BORING LOG NO. 09-B74

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
BORING LOCATION:	N: 13826538 E: 3260780	SITE:	Cedar Bayou PA6 Baytown, Texas

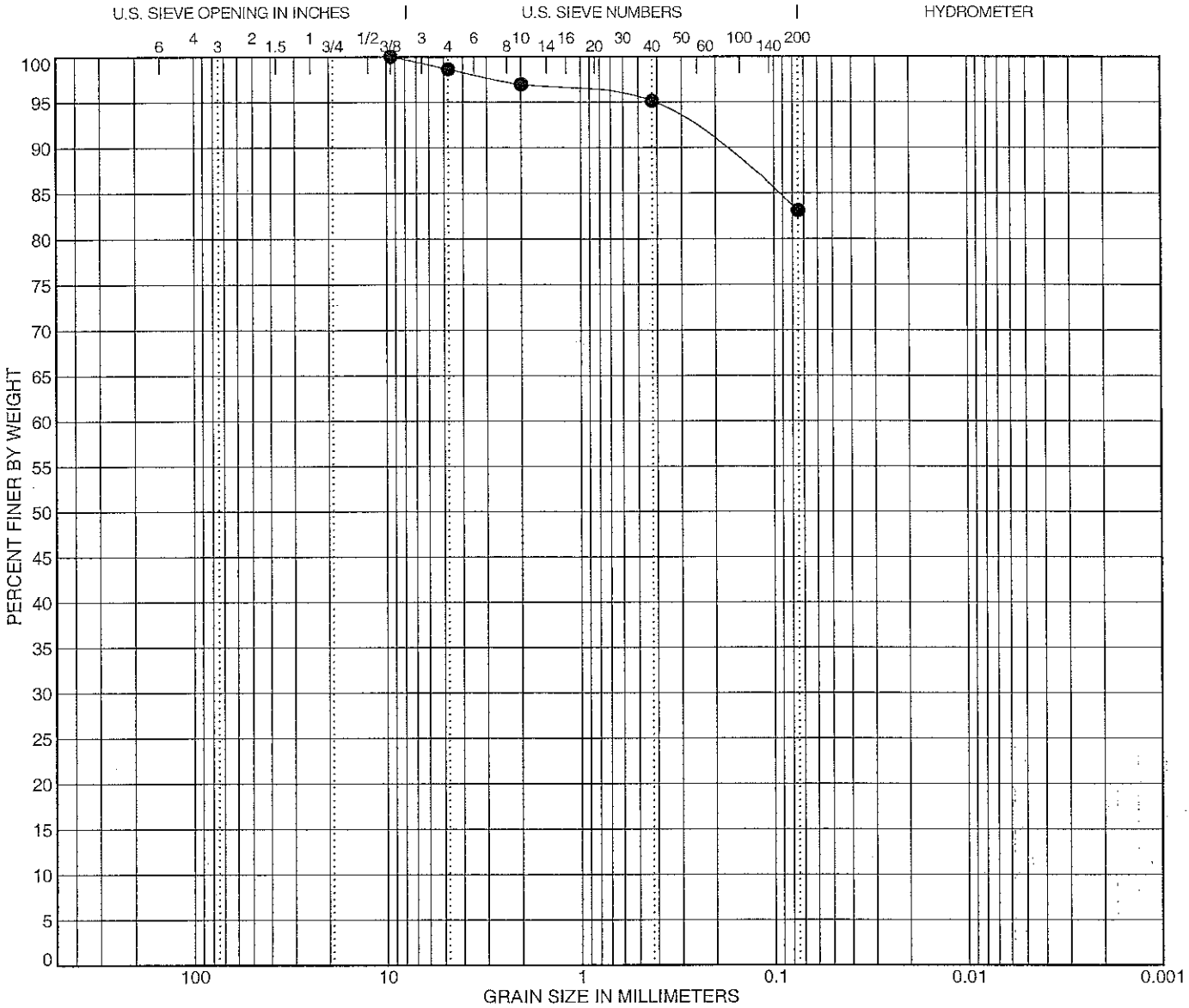
Approx. Surface Elevation: 14.9 feet

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
	FILL: FAT CLAY w/ SAND light brown, dark gray and gray, medium stiff to stiff, very high plasticity, moist, with calcareous nodules - with roots 0 to 1 foot	1	CH	ST	6		1.75		25								
		2															
		3		ST	7		0.75		29								
		4															
		5		ST	9		0.75		29	93	91	23	68	83			
	8.9 / 6.0	6															
	FAT CLAY dark gray, medium stiff to stiff, high plasticity, moist with sand seams	7	CH	ST	14		1.25		37								
		8															
		9		ST	12		0.75		44								
	4.9 / 10.0	10															
	LEAN CLAY dark gray, stiff, high plasticity, moist, with sand seams	11	CL	ST	15		0.75		45	79	45	20	25	93			
	2.9 / 12.0	12															
	FAT CLAY dark gray, medium stiff to stiff, very high plasticity, moist - with calcareous nodules 14 to 16 feet	13	CH	ST	6		1.0		38								
		14															
		15		ST	10		1.75		39								
		16															
		17		ST	9		0.75		46	77	96	35	61	93			
		18															
		19		ST	8		1.25		46								
	-5.1 / 20.0	20															
	Boring terminated at 20 feet.																

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

REMARKS: Dry augered to 20 feet

WATER LEVEL OBSERVATIONS		Terracon	DATE DRILLED	Page 1 of 1
▽	▼		3/22/2010	09-B74
▼	▼		PROJECT NUMBER	
FREE WATER WAS NOT OBSERVED DURING DRY DRILLING OPERATIONS			92105186-A	EXHIBIT A-



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	09-B74	4.0	**FAT CLAY with SAND(CH)**	**91**	**23**	**68**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
9.5				**1.4**	**15.5**	**83.1**	

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	**98.6**		**96.9**				**95.1**					**83.1**

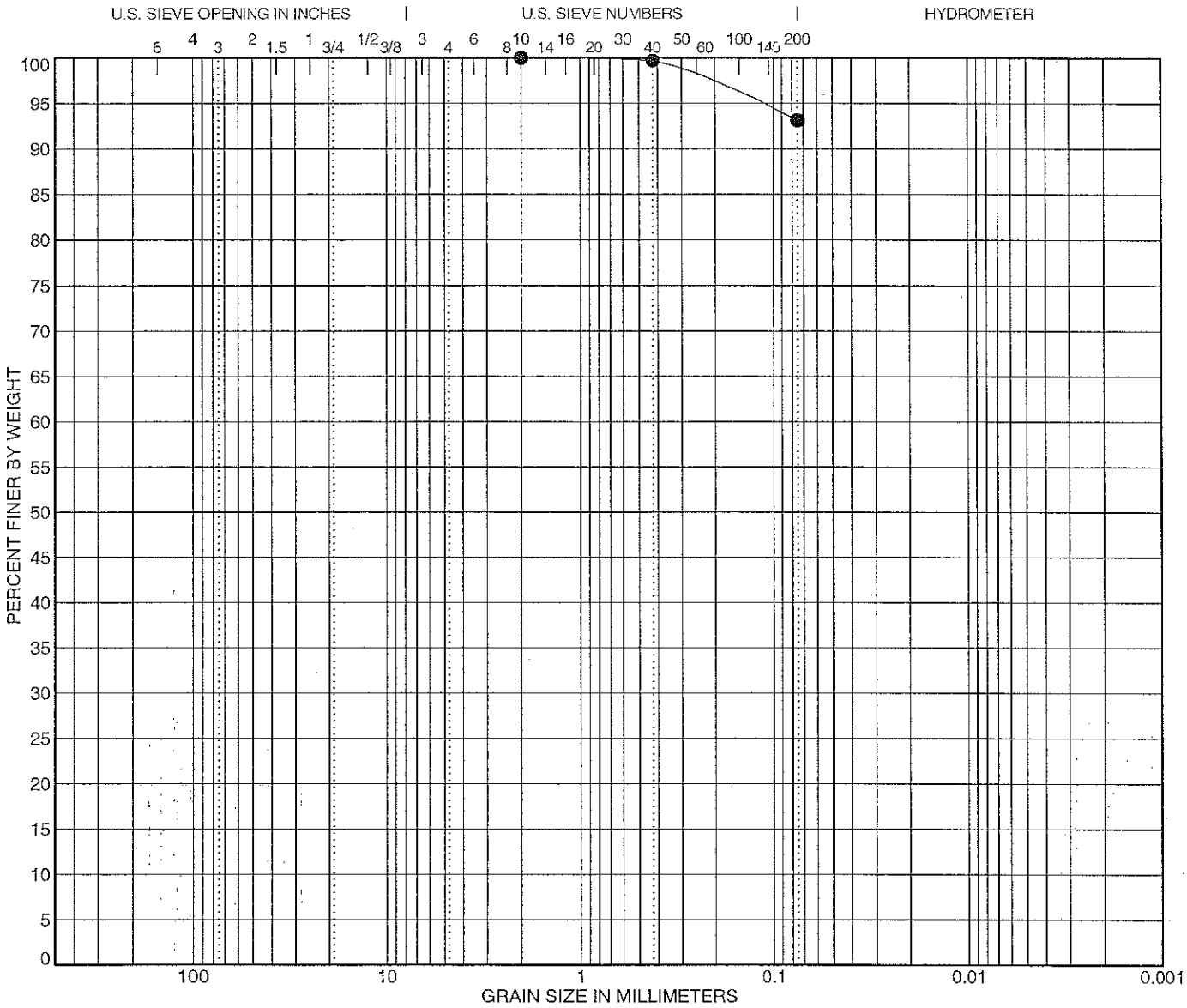
GRAIN SIZE DISTRIBUTION

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 a



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	09-B74	10.0	**LEAN CLAY(CL)**	**45**	**20**	**25**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
2				**0.0**	**6.9**	**93.1**	

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				**99.7**					**93.1**

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
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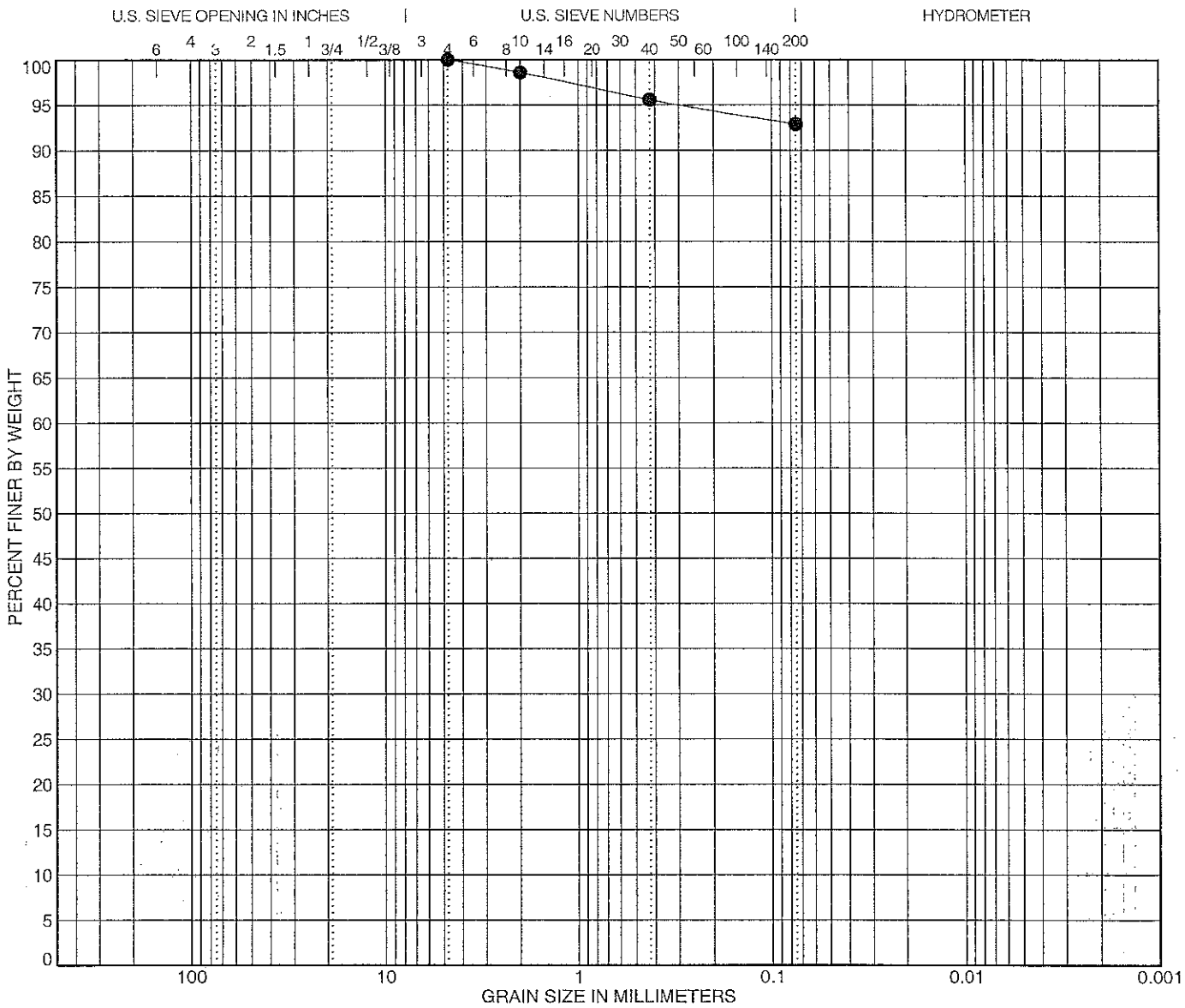
EXHIBIT b



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B74**	**16.0**	**FAT CLAY(CH)**	**96**	**35**	**61**		

D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
4.75				**0.0**	**7.1**	**92.9**	

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		**98.6**				**95.6**					**92.9**

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
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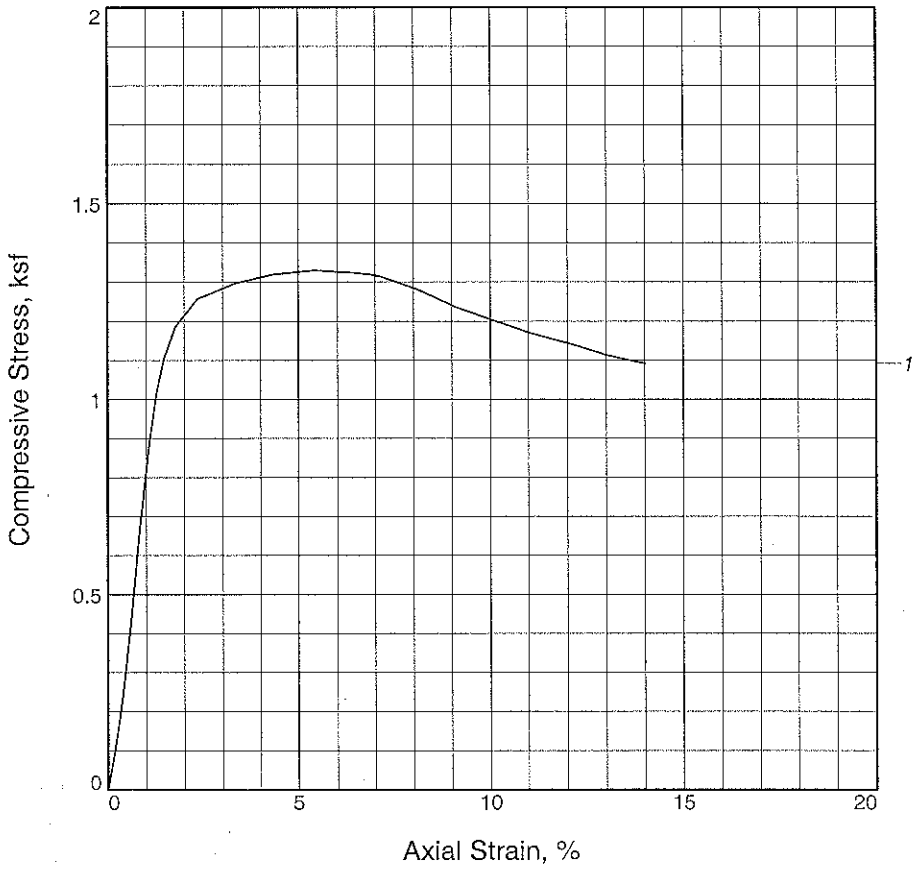
EXHIBIT C

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	1.330			
Undrained shear strength, ksf	0.665			
Failure strain, %	5.4			
Strain rate, in./min.	0.055			
Water content, %	44.8			
Wet density, pcf	114.8			
Dry density, pcf	79.2			
Saturation, %	105.7			
Void ratio	1.1667			
Specimen diameter, in.	2.708			
Specimen height, in.	5.592			
Height/diameter ratio	2.06			

Description: 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-B74

Sample Number: 6 **Depth:** 10-12 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-B74
Depth: 10-12 ft. **Sample Number:** 6
Description: 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.	118.410
Moisture content: Dry soil+tare, gms.	97.130
Moisture content: Tare, gms.	49.660
Moisture, %	44.8
Moist specimen weight, gms.	970.17
Diameter, in.	2.708
Area, in.^{2}	5.760
Height, in.	5.592
Wet density, pcf	114.8
Dry density, pcf	79.2
Void ratio	1.1667
Saturation, %	105.7

Test Readings for Specimen No. 1

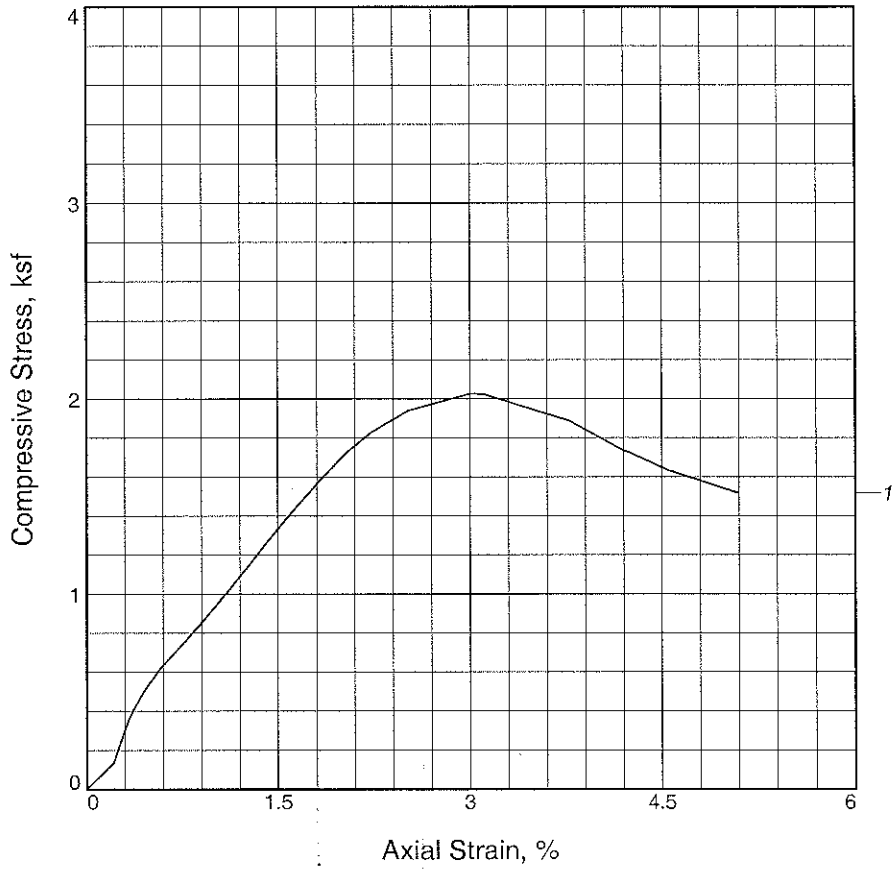
Strain rate, in./min. = 0.055
Unconfined compressive strength = 1.330 ksf **at reading no.** 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0011	0.399	0.4	0.0	0.010
2	0.0096	3.718	3.7	0.2	0.093
3	0.0162	6.906	6.9	0.3	0.172
4	0.0219	9.916	9.9	0.4	0.247
5	0.0271	13.312	13.3	0.5	0.331
6	0.0327	16.866	16.9	0.6	0.419
7	0.0370	20.032	20.0	0.7	0.498
8	0.0422	23.839	23.8	0.8	0.592
9	0.0464	26.887	26.9	0.8	0.667
10	0.0507	29.738	29.7	0.9	0.737
11	0.0602	35.702	35.7	1.1	0.883
12	0.0710	41.034	41.0	1.3	1.013
13	0.0824	44.883	44.9	1.5	1.106
14	0.0989	48.270	48.3	1.8	1.186
15	0.1315	51.482	51.5	2.4	1.257

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.1868	53.660	53.7	3.3	1.297
17	0.2417	55.143	55.1	4.3	1.319
18	0.3022	56.216	56.2	5.4	1.330
19	0.3575	56.559	56.6	6.4	1.324
20	0.3849	56.665	56.7	6.9	1.319
21	0.3986	56.610	56.6	7.1	1.314
22	0.4534	55.739	55.7	8.1	1.281
23	0.5087	54.407	54.4	9.1	1.237
24	0.5636	53.485	53.5	10.1	1.202
25	0.6184	52.596	52.6	11.1	1.170
26	0.6737	51.986	52.0	12.0	1.143
27	0.7286	51.179	51.2	13.0	1.113
28	0.7834	50.792	50.8	14.0	1.092

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	2.027			
Undrained shear strength, ksf	1.013			
Failure strain, %	3.0			
Strain rate, in./min.	0.055			
Water content, %	45.5			
Wet density, pcf	112.8			
Dry density, pcf	77.5			
Saturation, %	103.1			
Void ratio	1.2148			
Specimen diameter, in.	2.711			
Specimen height, in.	5.673			
Height/diameter ratio	2.09			

Description: Dark brown and 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-B74

Sample Number: 9 **Depth:** 16-18 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-B74
Depth: 16-18 ft. **Sample Number:** 9
Description: Dark brown and 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.	112.130
Moisture content: Dry soil+tare, gms.	92.880
Moisture content: Tare, gms.	50.610
Moisture, %	45.5
Moist specimen weight, gms.	969.72
Diameter, in.	2.711
Area, in.^{2}	5.772
Height, in.	5.673
Wet density, pcf	112.8
Dry density, pcf	77.5
Void ratio	1.2148
Saturation, %	103.1

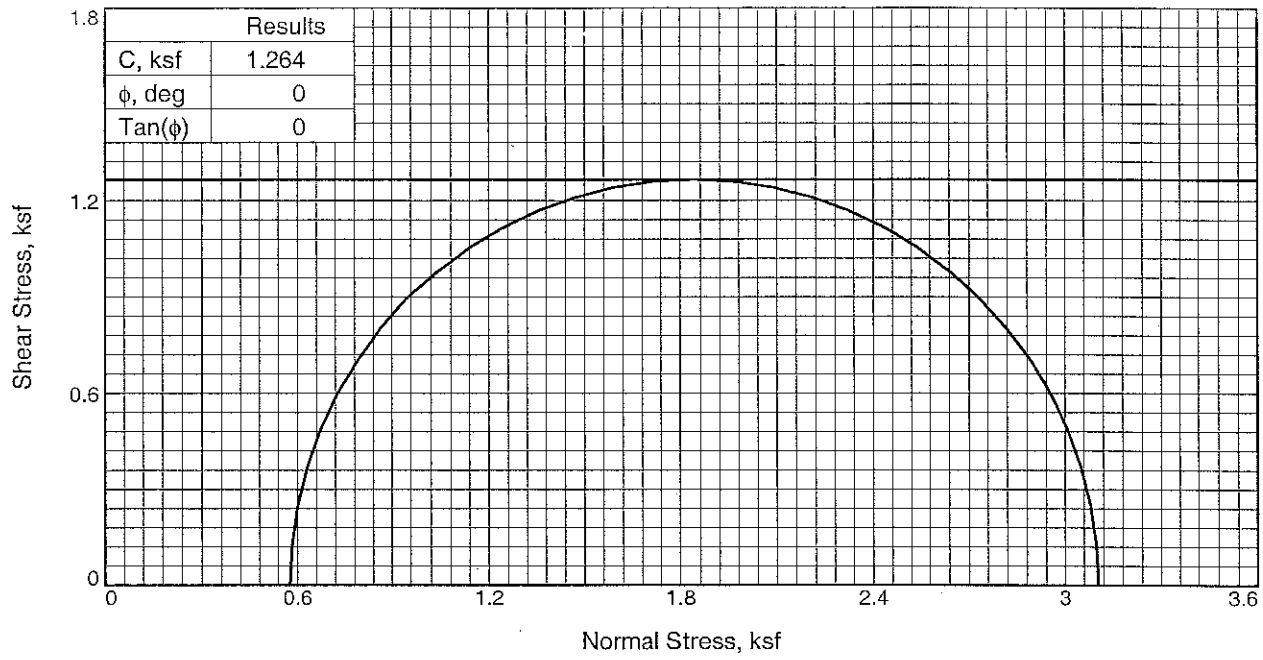
Test Readings for Specimen No. 1

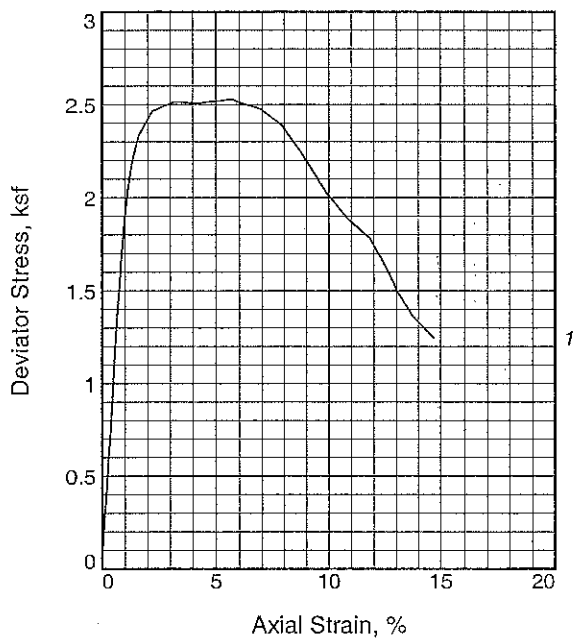
Strain rate, in./min. = 0.055
Unconfined compressive strength = 2.027 ksf **at reading no.** 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0000	0.105	0.1	0.0	0.003
2	0.0119	5.436	5.4	0.2	0.135
3	0.0162	11.279	11.3	0.3	0.281
4	0.0205	16.187	16.2	0.4	0.402
5	0.0261	20.612	20.6	0.5	0.512
6	0.0327	24.947	24.9	0.6	0.619
7	0.0413	29.220	29.2	0.7	0.724
8	0.0493	33.438	33.4	0.9	0.827
9	0.0602	39.735	39.7	1.1	0.981
10	0.0715	46.183	46.2	1.3	1.138
11	0.0824	52.622	52.6	1.5	1.294
12	0.0932	59.031	59.0	1.6	1.448
13	0.1041	65.010	65.0	1.8	1.592
14	0.1155	70.536	70.5	2.0	1.724
15	0.1263	74.933	74.9	2.2	1.828

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.1429	79.736	79.7	2.5	1.939
17	0.1703	83.765	83.8	3.0	2.027
18	0.1760	83.757	83.8	3.1	2.025
19	0.2143	78.598	78.6	3.8	1.887
20	0.2365	72.993	73.0	4.2	1.745
21	0.2582	68.644	68.6	4.6	1.634
22	0.2885	64.149	64.1	5.1	1.519





Sample No.		1
Initial	Water Content, %	28.9
	Dry Density, pcf	93.2
	Saturation, %	94.4
	Void Ratio	0.8417
	Diameter, in.	2.714
	Height, in.	5.618
At Test	Water Content, %	28.9
	Dry Density, pcf	93.2
	Saturation, %	94.4
	Void Ratio	0.8417
	Diameter, in.	2.714
	Height, in.	5.618
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		4.000
Fail. Stress, ksf		2.529
Ult. Stress, ksf		
σ_1 Failure, ksf		3.105
σ_3 Failure, ksf		0.576

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed

Description: Dark gray and tan 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-B74

Sample Number: 3 **Depth:** 4-6 ft.

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

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/5/2010
11:51 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-B74
Depth: 4-6 ft. **Sample Number:** 3
Description: Dark gray and tan Fat Clay
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.	153.240	153.240
Moisture content: Dry soil+tare, gms.	130.130	130.130
Moisture content: Tare, gms.	50.170	50.170
Moisture, %	28.9	28.9
Moist specimen weight, gms.	1025.10	
Diameter, in.	2.714	
Area, in.^{2}	5.785	
Height, in.	5.618	
Wet density, pcf	120.2	
Dry density, pcf	93.2	
Void ratio	0.8417	
Saturation, %	94.4	

Test Readings for Specimen No. 1

Cell pressure = 4.000 psi (0.576 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 2.529 ksf **at reading no.** 20

Test Results for Specimen No. 3

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	0.066	0.0	0.0	0.000	0.576	0.576	1.00	0.576	0.000
1	0.0010	4.523	4.5	0.0	0.111	0.576	0.687	1.19	0.631	0.055
2	0.0052	10.609	10.5	0.1	0.262	0.576	0.838	1.46	0.707	0.131
3	0.0113	16.962	16.9	0.2	0.420	0.576	0.996	1.73	0.786	0.210
4	0.0167	24.504	24.4	0.3	0.606	0.576	1.182	2.05	0.879	0.303
5	0.0209	30.289	30.2	0.4	0.750	0.576	1.326	2.30	0.951	0.375
6	0.0251	37.041	37.0	0.4	0.916	0.576	1.492	2.59	1.034	0.458
7	0.0293	43.762	43.7	0.5	1.082	0.576	1.658	2.88	1.117	0.541
8	0.0335	50.061	50.0	0.6	1.237	0.576	1.813	3.15	1.195	0.619
9	0.0383	56.241	56.2	0.7	1.389	0.576	1.965	3.41	1.270	0.694
10	0.0424	62.009	61.9	0.8	1.530	0.576	2.106	3.66	1.341	0.765
11	0.0466	67.754	67.7	0.8	1.671	0.576	2.247	3.90	1.411	0.835
12	0.0524	73.738	73.7	0.9	1.817	0.576	2.393	4.15	1.484	0.908
13	0.0623	82.842	82.8	1.1	2.038	0.576	2.614	4.54	1.595	1.019
14	0.0734	89.384	89.3	1.3	2.194	0.576	2.770	4.81	1.673	1.097
15	0.0903	95.409	95.3	1.6	2.335	0.576	2.911	5.05	1.744	1.168
16	0.1235	101.298	101.2	2.2	2.464	0.576	3.040	5.28	1.808	1.232
17	0.1790	104.424	104.4	3.2	2.515	0.576	3.091	5.37	1.833	1.257
18	0.2344	105.249	105.2	4.2	2.509	0.576	3.085	5.36	1.830	1.254
19	0.2922	106.911	106.8	5.2	2.521	0.576	3.097	5.38	1.837	1.261
20	0.3196	107.790	107.7	5.7	2.529	0.576	3.105	5.39	1.840	1.264
21	0.3336	107.411	107.3	5.9	2.513	0.576	3.089	5.36	1.833	1.257
22	0.3887	107.033	107.0	6.9	2.478	0.576	3.054	5.30	1.815	1.239
23	0.4439	104.262	104.2	7.9	2.389	0.576	2.965	5.15	1.770	1.194
24	0.4989	97.936	97.9	8.9	2.220	0.576	2.796	4.85	1.686	1.110
25	0.5539	90.624	90.6	9.9	2.032	0.576	2.608	4.53	1.592	1.016
26	0.6089	85.166	85.1	10.8	1.889	0.576	2.465	4.28	1.520	0.944
27	0.6639	81.307	81.2	11.8	1.783	0.576	2.359	4.10	1.468	0.892
28	0.7053	74.458	74.4	12.6	1.619	0.576	2.195	3.81	1.386	0.810
29	0.7328	69.055	69.0	13.0	1.493	0.576	2.069	3.59	1.323	0.747
30	0.7738	63.418	63.4	13.8	1.360	0.576	1.936	3.36	1.256	0.680
31	0.8263	58.806	58.7	14.7	1.247	0.576	1.823	3.17	1.200	0.624

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																						