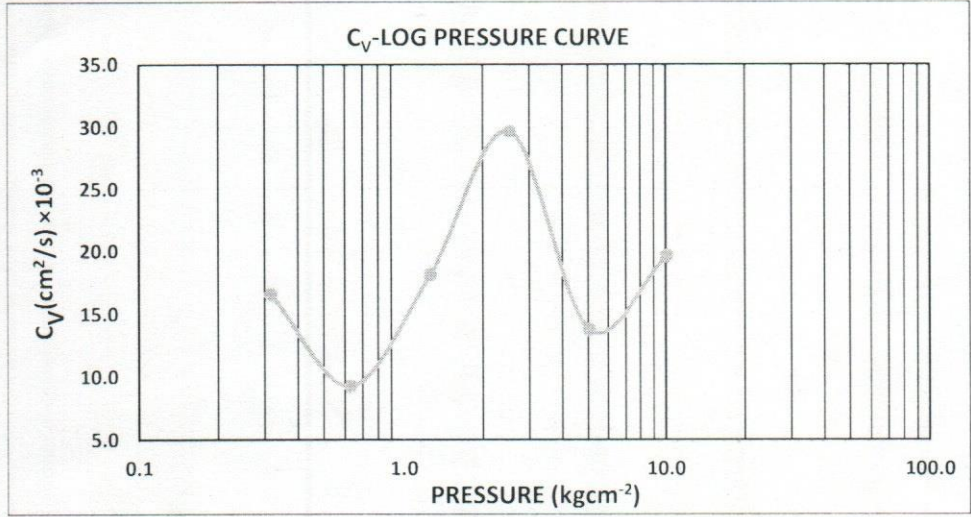
Checked by: *[Signature]*

Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.

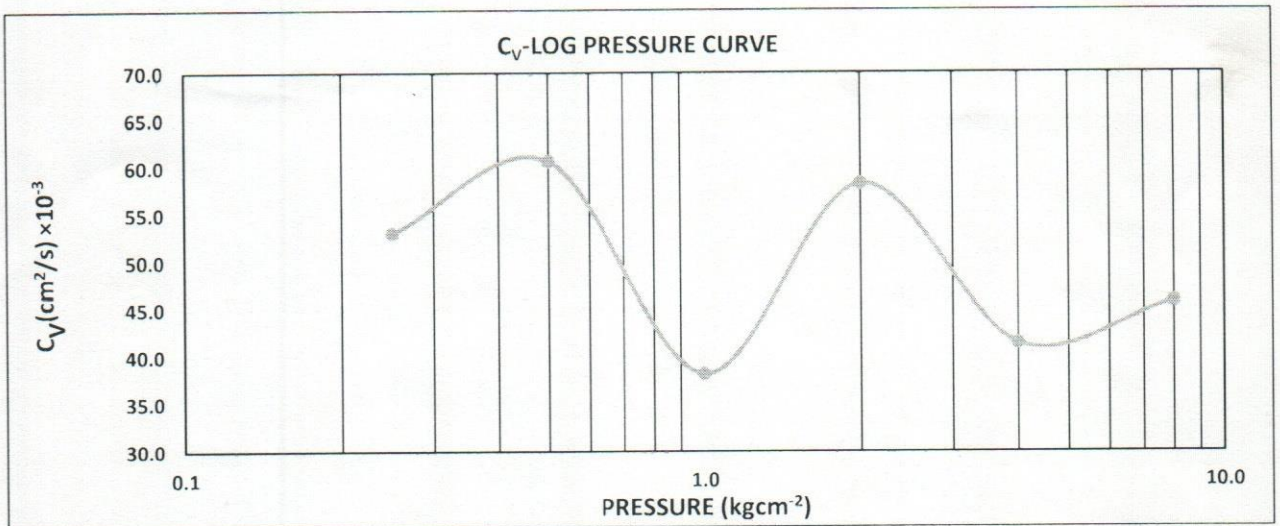
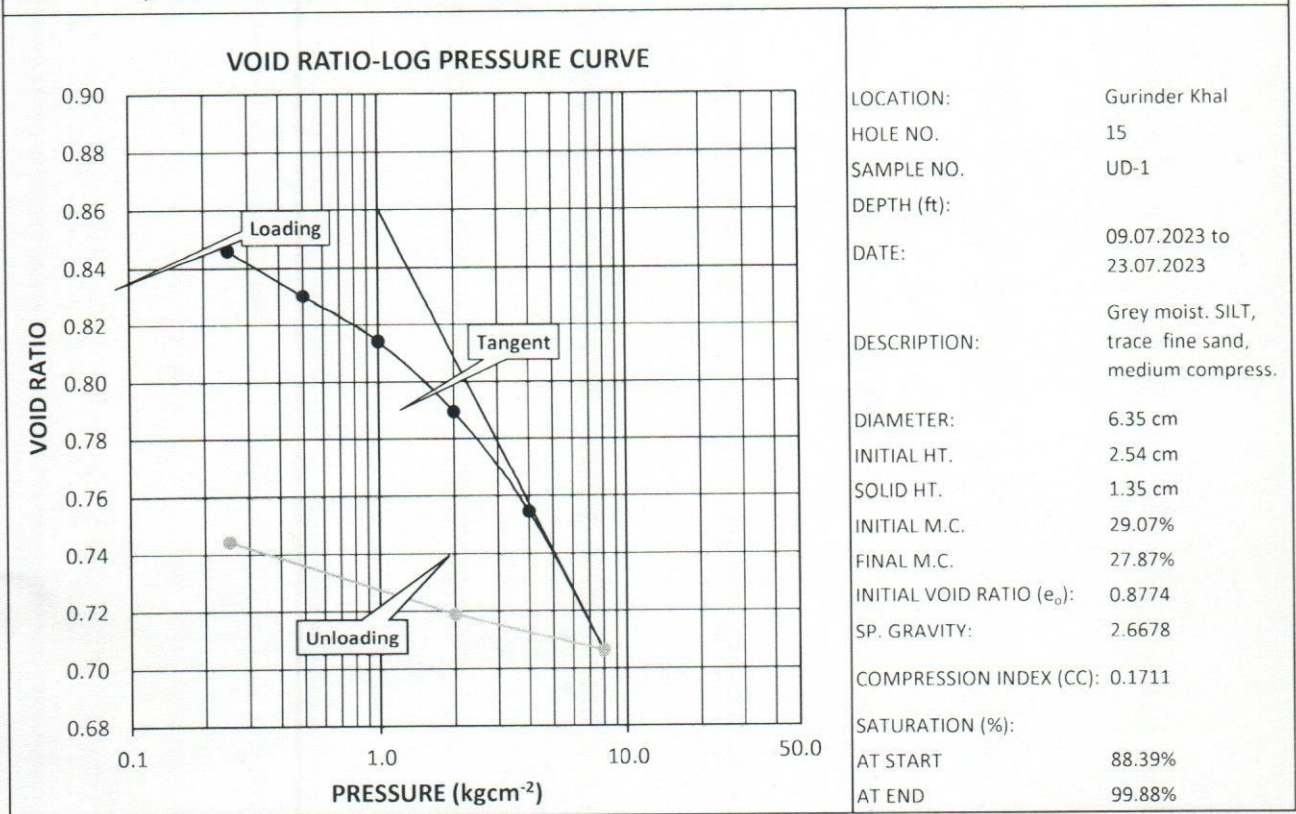


LOCATION:	Kalir Khal
HOLE NO.	14
SAMPLE NO.	UD-1
DEPTH (ft):	
DATE:	11.08.2023 to 20.08.2023
DESCRIPTION:	Grey moist. CLAY, trace fine sand, high plastic.
DIAMETER:	6.35 cm
INITIAL HT.	2.54 cm
SOLID HT.	1.1974
INITIAL M.C.	37.83%
FINAL M.C.	29.92%
INITIAL VOID RATIO (e ₀):	1.12120
SP. GRAVITY:	2.68
COMPRESSION INDEX (CC):	0.32400
SATURATION (%):	
AT START	90.42%
AT END	99.96%



Tested by: *[Signature]* Compiled by: *[Signature]* Checked by: *[Signature]* Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



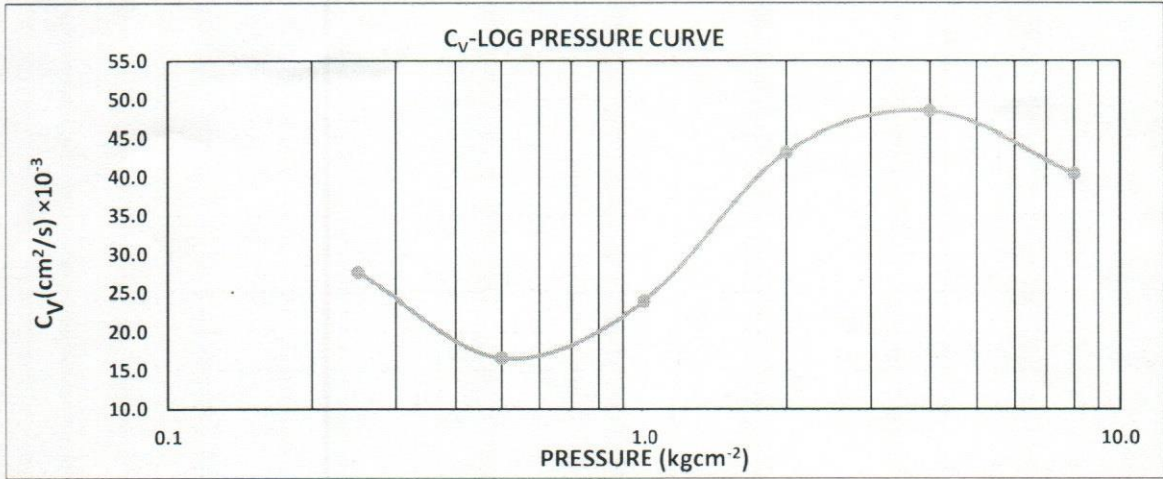
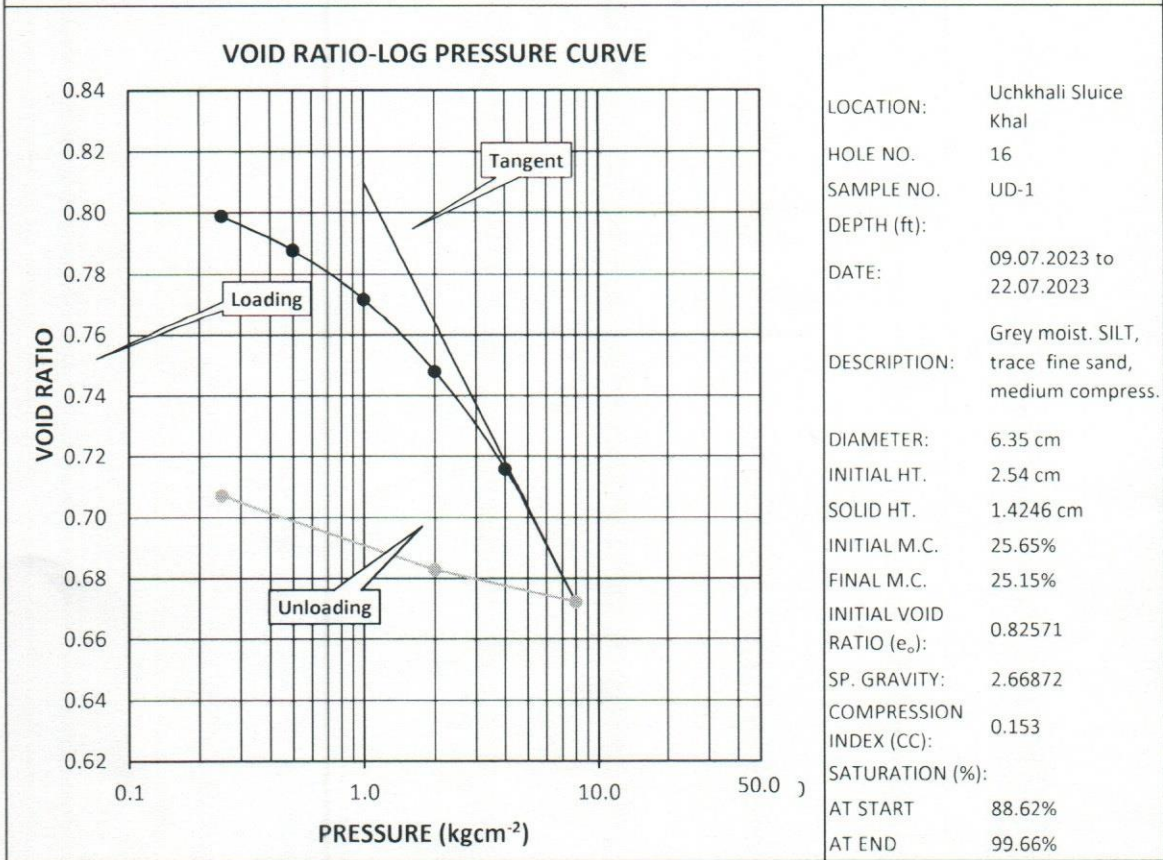
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Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved By: *[Signature]*

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmiipur District, Lakshmiipur O & M Division, BWDB, Lakshmiipur.



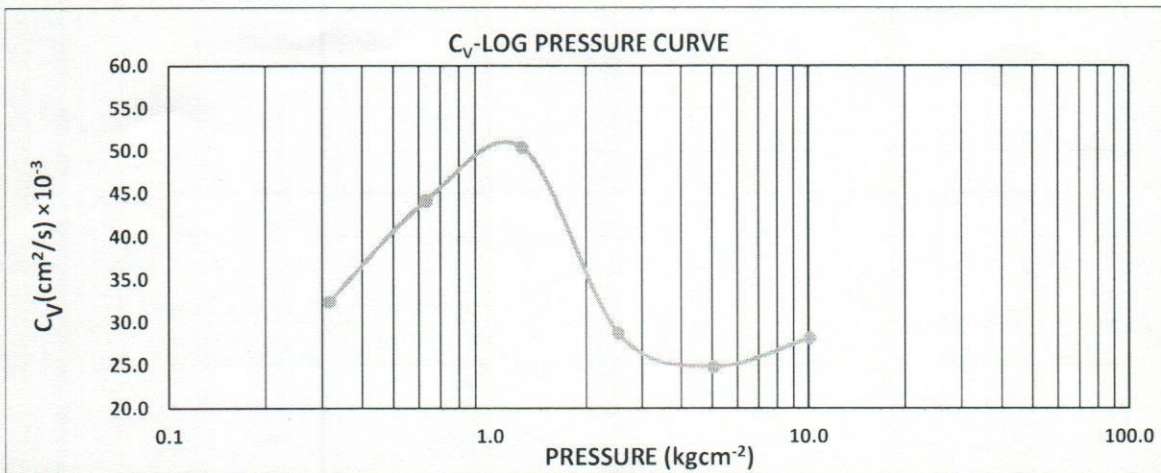
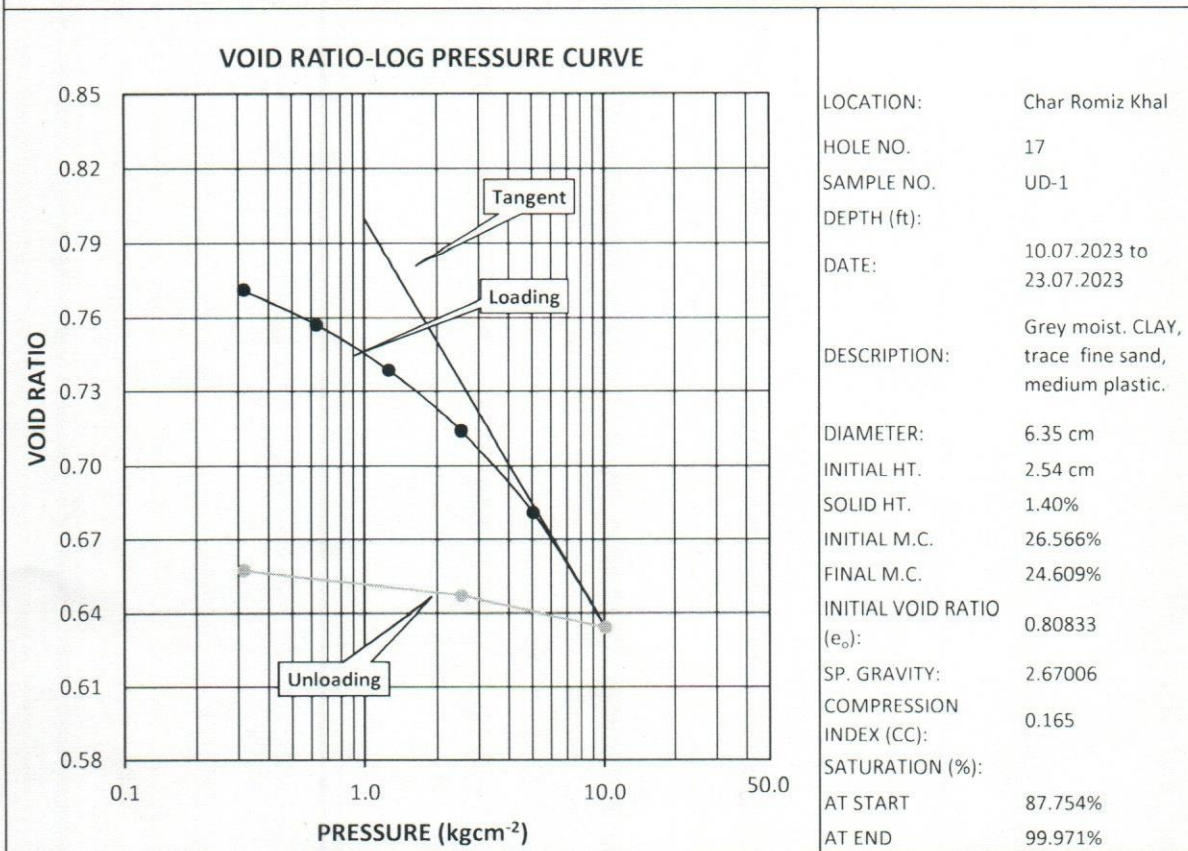
Tested by: *[Signature]*

Compiled by: *[Signature]*

Checked by: *[Signature]*

Approved By: *[Signature]*
Attachment-IV
Sheet 11 of 14

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



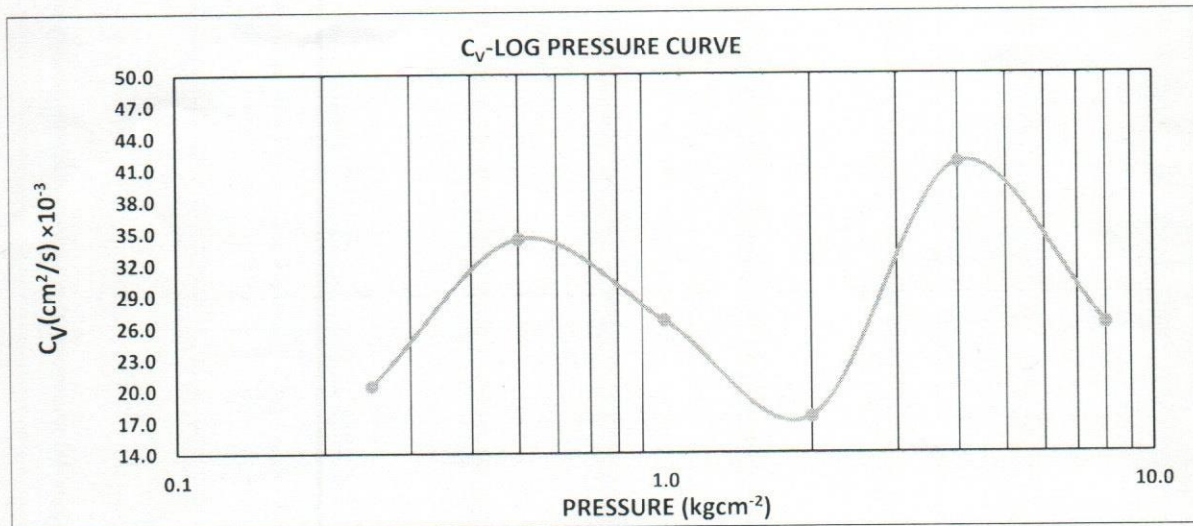
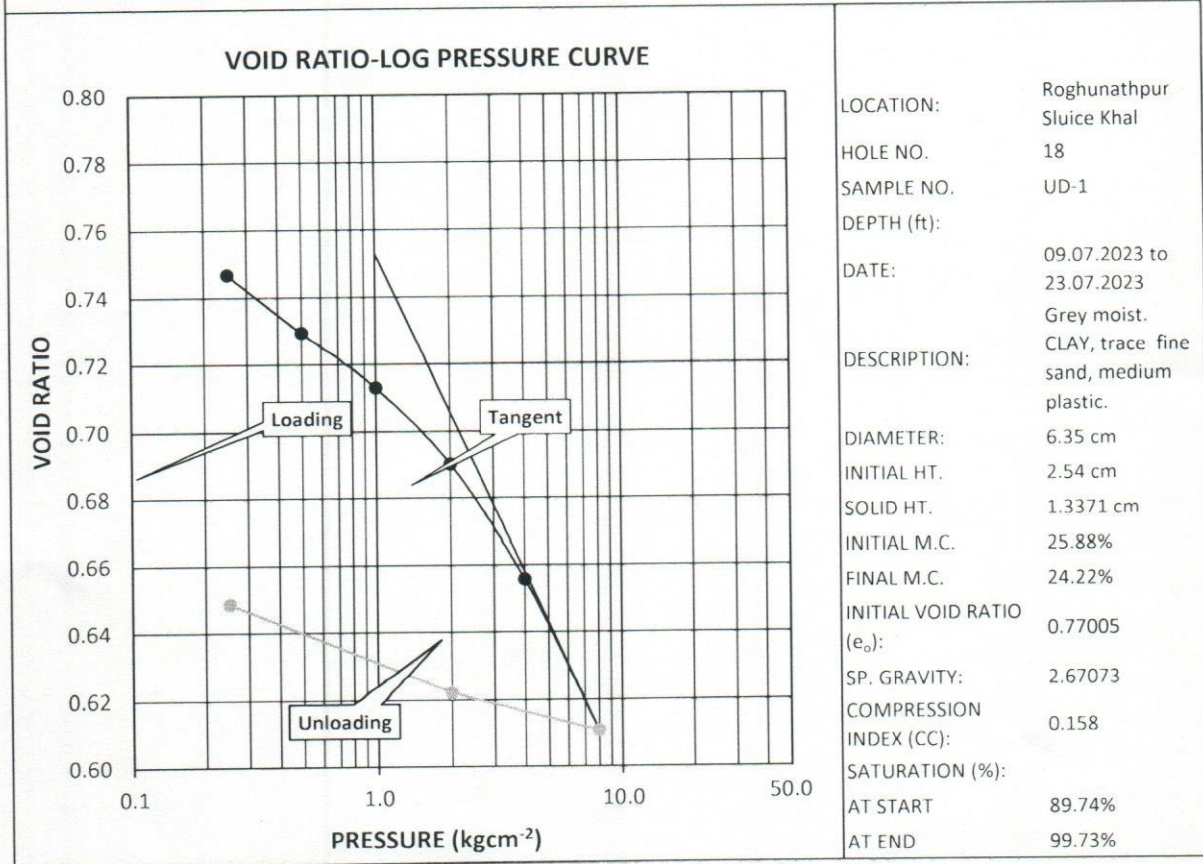
Tested by:


Compiled by:


Checked by:


Approved By:
Attachment-IV
Sheet 12 of 14

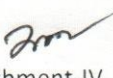
Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmiipur O & M Division, BWDB, Lakshmipur.



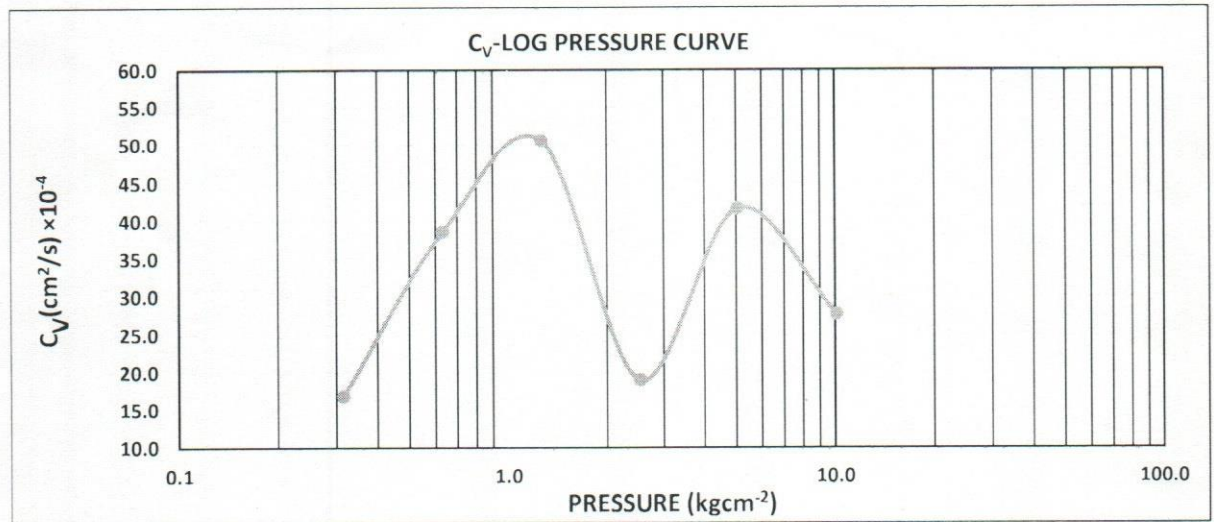
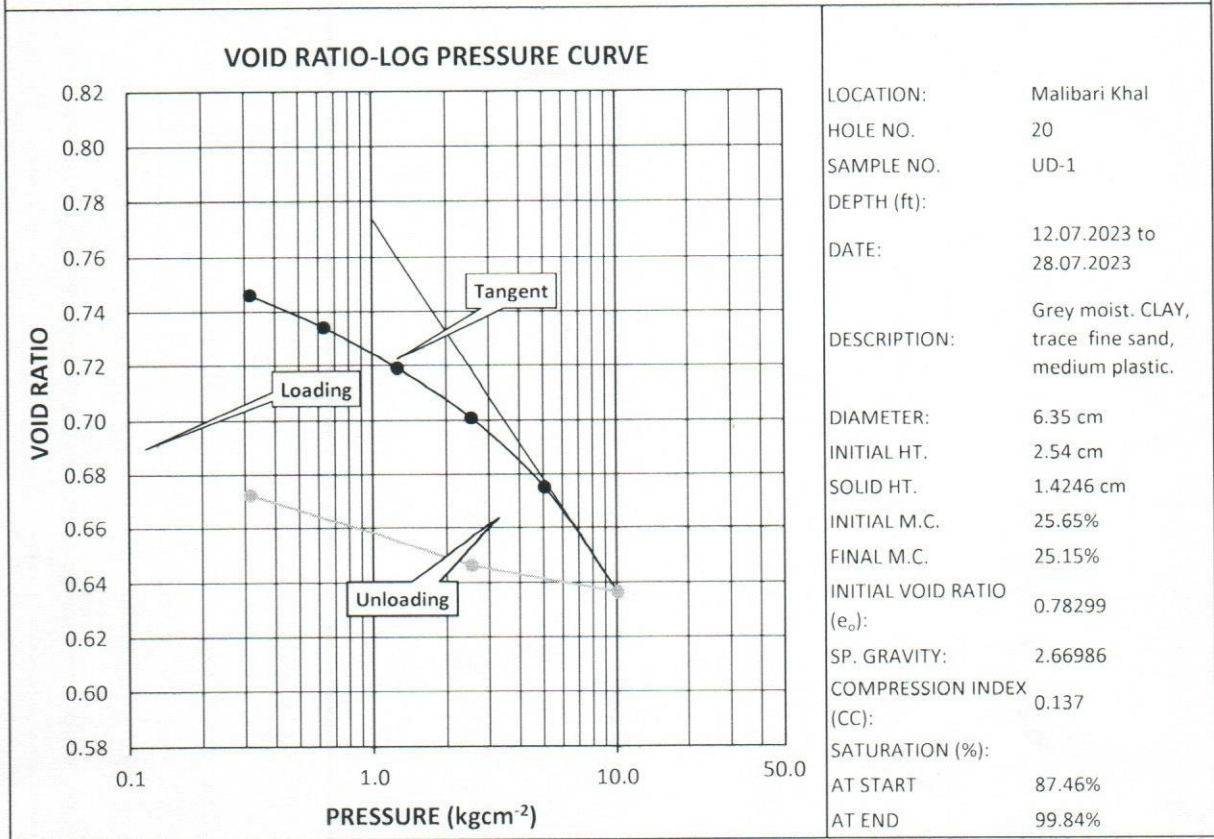
Tested by: 

Compiled by: 

Checked by: 

Approved By: 

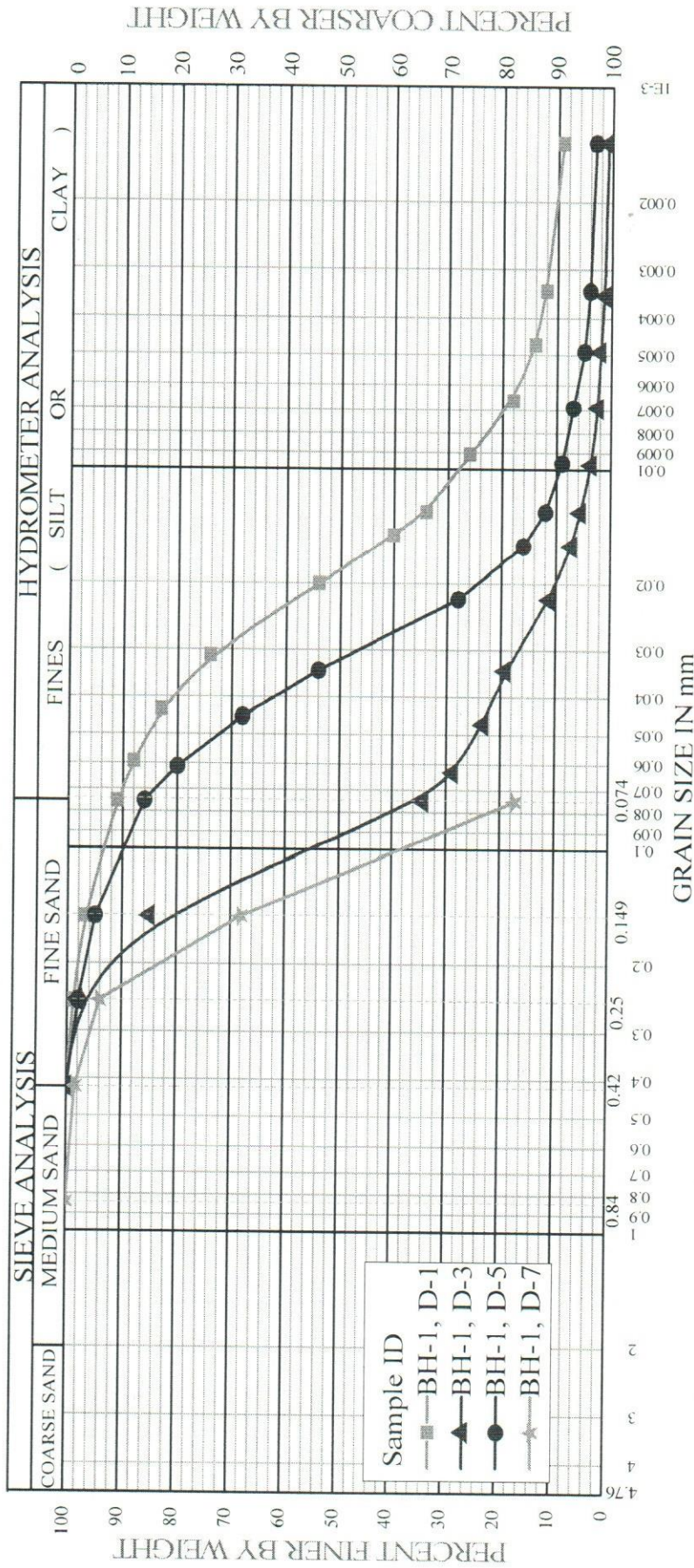
Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakshmpur.



Tested by: *[Signature]* Compiled by: *[Signature]* Checked by: *[Signature]* Approved By: *[Signature]*

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SOIL MECHANICS DIVISION
GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



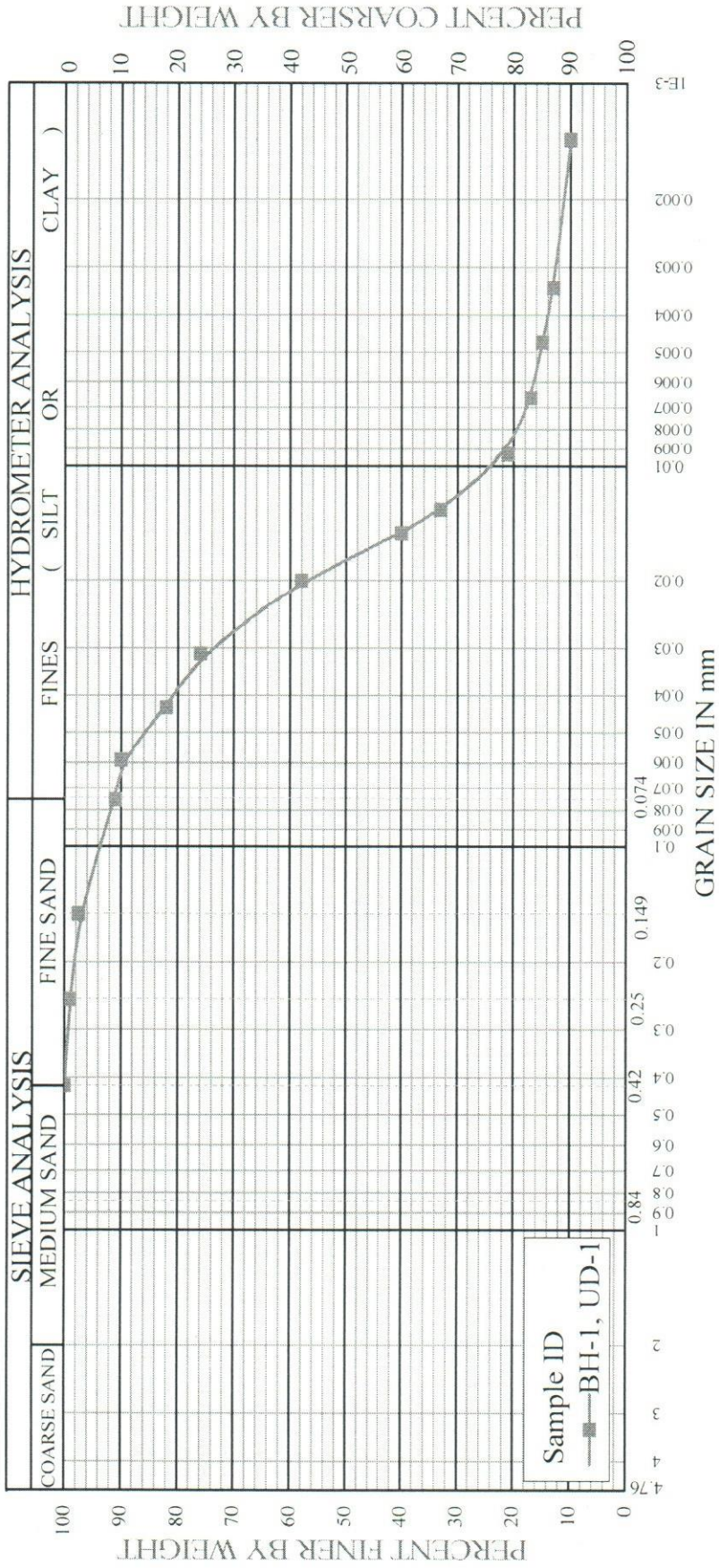
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Joybanglakhali	1	D-1	5	Sand-9.5, Silt-80.5 & Clay-10
Joybanglakhali	1	D-3	15	Sand-64, Silt-35 & Clay-1
Joybanglakhali	1	D-5	25	Sand-15, Silt-82 & Clay-3
Joybanglakhali	1	D-7	35	Sand-82.5 & Silt-17.5

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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Joybanglakhai	1	UD-1	N/S	Sand-9, Silt-80 & Clay-11

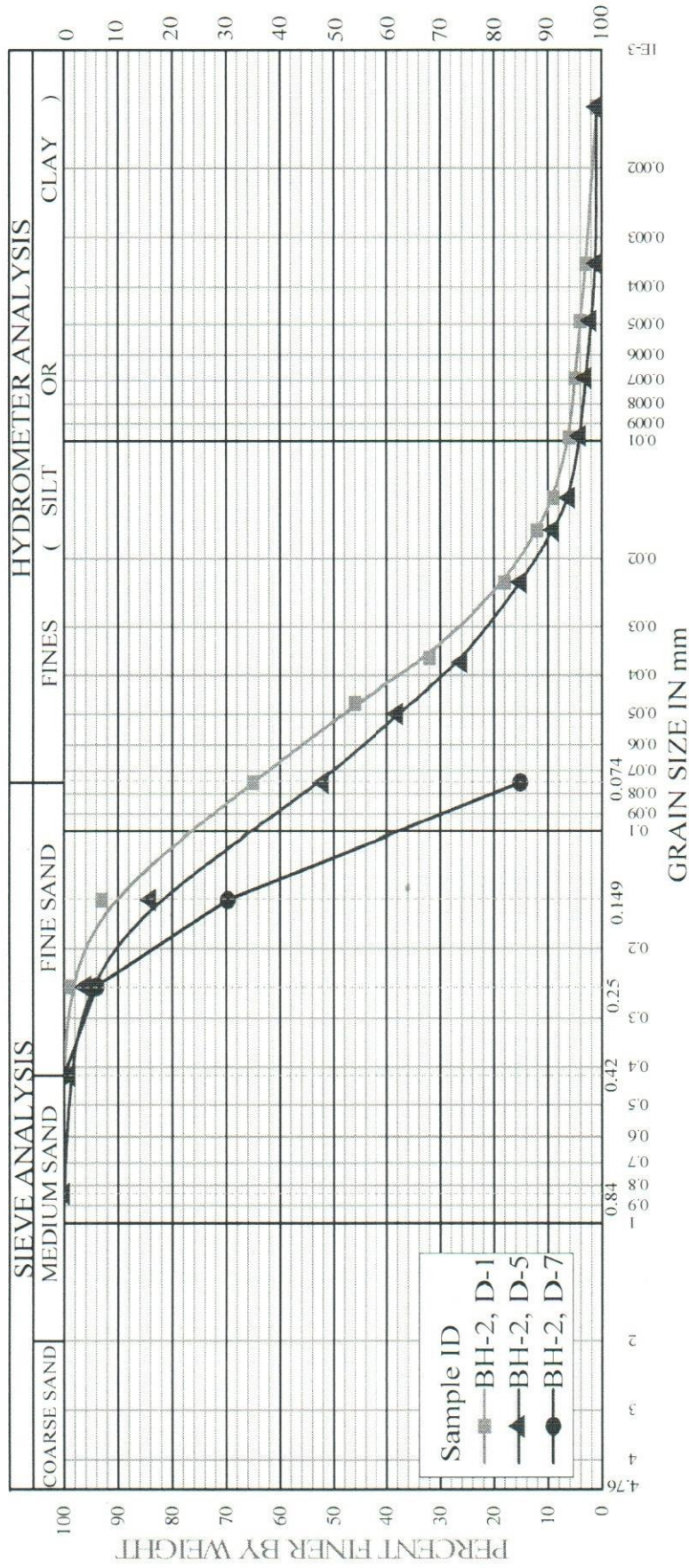
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GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Battir Khal	2	D-1	5	Sand-35, Silt-63 & Clay-2
Battir Khal	2	D-5	25	Sand-46, Silt-53 & Clay-1
Battir Khal	2	D-7	35	Sand-85 & Silt-15

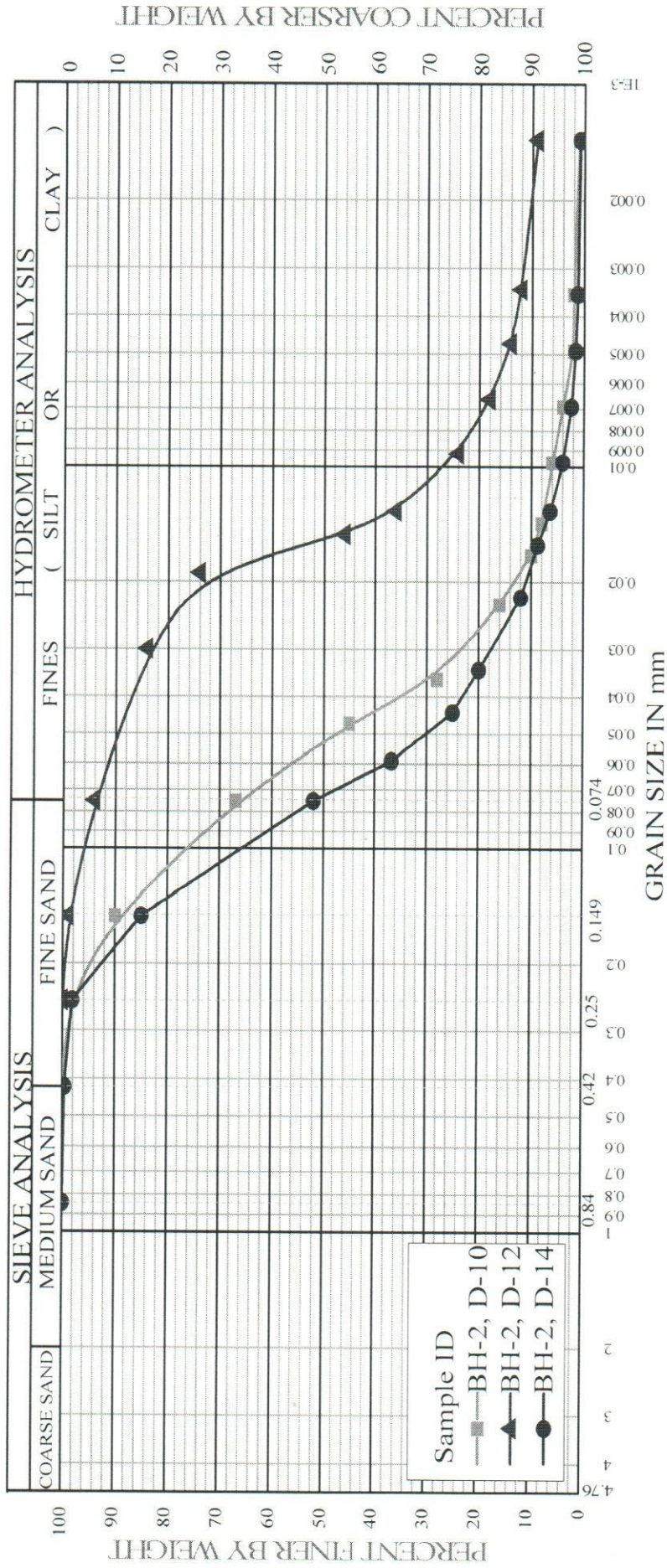
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SOIL MECHANICS DIVISION
GRADATION CURVE

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla ;
Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Battir Khal	2	D-10	50	Sand-34, Silt-65 & Clay-1
Battir Khal	2	D-12	60	Sand-6, Silt-84 & Clay-10
Battir Khal	2	D-14	70	Sand-48, Silt-51 & Clay-1

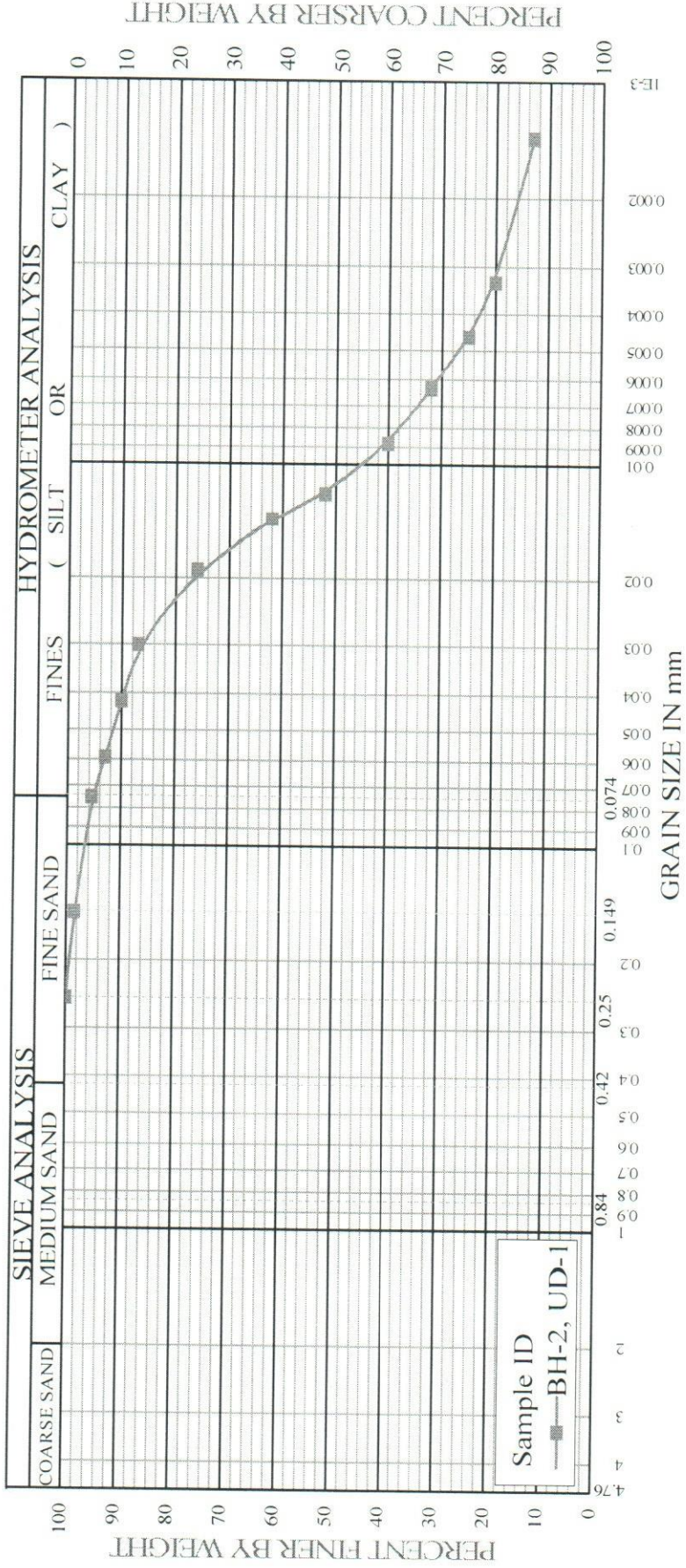
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GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



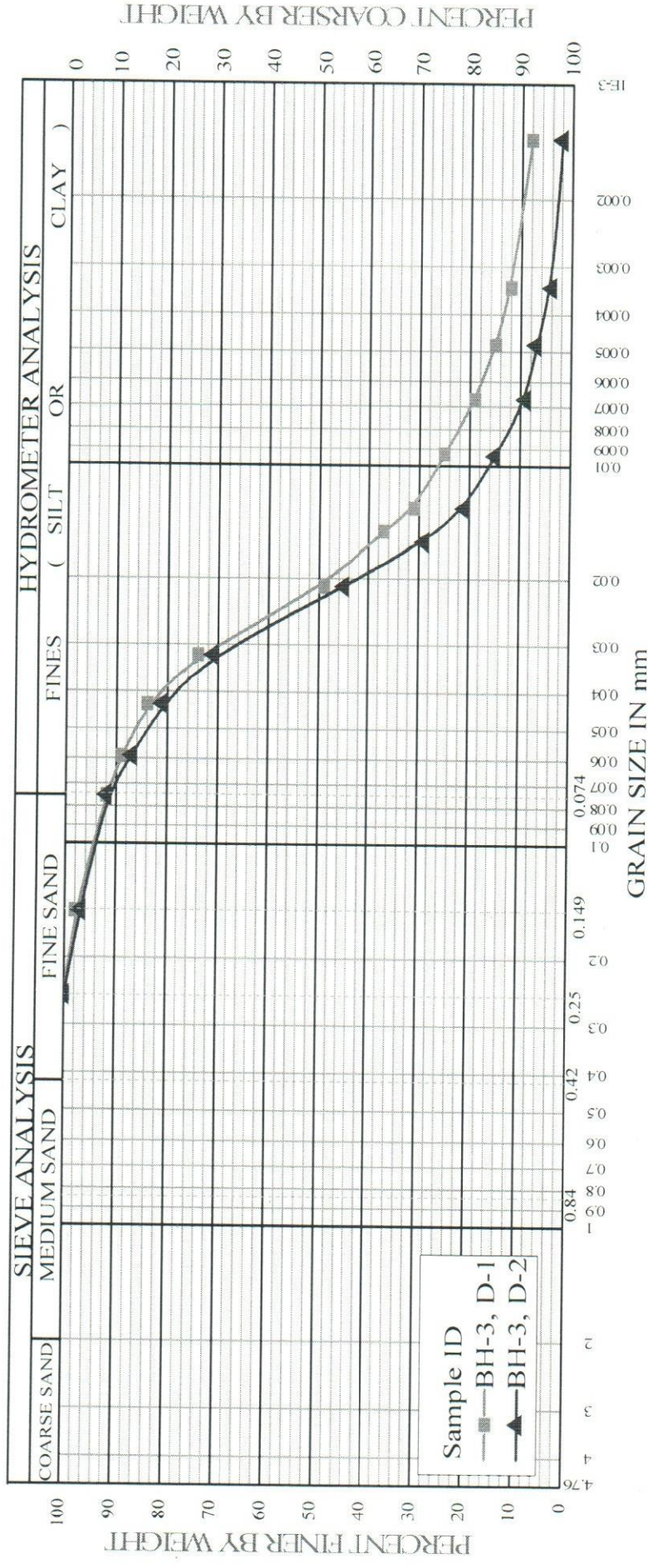
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Battir Khal	2	UD-1	N/S	Sand-3, Silt-81 & Clay-16

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GRADATION CURVE

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
M.P. Khal-1, Sluice	3	D-1	5	Sand-8, Silt-82 & Clay-10
M.P. Khal-1, Sluice	3	D-2	10	Sand-9, Silt-88 & Clay-3

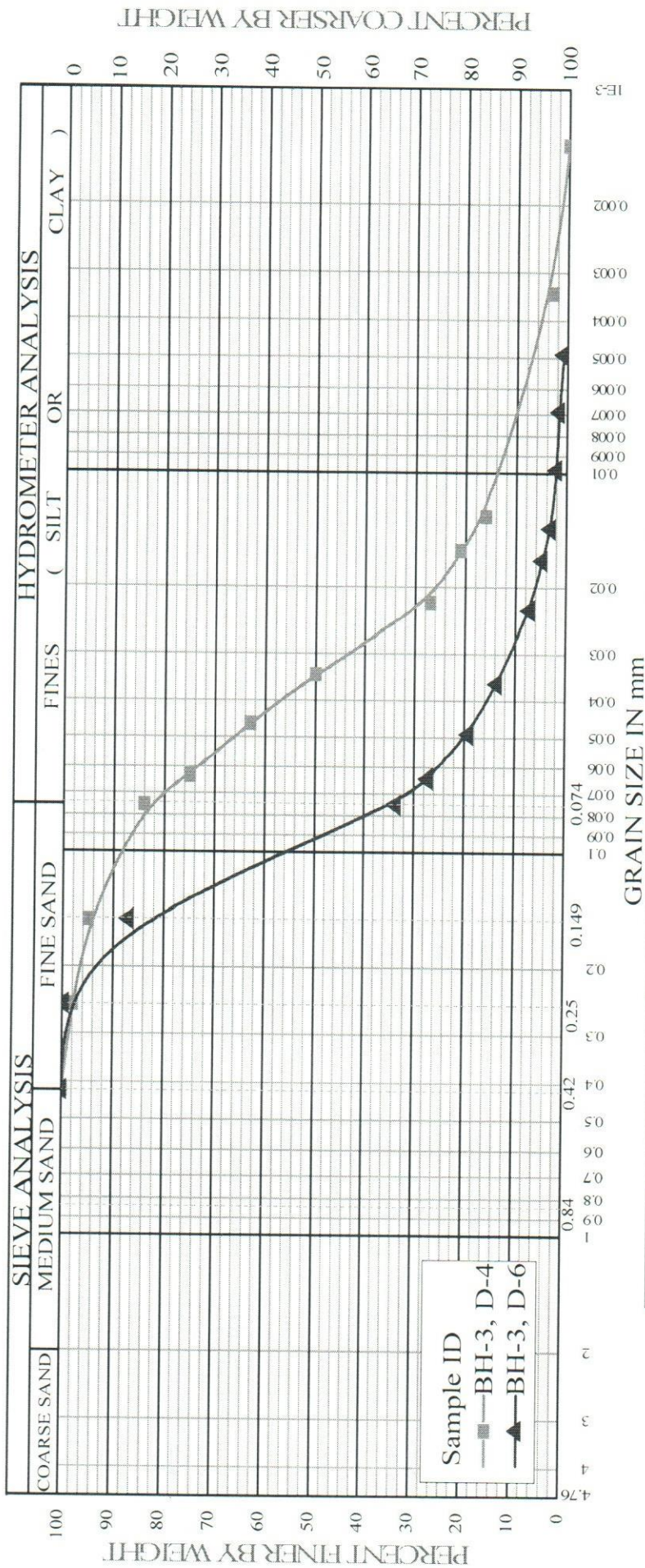
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Sheet 6 of 67
Attachment-V

Unified Soil classification

RIVER RESEARCH INSTITUTE
SOIL MECHANICS DIVISION
GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
M. P. Khal-1, Sluice	3	D-4	20	Sand-18, Silt-80.5 & Clay-1.5
M. P. Khal-1, Sluice	3	D-6	30	Sand-65 & Silt-35

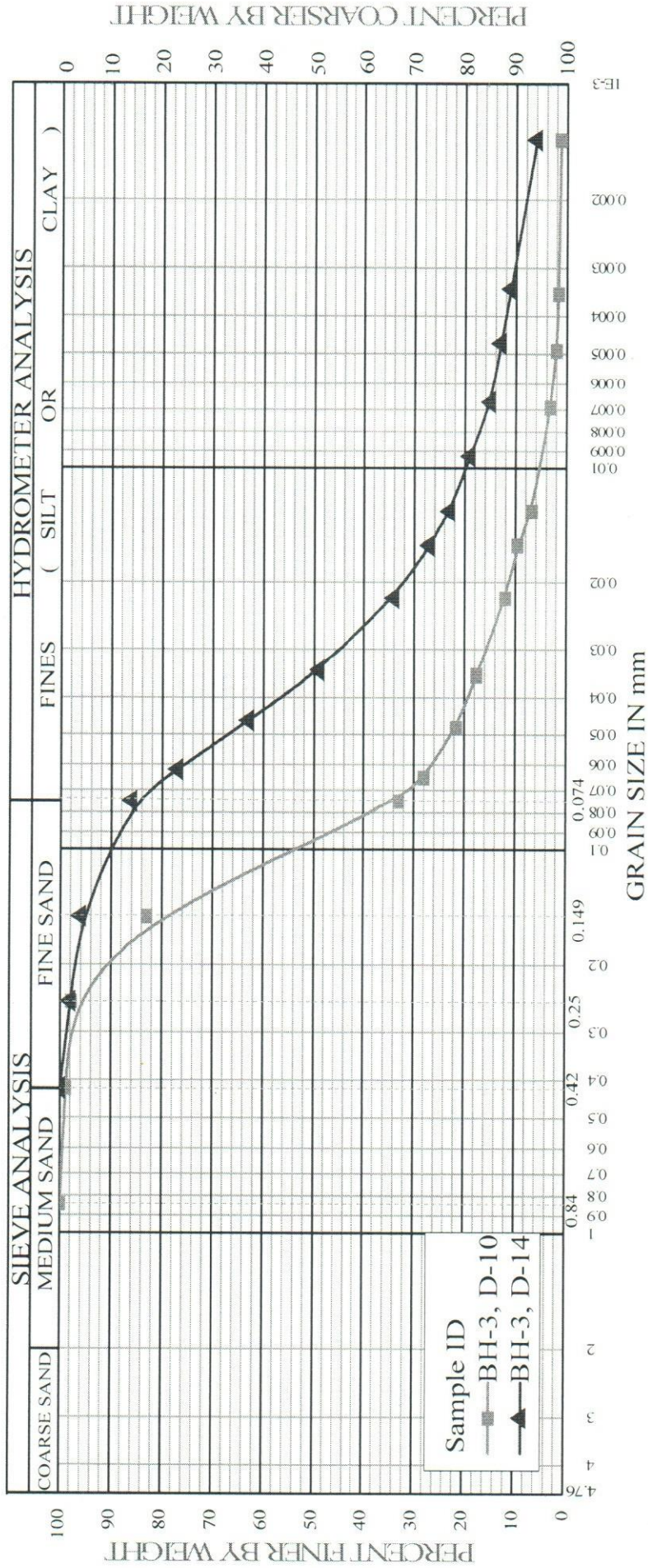
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GRADATION CURVE

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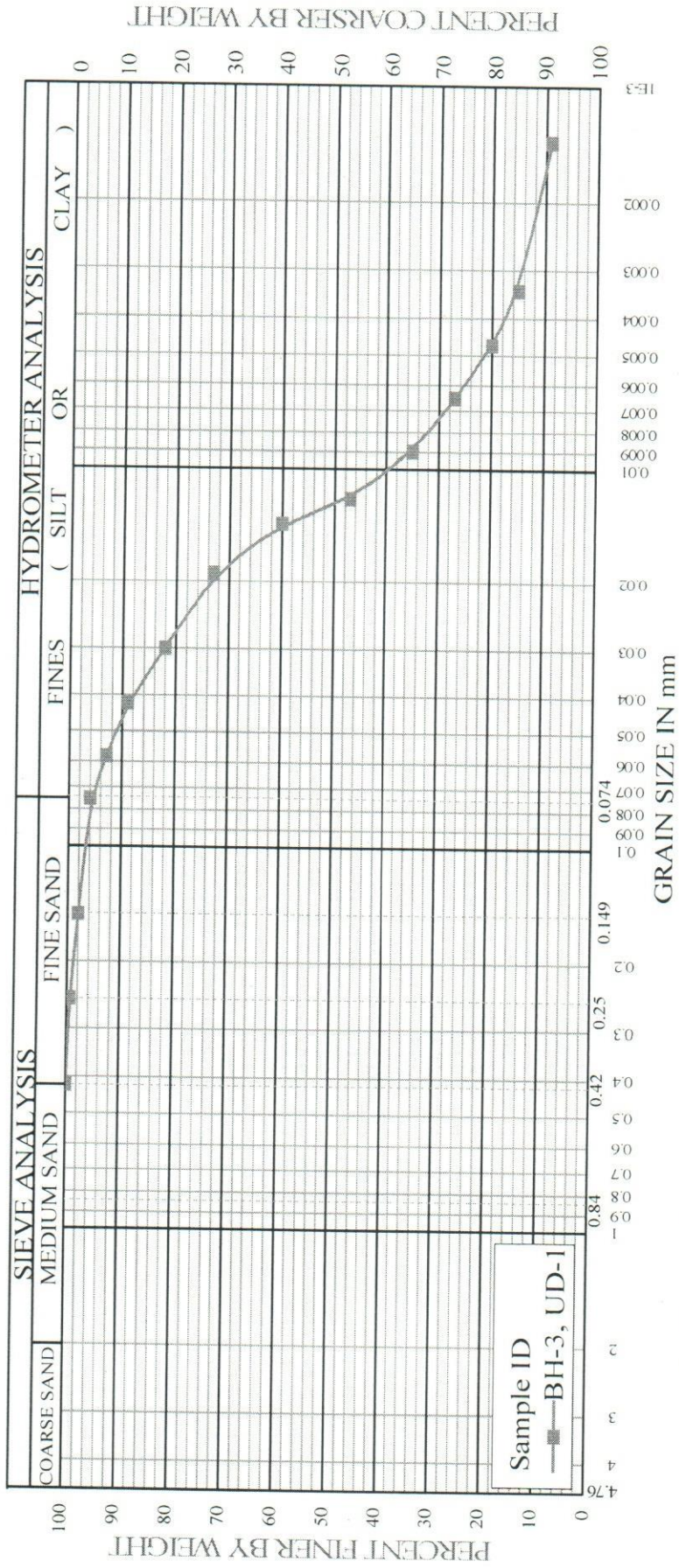
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
M.P. Khal-1, Sluice	3	D-10	50	Sand-66, Silt-32 & Clay-2
M.P. Khal-1, Sluice	3	D-14	70	Sand-16, Silt-76 & Clay-8

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Loaction	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
M.P Khal-1, Sluice	3	UD-1	--	Sand-4, Silt-84 & Clay-12

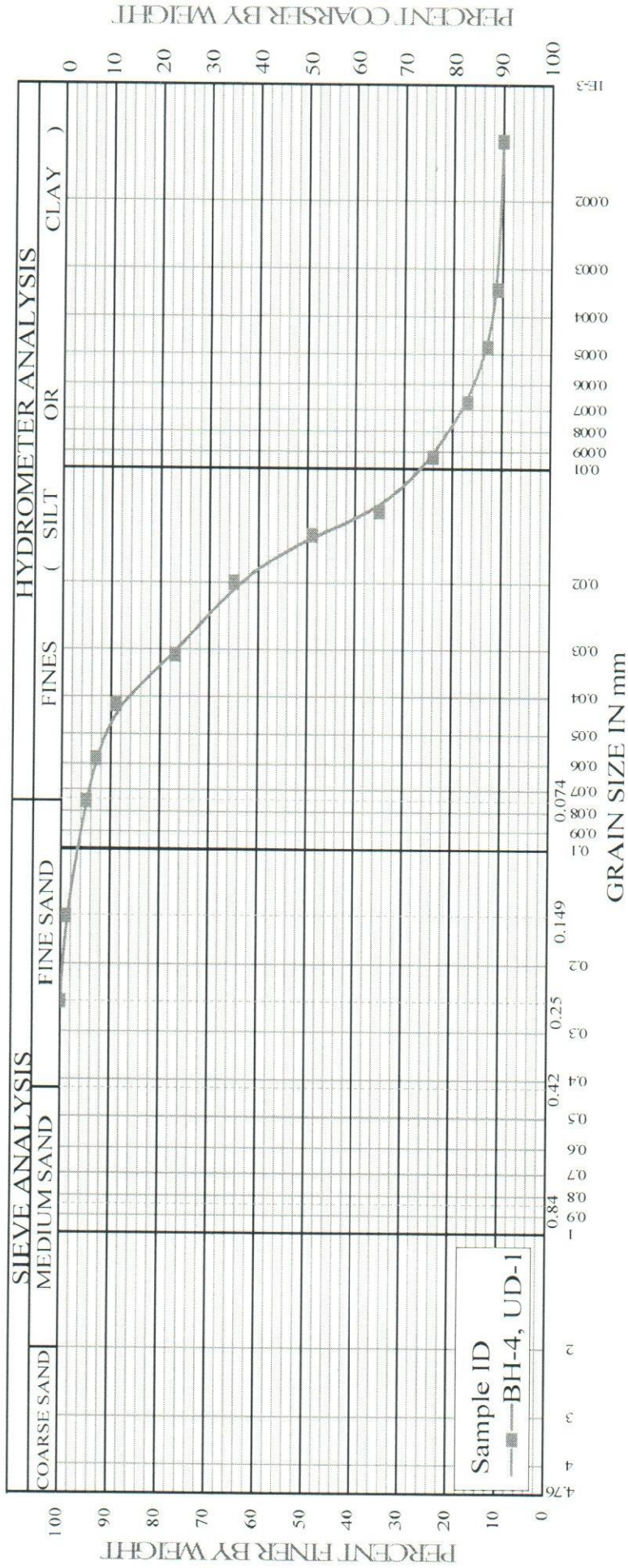
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Katoria Khal	4	UD-1	N/S	Sand-5, Silt-84.5 & Clay-10.5

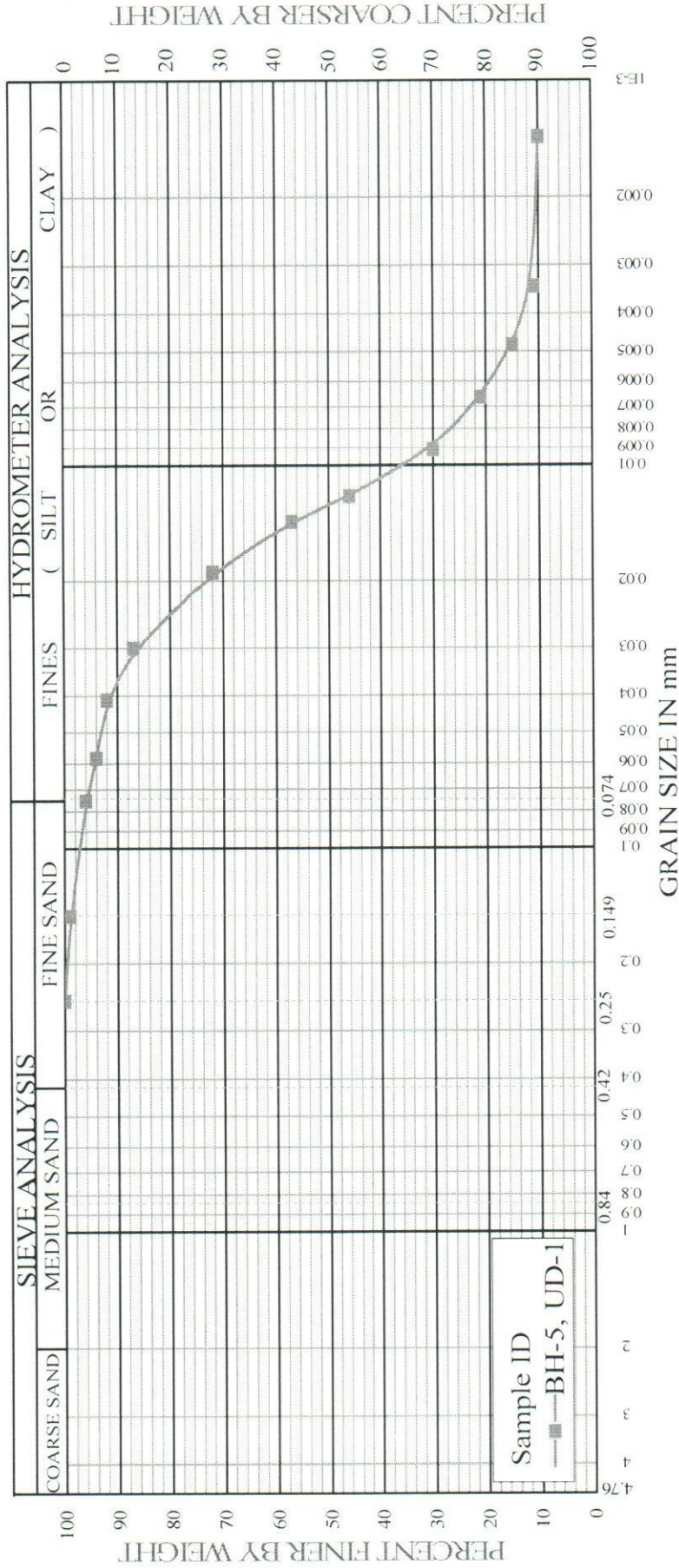
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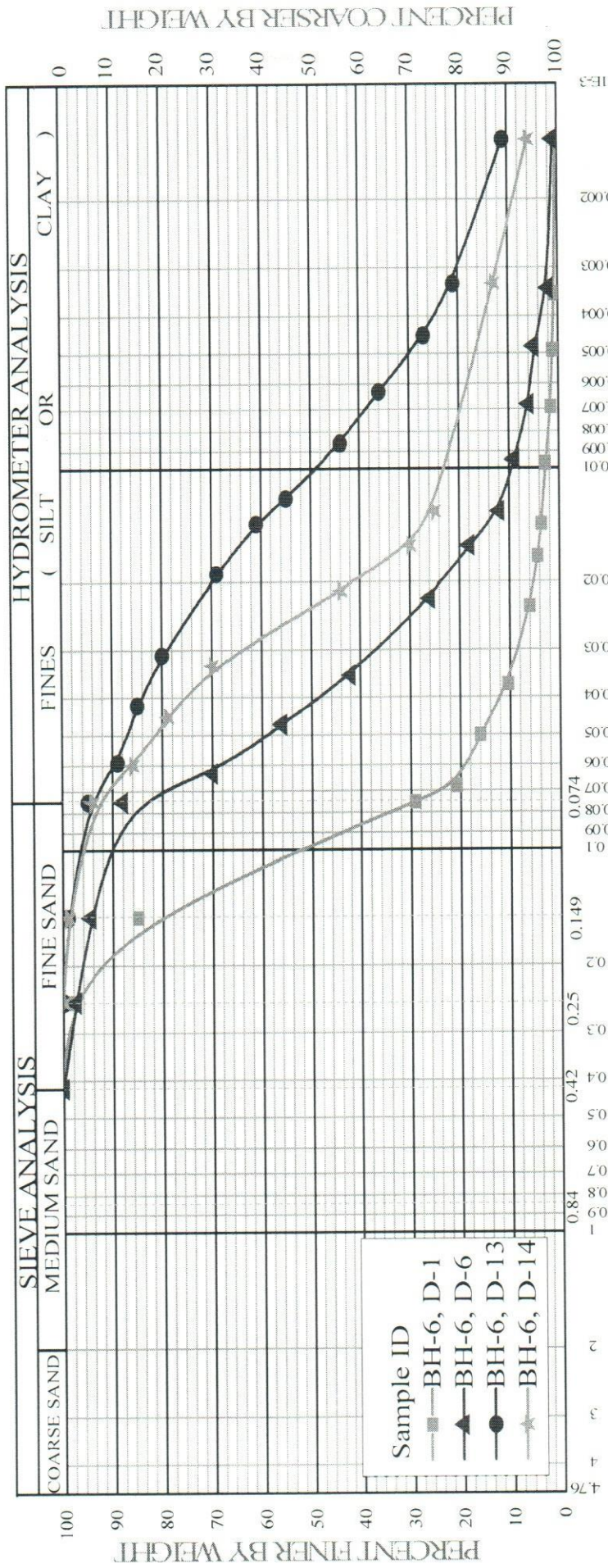
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Palabunia Khal Sluice	5	UD-1	N/S	Sand-4, Silt-86 & Clay-10

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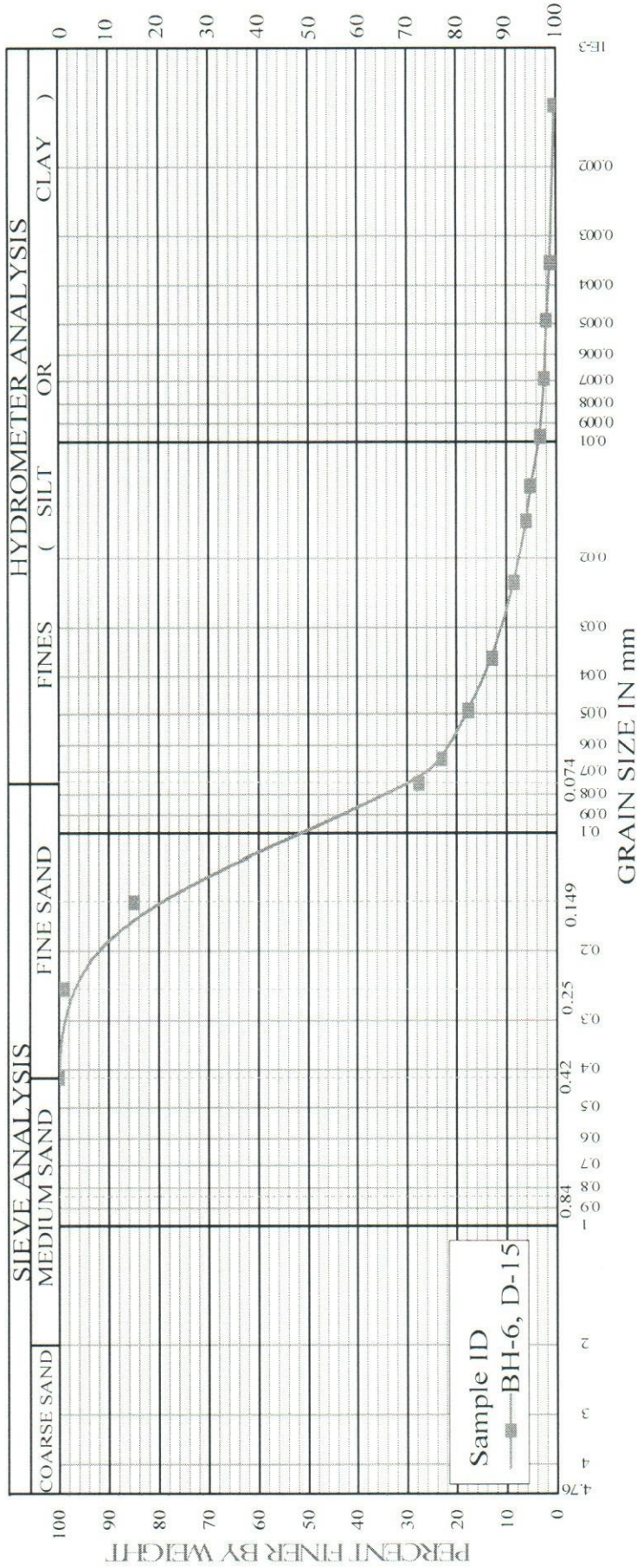
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Matabbor Khal Sluice	6	D-1	5	Sand-70.5 & Silt-29.5
Matabbor Khal Sluice	6	D-6	30	Sand-18, Silt-81 & Clay-1
Matabbor Khal Sluice	6	D-13	65	Sand-6, Silt-79 & Clay-15
Matabbor Khal Sluice	6	D-14	70	Sand-8, Silt-83 & Clay-9

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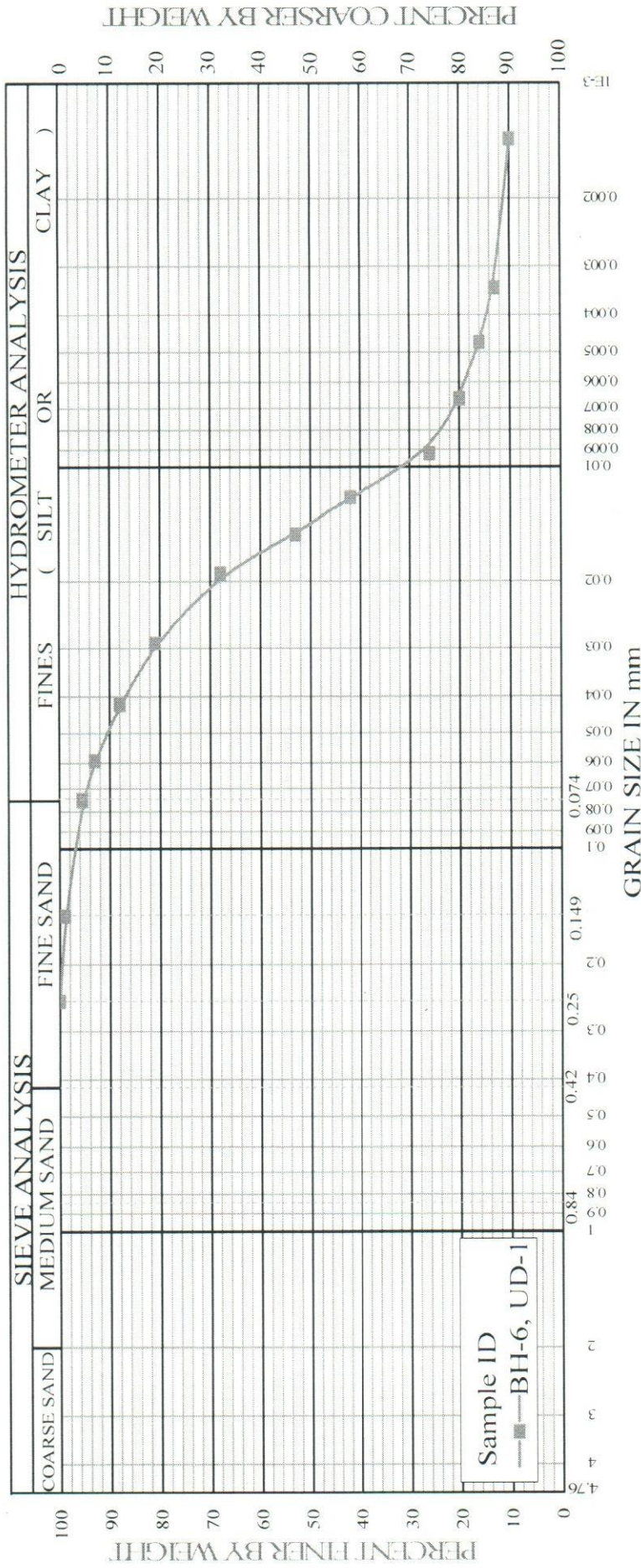
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Matabbor Khal Sluice	6	D-15	75	Sand-71.5, Silt-28 & Clay-0.5

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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Matabbor Khal Sluice	6	UD-1	N/S	Sand-5, Silt- 84 & Clay-11

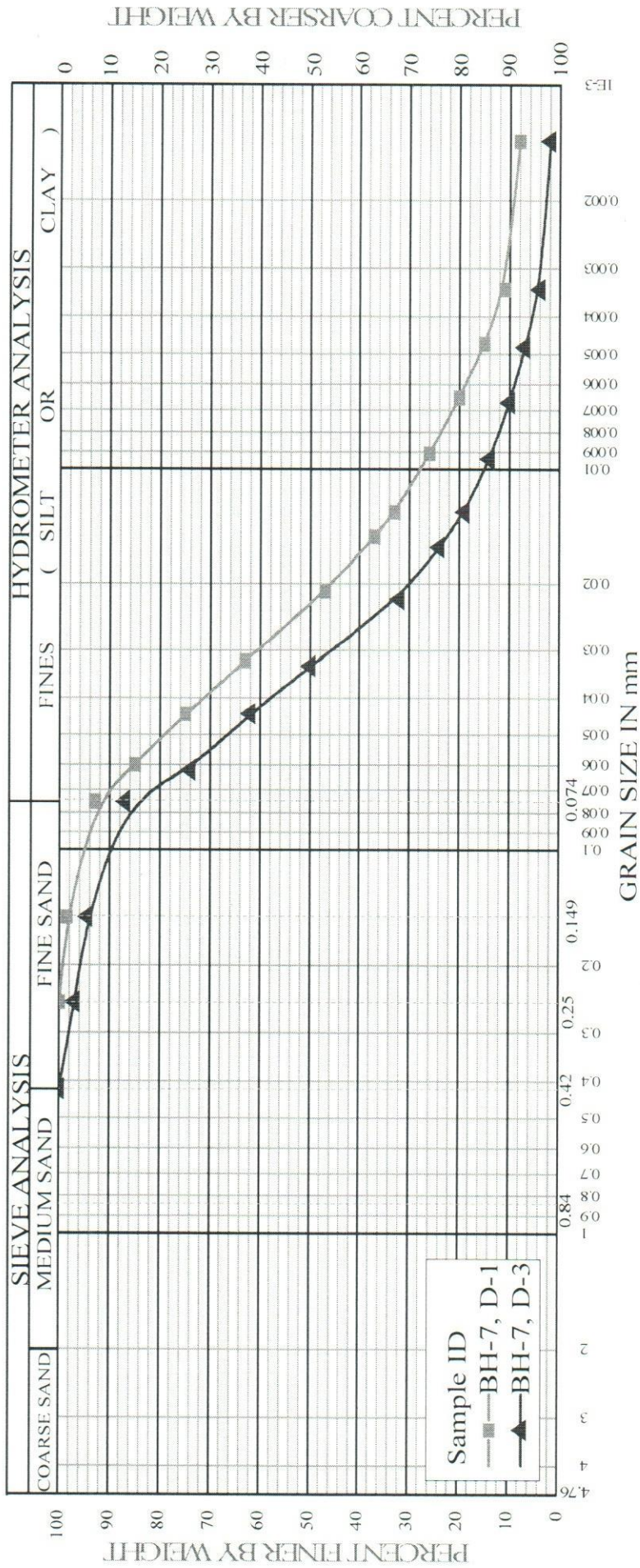
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GRADATION CURVE

Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Ludhua Khal (pipe Sluice)	7	D-1	5	Sand-9, Silt-82 & Clay-9
Ludhua Khal (pipe Sluice)	7	D-3	15	Sand-17, Silt-80 & Clay-3

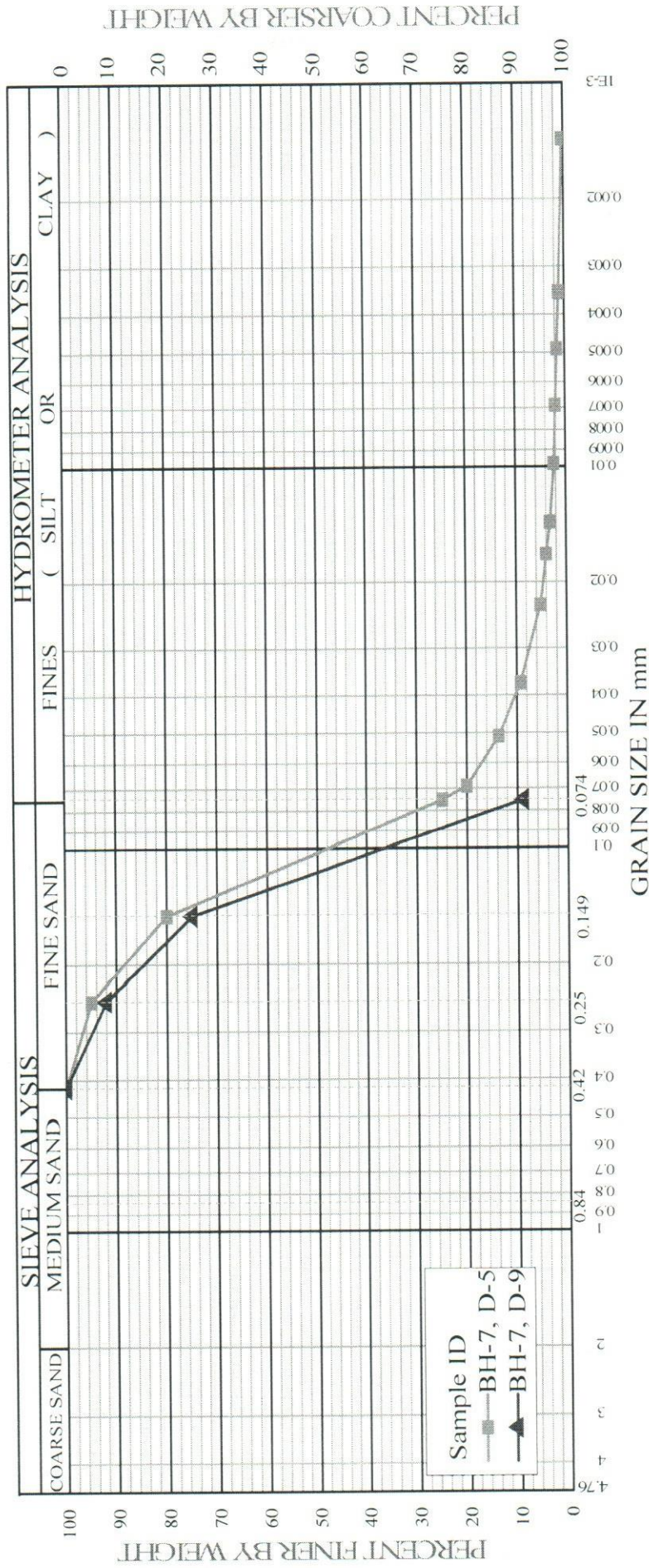
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Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



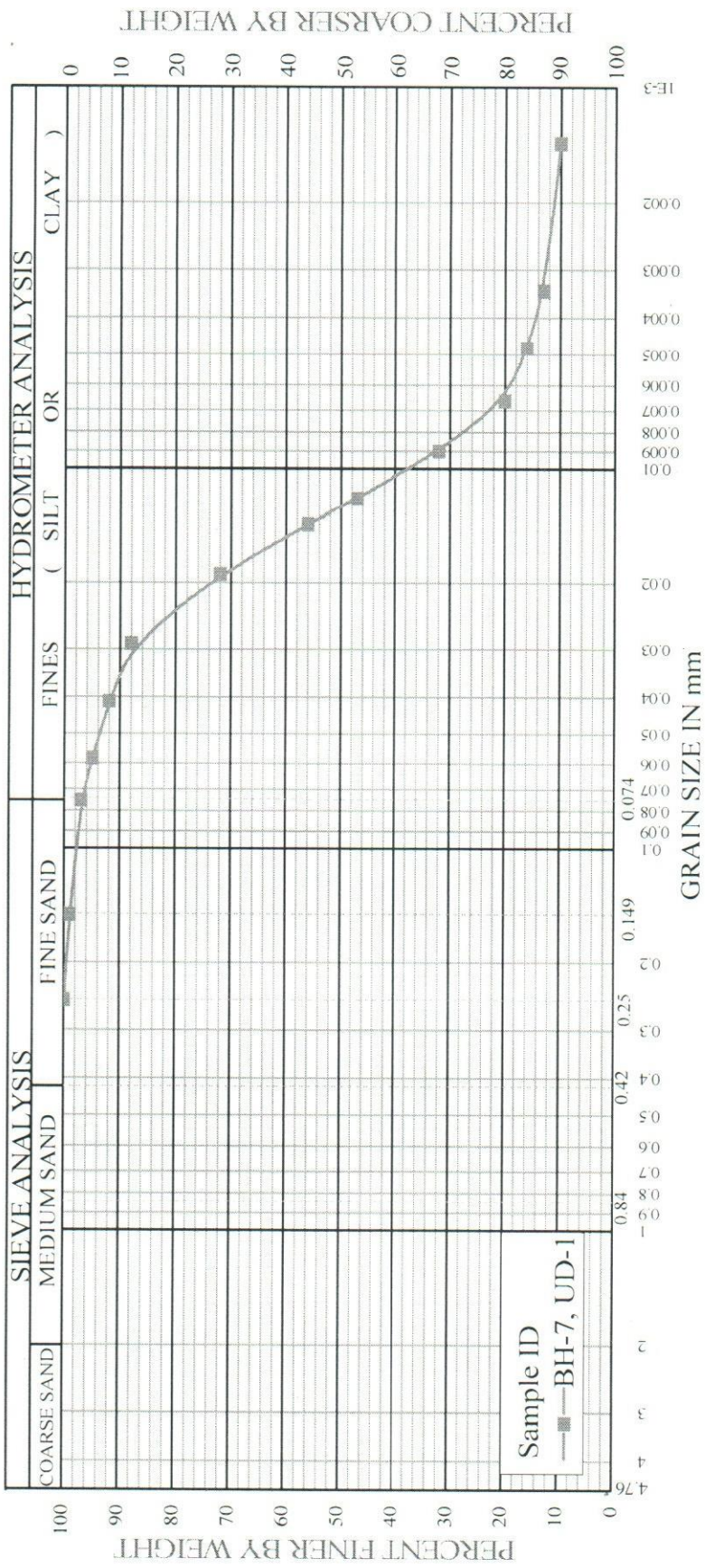
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Ludhua Khal (pipe Sluice)	7	D-5	25	Sand-75, Silt-24.5 & Clay-0.5
Ludhua Khal (pipe Sluice)	7	D-9	45	Sand-91 & Silt-9

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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Ludhwa Khal (pipe Sluice)	7	UD-1	N/S	Sand: 3, Silt: 86 & Clay: 11

Tested by: 

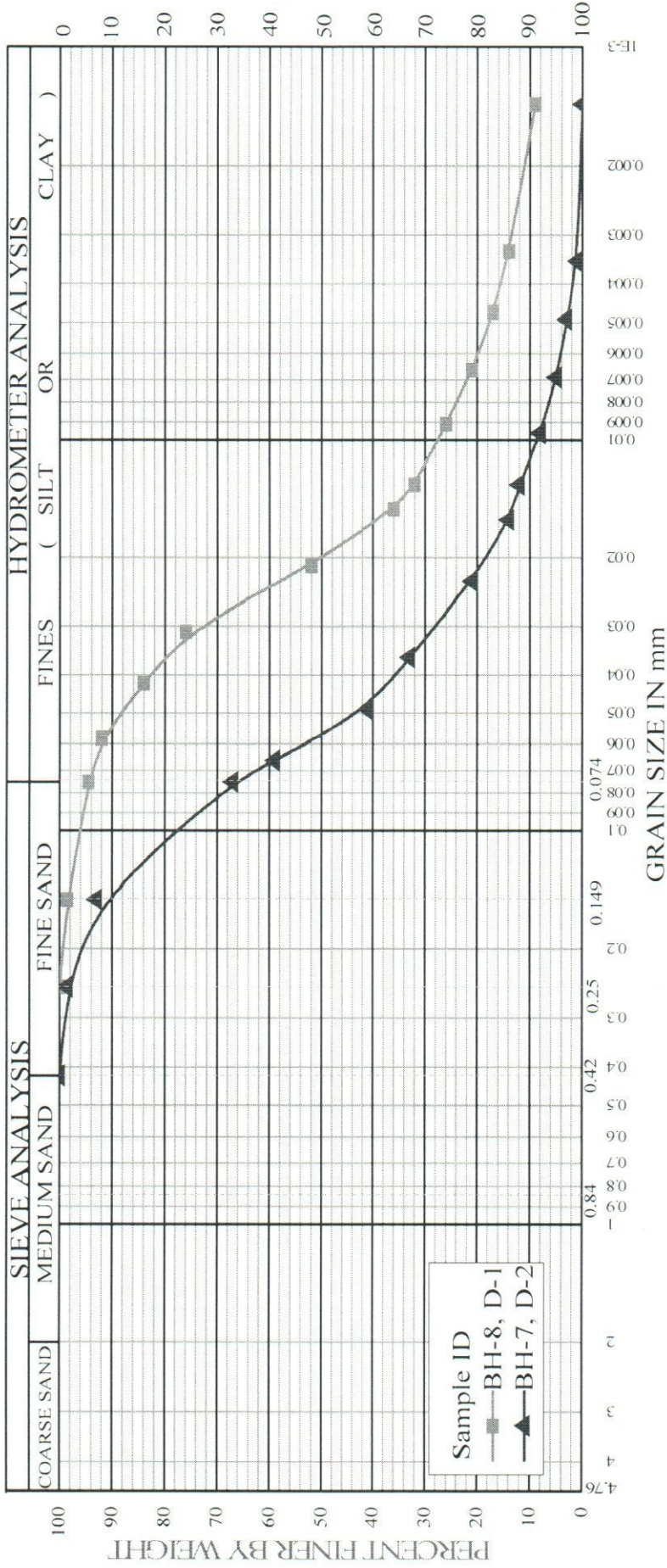
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Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakkhipur O & M Division, BWDB, Lakkhipur.



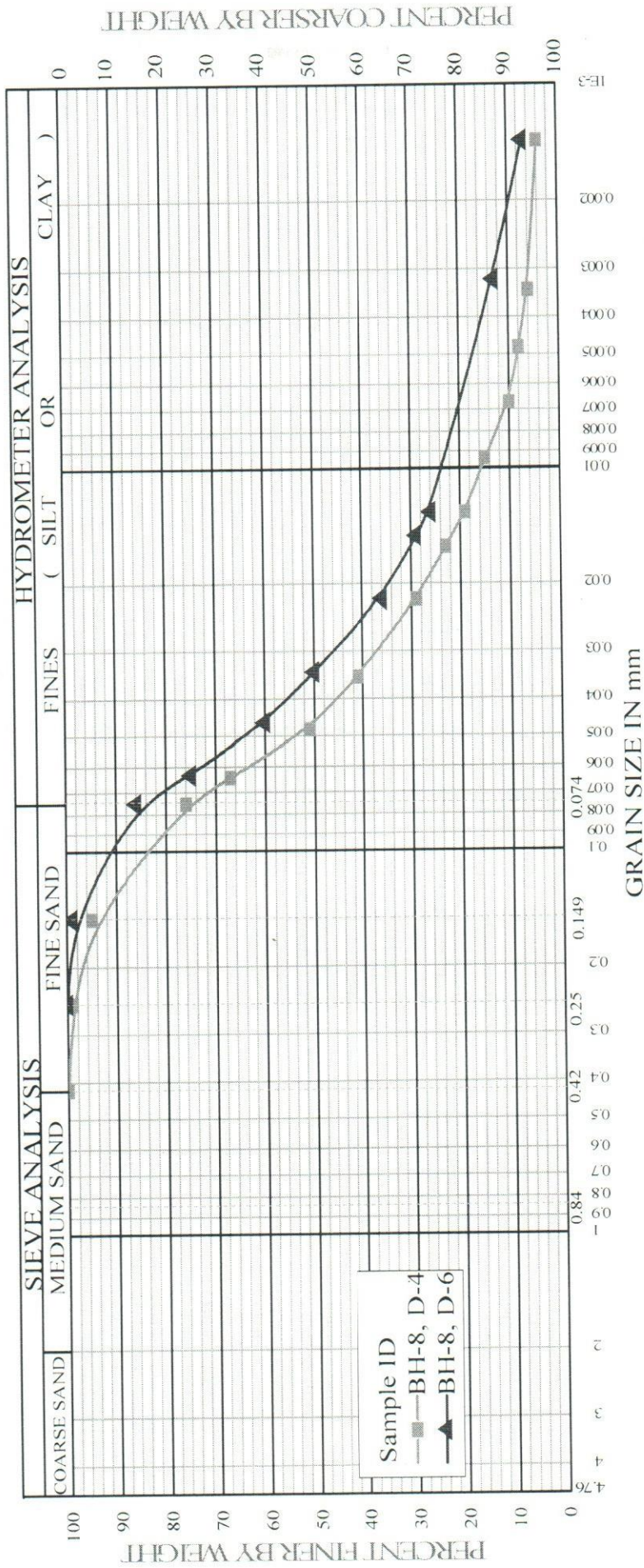
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Joridona Khal	8	D-1	5	Sand-6, Silt-83 & Clay-11
Joridona Khal	8	D-2	10	Sand-35, Silt-65 & Clay-0.1

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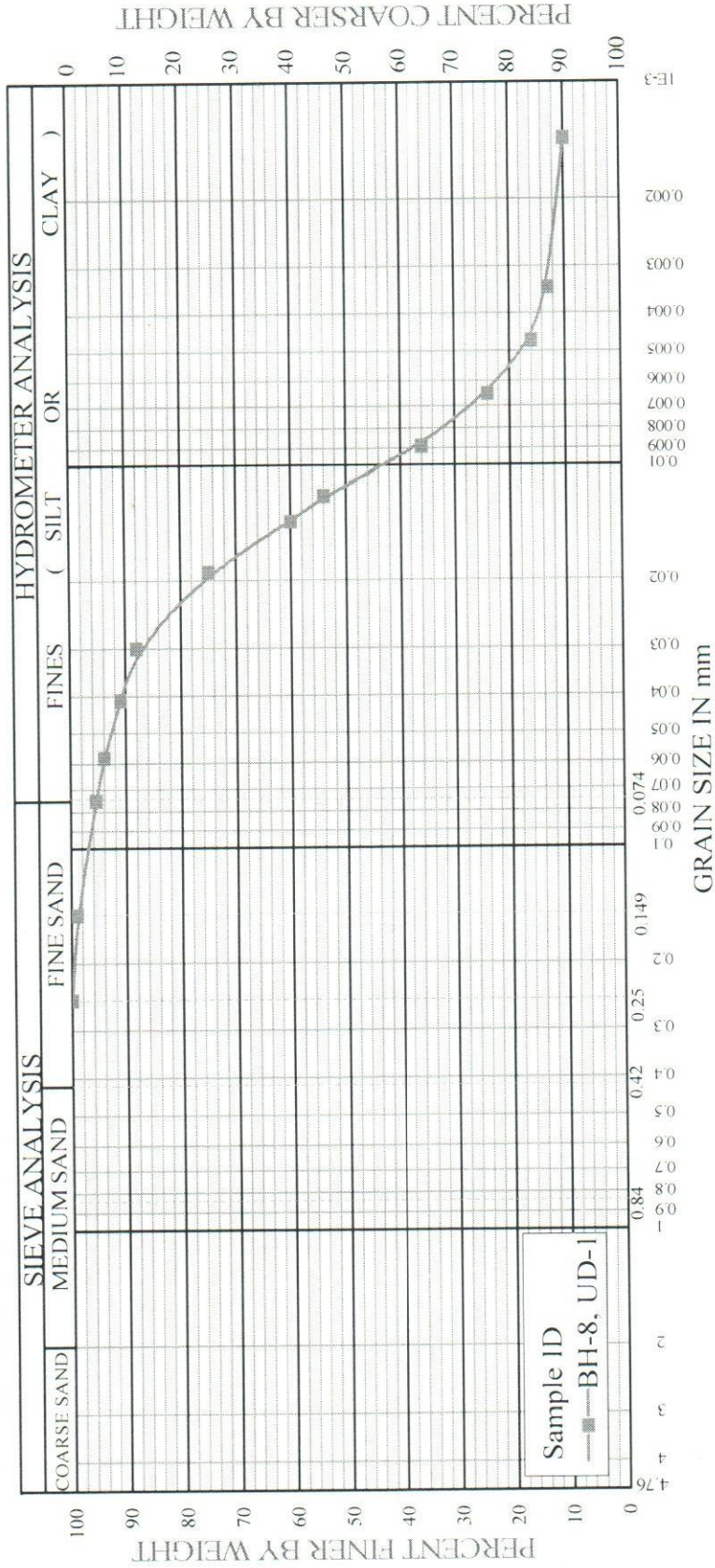
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Jorirdona Khal	8	D-4	20	Sand-25, Silt-70 & Clay-5
Jorirdona Khal	8	D-6	30	Sand-16, Silt-75 & Clay-9

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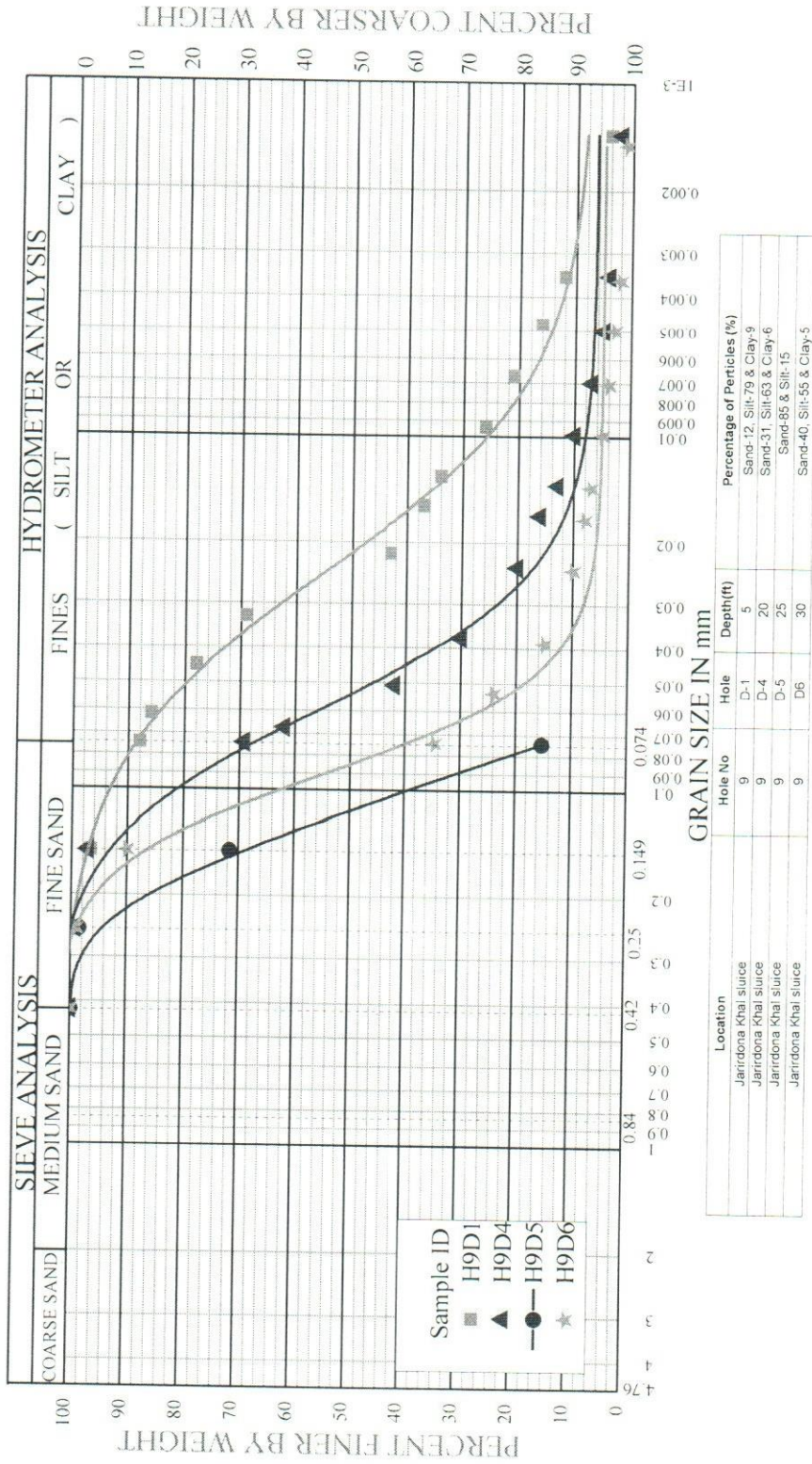


Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Jorirdona Khal	B	UD-1	N/S	Sand-5, Silt-83.5 & Clay-11.5

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RIVER RESEARCH INSTITUTE GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



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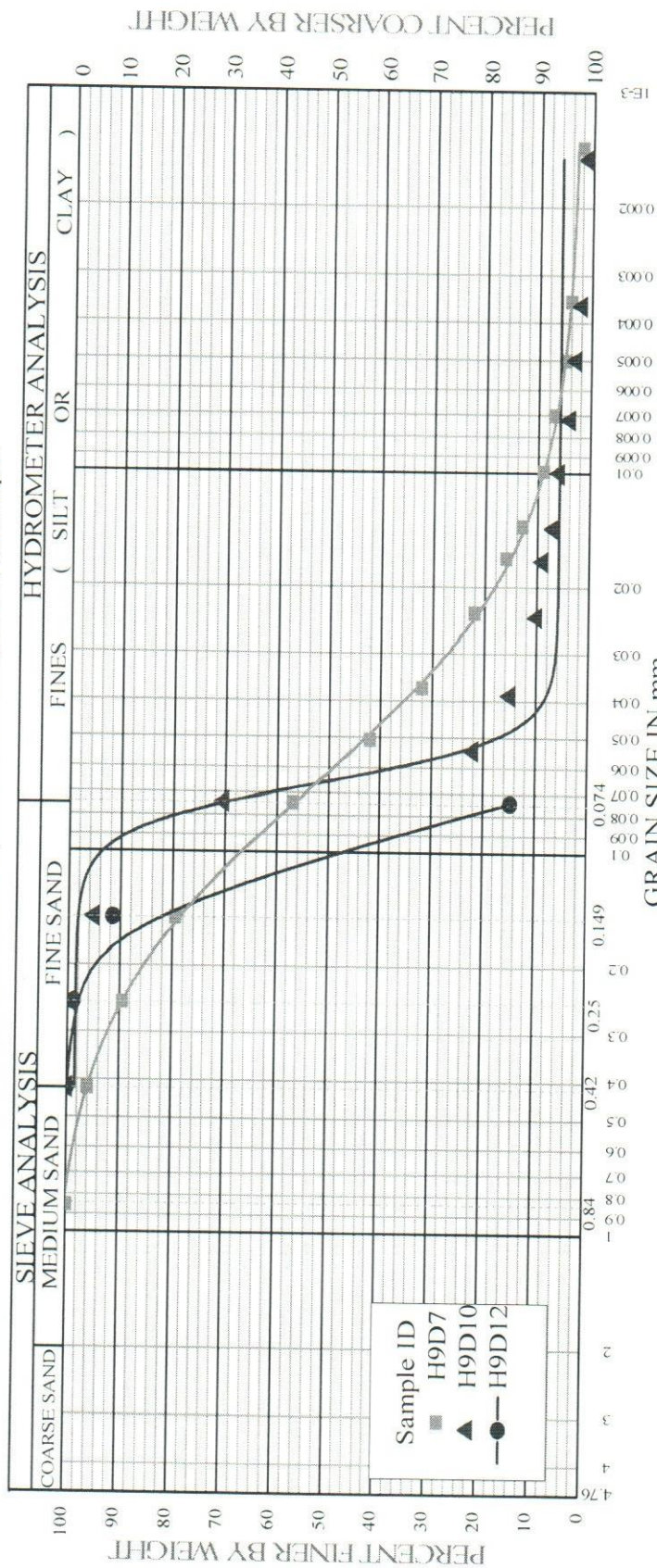
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Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Hole	Sample No	Depth (feet)	Percentage of Particles (%)
Jairdona Khai sluice	9	D-7	35	Sand-43, Silt-54 & Clay-3
Jairdona Khai sluice	9	D-10	50	SILT some fine sand non-plastic
Jairdona Khai sluice	9	D-12	60	FINE SAND little sand trace mica

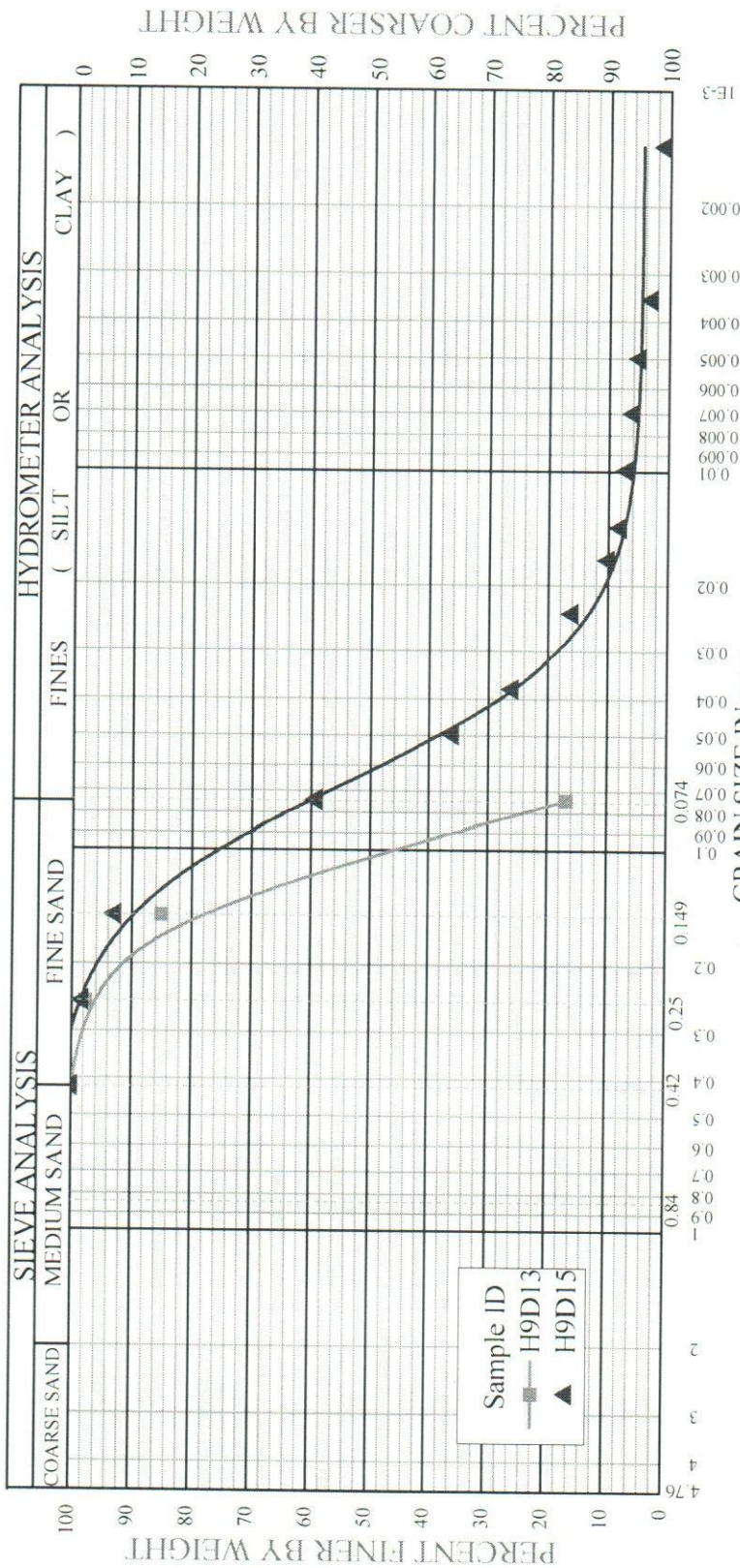
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Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Hole	Sample No	Depth (feet)	Percentage of Particles (%)
Jairdona Khal sluice	9	D-13	65	Sand-83 & Silt-17
Jairdona Khal sluice	9	D-15	75	Sand-40, Silt-56 & Clay-4

Tested by: *[Signature]*

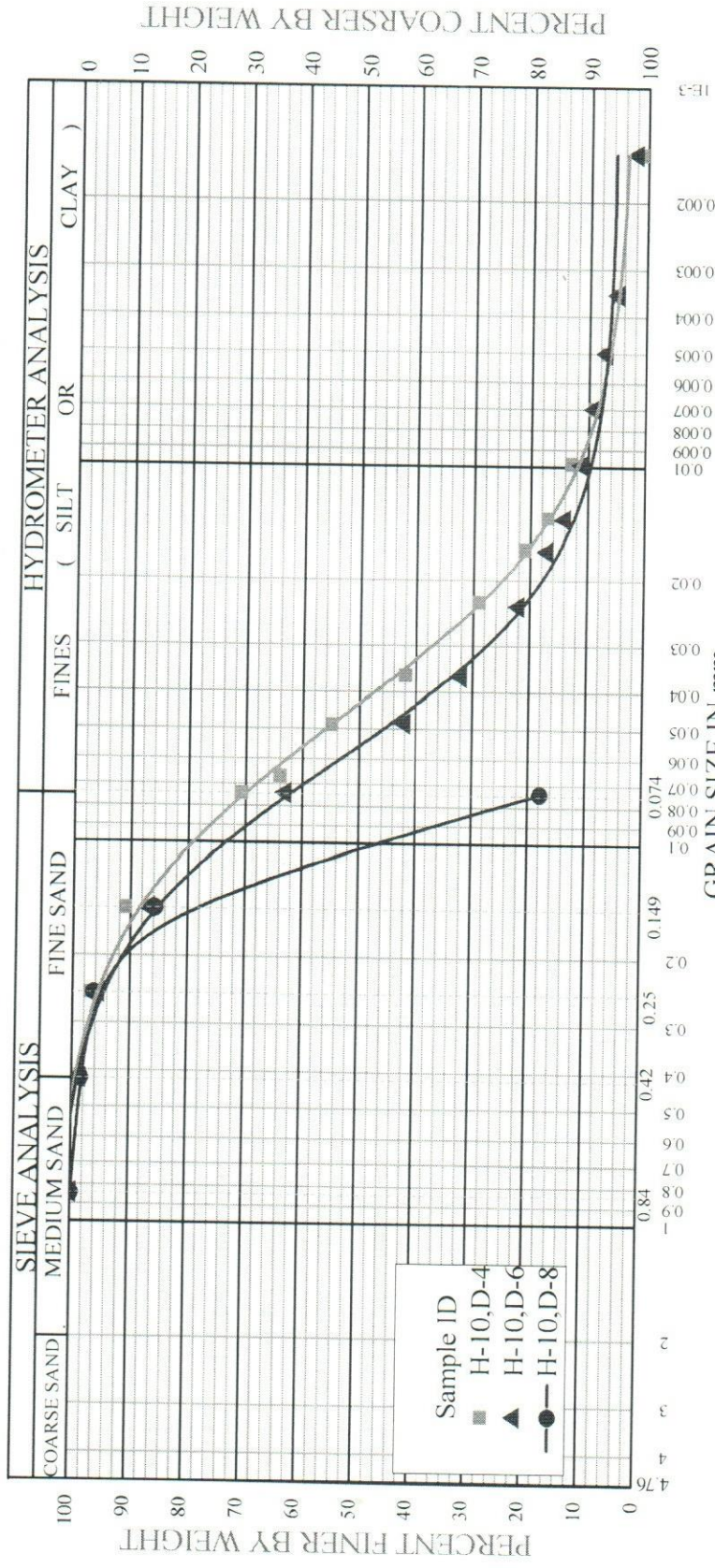
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GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Hole	Sample No	Depth(ft)	Percentage of Particles (%)
Hazirkhal pipe sluice	10	D-4	20	Sand:30 Silt:66 & Clay:4
Hazirkhal pipe sluice	10	D-6	30	Sand:38 Silt:50 & Clay:6
Hazirkhal pipe sluice	10	D-8	40	Sand:81 & Silt:19

Tested by: *S. Saha*

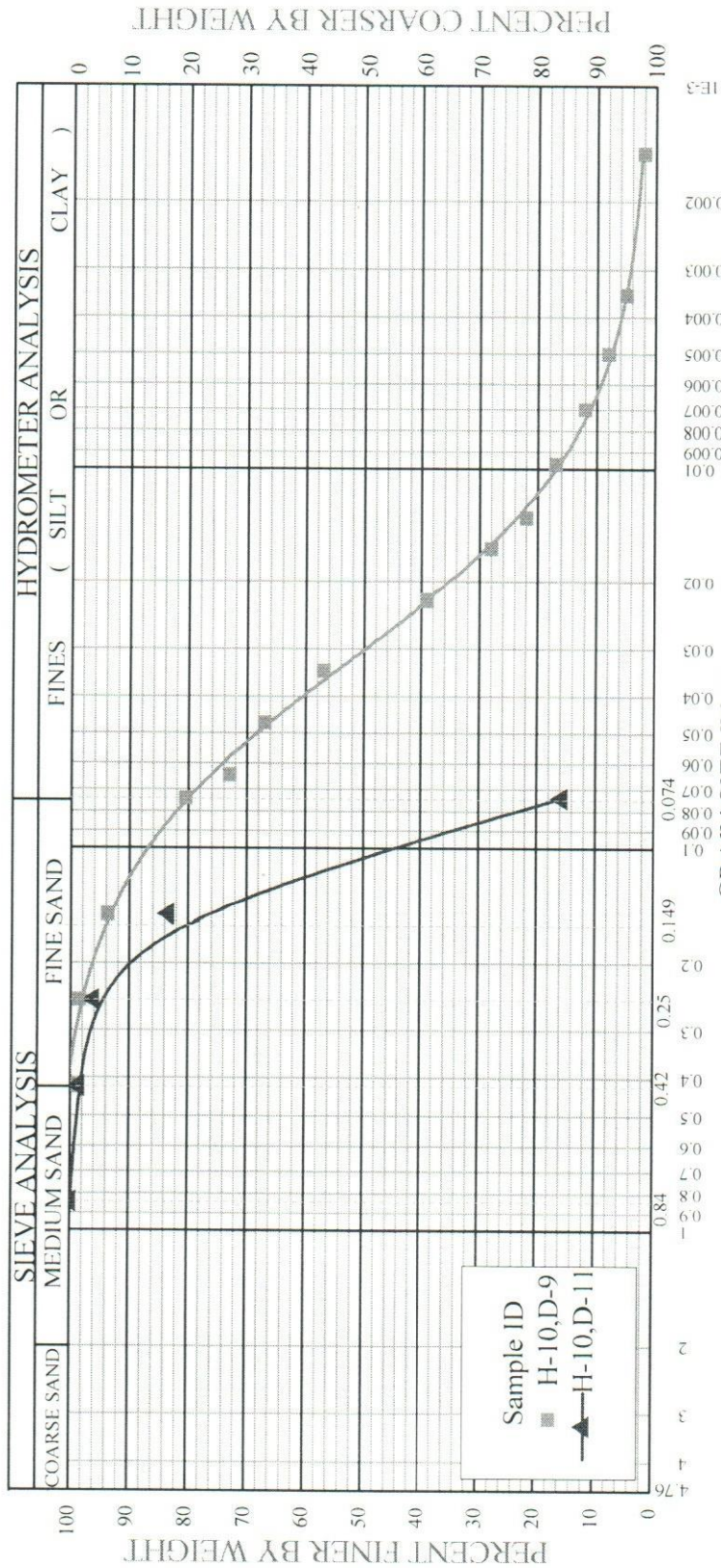
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Approved By: *R. Saha*

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GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Hole	Sample No	Depth (ft)	Percentage of Particles (%)
Hazirhat pipe sluice	10	D-9	45	Sand-20, Silt-77 & Clay-3
Hazirhat pipe sluice	10	D-11	55	Sand-84 & Silt-16

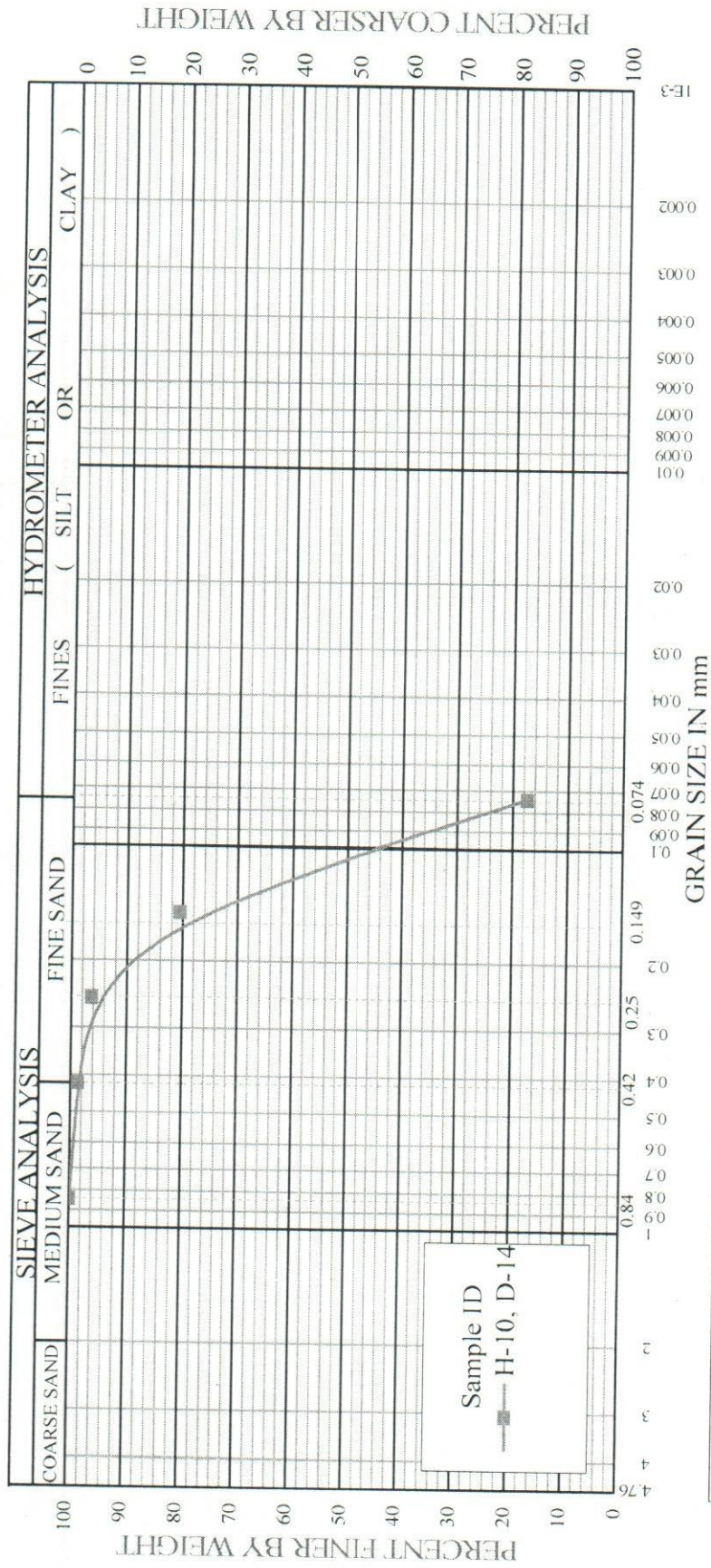
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Unified Soil classification

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GRADATION CURVE**

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and KomoInagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Sample No.	D-14	Boring	H-10	Depth (feet)	70	Percentage of Particle (%)	Sand - 82, Silt-18
Location	Hazirkhal pipe sluice						

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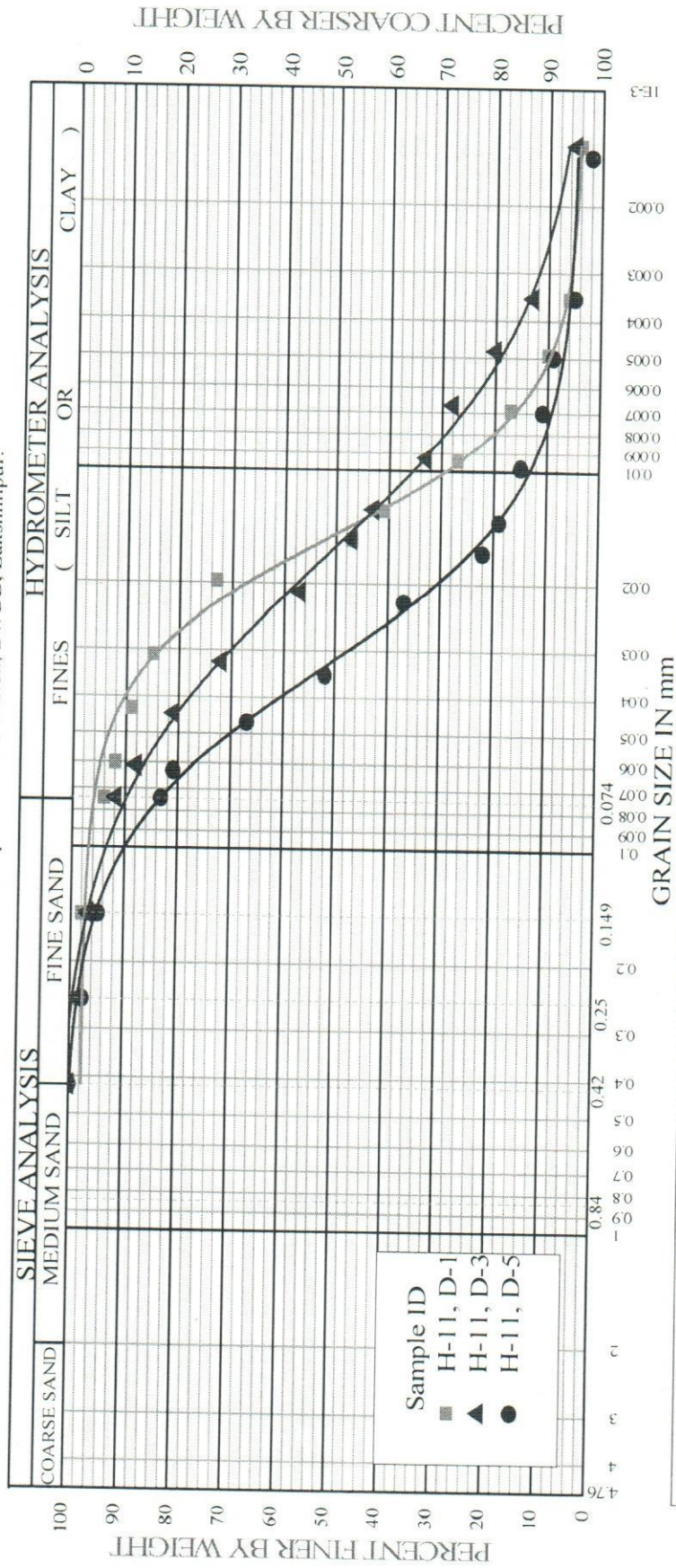
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Unified Soil classification

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GRADATION CURVE**

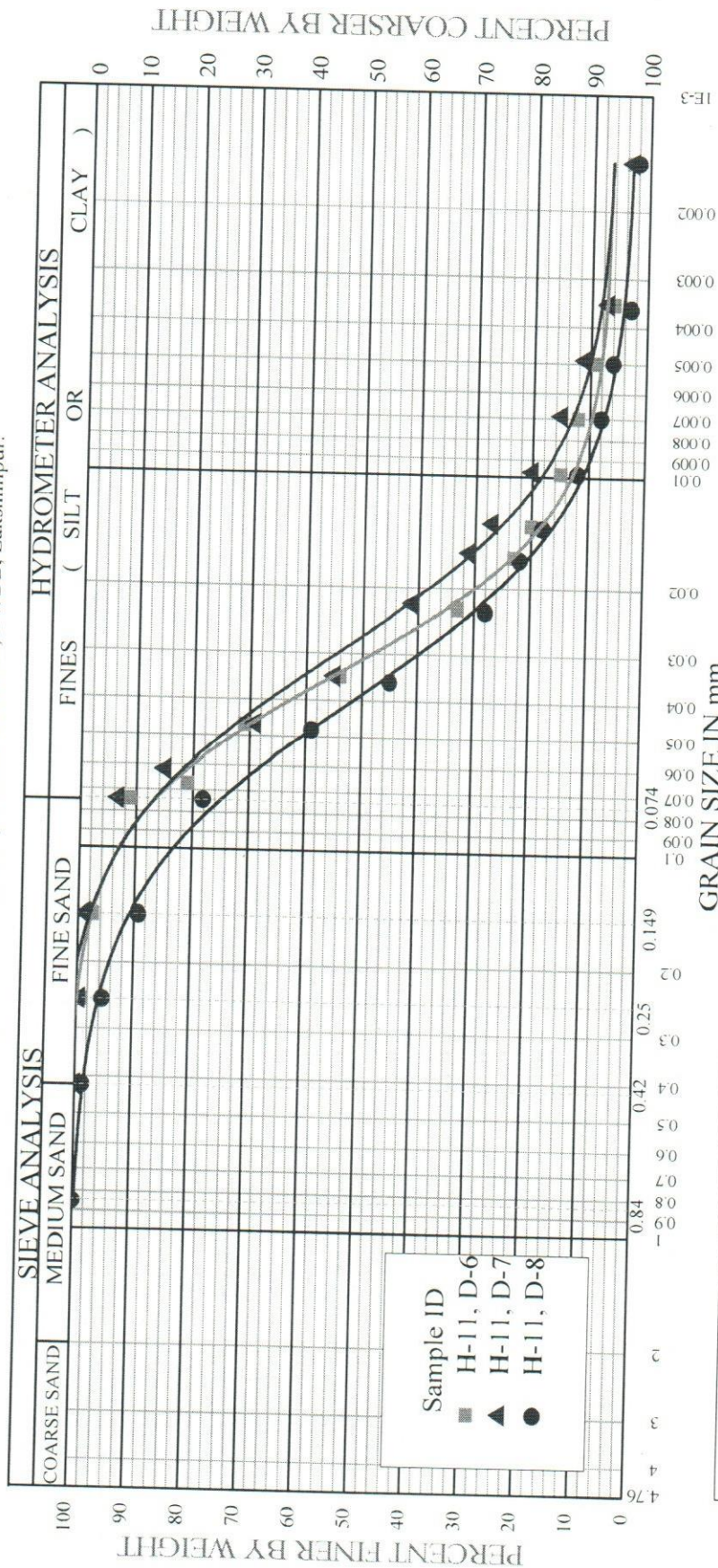
Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



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Location	Sample No.	Boring	Depth (feet)	Percentage of Particle(%)
Maleker Khal	D-6	H-11	30	Sand- 14, Silt- 82.5, Clay- 3.5
Maleker Khal	D-7	H-11	35	Sand- 14, Silt- 79, Clay- 7
Maleker Khal	D-8	H-11	40	Sand- 25, Silt- 72, Clay- 3

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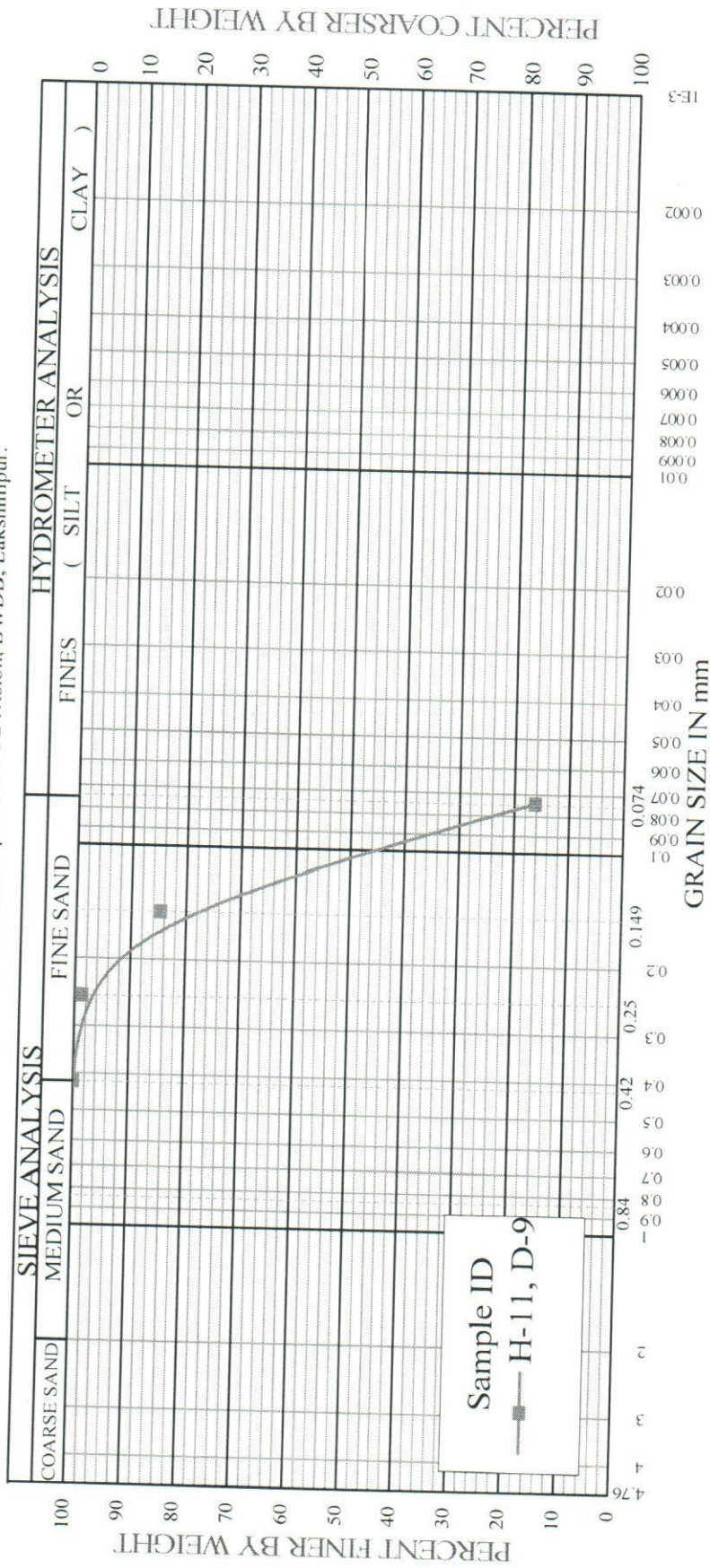
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Approved By: *[Signature]*

Unified Soil classification

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Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Maleker Khal	Boring	H-11	Depth (feet)	45	Percentage of Particle (%)	Sand- 84, Silt- 16
Sample No.	D-9						

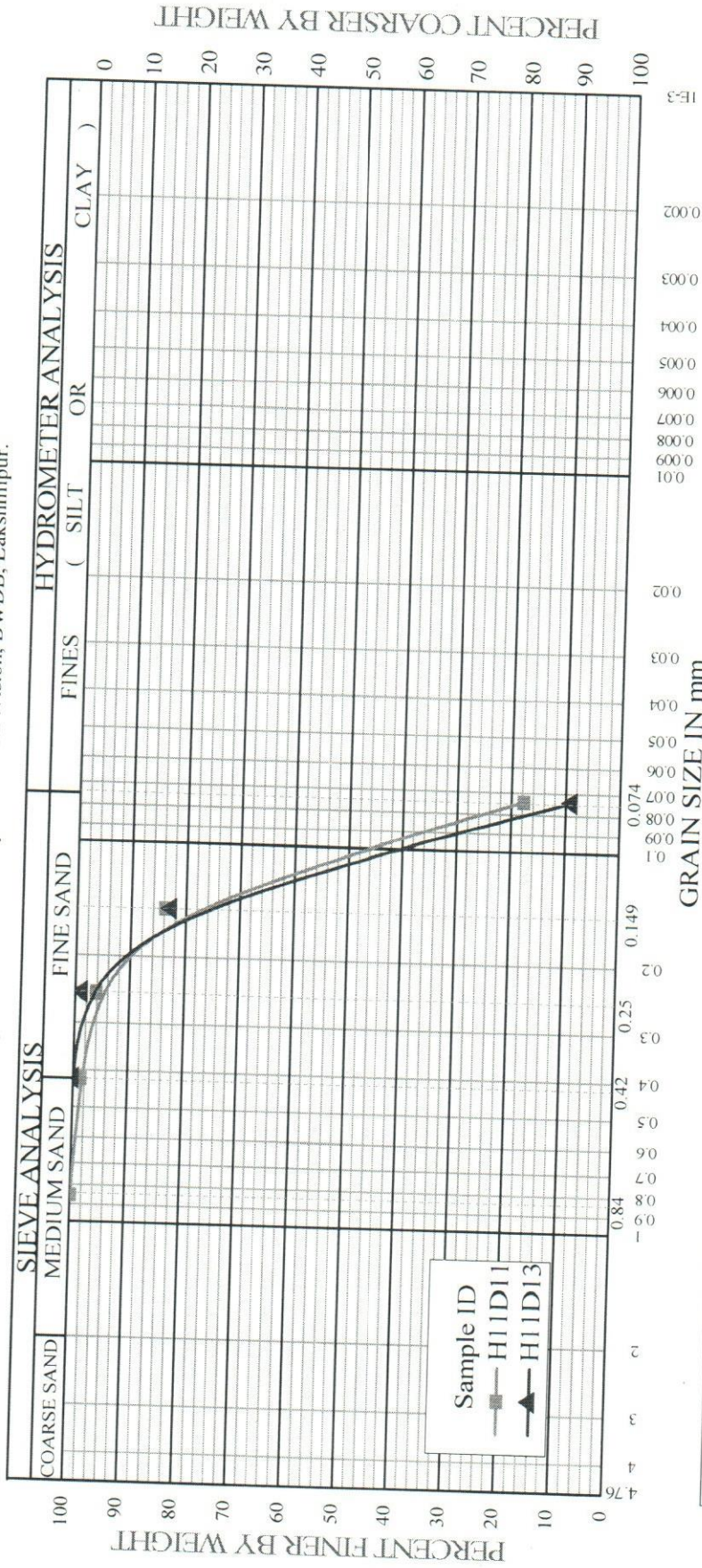
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Checked by: *[Signature]*

Approved By: *[Signature]*

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Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



Location	Sample No.	Boring	Depth (feet)	Percentage of Particles (%)
Maleker Khal	D11	H11	55	Sand- 82, Silt- 18
Maleker Khal	D13	H11	65	Sand- 91, Silt- 9

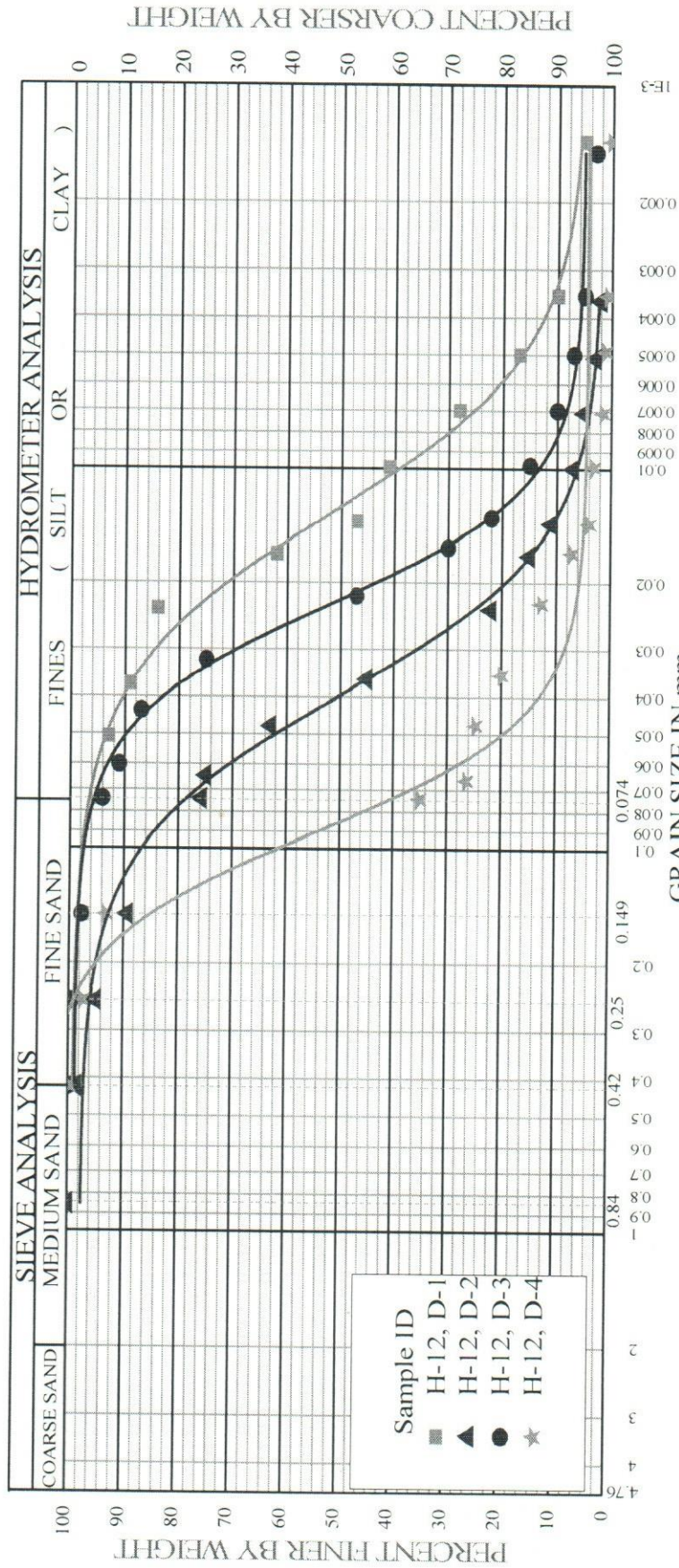
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Unified Soil classification

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Location	Sample No.	Boring	Depth (feet)	Percentage of Particles (%)
Munshir Khal	D-1	H-12	5	Sand- 4, Silt- 89, Clay- 7
Munshir Khal	D-2	H-12	10	Sand- 22, Silt- 76, Clay- 2
Munshir Khal	D-3	H-12	15	Sand- 4, Silt- 92, Clay- 4
Munshir Khal	D-4	H-12	20	Sand- 60, Silt- 36, Clay- 4

Tested by: *[Signature]* Compiled by: *[Signature]*

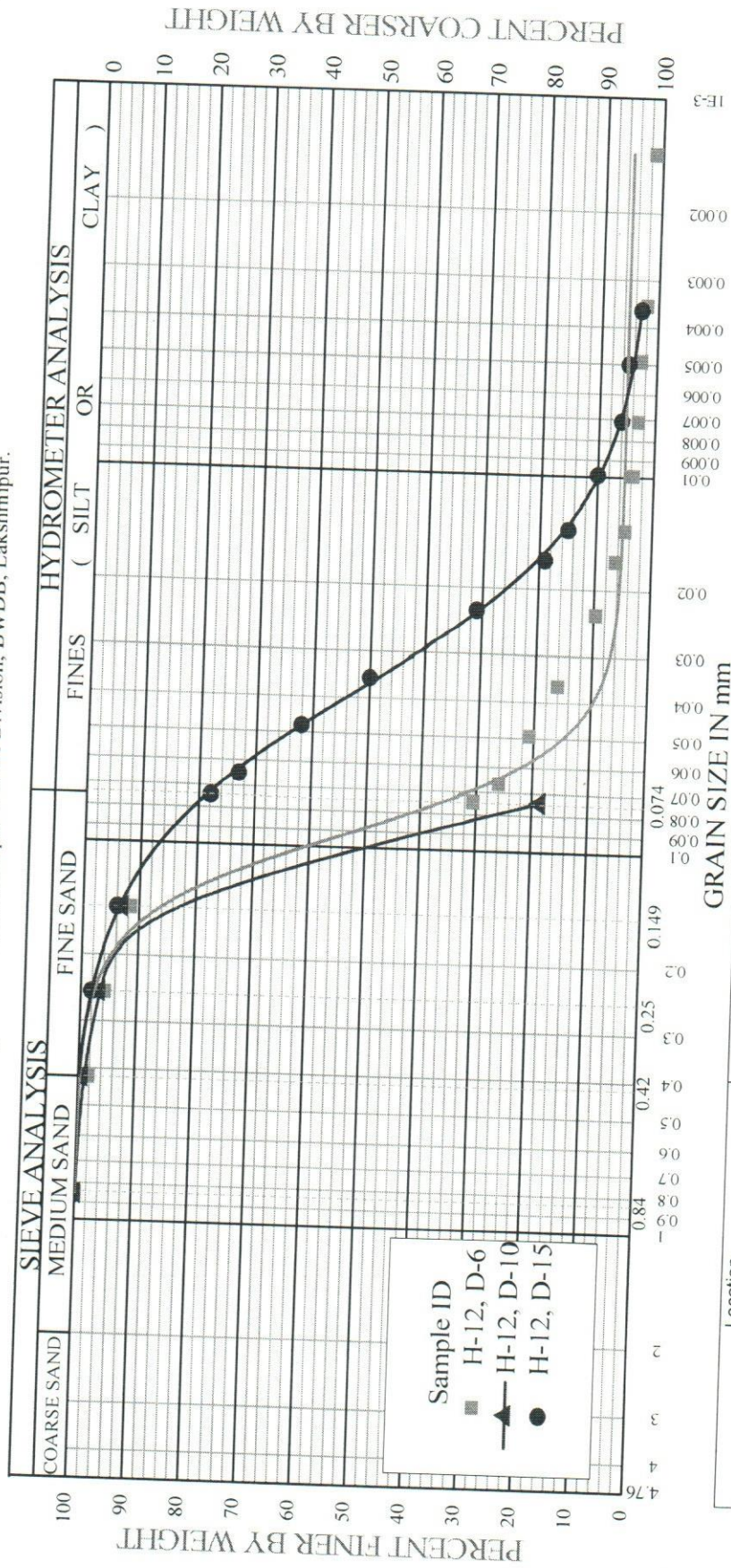
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Unified Soil classification

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Location	Sample No.	Boring	Depth (feet)	Percentage of Particles (%)
Munshir Khal	D-6	H-12	30	Sand- 64, Silt- 30, Clay- 6
Munshir Khal	D-10	H-12	50	Sand- 81, Silt- 19
Munshir Khal	D-15	H-12	75	Sand- 22, Silt- 78

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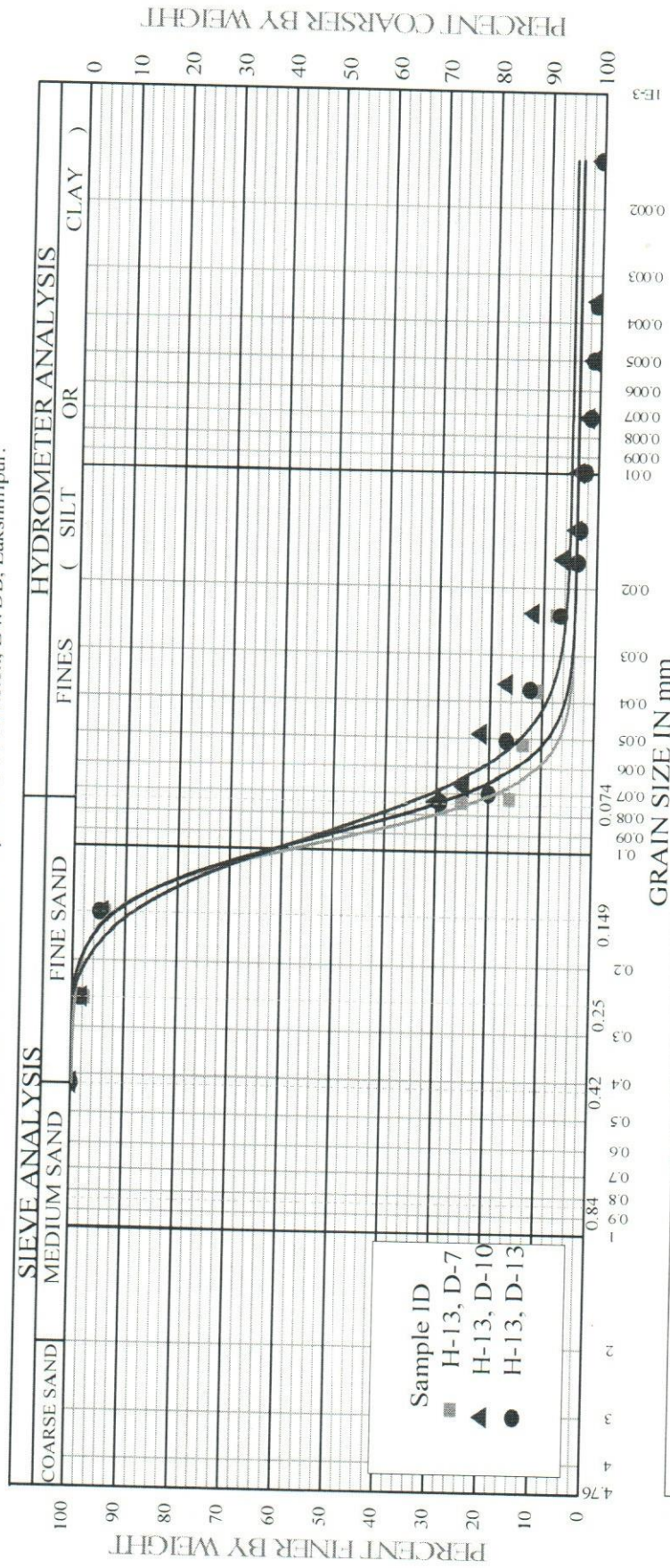
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Unified Soil classification

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Location	Sample No.	Boring	Depth (feet)	Percentage of Particles (%)
Ashol Khal	D-7	H-13	35	Sand- 75, Silt- 21, Clay- 4
Ashol Khal	D-10	H-13	50	Sand- 64, Silt- 31, Clay- 5
Ashol Khal	D-13	H-13	65	Sand- 68, Silt- 28, Clay- 4

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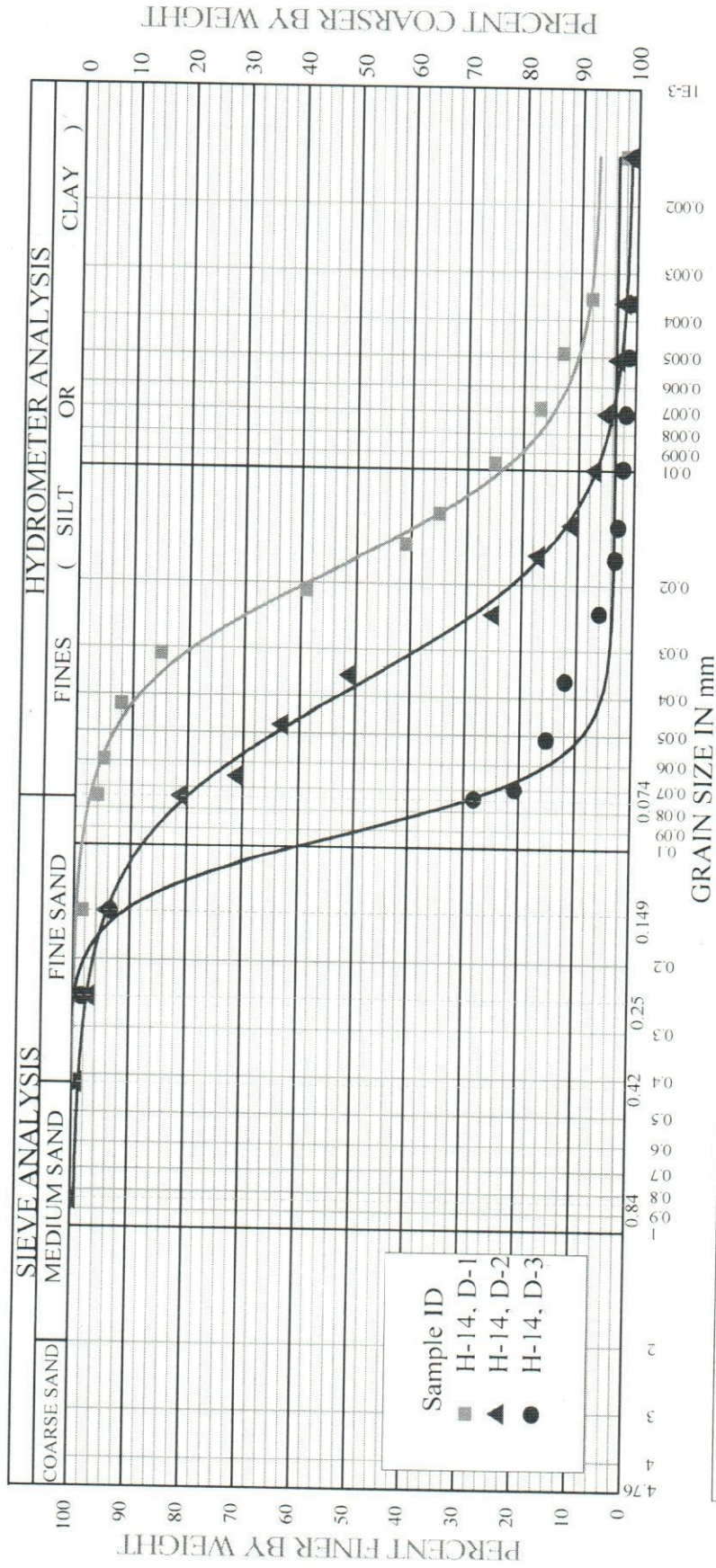
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Unified Soil classification

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Location	Sample No.	Boring Hole	Depth (feet)	Percentage og Particles (%)
Kalir Khal	D-1	H-14	5	Sand- 3.5, Silt- 89, Clay- 7.5
Kalir Khal	D-2	H-14	10	Sand- 20, Silt- 78, Clay- 2
Kalir Khal	D-3	H-14	15	Sand- 72, Silt- 24, Clay- 4

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Checked by: *[Signature]*

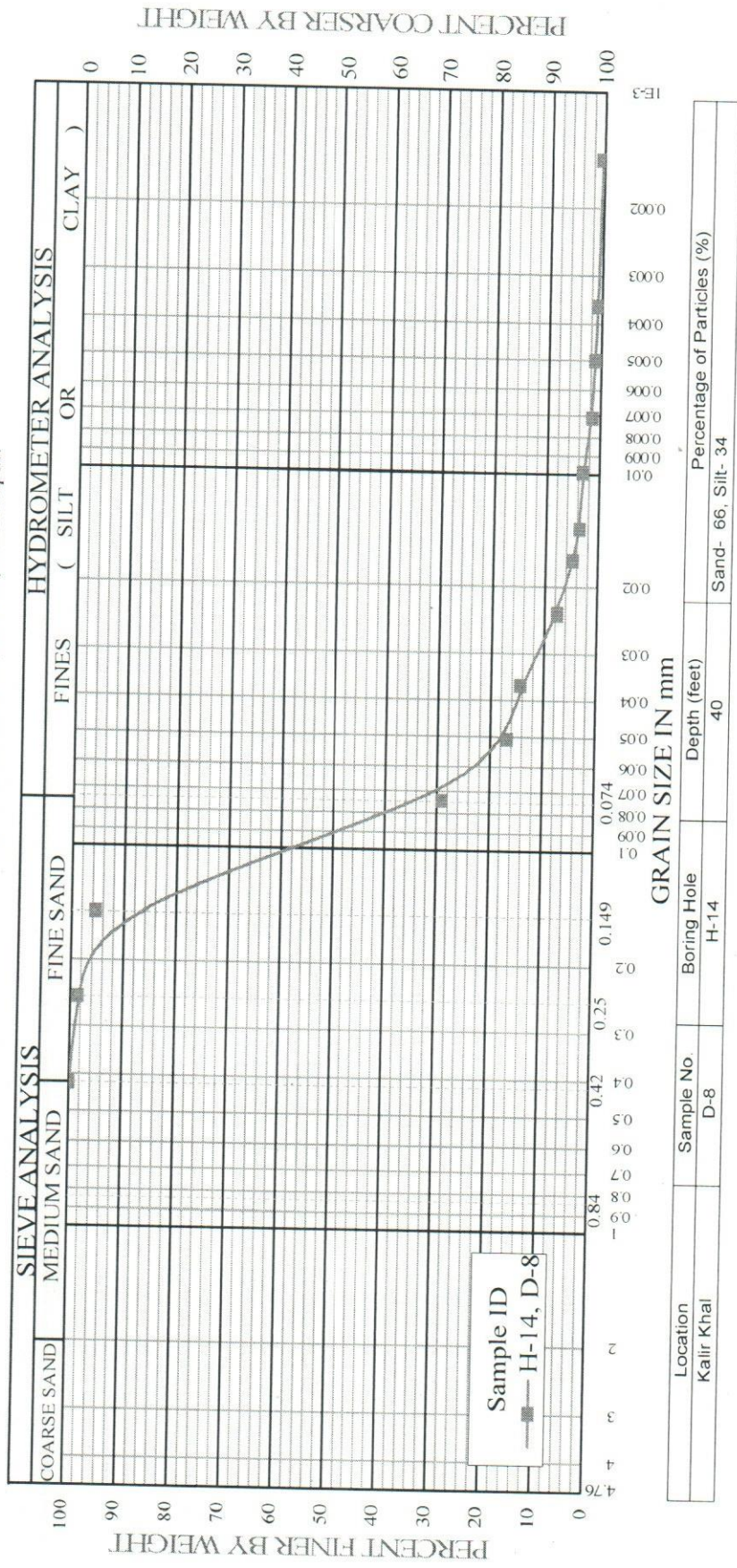
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Unified Soil classification

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Project: Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Pandit Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakshmipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.



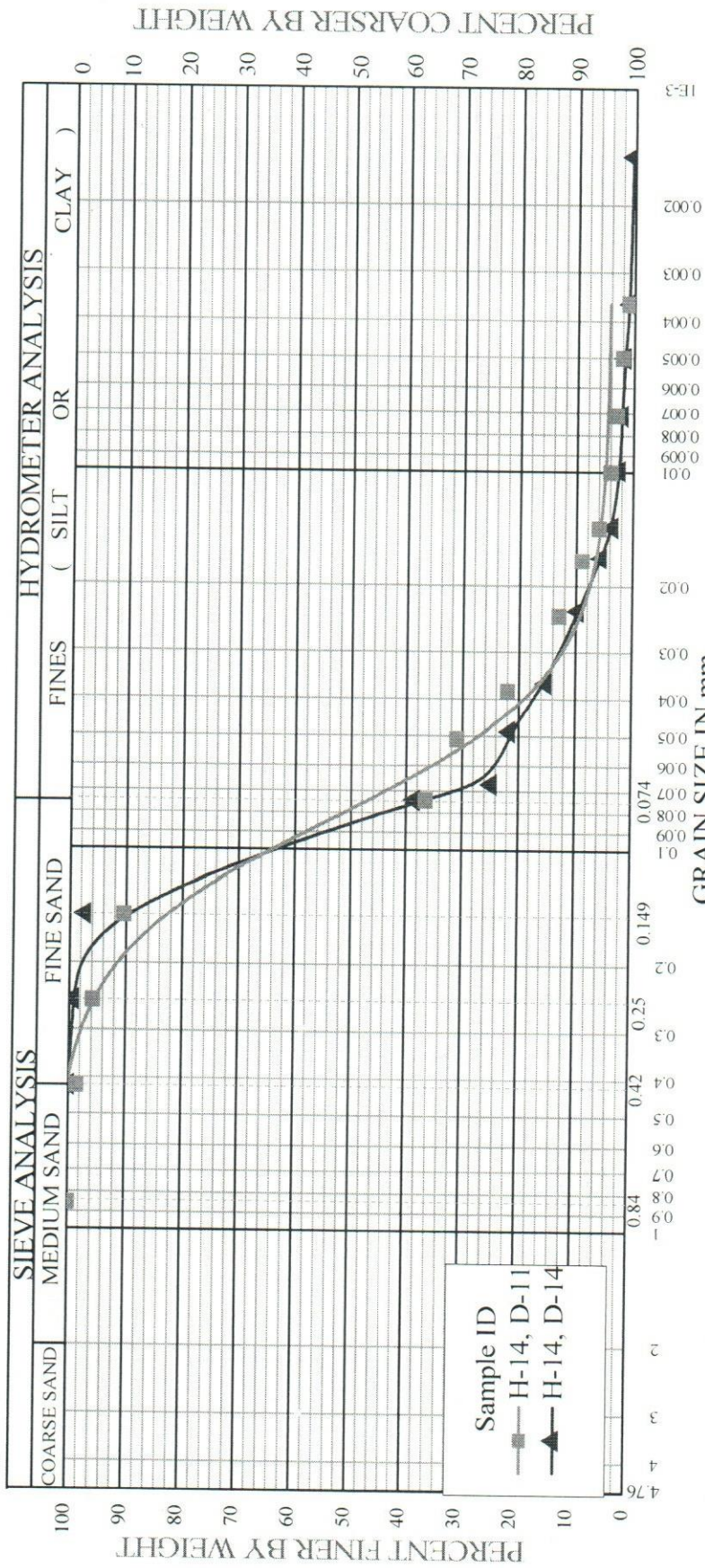
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Location	Sample No.	Boring Hole	Depth (feet)	Percentage of Particles (%)
Kalir Khal	D-11	H-14	55	Sand- 52 , Silt- 47, Clay- 1
Kalir Khal	D-14	H-14	70	Sand- 62 , Silt- 38

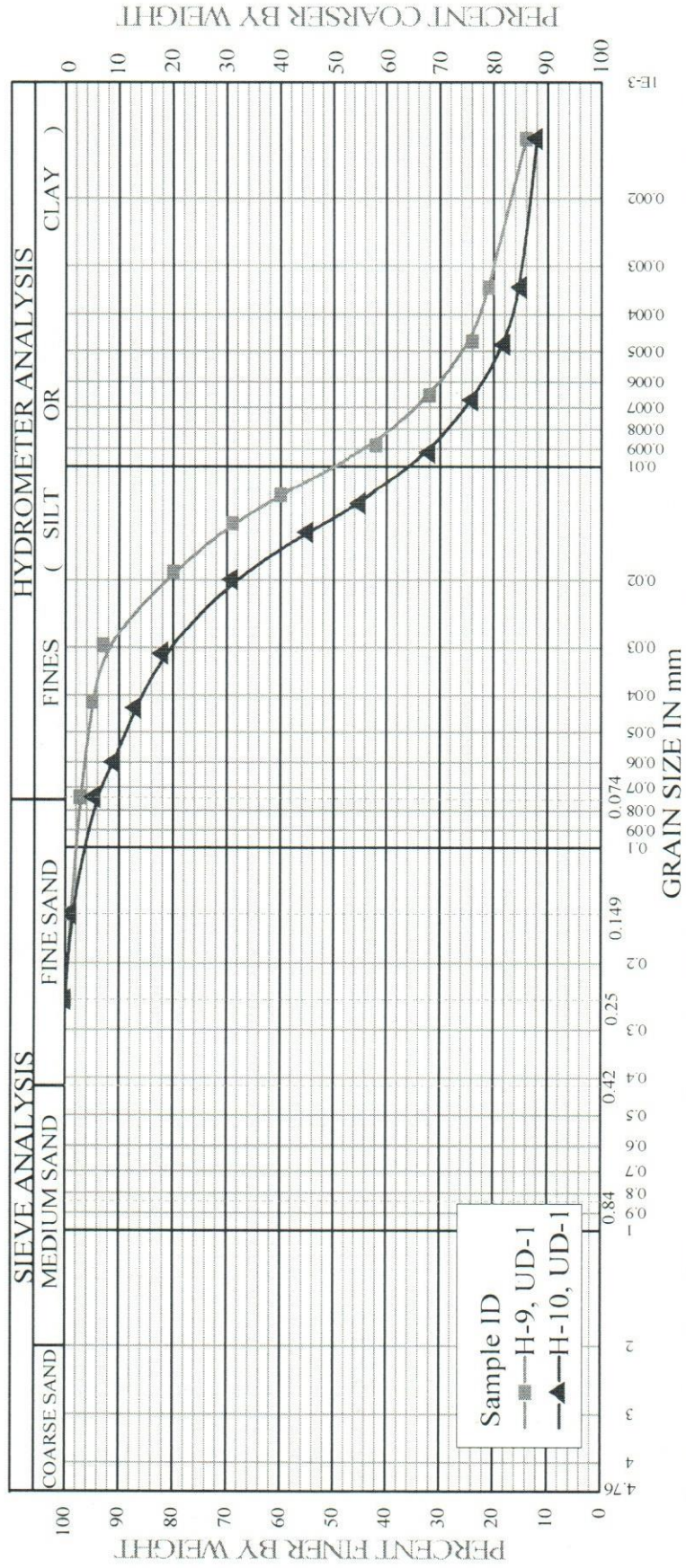
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Approved By: *[Signature]*

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Project : "River bank protective work along the left bank of Meghna River at Borokheri , Ludhuabazar and Kaderponditer hat areas in Ramgati and Kamal Nagar upazila Lakshmpur District" under Lakshmpur O&M Division, BWDB, Lakshmpur



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Jorirdona Khal SI	9	UD-1	N/S	Sand - 3, Silt - 80, Clay - 17
Hazir Khal (Pipe)	10	UD-1	N/S	Sand - 6, Silt - 81, Clay - 13

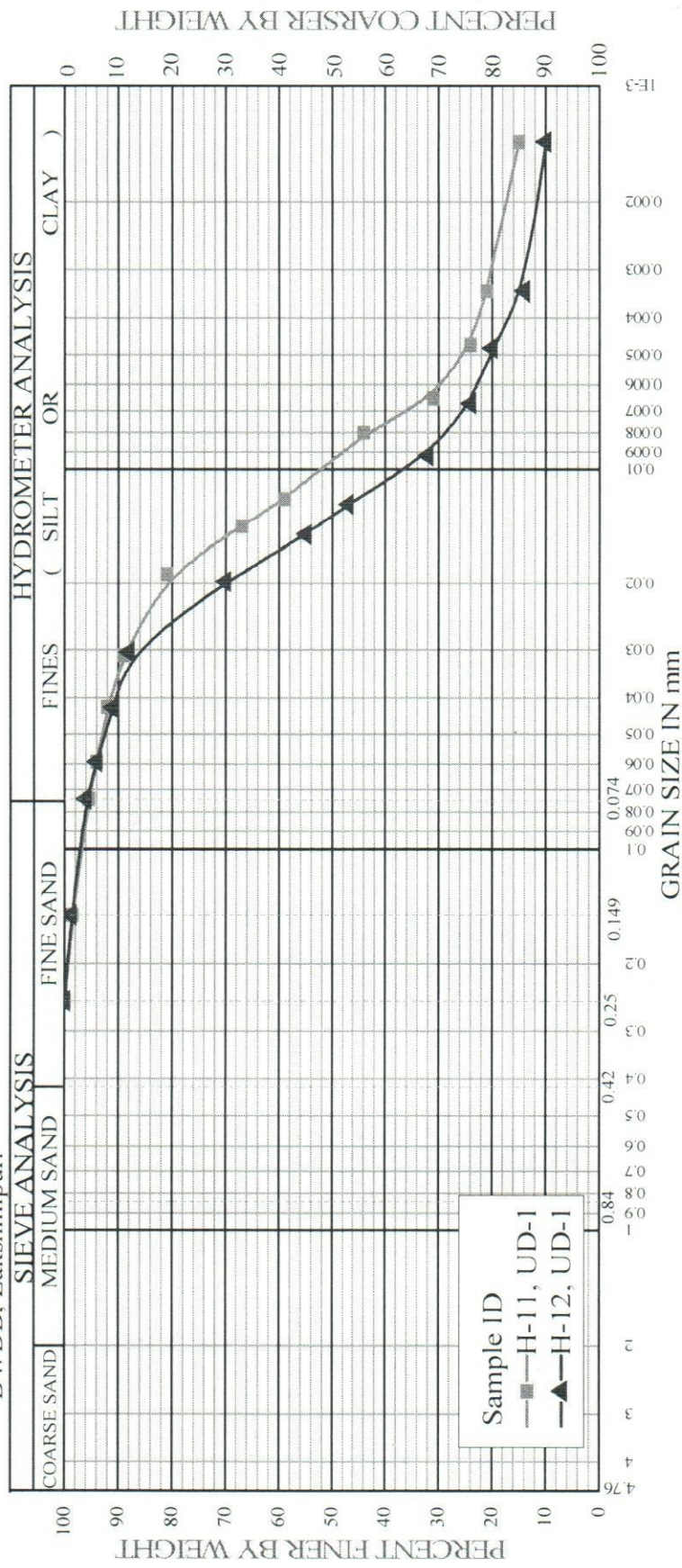
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Approved By: *[Signature]*

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GRADATION CURVE

Project : "River bank protective work along the left bank of Meghna river at Borokheri, Ludhuabazar and Kaderponditer Hat areas in Ramgati and Kamal Nagar upazila under Lakshmpur District" under Lakshmpur O&M Division, BWDB, Lakshmpur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Maleker Khal Sluice	H-11	UD-1	N/S	Sand - 4.5, Silt - 78, Clay - 17.5
Monsir Khal	H-12	UD-1	N/S	Sand - 4, Silt - 84, Clay - 12

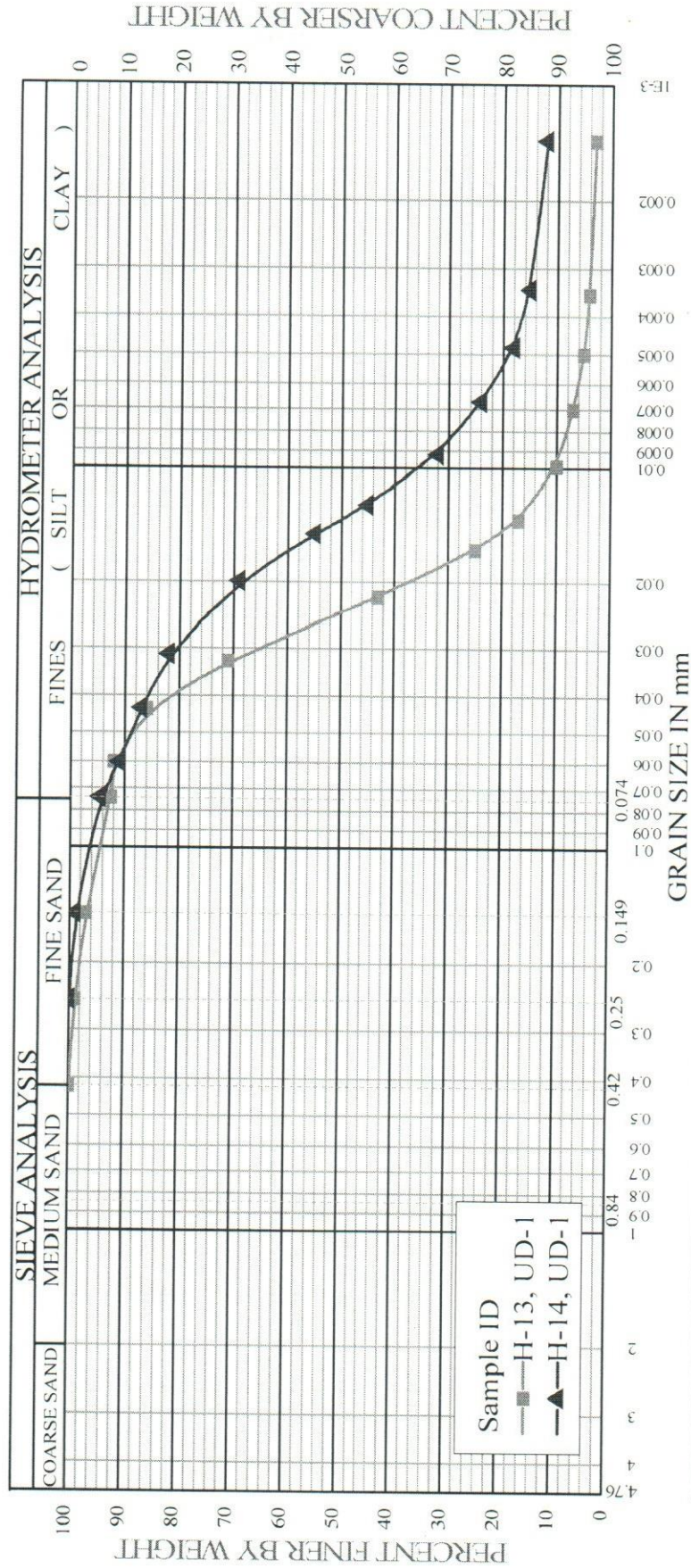
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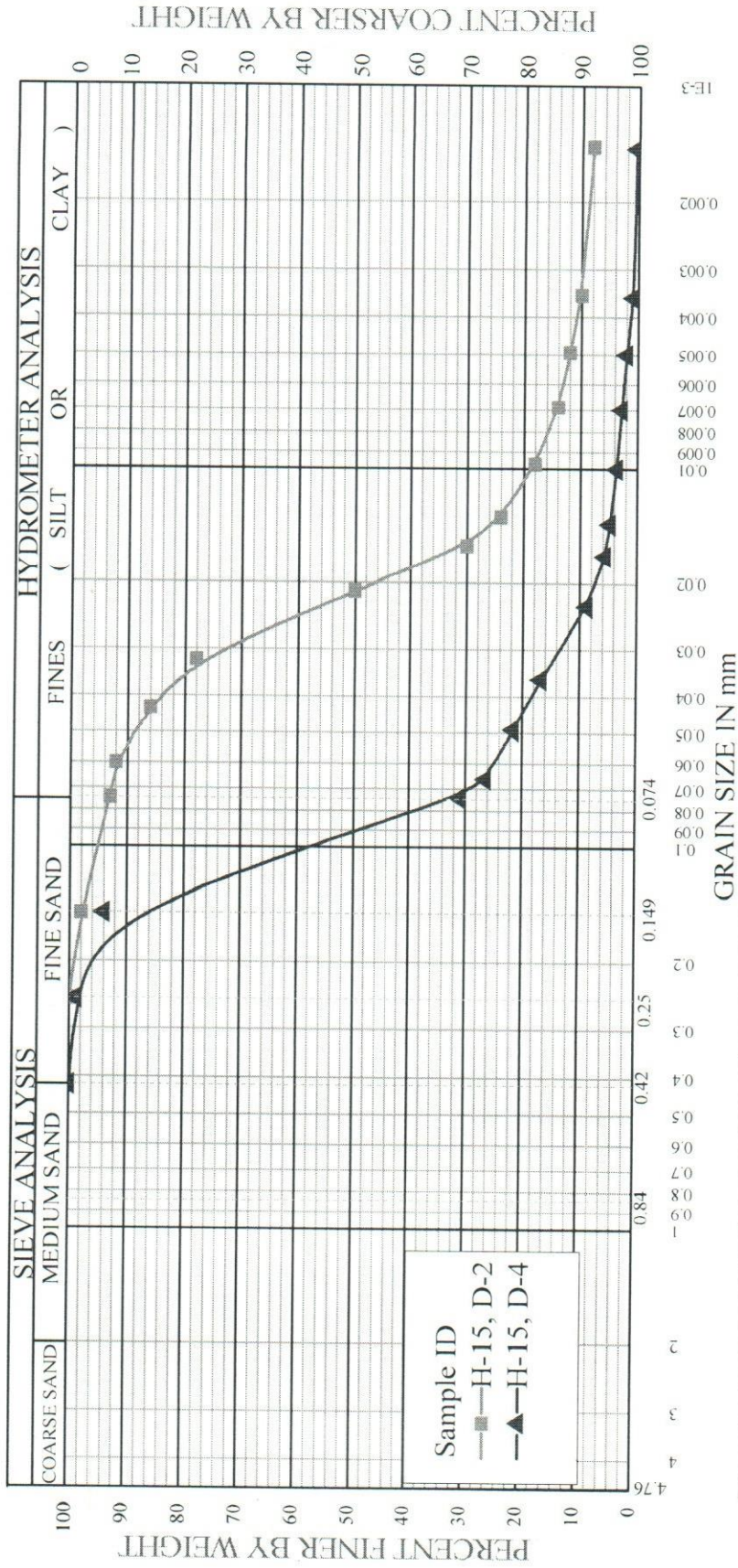
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Gurender Khal	15	D-2	5-10	Sand - 7, Silt - 84, Clay - 9
Gurender Khal	15	D-4	15-20	Sand - 65, Silt - 34, Clay - 1

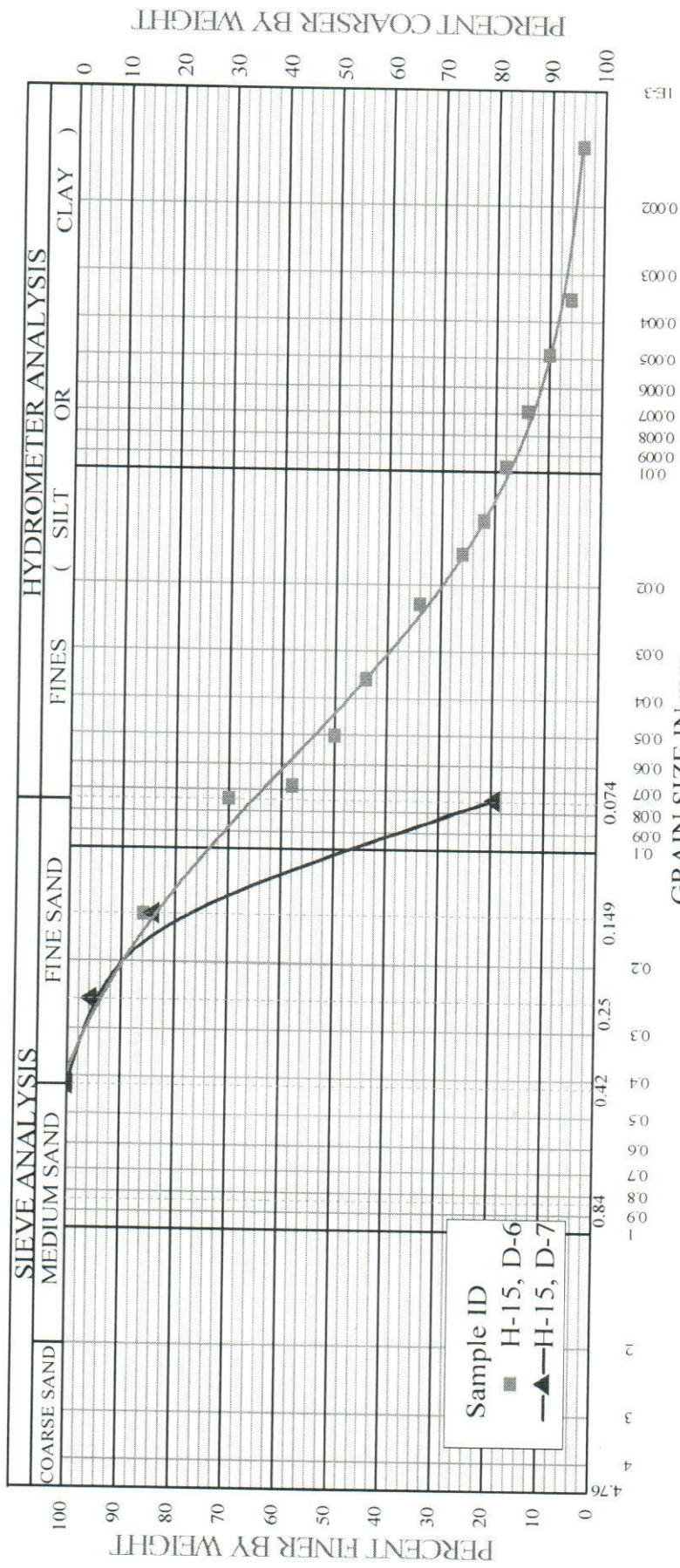
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Gurender Khal	15	D-6	25-30	Sand- 34 , Silt - 61 , Clay - 5
Gurender Khal	15	D-7	30-35	Sand- 80 , Silt - 20

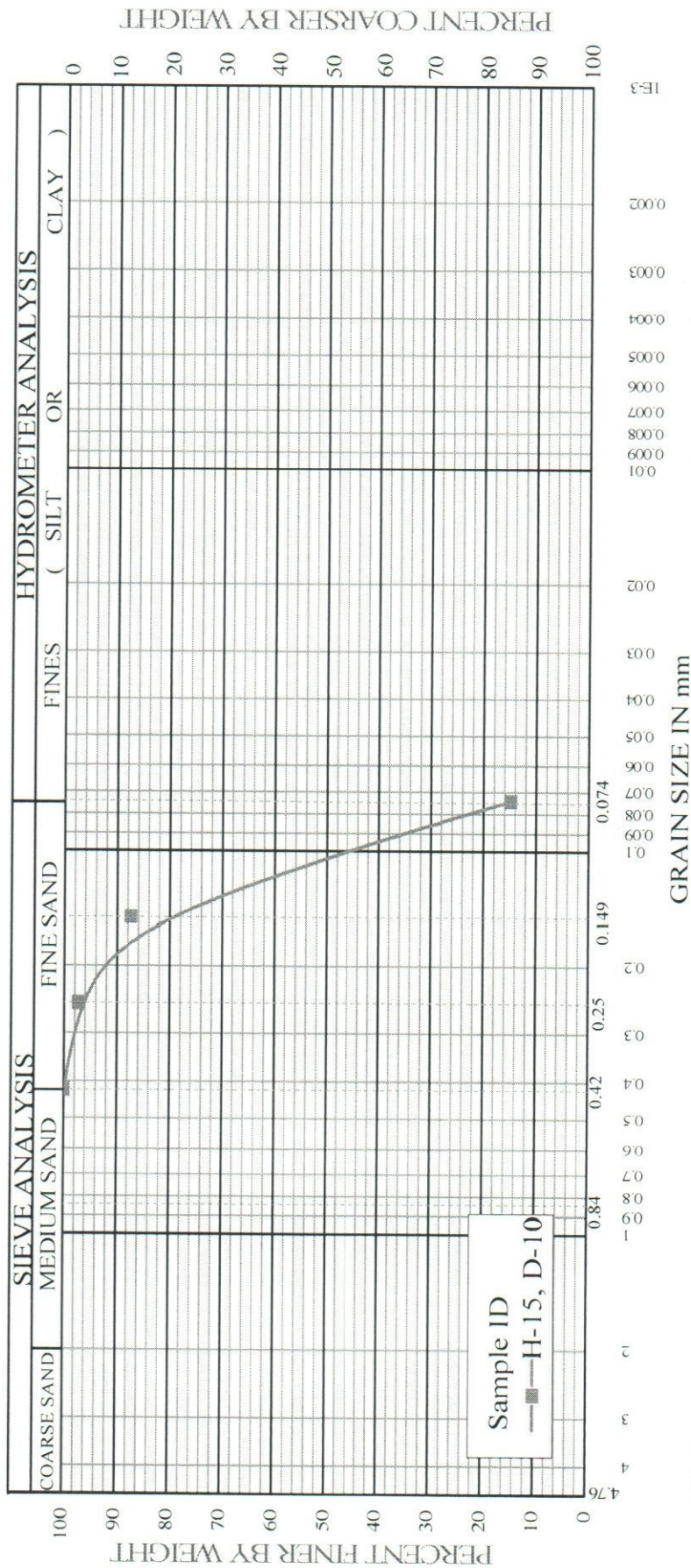
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particle (%)
Gurender Khal	15	D-10	45-50	Sand -85, Silt -15

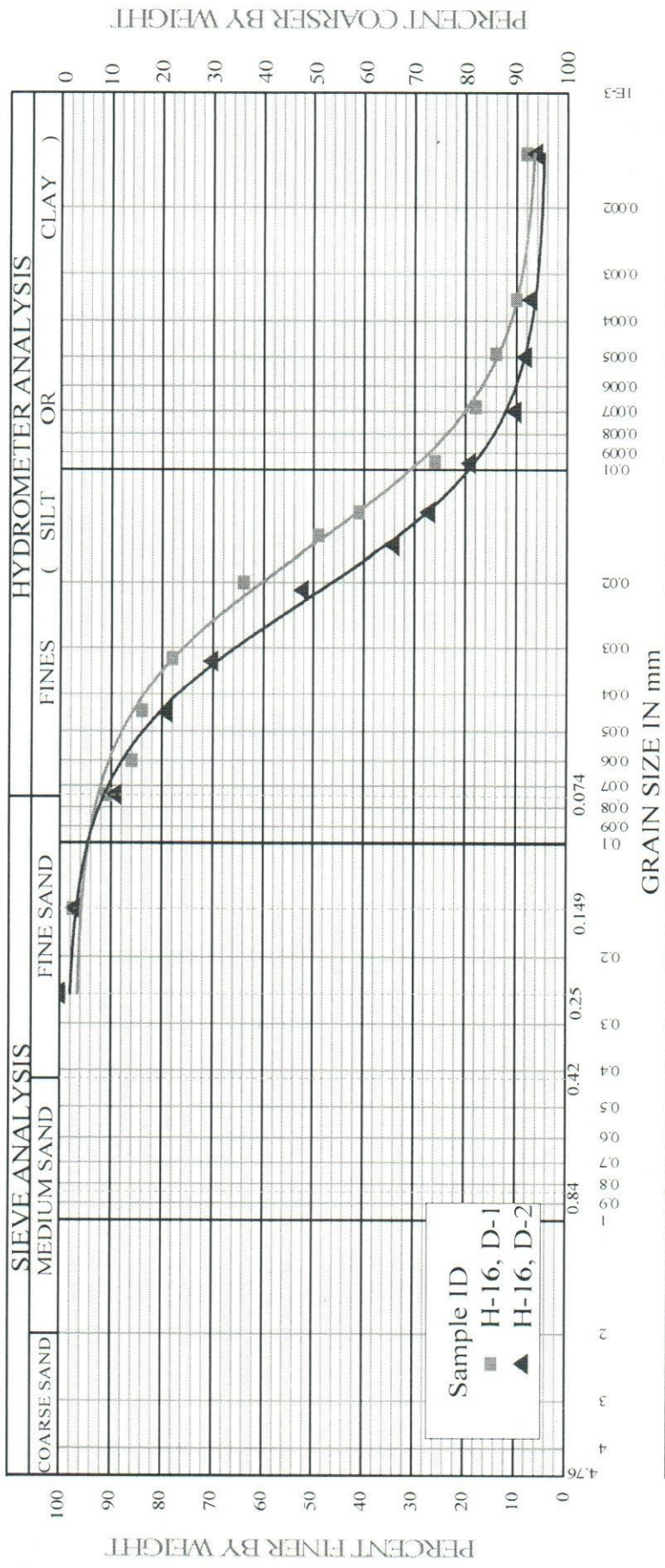
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Unified Soil classification

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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Uchkhali Khal	16	D-1	0-5	Sand - 8, Silt - 85, Clay - 7
Uchkhali Khal	16	D-2	5-10	Sand - 9, Silt - 86, Clay - 5

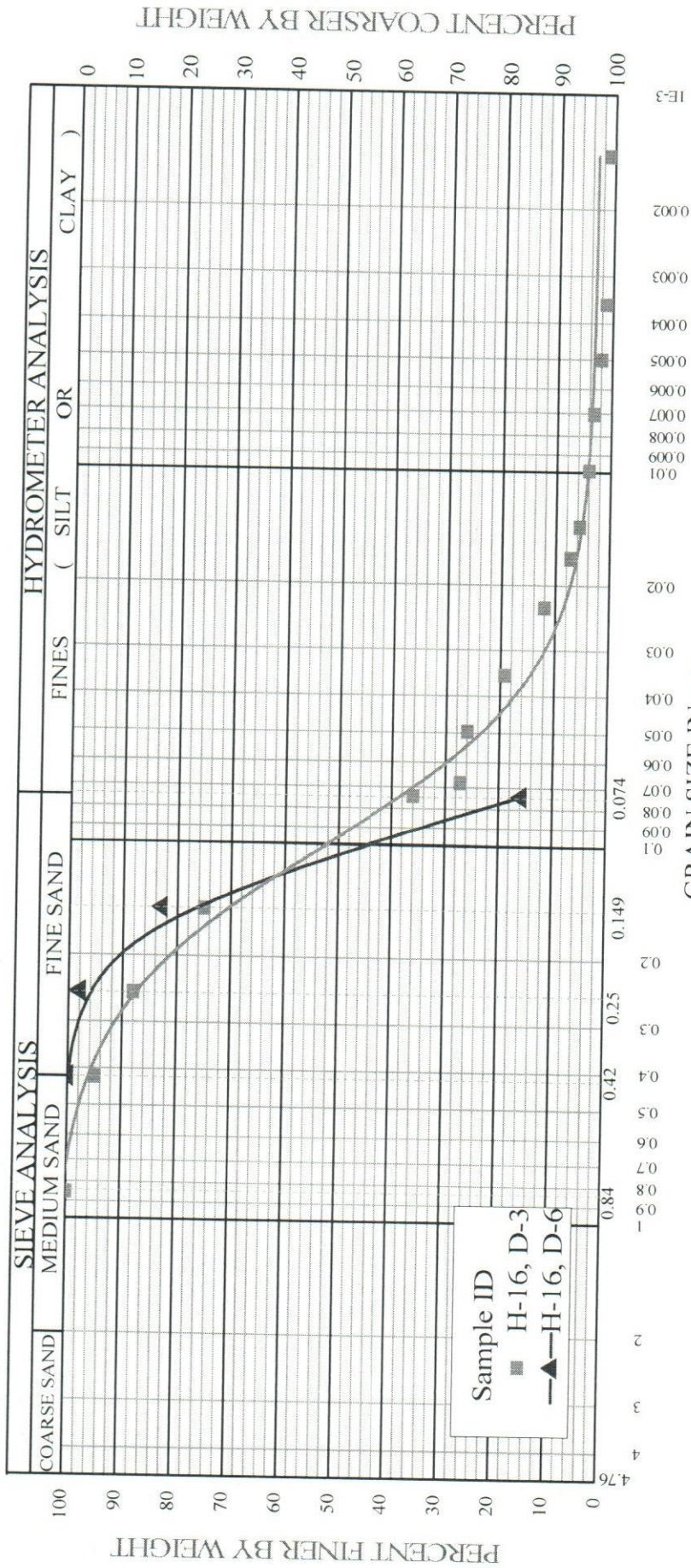
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Uchkhali Khal	16	D-3	10-15	Sand - 61, Silt - 36, Clay - 3
Uchkhali Khal	16	D-6	25-30	Sand - 83, Silt - 17

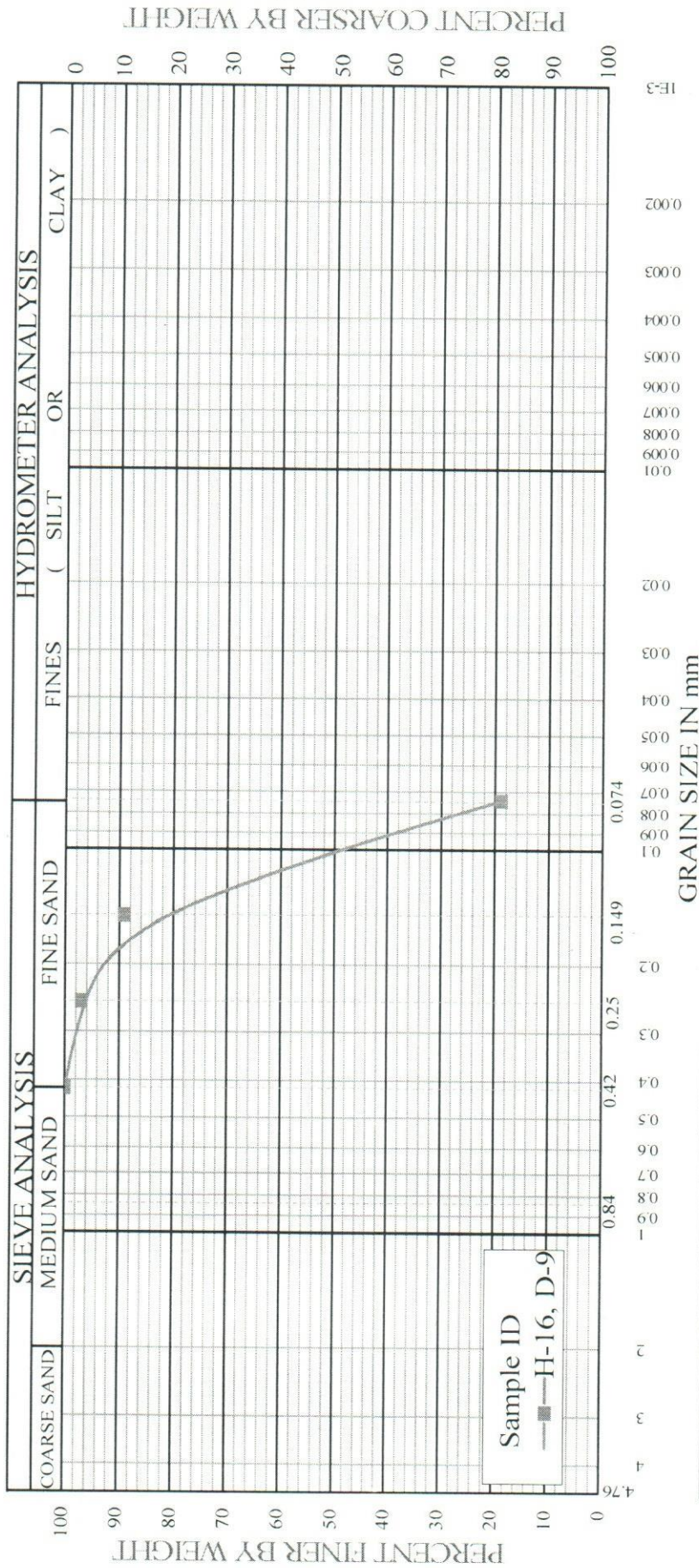
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Uchkhali Khal	16	D-9	40-45	Sand -81, Silt -19

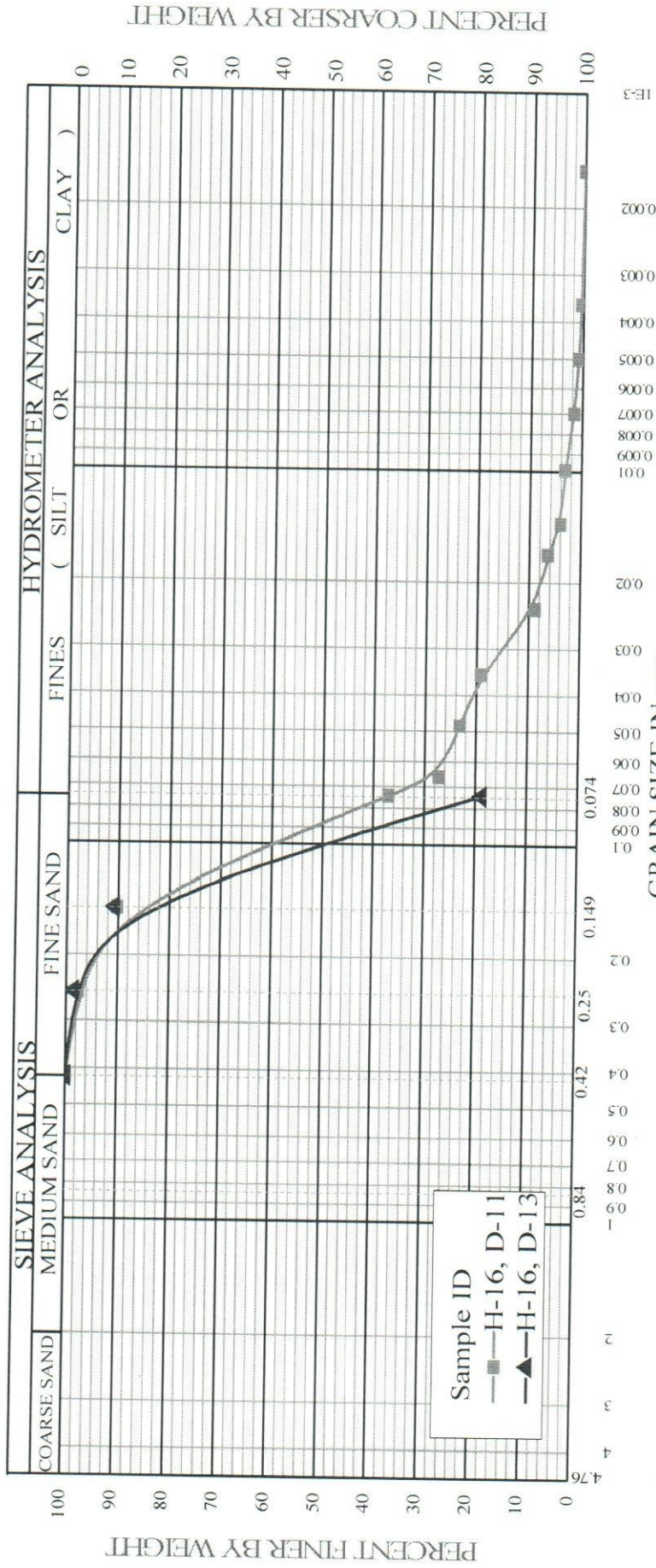
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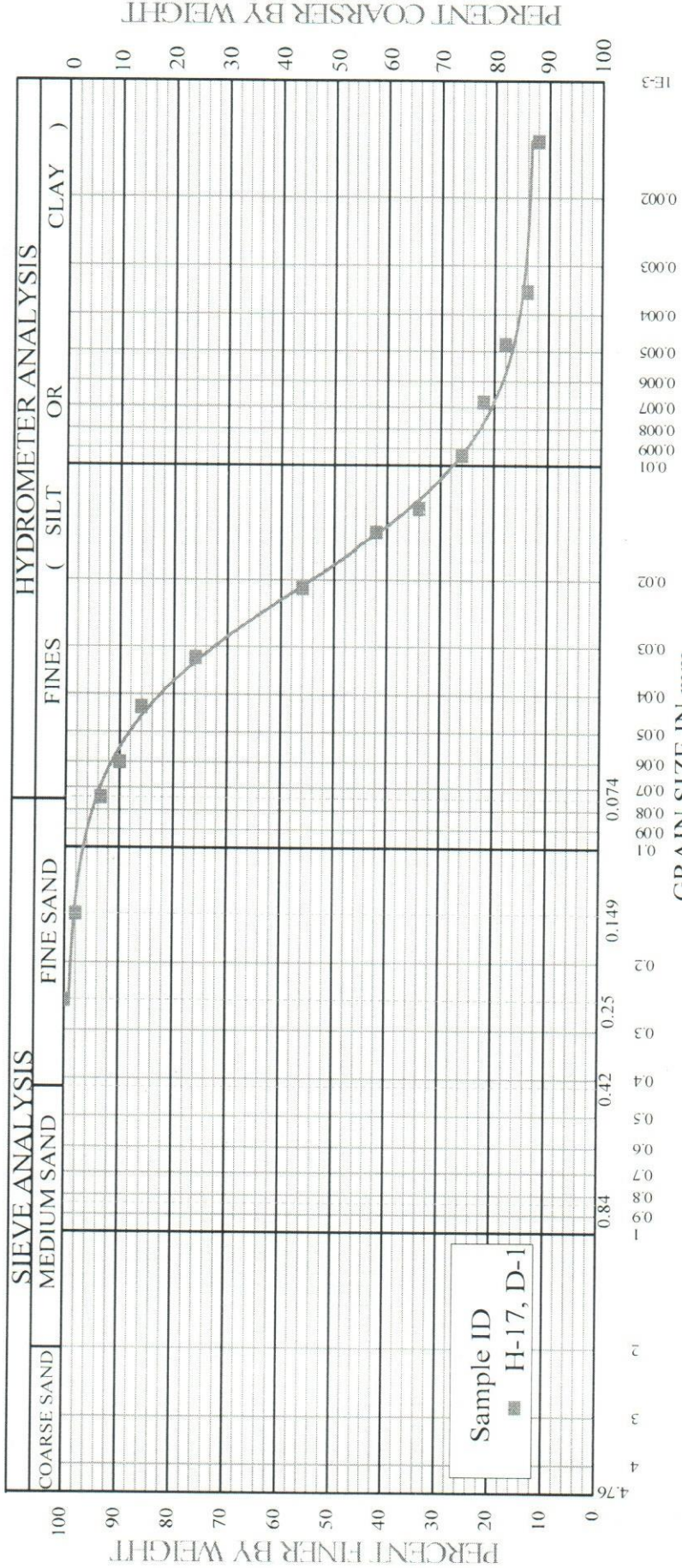
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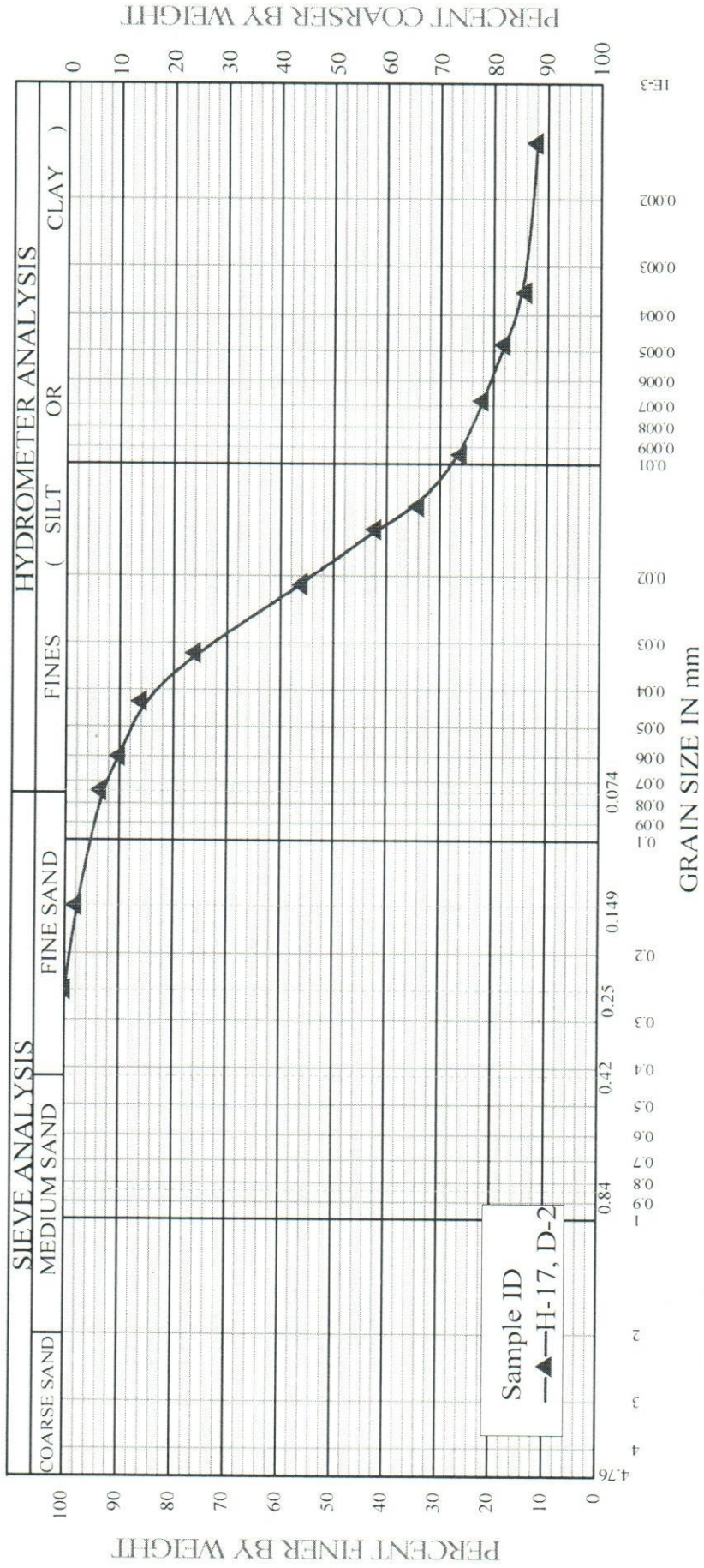
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Char Romiz	17	D-2	5-10	Sand -7, Silt -80, Clay -13

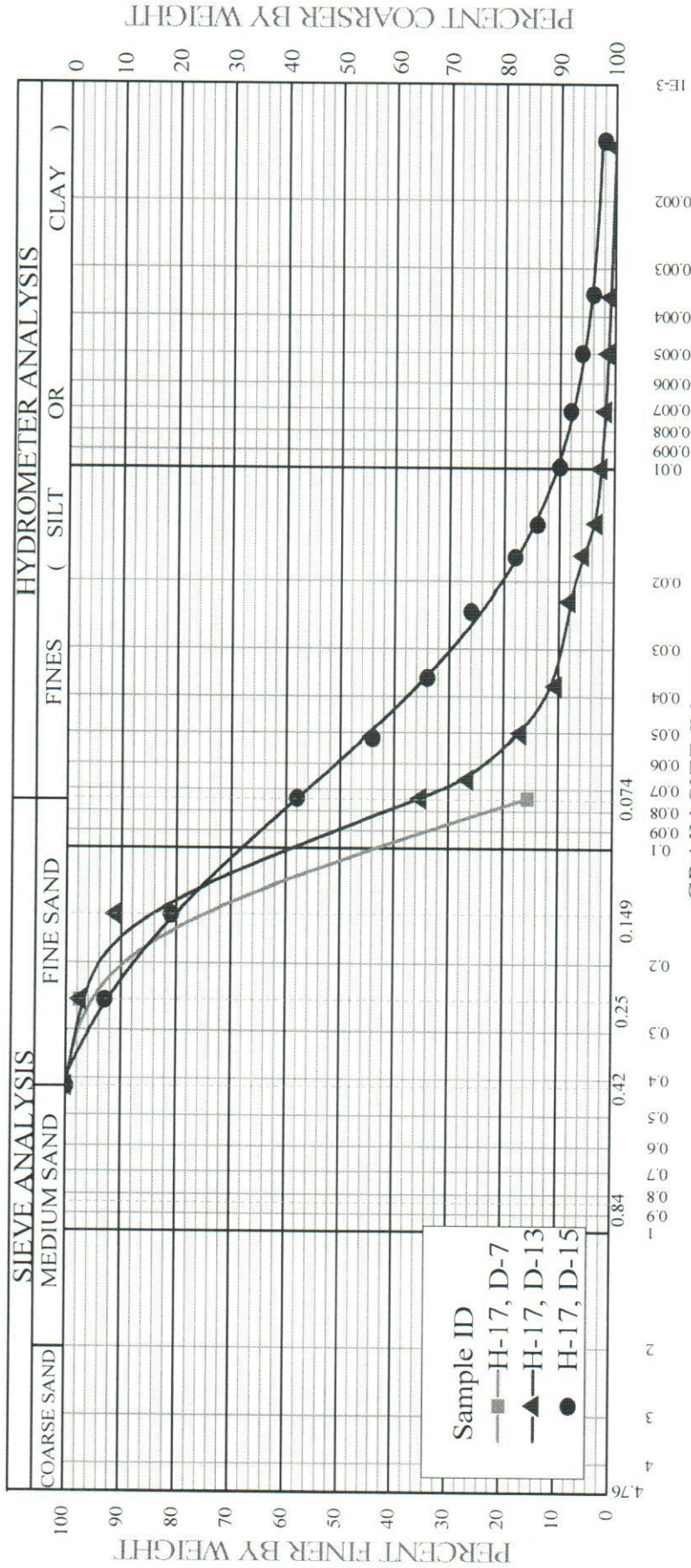
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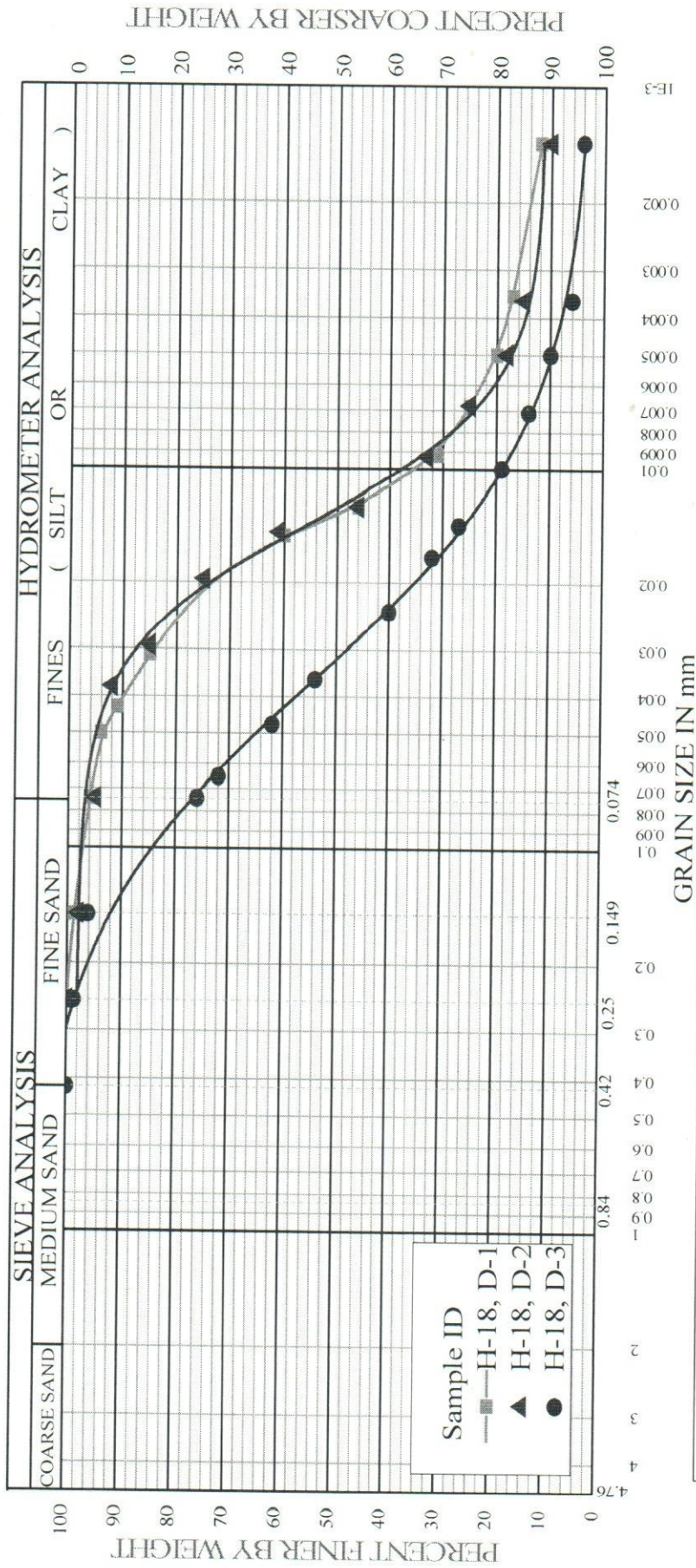
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Roghunathpur Sluice Khal	18	D-1	0-5	Sand - 4, Silt - 82, Clay - 14
Roghunathpur Sluice Khal	18	D-2	5-10	Sand - 5, Silt - 83, Clay - 12
Roghunathpur Sluice Khal	18	D-3	10-15	Sand - 23, Silt - 72, Clay - 5

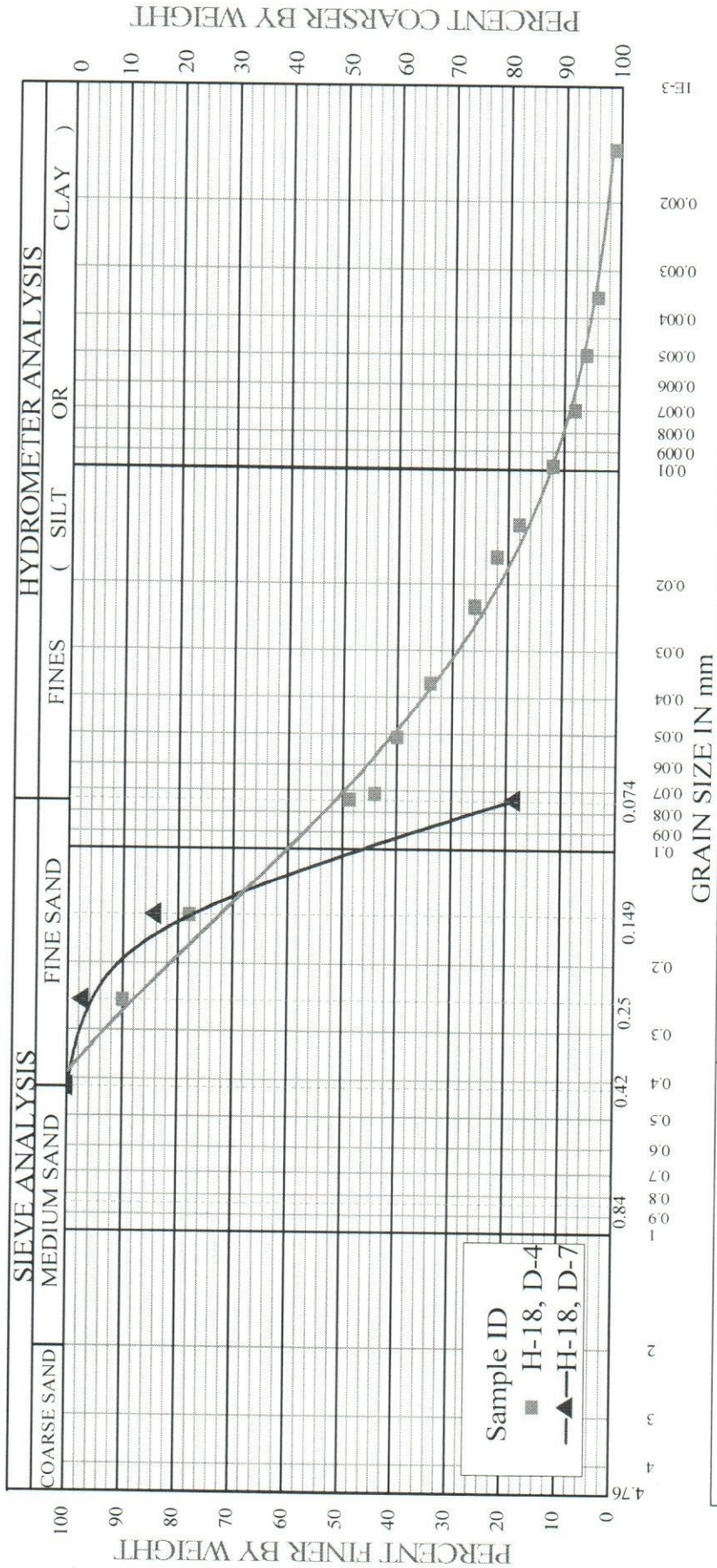
Tested by: *S. Saha*

Checked by: *MM*

Approved By: *am*

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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Roghunathpur Sluice Khal	18	D-4	15-20	Sand - 49, Silt - 49, Clay - 2
Roghunathpur Sluice Khal	18	D-7	30-35	Sand - 81, Silt - 19

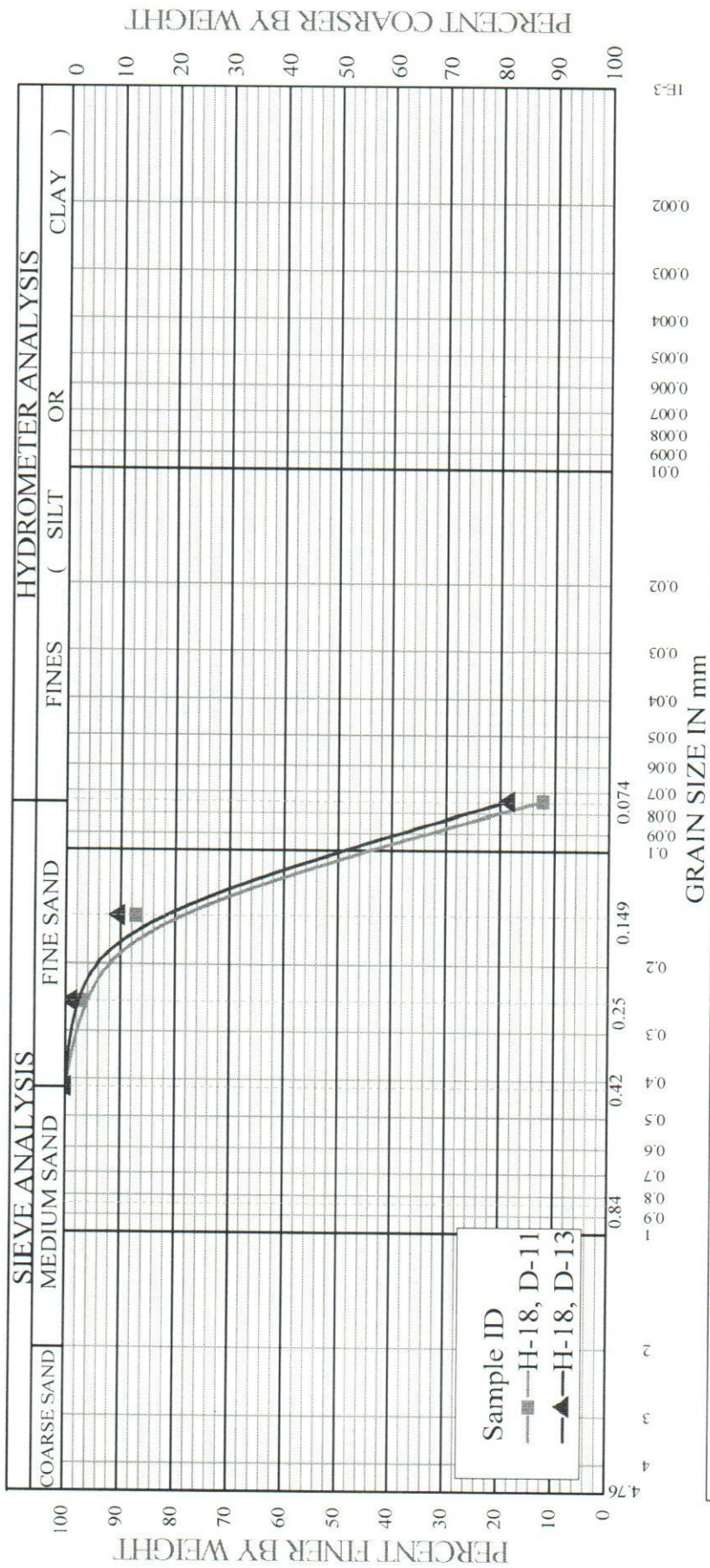
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Roghunathpur Sluice Khal	18	D-11	50-55	Sand - 88, Silt - 12
Roghunathpur Sluice Khal	18	D-13	60-65	Sand - 82, Silt - 18

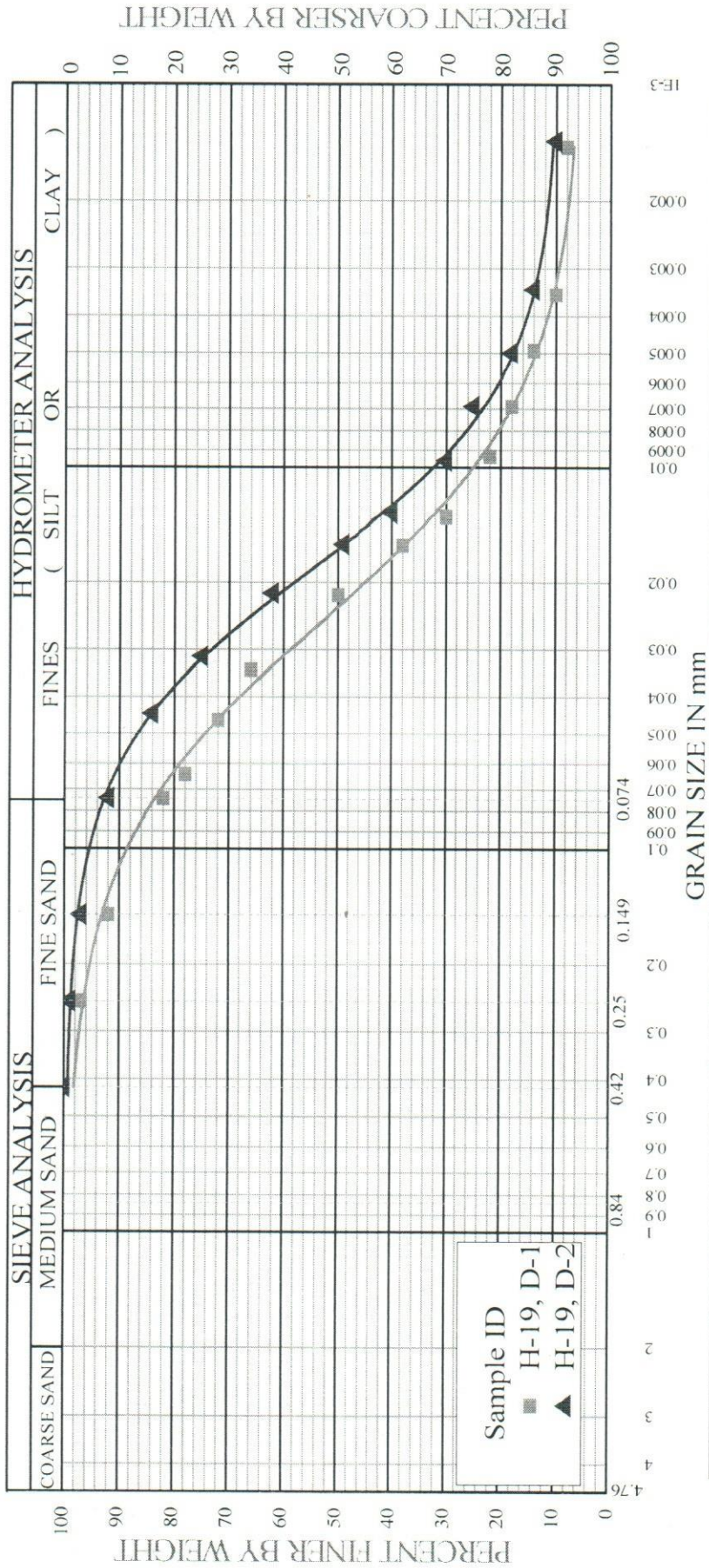
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Approved By: *[Signature]*

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Location	Hole No.	Sample No.	Depth (ft)	Percentage og Particles (%)
Roghunathpur Khal Sluice	19	D-1	0-5	Sand - 17 . Silt - 75 , Clay - 8
Roghunathpur Khal Sluice	19	D-2	5-10	Sand - 7 . Silt - 81 . Clay - 12

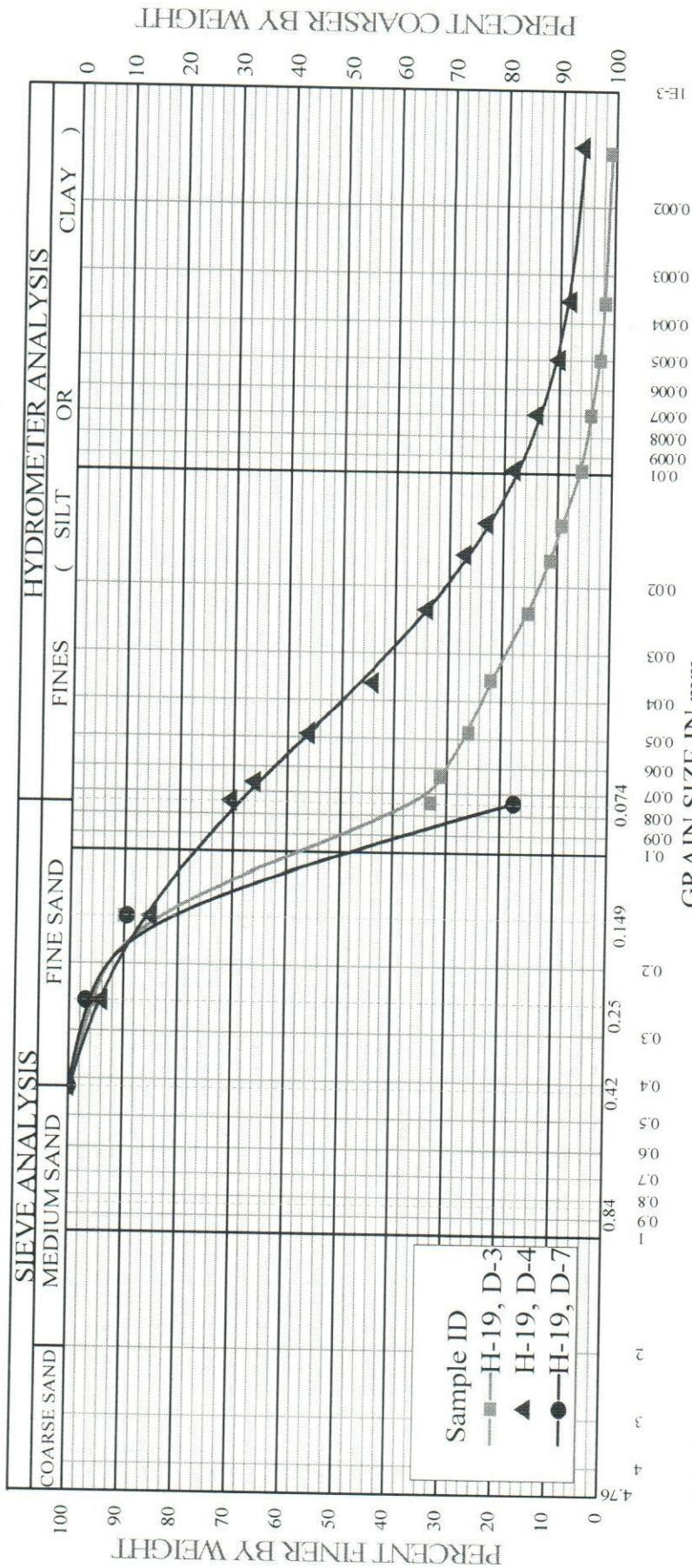
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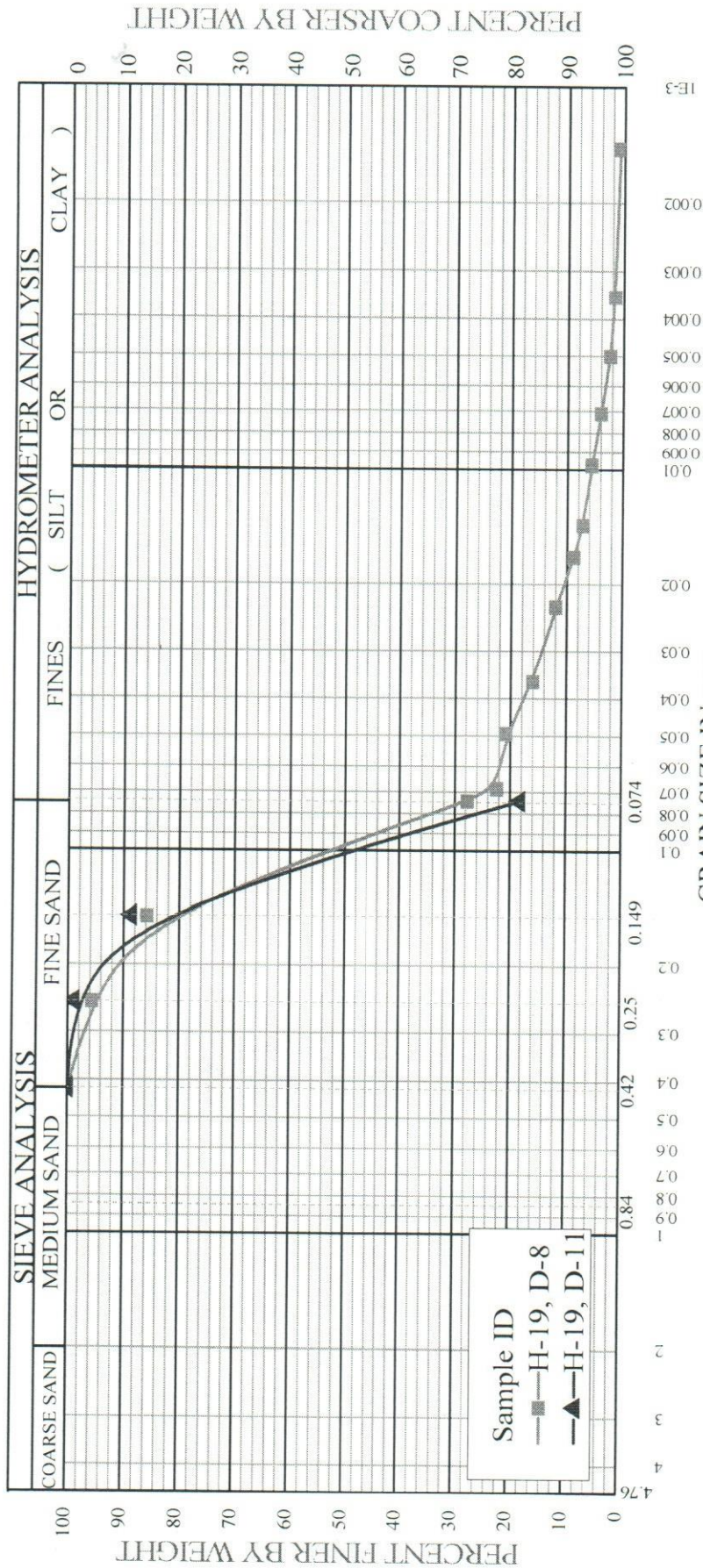
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Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Roghunathpur Khal Sluice	19	D-8	35-40	Sand - 72, Silt - 27, Clay - 1
Roghunathpur Khal Sluice	19	D-11	50-55	Sand - 82, Silt - 18

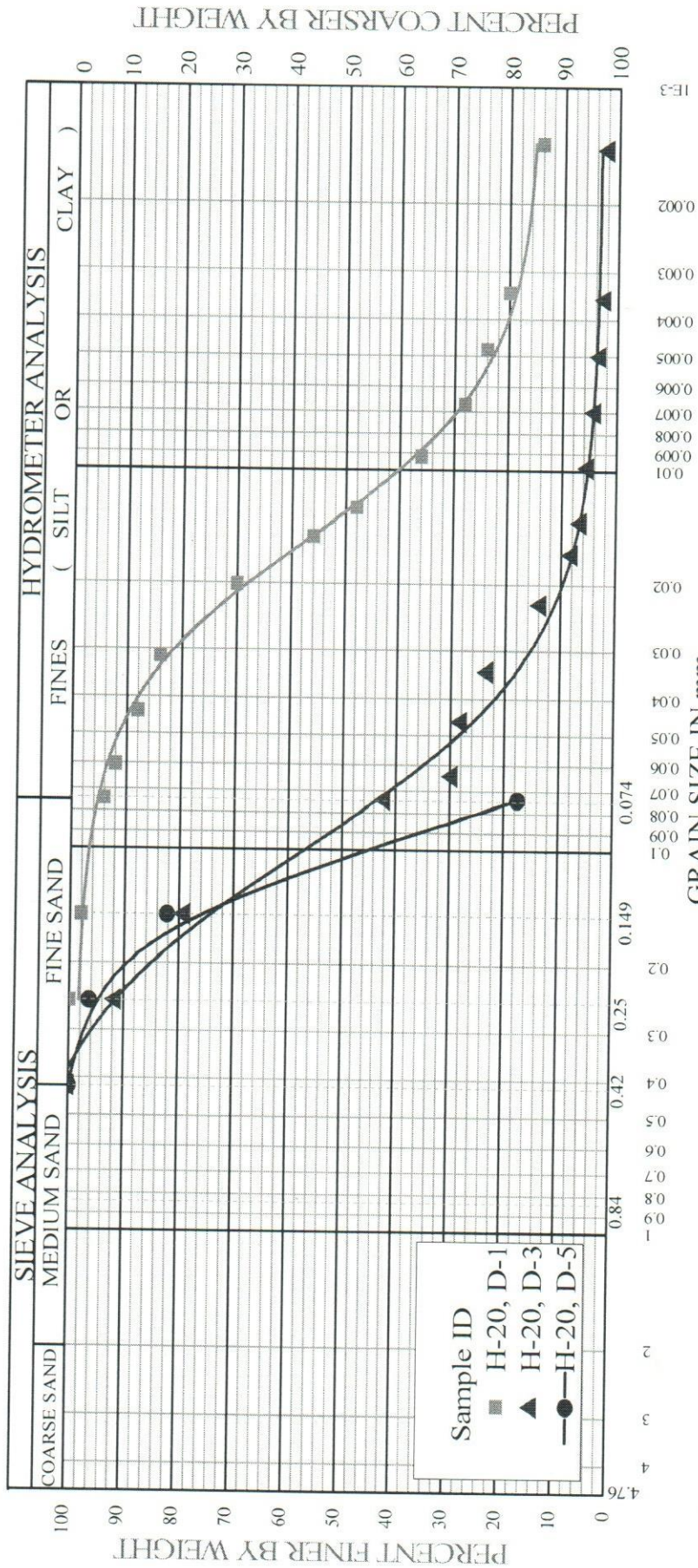
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Checked by: *[Signature]*

Approved By: *[Signature]*

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Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakhimpur District, Lakhimpur O & M Division, BWDB, Lakhimpur.



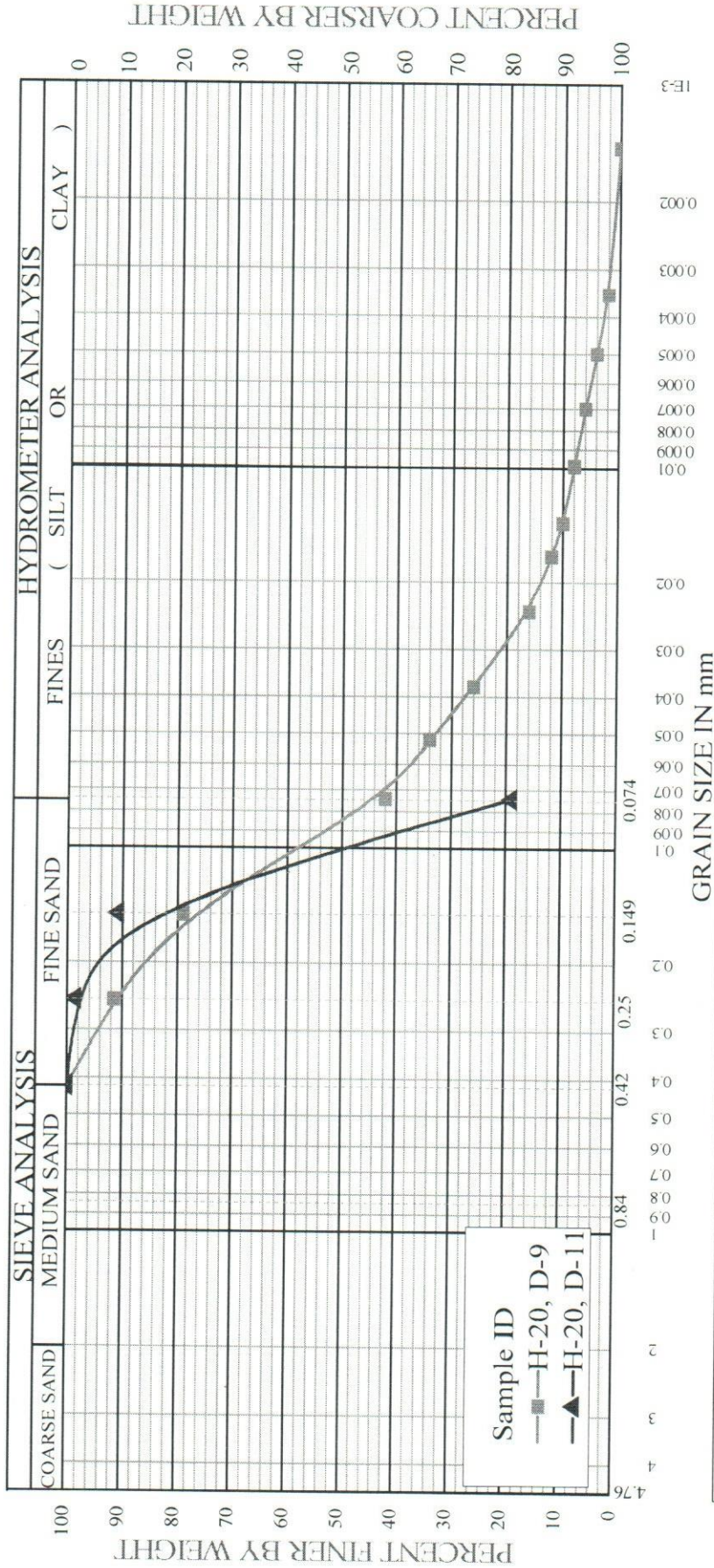
Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Malbari Khal	20	D-1	0-5	Sand - 5, Silt - 79, Clay - 16
Malbari Khal	20	D-3	10-15	Sand - 56, Silt - 41.2, Clay - 2.8
Malbari Khal	20	D-5	20-25	Sand - 82, Silt - 18

Tested by: *Shehjaan* Compiled by: *Shehjaan*

Checked by: *[Signature]* Approved By: *[Signature]*

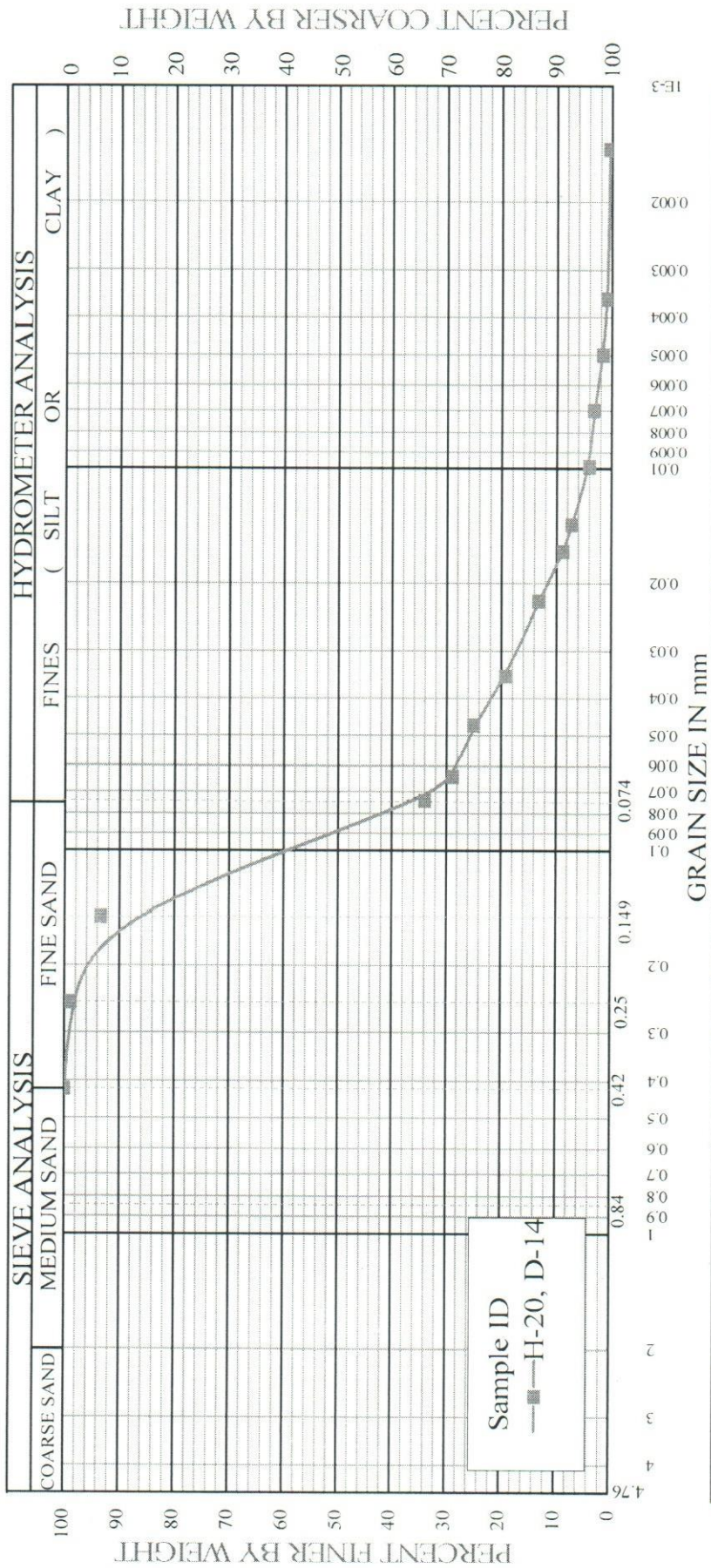
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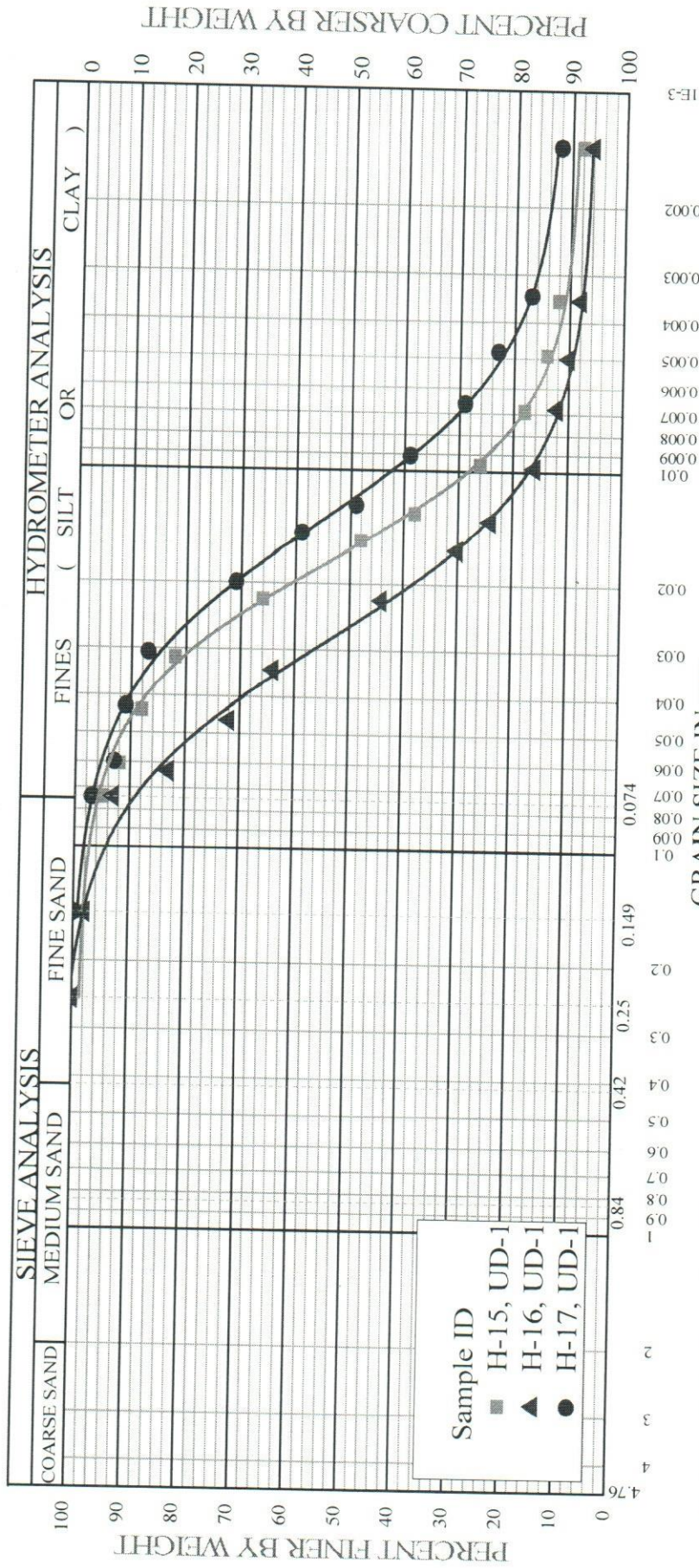
Loaction	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Malibari Khal	20	D-14	65-70	Sand - 63.5, Silt -36.2, Clay -0.3

Tested by: *Shahjahan* Compiled by: *Shahjahan*

Checked by: *[Signature]* Approved By: *[Signature]*

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GRADATION CURVE**

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakshmpur O & M Division, BWDB, Lakshmpur.



Location	Hole No.	Sample No.	Depth (ft)	Percentage of Particles (%)
Gurinder Khal	15	UD-1	N/S	Sand - 4, Silt - 86.5, Clay - 9.5
Uchkhali Khal	16	UD-1	N/S	Sand - 11, Silt - 82.5, Clay - 6.5
Char Romiz Khal	17	UD-1	N/S	Sand - 2.5, Silt - 83.5, Clay - 14

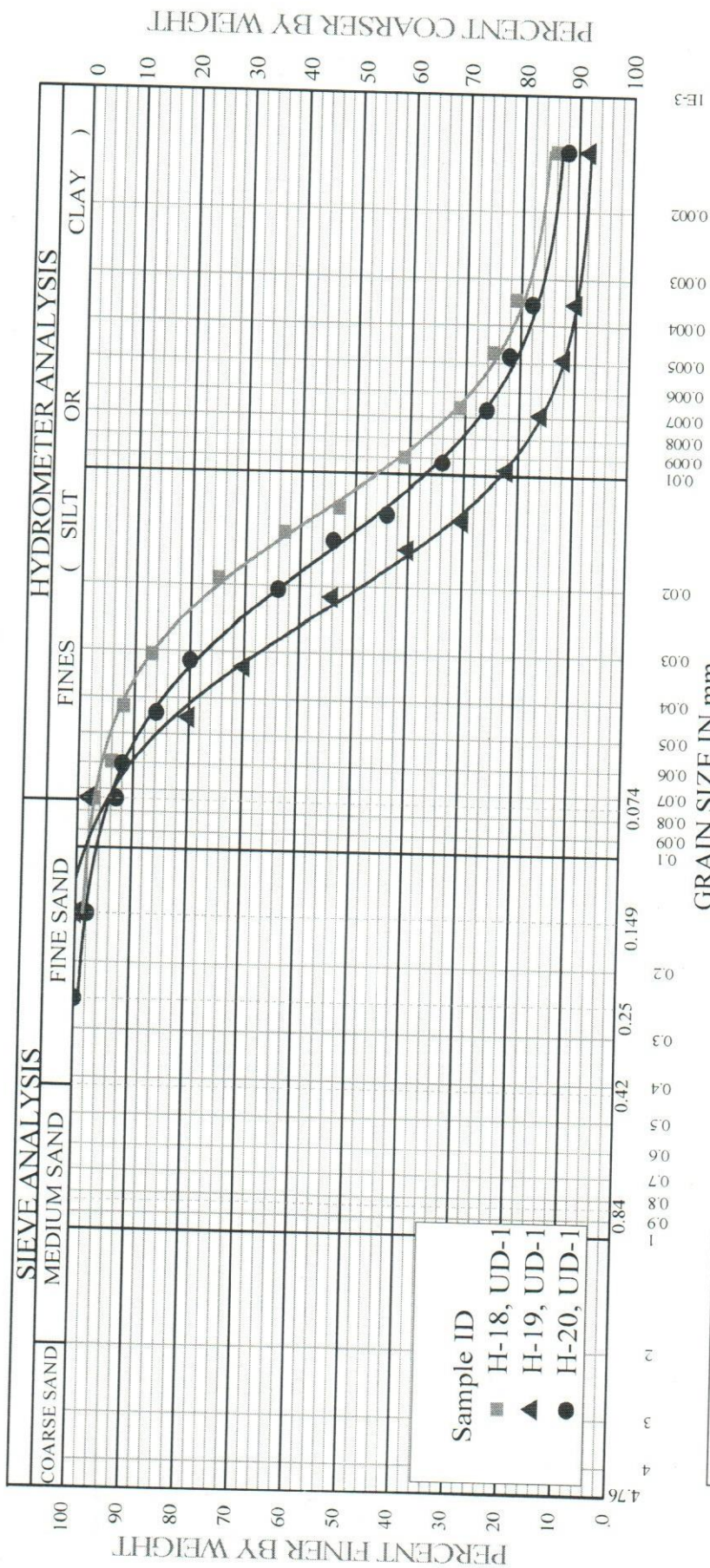
Tested by: *Shahjahan* Compiled by: *S. Sanyal*

Checked by: *[Signature]*

Approved By: *[Signature]*

RIVER RESEARCH INSTITUTE
SOIL MECHANICS DIVISION
GRADATION CURVE

Project : Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakshmpur O & M Division, BWDB, Lakshmpur.



APPENDIX - A
RIVER RESEARCH INSTITUTE
SOIL MECHANICS & GROUND WATER DIVISION

Soils are classified according to grain size distribution and moisture limit tests. Size and designation for various materials are as follows:

<u>SIEVE</u>	<u>SOIL DESIGNATION</u>
+No. 4(4.76 mm)	Gravel
No. 4 to No. 10(2.00 mm)	Coarse Sand
No. 10 to No. 40 (0.42 mm)	Medium Sand
No. 40 to No. 200 (0.074 mm)	Fine Sand
-No. 200	Silt or Clay

Silt and Clay are distinguished by the plasticity chart which is below. The liquid limit and plasticity index values are determined by laboratory tests and the results entered into the chart.

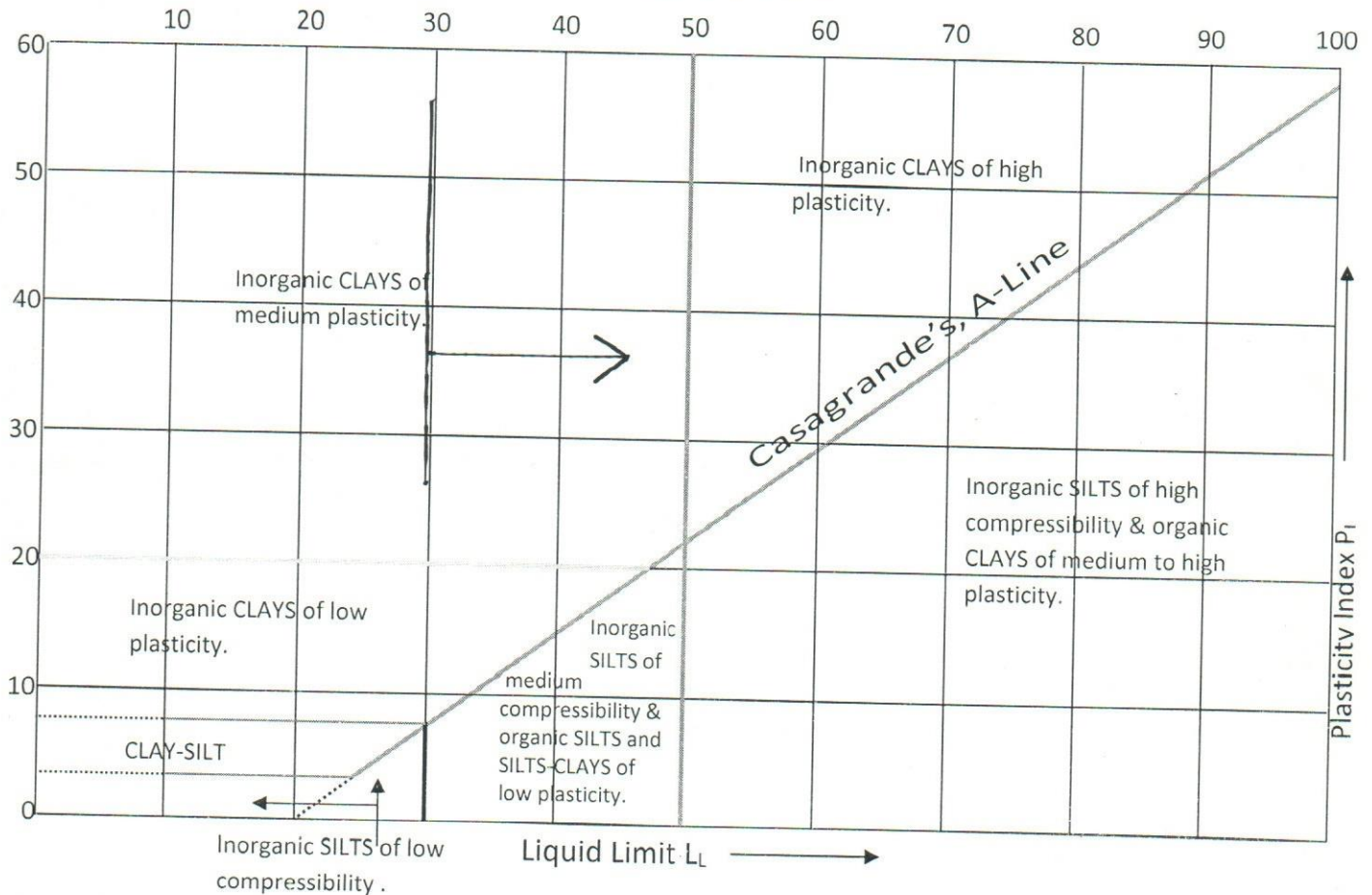
In giving a description of the materials the predominant soil type is printed in upper case letters for prominence.

In describing the secondary soils the following terms are used to represent percentages.

<u>TERM</u>	<u>PERCENTAGE</u>
Trace	0 - 10
Little	10 - 20
Some	20 - 40
And	40 - 50

Secondary materials are printed in lower case letters in the order of their significance.

PLASTICITY CHART



APPENDIX-B

SHEAR STRENGTH OF COHESIVE SOILS AND DENSITY INDEX (I_D) OF SANDS COMPARED WITH STANDARD PENETRATION RESISTANCE-'N'

Table-1: Shear Strength of Cohesive Soils

Consistency	Very Soft	Soft	Medium Stiff	Stiff	Very Stiff	Hard
Unconfined Compressive Strength (TSF)	0.25	0.50	1.00	2.00	4.00	
Compression Strength (kN/m ²)	23.94	47.88	95.76	191.52	383.04	
Standard Penetration Resistance-'N'	2	4	8	16	32	

N= Number of blows per foot
 1 foot=0.3048 meter

Table-2: Density Index (I_D) of Sand

Number of blows	Density Index (I_D)
0-4	Very loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Above 50	Very Dense



Appendix- C

Soil Testing Bill

Soil Mechanics and Ground Water Division
Geotechnical Research Directorate
River Research Institute, Faridpur.

Client : Executive Engineer, Lakshmipur O & M Division, BDWB, Lakshmipur.

Reference: His Memo No. RKBLK/D-1/3132,

Date: 22/06/2023

Bill No. : Soil-01 (2023-24)

Project :Meghna River Bank Protection at Barokheri, Ludhua Bazar and Kader Panditer Hat under Ramgati Upazilla and Komolnagar Upazilla of Lakkhipur District, Lakshmipur O & M Division, BWDB, Lakshmipur.


Location: 1. Barokheri, Ramgati, Lakshmipur, 2. Ludhua Bazar, Ramgati, Lakshmipur, Lakshmipur, 3. Kader Panditer Hat, Komolnagar, LakshmipurLakshmipur.

Report No. Soil-01 (2023-24)

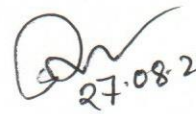
Date: 27.08.2023

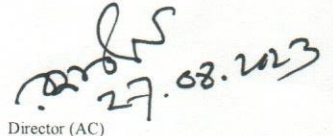
Sl. No.	Name of Soil Mechanics Tests	Rate (including all charges and VAT)	Nos of sample	Bill
1	2	3	4	5
1	Specific Gravity (Gs.)	1725	14	24150
2	Natural Moisture Content	750	106	79500
3	Mechanical Analysis :			
	a) Visual Inspection & Classification			
	(i) Disturbed Sample	300	300	90000
	(ii) Undisturbed Sample	500	20	10000
	b) Sieve Analysis	2850	28	79800
	c) Hydrometer Analysis (Including Gs.)	2850		
	d) Sieve & Hydrometer Analysis (Including Gs.)	5250	115	603750
	e) Particle Size Analysis using Particle Size Analyzer	6000		
4	Unit Weight	1500	20	30000
5	Loss-on-Ignition	3375		
6	Liquid Limit & Plastic Limit Combined	2475	20	49500
7	Shrinkage Limit	1275		
8	Consolidation Test (not excluding 6 loads + 2 unloads)	18750	14	262500
9	Direct Shear Test (3-point)	9750		
10	Triaxial Shear Test (for 3-specimen)			
	a) Unconsolidated Undrained	16500		
	b) Consolidated Undrained (without P.P.)	31500		
	c) Consolidated Undrained (with P.P.)	35250	16	564000
	d) Consolidated Drained Test	35250		
11	Vane Shear Test	8500		
12	Unconfined Compression Test/Remolded UCT	6000		
13	a) Standard AASHTO (4" dia mould)	9000		
	b) Standard AASHTO (6" dia mould)	9000		
	c) Modified AASHTO (4" dia mould)	11250		
	d) Modified AASHTO (6" dia mould)	11250		
	e) Field density per spot	4950		
	f) Field visit fee inside Faridpur	9750		
14	a) Permeability Test for Non-Cohesive Soils	6375		
	b) Permeability Test for Cohesive Soils	16500		
15	Density Index (I_d)	6000		
16	C.B.R. Test	16500		
17	Laboratory Boring Log (per sheet)	225		
18	Chemical test of soil ($P^{H+} + Cl^{-} + SO_4^{-2}$)	1350		
19	Chemical test of water ($P^{H+} + Cl^{-} + SO_4^{-2}$)	1350		
	Total (Taka)			1793200
	(In words) Taka Seventeen Lac Ninety Three Thousand and Two Hundred only.			

*Charges include 10% Printing and Binding Cost, 10% Testing and Consultancy Fee and 15% VAT.


27.08.23
Scientific Officer
Geotechnical Research Directorate
River Research Institute, Faridpur


27.08.2023
Senior Scientific Officer
Geotechnical Research Directorate
River Research Institute, Faridpur


27.08.2023
Principal Scientific Officer
Geotechnical Research Directorate
River Research Institute, Faridpur


27.08.2023
Director (AC)
Geotechnical Research Directorate
River Research Institute, Faridpur

APPENDIX-D

List of research personnel responsible for testing works, preparation and publication of the report.

1.	Engr. Kazi Rezaul Karim	Director (In Charge)
2.	Uma saha	PSO
3.	Engr. Md. Matiar Rahman Mondol	PSO
4.	Dr. Engr. Fatima Rukshana	PSO
5.	Mohammad Dulal Bawali	SSO
6.	Md. Moniruzzaman	SSO
7.	Engr. Khondoker Rajib Ahmed	SSO
8.	Engr. Sumiya Ferdhous	SO
9.	Kazi Md. Shajahan	ST-C
10.	A.B.M Tazul Islam Bhuiyan	ST-B
11.	Md. Nuruzzaman	ST-B
12.	Md. Nazrul Islam	ST-B
13.	Md. Golam Mostofa	ST-B
14.	Md. Abu Bakar Siddique	ST-B
15.	Md. Liakot Hossain Khan	ST-B
16.	Md. Ziaul Haque	ST-A
17.	Chinmoy Kumar Das	ST-A
18.	Md. Mahbulul Alam	ST-A
19.	Mrs. Lutfunnahar Lota	Tracer
20.	Md. Abdul Latif	Office Assistant
21.	Md. Mahfuzul Rahman	Office Assistant
22.	Abdul Jabbar	Office Assistant
23.	Md. Mohsin Mia	Office Assistant
24.	Md. Jamal Uddin	Office Assistant

Appendix - E

নির্বাহী প্রকৌশলীর দপ্তর
লক্ষ্মীপুর পওর বিভাগ
বাপাউবো, এস.আর. রোড, লক্ষ্মীপুর।
ফোন অফিস- ০২৩৩৪-৪৪১০৮০
মোবাইল নং-০১৩১৮২৩৬০৩৮

বাংলাদেশ পানি উন্নয়ন বোর্ড



Office of the
Executive Engineer
Lakshmipur O & M Division
BWDB, S. R. Road Lakshmipur.
Phone: Office- 02334-441080
E-mail: xn.laxmipur@gmail.com

BOX NO-01 (2023-24)

dt: 02.07.2023.

স্মারক নং-আরকেবিএলকে/ডি-১/৩১৩২

তারিখঃ ২-০৬-২০২৩খ্রিঃ

বববব,

মহাপরিচালক,
নদী পরবেষ্টিত ইনিকিটিউট,
লক্ষ্মীপুর।

D (CR)
25/6
2023

বিষয়ঃ Disturbed এবং Undisturbed নমুনা প্রেরণ প্রসঙ্গে।

সংক্ষেপে,

স্বতন্ত্র সম্মান প্রদর্শন পূর্বক উপস্থিত বিষয়ের আলোকে জানানো যাচ্ছে যে, "লক্ষ্মীপুর জেতার রামগতি ও কলকাতার উপজেলাধীন বড়খেরী ও লুখুয়াবাজার এবং কাদের পাড়তের হাট এলাকা গাছন চতে রক্ষাকল্পে মেঘনা নদীর উপর সংরক্ষণ" শীর্ষক প্রকল্পের আওতায় ২০ টি পানি নিষ্কাশন অবকাঠামোর ডিজাইন প্রণয়নের জন্য বিভিন্ন লোকেশনে Disturbed এবং Undisturbed নমুনা সংগ্রহ করা হয়েছে।

নমুনা সংগ্রহের তারিখ	নমুনার সংখ্যা	নমুনার প্রকৃতি	টেস্টের নাম
১৬-০৬-২০২৩ খ্রিঃ হতে	২০ টি	Undisturbed	1. Routine Test 2. Direct Shear Test 3. Triaxial Shear Test (Consolidated Undrained)
২২-০৬-২০২৩ খ্রিঃ পর্যন্ত	২০ টি	Disturbed	

এমতাবস্থায়, মাঠ পর্যায় হতে সংগৃহীত Disturbed এবং Undisturbed নমুনার ছকে উল্লেখিত পরীক্ষা করার সময় পরবর্তী প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য অনুরোধ করা হলো।

সংযুক্তিঃ ১। নমুনার সংগ্রহের লোকেশন।

২। নমুনা- ৪০ টি।

Report section
৩০০৫৫
02.07.2023
PSO/SSO

আপনার অনুগত
ফারুক আহমেদ
নির্বাহী প্রকৌশলী

আইডি নং-৮৪০১২৩০০১

ফোনঃ অফিস-০২৩৩৪-৪৪১০৮০

E-mail: xn.laxmipur@gmail.com

তারিখঃ ২২-০৬-২০২৩খ্রিঃ

স্মারক নং-আরকেবিএলকে/ডি-১/৩১৩২/১(১৬)

অনুলিপি সদয় অবগতি/অবগতি ও পরবর্তী প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য প্রেরণ করা হলোঃ

- ১। প্রধান প্রকৌশলী, পূর্বাঞ্চল, বাপাউবো, কুমিল্লা ও প্রকল্প পরিচালক।
- ২। তত্ত্বাবধায়ক প্রকৌশলী, ফেনী পওর সার্কেল, বাপাউবো, ফেনী।
- ৩। তত্ত্বাবধায়ক প্রকৌশলী, ডিজাইন সার্কেল-৪, বাপাউবো, পানি ভবন, লেভেল-৩, ৭২ গ্রীনরোড, ঢাকা।
- ৪-৬। উপ-বিভাগীয় প্রকৌশলী, লক্ষ্মীপুর/রামগতি/রায়পুর পওর উপ-বিভাগ, বাপাউবো, লক্ষ্মীপুর/রামগতি/রায়পুর।
- ৭-৮। সহকারী প্রকৌশলী/প্রাকল্পনিক, অত্র দপ্তর।
- ৯-১৬। উপ-সহকারী প্রকৌশলী/ শাখা কর্মকর্তা,, বাপাউবো, লক্ষ্মীপুর।
- ১৭। মাস্টার কপি/নথি।



নির্বাহী প্রকৌশলী
আইডি নং-৮৪০১২৩০০১

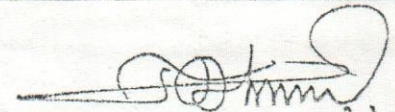
নমুনা সম্পর্কিত বিস্তারিত তথ্য

গানি নিষ্কাশন অবকাঠামোর নাম	ডেন্ট সাইজ	বোর হোল নং	Disturbed নমুনা	Undisturbed নমুনা
জয় বাংলা খাল	২	০১	১	১
বাতির খাল	২	০২	১	১
এম পির খাল-১ মুইস	৩	০৩	১	১
কনোরিয়া খাল	২	০৪	১	১
নাতাবুনিয়া খাল মুইস	১	০৫	১	১
মাতবরহাট খাল মুইস	২	০৬	১	১
লুখুয়া খাল (গাইগ মুইস)	১	০৭	১	১
জারিরদোনা খাল	৩	০৮	১	১
জারিরদোনা খাল মুইস	২	০৯	১	১
হাজির খাল (গাইগ মুইস)	১	১০	১	১
মালেকের খাল মুইস	১	১১	১	১
মুঞ্জির খাল	২	১২	১	১
জাসলগাড়া খাল	১	১৩	১	১
কালীর খাল	৩	১৪	১	১
✓ গুরিন্দার খাল	২	১৫	১	১
✓ উচখালী খাল	২	১৬	১	১
✓ চর রমিজ খাল	২	১৭	১	১
✓ রঘুনাথপুর মুইস খাল	২	১৮	১	১
✓ রঘুনাথপুর খাল মুইস	১	১৯	১	১
✓ মালীবাড়ি খাল	২	২০	১	১

Gr. No.-2

Gr. No.-4

Gr. No. 3


 24/04/22

(ফারুক আহমেদ)
 নির্বাহী প্রকৌশলী
 লক্ষ্মীপুর পওর বিভাগ
 বাপাউবো, লক্ষ্মীপুর।