BORING LOG NO. 10-B20

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	Galveston Channel Deepening, TO-0010
BORING LOCATION:	N: 13687273.9 E: 3317970.75	SITE:	San Jacinto Placement Area Galveston, Texas

Approx. Surface Elevation: 11.3 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
	FILL: LEAN CLAY w/ SAND brownish gray, with sand pockets and roots, stiff	1	CL	ST	5		1.0		30								
	9.3 / 2.0	2															
	FILL: FAT CLAY ligfht brownish gray and bluish gray, soft to very soft	3	CH	ST	22		0.5	0.25			100	32	68	99			
		4															
		5		ST	15		0.0	0.1	69								
		6															
		7		ST	19		0.0	0.1	96								
		8															
		9		ST	19		0.0	0.1	82								
		10															
		11		ST	21		0.0	0.1	59		105	30	75	93			
		12															
		13		SS	15	0			73								
		14															
		15		ST	16		0.0	0.05	52								
	-4.7 / 16.0	16															
	FILL: CLAYEY SAND bluish gray, with clay and silt layers, loose	17	SC	SS	20	22			42					49			
	-5.7 / 17.0	18	SP-SM														
	POORLY GRADED SAND w/ SILT bluish gray, with traces of finely broken shell, fine, slightly cohesive, medium dense	19		SS	16	22			26					7			
		20															
		21		SS	15	22			26								
		22															
		23		SS	11	19			36								
		24															
	-13.7 / 25.0	25		SS	9	4			26					8			
	Boring terminated at 25 feet.																

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

REMARKS: **Dry auger to 6 feet; wet rotary thereafter.**

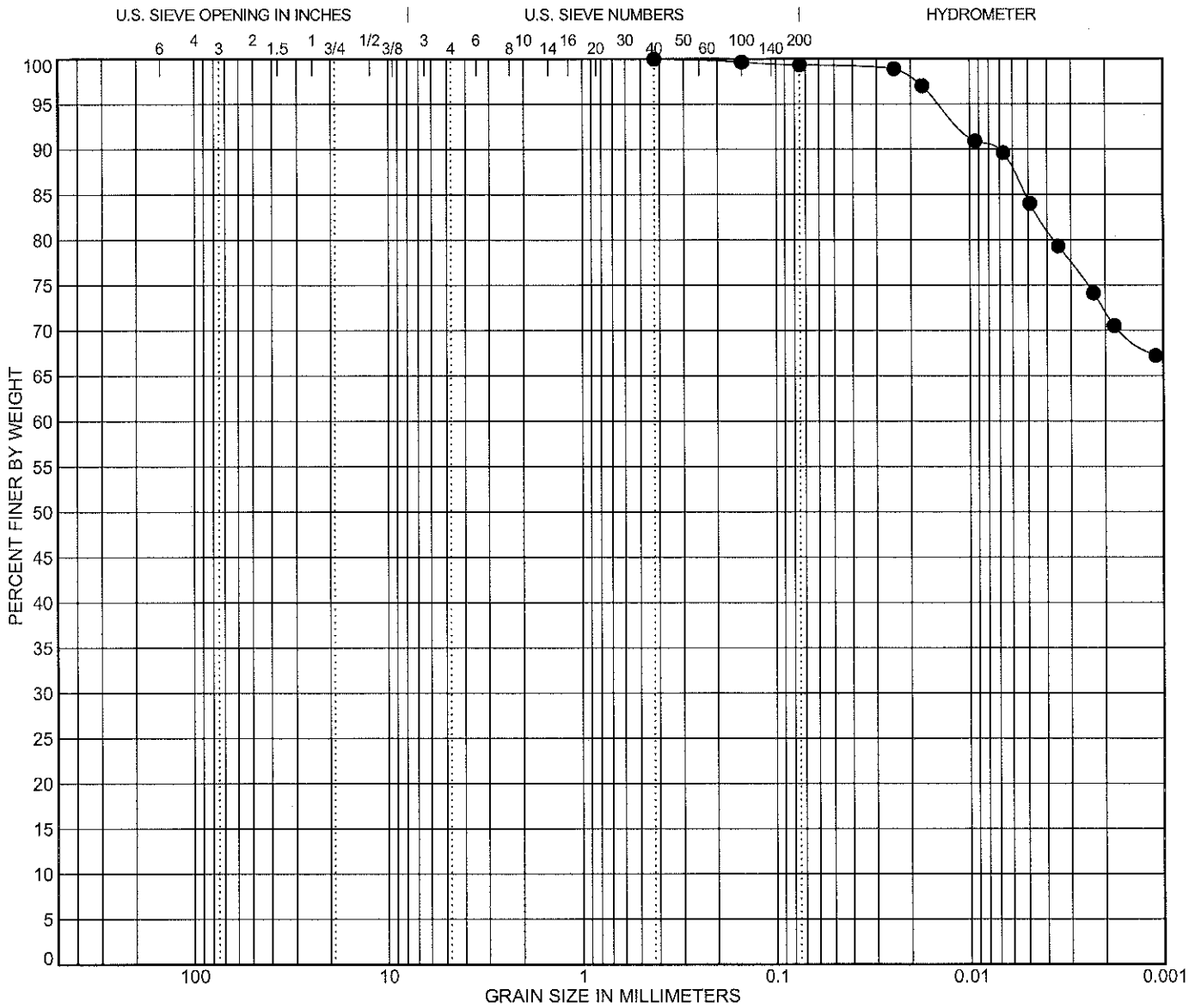
WATER LEVEL OBSERVATIONS			
▽ 5 ft	WS	▼ 2.5 ft	at 5 min
▼ 1.5 ft	at 10 min	▼ 1.5 ft	at 15 min

Terracon

DATE DRILLED	4/13/2010
PROJECT NUMBER	92105154

10-B20

EXHIBIT A-20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **10-B20**	**2.0**	**FAT CLAY(CH)**	**100**	**32**	**68**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **10-B20**	**2.0**				**100**	**99.6**	**99.3**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **10-B20**	**2.0**	**0.425**				**0.0**	**0.6**	**27.3**	**72.0**

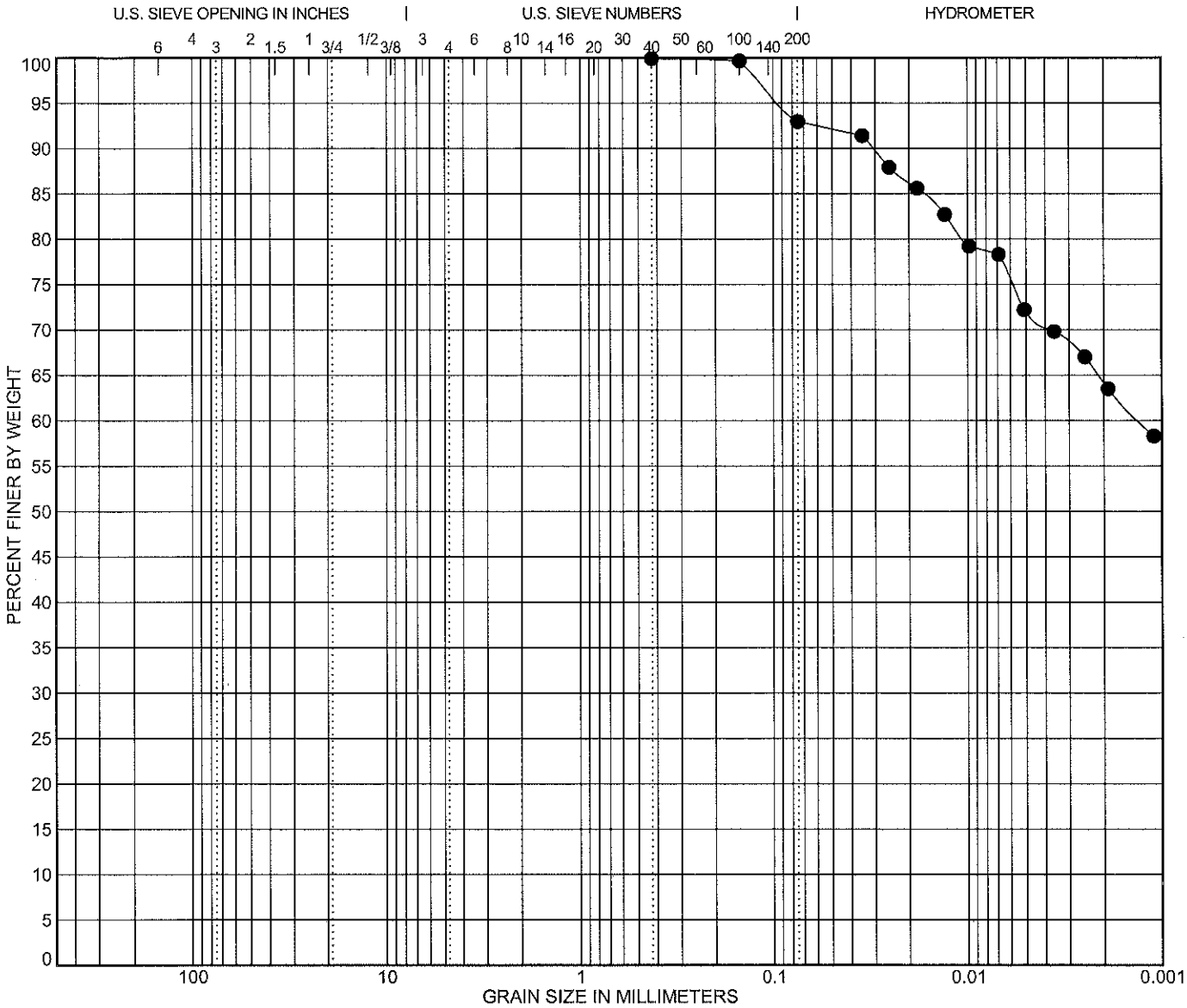
GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

Terracon

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

SPECIMEN ID
10-B20, 2.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**10-B20**	**10.0**	**FAT CLAY(CH)**	**105**	**30**	**75**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**10-B20**	**10.0**				**99.9**	**99.7**	**93**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**10-B20**	**10.0**	**0.425**				**0.0**	**6.9**	**28.8**	**64.2**

GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

Terracon

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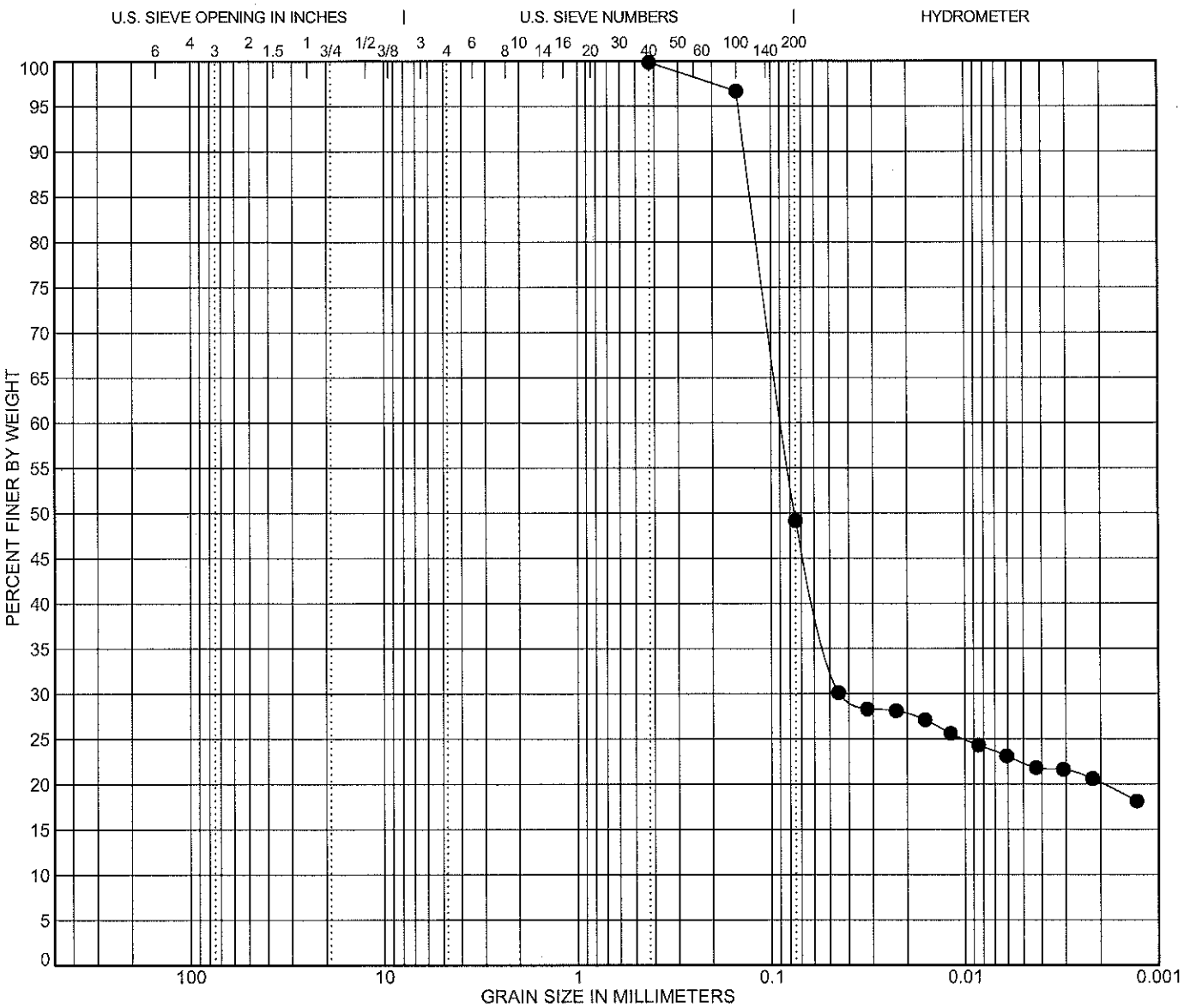
Telephone: 713-690-8989
Fax: 713-690-8787

SPECIMEN ID
10-B20, 10.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **10-B20**	**16.5**						

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **10-B20**	**16.5**				**99.9**	**96.7**	**49.1**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **10-B20**	**16.5**	**0.425**	**0.076**	**0.044**		**0.0**	**50.7**	**29.0**	**20.1**

GRAIN SIZE DISTRIBUTION

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Project Number 92105154

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Houston, Texas 77043
Telephone: 713-690-8989
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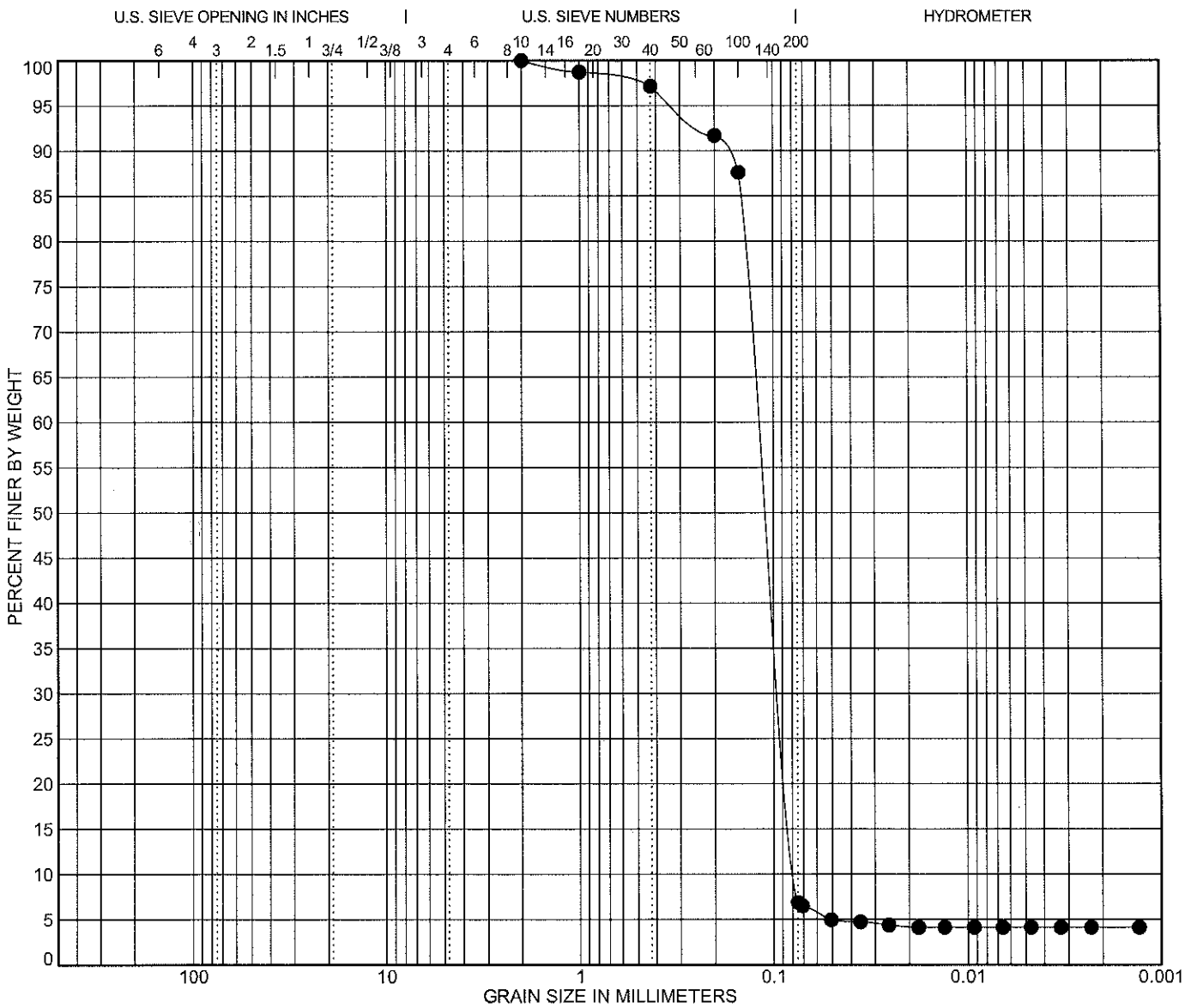
SPECIMEN ID
10-B20, 16.5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **10-B20**	**18.5**					**0.92**	**1.54**

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **10-B20**	**18.5**			**100**	**97.1**	**87.6**	**6.9**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **10-B20**	**18.5**	**2**	**0.109**	**0.091**	**0.077**	**0.0**	**93.1**	**2.7**	**4.1**

GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

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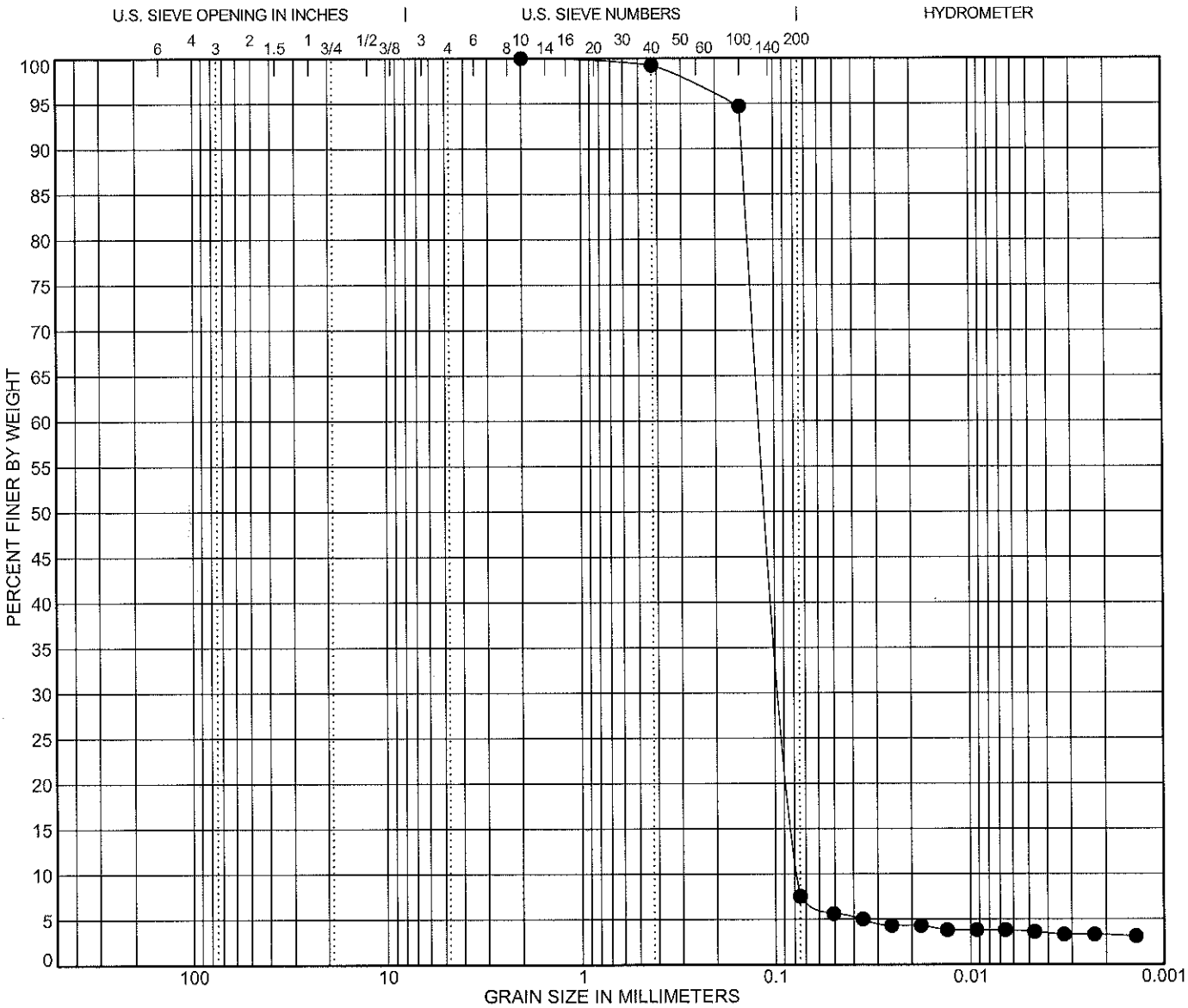
SPECIMEN ID
10-B20, 18.5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **10-B20**	**24.5**					**0.92**	**1.49**

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● **10-B20**	**24.5**			**100**	**99.2**	**94.7**	**7.5**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **10-B20**	**24.5**	**2**	**0.105**	**0.09**	**0.076**	**0.0**	**92.5**	**4.3**	**3.2**

GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

Terracon

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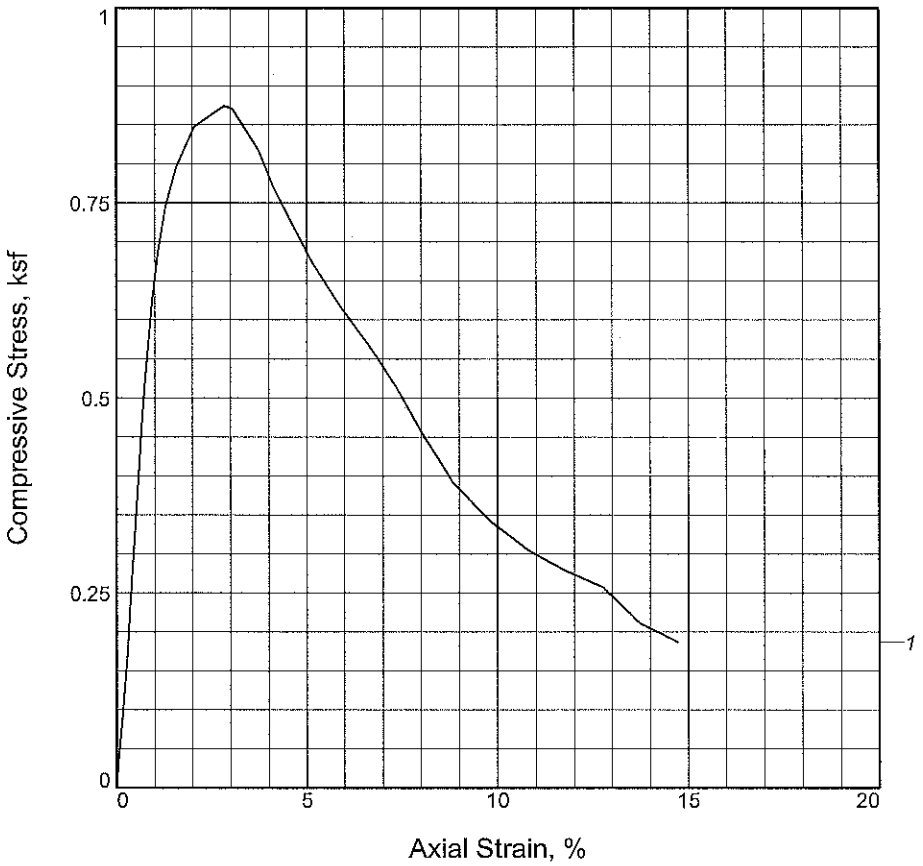
Houston, Texas 77043
Telephone: 713-690-8989
Fax: 713-690-8787

SPECIMEN ID
10-B20, 24.5

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.874			
Undrained shear strength, ksf	0.437			
Failure strain, %	2.8			
Strain rate, in./min.	0.055			
Water content, %	56.9			
Wet density, pcf	104.1			
Dry density, pcf	66.4			
Saturation, %	98.6			
Void ratio	1.5868			
Specimen diameter, in.	2.803			
Specimen height, in.	5.914			
Height/diameter ratio	2.11			

Description: Gray Fat Clay

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

Project No.: 92105154

Date Sampled:

Remarks:
ASTM D2166

Client: USACE

Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010

Location: 10-B20

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

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

7/22/2010

Date:
Client: USACE
Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Project No.: 92105154
Location: 10-B20
Depth: 2-4 ft. **Sample Number:** 2
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.	142.890
Moisture content: Dry soil+tare, gms.	112.160
Moisture content: Tare, gms.	58.140
Moisture, %	56.9
Moist specimen weight, gms.	997.40
Diameter, in.	2.803
Area, in.^{2}	6.171
Height, in.	5.914
Wet density, pcf	104.1
Dry density, pcf	66.4
Void ratio	1.5868
Saturation, %	98.6

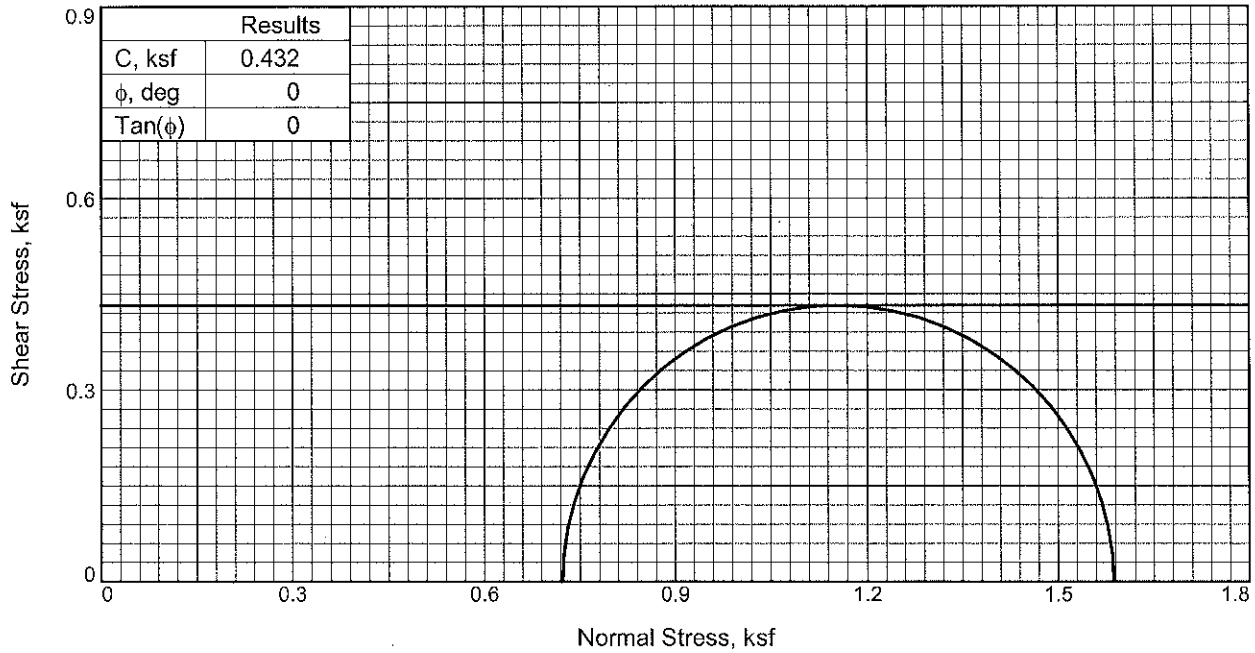
Test Readings for Specimen No. 1

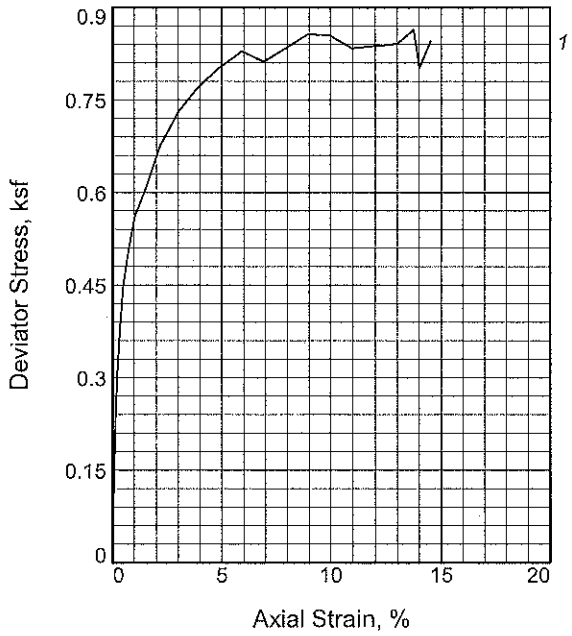
Strain rate, in./min. = 0.055
Unconfined compressive strength = 0.874 ksf **at reading no.** 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0020	0.900	0.9	0.0	0.021
2	0.0025	1.259	1.3	0.0	0.029
3	0.0085	3.552	3.6	0.1	0.083
4	0.0130	5.518	5.5	0.2	0.128
5	0.0175	7.620	7.6	0.3	0.177
6	0.0214	10.222	10.2	0.4	0.238
7	0.0259	12.744	12.7	0.4	0.296
8	0.0304	15.177	15.2	0.5	0.352
9	0.0349	17.663	17.7	0.6	0.410
10	0.0389	20.034	20.0	0.7	0.464
11	0.0434	22.265	22.3	0.7	0.516
12	0.0494	24.715	24.7	0.8	0.572
13	0.0548	27.011	27.0	0.9	0.624
14	0.0638	29.671	29.7	1.1	0.685
15	0.0753	32.274	32.3	1.3	0.744

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.0927	34.656	34.7	1.6	0.796
17	0.1216	37.096	37.1	2.1	0.848
18	0.1680	38.561	38.6	2.8	0.874
19	0.1800	38.524	38.5	3.0	0.872
20	0.2203	36.400	36.4	3.7	0.818
21	0.2438	34.463	34.5	4.1	0.771
22	0.2727	32.526	32.5	4.6	0.724
23	0.3046	30.420	30.4	5.2	0.673
24	0.3479	28.151	28.2	5.9	0.618
25	0.3913	26.110	26.1	6.6	0.569
26	0.4352	23.779	23.8	7.4	0.514
27	0.4785	20.950	21.0	8.1	0.449
28	0.5219	18.443	18.4	8.8	0.392
29	0.5797	16.277	16.3	9.8	0.343
30	0.6381	14.665	14.7	10.8	0.305
31	0.6959	13.521	13.5	11.8	0.278
32	0.7542	12.628	12.6	12.8	0.257
33	0.8120	10.493	10.5	13.7	0.211
34	0.8704	9.406	9.4	14.7	0.187





Sample No.		1
Initial	Water Content, %	58.6
	Dry Density, pcf	66.7
	Saturation, %	101.7
	Void Ratio	1.6015
	Diameter, in.	2.878
	Height, in.	5.829
At Test	Water Content, %	58.6
	Dry Density, pcf	66.7
	Saturation, %	101.7
	Void Ratio	1.6015
	Diameter, in.	2.878
	Height, in.	5.829
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		5.020
Fail. Stress, ksf		0.864
Ult. Stress, ksf		
σ_1 Failure, ksf		1.587
σ_3 Failure, ksf		0.723

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

Assumed Specific Gravity= 2.78
Remarks: ASTM D2850

Client: USACE

Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Location: 10-B20
Sample Number: 6 **Depth:** 10-12 ft.
Proj. No.: 92105154 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

7/20/2010
2:59 PM

Date:
Client: USACE
Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Project No.: 92105154
Location: 10-B20
Depth: 10-12 ft. **Sample Number:** 6
Description: Gray Fat Clay
Remarks: ASTM D2850
Type of Sample: Undisturbed
Assumed Specific Gravity=2.78 **LL=** **PL=** **PI=**
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	158.910	158.910
Moisture content: Dry soil+tare, gms.	118.630	118.630
Moisture content: Tare, gms.	49.870	49.870
Moisture, %	58.6	58.6
Moist specimen weight, gms.	1053.01	
Diameter, in.	2.878	
Area, in.^{2}	6.505	
Height, in.	5.829	
Wet density, pcf	105.8	
Dry density, pcf	66.7	
Void ratio	1.6015	
Saturation, %	101.7	

Test Readings for Specimen No. 1

Cell pressure = 5.020 psi (0.723 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 0.864 ksf **at reading no.** 23

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	1.730	0.0	0.0	0.000	0.723	0.723	1.00	0.723	0.000
1	0.0015	3.567	1.8	0.0	0.041	0.723	0.764	1.06	0.743	0.020
2	0.0028	6.335	4.6	0.0	0.102	0.723	0.825	1.14	0.774	0.051
3	0.0059	10.199	8.5	0.1	0.187	0.723	0.910	1.26	0.817	0.094
4	0.0090	12.762	11.0	0.2	0.244	0.723	0.967	1.34	0.845	0.122
5	0.0135	15.649	13.9	0.2	0.307	0.723	1.030	1.43	0.877	0.154
6	0.0198	18.817	17.1	0.3	0.377	0.723	1.100	1.52	0.911	0.188
7	0.0293	22.111	20.4	0.5	0.449	0.723	1.172	1.62	0.947	0.224
8	0.0429	24.735	23.0	0.7	0.505	0.723	1.228	1.70	0.976	0.253
9	0.0600	27.344	25.6	1.0	0.561	0.723	1.284	1.78	1.003	0.281
10	0.0913	29.722	28.0	1.6	0.610	0.723	1.333	1.84	1.028	0.305
11	0.1270	32.956	31.2	2.2	0.676	0.723	1.399	1.94	1.061	0.338
12	0.1746	35.747	34.0	3.0	0.730	0.723	1.453	2.01	1.088	0.365
13	0.2286	37.944	36.2	3.9	0.770	0.723	1.493	2.07	1.108	0.385
14	0.2818	39.738	38.0	4.8	0.801	0.723	1.524	2.11	1.123	0.400
15	0.3439	41.531	39.8	5.9	0.829	0.723	1.552	2.15	1.137	0.415
16	0.4029	41.141	39.4	6.9	0.812	0.723	1.535	2.12	1.129	0.406
17	0.4619	42.649	40.9	7.9	0.834	0.723	1.557	2.15	1.140	0.417
18	0.5209	44.235	42.5	8.9	0.857	0.723	1.580	2.19	1.151	0.428
19	0.5800	44.620	42.9	9.9	0.855	0.723	1.578	2.18	1.150	0.427
20	0.6390	44.037	42.3	11.0	0.834	0.723	1.557	2.15	1.140	0.417
21	0.6986	44.723	43.0	12.0	0.838	0.723	1.561	2.16	1.142	0.419
22	0.7577	45.411	43.7	13.0	0.841	0.723	1.564	2.16	1.143	0.421
23	0.8016	46.985	45.3	13.8	0.864	0.723	1.587	2.20	1.155	0.432
24	0.8168	43.879	42.1	14.0	0.802	0.723	1.525	2.11	1.124	0.401
25	0.8463	46.400	44.7	14.5	0.845	0.723	1.568	2.17	1.145	0.423

SUMMARY TABLE OF LABORATORY TEST DATA

Project name: TO-0010 Galveston Channel Deepening | Client: USACE, Galveston District | Terracon Project # : 92105154

Boring	Depth	Field tests			Atterberg Limits			Grain size Analysis										USCS Symbol	Wc	γd
								% by weight passing sieve					Soil Particle Content							
		PP	TV	SPTn	LL	PL	PI	4	10	40	100	200	gravel	sand	silt	clay	sieve 200			
	ft	tsf	tsf	bl/ft	%	%	%	%	%	%	%	%	%	%	%	%	%		%	pcf
10-B20	18.5-20			61				100	100	100	91	6	0	94	4	2		SP-SM*	25	
	20.5-22			72														SP-SM**	24	
	22.5-24			78														SP-SM**	26	
	24.5-26			21														SP-SM**	26	
	0-2	1.00																CL**	30	
	2-4	0.50	0.25		100	32	68	100	100	100	100	99	0	1	27	72		CH		
	4-6	0.00	0.10															CH**	69	
	6-8	0.00	0.10															CH**	96	
	8-10	0.00	0.10															CH**	82	
	10-12	0.00	0.10		105	30	75	100	100	100	100	93	0	7	29	64		CH	59	
	12.5-14			0														CH**	73	
	14-16	0.00	0.05															CH**	52	
	16.5-18			22				100	100	100	97	49	0	51	29	20		SC*	42	
	18.5-20			22				100	100	97	88	7	0	93	3	4		SP-SM*	26	
	20.5-22			22														SP-SM**	26	
	22.5-24			19														SP-SM**	36	
	24.5-26			4				100	100	99	95	8	0	92	5	3		SP-SM*	26	
10-B21	0-2	0.00	0.15															CH**	56	
	2-4	0.00	0.20		104	31	73	100	100	100	100	98	0	2			98	CH		
	4-6	0.00	0.10															CH**	68	
	6-8	0.00	0.10															CH**	67	
	8-10	0.00	0.10		111	30	81	100	100	100	99	95	0	5	36	59		CH		
	10-12	0.00	0.10		102	32	70	100	100	100	100	100	0	0	25	75		CH		
	12.5-14			3														CH**	48	
	14.5-16			32														SC**	26	
	16.5-18			18														SC**	33	
	18.5-20			32				100	98	97	92	18	0	82	6	12		SC*	35	
	20.5-22			32														SC**	33	
	22.5-24			25														SC**	34	
	24.5-26			18				100	100	96	92	16	0	84	6	10		SC*	31	

Strenght tests

Boring	Depth	Direct Shear Test					Unconfined Compression				UU Triaxial Test				CU Triaxial Test						
		C	φ	Wc	γd	Symbol	C	Wc	γd	Symbol	C	Wc	γd	Symbol	C	φ	c'	φ'	Wc	γd	Symbol
	ft	ksf	°	%	pcf		ksf	%	pcf		ksf	%	pcf		ksf	°	ksf	°	%	pcf	
10-B20	10-12										0.43	59	67	CH**							
10-B21	0-2																				
	2-4						0.27	57	67	CH**											
	8-10										0.12	65	62	CH**							

NOTES:

USCS Symbol - Classification based on laboratory test results.

USCS Symbol* - Classification based partially on laboratory test results together with visual description.

USCS Symbol** - Classification based only on visual descriptions.

b - Bag Sample.