BORING LOG NO. 09-B85

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
BORING LOCATION:	N: 13827609 E: 3261533	SITE:	Cedar Bayou PA6 Baytown, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	USCS SYMBOL	SAMPLES TYPE	RECOVERY, IN	SPT, BLOWS/FT	CALIBRATED HAND PENETROM., TSF	TORVANE, TSF	TESTS MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, TSF	FAILURE STRAIN, %	CONFINING PRESSURE, PSI
	Approx. Surface Elevation: 14.8 feet																
	FILL: FAT CLAY dark gray and brown, medium stiff to very stiff, very high plasticity, moist	1	CH	ST	5		1.0		27								
		2															
		3		ST	18		1.0		33	89	87	25	62	93			
		4															
		5		ST	10		2.0		30								
		6															
		7		ST	15		1.5		35								
6.8	8.0	8															
	FAT CLAY w/ SAND light gray, gray, brown and yellowish brown, medium stiff to stiff, very high plasticity, moist	9	CH	ST	20		1.25		34								
		10															
		11		ST	13		1.0		40	80	97	30	67	82			
		12															
		13		ST	13		1.25		25								
	- with calcareous nodules and ferrous stains below 14 feet	14															
-1.2	16.0	15		ST	15		1.0		24								
	LEAN CLAY brown, soft to medium stiff, medium plasticity, wet	16															
		17	CL	ST	19		0.5		35								
-4.2	19.0	18															
		19		ST	13		0.75		25	102	55	20	35	93			
-5.2	**FAT CLAY** 20.0	20	CH														
	brown, medium stiff, high plasticity, moist	21	CL	ST	13		1.0		26								
-7.2	22.0	22															
	LEAN CLAY brown, medium stiff, medium plasticity, moist, with silt and sand seams	23	CL	SS	12	25			24								
		24															
-11.2	**LEAN CLAY w/ SAND** 26.0	25		SS	16	15			24					77			
	brown, stiff to very stiff, medium plasticity, moist	26															
	SILTY SAND brown, medium dense, none to slight plasticity, fine grain, wet	27	SM	SS	14	22			25								
		28															
		29		SS	9	18			24								
		30															
		31		SS	12	13			23								
		32															
		33		SS	15	16			21					28			
		34															
	Continued Next Page																

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry augered to 16 feet; wet rotary thereafter.

WATER LEVEL OBSERVATIONS			
▽ 16 ft	WD	▼15.5 ft	at 5 min
▼ 13 ft	at 10 min	▼ 9.5 ft	at 15 min

Terracon

DATE DRILLED	3/24/2010
PROJECT NUMBER	92105186-A

09-B85

EXHIBIT A-

BORING LOG NO. 09-B85

CLIENT: USACE, Galveston District
Galveston, Texas

PROJECT: TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I

BORING LOCATION: N: 13827609
E: 3261533

SITE: Cedar Bayou PA6
Baytown, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	SAMPLES: USCS SYMBOL	SAMPLES: TYPE	SAMPLES: RECOVERY, IN	SAMPLES: SPT, BLOWS/FT	SAMPLES: CALIBRATED HAND PENETROM., TSF	SAMPLES: TORVANE, TSF	TESTS: MOISTURE CONTENT, %	TESTS: DRY DENSITY, PCF	TESTS: LIQUID LIMIT, %	TESTS: PLASTIC LIMIT, %	TESTS: PLASTICITY INDEX	TESTS: MINUS #200 SIEVE, %	TESTS: COMPRESSIVE STRENGTH, TSF	TESTS: FAILURE STRAIN, %	TESTS: CONFINING PRESSURE, PSI
	Approx. Surface Elevation: 14.8 feet																
	-20.2	35.0															
	FAT CLAY reddish brown, light gray and gray, stiff to very stiff, high to very high plasticity, moist - with ferrous stains 38 to 42 feet	35	CH	SS	16	16			45								
		36		ST	17		2.0		78								
		37															
		38															
		39		ST	12		2.75		36								
		40															
		41		ST	19		2.5		37	85	91	31	60	100			
		42															
		43		ST	15		2.25		40								
		44															
		45		ST	16		2.0		42								
	- with ferrous stains 46 to 48 feet	46															
		47		ST	9		1.75		40								
		48															
		49		ST	17		2.5		38								
		50															
		51		ST	15		1.75		26	98	50	20	30				
		52															
		53		ST	0												
		54															
		55		ST	10		2.25		31								
		56															
		57		ST	12		2.25		33								
		58															
		59		ST	30		2.5		29								
		60															
		61		ST	11		2.5		31								
		62															
	-48.2	63.0															
	LEAN CLAY w/ SAND gray, medium stiff to stiff, high plasticity, moist, with sand pockets and seams	63	CL	ST	15		1.5		23	106	37	16	21	82			
	-50.2	64															
		65		ST	5		1.0		26								
	Boring terminated at 65 feet.																

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: **Dry augered to 16 feet; wet rotary thereafter.**

WATER LEVEL OBSERVATIONS			
▽ 16 ft	WD	▼15.5 ft	at 5 min
▼ 13 ft	at 10 min	▼ 9.5 ft	at 15 min

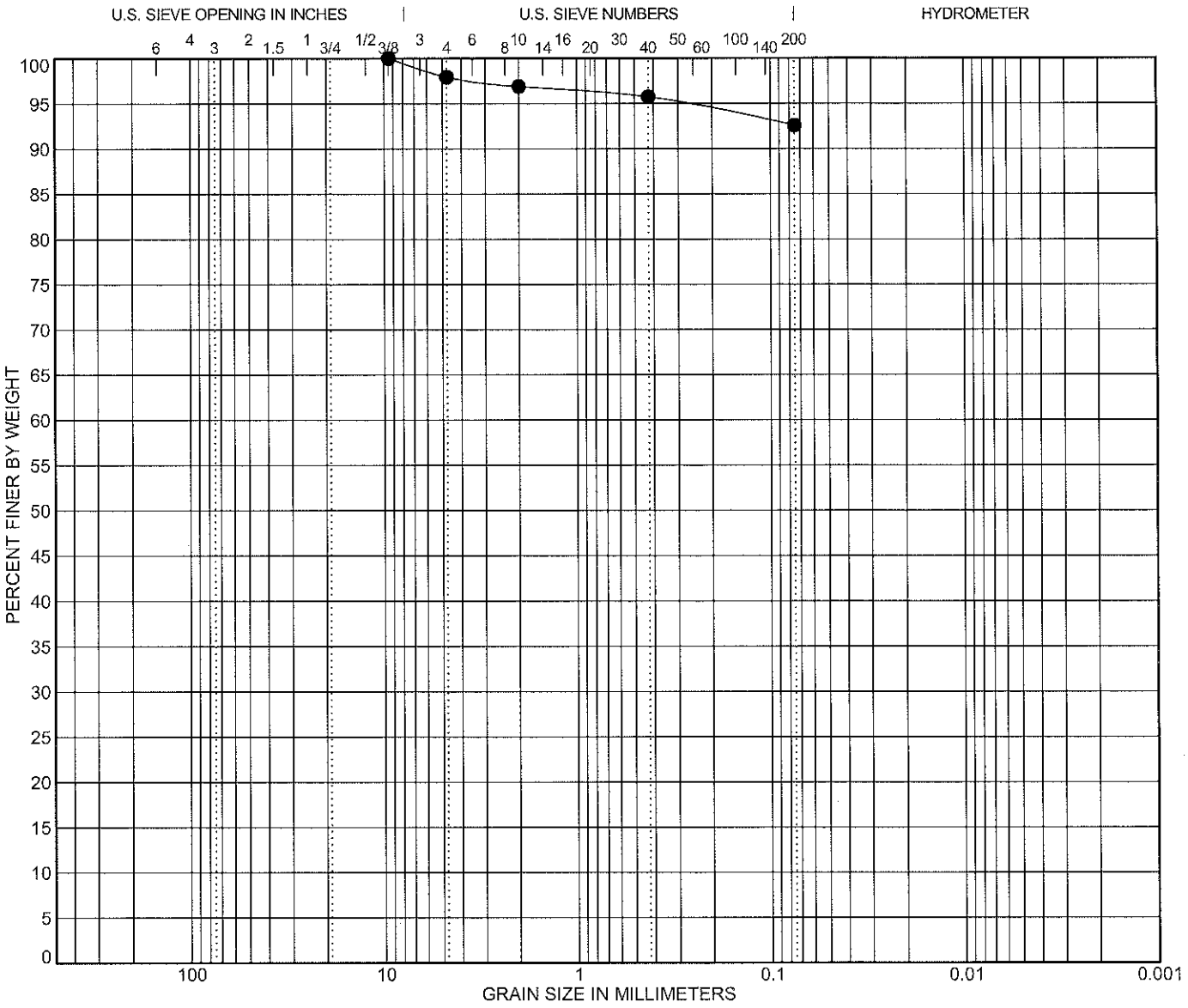
Terracon

DATE DRILLED
3/24/2010

PROJECT NUMBER
92105186-A

09-B85

EXHIBIT A-



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B85**	**2.0**	**FAT CLAY(CH)**	**87**	**25**	**62**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B85**	**2.0**	**100**	**97.9**	**96.9**	**95.7**		**92.6**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B85**	**2.0**	**9.5**				**2.1**	**5.3**	**92.6**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

Terracon

Terracon Consultants, Inc.
11555 Clay Road, Suite 100
Houston, Texas 77043
Telephone: 713-690-8989
Fax: 713-690-8787

EXHIBIT

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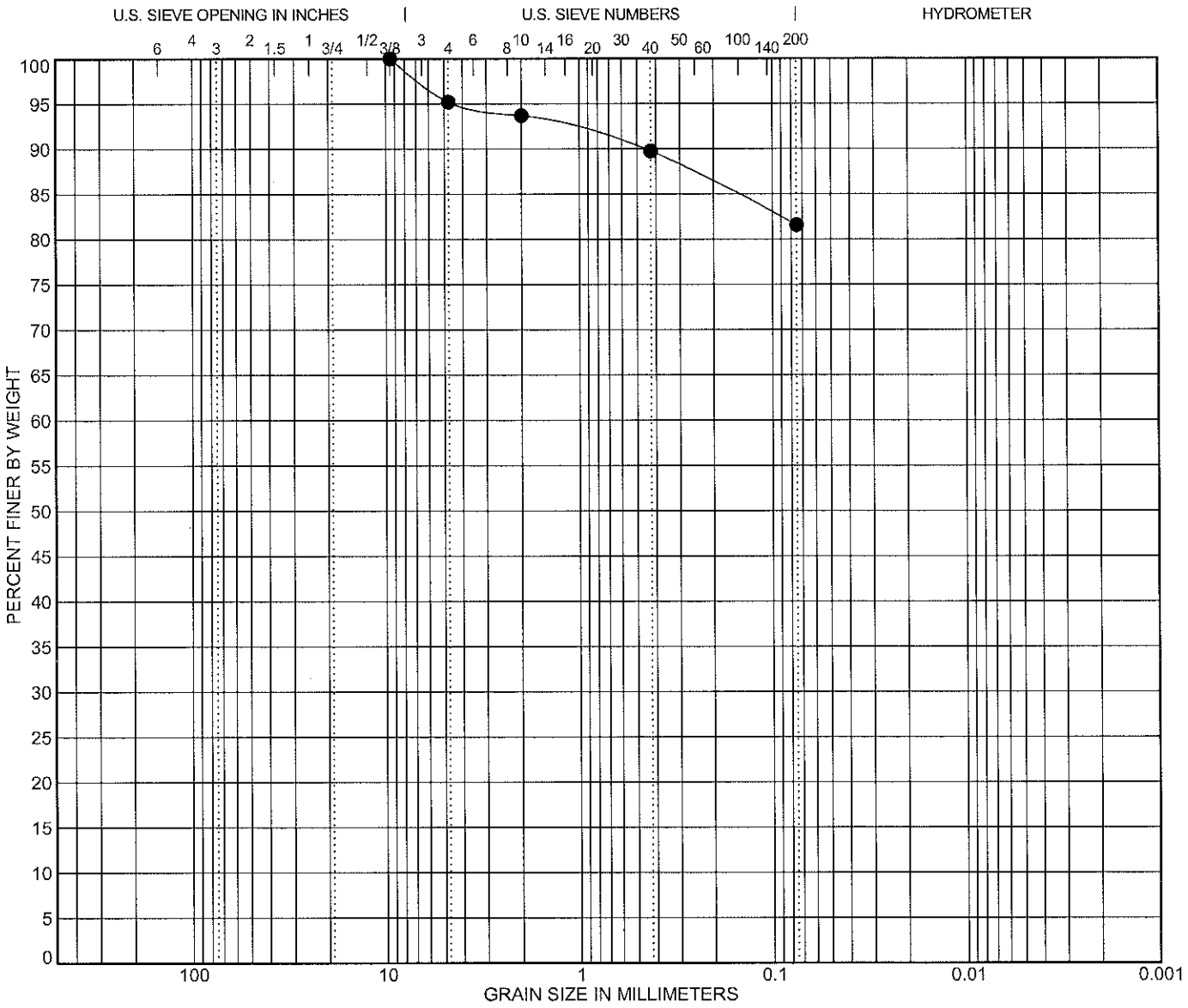

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **09-B85**	**10.0**	**FAT CLAY with SAND(CH)**	**97**	**30**	**67**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **09-B85**	**10.0**	**100**	**95.2**	**93.7**	**89.7**		**81.6**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **09-B85**	**10.0**	**9.5**				**4.8**	**13.6**	**81.6**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
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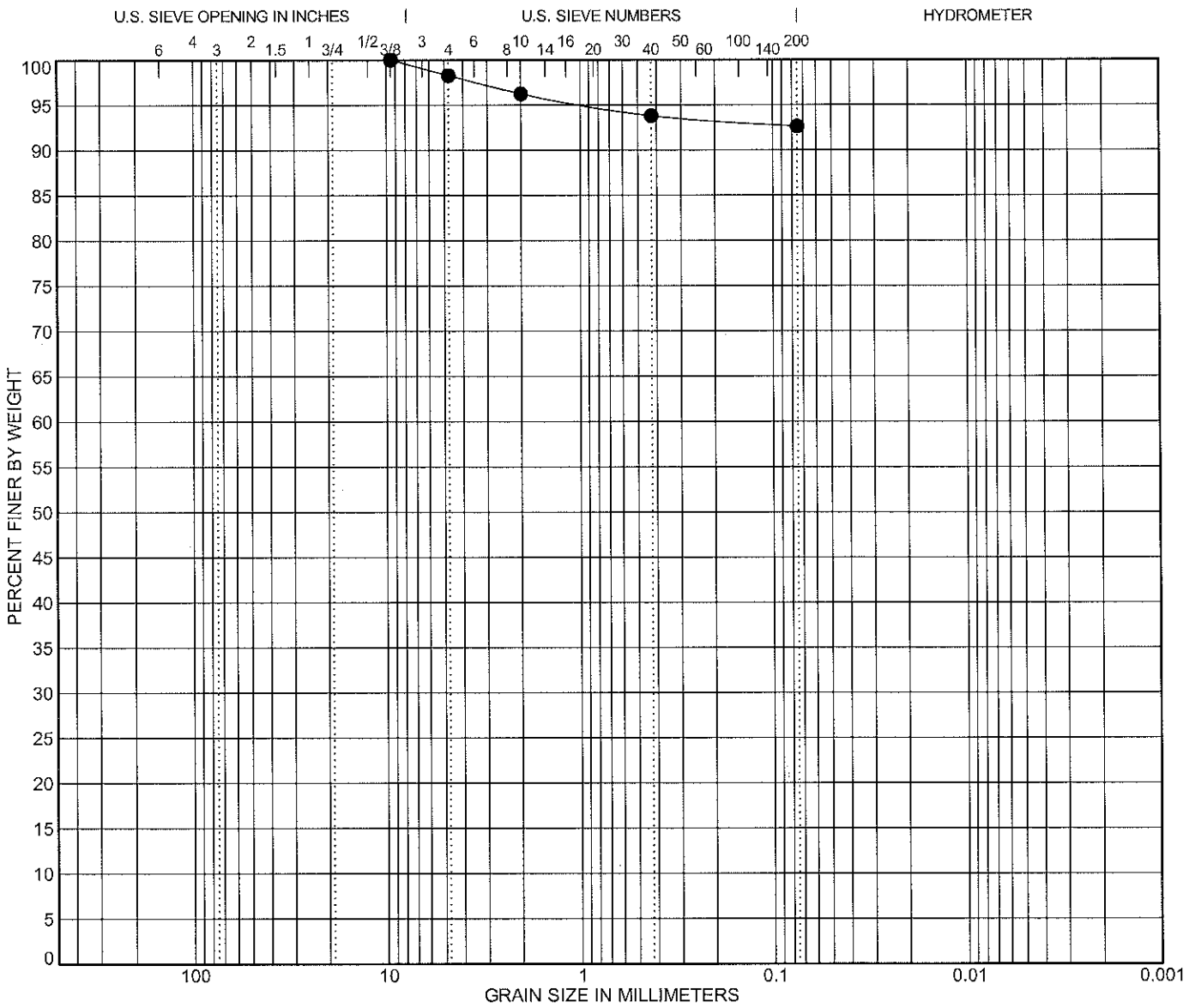

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B85**	**18.0**	**FAT CLAY(CH)**	**55**	**20**	**35**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B85**	**18.0**	**100**	**98.3**	**96.2**	**93.8**		**92.6**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B85**	**18.0**	**9.5**				**1.7**	**5.7**	**92.6**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

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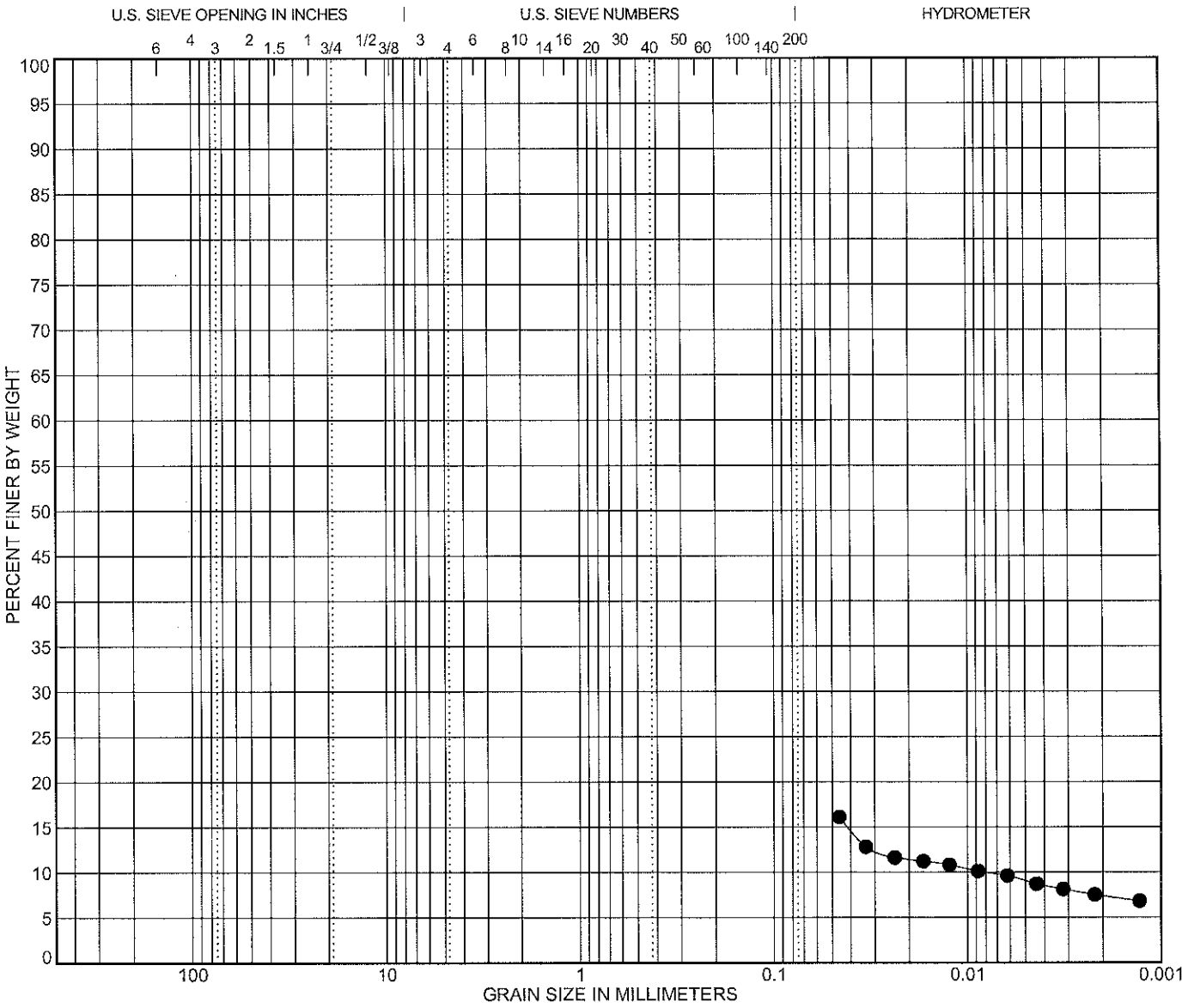

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **09-B85**	**24.0**						

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **09-B85**	**24.0**						

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **09-B85**	**24.0**				**0.008**				**7.4**

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

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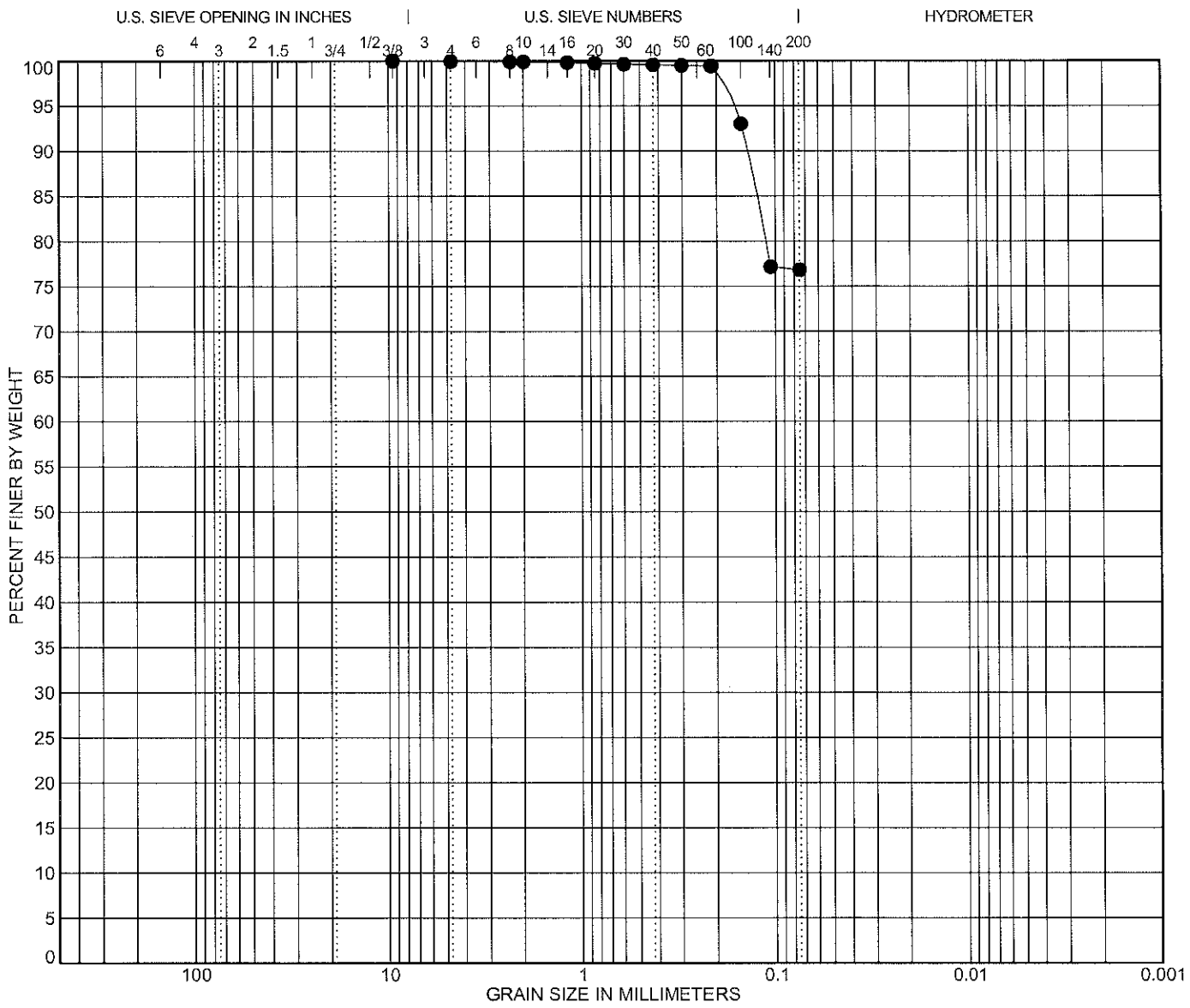

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B85**	**24.5**						

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B85**	**24.5**	**100**	**99.9**	**99.9**	**99.5**	**93**	**76.8**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B85**	**24.5**	**9.5**				**0.1**	**23.1**	**76.8**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
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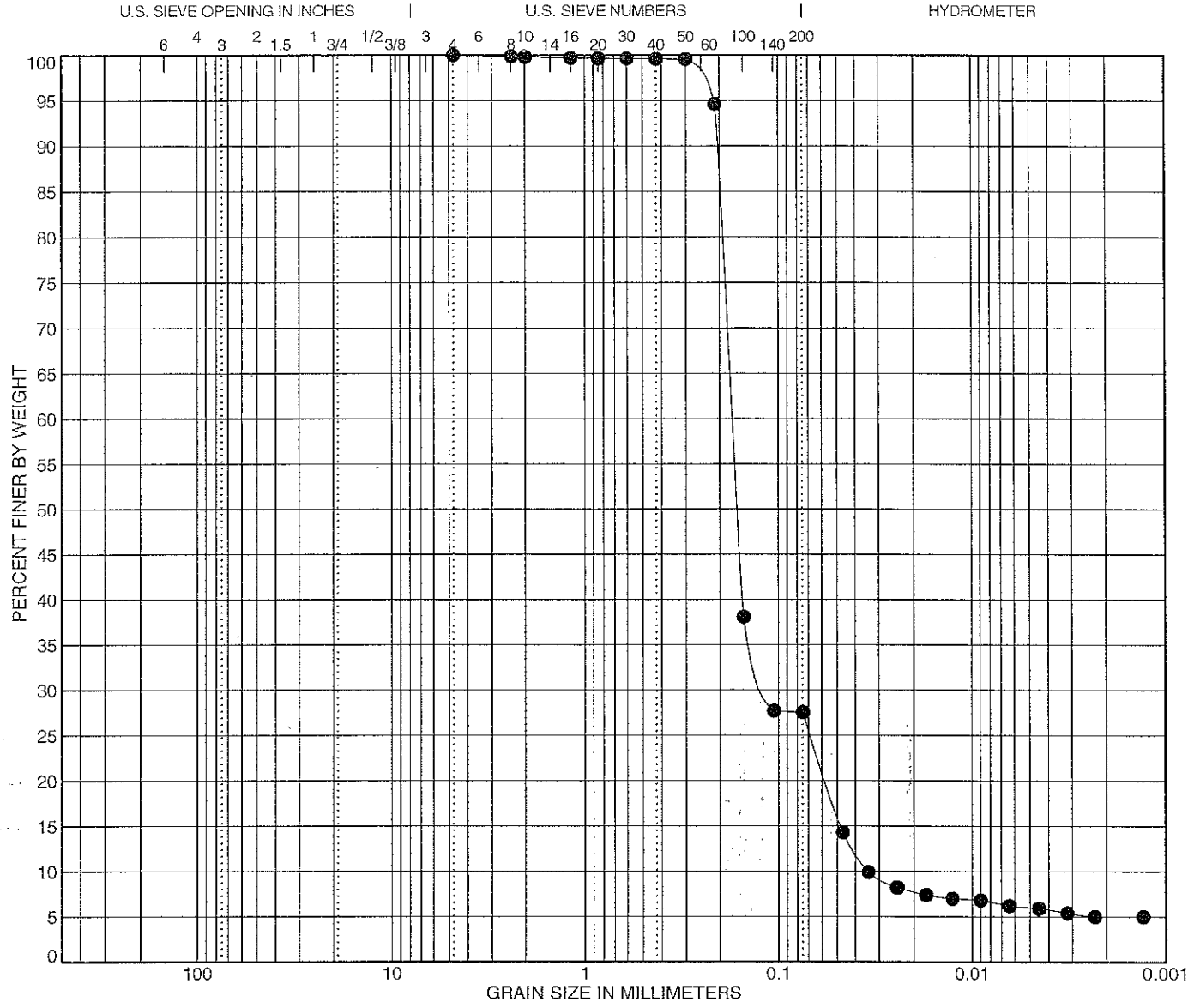

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	09-B85	32.0					2.23	5.00

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
4.75	0.161	0.115	0.034	0.0	72.5	22.5	5.0

Percent Passing the Indicated Sieve

2"	1-1/2"	1"	3/4"	3/8"	#4	#8	#10	#16	#20	#30	#40	#50	#70	#100	#140	#200
					100	99.8	99.8	99.7	99.6	99.6	99.6	99.5	94.6	38.1	27.7	27.5

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
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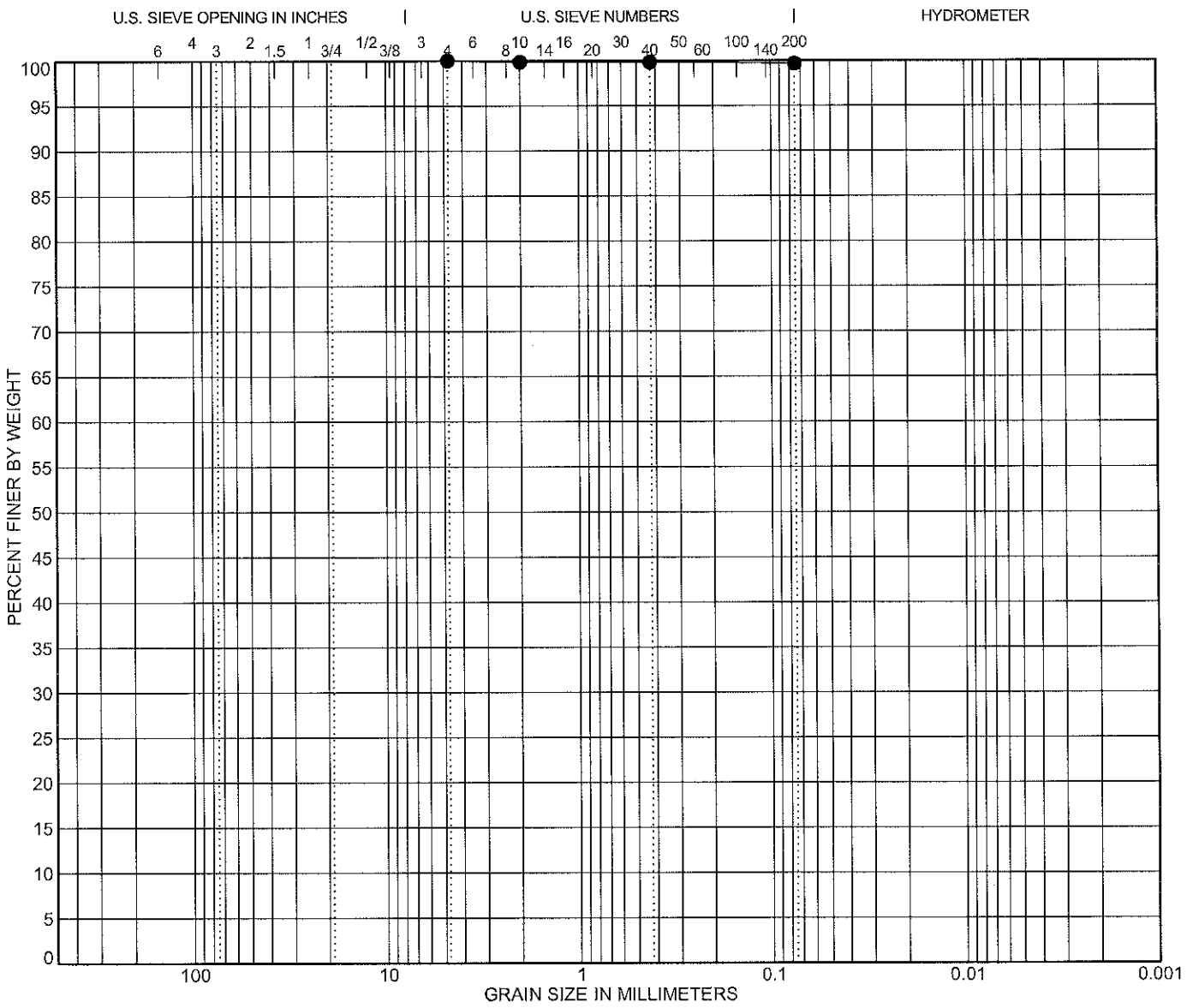

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B85**	**40.0**	**FAT CLAY(CH)**	**91**	**31**	**60**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B85**	**40.0**		**100**	**99.8**	**99.8**		**99.7**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B85**	**40.0**	**4.75**				**0.0**	**0.3**	**99.7**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

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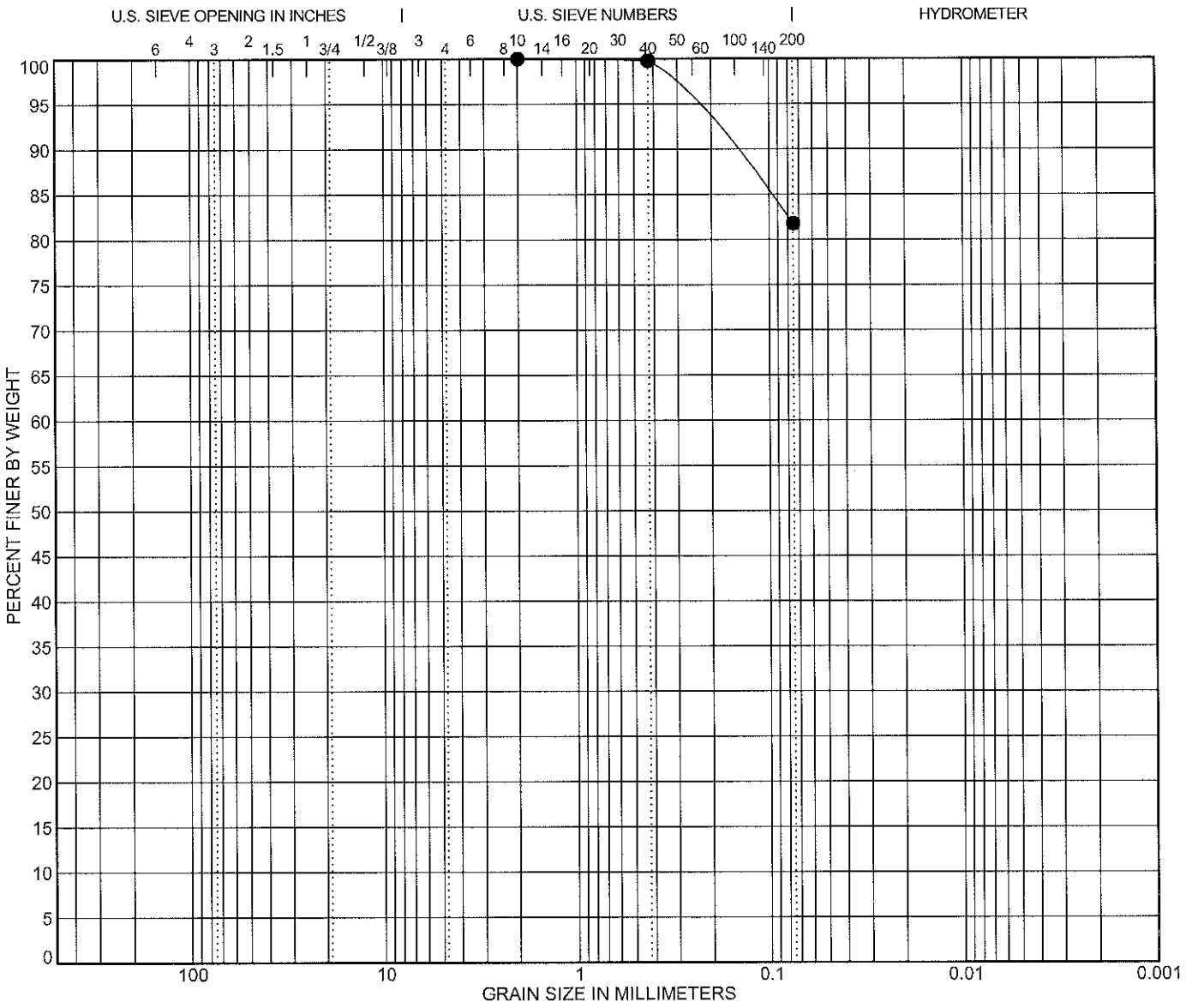

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **09-B85**	**62.0**	**LEAN CLAY with SAND(CL)**	**37**	**16**	**21**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **09-B85**	**62.0**			**100**	**99.8**		**81.8**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **09-B85**	**62.0**	**2**				**0.0**	**18.2**	**81.8**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

Terracon

Terracon Consultants, Inc.
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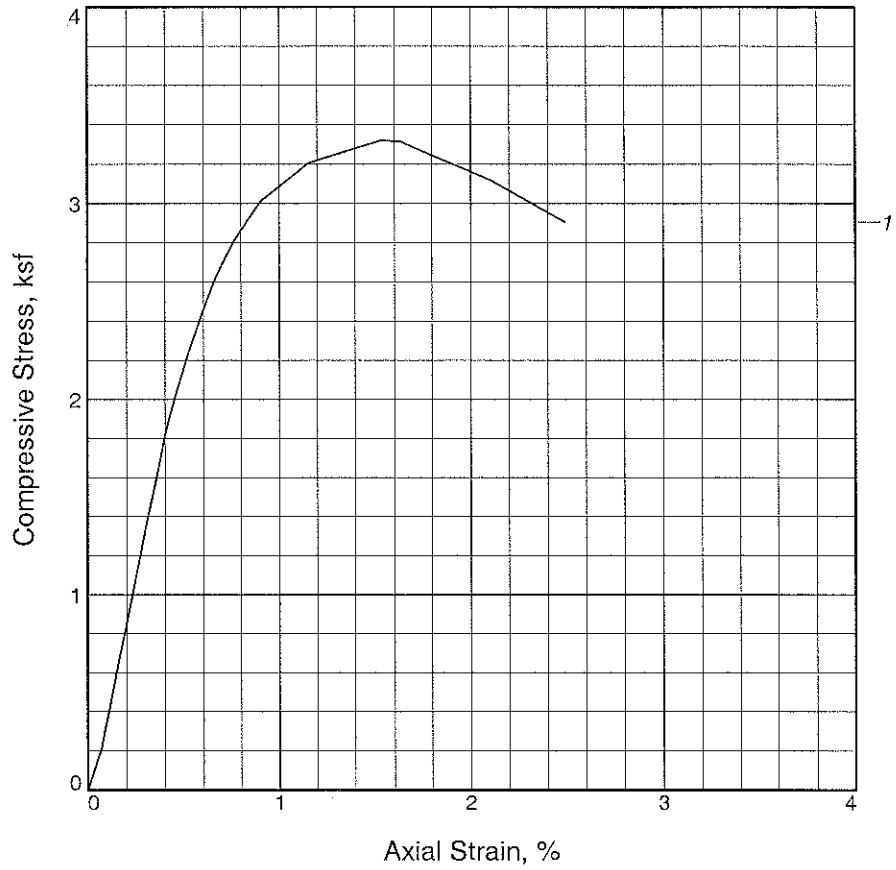
EXHIBIT

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	3.321			
Undrained shear strength, ksf	1.660			
Failure strain, %	1.5			
Strain rate, in./min.	0.055			
Water content, %	33.3			
Wet density, pcf	119.0			
Dry density, pcf	89.3			
Saturation, %	99.2			
Void ratio	0.9231			
Specimen diameter, in.	2.708			
Specimen height, in.	5.731			
Height/diameter ratio	2.12			

Description: dark gray Fat Clay

LL =	PL =	PI =	Assumed GS= 2.75	Type: Undisturbed

Project No.: 92105186-B

Date Sampled:

Remarks:
ASTM D2166

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B85

Sample Number: 2 **Depth:** 2-4 ft.

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

11/5/2010

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B85
Depth: 2-4 ft. **Sample Number:** 2
Description: dark gray Fat Clay
Remarks: ASTM D2166
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial
Moisture content: Moist soil+tare, gms.	171.540
Moisture content: Dry soil+tare, gms.	141.200
Moisture content: Tare, gms.	50.080
Moisture, %	33.3
Moist specimen weight, gms.	1031.05
Diameter, in.	2.708
Area, in.^{2}	5.760
Height, in.	5.731
Wet density, pcf	119.0
Dry density, pcf	89.3
Void ratio	0.9231
Saturation, %	99.2

Test Readings for Specimen No. 1

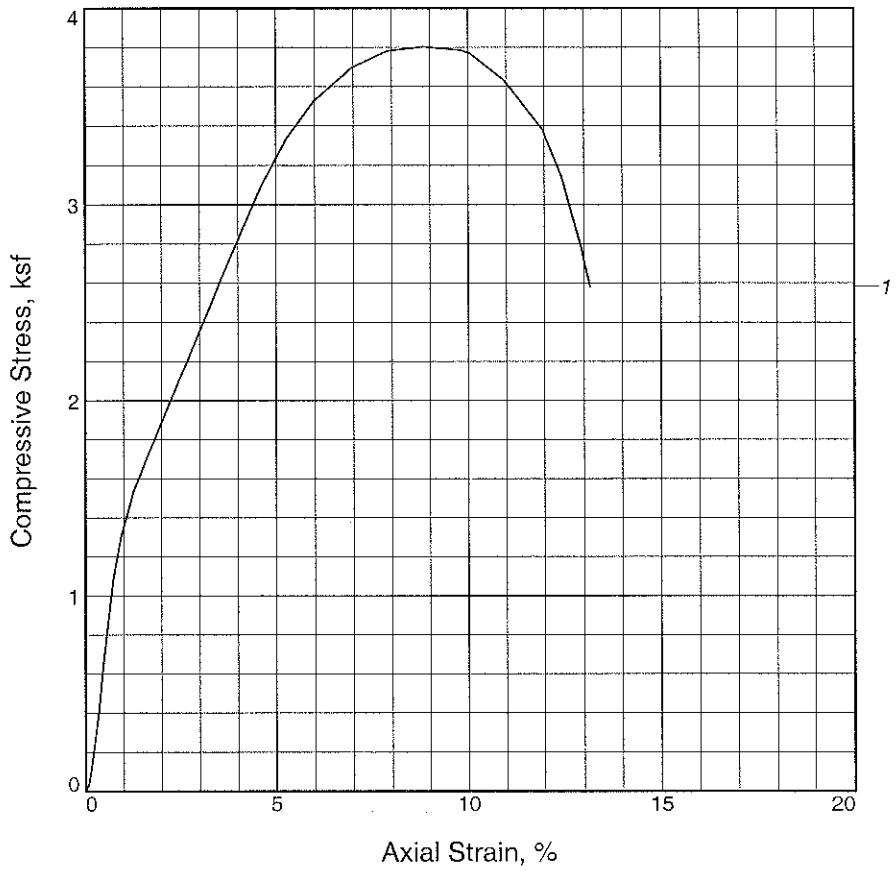
Strain rate, in./min. = 0.055
Unconfined compressive strength = 3.321 ksf **at reading no.** 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0002	0.100	0.1	0.0	0.003
2	0.0040	8.581	8.6	0.1	0.214
3	0.0064	16.961	17.0	0.1	0.424
4	0.0092	26.782	26.8	0.2	0.669
5	0.0121	36.251	36.3	0.2	0.904
6	0.0149	46.162	46.2	0.3	1.151
7	0.0177	55.662	55.7	0.3	1.387
8	0.0206	64.744	64.7	0.4	1.613
9	0.0229	73.175	73.2	0.4	1.822
10	0.0258	80.784	80.8	0.4	2.011
11	0.0300	90.444	90.4	0.5	2.249
12	0.0343	98.765	98.8	0.6	2.455
13	0.0381	105.650	105.6	0.7	2.624
14	0.0437	113.276	113.3	0.8	2.811
15	0.0518	121.513	121.5	0.9	3.011

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.0660	129.646	129.6	1.2	3.204
17	0.0877	134.874	134.9	1.5	3.321
18	0.0934	134.793	134.8	1.6	3.315
19	0.1208	127.376	127.4	2.1	3.118
20	0.1425	119.247	119.2	2.5	2.907

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	3.804			
Undrained shear strength, ksf	1.902			
Failure strain, %	8.9			
Strain rate, in./min.	0.055			
Water content, %	22.7			
Wet density, pcf	130.1			
Dry density, pcf	106.0			
Saturation, %	100.8			
Void ratio	0.6190			
Specimen diameter, in.	2.725			
Specimen height, in.	5.749			
Height/diameter ratio	2.11			

Description: Gray Clay

LL =	**PL =**	**PI =**	**Assumed GS=** 2.75	**Type:** Undisturbed

Project No.: 92105186-B

Date Sampled:

Remarks:
ASTM D2166

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B85

Sample Number: 32 **Depth:** 62-64 ft.

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

11/5/2010

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B85
Depth: 62-64 ft. **Sample Number:** 32
Description: Gray Clay
Remarks: ASTM D2166
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial
Moisture content: Moist soil+tare, gms.	177.510
Moisture content: Dry soil+tare, gms.	153.850
Moisture content: Tare, gms.	49.550
Moisture, %	22.7
Moist specimen weight, gms.	1144.98
Diameter, in.	2.725
Area, in.^{2}	5.832
Height, in.	5.749
Wet density, pcf	130.1
Dry density, pcf	106.0
Void ratio	0.6190
Saturation, %	100.8

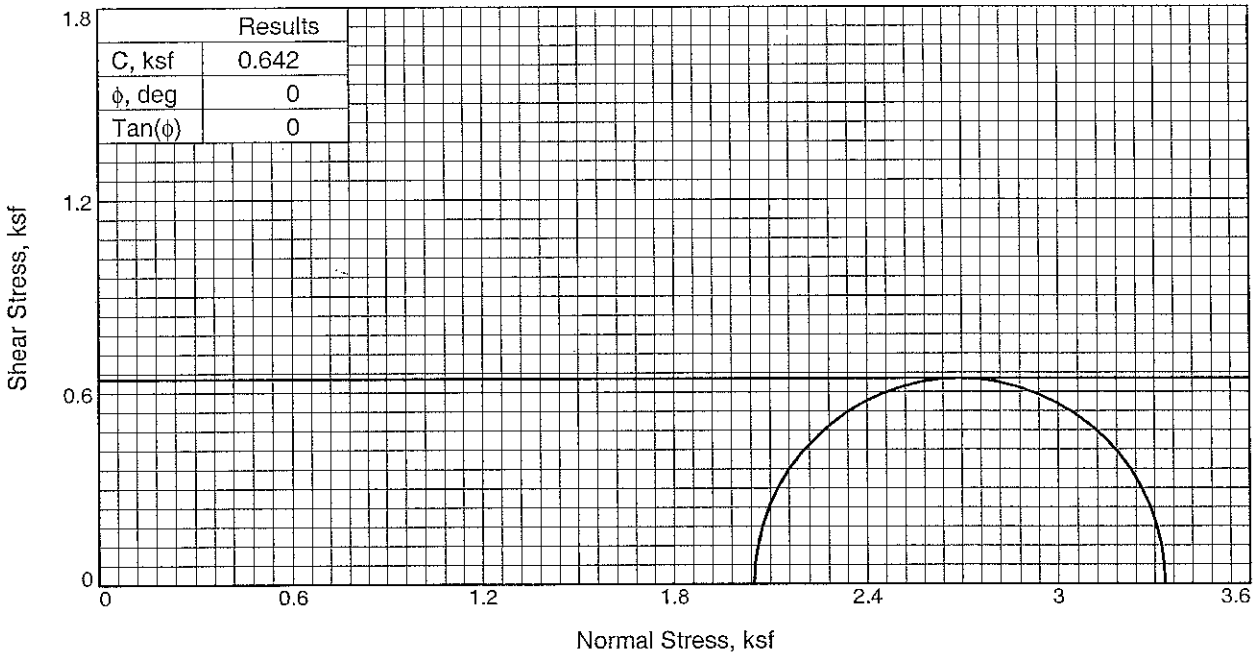
Test Readings for Specimen No. 1

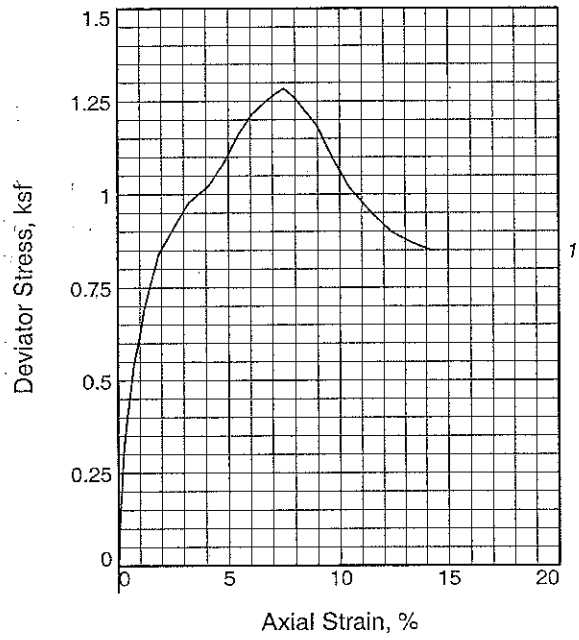
Strain rate, in./min. = 0.055
Unconfined compressive strength = 3.804 ksf **at reading no.** 21

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0002	0.100	0.1	0.0	0.002
2	0.0050	1.300	1.3	0.1	0.032
3	0.0122	7.675	7.7	0.2	0.189
4	0.0207	16.523	16.5	0.4	0.406
5	0.0273	26.840	26.8	0.5	0.660
6	0.0344	35.707	35.7	0.6	0.876
7	0.0424	44.591	44.6	0.7	1.093
8	0.0538	53.354	53.4	0.9	1.305
9	0.0713	62.563	62.6	1.2	1.526
10	0.0991	72.474	72.5	1.7	1.759
11	0.1266	81.970	82.0	2.2	1.979
12	0.1540	91.574	91.6	2.7	2.200
13	0.1814	101.466	101.5	3.2	2.426
14	0.2088	111.425	111.4	3.6	2.651
15	0.2367	121.502	121.5	4.1	2.876

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.2641	131.100	131.1	4.6	3.088
17	0.3024	142.394	142.4	5.3	3.331
18	0.3440	151.982	152.0	6.0	3.528
19	0.3988	160.761	160.8	6.9	3.694
20	0.4537	166.263	166.3	7.9	3.781
21	0.5090	169.009	169.0	8.9	3.804
22	0.5638	169.978	170.0	9.8	3.785
23	0.5775	169.752	169.8	10.0	3.770
24	0.6286	165.290	165.3	10.9	3.635
25	0.6877	155.557	155.6	12.0	3.381
26	0.7151	145.494	145.5	12.4	3.146
27	0.7425	130.013	130.0	12.9	2.796
28	0.7562	120.441	120.4	13.2	2.583





Sample No.		1
Initial	Water Content, %	24.9
	Dry Density, pcf	102.0
	Saturation, %	100.3
	Void Ratio	0.6832
	Diameter, in.	2.753
	Height, in.	5.717
At Test	Water Content, %	24.6
	Dry Density, pcf	102.0
	Saturation, %	98.9
	Void Ratio	0.6832
	Diameter, in.	2.753
	Height, in.	5.717
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		14.230
Fail. Stress, ksf		1.284
Ult. Stress, ksf		
σ_1 Failure, ksf		3.333
σ_3 Failure, ksf		2.049

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed

Description: Tan Clay w/sand pockets

Assumed Specific Gravity= 2.75

Remarks: ASTM D2850

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B85

Sample Number: 10 **Depth:** 18-20 ft.

Proj. No.: 92105186-B **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/5/2010
3:16 PM

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B85
Depth: 18-20 ft. **Sample Number:** 10
Description: Tan Clay w/sand pockets
Remarks: ASTM D2850
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: ASTM D 2850

Parameters for Specimen No. 1

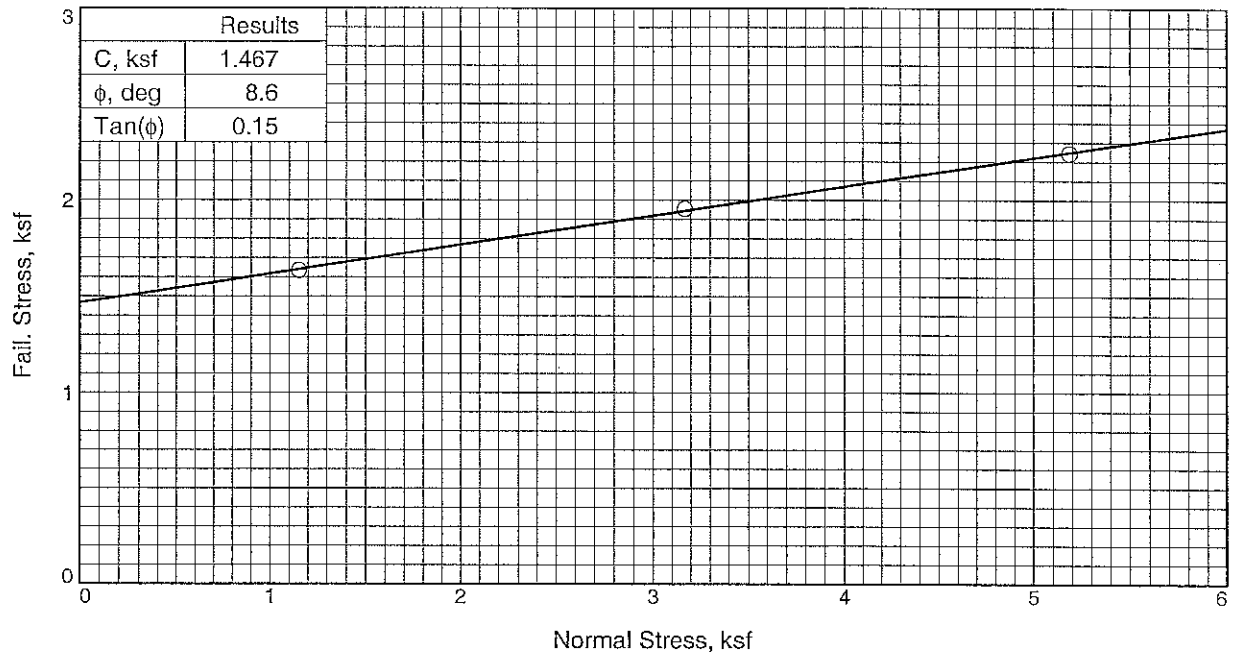
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	161.020	161.020
Moisture content: Dry soil+tare, gms.	139.000	139.240
Moisture content: Tare, gms.	50.600	50.600
Moisture, %	24.9	24.6
Moist specimen weight, gms.	1138.07	
Diameter, in.	2.753	
Area, in.^{2}	5.953	
Height, in.	5.717	
Wet density, pcf	127.4	
Dry density, pcf	102.0	
Void ratio	0.6832	
Saturation, %	100.3	

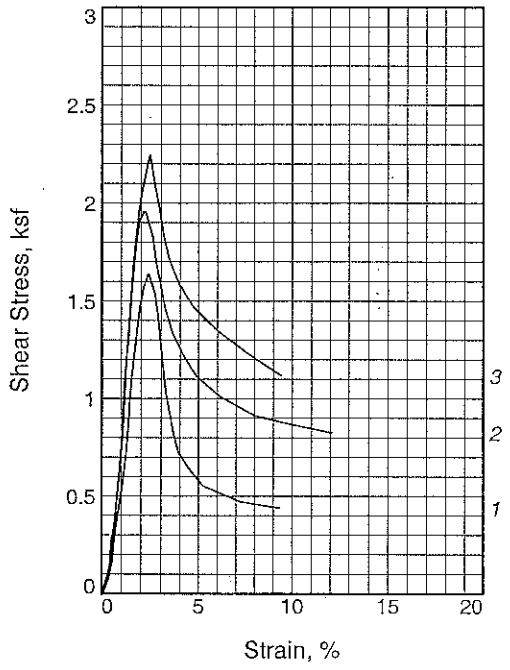
Test Readings for Specimen No. 1

Cell pressure = 14.230 psi (2.049 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 1.284 ksf **at reading no.** 20

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf	Minor Princ. Stress ksf	Major Princ. Stress ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.000	2.049	2.049	1.00	2.049	0.000
1	0.0000	-2.891	-2.9	0.0	-0.070	2.049	1.979	0.97	2.014	-0.035
2	0.0014	0.086	0.1	0.0	0.002	2.049	2.051	1.00	2.050	0.001
3	0.0043	3.945	3.9	0.1	0.095	2.049	2.144	1.05	2.097	0.048
4	0.0085	8.020	8.0	0.1	0.194	2.049	2.243	1.09	2.146	0.097
5	0.0151	12.575	12.6	0.3	0.303	2.049	2.353	1.15	2.201	0.152
6	0.0240	16.630	16.6	0.4	0.401	2.049	2.450	1.20	2.249	0.200
7	0.0327	19.668	19.7	0.6	0.473	2.049	2.522	1.23	2.286	0.237
8	0.0416	22.544	22.5	0.7	0.541	2.049	2.591	1.26	2.320	0.271
9	0.0557	25.511	25.5	1.0	0.611	2.049	2.660	1.30	2.355	0.306
10	0.0685	29.025	29.0	1.2	0.694	2.049	2.743	1.34	2.396	0.347
11	0.0849	31.911	31.9	1.5	0.760	2.049	2.810	1.37	2.429	0.380
12	0.1070	35.364	35.4	1.9	0.839	2.049	2.889	1.41	2.469	0.420
13	0.1463	38.618	38.6	2.6	0.910	2.049	2.959	1.44	2.504	0.455
14	0.1849	41.781	41.8	3.2	0.978	2.049	3.027	1.48	2.538	0.489
15	0.2351	44.079	44.1	4.1	1.022	2.049	3.072	1.50	2.560	0.511
16	0.2737	46.961	47.0	4.8	1.082	2.049	3.131	1.53	2.590	0.541
17	0.3070	50.300	50.3	5.4	1.151	2.049	3.201	1.56	2.625	0.576
18	0.3480	53.530	53.5	6.1	1.216	2.049	3.265	1.59	2.657	0.608
19	0.4030	56.301	56.3	7.0	1.266	2.049	3.315	1.62	2.682	0.633
20	0.4305	57.406	57.4	7.5	1.284	2.049	3.333	1.63	2.691	0.642
21	0.4580	56.568	56.6	8.0	1.259	2.049	3.308	1.61	2.679	0.629
22	0.5130	53.774	53.8	9.0	1.184	2.049	3.233	1.58	2.641	0.592
23	0.5546	50.043	50.0	9.7	1.093	2.049	3.142	1.53	2.596	0.547
24	0.5959	47.009	47.0	10.4	1.019	2.049	3.068	1.50	2.558	0.509
25	0.6510	44.528	44.5	11.4	0.955	2.049	3.004	1.47	2.526	0.477
26	0.7060	42.416	42.4	12.3	0.899	2.049	2.949	1.44	2.499	0.450
27	0.7610	41.501	41.5	13.3	0.870	2.049	2.919	1.42	2.484	0.435
28	0.8160	40.906	40.9	14.3	0.848	2.049	2.897	1.41	2.473	0.424





Sample No.		1	2	3
Initial	Water Content, %	36.5	36.5	36.5
	Dry Density, pcf	85.0	85.5	84.6
	Saturation, %	98.5	99.6	97.7
	Void Ratio	1.0203	1.0083	1.0286
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	37.2	36.8	37.3
	Dry Density, pcf	85.0	85.5	84.6
	Saturation, %	100.1	100.4	99.8
	Void Ratio	1.0203	1.0083	1.0286
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf		1.152	3.168	5.184
Fail. Stress, ksf		1.636	1.955	2.243
Strain, %		2.3	2.2	2.5
Ult. Stress, ksf				
Strain, %				
Strain rate, in./min.		0.001	0.001	0.001

Sample Type: Undisturbed
Description: Brown Fat Clay

LL= 91 **PL=** 31 **PI=** 60
Assumed Specific Gravity= 2.75
Remarks: ASTM D3080
Specific gravity assumed
Percent pass #200 sieve = 99.7

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Location: 09B-85
Sample Number: 21 **Depth:** 40-42 ft.
Proj. No.: 92105186 **Date Sampled:**

DIRECT SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

DIRECT SHEAR TEST

11/29/2010

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186
Location: 09B-85
Depth: 40-42 ft. **Sample Number:** 21
Description: Brown Fat Clay
Remarks: ASTM D3080
Specific gravity assumed
Percent pass #200 sieve = 99.7
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=**91 **PL=**31 **PI=**60

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	128.830		174.590
Moisture content: Dry soil+tare, gms.	108.080		133.500
Moisture content: Tare, gms.	51.290		22.910
Moisture, %	36.5	37.2	37.2
Moist specimen weight, gms.	149.50		
Diameter, in.	2.500	2.500	
Area, in.²	4.909	4.909	
Height, in.	1.000	1.000	
Net decrease in height, in.		0.000	
Wet density, pcf	116.0	116.5	
Dry density, pcf	85.0	85.0	
Void ratio	1.0203	1.0203	
Saturation, %	98.5	100.1	

Test Readings for Specimen No. 1

Normal stress = 1.152 ksf
Strain rate, in./min. = 0.001
Fail. Stress = 1.636 ksf **at reading no.** 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
0	0.0000	-0.428	0.0	0.0	0.000
1	0.0005	-0.367	0.1	0.0	0.002
2	0.0010	-0.662	-0.2	0.0	-0.007
3	0.0095	2.284	2.7	0.4	0.080
4	0.0140	5.366	5.8	0.6	0.170
5	0.0155	8.261	8.7	0.6	0.255
6	0.0185	11.131	11.6	0.7	0.339
7	0.0215	14.033	14.5	0.9	0.424
8	0.0250	17.317	17.7	1.0	0.521
9	0.0285	20.503	20.9	1.1	0.614
10	0.0315	24.052	24.5	1.3	0.718
11	0.0330	26.849	27.3	1.3	0.800

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
12	0.0345	29.752	30.2	1.4	0.885
13	0.0360	32.571	33.0	1.4	0.968
14	0.0390	37.942	38.4	1.6	1.126
15	0.0420	42.010	42.4	1.7	1.245
16	0.0450	45.884	46.3	1.8	1.359
17	0.0480	49.121	49.5	1.9	1.454
18	0.0525	52.689	53.1	2.1	1.558
19	0.0586	55.329	55.8	2.3	1.636
20	0.0601	55.223	55.7	2.4	1.633
21	0.0676	51.819	52.2	2.7	1.533
22	0.0706	48.695	49.1	2.8	1.441
23	0.0736	44.673	45.1	2.9	1.323
24	0.0766	40.736	41.2	3.1	1.208
25	0.0796	36.634	37.1	3.2	1.087
26	0.0826	33.805	34.2	3.3	1.004
27	0.0871	30.806	31.2	3.5	0.916
28	0.0916	27.697	28.1	3.7	0.825
29	0.0976	24.383	24.8	3.9	0.728
30	0.1126	21.344	21.8	4.5	0.639
31	0.1306	18.427	18.9	5.2	0.553
32	0.1816	15.629	16.1	7.3	0.471
33	0.2327	14.556	15.0	9.3	0.440

Initial and Final Specimen Data

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	128.830		199.730
Moisture content: Dry soil+tare, gms.	108.080		158.920
Moisture content: Tare, gms.	51.290		48.010
Moisture, %	36.5	36.8	36.8
Moist specimen weight, gms.	150.39		
Diameter, in.	2.500	2.500	
Area, in.^{2}	4.909	4.909	
Height, in.	1.000	1.000	
Net decrease in height, in.		0.000	
Wet density, pcf	116.7	116.9	
Dry density, pcf	85.5	85.5	
Void ratio	1.0083	1.0083	
Saturation, %	99.6	100.4	

Test Readings for Specimen No. 2

Normal stress = 3.168 ksf

Strain rate, in./min. = 0.001

Fail. Stress = 1.955 ksf **at reading no.** 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0005	0.412	0.4	0.0	0.012
2	0.0095	3.038	3.0	0.4	0.089
3	0.0115	6.388	6.4	0.5	0.187
4	0.0130	9.850	9.8	0.5	0.289
5	0.0135	9.950	9.9	0.5	0.292
6	0.0150	10.390	10.4	0.6	0.305
7	0.0170	13.327	13.3	0.7	0.391
8	0.0200	17.185	17.2	0.8	0.504
9	0.0225	20.956	21.0	0.9	0.615
10	0.0245	24.567	24.6	1.0	0.721
11	0.0270	31.584	31.6	1.1	0.927
12	0.0285	35.119	35.1	1.1	1.030
13	0.0315	40.524	40.5	1.3	1.189
14	0.0345	44.498	44.5	1.4	1.305
15	0.0375	50.824	50.8	1.5	1.491
16	0.0405	55.980	56.0	1.6	1.642
17	0.0435	60.871	60.9	1.7	1.786
18	0.0480	65.054	65.1	1.9	1.908
19	0.0541	66.648	66.6	2.2	1.955
20	0.0556	66.624	66.6	2.2	1.954
21	0.0646	62.385	62.4	2.6	1.830
22	0.0691	57.878	57.9	2.8	1.698
23	0.0751	53.385	53.4	3.0	1.566
24	0.0811	49.589	49.6	3.2	1.455
25	0.0901	45.671	45.7	3.6	1.340
26	0.1036	41.890	41.9	4.1	1.229
27	0.1216	38.095	38.1	4.9	1.118
28	0.1516	34.607	34.6	6.1	1.015

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
29	0.1996	31.127	31.1	8.0	0.913
30	0.2507	29.551	29.6	10.0	0.867
31	0.3017	28.123	28.1	12.1	0.825

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	128.830		207.770
Moisture content: Dry soil+tare, gms.	108.080		167.480
Moisture content: Tare, gms.	51.290		59.550
Moisture, %	36.5	37.3	37.3
Moist specimen weight, gms.	148.89		
Diameter, in.	2.500	2.500	
Area, in.^{2}	4.909	4.909	
Height, in.	1.000	1.000	
Net decrease in height, in.		0.000	
Wet density, pcf	115.6	116.2	
Dry density, pcf	84.6	84.6	
Void ratio	1.0286	1.0286	
Saturation, %	97.7	99.8	

Test Readings for Specimen No. 3

Normal stress = 5.184 ksf

Strain rate, in./min. = 0.001

Fail. Stress = 2.243 ksf **at reading no.** 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
0	0.0000	0.853	0.0	0.0	0.000
1	0.0005	0.792	-0.1	0.0	-0.002
2	0.0105	5.414	4.6	0.4	0.134
3	0.0135	9.853	9.0	0.5	0.264
4	0.0170	14.406	13.6	0.7	0.398
5	0.0200	18.530	17.7	0.8	0.519
6	0.0230	22.889	22.0	0.9	0.646
7	0.0270	29.044	28.2	1.1	0.827
8	0.0300	36.338	35.5	1.2	1.041
9	0.0315	40.714	39.9	1.3	1.169
10	0.0345	47.012	46.2	1.4	1.354
11	0.0375	52.527	51.7	1.5	1.516
12	0.0405	58.126	57.3	1.6	1.680
13	0.0436	62.596	61.7	1.7	1.811
14	0.0466	66.495	65.6	1.9	1.926
15	0.0511	70.702	69.8	2.0	2.049
16	0.0586	75.935	75.1	2.3	2.203
17	0.0616	77.326	76.5	2.5	2.243
18	0.0631	75.984	75.1	2.5	2.204
19	0.0676	71.917	71.1	2.7	2.085
20	0.0736	67.761	66.9	2.9	1.963
21	0.0781	63.749	62.9	3.1	1.845

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress ksf
22	0.0856	59.443	58.6	3.4	1.719
23	0.0991	54.902	54.0	4.0	1.586
24	0.1186	50.832	50.0	4.7	1.466
25	0.1486	46.934	46.1	5.9	1.352
26	0.1906	42.815	42.0	7.6	1.231
27	0.2357	38.949	38.1	9.4	1.118

Project name: TO-0012 Pipeline Dredging, Volume I, Cedar Bayou PA 6																							Client: USACE, Galveston District																			Terracon Project # : 92105186-A							
Boring	Depth	Field tests			Atterberg Limits			Grain Size Analysis															USCS Symbol (ASTM 2487)	Wc	γd	Strength tests																									
								Percent Pasing Sieve																		Direct Shear Test					Unconfined Compression				UU Triaxial Test				CU Triaxial Test							
		PP	TV	SPTn	LL	PL	PI	3/4"	3/8"	4	8	10	16	20	30	40	50	70	100	140	200				C	φ	Wc	γd	Symbol	C	Wc	γd	Symbol	C	Wc	γd	Symbol	C	φ	c'	φ'	Wc	γd	Symbol
	ft	tsf	tsf	bl/ft	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		%	pcf	ksf	°	%	pcf		ksf	%	pcf		ksf	%	pcf		ksf	°	ksf	°	%	pcf	
09-B85	0-2	1.00																				CH**	27																					
	2-4	1.00			87	25	62		100	98		97				96					93	CH	33						1.7	33	89	CH**											
	4-6	2.00																				CH**	30																					
	6-8	1.50																				CH**	35																					
	8-10	1.25																				CH**	34																					
	10-12	1.00			97	30	67		100	95		94				90					82	CH	40	80																					
	12-14	1.25																				CH**	25																					
	14-16	1.00																				CH**	24																					
	16-18	0.50																				CL**	35																					
	18-20	0.75			55	20	35		100	98		96				94					93	CH	25																					
	20-22	1.00																				CL**	26																					
	22-24			25																		CL**	24																					
	24-26			15					100	100	100	100	100	100	100	100	100	99	93	77	77	CL*	24																					
	26-28			22																		SM**	25																					
	28-30			18																		SM**	24																					
	30-32			13																		SM**	23																					
	32-34			16						100	100	100	100	100	100	100	100	95	38	28	28	SM*	21																					
	34-36			16																		SM**/CH**	45																					
	36-38	2.00																				CH**	78																					
	38-40	2.75																				CH**	36																					
	40-42	2.50			91	31	60			100		100				100					100	CH	37		1.5	9	37	85	CH**															
	42-44	2.25																				CH**	40																					
	44-46	2.00																				CH**	42																					
	46-48	1.75																				CH**	40																					
	48-50	2.50																				CH**	38																					
	50-52	1.75			50	20	30															CH**	26	98																				
	54-56	2.25																				CH**	31																					
	56-58	2.25																				CH**	33																					
	58-60	2.50																				CH**	29																					
	60-62	2.50																				CH**	31																					
	62-64	1.50			37	16	21					100				100					82	CL	23						1.9	23	106	CL**											
	64-66	1.00																				CL**	26																					