- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

June 15, 2020

Moeller and Associates
2021 SH 46 W, Ste. 105
New Braunfels, Texas 78132

Attention: James Ingalls, P.E.

SUBJECT: **SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM AND PAVEMENT EVALUATION FOR THE PROPOSED ORION SUBDIVISION ROADWAYS ORION DRIVE NEW BRAUNFELS, TEXAS RETL Project No.: 220270**

Dear Mr. Ingalls,

In accordance with our agreement, we have conducted a subsurface exploration and pavement evaluation for the above referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report, an electronic copy of which is being transmitted herewith. RETL will provide up to two (2) versions of this report in hard copy at the request of the client.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions and Rock Engineering and Testing Laboratory, Inc. (RETL), would be pleased to continue its role as the Geotechnical Engineer during project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

Kyle D. Hammock, P.E.
Vice President - San Antonio

ROCK ENGINEERING & TESTING LABORATORY, INC.

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SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM,
AND PAVEMENT EVALUATION
FOR THE PROPOSED
ORION SUBDIVISION ROADWAYS
ORION DRIVE
NEW BRAUNFELS, TEXAS

RETL PROJECT NUMBER: 220270

PREPARED FOR:

MOELLER AND ASSOCIATES
2021 SH 46 W, STE. 105
NEW BRAUNFELS, TEXAS 78132

JUNE 15, 2020

PREPARED BY:

ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE STREET
SAN ANTONIO, TEXAS 78216
PHONE: (210) 495-8000; FAX: (210) 495-8015

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NUMBER 2101

Kyle D. Hammock, P.E.
Vice President - San Antonio

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INTRODUCTION

This report presents the results of a subsurface exploration and pavement evaluation for the proposed Orion Subdivision Roadways to be constructed off Orion Drive in New Braunfels, Texas. This study was conducted for Moeller and Associates.

Authorization

The work for this project was performed in accordance with RETL Proposal Number P012420A dated January 24, 2020. The proposal contained a scope of work, lump sum fee and limitations. The proposal was approved and signed by James Ingalls, P.E. on May 8, 2020 and returned to RETL via email.

Purpose and Scope

The purpose of this exploration was to evaluate the soil conditions at the site and to provide pavement recommendations suitable for the proposed subdivision roadways.

The scope of the exploration and evaluation included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, provision of pavement recommendations, and preparation of this report.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the pavement design. The recommendations submitted for the proposed project are based on the available soil information and the preliminary design details provided by James Ingalls, P.E. of Moeller and Associates. If the civil engineer requires additional soil parameters to complete the pavement design, RETL will provide the requested information as a supplement to this report.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein, have been presented after being prepared in a manner consistent with the level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. RETL operates in general accordance with "*Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*", (ASTM D3740). No other representations are expressed or implied, and no warranty or guarantee is included or intended.

FIELD EXPLORATION

Scope

The field exploration completed in order to evaluate the engineering characteristics of the pavement materials included a reconnaissance of the project site, drilling the test borings, and recovering disturbed split spoon and relatively undisturbed Shelby tube samples.

A total of 20 borings were performed at the site and were drilled to a depth of 10-feet: seventeen (17) within the proposed new subdivision roadways, and three (3) within the existing Orion Drive. RETL determined the number, depth and general location of the borings and staked the borings in the field. RETL performed the boring operations. Upon completion of the drilling operations and obtaining the groundwater observations, the bore holes were backfilled with excavated soil and the site cleaned as required. A Boring Location Plan is provided in the Appendix of this report.

Drilling and Sampling Procedures

The borings were performed using a drilling rig equipped with a rotary head and solid stem auger drilling methods were used to advance the boreholes to their desired depths. Disturbed samples were obtained employing split-barrel sampling procedures in general accordance with the procedures for "*Penetration Test and Split-Barrel Sampling of Soils*" (ASTM D1586). Relatively undisturbed soil samples were obtained using thin-wall tube sampling procedures in accordance with the procedures for "*Thin Walled Tube Sampling of Soils*" (ASTM D1587).

The samples were classified in the field, placed in plastic bags, marked according to their boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Measurements

Penetration Tests - During the sampling procedures, standard penetration tests (SPT) were performed to obtain the standard penetration value of the soil. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer falling 30 inches required to advance the split-barrel sampler 1-foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three successive 6-inch penetrations. The "N" value is obtained by adding the second and third 6-inch increment number of blows. The results of standard penetration tests indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, thereby providing a basis for estimating the relative strength and compressibility of the soil profile components.

Water Level Observations - Water level observations were obtained during the test boring operations and are noted on the boring logs provided in the Appendix. The amount of water in open boreholes largely depends on the permeability of the soils encountered at the boring locations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a body of water, and recent rainfall conditions may influence the depth to the groundwater.

Ground Surface Elevations - Ground surface elevations were not provided at the boring locations. All depths referred to in this report are reported from the actual ground surface elevations at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory-testing program was conducted to determine additional pertinent engineering characteristics of the subgrade materials necessary in developing the pavement recommendations for the roadways.

The laboratory-testing program included supplementary visual classification (ASTM D2487) on all samples. In addition, selected samples were subjected water content tests (ASTM D2216), Atterberg limits tests (ASTM D4318), percent material finer than the #200 sieve tests (ASTM D1140), one dimensional swell tests (ASTM D4546), moisture density relationship tests (ASTM D 698), California Bearing Ratio (CBR) tests (ASTM D1883), pH tests, and lime series (TEX Method 121-E). Analytical testing for sulfates was performed in accordance with TxDOT Test Method TEX-620-J. Estimated soil strengths were obtained in the field using a hand penetrometer.

All phases of the laboratory-testing program were conducted in general accordance with applicable ASTM or TxDOT Specifications. The results of these tests are to be found in this report or on the accompanying boring logs provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of subsurface materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the standard penetration tests, strength tests, water level observations and laboratory tests are presented on the boring logs in numerical form.

Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, all samples will be disposed of 6 months after issuance of this report.

The stratification of the soil, as shown on the boring logs, represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined. It should be noted that, whereby the test borings were drilled and sampled by experienced technicians, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Generalized Soil Conditions

The soil conditions at the project site generally consist of fat clays (CH) and lean clays (CL) which extend to the boring termination depths of 10-feet. The fat clay soils are high to very high in plasticity and the lean clays are low to moderate in plasticity. Tested liquid limits of the soils ranged from 29 to 90-percent and the plasticity indices (PI) ranged from 18 to 57. The soils contain between 3 and 50-percent sand size particles.

Sulfate Test Results

The sulfate test results on representative subgrade samples are provided in the following table:

UPPER CLAY SUBGRADE SULFATE TEST RESULTS	
Boring No.	**Sulfate (ppm)**
B-1 (Bulk)	<100
B-16 (Bulk)	<100

The TxDOT Technical Memorandum for treatment of soils containing sulfates with lime indicates the following risk levels:

SULFATE RISK LEVELS	
Sulfate (ppm)	**Risk**
<3,000	Low
3,000-5,000	Moderate
5,000-8,000	Moderate to High
>8,000	High and Unacceptable

The sulfate concentrations indicate the subgrade soils at the site are in a low risk level of using lime as a treatment method.

Lime Series and pH Test Results

The lime series and pH test results on the bulk subgrade sample are provided in the following tables:

BORING B-1 BULK SUBGRADE SAMPLE LIME SERIES AND pH TEST RESULTS		
% Lime	**LL / PI**	**pH**
0	69 / 48	6.5
2	50 / 22	9.6
4	52 / 18	10.4
6	52 / 16	11.4
8	52 / 15	11.8

BORING B-16 BULK SUBGRADE SAMPLE LIME SERIES AND pH TEST RESULTS		
% Lime	**LL / PI**	**pH**
0	69 / 48	6.2
2	50 / 23	9.3
4	52 / 19	10.0
6	51 / 16	11.1
8	51 / 15	11.8

Where: LL = Liquid Limit (%)
PI = Plasticity Index

The results indicate the subgrade soils should be treated with 8-percent lime to reduce the plasticity index (PI) and pH to acceptable levels.

Groundwater Observations

Groundwater was not encountered in the borings during the drilling nor measured in the borings upon completion of the drilling. It should be noted that water levels in open boreholes may require anywhere from several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site may be subject to seasonal conditions, recent rainfall, drought or temperature effects.

PAVEMENT RECOMMENDATIONS

Based on the information provided to RETL, the proposed project will consist of the development of asphaltic concrete subdivision roadways with a combined length of approximately 9,000 linear feet. In addition, Orion Drive will likely be reconstructed. In designing the proposed pavements, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

1. Bearing values of the subgrade. These values can be represented by a California Bearing Ratio (CBR) for the design of flexible asphalt pavements.
2. Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.
3. Probable increase in vehicular use over the life of the pavement.
4. The availability of suitable materials to be used in the construction of the pavement and their relative costs.

Specific laboratory testing to define the subgrade strength (i.e. CBR/K values) has been performed for this analysis. **Based upon the CBR test results and the plasticity indices and strengths of the natural clay subgrade soils, a CBR value of 2 has been selected for design.**

We have evaluated the proposed new subdivision roadways considering the City of New Braunfels Street Design Standards, which are designated as "One and Two Family Residential" and "Residential Collector" streets. **The AASHTO 18-kip ESAL for the City of New Braunfels "One and Two Family Residential" and "Residential Collector" streets are 58,000 and 279,000, respectively.**

RETL used the following pavement design parameters for the flexible pavement design:

AASHTO PAVEMENT DESIGN PARAMETER	DESIGN VALUE
Reliability (R)	70%
Overall Deviation	0.45
Initial/Terminal Serviceability	4.2 / 2.0
Subgrade Design CBR	2
Design Life	20 years

The following lime treated subgrade, limestone base, and hot mix asphaltic concrete layer coefficients were selected for the pavement design:

Pavement Constituent	Layer Coefficient (α)
Lime Stabilized Subgrade	0.08
New Crushed Limestone Base (TxDOT Item 247 Type A, Grade 1-2)	0.14
Type D HMAC	0.44

The recommended hot mixed asphaltic concrete (HMAC) pavement sections are provided in the following tables:

"ONE AND TWO FAMILY RESIDENTIAL" (Required AASHTO 18-KIP ESAL = 58,000)				
Hot Mix Asphaltic Concrete	2"	2"	2"	2"
Crushed Limestone Base Material (TxDOT Item 247 Type A; Gr. 2)	12.5"	7"	9"	7"
TENSAR Geogrid	---	TX-5	---	TX-130S
Lime Stabilized Subgrade	---	---	6"	6"
Moisture Conditioned Subgrade	6"	6"	---	---
Calculated AASHTO 18-kip ESAL	62,000	71,000	60,000	71,000

"RESIDENTIAL COLLECTOR" (Required AASHTO 18-KIP ESAL = 279,000)				
Hot Mix Asphaltic Concrete	2½"	2"	2"	2"
Crushed Limestone Base Material (TxDOT Item 247 Type A; Gr. 2)	16"	11"	14"	10½"
TENSAR Geogrid	---	TX-5	---	TX-130S
Lime Stabilized Subgrade	---	---	6"	6"
Moisture Conditioned Subgrade	6"	6"	---	---
Calculated AASHTO 18-kip ESAL	297,000	293,000	285,000	285,000

It is anticipated that Orion Drive may be considered a "Residential Collector" and that a portion of the existing roadway may be upgraded to meet the required 18-kip ESAL. RETL has calculated that an overlay utilizing 3-inches of Type B HMAC and 1½-inches of Type D HMAC should meet the required 279,000 18-kip ESAL when placed over the existing roadway section.

Moisture Conditioned Subgrade

After all surface organics and deleterious materials have been removed and the desired subgrade elevation has been achieved, the upper 6-inches of exposed subgrade soils should be compacted to a minimum density of 95-percent of the maximum dry unit weight of the subgrade soils as determined by TEX 114E and at or above the optimum moisture content. Any embankment fill required to achieve the final subgrade elevation shall be placed in maximum 8-inch loose lifts and compacted as specified above.

Lime Stabilized Subgrade

Lime placement and mixing operations should be performed in accordance with TxDOT Item 260, *"LIME TREATMENT FOR MATERIALS USED AS SUBGRADE (ROAD MIXED)."* Lime shall be properly mixed at a rate of 8-percent of the maximum dry unit weight of the raw subgrade soils as determined by TEX 114E.

After proper curing time, usually 48 to 72 hours, the lime stabilized soils should be remixed and compacted to a minimum density of 95-percent of the maximum dry unit weight of the lime stabilized subgrade soils as determined by TEX 114E and at or above the optimum moisture content.

Triaxial Geogrid

The Geogrid TENSAR shall be placed in accordance with the manufacturer's recommendations. Geogrid is recommended to reduce the magnitude of cracking, reduce maintenance costs and increase the life of the flexible pavements. Alternate geogrid products will not be considered unless the submittal contains a pavement design sealed by a licensed engineer.

Limestone Base

Limestone base materials in flexible pavement areas should meet the requirements set forth in the Texas Department of Transportation (TxDOT) 2014 Standard Specifications for Construction of Highways, Streets and Bridges; Item 247, Type A, Grade 1-2. The base material should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 100-percent of the maximum dry density as determined by TEX 113E and within -2 to +2 percent of the optimum moisture content.

Hot Mix Asphalt

Hot mix asphaltic concrete should meet the requirements set forth in TxDOT Item 340 or Item 341; Type D surface course and Type B base course. The asphaltic concrete should be compacted to between 92 and 97-percent of the maximum theoretical density as determined by the Rice specific gravity.

Drainage

Proper drainage is very important for the adequate performance of asphaltic pavements. Ruts and birdbaths in asphalt pavements allow for quick deterioration of the pavement primarily due to saturation of the underlying base materials and subgrade soils.

The pavement design recommendations in this report are based on the assumption that the pavements will have good drainage. A minimum of 1-percent slope in the pavement surface is recommended.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed project, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of RETL be engaged to test and evaluate the subgrade soils in the pavement areas prior to placing pavement constituents in order to verify that the bearing soils are consistent with those encountered in the borings. RETL cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the pavements if not engaged to also provide construction observation and testing for this project. If it is required for RETL to accept any liability, then RETL must agree with the plans and perform such observation during construction as we recommend.

All sheeting, shoring and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.

APPENDIX

BORING LOCATION PLAN

NO SCALE
BORING LOCATIONS ARE APPROXIMATE

June 15, 2020
Moeller and Associates
RETL Project No.: 220270

ORION SUBDIVISION ROADWAYS
Orion Drive
New Braunfels, Texas

ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE STREET
SAN ANTONIO, TEXAS 78216
(210) 495-8000

LOG OF BORING 01

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/11/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 4.0	18	61	23	38			96	**FAT CLAY**, dark brown, moist, very stiff. (CH)
	2											
	3	SH S-2		P= 4.0	22							Same as above. (swell= 3.3%, final moisture= 31%)
	4											
	5	SH S-3		P= 2.0	28	68	25	43			92	Same as above, brown, stiff. (CH)
	6											
	7	SH S-4		P= 2.0	20							**FAT CLAY**, brown, moist, stiff.
	8											
	9	SPT S-5		N= 20	12							**SANDY LEAN CLAY**, light brown, slightly moist, very stiff.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.75092°, W -98.08205°

LOG OF BORING 02

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/11/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 4.5	15							**FAT CLAY**, dark brown, slightly moist, very stiff.
	2											
	3	SPT S-2		N= 8	30	67	25	42			97	Same as above, moist, stiff. (CH)
	4											
	5	SH S-3		P= 2.0	29							Same as above, brown.
	6											
	7	SH S-4		P= 2.0	29							**FAT CLAY**, brown, moist, stiff.
	8											
	9	SH S-5		P= 4.0	10	42	17	25			50	**SANDY LEAN CLAY**, light brown, slightly moist, very stiff. (CL)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74997°, W -98.08317°

LOG OF BORING 03

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/11/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 4.5	17	62	23	39			93	**FAT CLAY**, dark brown, moist, very stiff. (CH) (swell= 9.1%, final moisture= 30%)
	2											
	3	SH S-2		P= 2.0	29							Same as above, stiff.
	4											
	5	SH S-3		P= 2.5	26							Same as above, brown, very stiff.
	6											
	7	SH S-4		P= 3.0	23	67	25	42			79	**FAT CLAY**, with sand, brown, moist, very stiff. (CH)
	8											
	9	SPT S-5		N= 32	9							**SANDY LEAN CLAY**, light brown, dry, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74868°, W -98.08385°

LOG OF BORING 04

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/11/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater (GW) was encountered at 8-feet during drilling. GW measured at 8-feet upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 2.5	19							**FAT CLAY**, dark brown, moist, very stiff.
	2											
	3	SH S-2		P= 4.5	27	68	24	44			97	Same as above. (CH)
	4											
	5	SH S-3		P= 2.5	20							Same as above, brown.
	6											
	7	SPT S-4		N= 18	20							**FAT CLAY**, brown, moist, very stiff.
	8											
	9	SPT S-5		N= 33	20	46	15	31			52	**SANDY LEAN CLAY**, light brown, moist, hard. (CL)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74745°, W -98.08433°

LOG OF BORING 05

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	29	65	24	41			95	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 2.5	30							Same as above, very stiff.
	4											
	5	SH S-3		P= 2.0	31	90	33	57			87	Same as above. (CH)
	6											
	7	SH S-4		P= 3.0	16							**FAT CLAY**, brown, slightly moist, very stiff.
	8											
	9	SPT S-5		N= 24	18							**SANDY LEAN CLAY**, light brown, moist, very stiff.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74612°, W -98.08371°

LOG OF BORING 06

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	30							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-2		P= 1.5	31	69	25	44			94	Same as above. (CH)
	4											
	5	SH S-3		P= 1.5	20							Same as above, brown.
	6											
	7	SH S-4		P= 3.0	21							**FAT CLAY**, brown, moist, very stiff.
	8											
	9	SPT S-5		N= 17	16	65	22	43			50	**SANDY FAT CLAY**, with gravel, light brown, slightly moist, very stiff. (CH)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74717°, W -98.08248°

LOG OF BORING 07

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	21	64	25	39			95	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 1.5	30							Same as above.
	4											
	5	SH S-3		P= 2.5	23	78	27	51			76	**FAT CLAY**, with sand, brown, moist, very stiff. (CH)
	6											
	7	SH S-4		P= 3.0	16							Same as above, light brown.
	8											
	9	SPT S-5		N= 15	18							Same as above.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74825°, W -98.08123°

LOG OF BORING 08

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 3.0	24							**FAT CLAY**, dark brown, moist, very stiff.
	2											
	3	SH S-2		P= 3.0	24	64	23	41			87	Same as above. (CH)
	4											
	5	SPT S-3		N= 13	12							**SANDY LEAN CLAY**, with gravel, light brown, slightly moist, stiff.
	6											
	7	SPT S-4		N= 19	16							Same as above, very stiff.
	8											
	9	SPT S-5		N= 52	15	42	15	27			53	Same as above, hard. (CL)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74919°, W -98.08011°

LOG OF BORING 09

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	28	64	25	39			86	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 2.0	28							Same as above.
	4											
	5	SPT S-3		N= 23	11	29	11	18			50	**SANDY LEAN CLAY**, with gravel, light brown, moist, very stiff. (CL)
	6											
	7	SPT S-4		N= 26	13							Same as above.
	8											
	9	SPT S-5		N= 49	6							Same as above, dry, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.75007°, W -98.08107°

LOG OF BORING 10

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	31	64	22	42			95	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 1.0	31							Same as above.
	4											
	5	SH S-3		P= 2.0	34							Same as above.
	6											
	7	SH S-4		P= 4.0	32	71	20	51			79	**FAT CLAY**, with sand, light brown, moist, very stiff. (CH)
	8											
	9	SPT S-5		N= 30	16						56	**SANDY LEAN CLAY**, light brown, moist, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.75005°, W -98.08214°

LOG OF BORING 11

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270

DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	29							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-2		P= 2.0	29	66	23	43			93	Same as above. (CH)
	4											
	5	SH S-3		P= 2.0	29							Same as above.
	6											
	7	SH S-4		P= 2.5	24							**FAT CLAY**, light brown, moist, very stiff.
	8											
	9	SPT S-5		N= 16	22	69	27	42			66	**SANDY FAT CLAY**, light brown, moist, very stiff. (CH)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74923°, W -98.08119°

LOG OF BORING 12

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	28							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-2		P= 2.0	30	64	24	40			94	Same as above. (CH)
	4											
	5	SH S-3		P= 2.0	21	74	27	47			91	Same as above, brown. (CH)
	6											
	7	SPT S-4		N= 13	26							**FAT CLAY**, light brown, moist, stiff.
	8											
	9	SPT S-5		N= 31	7							**SANDY FAT CLAY**, with gravel, light brown, dry, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74909°, W -98.08216°

LOG OF BORING 13

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	28	59	21	38			94	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 1.5	29							Same as above.
	4											
	5	SH S-3		P= 2.5	29							Same as above, brown.
	6											
	7	SH S-4		P= 3.0	21	62	24	38			65	**SANDY FAT CLAY**, light brown, moist, very stiff. (CH)
	8											
	9	SPT S-5		N= 51	9							**SANDY LEAN CLAY**, with gravel, light brown, dry, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74824°, W -98.08232°

LOG OF BORING 14

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 2.0	29							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-2		P= 2.5	28	62	22	40			94	Same as above, very stiff. (CH)
	4											
	5	SH S-3		P= 2.0	24	52	16	36			91	Same as above. (CH)
	6											
	7	SPT S-4		N= 18	22							**FAT CLAY**, light brown, moist, very stiff.
	8											
	9	SPT S-5		N= 22	12							**SANDY LEAN CLAY**, with gravel, light brown, slightly moist, very stiff.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74902°, W -98.08323°

LOG OF BORING 15

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 2.5	26	60	21	39			94	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 2.0	28							Same as above, stiff.
	4											
	5	SH S-3		P= 2.0	29							Same as above.
	6											
	7	SPT S-4		N= 18	20							**FAT CLAY**, with gravel, light brown, moist, very stiff.
	8											
	9	SPT S-5		N= 32	17	48	18	30			73	**LEAN CLAY**, with gravel, light brown, moist, hard. (CL)
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74799°, W -98.08332°

LOG OF BORING 16

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	27	59	22	37			95	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 1.5	28							Same as above.
	4											
	5	SH S-3		P= 2.0	28	65	19	46			86	Same as above. (CH)
	6											
	7	SPT S-4		N= 18	13							**FAT CLAY**, with gravel, light brown, slightly moist, very stiff.
	8											
	9	SPT S-5		N= 26	20							Same as above, moist.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74715°, W -98.08359°

LOG OF BORING 17

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/22/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 1.5	31							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-2		P= 2.0	30	68	20	48			95	Same as above. (CH)
	4											
	5	SH S-3		P= 2.0	28							Same as above.
	6											
	7	SPT S-4		N= 16	25	74	21	53			80	**FAT CLAY**, with gravel, light brown, moist, very stiff. (CH)
	8											
	9	SPT S-5		N= 29	14							Same as above.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74641°, W -98.08450°

LOG OF BORING 18

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/13/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		AUGER S-1			5							**ASPHALT= 3-INCHES / BASE= 4-INCHES**
	1	SPT S-2		N= 8	25	62	23	39			90	**FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-3		P= 4.5+	22							Same as above, very stiff. (swell= 9.9%, final moisture= 29%)
	4											
	5	SH S-4		P= 4.5+	21	71	27	44			93	Same as above. (CH)
	6											
	7	SH S-5		P= 4.5+	22							**FAT CLAY**, dark brown, moist, very stiff.
	8											
	9	SPT S-6		N= 30	19							Same as above, with gravel, brown, hard.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74723°, W -98.07703°

LOG OF BORING 19

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/13/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		AUGER S-1			6							**ASPHALT= 2-INCHES / BASE= 8-INCHES**
	1	SPT S-2		N= 11	27							**FAT CLAY**, dark brown, moist, stiff.
	2											
	3	SH S-3		P= 4.5+	22	75	27	48			94	Same as above, very stiff. (CH)
	4											
	5	SH S-4		P= 4.5+	17							Same as above.
	6											
	7	SPT S-5		N= 23	13	53	22	31			77	**FAT CLAY**, with gravel and calcareous material, brown, slightly moist, very stiff.
	8											
	9	SPT S-6		N= 28	20							Same as above, moist.
	10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.74919°, W -98.07927°

LOG OF BORING 20

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: Moeller and Associates
PROJECT: Orion Subdivision Roadways
LOCATION: Orion Dr; New Braunfels, Texas
NUMBER: 220270
DATE(S) DRILLED: 05/11/2020

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling, nor observed upon the completion of the drilling.

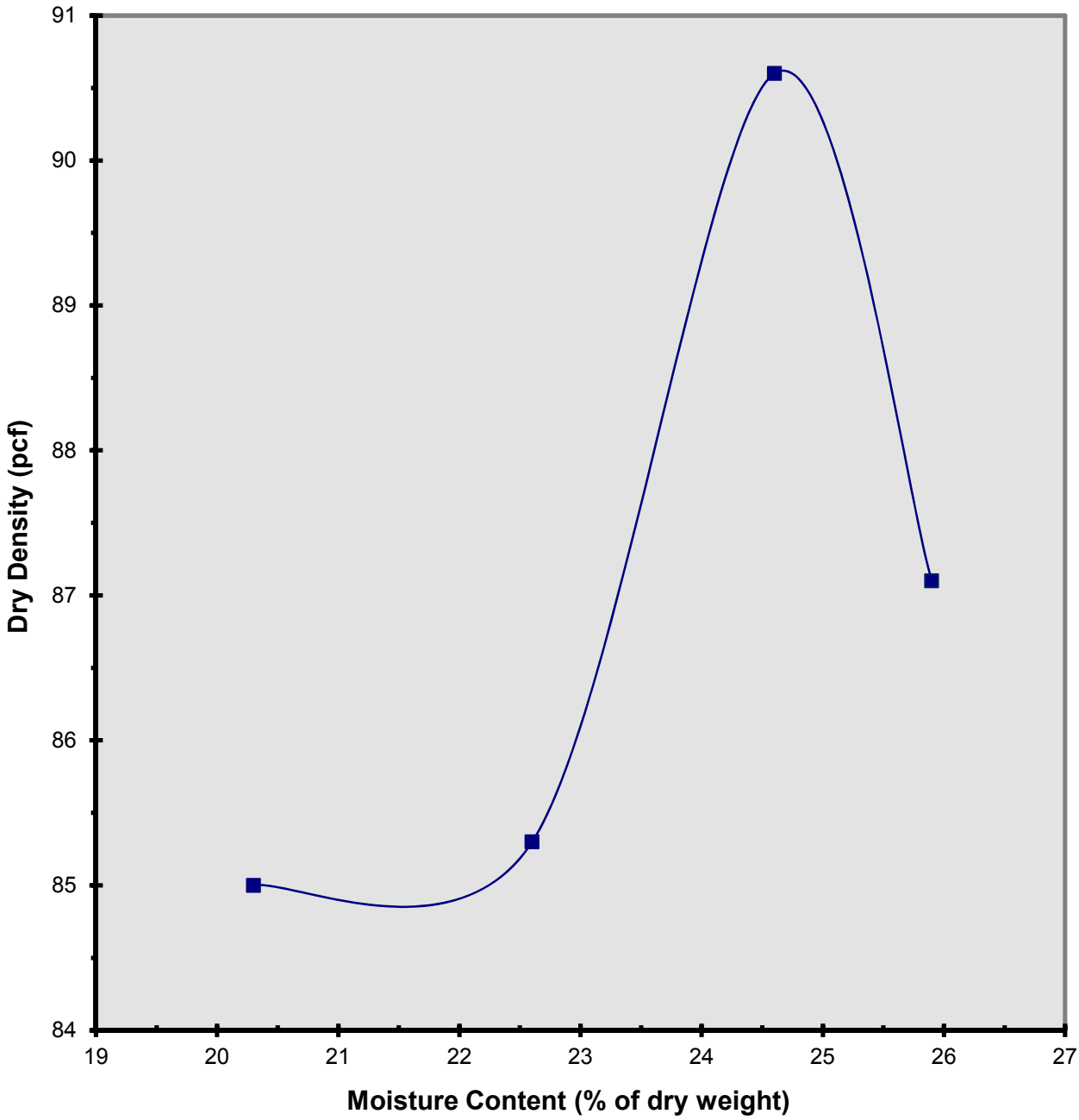
SURFACE ELEVATION: N/A

DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	AUGER S-1			6							**ASPHALT= 1-INCH / BASE= 8-INCHES**
1	SPT S-2		N= 8	25	66	25	41			92	**FAT CLAY**, dark brown, moist, stiff. (CH)
2											
3	SPT S-3		N= 9	27							Same as above.
4											
5	SH S-4		P= 2.0	25	75	27	48			92	Same as above. (CH) (swell= 2.7%, final moisture= 31%)
6											
7	SH S-5		P= 2.0	23							**FAT CLAY**, brown, moist, stiff.
8											
9	SPT S-6		N= 33	9							**SANDY LEAN CLAY**, with gravel, brown, dry, hard.
10											Boring terminated at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.75087°, W -98.08121°

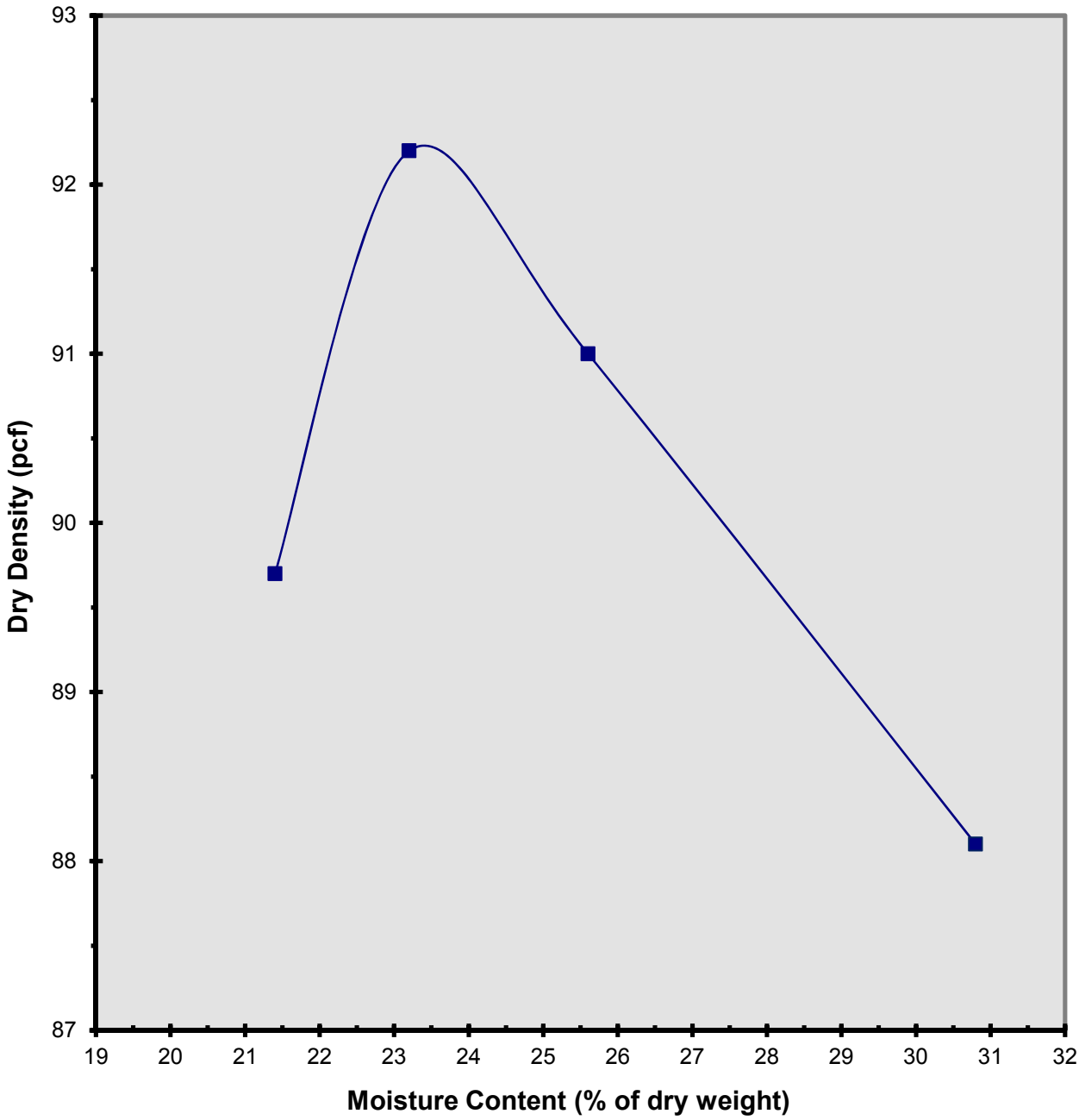
DENSITY VERSUS MOISTURE CURVE



PROJECT	MAXIMUM LAB DENSITY	LAB DATA
Orion Subdivision Roadways New Braunfels, Texas	90.6 pcf ASTM D698	LL = 69 PI = 48 Minus #200 = 96%
SAMPLE DESCRIPTION	**OPTIMUM MOISTURE**	**RETL PROJ. NO.**
Bulk Sample Boring B-1 Subgrade Dark Brown Fat CLAY (CH)	24.6%	220270

ROCK ENGINEERING AND TESTING LABORATORY, INC.

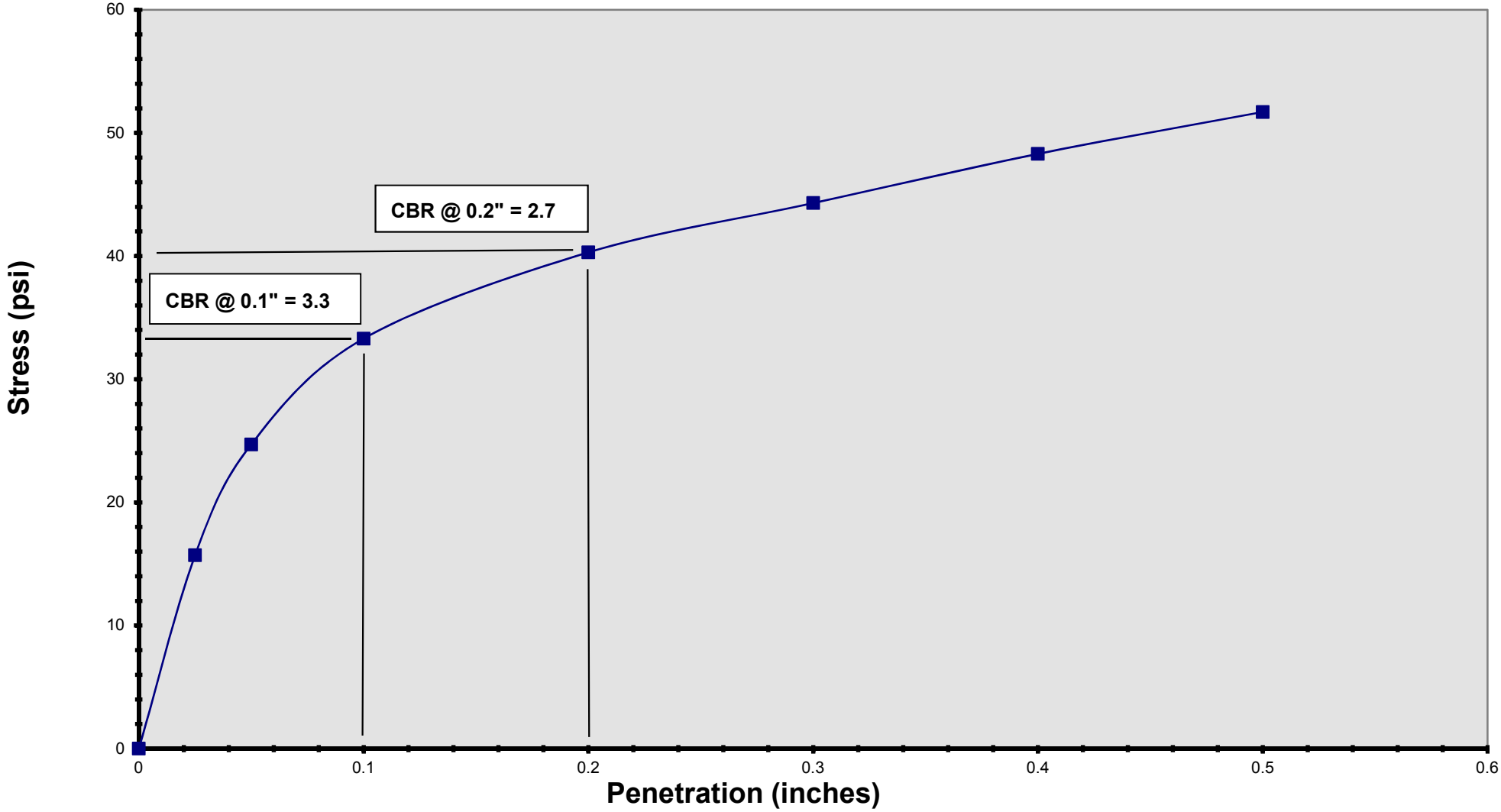
DENSITY VERSUS MOISTURE CURVE



PROJECT	MAXIMUM LAB DENSITY	LAB DATA
Orion Subdivision Roadways New Braunfels, Texas	92.3 pcf ASTM D698	LL = 62 PI = 42 Minus #200 = 95%
SAMPLE DESCRIPTION	**OPTIMUM MOISTURE**	**RETL PROJ. NO.**
Bulk Sample Boring B-16 Subgrade Dark Brown Fat CLAY (CH)	23.6%	220270

ROCK ENGINEERING AND TESTING LABORATORY, INC.

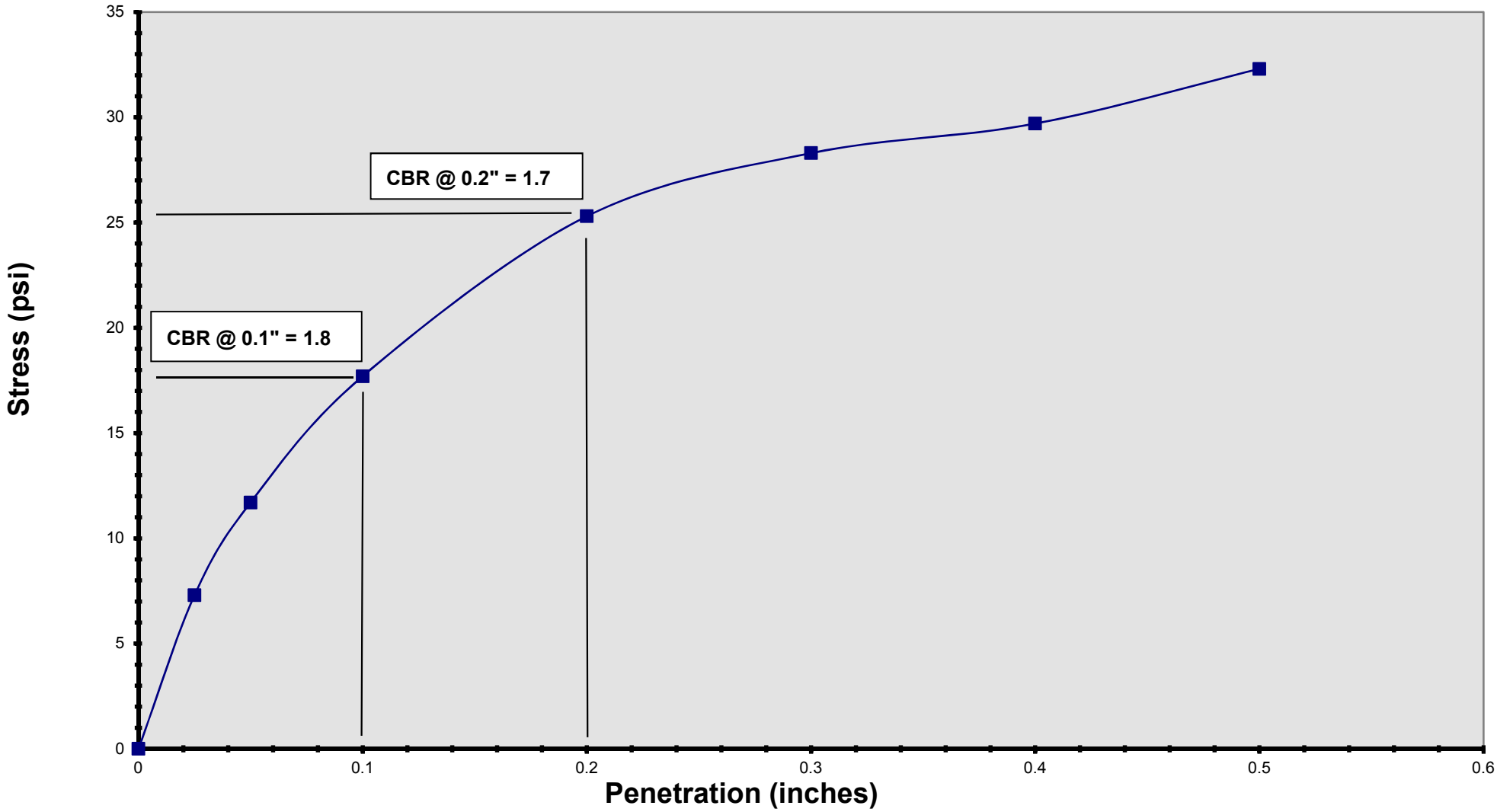
CBR - Stress versus Penetration Curve



PROJECT DESCRIPTION	MOLDED DRY DENSITY	CBR @ 0.1 INCH PENETRATION	TEST DATE
Orion Subdivision Roadways New Braunfels, Texas	86.3 pcf (95.3% of max density)	3.3	June 2020
SAMPLE DESCRIPTION	**MOLDED MOISTURE CONT.**	**CBR @ 0.2 INCHES PENETRATION**	**RETL PROJ. NO.**
Bulk Sample Boring B-1 Subgrade Dark Brown Fat CLAY (CH)	25.3%	2.7	220270

ROCK ENGINEERING AND TESTING LABORATORY, INC.

CBR - Stress versus Penetration Curve



PROJECT DESCRIPTION	MOLDED DRY DENSITY	CBR @ 0.1 INCH PENETRATION	TEST DATE
Orion Subdivision Roadways New Braunfels, Texas	88.4 pcf (95.8% of max density)	1.8	June 2020
SAMPLE DESCRIPTION	**MOLDED MOISTURE CONT.**	**CBR @ 0.2 INCHES PENETRATION**	**RETL PROJ. NO.**
Bulk Sample Boring B-16 Subgrade Dark Brown Fat CLAY (CH)	24.7%	1.7	220270

ROCK ENGINEERING AND TESTING LABORATORY, INC.

Engineering & Testing
Laboratory, Inc.

Rock Engineering & Testing Laboratory
10856 Vandale
San Antonio, TX 78216
Telephone: 210-495-8000
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KEY TO SOIL CLASSIFICATION AND SYMBOLS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well Graded Gravels or Gravel-Sand mixtures, little or no fines
		GP	Poorly Graded Gravels or Gravel-Sand mixtures, little or no fines
		GM	Silty Gravels, Gravel-Sand-Silt mixtures
		GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SAND AND SANDY SOILS	SW	Well Graded Sands or Gravelly Sands, little or no fines
		SP	Poorly Graded Sands or Gravelly Sands, little or no fines
		SM	Silty Sands, Sand-Silt Mixtures
		SC	Clayey Sands, Sand-Clay mixtures
FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML	Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts
		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
	SILTS AND CLAYS LL > 50	MH	Inorganic Silts, Micaceous or Diatomaceous fine Sandy or Silty soils, Elastic Silts
		CH	Inorganic Clays of high plasticity, Fat Clays
		OH	Organic Clays of medium to high plasticity, Organic Silts
HIGHLY ORGANIC SOILS		PT	Peat and other Highly Organic soils

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance

FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical

LAMINATED (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top

CRUMBLY - cohesive soils which break into small blocks or crumbs on drying

CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular

WELL GRADED - having wide range in grain sizes and substantial amounts of all intermediate particle sizes

POORLY GRADED - predominantly of one grain size uniformly graded) or having a range of sizes with some intermediate size missing (gap or skip graded)

SYMBOLS FOR TEST DATA

- — Groundwater Level (Initial Reading)
- — Groundwater Level (Final Reading)
- — Shelby Tube Sample
- — SPT Samples
- — Auger Sample
- — Rock Core

TERMS DESCRIBING CONSISTENCY OF SOIL

COARSE GRAINED SOILS		FINE GRAINED SOILS		
DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	UNCONFINED COMPRESSION TONS PER SQ. FT.
Very Loose	0 - 4	Very Soft	< 2	< 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.50
Medium	10 - 30	Firm	4 - 8	0.50 - 1.00
Dense	30 - 50	Stiff	8 - 15	1.00 - 2.00
Very Dense	over 50	Very Stiff	15 - 30	2.00 - 4.00
		Hard	over 30	over 4.00

Field Classification for "Consistency" is determined with a 0.25" diameter penetrometer