PRICE ROAD STORM DRAIN

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

PRICE ROAD STORM DRAIN

M.C.F.C.D Project No: 86-8
Western Canal Between Price Road & Cooper Road
Chandler, Gilbert, & Mesa, Arizona

Registered Professional Engineer (Civil)
CERTIFICATE NO.
19709
CHET L. PEARSON
Date Signed 10/16/86
ARIZONA U.S.A.

Chet L. Pearson
10/16/86

Prepared for

Dibble and Associates
3625 North 16th Street
Phoenix, Arizona

THOMAS-HARTIG & ASSOCIATES, INC.
SOIL & FOUNDATION ENGINEERS

A115.903

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL AND FOUNDATION ENGINEERING · MATERIALS TESTING

Tom W. Thomas, P.E.
James R. Morrow, Lab Director
Charles H. Atkinson, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

7031 West Oakland Street
Chandler, Arizona 85226
602/961-1169

Harry E. Hartig, P.E.
John P. Boyd, P.E.
Glen K. Copeland, P.E.
Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Donald J. Spadola, P.E.

Dibble and Associates
3625 North 16th Street
Phoenix, Arizona

16 October 1986

Attention: Kent Dibble, P.E.

Project: Price Road Storm Drain
M.C.F.C.D. Project No: 86-8
Western Canal Between Price Road & Cooper Road
Chandler, Gilbert, & Mesa, Arizona

Project No: 86-991

In accordance with your authorization, test borings were drilled and soil resistivity measurements were made at 20 locations along the proposed alignments for the new storm drain. We understand the storm drain will be 57 to 90 inches in diameter and installed approximately 10 to 20 feet below existing ground surface. The test locations are shown on the attached site plan and the results of all testing are attached.

The test borings were drilled to various depths from 15 to 25 feet. The subsurface soil profile along the proposed alignment varied somewhat. The surficial soils at the test boring locations were predominantly composed of silty-sandy clay and sandy clay. These soils generally exhibited stiff to hard consistency, medium to high plasticity, and variable weak to moderate cementation with localized zones of strong cementation. These surficial clay soils were underlain by stratified deposits of clayey sand, sandy clay, silty sand, and sandy silt/silty sand. The attached boring logs present detailed descriptions of these soils and the predominant soil types encountered at each test boring. Soil moisture contents were generally described as damp to moist, and no groundwater was encountered in any of the test borings during drilling.

OCT 17 1986

Representative soil samples were obtained during the drilling. Eight (8) samples were selected for sieve and plasticity index analyses; eight (8) samples were selected for pH, chloride, and sulfate analyses; seven (7) samples were selected for maximum dry density-optimum moisture content determination (ASTM D698-A); and two (2) samples were selected for direct shear tests.

The soil resistivity was measured using a 4-terminal "Vibroground Model 263" resistivity meter. The resistivity tests were conducted using three different electrode spacings to indicate the variation in soil resistance with depth. The resistivity readings were influenced by the underground pipes, canal, metal fences, and overhead high-voltage electric lines in the immediate vicinity of the tests. Efforts were made to try to minimize outside interference; however, it is unknown how much effect the surrounding development had on the tests. The resistivity values ranged from about 1200 to 37300 ohm-cm.

The following recommendations are based upon the results of the field and laboratory testing which are attached. The following parameters are recommended for design purposes:

<u>Natural In-Place Soils</u>:

- moist density (γm) = 128 pcf
- Rankine's active earth pressure coefficient (K) = 0.405
- coefficient of friction (μ) = 0.466
- load factor ($K\mu$) = 0.189

<u>Fill Materials Utilizing Natural Soils</u>:

- at 100% ASTM D698 - moist density (γm) = 125 pcf
- at 95% ASTM D698 - moist density (γm) = 120 pcf
- Rankine's active earth pressure coefficient (K) = 0.589
- coefficient of friction (μ) = 0.268
- load factor ($K\mu$) = 0.158

Saturated unit weights should be used if the natural soils or backfill materials are subjected to inundation.

The following recommendations are presented to aid in the development of excavation plans:

1. Temporary unbraced excavations into the clay subgrade soils should be no steeper than 0.5H:1V. Slopes should be flattened to at least 1H:1V where clayey sand soils are encountered. Flatter slopes may be required where clean sand layers or utility line fill are encountered.

2. All existing utilities should be located on the excavation plans to evaluate the effect of existing trenches and backfill material on the excavation slopes. Flatter slopes and seepage control measures may be required in the vicinity of the existing utility lines and backfill material. Any existing utilities near the excavation to remain in-place should be adequately supported to prevent movements of the utility line.

3. Open excavations should not be used in areas where the crest of the slope will fall within 15 feet of the canal or any above-grade structures.

4. No surface water should be allowed to pond within 20 feet of the crest of the excavation nor should any surface water drain over the top of the crest and down the excavation slope. Precautions should be taken to help prevent erosion of the excavation slopes. No surface water should be allowed to pond within the limits of the excavation.

5. No soil or construction materials should be stored within 20 feet of the crest, and no construction equipment should operate within 15 feet of the crest.

All excavation plans and designs (including bracing systems) should be reviewed by a qualified geotechnical engineer. Periodic observation should be made by the reviewing geotechnical engineer during excavating and after completion of the excavation to evaluate site conditions and to determine if any modifications are necessary. Some surface raveling and caving should be expected in unbraced excavations unless measures are taken to stabilize the exposed cut surface.

Please do not hesitate to call if you have any questions or if we can be of further assistance.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: Chet L. Pearson Reviewed by: Glen K. Copeland

Chet L. Pearson, P.E. Glen K. Copeland, P.E.

/cmm

Copies to: Addressee (5)

APPENDIX A

FIELD RESULTS

LEGEND

LOCATION OF TEST BORINGS

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-991

APPROXIMATE LOCATION OF TEST BORINGS

Test Boring	Station, ft.	Offset from centerline of canal	Surface Elevation, ft.
1	263+50	40'N	1220.7
2	250+20	45'S	1217.9
3	237+10	40'N	1217.5
4	223+60	50'S	1216.0
5	210+50	30'N	1214.5
6	197+20	80'S	1211.6
7	184+60	20'N	1210.7
8	170+30	15'S	1208.5
9	157+20	25'N	1207.0
10	144+00	80'S	1199.0
11	130+80	25'N	1205.5
12	117+70	60'S	1197.0
13	104+50	30'N	1202.5
14	91+20	80'S	1195.0
15	78+00	30'N	1200.5
16	64+50	85'S	1191.0
17	51+30	45'N	1196.3
18	38+30	70'S	1194.2
19	24+80	40'N	1193.7
20	11+70	90'S	1185.5

LEGEND

SOIL CLASSIFICATION ASTM: D2487

COARSE-GRAINED SOIL

MORE THAN 50% LARGER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	GRAVELS More than half of coarse fraction is larger than No 4 Sieve size
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% - 200 FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% - 200 FINES	
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	SANDS More than half of coarse fraction is smaller than No 4 sieve size
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES MORE THAN 12% - 200 FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES MORE THAN 12% - 200 FINES	

FINE-GRAINED SOIL

MORE THAN 50% SMALLER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	SILTS AND CLAYS Liquid limit less than 50
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit greater than 50
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

log denotes visual approximation unless accompanied by mechanical analysis and Atterberg limits.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE: 200, 50, 16, 4

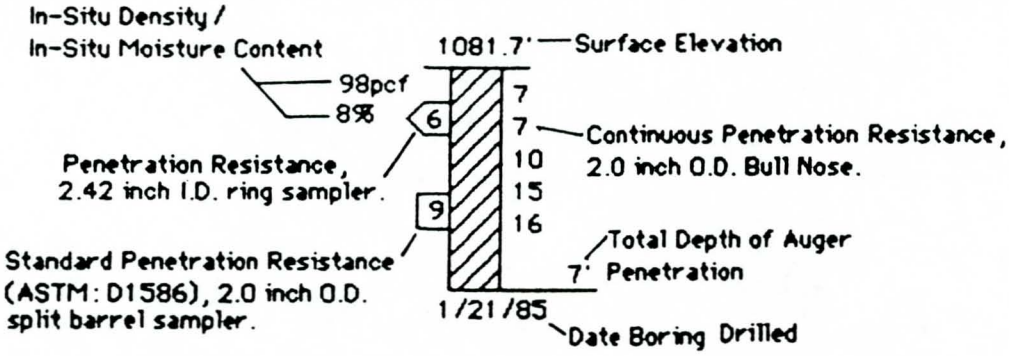
CLEAR SQUARE SIEVE OPENINGS: ¾", 3", 6"

SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE ⟶)

DRY — SLIGHTLY DAMP — DAMP — MOIST — VERY MOIST — WET (SATURATED)

(PL) (LL)



PENETRATION RESISTANCE:
Blows per foot using 140 lb. hammer with 30 inch free fall unless otherwise noted.

CONSISTENCY			RELATIVE DENSITY	
CLAYS & SILTS	BLOWS/FOOT*	STRENGTH‡	SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	0-¼	VERY LOOSE	0-4
SOFT	2-4	¼-½	LOOSE	4-10
FIRM	4-8	½-1	MEDIUM DENSE	10-30
STIFF	8-16	1-2	DENSE	30-50
VERY STIFF	16-32	2-4	VERY DENSE	OVER 50
HARD	OVER 32	OVER 4		

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-⅜ inch I.D.) split spoon (ASTM D-1588).

‡ Unconfined compressive strength in tons/sq. ft. Read from a pocket penetrometer.

Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

LEGEND OF SOIL TYPES

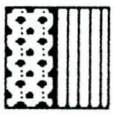
SILTY-SANDY CLAY (CL-CH); brown; stiff to hard; medium to high plasticity; variable weak to strong cementation; damp.

SANDY CLAY (CL); brown and light brown; stiff to hard; medium plasticity; variable weak to strong cementation; damp.

SILTY CLAY (CL); brown; firm to stiff; medium plasticity; weak cementation; moist.

CLAYEY SAND/SANDY CLAY (SC/CL); brown and light brown; medium dense; medium plasticity; variable weak to strong cementation; damp.

CLAYEY SAND (SC); brown and light brown; medium dense to dense; medium plasticity; variable weak to moderate cementation; contains some gravel; damp.

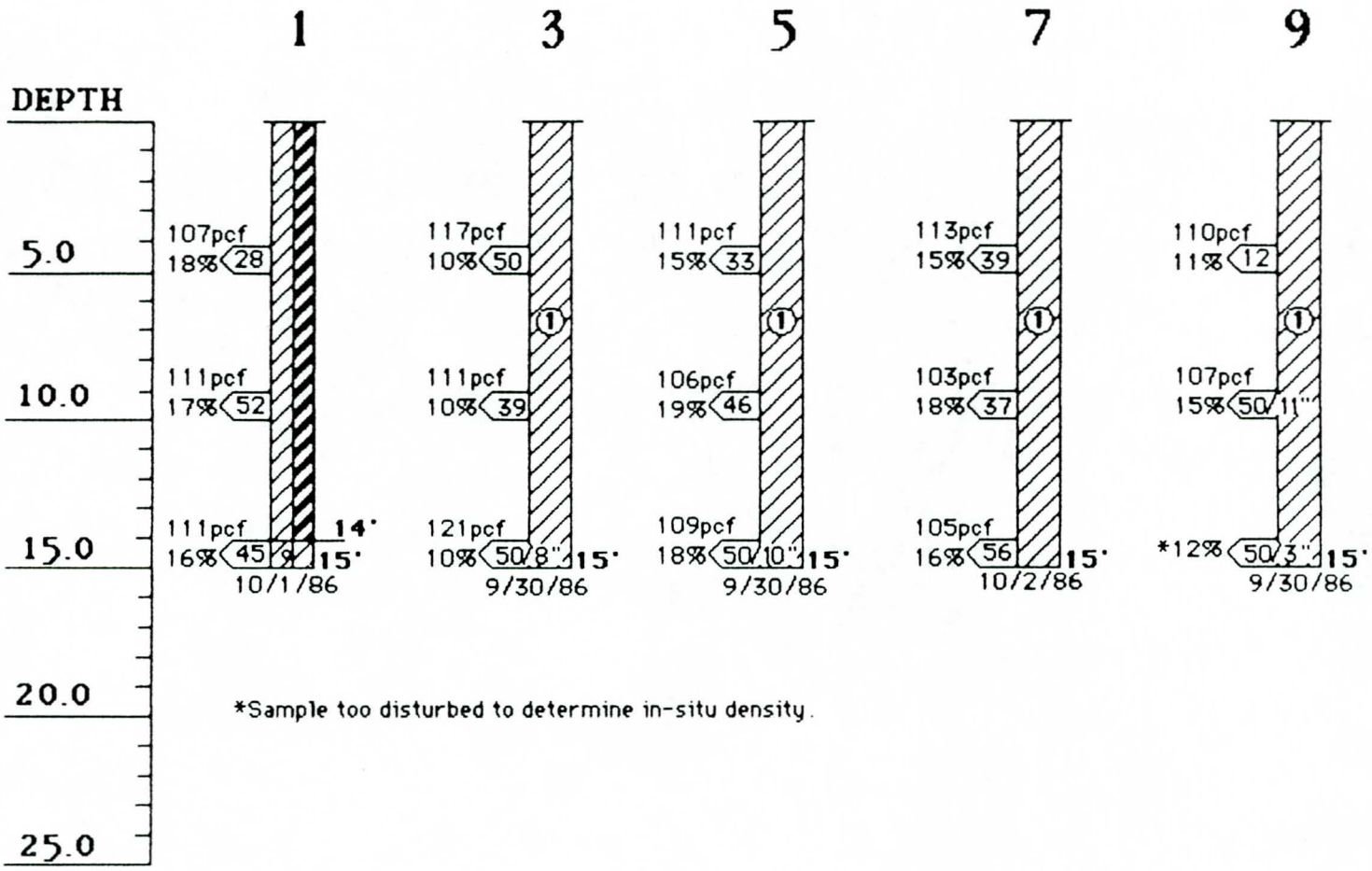


SILTY SAND/SANDY SILT (SM/ML); light brown; medium dense; low plasticity; weak cementation; damp.

Project No. 86-991

Thomas - Hartig & Associates

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.



*Sample too disturbed to determine in-situ density.

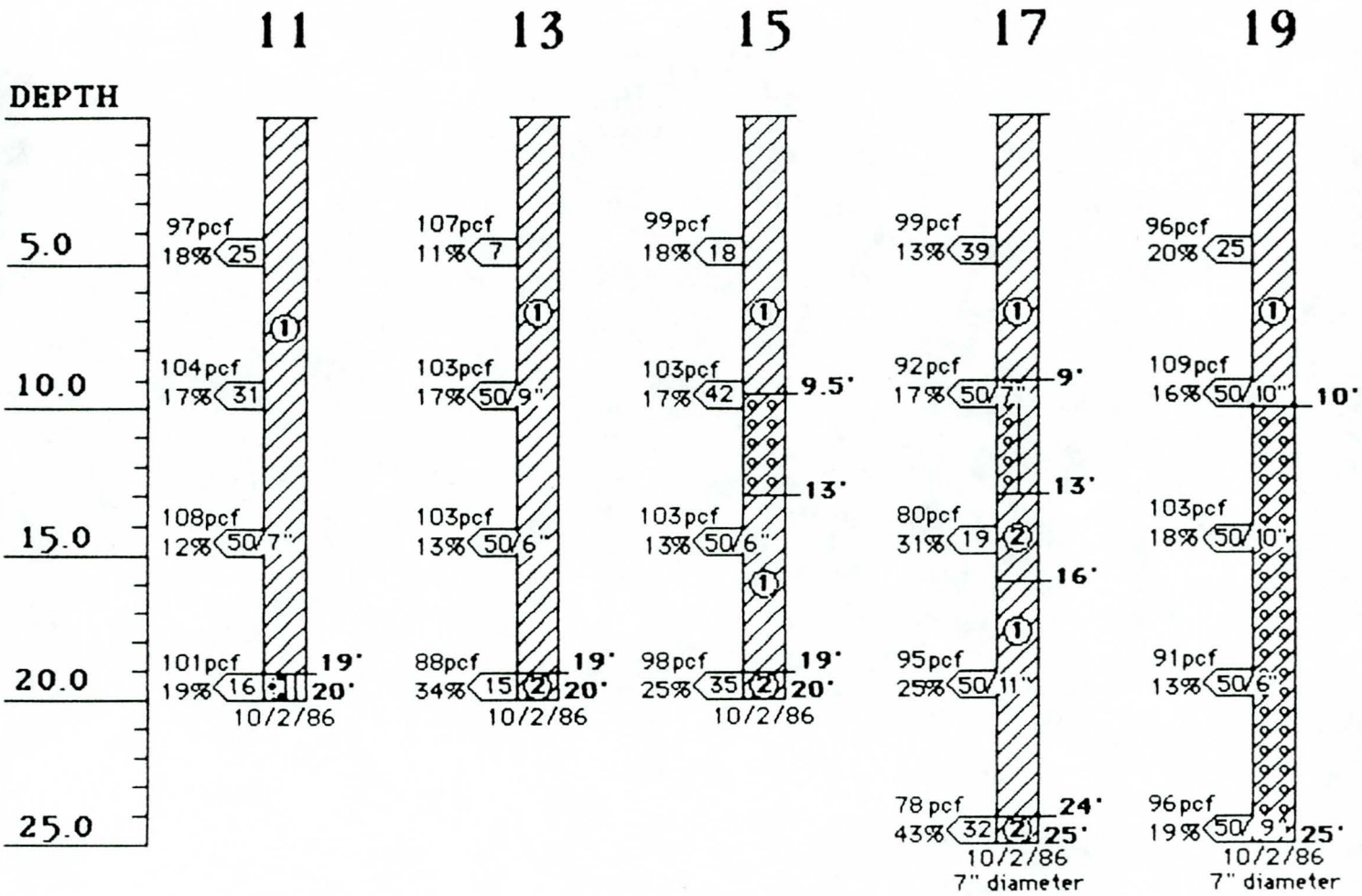
No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight auger unless otherwise noted.

Project No. 86-991

Thomas - Hartig & Associates

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

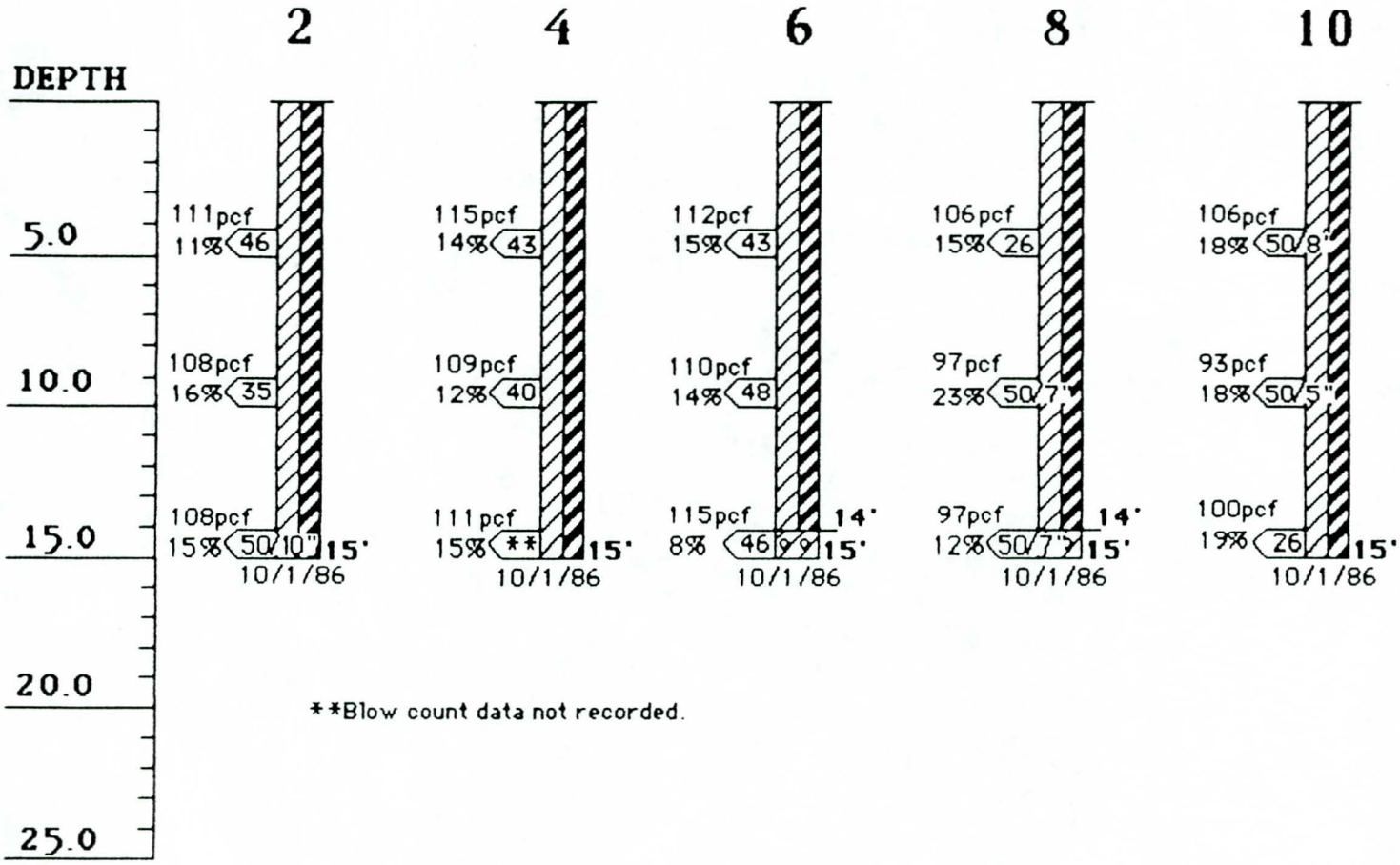


No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight auger unless otherwise noted.

Project No. 86-991
Thomas - Hartig & Associates

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.



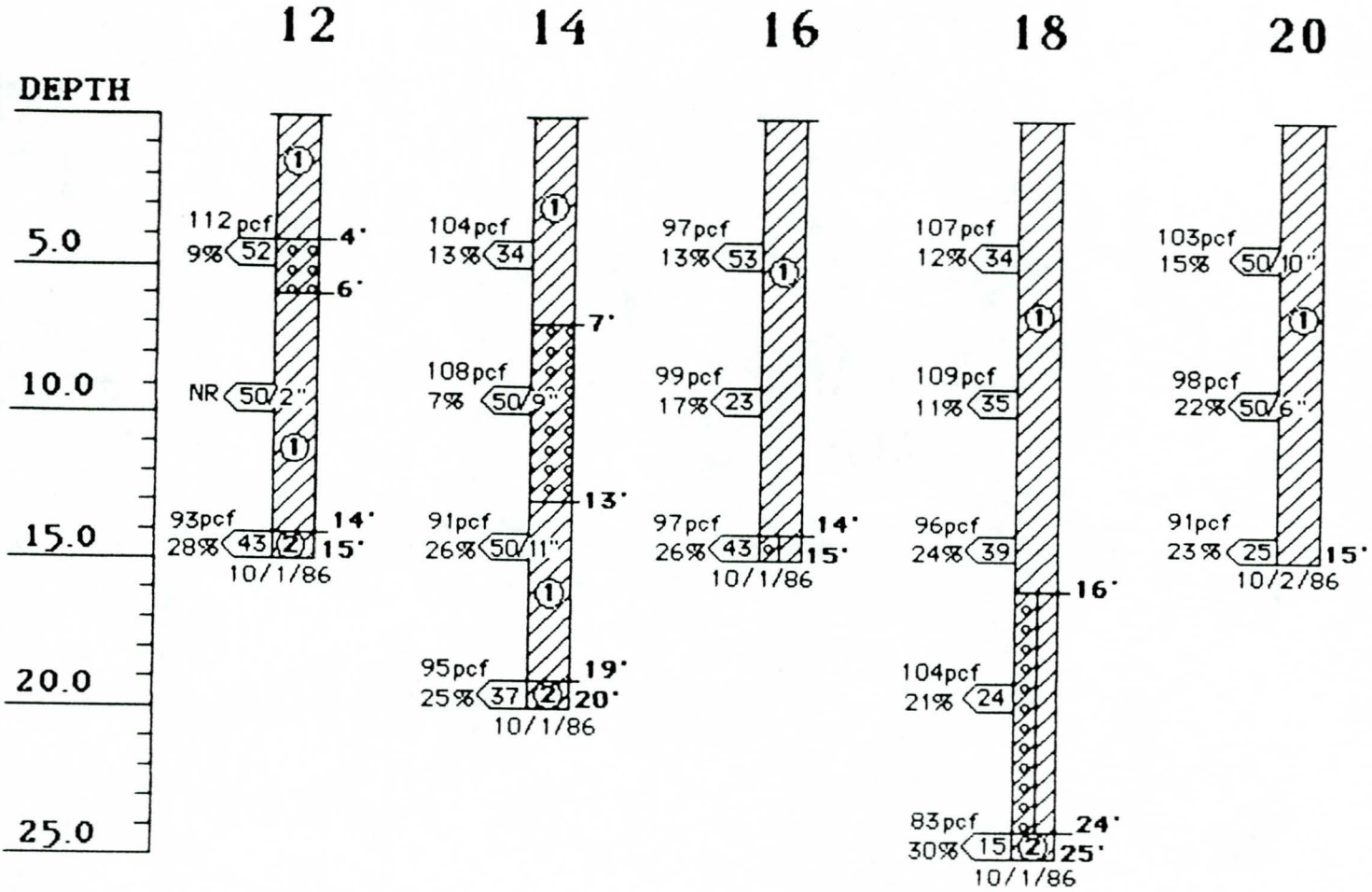
**Blow count data not recorded.

No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight auger unless otherwise noted.

Project No. 86-991
Thomas - Hartig & Associates

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.



No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 4" diameter continuous flight auger unless otherwise noted.

Project No. 86-991
Thomas - Hartig & Associates

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather than abrupt. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

REPORT ON FIELD TESTS

DESCRIPTION:

Location: Noted below

Material: Native soils

Performed by: TH/Ethington

TESTED:

Resistivity tests measured by the 4-probe method

RESULTS:

Location	Electrode Spacing (ft.)	Depth of Measurement (ft.)	Soil Resistivity (ohm-cm)
1	5	0 - 5	2200
	10	0 - 10	2700
	15	0 - 15	2100
2	5	0 - 5	1600
	10	0 - 10	1300
	15	0 - 15	1600
3	5	0 - 5	2000
	10	0 - 10	1700
	15	0 - 15	2500
4	5	0 - 5	2100
	10	0 - 10	1700
	15	0 - 15	1900
5	5	0 - 5	1200
	10	0 - 10	1500
	15	0 - 15	2100
6	5	0 - 5	1700
	10	0 - 10	1500
	15	0 - 15	1300
7	5	0 - 5	1800
	10	0 - 10	1600
	15	0 - 15	2100
8	5	0 - 5	1800
	10	0 - 10	1300
	15	0 - 15	1600
9	5	0 - 5	3400
	10	0 - 10	2700
	15	0 - 15	2700

REPORT ON FIELD TESTS
(CONTINUED)

DESCRIPTION:

Location: Noted below
Material: Native soils
Performed by: TH/Ethington

TESTED:

Resistivity tests measured by the 4-probe method

RESULTS:

Location	Electrode Spacing (ft.)	Depth of Measurement (ft.)	Soil Resistivity (ohm-cm)
10	5	0 - 5	2900
	10	0 - 10	2500
	15	0 - 15	1700
11	5	0 - 5	1200
	10	0 - 10	1200
	15	0 - 15	1700
12	5	0 - 5	2500
	10	0 - 10	3100
	15	0 - 15	2500
13	5	0 - 5	4900
	10	0 - 10	2100
	15	0 - 15	37300
14	5	0 - 5	2200
	10	0 - 10	3100
	15	0 - 15	2800
15	5	0 - 5	2100
	10	0 - 10	3100
	15	0 - 15	2600
16	5	0 - 5	2100
	10	0 - 10	2700
	15	0 - 15	2000
17	5	0 - 5	2900
	10	0 - 10	3600
	15	0 - 15	4300
18	5	0 - 5	1800
	10	0 - 10	1600
	15	0 - 15	2100
19	5	0 - 5	1700
	10	0 - 10	1900
	15	0 - 15	2200
20	5	0 - 5	3500
	10	0 - 10	3600
	15	0 - 15	2700

APPENDIX B

LABORATORY RESULTS

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source: Test boring 18; 14 - 15'

Type: Driven ring sample; 96 pcf dry density; 24% field moisture

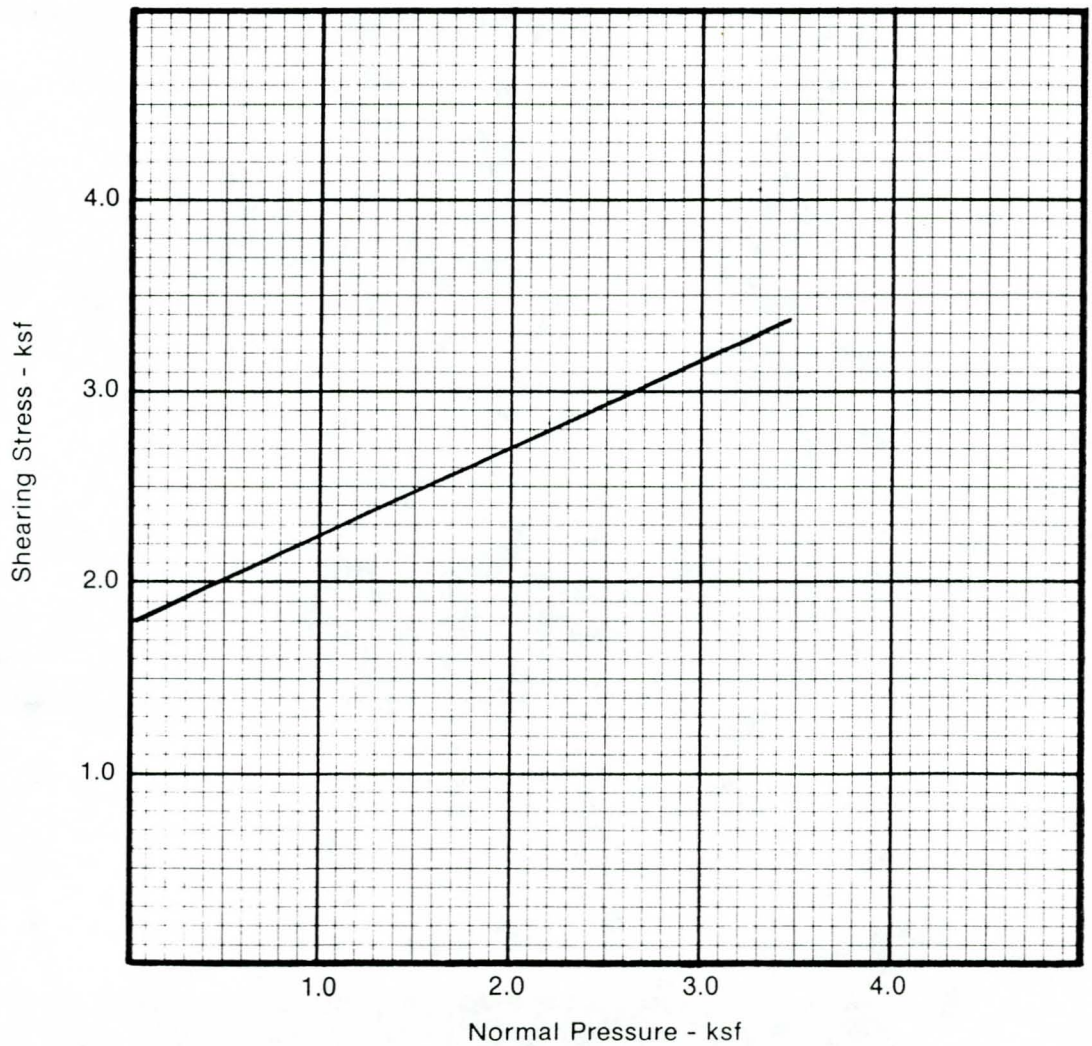
Material: Sandy Clay (CL)

Sampled By: TH/Thompson

TESTED: Direct Shear; sample tested at in-situ moisture content

RESULTS:

Friction Angle (Ø) = 25° Cohesion (c) = 1.8 ksf



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source: Test boring 18; 24 - 25'

Type: Driven ring sample; 83 pcf dry density; 30% field moisture

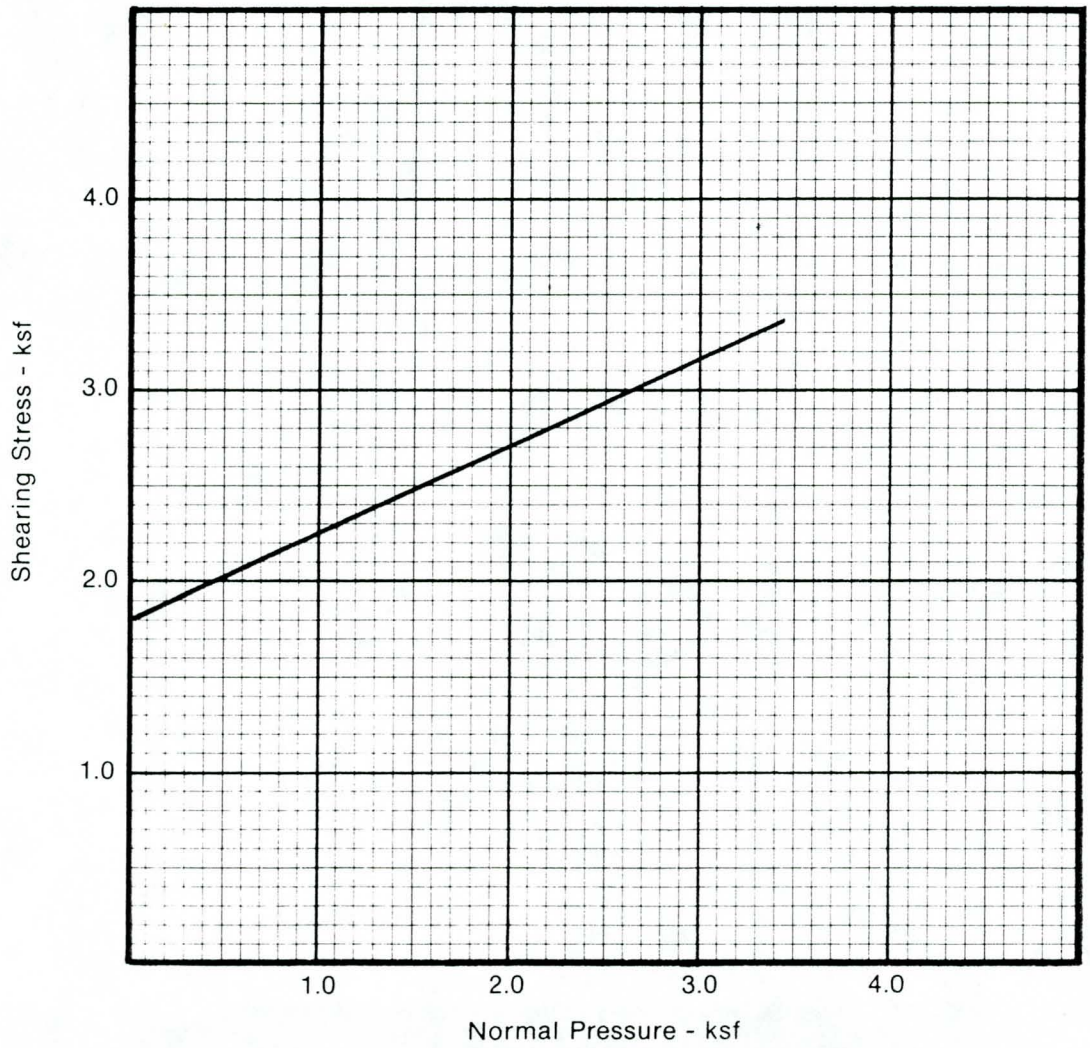
Material: Silty Clay (CL)

Sampled By: TH/Thompson

TESTED: Direct Shear; sample tested at in-situ moisture content

RESULTS:

Friction Angle (Ø) = 25° Cohesion (c) = 1.8 ksf



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Noted below

Type Grab samples

Material Noted below

Sampled By TH/Thompson

TESTED: Sieve analysis and plasticity index

RESULTS:

Sample	LL	PI	Sieve Size - Accum. % Passing 200	100	50	30	16	8	4	3/4"	1"	2"	3"	* Class
1; 2 - 14'	53	35	67	75	92	97	99	100						CH
4; 2 - 14'	54	33	63	68	86	95	98	99	100					CH
7; 2 - 14'	44	23	74	83	93	96	98	99	100					CL
10; 2 - 14'	54	30	67	71	82	88	93	97	99	100				CH
13; 2 - 19'	38	20	58	68	78	82	84	87	90	100				CL
16; 2 - 14'	43	21	59	64	77	83	89	94	98	100				CL
19; 2 - 10'	47	27	71	79	86	89	91	94	97	100				CL
19; 10 - 18'	59	35	42	48	53	57	62	69	80	100				SC

* Unified Soil Classification

Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

DESCRIPTION:

Location: Noted below
Sample Type: Grab sample
Material: Surface and subsurface soils
Sampled by: TH/Ethington

TESTED:

pH and soluble sulfates and chlorides concentrations

RESULTS:

Sample	pH	Soluble Sulfates	Soluble Chlorides
1; 9 - 10'	8.6	0.0091%	0.013%
4; 9 - 10'	8.8	0.013%	0.013%
7; 9 - 10'	8.6	0.0093%	0.015%
10; 9 - 10'	8.7	0.0073%	0.014%
13; 14 - 15'	8.7	0.0043%	0.011%
16; 9 - 10'	8.7	0.0021%	0.014%
17; 14 - 15'	8.2	0.010%	0.041%
20; 9 - 10'	8.9	0.019%	0.023%

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 1; 2 - 14'

Type Bulk sample

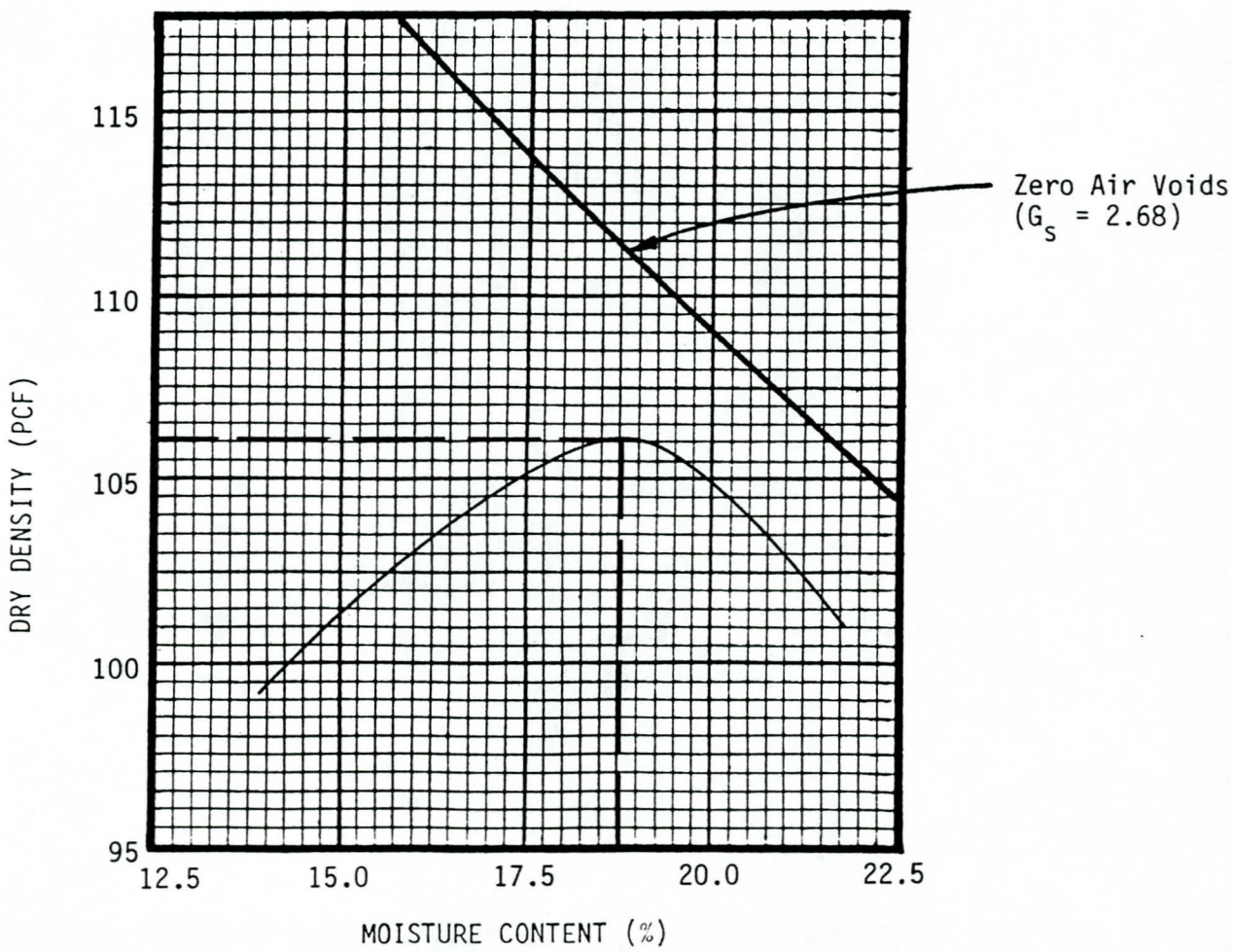
Material Silty-Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 106.1 Optimum Moisture Content (%) 18.8



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 4; 2 - 14'

Type Bulk sample

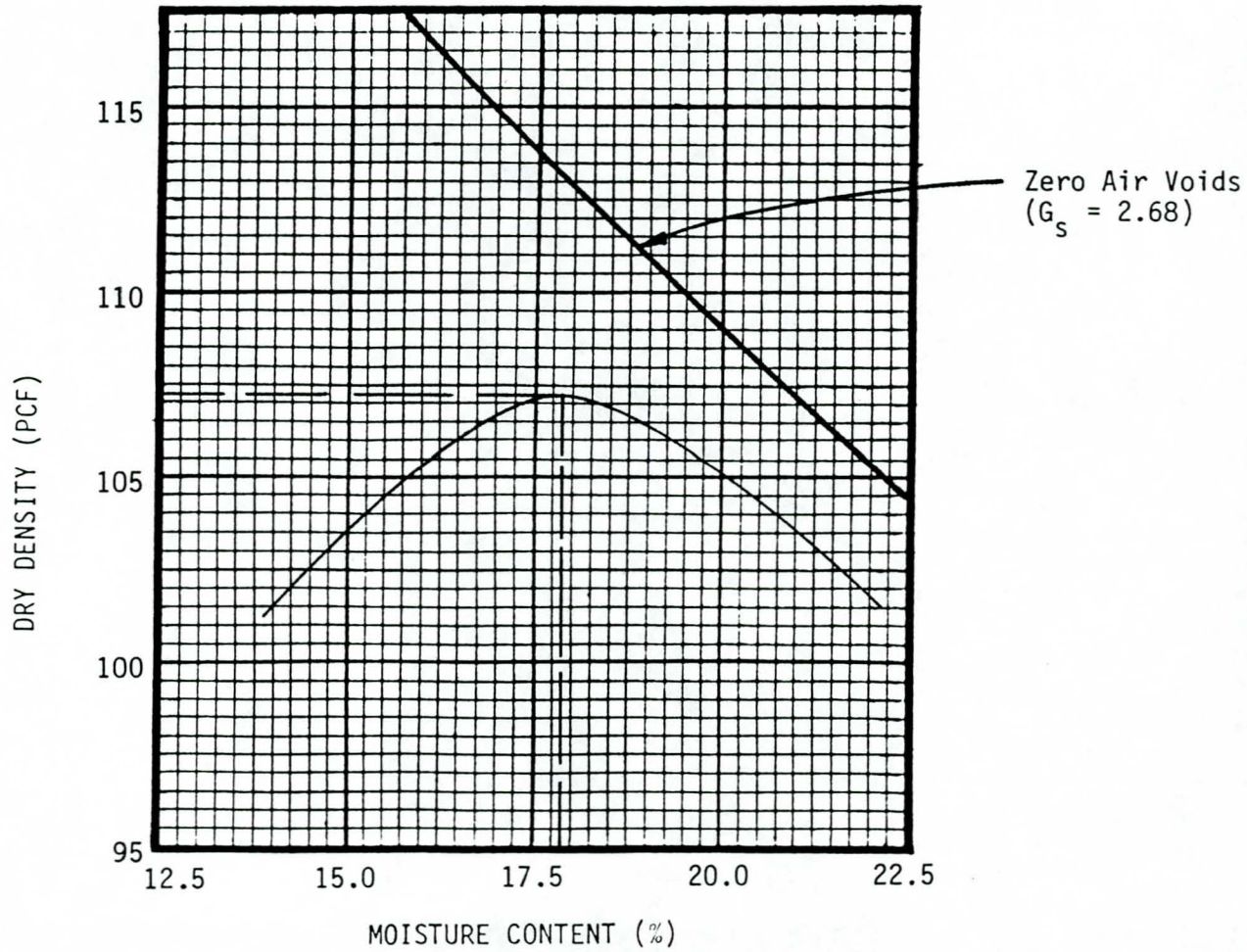
Material Silty-Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 107.2 Optimum Moisture Content (%) 17.8



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 7; 2 - 14'

Type Bulk sample

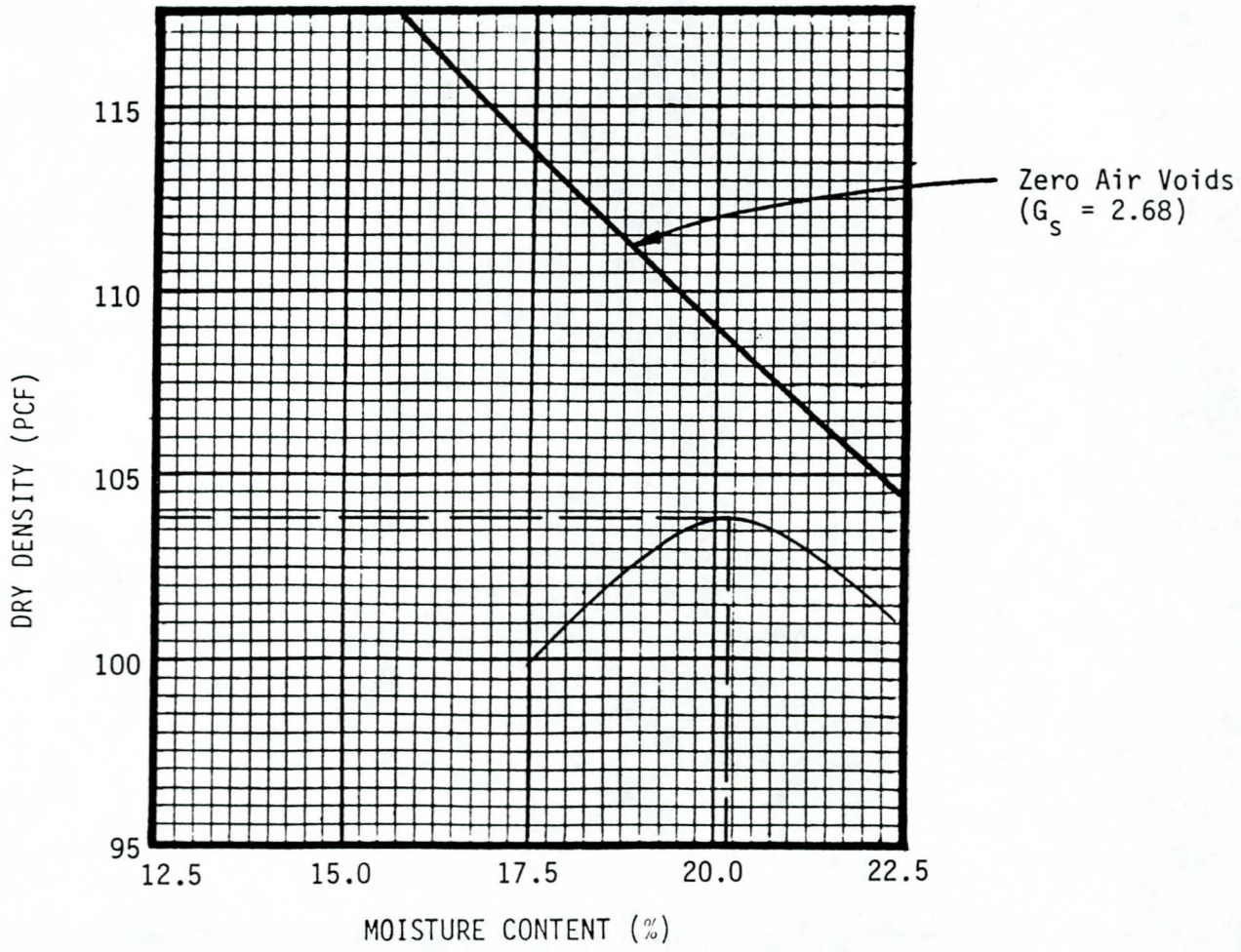
Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 103.8 Optimum Moisture Content (%) 20.2



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 10; 2 - 14'

Type Bulk sample

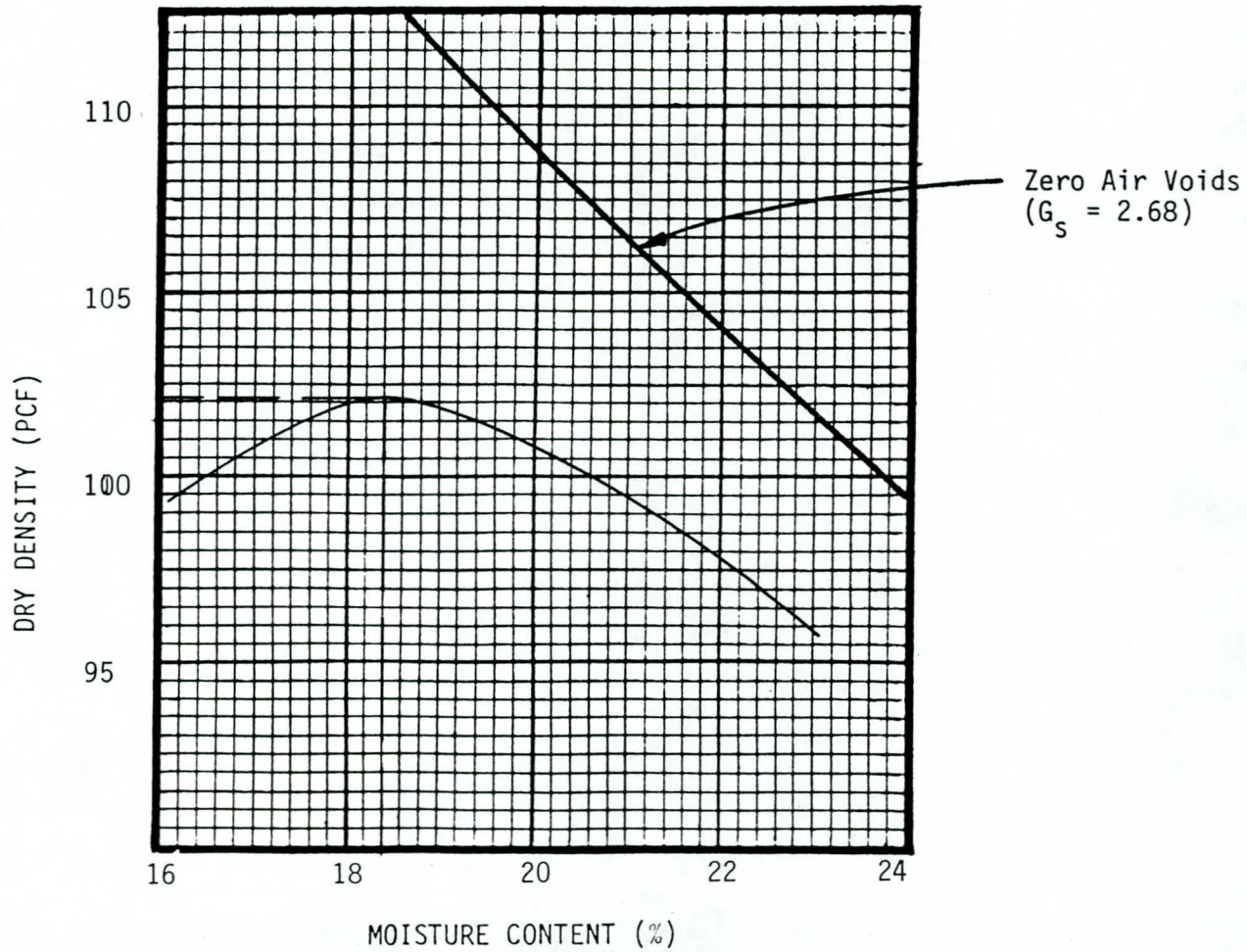
Material Silty-Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 102.1 Optimum Moisture Content (%) 18.4



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 13; 2 - 9'

Type Bulk sample

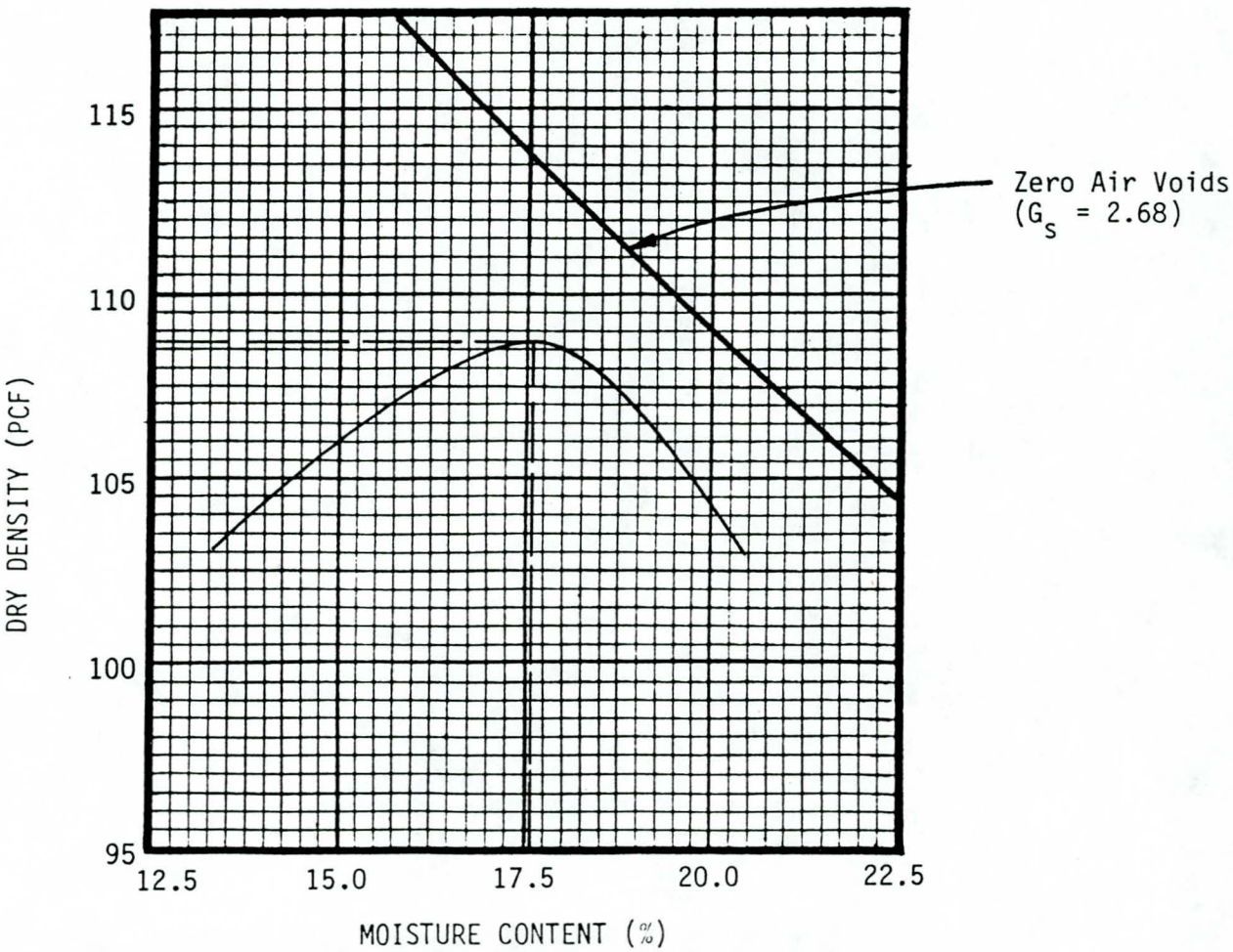
Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 108.7 Optimum Moisture Content (%) 17.6



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source: Test boring 16; 2 - 14'

Type: Bulk sample

Material: Sandy Clay (CL)

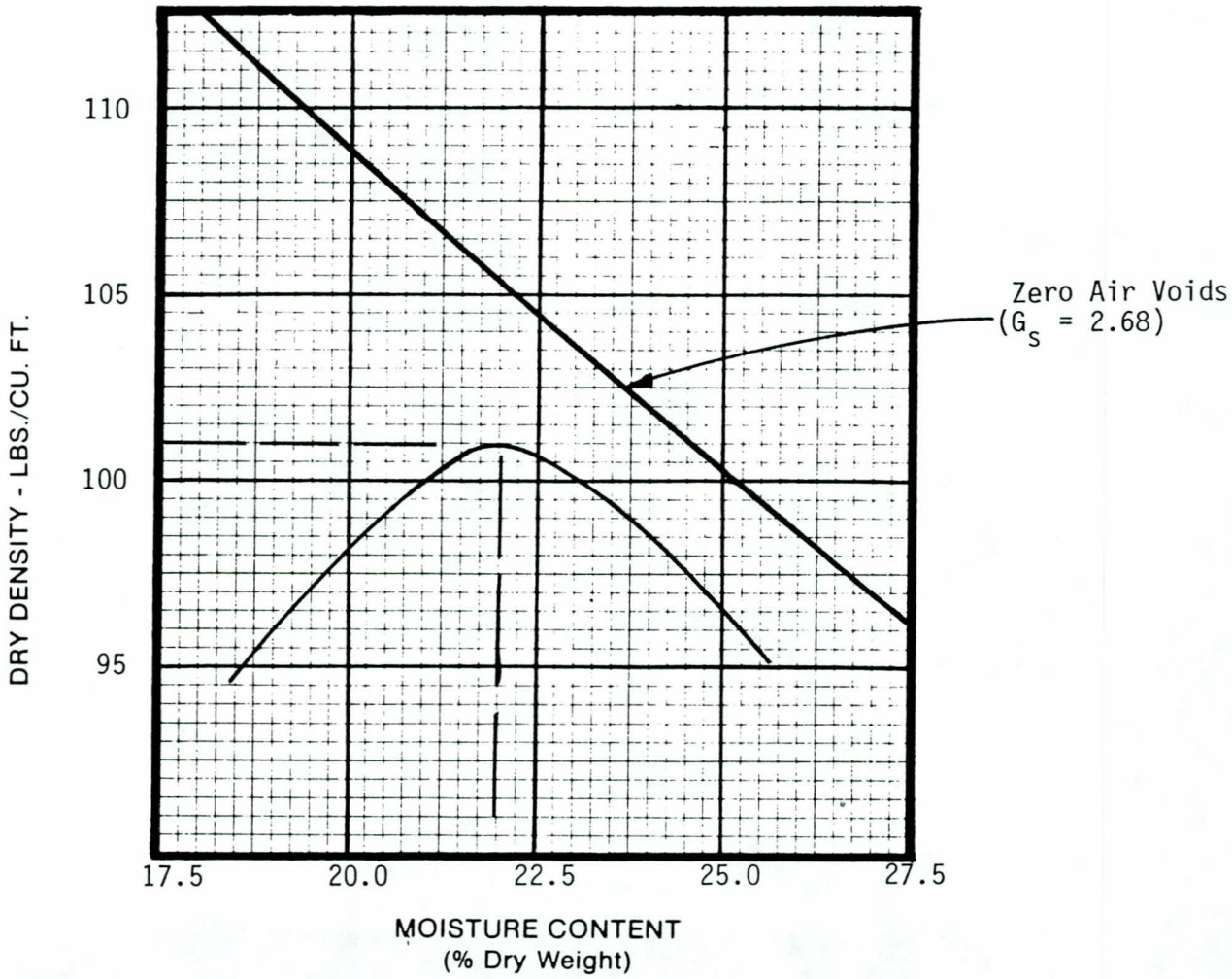
Sampled By: TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density, lbs./cu. ft. 101.0

Optimum Moisture Content, % 22.1



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 10/15/86

Source Test boring 19; 10 - 18'

Type Bulk sample

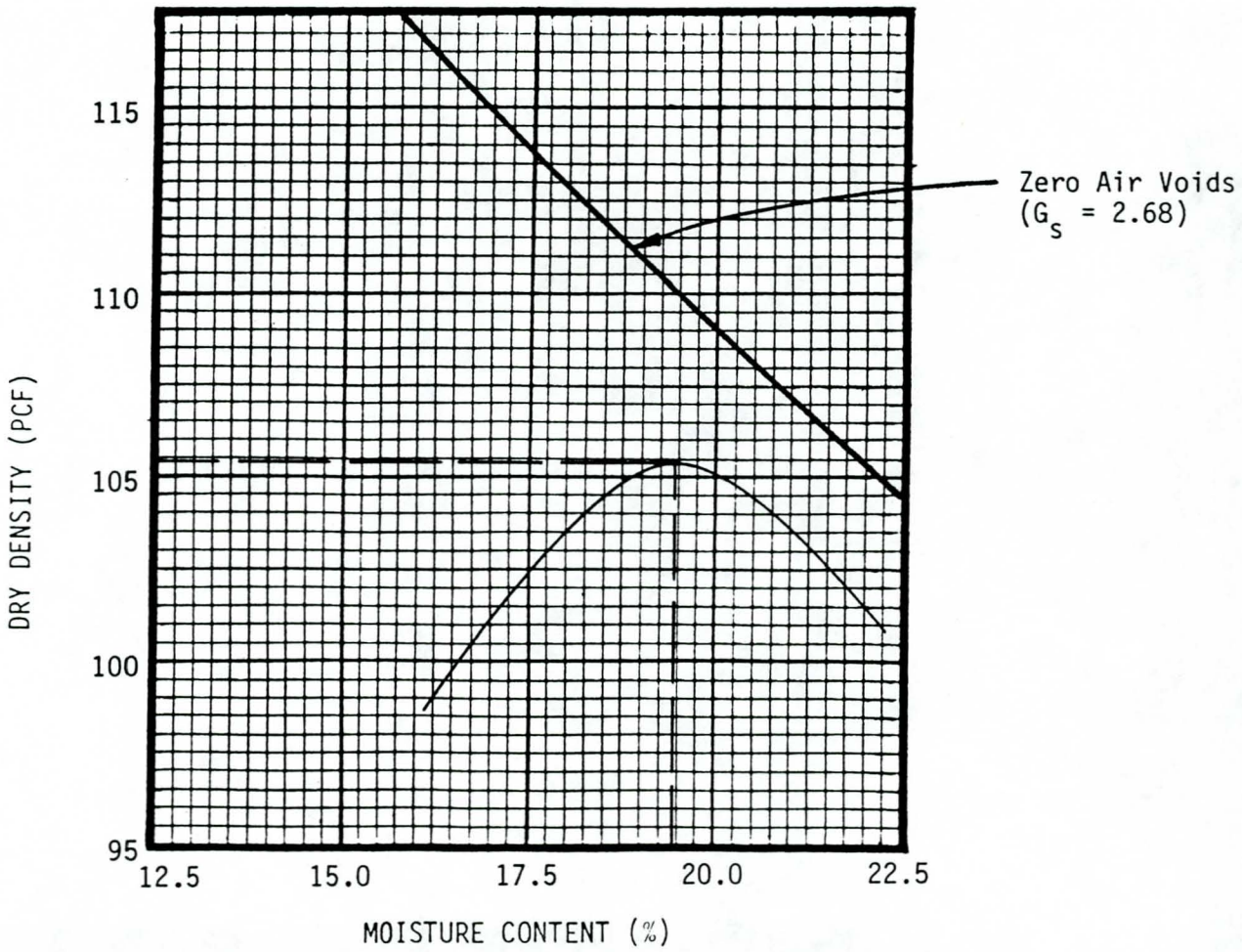
Material Clayey Sand (SC)

Sampled By TH/Thompson

TESTED: ASTM D698 Method A

RESULTS:

Max. Dry Density (pcf) 105.4 Optimum Moisture Content (%) 19.4



Project No. 86-991

THOMAS-HARTIG & ASSOCIATES, INC.