# BORING LOG NO. 09-B94

| | | | |
|---|---|---|---|
| CLIENT: | USACE, Galveston District<br>Galveston, Texas | PROJECT: | TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I |
| BORING LOCATION: | N: 13826800<br>E: 3259879 | SITE: | Cedar Bayou PA6<br>Baytown, Texas |

**Approx. Surface Elevation: 11.0 feet**

| Graphic Log | DESCRIPTION | Elevation | Depth |
|---|---|---|---|
| | **FILL: FAT CLAY** dark gray and brown, very soft, very high plasticity, wet, with roots | 9.0 | 2.0 |
| | **FILL: FAT CLAY w/SAND** dark gray, soft, very high plasticity, moist | 7.0 | 4.0 |
| | **FILL: ORGANIC FAT CLAY** black, very soft, very high plasticity, wet, with organic matter odor | 6.0 | 5.0 |
| | **FILL: FAT CLAY w/SAND** gray, light gray and dark gray, high plasticity, wet, with sand seams and layers | 3.0 | 8.0 |
| | **FILL: LEAN CLAY w/SAND** gray and dark gray, very soft, very high plasticity, moist, with sand layers and seams | -2.0 | 13.0 |
| | **ORGANIC FAT CLAY** black, very soft, high plasticity, wet, with roots | -3.0 | 14.0 |
| | **LEAN CLAY w/ SAND** dark gray, soft to medium stiff, high plasticity, moist<br>- with roots 14 to 16 feet<br>- with ferrous nodules below 16 feet | -7.0 | 18.0 |
| | **FAT CLAY** light gray and light brown, very soft, very high plasticity, moist | -9.0 | 20.0 |

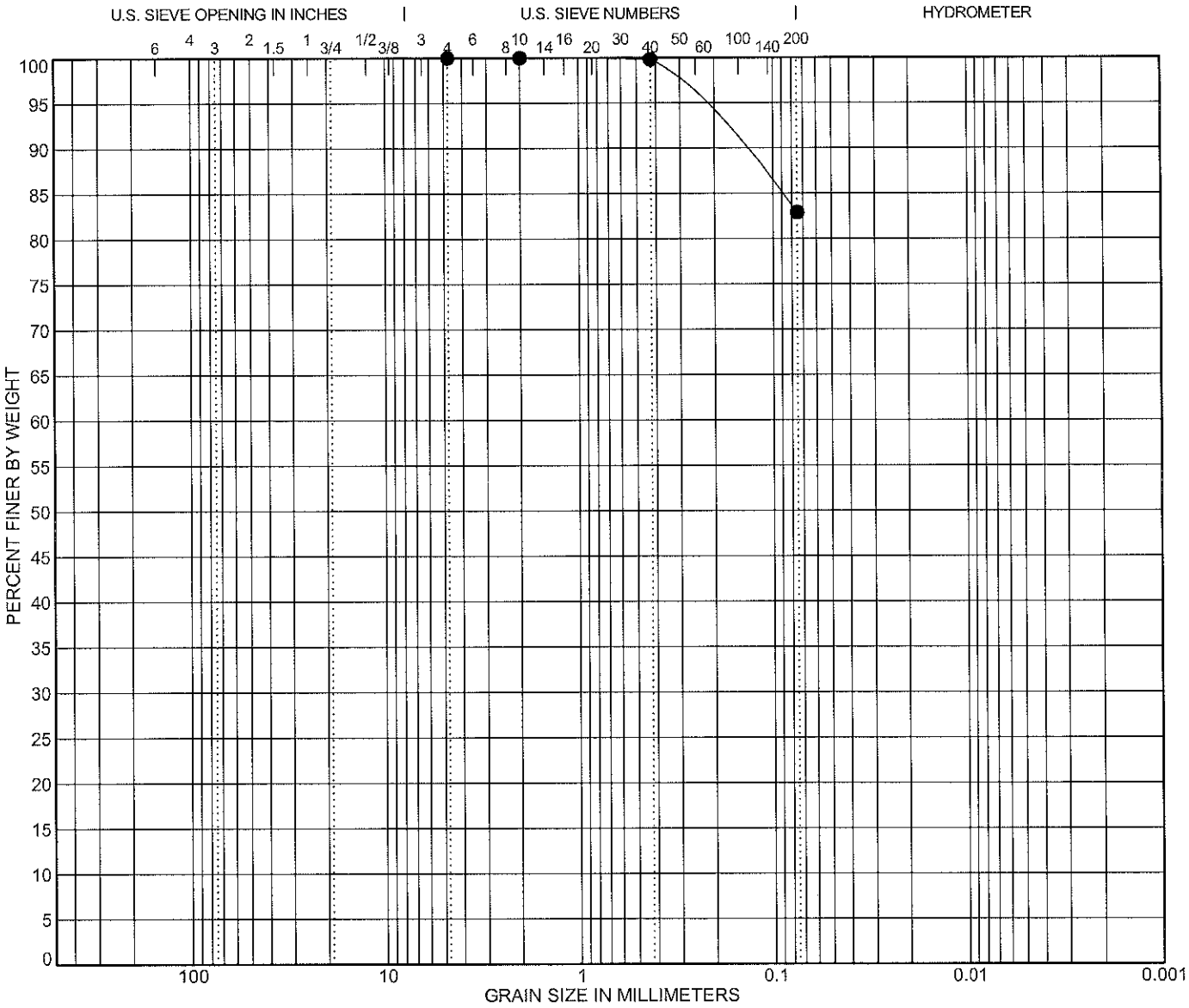
Boring terminated at 20 feet.

| 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 | 12 | | 0.0 | 0.3 | 60 | | | | | | | | |
| 2 | | | | | | | | | | | | | | | |
| 3 | CH | ST | 14 | | 0.25 | 0.05 | 45 | 78 | 62 | 21 | 41 | 83 | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | OH | ST | 22 | | 0.25 | 0.3 | 60 | | 113 | 33 | 80 | 99 | | | |
| 6 | CH | | | | | | | | | | | | | | |
| 7 | | ST | 11 | | 0.25 | 0.3 | 48 | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | CL | BS | 11 | | | | 39 | | | | | | | | |
| 10 | | | | | | | | | | | | | | | |
| 11 | | ST | 15 | | 0.25 | 0.05 | 39 | 83 | 48 | 18 | 30 | 85 | | | |
| 12 | | | | | | | | | | | | | | | |
| 13 | | ST | 18 | | 0.25 | 0.1 | 78 | | | | | | | | |
| 14 | OH | | | | | | | | | | | | | | |
| 15 | CL | ST | 12 | | 1.0 | | 26 | | | | | | | | |
| 16 | | | | | | | | | | | | | | | |
| 17 | | ST | 23 | | 0.5 | | 33 | | | | | | | | |
| 18 | | | | | | | | | | | | | | | |
| 19 | CH | ST | 19 | | 0.25 | 0.3 | 42 | | | | | | | | |
| 20 | | | | | | | | | | | | | | | |

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

REMARKS: Wet rotary from ground surface due to the presence of surface water ponded.

| WATER LEVEL OBSERVATIONS | | | | |
|---|---|---|---|---|
| | | Terracon | DATE DRILLED 3/18/2010 | Page 1 of 1 |
| | | | | 09-B94 |
| | | | PROJECT NUMBER 92105186-A | EXHIBIT A- |




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 09-B94 | 2.0 | **FAT CLAY with SAND(CH)** | **62** | **21** | **41** | | |

Percent Passing the Indicated Sieve

| Specimen Identification | | 3/8" | #4 | #10 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|
| ● 09-B94 | 2.0 | | **100** | **100** | **99.8** | | **82.9** |

| Specimen Identification | | D100 | D50 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● 09-B94 | 2.0 | **4.75** | | | | **0.0** | **17.1** | **82.9** | |

# GRAIN SIZE DISTRIBUTION

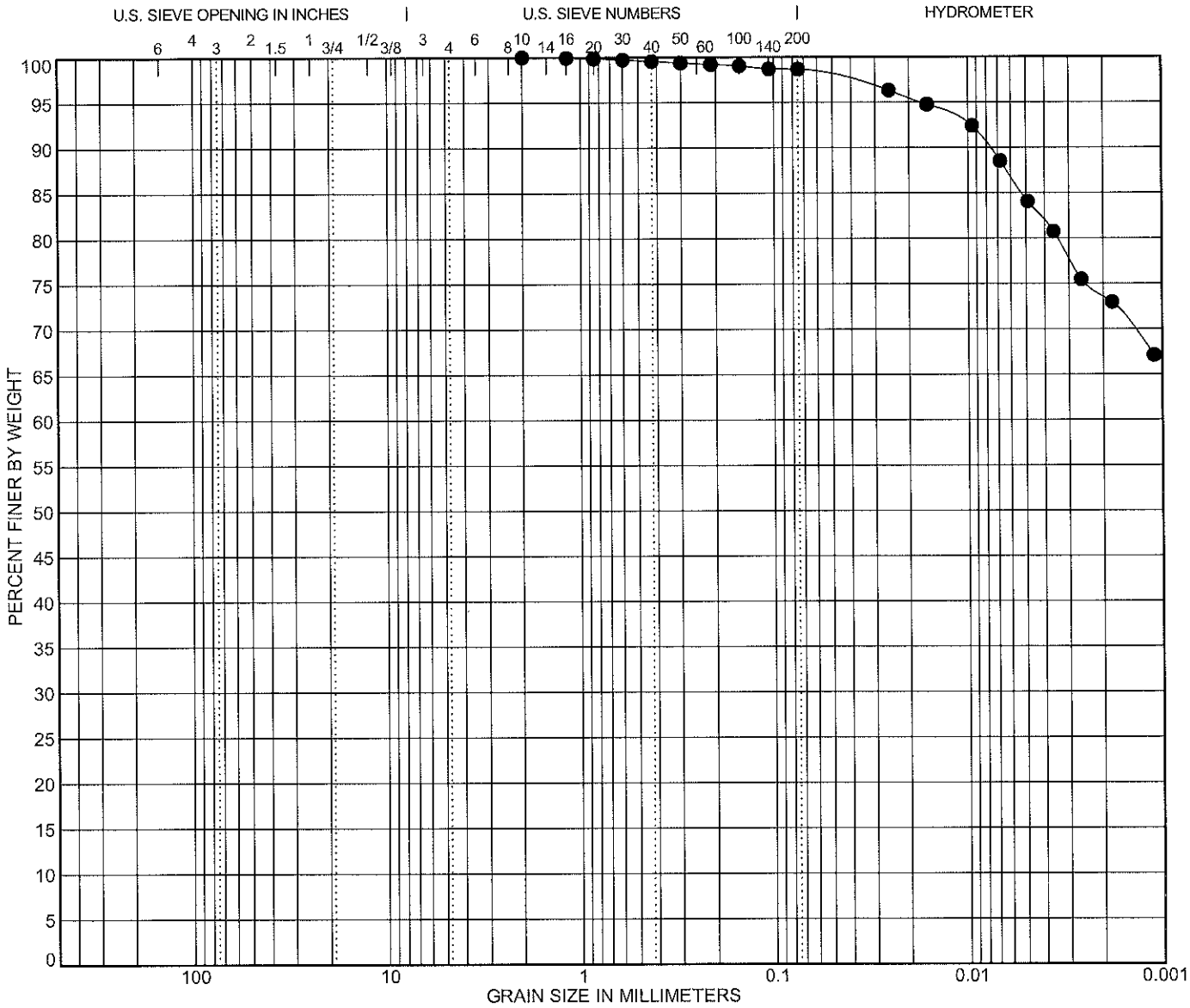
TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

Terracon

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



**EXHIBIT Ê**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● **09-B94** | **4.0** | **FAT CLAY(CH)** | **113** | **33** | **80** | | |

Percent Passing the Indicated Sieve

| Specimen Identification | | 3/8" | #4 | #10 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|
| ● **09-B94** | **4.0** | | | **100** | **99.5** | **99** | **98.7** |

| Specimen Identification | | D100 | D50 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● **09-B94** | **4.0** | **2** | | | | **0.0** | **1.3** | **25.0** | **73.7** |

# GRAIN SIZE DISTRIBUTION

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

Terracon

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11555 Clay Road, Suite 100
Houston, Texas 77043
Telephone: 713-690-8989
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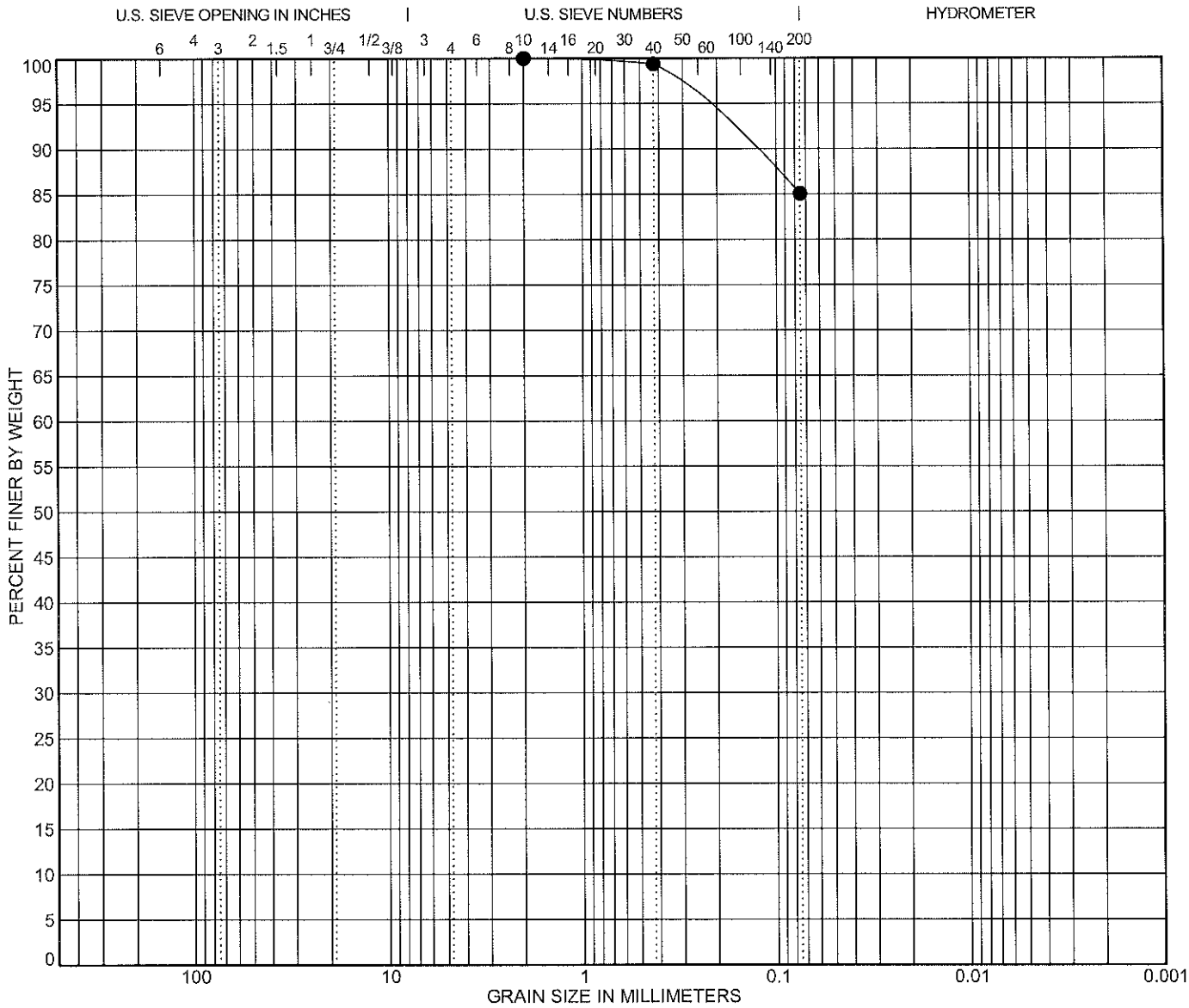
**EXHIBIT Ë**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● **09-B94** | **10.0** | **LEAN CLAY(CL)** | **48** | **18** | **30** | | |

Percent Passing the Indicated Sieve

| Specimen Identification | | 3/8" | #4 | #10 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|
| ● **09-B94** | **10.0** | | | **100** | **99.4** | | **85.1** |

| Specimen Identification | | D100 | D50 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● **09-B94** | **10.0** | **2** | | | | **0.0** | **14.9** | **85.1** | |

# GRAIN SIZE DISTRIBUTION

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Baytown, Texas
Project Number 92105186-A

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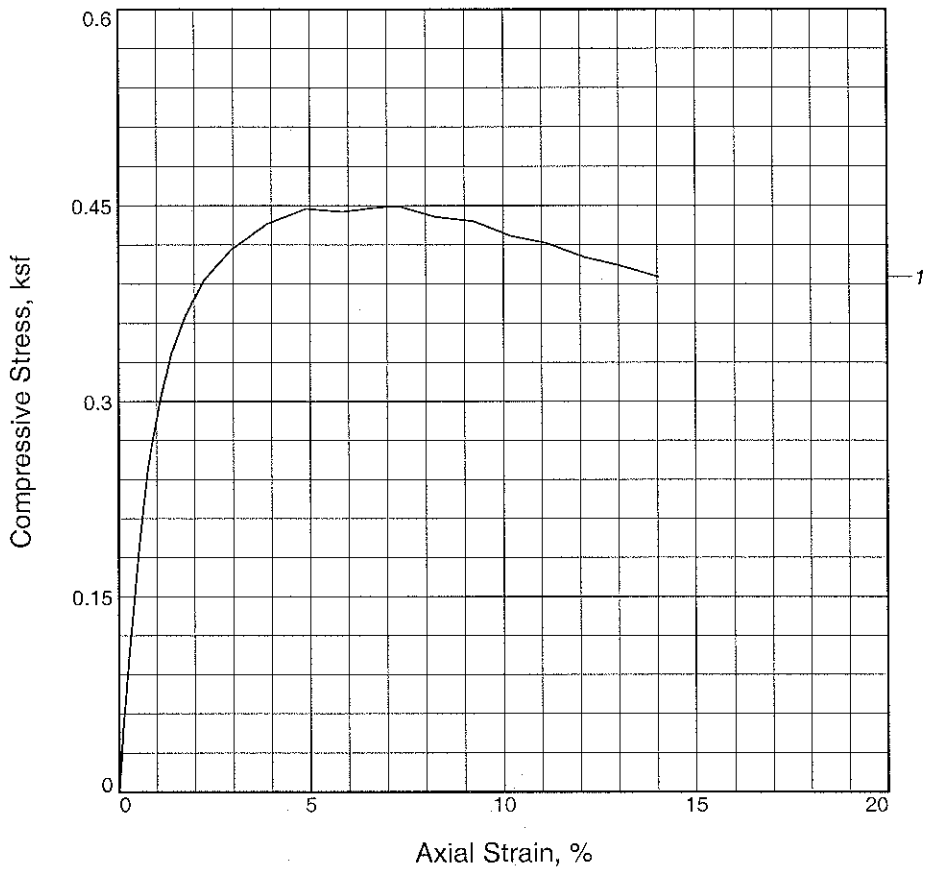
EXHIBIT
I

# UNCONFINED COMPRESSION TEST




| | | | | |
|---|---|---|---|---|
| Sample No. | 1 | | | |
| Unconfined strength, ksf | 0.449 | | | |
| Undrained shear strength, ksf | 0.225 | | | |
| Failure strain, % | 7.3 | | | |
| Strain rate, in./min. | 0.055 | | | |
| Water content, % | 44.5 | | | |
| Wet density, pcf | 112.4 | | | |
| Dry density, pcf | 77.8 | | | |
| Saturation, % | 101.4 | | | |
| Void ratio | 1.2063 | | | |
| Specimen diameter, in. | 2.688 | | | |
| Specimen height, in. | 5.726 | | | |
| Height/diameter ratio | 2.13 | | | |

**Description:** Dark 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-B94

**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-B94
**Depth:** 2-4 ft. **Sample Number:** 2
**Description:** Dark 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. | 159.890 |
| Moisture content: Dry soil+tare, gms. | 126.180 |
| Moisture content: Tare, gms. | 50.400 |
| Moisture, % | 44.5 |
| Moist specimen weight, gms. | 958.94 |
| Diameter, in. | 2.688 |
| Area, in.$^2$ | 5.675 |
| Height, in. | 5.726 |
| Wet density, pcf | 112.4 |
| Dry density, pcf | 77.8 |
| Void ratio | 1.2063 |
| Saturation, % | 101.4 |

## Test Readings for Specimen No. 1

**Strain rate, in./min. =** 0.055

**Unconfined compressive strength =** 0.449 ksf **at reading no.** 21

| No. | Def. Dial in. | Load Dial | Load lbs. | Strain % | Deviator Stress ksf |
|---|---|---|---|---|---|
| 0 | 0.0080 | 0.000 | 0.0 | 0.0 | 0.000 |
| 1 | 0.0090 | 0.300 | 0.3 | 0.0 | 0.008 |
| 2 | 0.0110 | 0.810 | 0.8 | 0.1 | 0.021 |
| 3 | 0.0138 | 1.891 | 1.9 | 0.1 | 0.048 |
| 4 | 0.0190 | 3.098 | 3.1 | 0.2 | 0.078 |
| 5 | 0.0232 | 4.158 | 4.2 | 0.3 | 0.105 |
| 6 | 0.0289 | 5.395 | 5.4 | 0.4 | 0.136 |
| 7 | 0.0341 | 6.583 | 6.6 | 0.5 | 0.166 |
| 8 | 0.0398 | 7.654 | 7.7 | 0.6 | 0.193 |
| 9 | 0.0450 | 8.669 | 8.7 | 0.6 | 0.219 |
| 10 | 0.0521 | 9.871 | 9.9 | 0.8 | 0.249 |
| 11 | 0.0601 | 10.833 | 10.8 | 0.9 | 0.272 |
| 12 | 0.0715 | 12.046 | 12.0 | 1.1 | 0.302 |
| 13 | 0.0880 | 13.448 | 13.4 | 1.4 | 0.336 |
| 14 | 0.1097 | 14.682 | 14.7 | 1.8 | 0.366 |
| 15 | 0.1372 | 15.860 | 15.9 | 2.3 | 0.393 |

## Test Readings for Specimen No. 1

| No. | Def. Dial in. | Load Dial | Load lbs. | Strain % | Deviator Stress ksf |
|---|---|---|---|---|---|
| 16 | 0.1759 | 16.880 | 16.9 | 2.9 | 0.416 |
| 17 | 0.2308 | 17.874 | 17.9 | 3.9 | 0.436 |
| 18 | 0.2884 | 18.542 | 18.5 | 4.9 | 0.447 |
| 19 | 0.3437 | 18.641 | 18.6 | 5.9 | 0.445 |
| 20 | 0.3986 | 18.978 | 19.0 | 6.8 | 0.449 |
| 21 | 0.4260 | 19.103 | 19.1 | 7.3 | 0.449 |
| 22 | 0.4813 | 18.959 | 19.0 | 8.3 | 0.441 |
| 23 | 0.5361 | 19.025 | 19.0 | 9.2 | 0.438 |
| 24 | 0.5909 | 18.726 | 18.7 | 10.2 | 0.427 |
| 25 | 0.6462 | 18.685 | 18.7 | 11.1 | 0.421 |
| 26 | 0.7011 | 18.410 | 18.4 | 12.1 | 0.411 |
| 27 | 0.7559 | 18.319 | 18.3 | 13.1 | 0.404 |
| 28 | 0.8112 | 18.130 | 18.1 | 14.0 | 0.396 |

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-B94 | 0-2 | 0.00 | 0.30 | | | | | | | | | | | | | | | | | | | CH** | 60 | | | | | | | | | | | | | | | | | | | | | | |
| | 2-4 | 0.25 | 0.05 | | 62 | 21 | 41 | | | 100 | | 100 | | | | 100 | | | | | 83 | CH | 45 | | | | | | | 0.2 | 45 | 78 | CH** | | | | | | | | | | | |
| | 4-6 | 0.25 | 0.30 | | 113 | 33 | 80 | | | | | 100 | | | | 100 | | | 99 | | 99 | OH | 60 | | | | | | | | | | | | | | | | | | | | | | |
| | 6-8 | 0.25 | 0.30 | | | | | | | | | | | | | | | | | | | CH** | 48 | | | | | | | | | | | | | | | | | | | | | | |
| | 8-10 | | | | | | | | | | | | | | | | | | | | | CL** | 39 | | | | | | | | | | | | | | | | | | | | | | |
| | 10-12 | 0.25 | 0.05 | | 48 | 18 | 30 | | | | | 100 | | | | 99 | | | | | 85 | CL | 39 | 83 | | | | | | | | | | | | | | | | | | | | | |
| | 12-14 | 0.25 | 0.10 | | | | | | | | | | | | | | | | | | | OH** | 78 | | | | | | | | | | | | | | | | | | | | | | |
| | 14-16 | 1.00 | | | | | | | | | | | | | | | | | | | | CL** | 26 | | | | | | | | | | | | | | | | | | | | | | |
| | 16-18 | 0.50 | | | | | | | | | | | | | | | | | | | | CL** | 33 | | | | | | | | | | | | | | | | | | | | | | |
| | 18-20 | 0.25 | 0.30 | | | | | | | | | | | | | | | | | | | CH** | 42 | | | | | | | | | | | | | | | | | | | | | | |
| 09-B95 | 0-2 | 0.25 | 0.20 | | 96 | 28 | 68 | | | | | 100 | | | | 100 | | | | | 95 | CH | 51 | | | | | | | 0.3 | 51 | 68 | CH** | | | | | | | | | | | |
| | 4-6 | 0.25 | 0.15 | | | | | | | | | | | | | | | | | | | CH** | 48 | | | | | | | | | | | | | | | | | | | | | | |
| | 6-8 | 0.25 | 0.30 | | | | | | | | | | | | | | | | | | | CH** | 31 | | | | | | | | | | | | | | | | | | | | | | |
| | 8-10 | 0.25 | 0.20 | | 51 | 18 | 33 | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 94 | 94 | CH | 54 | | | | | | | | | | | 0.5 | 54 | 71 | CH** | | | | | | | |
| | 10-12 | 0.25 | 0.05 | | | | | | | | | | | | | | | | | | | CH** | 47 | | | | | | | | | | | | | | | | | | | | | | |
| | 12-14 | 0.50 | | | | | | | | | | | | | | | | | | | | CH** | 35 | | | | | | | | | | | | | | | | | | | | | | |
| | 14-16 | 1.50 | | | | | | | | | | | | | | | | | | | | CH** | 30 | | | | | | | | | | | | | | | | | | | | | | |
| | 16-18 | 1.00 | | | 67 | 19 | 48 | | | | | 100 | | | | 100 | | | | | 97 | CH | 33 | | | | | | | 1.0 | 33 | 91 | CH** | | | | | | | | | | | |
| | 18-20 | 0.50 | | | | | | | | | | | | | | | | | | | | CH** | 35 | | | | | | | | | | | | | | | | | | | | | | |
| 09-B96 | 0-2 | 0.25 | 0.25 | | | | | | | | | | | | | | | | | | | CH** | 37 | | | | | | | | | | | | | | | | | | | | | | |
| | 2-4 | 0.75 | | | 83 | 23 | 60 | | | | | 100 | | | | 100 | | | | | 90 | CH | 41 | | | | | | | 0.8 | 41 | 84 | CH** | | | | | | | | | | | |
| | 4-6 | 0.50 | | | | | | | | | | | | | | | | | | | | CL-ML** | 55 | | | | | | | | | | | | | | | | | | | | | | |
| | 6-8 | | | | 26 | 20 | 6 | | | | | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 86 | 51 | 50 | CL-ML | 26 | | | | | | | | | | | | | | | | | | | | | | |
| | 10-12 | 0.50 | | | | | | | | | | | | | | | | | | | | CL** | 32 | | | | | | | | | | | | | | | | | | | | | | |
| | 12-14 | 0.75 | | | 55 | 18 | 37 | | | | | 100 | | | | 99 | | | | | 88 | CH | 25 | 97 | | | | | | | | | | | | | | | | | | | | | |
| | 14-16 | 1.75 | | | | | | | | | | | | | | | | | | | | CH** | 23 | | | | | | | | | | | | | | | | | | | | | | |
| | 16-18 | 0.75 | | | | | | | 100 | 95 | | 93 | | | | 91 | | | | | 72 | CL* | 26 | | | | | | | | | | | | | | | | | | | | | | |
| | 18-20 | 0.75 | | | | | | | | | | | | | | | | | | | | CL** | 29 | | | | | | | | | | | | | | | | | | | | | | |
| 09-B97 | 0-2 | 0.50 | | | 88 | 33 | 55 | | | 100 | | 100 | | | | 98 | | | | | 95 | CH | 46 | 74 | | | | | | | | | | | | | | | | | | | | | |
| | 2-4 | 0.50 | | | | | | | | | | | | | | | | | | | | CH** | 39 | | | | | | | | | | | | | | | | | | | | | | |
| | 4-6 | 0.50 | | | | | | | | | | | | | | | | | | | | CH** | 43 | | | | | | | | | | | | | | | | | | | | | | |
| | 6-8 | 1.50 | | | | | | | | | | | | | | | | | | | | CH** | 30 | | | | | | | | | | | | | | | | | | | | | | |
| | 8-10 | 2.50 | | | | | | | | | | | | | | | | | | | | CH** | 24 | | | | | | | | | | | | | | | | | | | | | | |
| | 10-12 | 2.25 | | | 81 | 25 | 56 | | 100 | 100 | | 100 | | | | 99 | | | | | 99 | CH | 29 | | | | | | | 1.7 | 29 | 96 | CH** | | | | | | | | | | | |
| | 12-14 | 0.50 | | | | | | | | | | | | | | | | | | | | CH** | 23 | | | | | | | | | | | | | | | | | | | | | | |
| | 14-16 | | | 8 | | | | | | | | | | | | | | | | | | CL** | 27 | | | | | | | | | | | | | | | | | | | | | | |
| | 16-18 | | | 7 | 29 | 20 | 9 | | | 100 | | 100 | | | | 98 | | | | | 69 | CL | 24 | | | | | | | | | | | | | | | | | | | | | | |

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.