SUPPLEMENTAL GEOTECHNICAL SERVICES
OLIVE AVENUE STORM DRAIN

67th Avenue to 99th Avenue
Maricopa County, Arizona

Registered Professional Engineer (Civil)
CERTIFICATE NO.
12875
STEVEN A.
HAIRE
Date Signed .....
ARIZONA, U.S.A.

Prepared for

Boyle Engineering Corporation
7600 North 16th Street, Suite 110
Phoenix, Arizona

THOMAS-HARTIG & ASSOCIATES, INC.
SOIL AND FOUNDATION ENGINEERING • MATERIALS TESTING

A450.901

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Boyle Engineering Corporation
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31 July 1987

Attention: Steve Bruflat

Project: Supplemental Geotechnical Services
Olive Avenue Storm Drain
67th Avenue to 99th Avenue
Maricopa County, Arizona

Project No. 87-0664

In accordance with your authorization, we have performed supplemental geotechnical services for the Olive Road Storm Drain project. The purpose of our investigation was to provide recommendations for trench slope configurations, evaluation of cast-in-place pipe options, and to provide parameters for D-loadings. Preliminary design indicates pipe diameters ranging from 5 to 9 feet with invert depths about 20 to 23 feet below grade.

INVESTIGATION

The field exploration consisted of five (5) 7-inch-diameter hollow stem auger test borings at the locations shown on the attached site plan. During the test drilling, soils were visually classified and representative samples were obtained at selected depths. The results of the test drilling are presented in "Appendix A, Field Results". Also shown on the site plan are the locations of 24 borings performed as a part of a previous investigation performed in May 1986 by this firm (Thomas-Hartig & Associates Project No. 86-571). Data from this previous investigation was also utilized to provide the recommendations presented in this report.

Representative samples obtained during the field investigation were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Direct Shear	Relatively undisturbed soils (5)	Slope stability analyses
Maximum Density-Optimum Moisture (ASTM D698A)	Representative soils (3)	Maximum densities for development of pipe D-loads
Dry Density and Moisture Content	Relatively undisturbed (15)	In situ density and moisture determination

The results of the dry density and moisture content testing are presented on the boring logs in Appendix A. The results of the remaining laboratory testing are presented in "Appendix B, Laboratory Results".

SOIL CONDITIONS

The natural soil profile is stratified and somewhat variable along the 4 mile Storm Drain Alignment. In most areas, the natural surface soils to variable depths (typically 7 feet or more) are sandy clays. Underlying soils are primarily stratified deposits of sands and gravels containing variable amounts of silt and clay. Occasional lenses of cemented sandy clay are also present.

The soil moisture contents encountered during our field investigation were described as slightly damp to damp, and no free groundwater surface was detected in any of the borings during drilling.

DISCUSSION AND RECOMMENDATIONS

Construction Excavation Slope Configuration: Due to the wide spacing between borings (1/4 mile) and the stratified, variable nature of the natural soil stratigraphy, only general slope recommendations are presented in this report. We understand that excavations to depths of approximately 23 feet are proposed. The following recommendations are presented for unbraced construction excavations which must be safe for personnel entry:

1. Unbraced excavations into the surface undisturbed sandy clay soils to a depth of about 7 feet should be no steeper than 1H:1V. Excavations into the underlying stratified sand and gravel deposits should be no steeper than 1.5H:1V.

In the vicinity of the New River channel (between borings 21 and 24), surface clays are not present, and slopes should be no steeper than 1.5H:1V throughout the entire depth of excavation in this area.

2. The grade beyond the crest of the excavations should be sloped or otherwise protected so that surface runoff cannot pond near or drain into the excavation.

3. Construction vehicles should not traverse, or material stockpiles be placed within 10 feet of the excavation crest.

The excavation slopes as described should be stable unless anomalies such as old backfills, adjacent utility trenches (existing or new), wet soils, or clean sands or sands and gravels, etc., are encountered. Some surface raveling should be expected unless measures are taken to stabilize the exposed surfaces.

Cast-in-Place Pipe: Cast-in-place pipe will require vertical trench excavation walls roughly 7 to 11 feet high at the base of the trench excavation. As previously discussed, the soils at those depths are highly stratified, and scattered zones of relatively clean, non-cohesive granular soils can be anticipated. In these areas, caving and sloughing soils may make cast-in-place construction impractical or impossible. A few test excavations could be made in areas with cleaner granular soils to verify the ability of vertical trench walls to remain temporarily stable during construction. However, vertical-walled excavations will still require temporary shoring for protection of personnel.

Trench Backfill Settlements: It has been our experience that trench backfills placed without mechanical compaction or at densities less than 95 percent of maximum density (ASTM D698A) may exhibit excessive settlements when the moisture content increases or traffic loads are applied. Therefore, compaction of trench backfills should be accomplished using mechanical methods with the backfill materials moisture conditioned and placed in horizontal lifts of thicknesses compatible with the compaction equipment used. Water-settlement or water jetting would not be expected to achieve adequate uniform densities. It is also

recommended that compaction be accomplished to a minimum 95 percent of the maximum density (ASTM D698A) and at the optimum moisture content ±3 percent. Even deep, uniformily compacted backfills have been observed to settle as much as 1/5 to 1 percent of the total depth of backfill (i.e., 24 foot depth of backfill may settle 1 to 2 inches).

Please do not hesitate to call if we can be of further service to you or if you have any questions regarding the recommendations.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

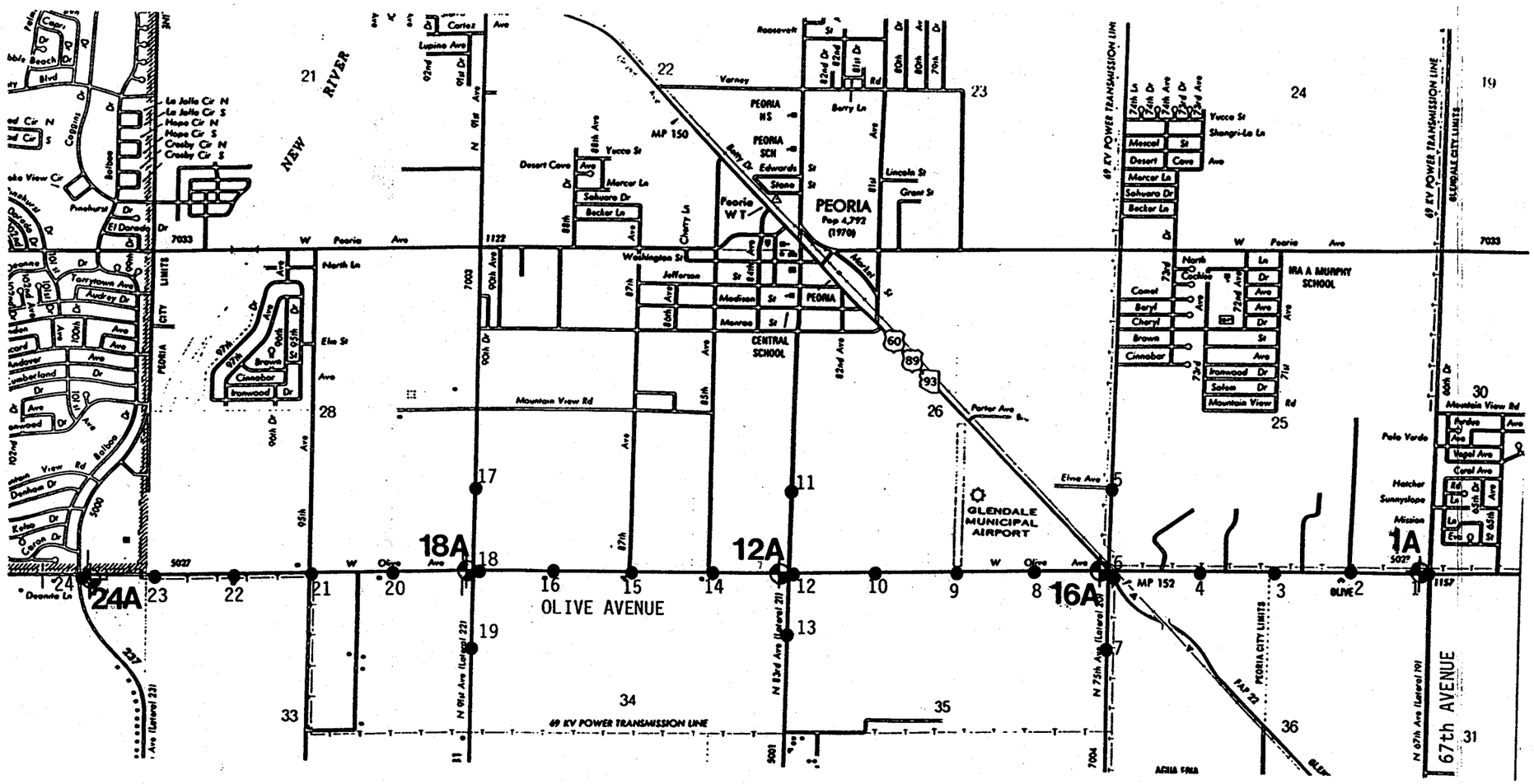
Steven A. Haire, P.E. Glen K. Copeland, P.E.

/cb

Copies to: Addressee (5)

APPENDIX A

FIELD RESULTS



N

Scale

1" = 2000'

LEGEND

● Location of test borings and soil resistivity tests performed in May 1986 and presented in Thomas-Hartig & Associates report, Project No. 86-571

⊕ Location of test borings performed as part of this investigation

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LEGEND OF SOIL TYPES

ASPHALTIC CONCRETE OVERLYING AGGREGATE BASE (see individual logs for thicknesses)

SANDY CLAY (CL); brown; low to medium plasticity; stratified; stiff to hard; occasional lenses of clayey sand (SC); damp to moist; intermittent light cementation.

SILTY SAND (SM); brown; non-plastic; predominantly fine to medium; medium dense to dense; slightly damp to damp.

CLAYEY GRAVELLY SAND, GRAVELLY SAND, AND CLAYEY SANDY GRAVEL (SC, SC-SP, and GC); brown; stratified; low plasticity; dense; slightly damp; occasional lenses of non-plastic sand to gravelly sand (SP-SM).

FILL; clayey sand and gravel (SC/GC); low plasticity; damp.

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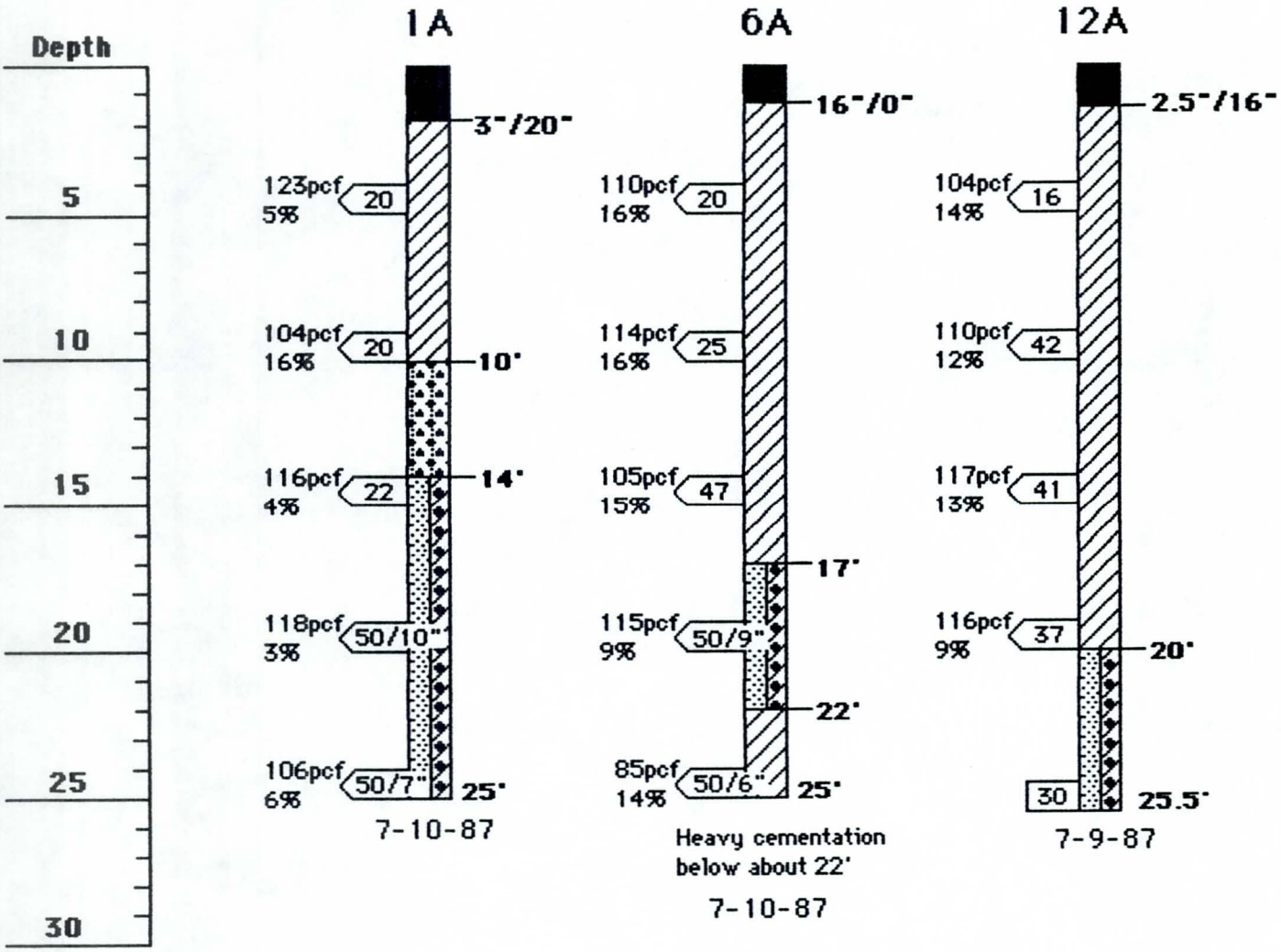

No free groundwater was encountered in any of the borings during drilling.

All borings drilled with 7" diameter hollow stem auger unless otherwise noted.

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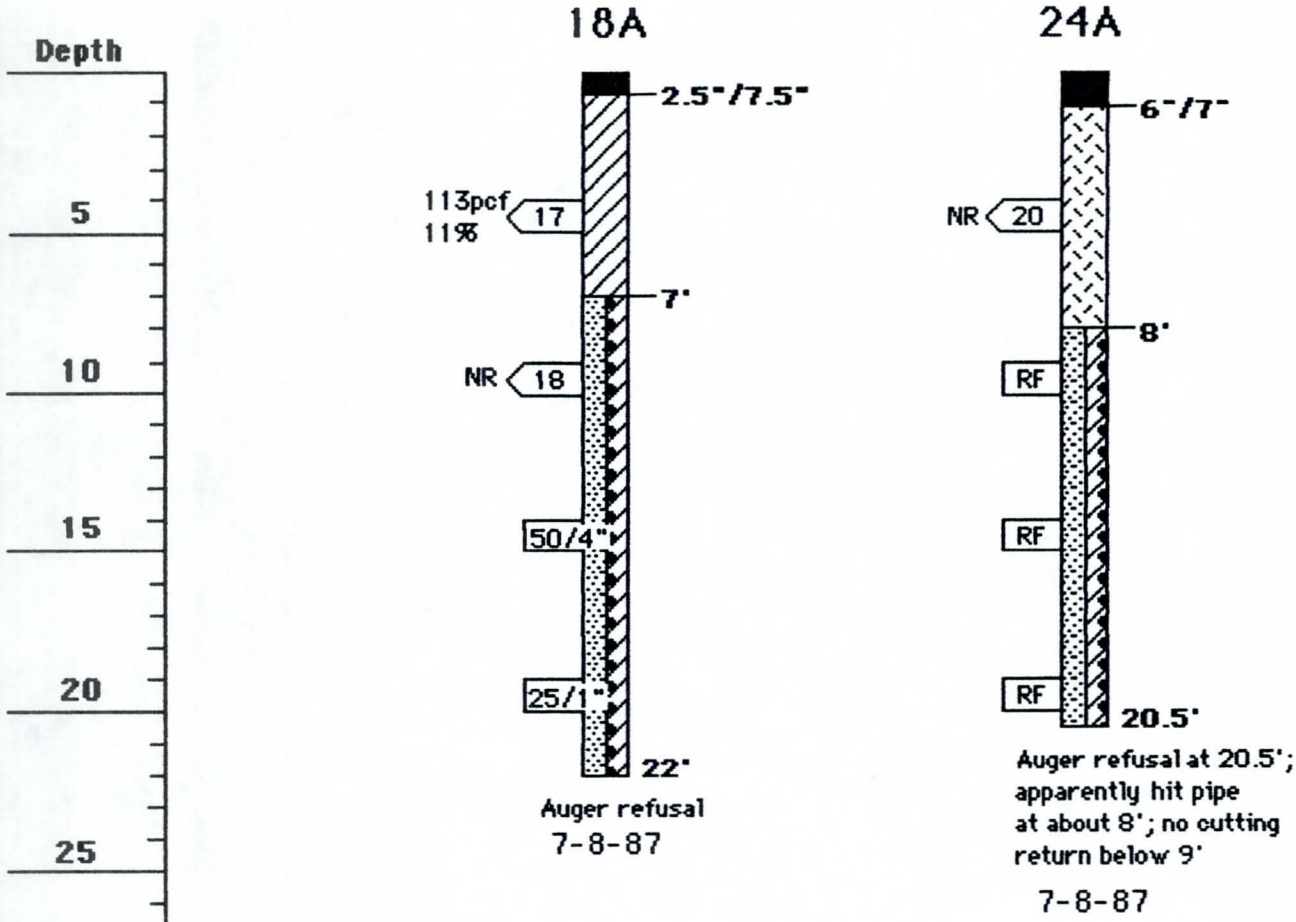
NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. Contacts between soil strata are approximate and changes between soil types may be gradual rather 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.



RF = Refusal to penetration (i.e., more than 100 blows/foot)

NR = No recovery

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

All borings drilled with 7" diameter hollow stem auger unless otherwise noted.

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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.

APPENDIX B

LABORATORY RESULTS

REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #1; 9 - 10'

Type Driven ring sample; 104 pcf dry density; 16% field moisture

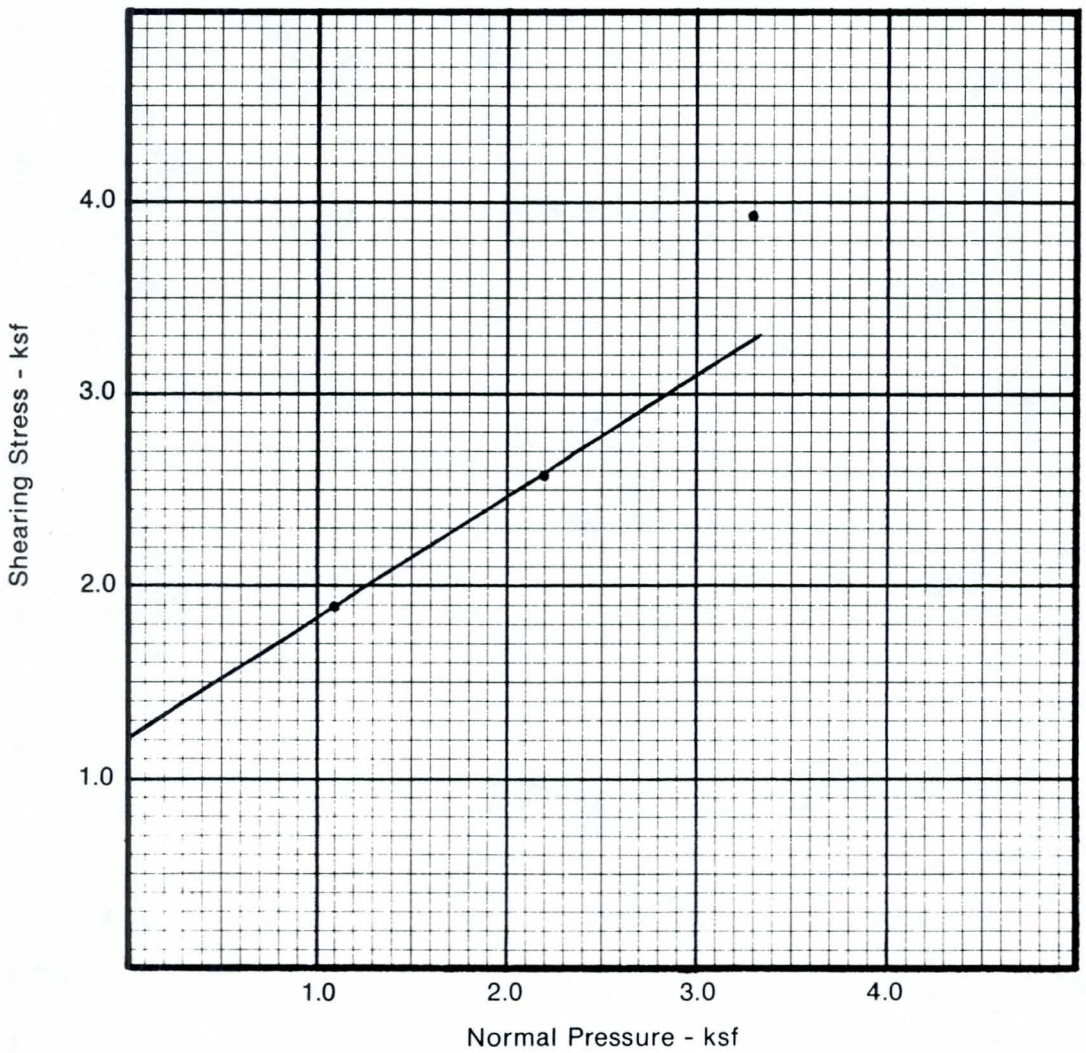
Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: Direct shear, sample sheared at in situ moisture content immediately upon application of normal pressure

RESULTS:

Friction Angle (Ø) = 32° Cohesion (c) = 1.2 ksf



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REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #1; 14 - 15'

Type Driven ring sample; 116 pcf dry density; 4% field moisture

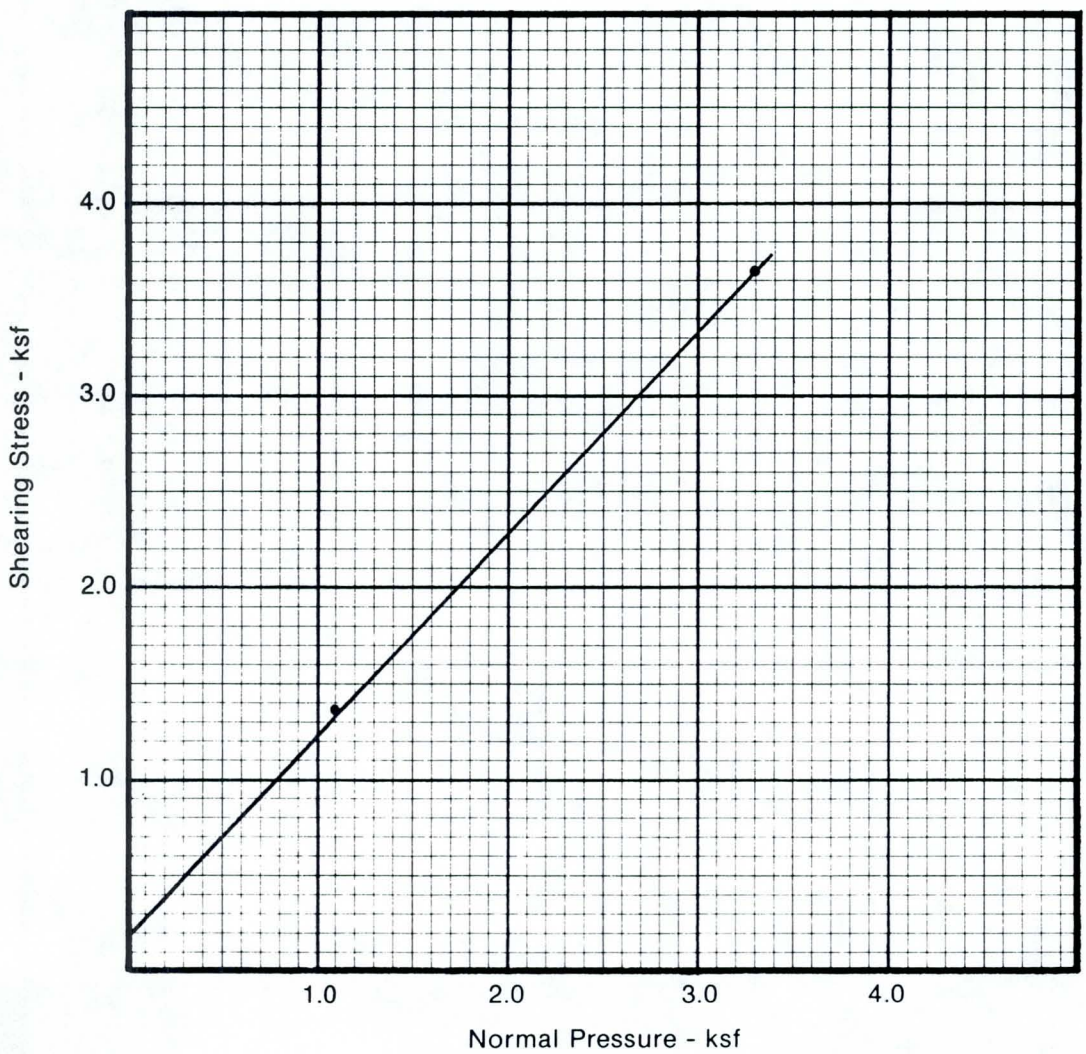
Material Silty Sand (SM), trace of gravel

Sampled By TH/Thompson

TESTED: Direct shear, sample sheared at in situ moisture content immediately upon application of normal pressure

RESULTS:

Friction Angle (Ø) = 46° Cohesion (c) = 0.2 ksf



Project No. 87-0664

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #6; 4 - 5'

Type Driven ring sample; 110 pcf dry density; 16% field moisture

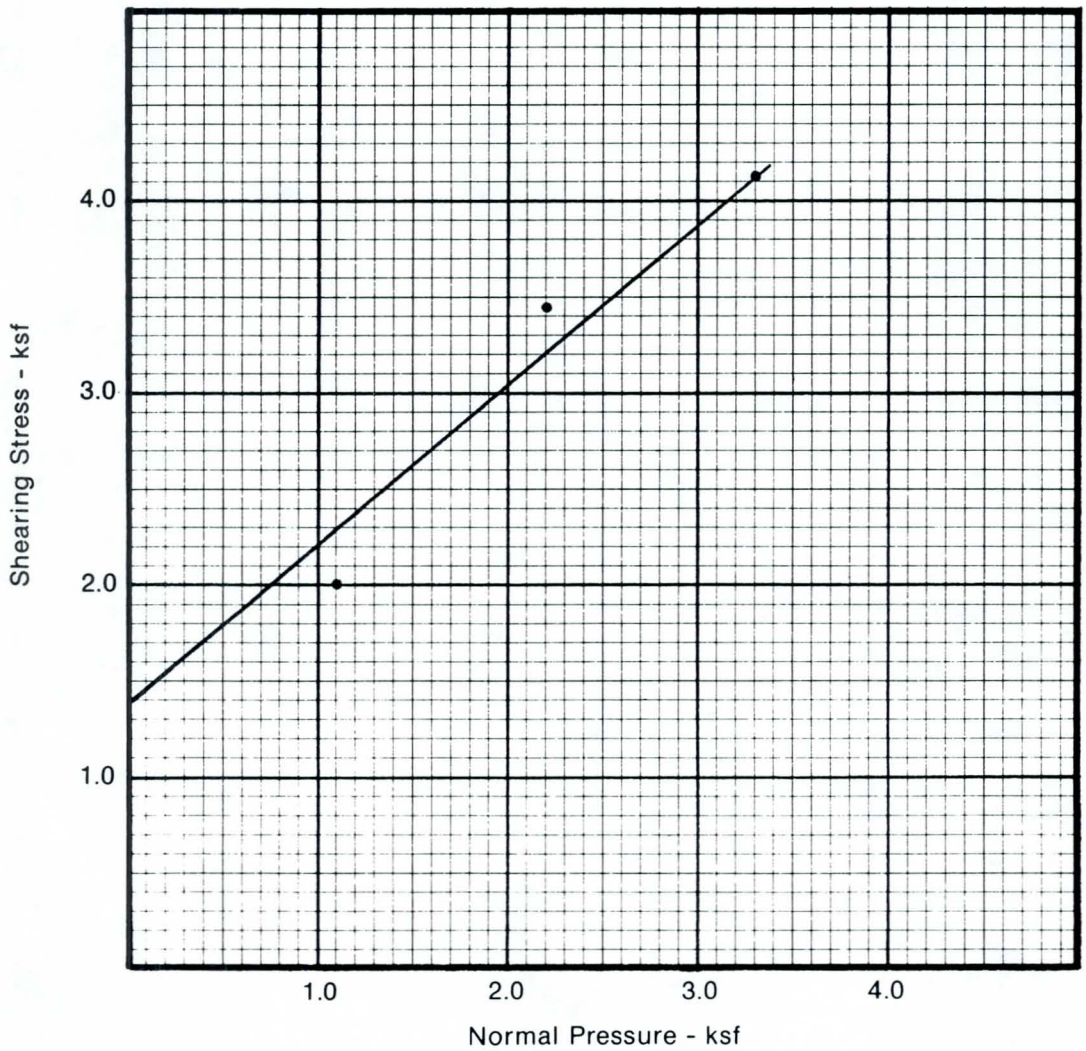
Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: Direct shear, sample sheared at in situ moisture content immediately upon application of normal pressure

RESULTS:

Friction Angle (Ø) = 40° Cohesion (c) = 1.4 ksf



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REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #12; 4 - 5'

Type Driven ring sample; 104 pcf dry density; 14% field moisture

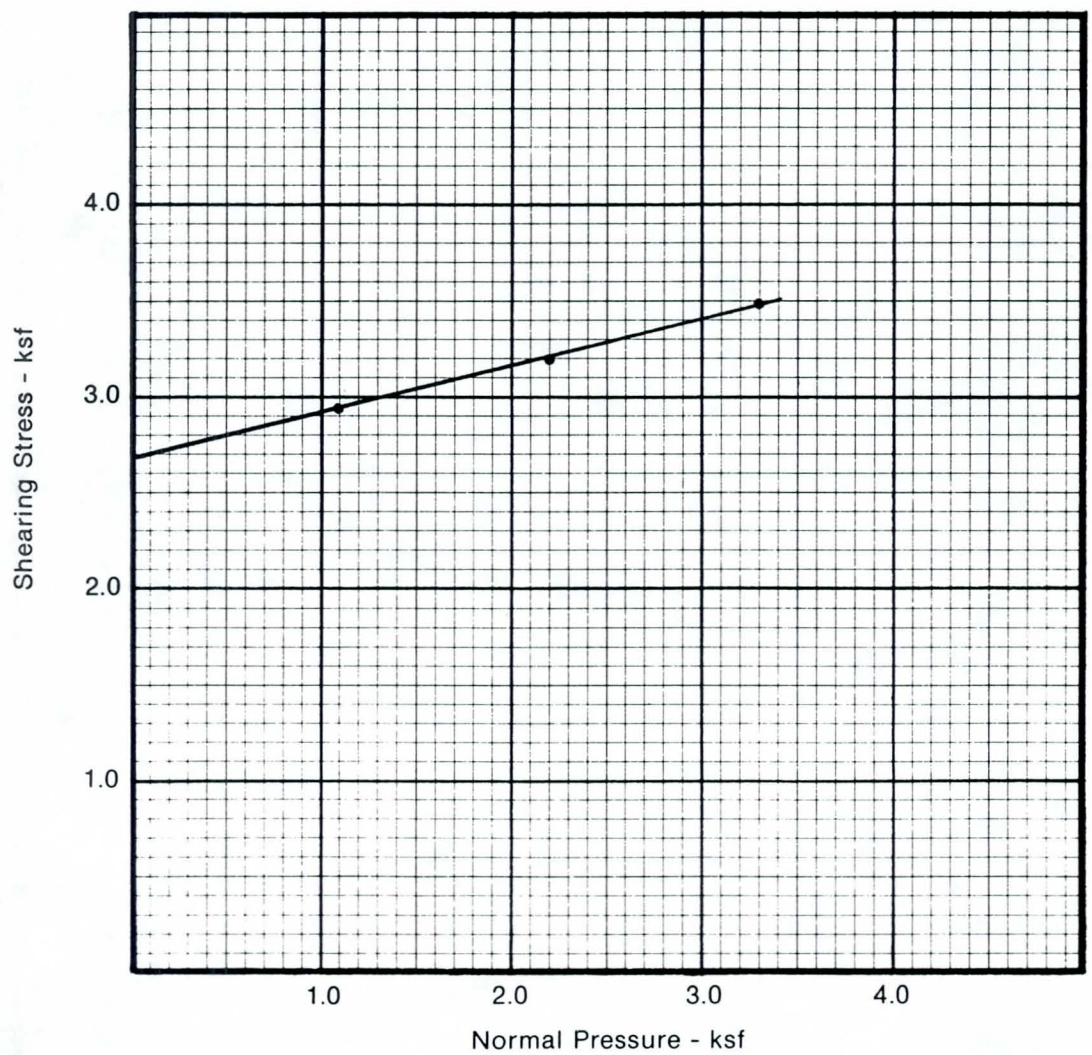
Material Sandy Clay (CL), weakly cemented

Sampled By TH/Thompson

TESTED: Direct shear, sample sheared at in situ moisture content immediately upon application of normal pressure

RESULTS:

Friction Angle (Ø) = 13° Cohesion (c) = 2.7 ksf



Project No. 87-0664

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #18; 4 - 5'

Type Driven ring sample; 113 pcf dry density; 11% field moisture

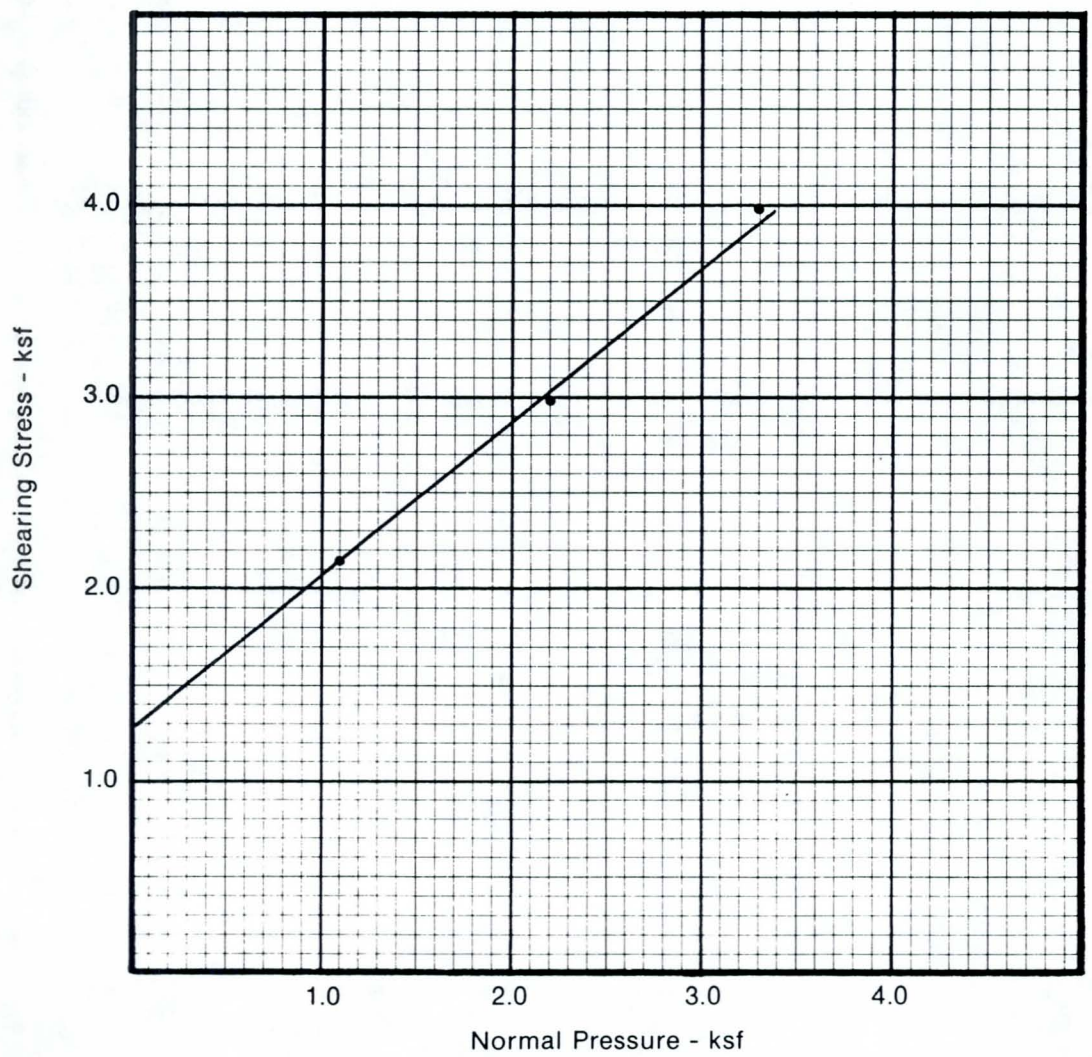
Material Sandy Clay (CL)

Sampled By TH/Thompson

TESTED: Direct shear, sample sheared at in situ moisture content immediately upon application of normal pressure

RESULTS:

Friction Angle (Ø) = 38° Cohesion (c) = 1.3 ksf



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REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #1; 14 - 22'

Type Bulk sample

Material Silty Sand with Gravel (SM)

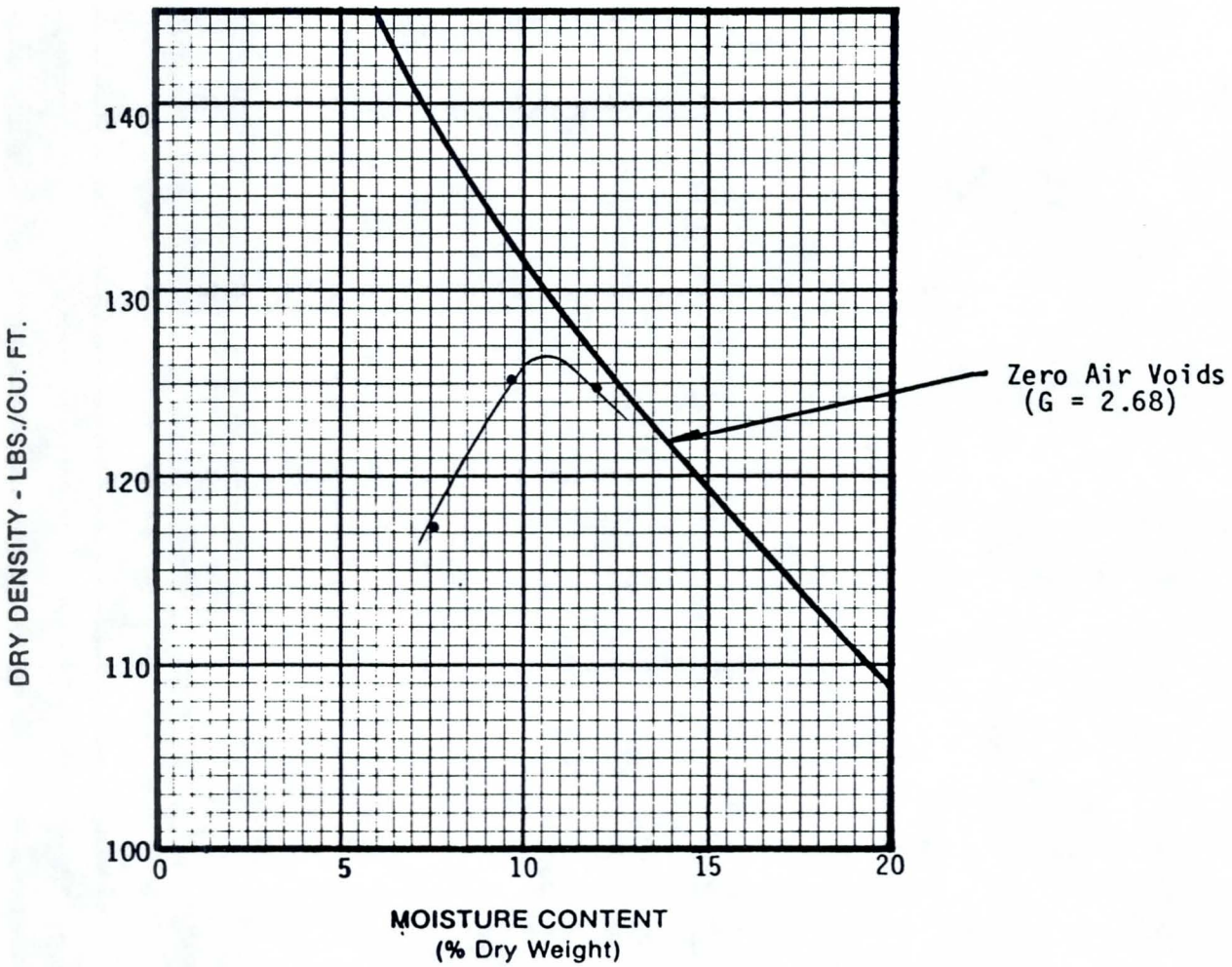
Sampled By TH/Thompson

TESTED: ASTM D698A, Moisture-Density Relationship of compacted soils

RESULTS:

Max. Dry Density, lbs./cu. ft. 126.5

Optimum Moisture Content, % 10.5



Project No. 87-0664

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #6; 0 - 11'

Type Bulk sample

Material Sandy Clay (CL)

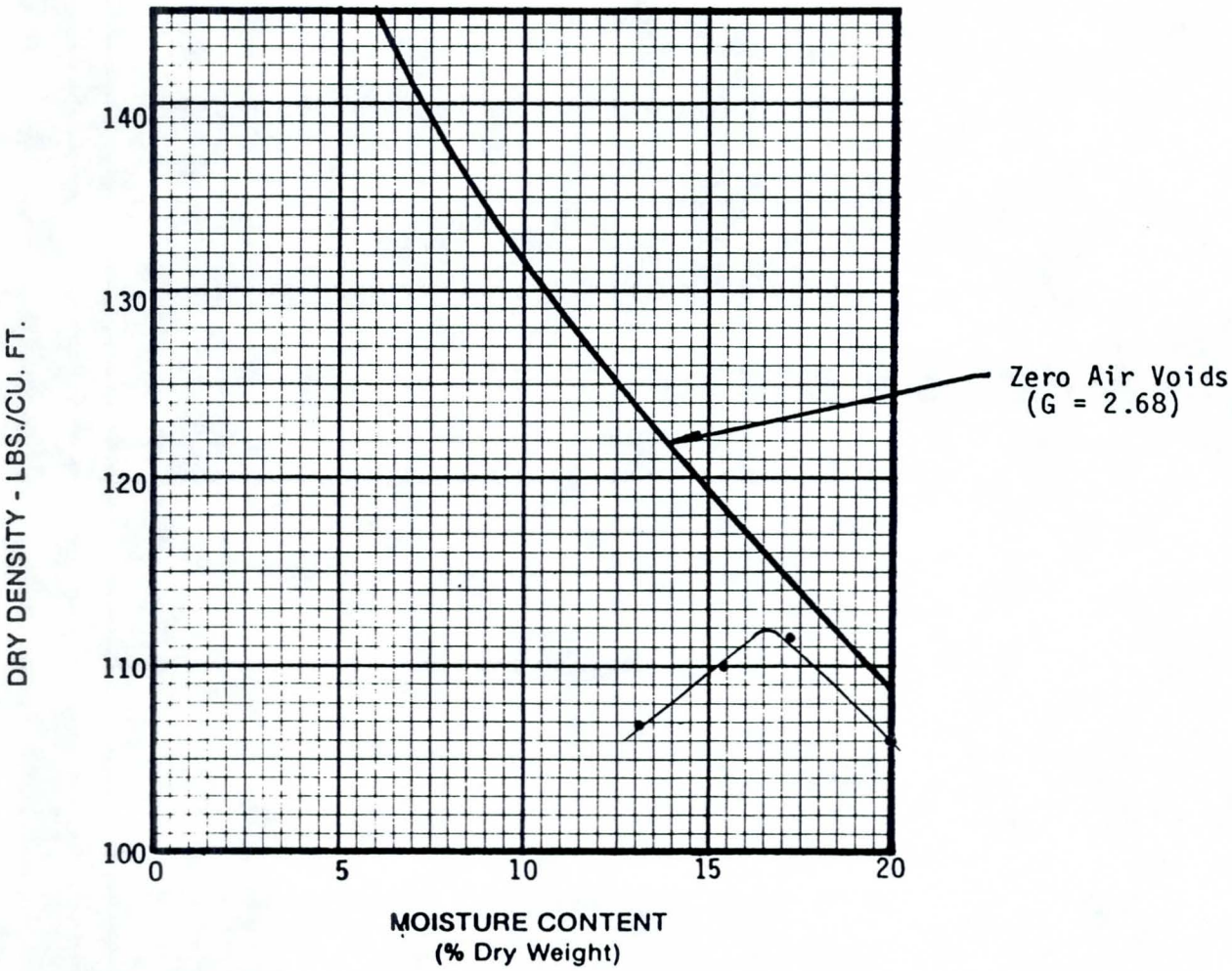
Sampled By TH/Thompson

TESTED: ASTM D698A, Moisture-Density Relationship of compacted soils

RESULTS:

Max. Dry Density, lbs./cu. ft. 112.0

Optimum Moisture Content, % 16.5



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REPORT ON LABORATORY TESTS

SAMPLE: Date 15 July 1987

Source Test Boring #18; 7 - 22'

Type Bulk sample

Material Gravelly Clayey Sand (SC)

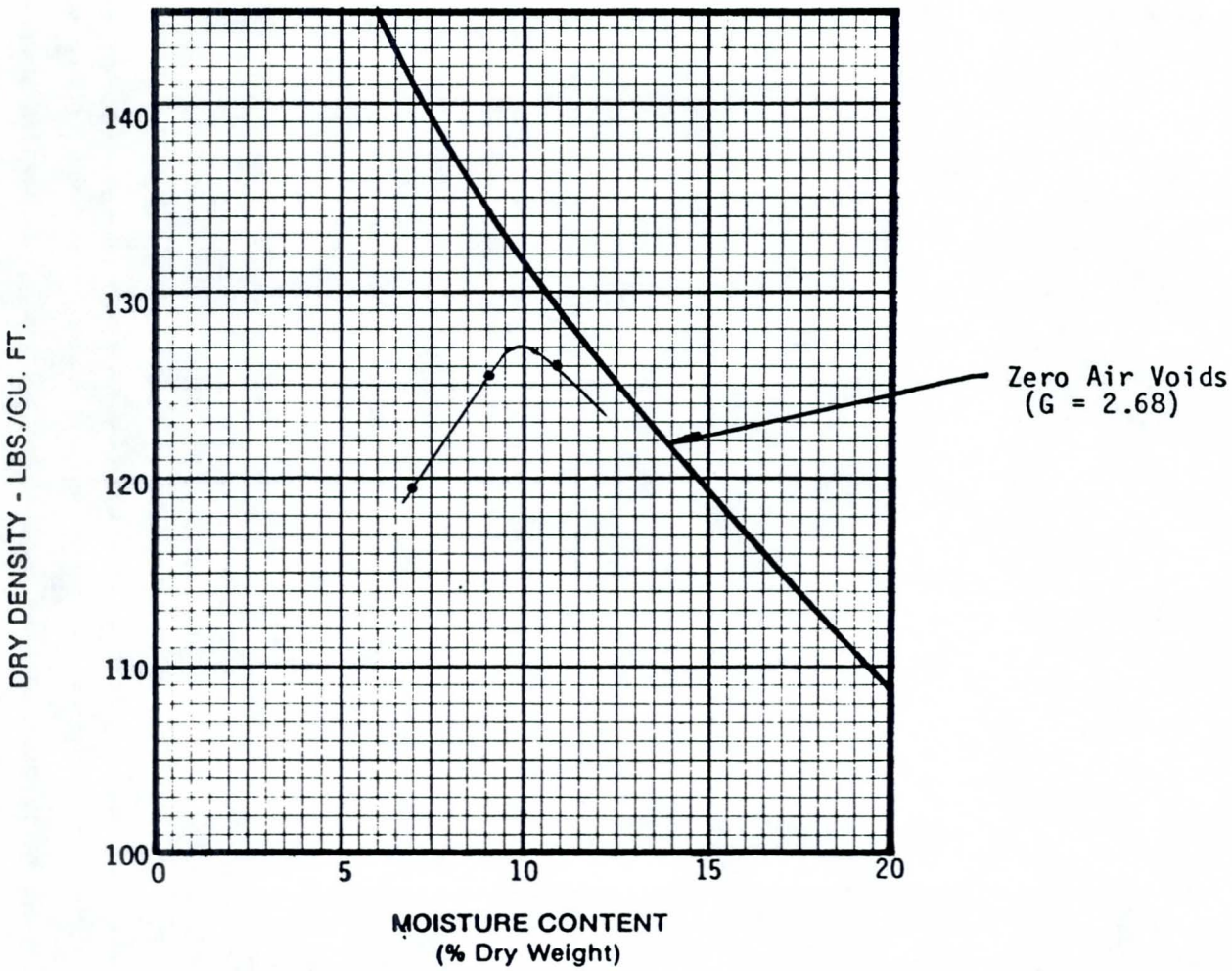
Sampled By TH/Thompson

TESTED: ASTM D698A, Moisture-Density Relationship of compacted soils

RESULTS:

Max. Dry Density, lbs./cu. ft. 127.0

Optimum Moisture Content, % 10.0



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