BORING LOG NO. 09-B76

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
BORING LOCATION:	N: 13826371 E: 3261323	SITE:	Cedar Bayou PA6 Baytown, Texas

Approx. Surface Elevation: 14.3 feet

FILL: FAT CLAY
dark gray, brown and light brown, medium stiff to very stiff, very high plasticity, moist
- with roots 0 to 2 feet
- with calcareous nodules and sand seams 2 to 4 feet
- with shell 6 to 10 feet
- with calcareous nodules 10 to 16 feet

-1.7 16.0

FAT CLAY
light gray, dark gray, light brown and brown, very soft to very stiff, very high plasticity, moist to wet
- with roots and organic matter 16 to 20 feet
- with calcareous nodules and ferrous stains 24 to 38 feet

Continued Next Page

DEPTH, FEET	USCS SYMBOL	TYPE	RECOVERY, IN	SPT, BLOWS/FT	CALIBRATED HAND PENETROM., TSF	TORVANE, TSF	MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, TSF	FAILURE STRAIN, %	CONFINING PRESSURE, PSI
1	CH	ST	5		3.0		27								
3		ST	17		2.5		32	94	65	22	43	94			
5		ST	8		4.0		25								
7		ST	16		1.75		23								
9		ST	13		0.5		37	85	93	30	63	99			
11		ST	12		0.75		22								
13		ST	6		2.75		18								
15		ST	6		1.25		25								
17	CH	ST	7		0.75		30								
19		ST	11		0.75		35	83	91	29	62	95			
21		ST	24		0.25	0.2	81								
23		ST	15		0.25	0.1	40								
25		ST	20		0.5		43	78	66	20	46	98			
27		ST	19		0.25		39								
29		ST	0				42								
31		ST	13		1.0		36								
33		ST	14		0.75		35	89	75	25	50				

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

REMARKS: Dry augered to 23 feet, wet rotary thereafter because of bore hole walls squeezing off.

WATER LEVEL OBSERVATIONS	
▽	▼
▼	▼

FREE WATER WAS NOT OBSERVED DURING DRY DRILLING OPERATIONS

Terracon

DATE DRILLED	Page 1 of 2
3/22/2010	09-B76
PROJECT NUMBER 92105186-A	EXHIBIT A-

BORING LOG NO. 09-B76

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
BORING LOCATION:	N: 13826371 E: 3261323	SITE:	Cedar Bayou PA6 Baytown, Texas

Approx. Surface Elevation: 14.3 feet

Graphic Log	DESCRIPTION	DEPTH, FEET	USCS SYMBOL	TYPE	RECOVERY, IN	SPT, BLOWS/FT	CALIBRATED HAND PENETROM., TSF	TORVANE, TSF	MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, TSF	FAILURE STRAIN, %	CONFINING PRESSURE, PSI
	FAT CLAY light gray, dark gray, light brown and brown, very soft to very stiff, very high plasticity, moist to wet	35		ST	10		1.25		25								
		36															
		37		ST	15		1.5		34								
		38															
		39		ST	8		1.5		42								
		40															
		41		ST	9		1.25		36								
		42															
	- with slickensides 42 to 44 feet	43		ST	16		1.0		43	80	111	33	78	100			
		44															
		45		ST	2		1.5		41								
		46															
		47		ST	13		1.25		29								
		48															
		49		ST	8		1.5		33								
		50															
		51		ST	15		1.5		25	99	58	20	38	94			
	-37.7 52.0	52															
	SANDY FAT CLAY light gray and light brown, very soft to medium stiff, high plasticity, moist, with sand pockets and seams	53	CH	ST	4		1.0		28								
		54															
		55		ST	20		0.5		29								
		56															
		57		BS	17				30								
		58															
		59		ST	9		0.25		27								
		60															
		61		ST	19		0.5		27								
		62															
		63		ST	20		0.5		27								
		64															
	-50.7 65.0	65		ST	10		0.5		25								
	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 23 feet, wet rotary thereafter because of bore hole walls squeezing off.**

WATER LEVEL OBSERVATIONS	
∇	▼
▼	∇

FREE WATER WAS NOT OBSERVED DURING DRY DRILLING OPERATIONS

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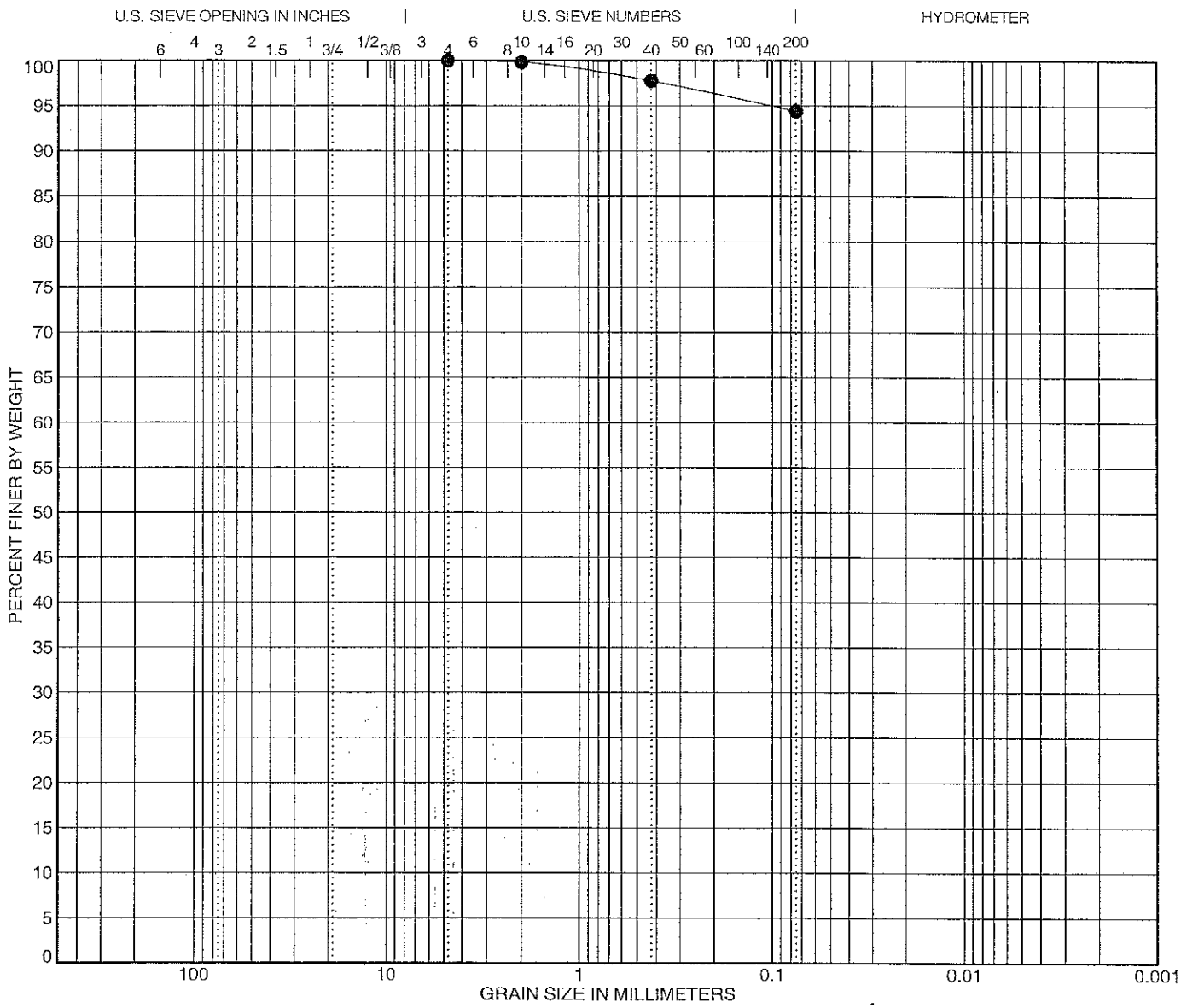
DATE DRILLED	Page 2 of 2
3/22/2010	09-B76
PROJECT NUMBER	EXHIBIT A-
92105186-A	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B76**	**2.0**	**FAT CLAY(CH)**	**65**	**22**	**43**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
4.75				**0.0**	**5.6**	**94.4**	

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**				**97.8**					**94.4**

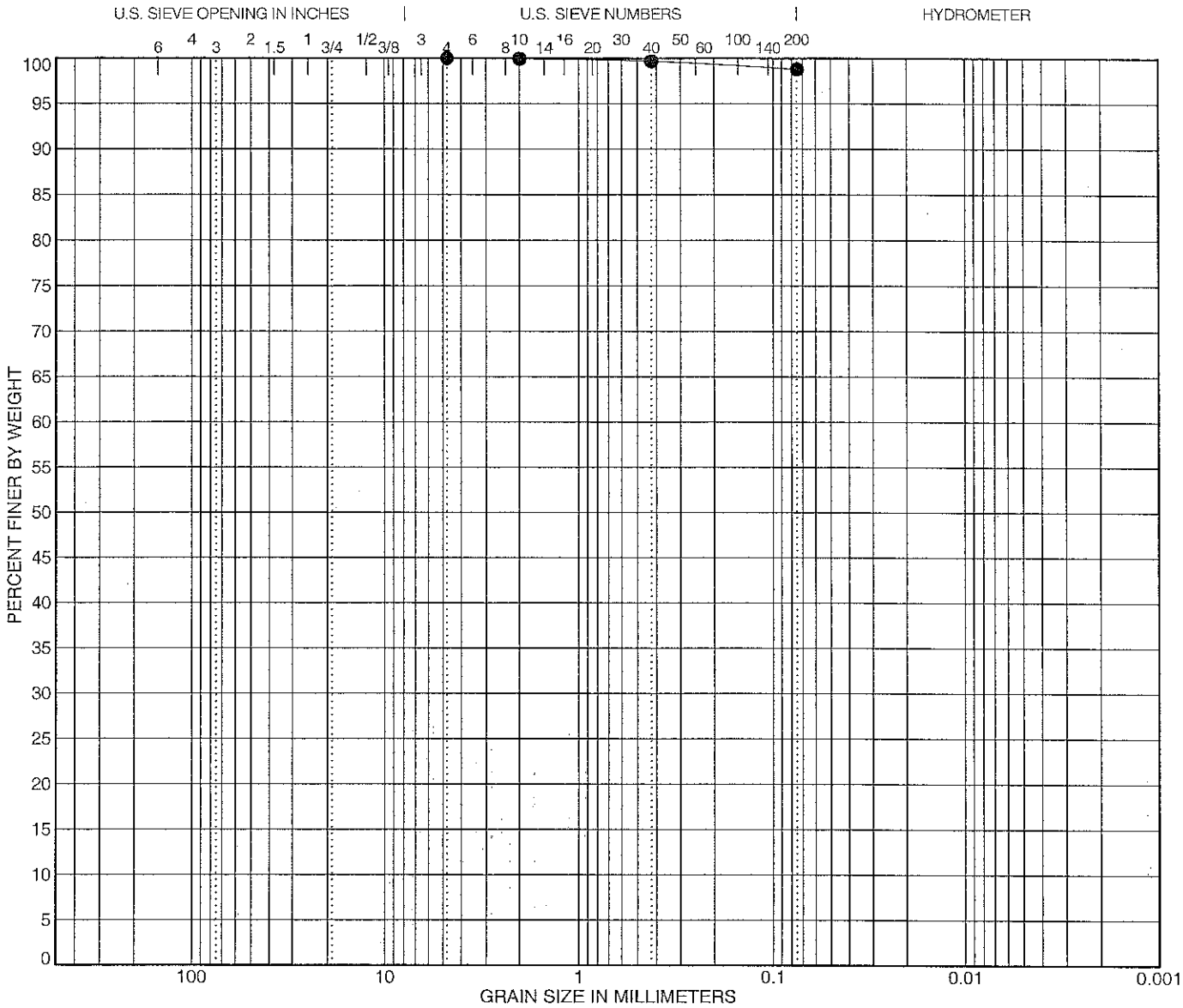
GRAIN SIZE DISTRIBUTION

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 g



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B76**	**8.0**	**FAT CLAY(CH)**	**93**	**30**	**63**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
4.75				**0.0**	**1.2**	**98.8**	

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		**99.9**				**99.7**					**98.8**

GRAIN SIZE DISTRIBUTION

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

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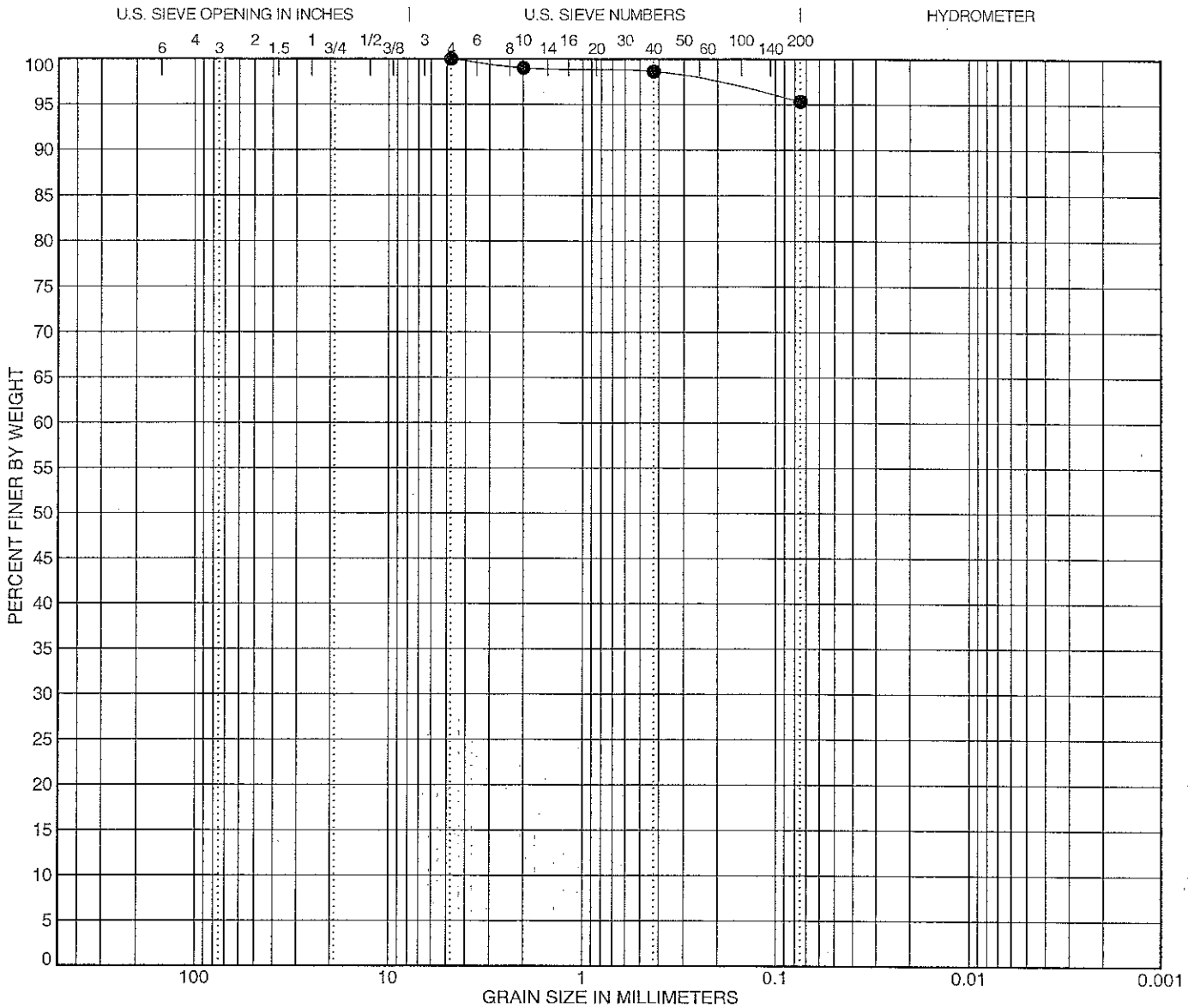

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	09-B76	18.0	**FAT CLAY(CH)**	**91**	**29**	**62**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
4.75				**0.0**	**4.7**	**95.3**	

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**				**98.6**					**95.3**

GRAIN SIZE DISTRIBUTION

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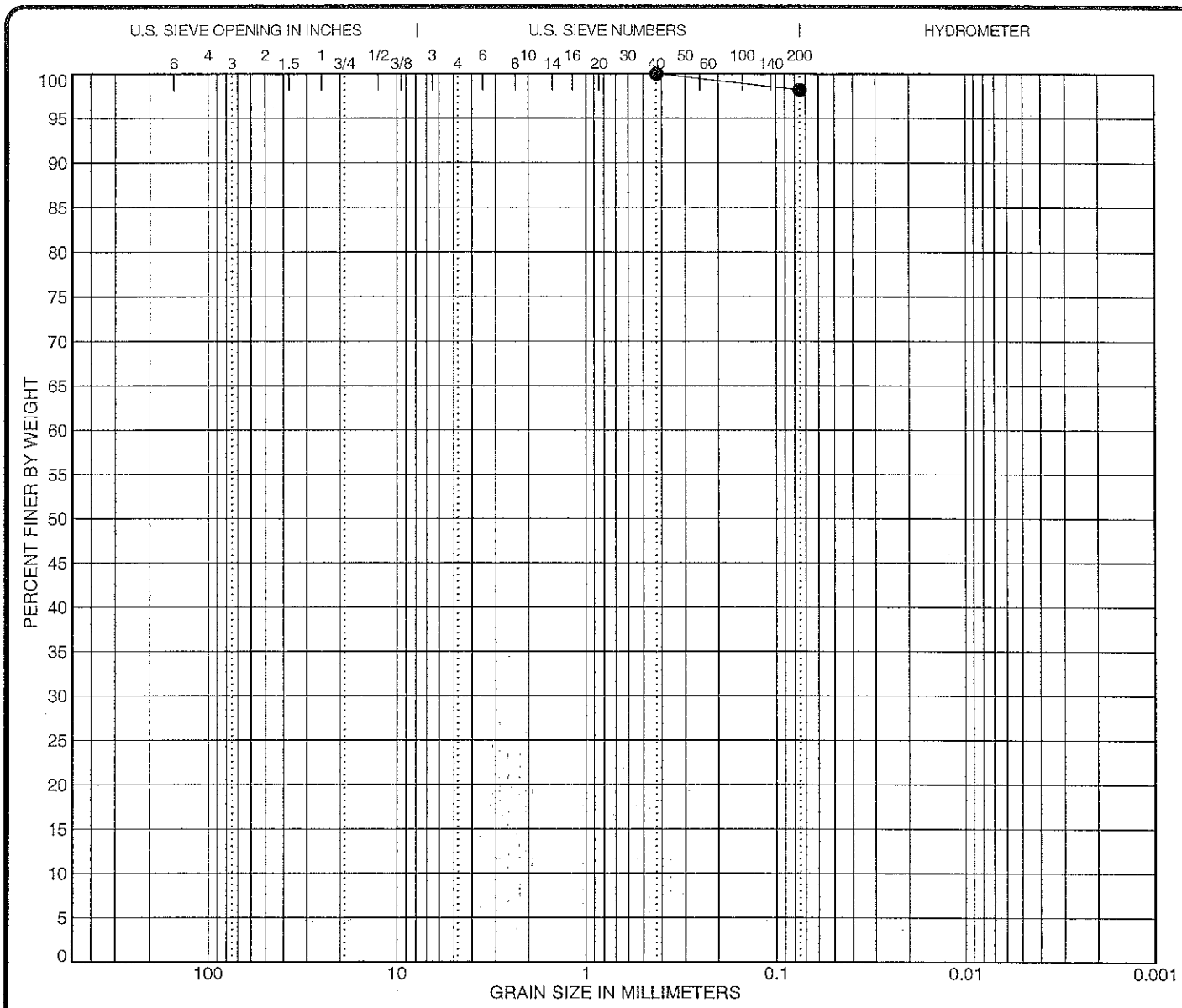

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B76**	**24.0**	**FAT CLAY(CH)**	**66**	**20**	**46**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
0.425				**0.0**	**1.8**	**98.2**	

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					**98.2**

GRAIN SIZE DISTRIBUTION

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

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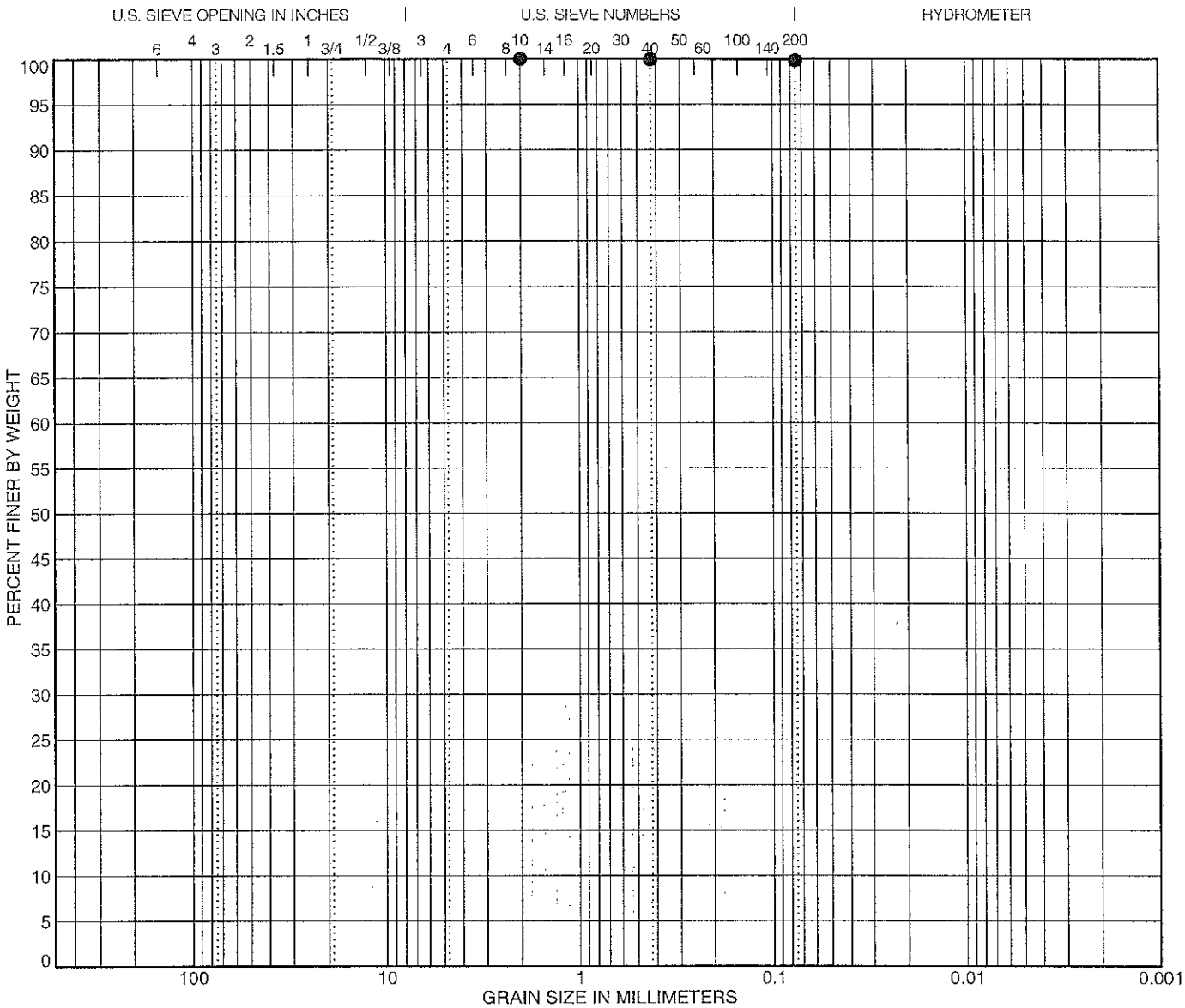

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B76**	**42.0**	**FAT CLAY(CH)**	**111**	**33**	**78**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
2				**0.0**	**0.2**	**99.8**	

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				**99.9**					**99.8**

GRAIN SIZE DISTRIBUTION

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

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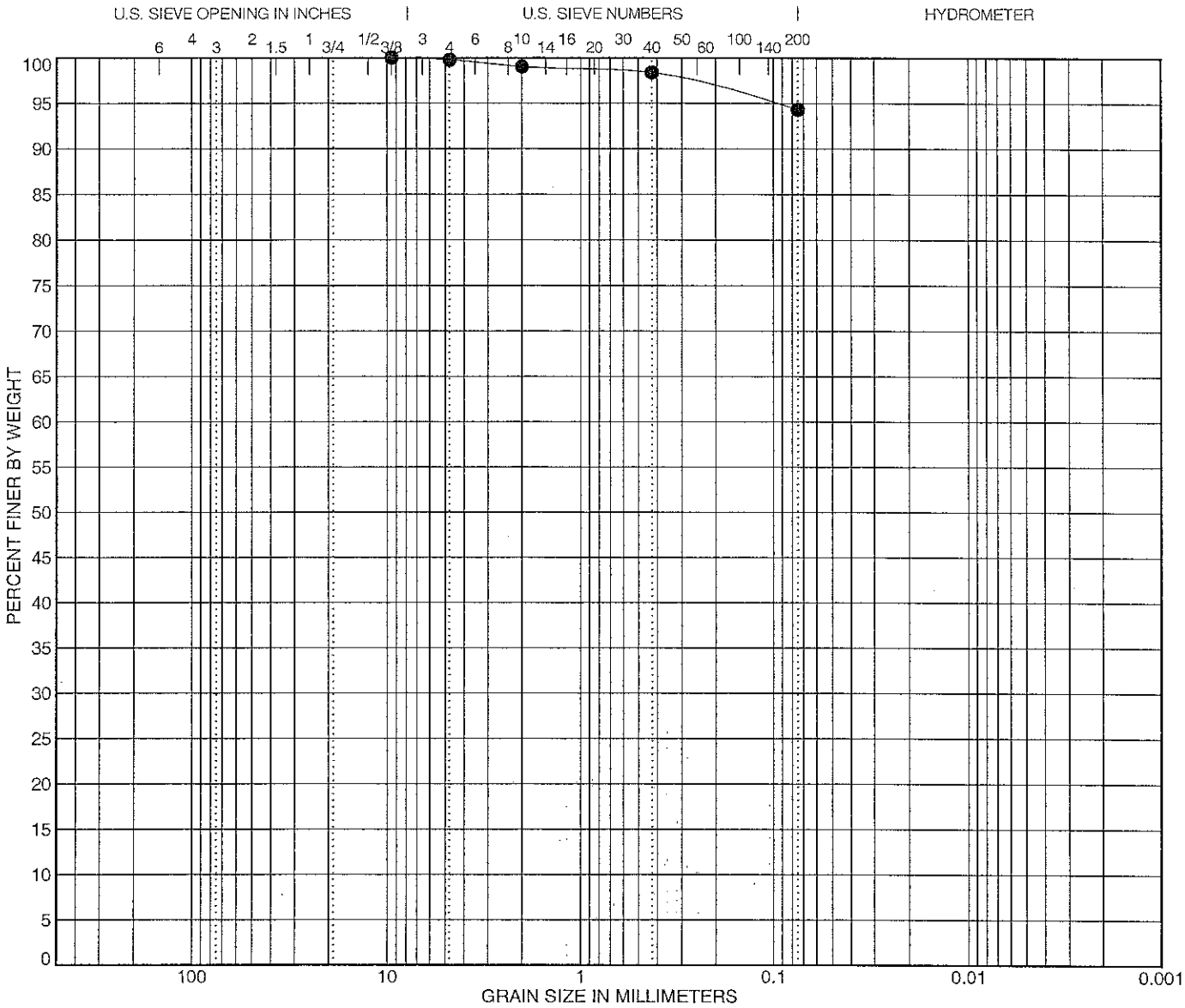

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B76**	**50.0**	**FAT CLAY(CH)**	**58**	**20**	**38**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
9.5				**0.2**	**5.5**	**94.3**	

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**				**98.4**					**94.3**

GRAIN SIZE DISTRIBUTION

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

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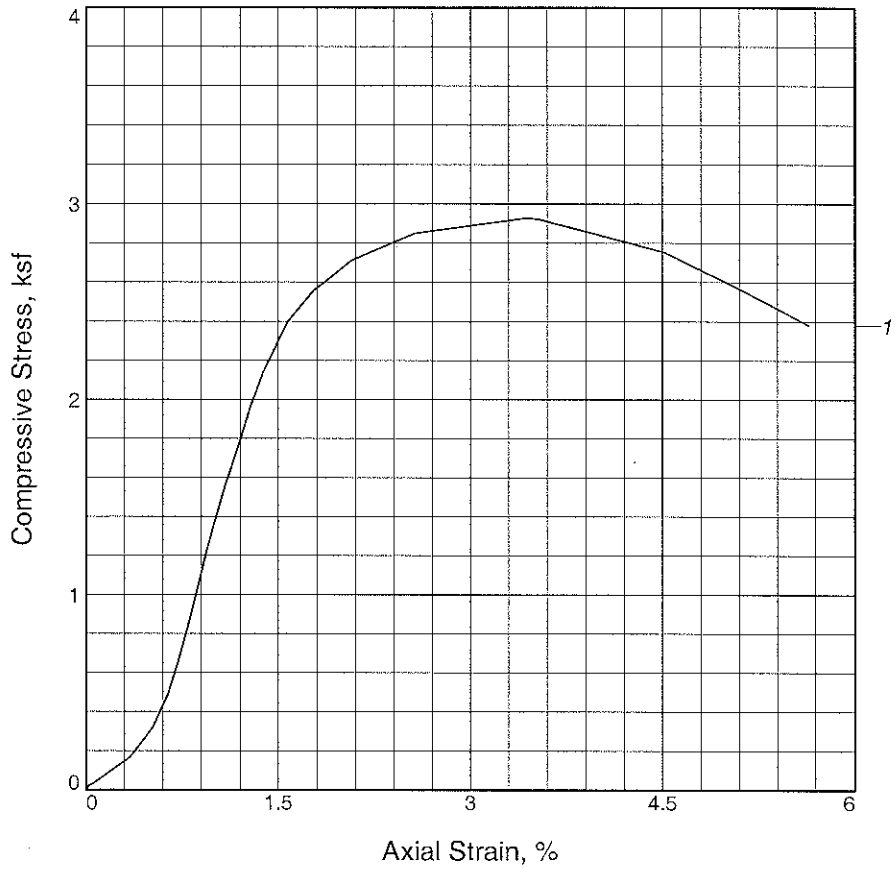
EXHIBIT I

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	2.927			
Undrained shear strength, ksf	1.464			
Failure strain, %	3.4			
Strain rate, in./min.	0.055			
Water content, %	37.0			
Wet density, pcf	115.8			
Dry density, pcf	84.5			
Saturation, %	98.8			
Void ratio	1.0309			
Specimen diameter, in.	2.722			
Specimen height, in.	5.607			
Height/diameter ratio	2.06			

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-B76

Sample Number: 5 **Depth:** 8-10 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-B76
Depth: 8-10 ft. **Sample Number:** 5
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.	100.910
Moisture content: Dry soil+tare, gms.	83.360
Moisture content: Tare, gms.	35.960
Moisture, %	37.0
Moist specimen weight, gms.	992.05
Diameter, in.	2.722
Area, in.^{2}	5.819
Height, in.	5.607
Wet density, pcf	115.8
Dry density, pcf	84.5
Void ratio	1.0309
Saturation, %	98.8

Test Readings for Specimen No. 1

Strain rate, in./min. = 0.055

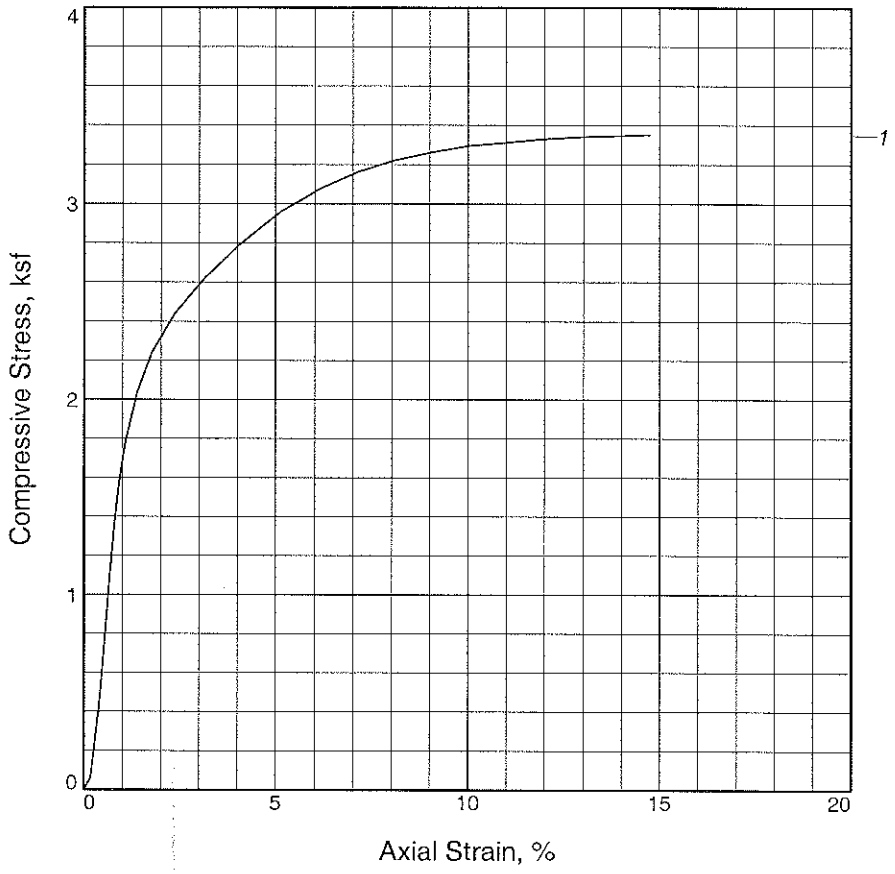
Unconfined compressive strength = 2.927 ksf **at reading no.** 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0013	1.000	1.0	0.0	0.025
2	0.0027	1.200	1.2	0.0	0.030
3	0.0192	6.778	6.8	0.3	0.167
4	0.0292	12.936	12.9	0.5	0.318
5	0.0358	19.898	19.9	0.6	0.489
6	0.0400	26.111	26.1	0.7	0.642
7	0.0443	33.494	33.5	0.8	0.822
8	0.0486	41.527	41.5	0.9	1.019
9	0.0528	49.845	49.8	0.9	1.222
10	0.0608	63.747	63.7	1.1	1.560
11	0.0665	72.269	72.3	1.2	1.767
12	0.0717	80.596	80.6	1.3	1.969
13	0.0774	87.697	87.7	1.4	2.140
14	0.0883	98.360	98.4	1.6	2.396
15	0.0996	105.332	105.3	1.8	2.560

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.1157	111.807	111.8	2.1	2.710
17	0.1436	118.147	118.1	2.6	2.849
18	0.1927	122.506	122.5	3.4	2.927
19	0.1984	122.377	122.4	3.5	2.921
20	0.2532	116.528	116.5	4.5	2.753
21	0.2892	108.604	108.6	5.2	2.549
22	0.3166	102.018	102.0	5.6	2.382

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	3.352			
Undrained shear strength, ksf	1.676			
Failure strain, %	14.7			
Strain rate, in./min.	0.055			
Water content, %	25.4			
Wet density, pcf	124.4			
Dry density, pcf	99.2			
Saturation, %	95.6			
Void ratio	0.7303			
Specimen diameter, in.	2.737			
Specimen height, in.	5.612			
Height/diameter ratio	2.05			

Description: Tan and light 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-B76

Sample Number: 26 **Depth:** 50-52 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-B76
Depth: 50-52 ft. **Sample Number:** 26
Description: Tan and light 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.	138.450
Moisture content: Dry soil+tare, gms.	117.690
Moisture content: Tare, gms.	35.960
Moisture, %	25.4
Moist specimen weight, gms.	1078.36
Diameter, in.	2.737
Area, in.^{2}	5.884
Height, in.	5.612
Wet density, pcf	124.4
Dry density, pcf	99.2
Void ratio	0.7303
Saturation, %	95.6

Test Readings for Specimen No. 1

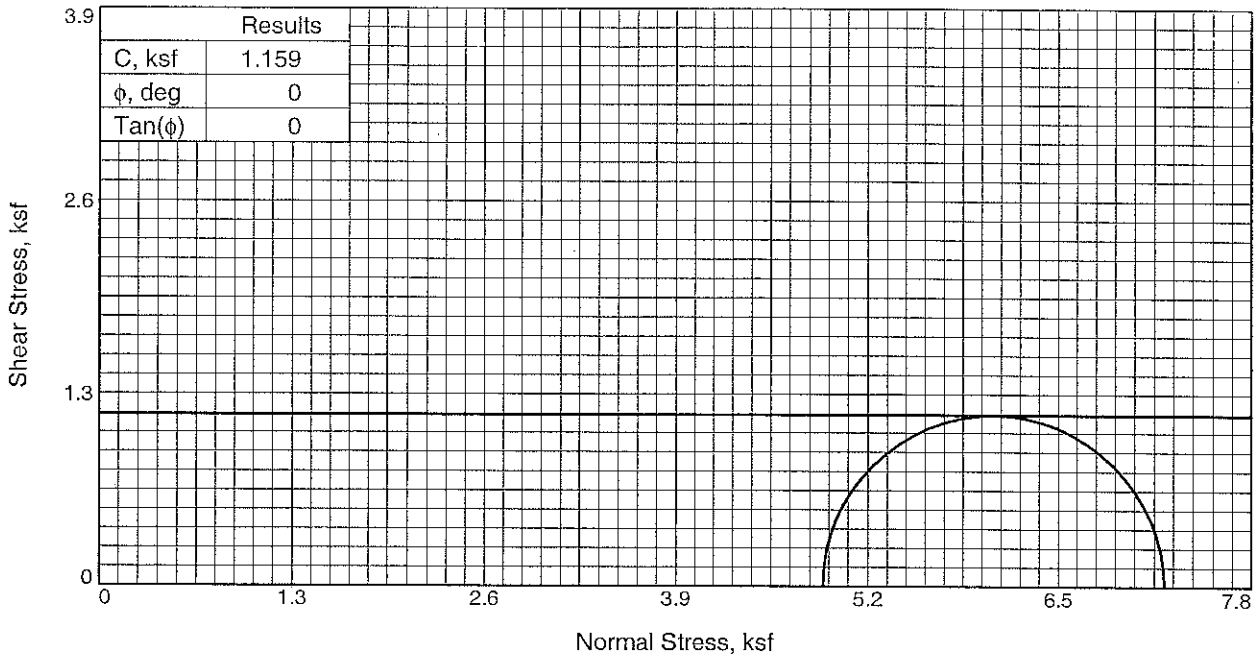
Strain rate, in./min. = 0.055

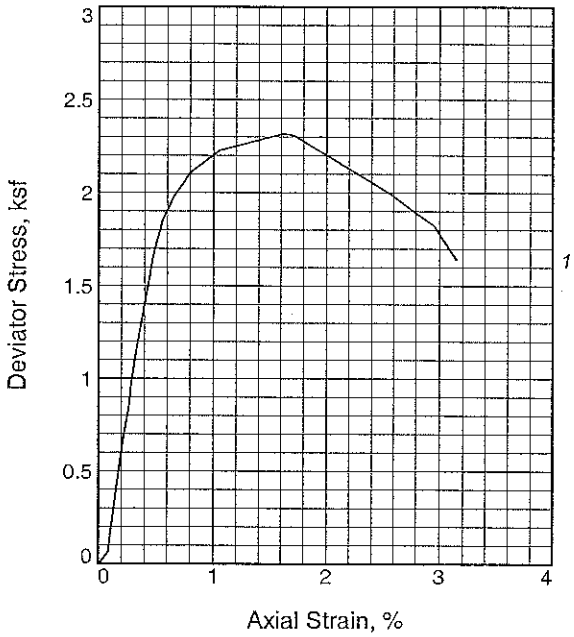
Unconfined compressive strength = 3.352 ksf **at reading no.** 25

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0100	2.510	2.5	0.2	0.061
2	0.0147	8.063	8.1	0.3	0.197
3	0.0218	17.743	17.7	0.4	0.433
4	0.0275	26.371	26.4	0.5	0.642
5	0.0327	36.335	36.3	0.6	0.884
6	0.0384	46.604	46.6	0.7	1.133
7	0.0441	55.800	55.8	0.8	1.355
8	0.0507	64.595	64.6	0.9	1.567
9	0.0606	73.736	73.7	1.1	1.785
10	0.0771	84.374	84.4	1.4	2.037
11	0.0989	93.106	93.1	1.8	2.239
12	0.1320	101.976	102.0	2.4	2.437
13	0.1759	110.533	110.5	3.1	2.620
14	0.2256	118.675	118.7	4.0	2.788
15	0.2885	127.497	127.5	5.1	2.960

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.3438	133.913	133.9	6.1	3.077
17	0.3986	139.015	139.0	7.1	3.161
18	0.4539	143.239	143.2	8.1	3.222
19	0.5087	146.621	146.6	9.1	3.263
20	0.5636	149.726	149.7	10.0	3.297
21	0.6189	152.077	152.1	11.0	3.312
22	0.6737	154.635	154.6	12.0	3.330
23	0.7285	156.893	156.9	13.0	3.341
24	0.7838	158.962	159.0	14.0	3.347
25	0.8250	160.543	160.5	14.7	3.352
26	0.8264	160.534	160.5	14.7	3.351





Sample No.		1
Initial	Water Content, %	43.3
	Dry Density, pcf	79.8
	Saturation, %	103.5
	Void Ratio	1.1511
	Diameter, in.	2.728
	Height, in.	5.826
At Test	Water Content, %	41.9
	Dry Density, pcf	79.8
	Saturation, %	100.0
	Void Ratio	1.1511
	Diameter, in.	2.728
	Height, in.	5.826
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		34.020
Fail. Stress, ksf		2.318
Ult. Stress, ksf		
σ_1 Failure, ksf		7.217
σ_3 Failure, ksf		4.899

Type of Test:
Unconsolidated Undrained
Sample Type: Undisturbed
Description: Gray Fat Clay

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-B76
Sample Number: 21 **Depth:** 42-44 ft.
Proj. No.: 92105186-B **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/5/2010
11:55 AM

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-B76
Depth: 42-44 ft. **Sample Number:** 21
Description: Gray Fat Clay
Remarks: ASTM D2850
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

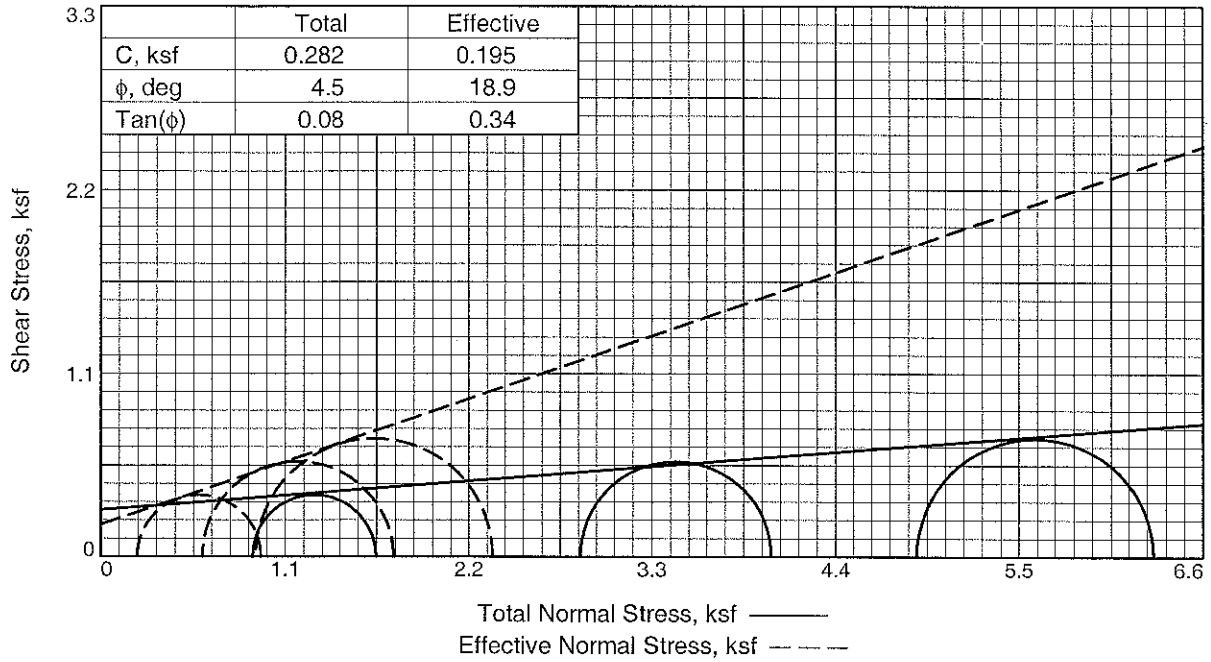
Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	160.600		160.600
Moisture content: Dry soil+tare, gms.	127.070		127.070
Moisture content: Tare, gms.	49.670		49.670
Moisture, %	43.3	41.9	43.3
Moist specimen weight, gms.	1022.43		
Diameter, in.	2.728	2.728	
Area, in.^{2}	5.845	5.845	
Height, in.	5.826	5.826	
Net decrease in height, in.		0.000	
Wet density, pcf	114.4	113.2	
Dry density, pcf	79.8	79.8	
Void ratio	1.1511	1.1511	
Saturation, %	103.5	100.0	

Test Readings for Specimen No. 1

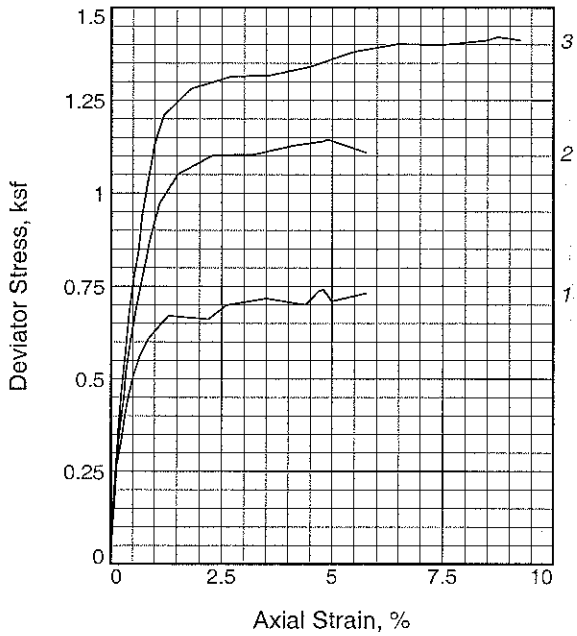
Cell pressure = 34.020 psi (4.899 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 2.318 ksf **at reading no.** 17

Test Readings for Specimen No. [illegible]

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	0.0020	0.000	0.0	0.0	0.000	4.899	4.899	1.00	4.899	0.000
1	0.0022	0.000	0.0	0.0	0.000	4.899	4.899	1.00	4.899	0.000
2	0.0025	0.000	0.0	0.0	0.000	4.899	4.899	1.00	4.899	0.000
3	0.0072	2.617	2.6	0.1	0.064	4.899	4.963	1.01	4.931	0.032
4	0.0084	7.551	7.6	0.1	0.186	4.899	5.085	1.04	4.992	0.093
5	0.0113	17.324	17.3	0.2	0.426	4.899	5.325	1.09	5.112	0.213
6	0.0142	26.407	26.4	0.2	0.649	4.899	5.548	1.13	5.223	0.325
7	0.0173	34.425	34.4	0.3	0.846	4.899	5.745	1.17	5.322	0.423
8	0.0184	39.234	39.2	0.3	0.964	4.899	5.863	1.20	5.381	0.482
9	0.0215	47.955	48.0	0.3	1.178	4.899	6.076	1.24	5.488	0.589
10	0.0238	53.615	53.6	0.4	1.316	4.899	6.215	1.27	5.557	0.658
11	0.0269	60.343	60.3	0.4	1.480	4.899	6.379	1.30	5.639	0.740
12	0.0298	67.636	67.6	0.5	1.658	4.899	6.557	1.34	5.728	0.829
13	0.0344	75.391	75.4	0.6	1.847	4.899	6.746	1.38	5.822	0.924
14	0.0398	80.473	80.5	0.6	1.970	4.899	6.869	1.40	5.884	0.985
15	0.0486	86.248	86.2	0.8	2.108	4.899	7.007	1.43	5.953	1.054
16	0.0630	91.340	91.3	1.0	2.227	4.899	7.126	1.45	6.012	1.113
17	0.0963	95.628	95.6	1.6	2.318	4.899	7.217	1.47	6.058	1.159
18	0.1015	95.355	95.4	1.7	2.309	4.899	7.208	1.47	6.053	1.155
19	0.1237	89.904	89.9	2.1	2.169	4.899	7.068	1.44	5.983	1.084
20	0.1518	83.085	83.1	2.6	1.994	4.899	6.893	1.41	5.896	0.997
21	0.1740	76.300	76.3	3.0	1.824	4.899	6.723	1.37	5.811	0.912
22	0.1851	68.730	68.7	3.1	1.640	4.899	6.539	1.33	5.719	0.820



	Total	Effective
C, ksf	0.282	0.195
ϕ, deg	4.5	18.9
Tan(ϕ)	0.08	0.34



Sample No.		1	2	3
Initial	Water Content, %	43.0	43.0	43.0
	Dry Density, pcf	77.9	77.9	77.9
	Saturation, %	98.2	98.2	98.2
	Void Ratio	1.2024	1.2024	1.2024
	Diameter, in.	2.702	2.702	2.702
	Height, in.	6.027	6.027	6.027
At Test	Water Content, %	41.8	41.8	41.8
	Dry Density, pcf	77.9	77.9	77.9
	Saturation, %	95.6	95.6	95.6
	Void Ratio	1.2024	1.2024	1.2024
	Diameter, in.	2.702	2.702	2.702
	Height, in.	6.027	6.027	6.027
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.000	50.020	50.000
Cell Pressure, psi		56.280	69.960	83.930
Fail. Stress, ksf		0.741	1.145	1.421
Excess Pore Pr., ksf		0.691	2.269	3.963
Ult. Stress, ksf				
Excess Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		0.954	1.747	2.344
$\bar{\sigma}_3$ Failure, ksf		0.213	0.602	0.923

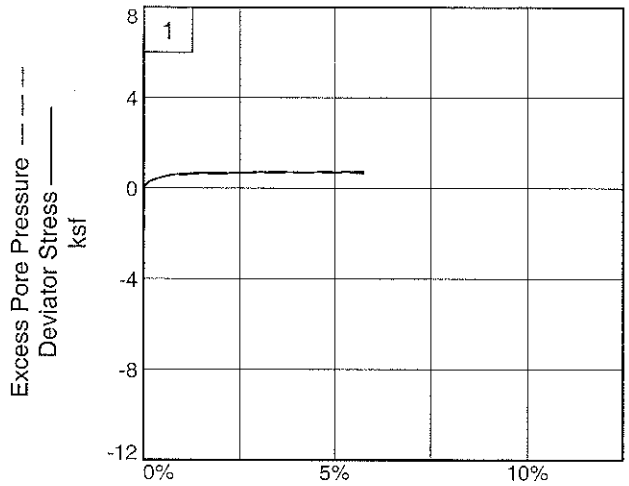
Type of Test:
CU with Pore Pressures
Sample Type: Undisturbed
Description: Gray Fat Clay

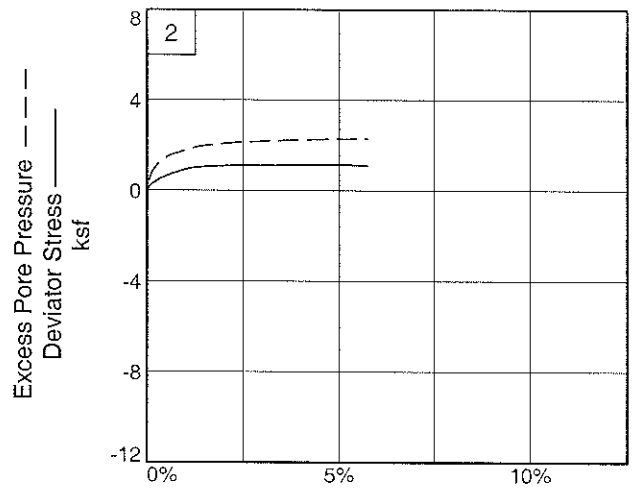
LL= 66 **PL=** 20 **PI=** 46
Assumed Specific Gravity= 2.75
Remarks: ASTM D4767
Specific gravity assumed
percent pass #200 sieve = 95.3

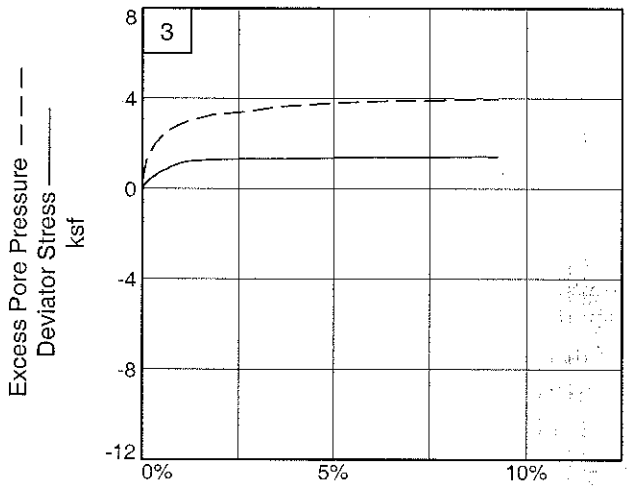
Client: USACE

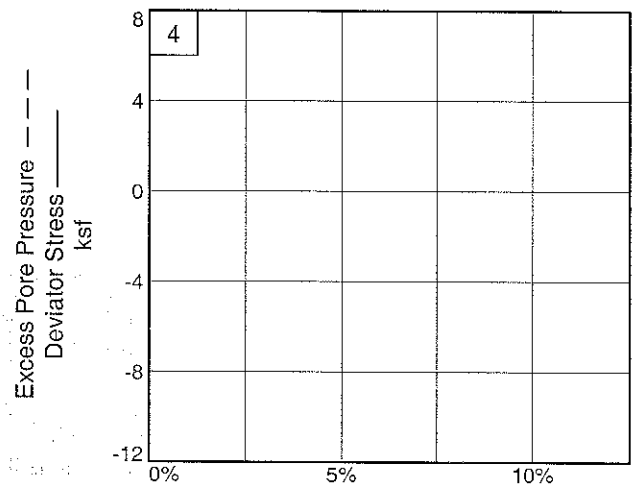
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Location: 09-B76
Sample Number: 13 **Depth:** 24-26 ft.
Proj. No.: 92105186 **Date Sampled:**

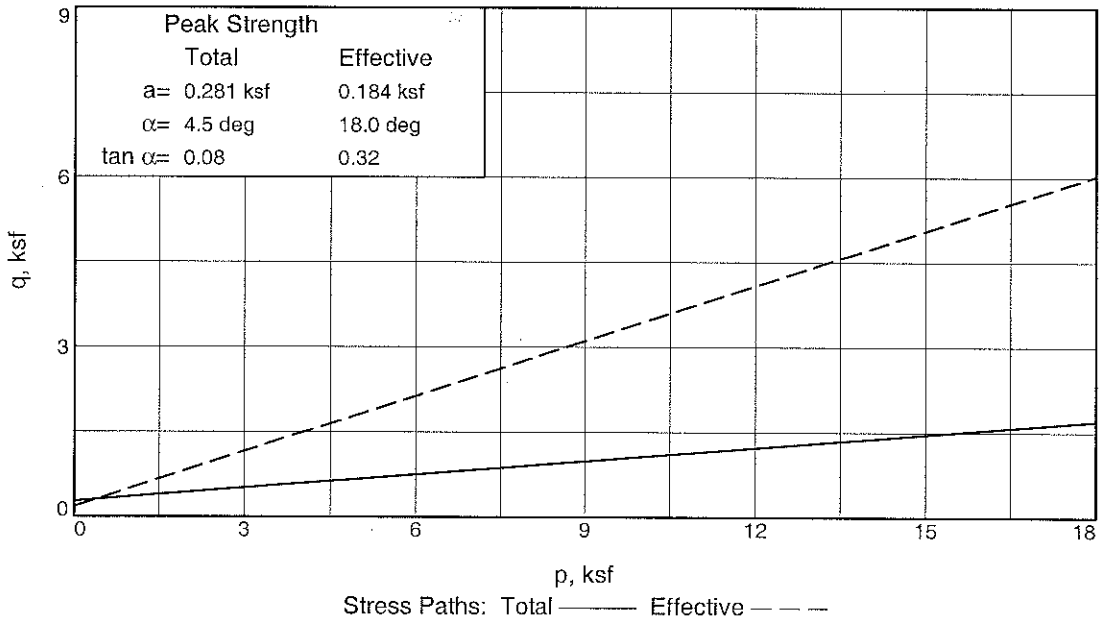
TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX











Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.

Location: 09-B76 **Depth:** 24-26 ft. **Sample Number:** 13

Project No.: 92105186

Terracon, Inc.

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/29/2010
11:25 AM

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: 09-B76
Depth: 24-26 ft. **Sample Number:** 13
Description: Gray Fat Clay
Remarks: ASTM D4767
Specific gravity assumed
percent pass #200 sieve = 95.3
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=**66 **PL=**20 **PI=**46
Test Method: ASTM D 4767 Method A

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	149.570			138.920
Moisture content: Dry soil+tare, gms.	119.920			108.160
Moisture content: Tare, gms.	50.890			34.610
Moisture, %	43.0	41.8	41.8	41.8
Moist specimen weight, gms.	1010.85			
Diameter, in.	2.702	2.702	2.702	
Area, in.^{2}	5.734	5.734	5.734	
Height, in.	6.027	6.027	6.027	
Net decrease in height, in.		0.000	0.000	
Net decrease in water volume, cc.			0.000	
Wet density, pcf	111.4	110.5	110.5	
Dry density, pcf	77.9	77.9	77.9	
Void ratio	1.2024	1.2024	1.2024	
Saturation, %	98.2	95.6	95.6	

Test Readings for Specimen No. 1

Consolidation cell pressure = 56.280 psi (8.104 ksf)
Consolidation back pressure = 50.000 psi (7.200 ksf)
Consolidation effective confining stress = 0.904 ksf
Strain rate, in./min. = 0.001
Fail. Stress = 0.741 ksf **at reading no.** 18

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf	Minor Eff. Stress ksf	Major Eff. Stress ksf	1:3 Ratio	Pore Press. psi	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.000	8.104	8.104	1.00	0.000	8.104	0.000
1	0.0009	2.389	2.4	0.0	0.060	0.903	0.963	1.07	50.008	0.933	0.030
2	0.0024	4.627	4.6	0.0	0.116	0.766	0.882	1.15	50.958	0.824	0.058
3	0.0054	7.441	7.4	0.1	0.187	0.667	0.854	1.28	51.646	0.761	0.093
4	0.0084	10.644	10.6	0.1	0.267	0.615	0.882	1.43	52.011	0.748	0.133
5	0.0129	12.673	12.7	0.2	0.318	0.554	0.871	1.57	52.436	0.712	0.159
6	0.0174	14.965	15.0	0.3	0.375	0.508	0.882	1.74	52.754	0.695	0.187
7	0.0204	16.569	16.6	0.3	0.415	0.513	0.927	1.81	52.721	0.720	0.207
8	0.0249	18.343	18.3	0.4	0.459	0.448	0.906	2.02	53.172	0.677	0.229
9	0.0309	20.417	20.4	0.5	0.510	0.411	0.921	2.24	53.429	0.666	0.255
10	0.0399	22.526	22.5	0.7	0.562	0.370	0.932	2.52	53.708	0.651	0.281
11	0.0519	24.459	24.5	0.9	0.609	0.331	0.940	2.84	53.979	0.636	0.304
12	0.0789	27.039	27.0	1.3	0.670	0.282	0.952	3.38	54.321	0.617	0.335
13	0.1329	26.902	26.9	2.2	0.661	0.274	0.935	3.41	54.377	0.604	0.330
14	0.1569	28.572	28.6	2.6	0.699	0.243	0.941	3.88	54.595	0.592	0.349
15	0.2109	29.597	29.6	3.5	0.717	0.235	0.953	4.05	54.645	0.594	0.359
16	0.2649	29.150	29.1	4.4	0.700	0.229	0.929	4.06	54.692	0.579	0.350
17	0.2829	30.768	30.8	4.7	0.736	0.216	0.952	4.41	54.781	0.584	0.368
18	0.2889	31.002	31.0	4.8	0.741	0.213	0.954	4.48	54.799	0.584	0.371
19	0.3009	29.728	29.7	5.0	0.709	0.205	0.914	4.46	54.858	0.559	0.355
20	0.3459	30.858	30.9	5.7	0.730	0.243	0.973	4.01	54.593	0.608	0.365

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	149.570			138.920
Moisture content: Dry soil+tare, gms.	119.920			108.160
Moisture content: Tare, gms.	50.890			34.610
Moisture, %	43.0	41.8	41.8	41.8
Moist specimen weight, gms.	1010.85			
Diameter, in.	2.702	2.702	2.702	
Area, in.^{2}	5.734	5.734	5.734	
Height, in.	6.027	6.027	6.027	
Net decrease in height, in.		0.000	0.000	
Net decrease in water volume, cc.			0.000	
Wet density, pcf	111.4	110.5	110.5	
Dry density, pcf	77.9	77.9	77.9	
Void ratio	1.2024	1.2024	1.2024	
Saturation, %	98.2	95.6	95.6	

Test Readings for Specimen No. 2

Consolidation cell pressure = 69.960 psi (10.074 ksf)

Consolidation back pressure = 50.020 psi (7.203 ksf)

Consolidation effective confining stress = 2.871 ksf

Strain rate, in./min. = 0.001

Fail. Stress = 1.145 ksf **at reading no.** 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf	Minor Eff. Stress ksf	Major Eff. Stress ksf	1:3 Ratio	Pore Press. psi	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.000	10.074	10.074	1.00	0.000	10.074	0.000
1	0.0011	2.897	2.9	0.0	0.073	2.849	2.922	1.03	50.177	2.885	0.036
2	0.0026	5.526	5.5	0.0	0.139	2.505	2.644	1.06	52.565	2.574	0.069
3	0.0041	8.048	8.0	0.1	0.202	2.320	2.522	1.09	53.848	2.421	0.101
4	0.0086	11.591	11.6	0.1	0.291	2.026	2.317	1.14	55.890	2.171	0.145
5	0.0131	15.165	15.2	0.2	0.380	1.854	2.234	1.20	57.083	2.044	0.190
6	0.0176	17.956	18.0	0.3	0.450	1.689	2.138	1.27	58.233	1.913	0.225
7	0.0206	20.678	20.7	0.3	0.518	1.634	2.151	1.32	58.615	1.892	0.259
8	0.0266	23.933	23.9	0.4	0.598	1.499	2.097	1.40	59.552	1.798	0.299
9	0.0326	26.880	26.9	0.5	0.671	1.374	2.046	1.49	60.417	1.710	0.336
10	0.0386	29.312	29.3	0.6	0.731	1.295	2.026	1.56	60.968	1.660	0.366
11	0.0476	32.658	32.7	0.8	0.814	1.209	2.022	1.67	61.567	1.615	0.407
12	0.0536	35.271	35.3	0.9	0.878	1.151	2.029	1.76	61.967	1.590	0.439
13	0.0672	39.196	39.2	1.1	0.973	1.018	1.991	1.96	62.890	1.505	0.487
14	0.0911	42.487	42.5	1.5	1.051	0.894	1.945	2.18	63.752	1.419	0.525
15	0.1391	44.940	44.9	2.3	1.103	0.757	1.860	2.46	64.703	1.308	0.551
16	0.1931	45.406	45.4	3.2	1.104	0.686	1.789	2.61	65.200	1.237	0.552
17	0.2471	46.825	46.8	4.1	1.128	0.631	1.758	2.79	65.581	1.194	0.564
18	0.2891	47.664	47.7	4.8	1.140	0.605	1.744	2.88	65.759	1.175	0.570
19	0.2951	47.935	47.9	4.9	1.145	0.602	1.747	2.90	65.776	1.175	0.572
20	0.3461	46.891	46.9	5.7	1.110	0.587	1.697	2.89	65.882	1.142	0.555

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	149.570			138.920
Moisture content: Dry soil+tare, gms.	119.920			108.160
Moisture content: Tare, gms.	50.890			34.610
Moisture, %	43.0	41.8	41.8	41.8
Moist specimen weight, gms.	1010.85			
Diameter, in.	2.702	2.702	2.702	
Area, in.^{2}	5.734	5.734	5.734	
Height, in.	6.027	6.027	6.027	
Net decrease in height, in.		0.000	0.000	
Net decrease in water volume, cc.			0.000	
Wet density, pcf	111.4	110.5	110.5	
Dry density, pcf	77.9	77.9	77.9	
Void ratio	1.2024	1.2024	1.2024	
Saturation, %	98.2	95.6	95.6	

Test Readings for Specimen No. 3

Consolidation cell pressure = 83.930 psi (12.086 ksf)

Consolidation back pressure = 50.000 psi (7.200 ksf)

Consolidation effective confining stress = 4.886 ksf

Strain rate, in./min. = 0.001

Fail. Stress = 1.421 ksf **at reading no.** 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf	Minor Eff. Stress ksf	Major Eff. Stress ksf	1:3 Ratio	Pore Press. psi	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.000	12.086	12.086	1.00	0.000	12.086	0.000
1	0.0008	2.094	2.1	0.0	0.053	4.727	4.779	1.01	51.104	4.753	0.026
2	0.0023	5.417	5.4	0.0	0.136	4.207	4.343	1.03	54.712	4.275	0.068
3	0.0068	10.697	10.7	0.1	0.268	3.608	3.876	1.07	58.876	3.742	0.134
4	0.0099	14.084	14.1	0.2	0.353	3.383	3.736	1.10	60.437	3.560	0.177
5	0.0144	18.629	18.6	0.2	0.467	3.184	3.650	1.15	61.822	3.417	0.233
6	0.0204	23.203	23.2	0.3	0.581	2.885	3.466	1.20	63.896	3.175	0.290
7	0.0249	27.011	27.0	0.4	0.676	2.760	3.436	1.24	64.764	3.098	0.338
8	0.0309	30.757	30.8	0.5	0.768	2.548	3.317	1.30	66.234	2.932	0.384
9	0.0384	34.110	34.1	0.6	0.851	2.425	3.276	1.35	67.090	2.851	0.426
10	0.0429	37.650	37.7	0.7	0.939	2.282	3.221	1.41	68.084	2.751	0.469
11	0.0504	41.139	41.1	0.8	1.025	2.153	3.178	1.48	68.978	2.665	0.512
12	0.0594	45.307	45.3	1.0	1.127	2.022	3.149	1.56	69.888	2.585	0.563
13	0.0729	48.774	48.8	1.2	1.210	1.870	3.080	1.65	70.945	2.475	0.605
14	0.1089	51.947	51.9	1.8	1.281	1.615	2.896	1.79	72.717	2.255	0.640
15	0.1629	53.775	53.8	2.7	1.314	1.476	2.790	1.89	73.678	2.133	0.657
16	0.2169	54.396	54.4	3.6	1.317	1.245	2.561	2.06	75.287	1.903	0.658
17	0.2709	55.870	55.9	4.5	1.340	1.145	2.485	2.17	75.982	1.815	0.670
18	0.3309	58.164	58.2	5.5	1.381	1.051	2.432	2.31	76.630	1.741	0.690
19	0.3909	59.673	59.7	6.5	1.401	1.000	2.401	2.40	76.986	1.701	0.701
20	0.4509	60.208	60.2	7.5	1.399	0.980	2.379	2.43	77.122	1.680	0.699
21	0.5109	61.376	61.4	8.5	1.411	0.926	2.337	2.52	77.497	1.632	0.705
22	0.5259	61.982	62.0	8.7	1.421	0.923	2.344	2.54	77.521	1.633	0.710
23	0.5558	61.936	61.9	9.2	1.412	0.909	2.321	2.55	77.617	1.615	0.706

SUMMARY TABLE OF LABORATORY TEST DATA

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-B74	0-2	1.75																				CH**	25																						
	2-4	0.75																				CH**	29																						
	4-6	0.75			91	23	68		100	99		97				95					83	CH	29											1.3	29	93	CH**							
	6-8	1.25																				CH**	37																						
	8-10	0.75																				CH**	44																						
	10-12	0.75			45	20	25					100				100					93	CL	45							0.7	45	79	CH**											
	12-14	1.00																				CH**	38																						
	14-16	1.75																				CH**	39																						
	16-18	0.75			96	35	61			100		99				96					93	CH	46							1.0	46	77	CH**											
	18-20	1.25																				CH**	46																						
09-B75	0-2	0.75			95	31	64			100		99				95					93	CH	44							0.5	44	77	CH**											
	2-4	0.75																				CH**	36																						
	4-6	1.50																				CH**	35																						
	6-8	2.00			82	26	56			100		100				100					100	CH	28							1.4	28	95	CH**											
	8-10	2.00																				CH**	29																						
	10-12	1.00																				CH**	22																						
	12-14	1.00			62	23	39					100				100					97	CH	24		0.5	24	24	101	CH**															
	14-16	0.25																				CL**	25																						
	16-18	0.50																				CL**	23																						
	18-20	0.50																				CL**	27																						
09-B76	0-2	3.00																				CH**	27																						
	2-4	2.50			65	22	43			100		100				98					94	CH	32	94																				
	4-6	4.00																				CH**	25																						
	6-8	1.75																				CH**	23																						
	8-10	0.50			93	30	63			100		100				100					99	CH	37							1.5	37	85	CH**											
	10-12	0.75																				CH**	22																						
	12-14	2.75																				CH**	18																						
	14-16	1.25																				CH**	25																						
	16-18	0.75																				CH**	30																						
	18-20	0.75			91	29	62			100		99			99						95	CH	35	83																				
	20-22	0.25	0.20																			CH**	81																						
	22-24	0.25	0.10																			CH**	40																						
	24-26	0.50			66	20	46					100			100						98	CH	43															0.3	5	0.2	19	43	78	CH**
	26-28	0.25																				CH**	39																						
	28-30																					CH**	42																						
	30-32	1.00																				CH**	36																						
	32-34	0.75			75	25	50															CH*	35	89																				
	34-36	1.25																				CH**	25																						
	36-38	1.50																				CH**	34																						
	38-40	1.50																				CH**	42																						
	40-42	1.25																				CH**	36																						
	42-44	1.00			111	33	78					100			100						100	CH	43											1.2	43	80	CH**							
	44-46	1.50																				CH**	41																						
	46-48	1.25																				CH**	29																						
	48-50	1.50																				CH**	33																						
	50-52	1.50			58	20	38		100			100			99						94	CH	25							1.7	25	99	CH**											
	52-54	1.00																				CH**	28																						
	54-56	0.50																				CH**	29																						
	56-58																					CH**	30																						
	58-60	0.25																				CH**	27																						
	60-62	0.50																				CH**	27																						
	62-64	0.50																				CH**	27																						
	64-66	0.50																				CH**	25																						