GEOTECHNICAL ENGINEERING REPORT

Pheasant Run Crossing
Pavement Evaluation
Blacksburg, Virginia

Schnabel Reference No. 17C16038.00
July 24, 2017

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July 24, 2017

Mr. Reggie Britts
Raines Property Management
1007 North Main Street
Blacksburg, VA 24060

Subject: **Project No. 17C16038.00, Geotechnical Engineering Report, Pheasant Run Crossing Pavement Evaluation, Blacksburg, Virginia**

Dear Mr. Britts:

SCHNABEL ENGINEERING, LLC (Schnabel) is pleased to submit our geotechnical engineering report for this project. This study was performed in accordance with our proposal dated March 22, 2017 and accepted May 11, 2017.

SCOPE OF SERVICES

Our proposal dated March 22, 2017 defines the scope of services for this project. The scope of services includes the following:

- Field exploration consisting of drilling hand auger probes at five (5) locations within the travel lanes of the existing pavements.
- Soil laboratory testing consisting of natural moisture content (5), soil classification (1), laboratory proctor (1), and California Bearing Ratio (1) tests.
- Preparation of a summary report documenting our observations in the hand auger probes, hand auger probe logs, soil laboratory test results, our opinions regarding adequacy of the existing pavement sections for the traffic loading, and recommendations for pavement repairs or modifications, if necessary.

SITE AND PROJECT DESCRIPTION

The subject pavement consists of automobile driveways and parking spaces serving the townhouses at Pheasant Run Crossing off Chickahominy Drive in the north end of Blacksburg, Virginia. A single entrance provides access into the property off Chickahominy Drive. This entrance drive is named Laurence Lane. Two additional interior driveways, named Christine Court and Jennifer Drive, extend northward off Laurence Lane. A total of about 225 parking spaces line these driveways. The property was developed for its current use in the 1990's.

We initially visited the site on March 21, 2017 and met with Mr. Reggie Britts with Raines Property Management. Mr. Britts explained that most high traffic areas had been overlain or repaved once since the original construction and the homeowners association was interested in knowing whether the existing pavements are adequate for the current traffic loading and whether pavement modifications are necessary. We observed some random pavement cracking in high traffic areas but did not observe significant depressions or ruts in the pavement surface or clear indications of past groundwater seepage.

SUBSURFACE EXPLORATION AND LABORATORY TESTING PROGRAM

We performed a subsurface exploration and field testing program to identify the subsurface stratigraphy underlying the site and to evaluate the geotechnical properties of the materials encountered. This program consisted of hand auger probes. Exploration methods used are discussed below. The appendices contain the results of our exploration.

Subsurface Exploration Methods

Hand Auger Probes

Our personnel drilled five hand auger probes in traffic areas on May 31 and June 1, 2017. We cored through the asphalt at each hand auger probe location using an electric core drill. Probes were then advanced to their target depth of 3 ft using a 3-1/4" diameter bucket hand auger. We measured the asphalt and base stone thicknesses at each hand auger probe location. We also obtained Geostick Penetrometer readings at various depths in each probe and collected soil samples for testing in our soils laboratory. Appendix A includes specific observations, remarks, and logs for the hand auger probes; classification criteria; drilling methods; and sampling protocols. Figure 1, included at the end of this report, indicates the approximate hand auger probe locations. We will retain soil samples up to 45 days beyond the issuance of this report, unless you request other disposition.

Soil Laboratory Testing

Our laboratory performed tests on selected samples collected during the subsurface exploration. The testing aided in the classification of materials encountered in the subsurface exploration and provided data for use in the assessment of the pavement subgrades. The results of the laboratory tests are included in Appendix B and are summarized in the Subsurface Conditions section of this report. Selected test results are also shown on the hand auger probe logs in Appendix A.

Index Testing

We performed index testing on one composite bulk sample collected as part of the exploration to provide soil classifications and to provide parameters for use with published correlations with soil properties. Index testing included performing natural moisture content, Atterberg Limit, and gradation tests on a bulk sample of soil.

Compaction and CBR Testing

We performed Standard Proctor compaction and CBR testing to evaluate compaction characteristics and to provide soil parameters for pavement design. Testing was performed on one composite bulk sample from all of the hand auger probes representing Stratum A fill soils, which were predominant in the probes.

SUBSURFACE CONDITIONS

During our exploration, we encountered the following stratigraphy:

Pavement

All five hand auger probes were drilled in the travel lanes of the existing pavement. The pavement sections encountered are summarized in Table 1.

Table 1: Existing Pavement Sections

Hand Auger Probe Number	Approx. Asphalt Thickness (in)	Approx. Stone Base Course Thickness (in)
HA-1	2.75	8.75
HA-2	3.25	8.75
HA-3	4.00	8.00
HA-4	2.50	10.00
HA-5	3.25	9.25

Stratum A – Existing Fill

We encountered firm to stiff consistency existing fill soils beneath the pavement section in all five of the hand auger probes to depths of 2.5 to 3.0 ft, the maximum depth explored. Existing fill encountered in the hand auger probes consisted of fat clay with sand and lean clay with sand. Gravel was present in the samples recovered. Geostick penetrations in Stratum A fill ½ inch to 2.5 inches.

Laboratory tests conducted on samples representing the existing fill soils of Stratum A indicated natural moisture contents ranging from 26.1 to 33.1 percent. These moisture contents are about 6 percent to 13 percent above the optimum for compaction. A Liquid Limit (LL) of 54 and Plasticity Index (PI) of 29 were recorded, indicating relatively high plasticity.

We conducted a Standard Proctor Compaction test and two CBR tests on a bulk sample representing the fill soils. One CBR test was performed at optimal moisture and compaction conditions and a second CBR test was performed at conditions that were more representative of the subgrade conditions encountered in the hand auger probes. The second CBR was performed on a sample remolded at about five percent above the optimum moisture content and compacted to about 96 percent of the maximum dry density. The results are summarized in Table 2.

Table 2: Proctor and CBR Summary

Hand Auger Probe	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR Dry Density at Compaction (pcf)	CBR Moisture Content at Compaction (pcf)	CBR Value
Composite	102.0	20.6	102.8	20.9	8.7
			98.2	25.4	4.0

Stratum B – Residual

Residual soil consists of material derived from weathering of the underlying bedrock. We encountered residual soils in Hand Auger Probe HA-3 beneath Stratum A fill at a depth of about 2.5 ft. The soil consisted of firm consistency FAT CLAY WITH SAND (CH).

Groundwater

We did not observe groundwater in the hand auger probes. We did not obtain long-term water level readings since we backfilled the hand auger probes upon completion for safety. During our initial site visit on March 21 and during our subsurface exploration on May 31 and June 1, 2017, we did not observe water seeping from pavements and there were no clear indications of past groundwater seepage through pavements. The presence and elevation of perched water may vary significantly with variations in weather conditions.

GEOTECHNICAL RECOMMENDATIONS

We based our geotechnical engineering analysis on the information developed from our subsurface exploration and soil laboratory testing, along with our site observations.

Existing Pavements

We evaluated the suitability of the existing pavement sections observed in the hand auger probes using the VDOT Vaswani design method for flexible pavements. This method is based on a design CBR value that is two-thirds of the laboratory value when the sample is remolded to ideal conditions. For this project, we identified that the soils encountered beneath the existing pavements were significantly wetter than the optimum for compaction. To better model the existing subgrade pavement conditions, we molded a second sample at approximately five percent above the optimum for compaction at about 96 percent of the maximum dry density. We used the resulting CBR value of 4.0 in our analyses without the two-thirds reduction because the molding conditions more closely modeled the actual conditions. A resiliency factor of 2.0 was also used in this design method. The Vaswani method calculates a minimum thickness index based on the input CBR value and traffic volume. For this site, the calculated Vaswani minimum thickness index is 14.2 based on an estimated traffic volume of 1,000 vehicles per day. To determine the equivalent thickness of a pavement, equivalency factors are applied to the components of the pavement section. For stone base course, an equivalency factor of 1.0 is used for thicknesses up to 8 inches. If the total stone thickness exceeds 8 inches, then an equivalency factor of 0.6 is used for the portion greater than 8 inches. For asphalt, an equivalency factor of 1.67 is used in the Vaswani Method. The calculated in-place equivalent thicknesses at the five hand auger probe locations are tabulated below:

Table 3: Thickness Indices of Existing Pavement Sections

Hand Auger Probe Number	Asphalt		Stone Base Course		Total Equivalent Thickness (in)	Maximum Design Traffic Capacity (vpd)
	Approx. Measured Thickness (in)	Equivalent Thickness (in)	Approx. Stone Measured Thickness (in)	Equivalent Thickness (in)		
HA-1	2.75	4.59	8.75	8.45	13.04	750
HA-2	3.25	5.43	8.75	8.45	13.88	900
HA-3	4.00	6.68	8.00	8.00	14.68	1,100
HA-4	2.50	4.18	10.00	9.20	13.38	800
HA-5	3.25	5.43	9.25	8.75	14.18	1,000

The results indicate that for the maximum estimated traffic loading of 1,000 vehicles per day, at two of hand auger probe locations (HA-3 and HA-5), the thicknesses of the existing pavement sections are adequate. At the remaining three locations (HA-1, HA-2, and HA-4), the existing pavement thicknesses are marginally inadequate. It should be noted that the maximum traffic volume occurs only at and near the main entrance with Chickahominy Drive. Elsewhere, the traffic volumes are lower, as vehicles leave the driveways and park. With lower traffic volumes, the Vaswani thickness index will also be lower. Also, the 1,000 vehicle per day traffic volume is our estimate based on 225 parking spaces, and could be higher or lower. The table also indicates the design traffic capacity in vehicles per day (vpd) at each hand auger probe location based on the measured thickness of the existing pavement section. These design capacities range from 750 vpd to 1,100 vpd, with an average of 900 vpd. Based on our observations, test results, and pavement design analyses, we conclude that, on average, the existing pavement sections and underlying subgrades are marginally adequate to support the estimated traffic load. The observed random pavement cracking could be related to wet subgrade conditions and/or inadequate pavement thicknesses.

Recommendations

Pavements require ongoing maintenance and periodic repaving and/or resurfacing of high traffic areas should be a part of long-term planning to preserve the utility of pavements. The lifespan of a pavement surface is affected by a number of factors including, but not limited to, subgrade conditions, quality of construction, groundwater, traffic loading patterns, heavy loading events, plowing, surface water runoff, and freeze/thaw cycles.

It appears that the pavements at this site are underlain by relatively wet subgrades composed of clay soils. The high moisture content of these subgrades results in a lower CBR value, which could be contributing to the observed random cracking and shorter pavement surface lifespan. We anticipate that a 1-inch thick asphalt overlay in high-traffic areas should be adequate to reduce the occurrence of random surface cracking.

Surface cracking that develops from normal wear and/or loading from excess truck traffic provides and avenue for surface water to infiltrate the asphalt and potentially saturate and weaken the underlying stone

base and subgrades. Weakened stone base and/or subgrades can lead to the rapid propagation of pavement cracks under traffic loading. Therefore, we recommend that pavement cracks be sealed periodically to limit the potential for surface water infiltration. Pavements typically sustain the greatest wear and damage during the winter months with frequent freeze/thaw cycles and the adverse effects of snow plowing. Therefore, pavement sealing should be performed in the spring or summer months.

LIMITATIONS

We based the analyses and recommendations submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

This report has been prepared to aid in the evaluation of this site and to assist in the evaluation of existing pavements. It is intended for use concerning this specific project. We based our recommendations on information on the site and estimated traffic volumes as described in this report. Substantial changes in traffic volumes, locations, or grades should be brought to our attention so we can modify our recommendations as needed.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or other instrument of service.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

Steven J. Winter, PE
Senior Associate

Steven E. Conner, PE
Principal

SJW:SEC:rl

Figure
Appendix A: Subsurface Exploration Data
Appendix B: Soil Laboratory Test Data

FIGURE

Figure 1: Hand Auger Probe Location Plan

HA-1

Schnabel ENGINEERING		Figure Name:	Done:	Figure Number:
		Project Number:	Reviewed:	Date:

APPENDIX A

SUBSURFACE EXPLORATION DATA

Subsurface Exploration Procedures
General Notes for Subsurface Exploration Logs
Identification of Soil
Hand Auger Probe Logs, HA-1 through HA-5

SUBSURFACE EXPLORATION PROCEDURES

Hand Auger Probes

Our personnel drilled the hand auger probes using a 3-1/4-inch O.D. auger. We visually classified the soils encountered according to ASTM D2488. Geostick penetrometer readings were taken during excavation. Geostick penetrometer readings give a general indication of the soil's in place density or consistency. Geostick penetrations are shown in the Remarks column as "GP= ."

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Residual soils are derived through the in-place physical and chemical weathering of the underlying rock. Disintegrated rock is defined as residual material with SPT N values between 60 blows per foot and refusal. Refusal is defined as an N value of 50 blows for a penetration of one inch or less.

Hand Auger Probe Locations

Hand auger probe locations were marked by Schnabel Engineering personnel by taping and pacing from existing features. Approximate boring locations are shown on Figure 1. Locations should be considered no more accurate than the methods used to determine them.

GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1⅜-inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6 inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.
2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Estimated water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.
4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 50 blows for 1 inch or less of penetration.
5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.
6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
7. Key to symbols and abbreviations:

S-1, SPT	Sample No., Standard Penetration Test
5+10+1	Number of blows in each 6-inch increment

S-1, SAMPLE	Sample No., Hand Auger or Test Pit sample

LL	Liquid Limit
MC	Moisture Content (percent)
PL	Plastic Limit
GP	Geostick Penetrometer Reading (inches)
%Passing#200	Percent by weight passing a No. 200 Sieve

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

			SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS ..... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.

FILL ..... Man-made deposit containing soil, rock and often foreign matter.

PROBABLE FILL ..... Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

DISINTEGRATED ROCK (DR) ..... Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.

PARTIALLY WEATHERED ROCK (PWR) ..... Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.

BOULDERS & COBBLES ..... Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12-inch size.

LENSES ..... 0 to ½-inch seam within a material in a test pit.

LAYERS ..... ½ to 12-inch seam within a material in a test pit.

POCKET ..... Discontinuous body within a material in a test pit.

MOISTURE CONDITIONS ..... Wet, moist or dry to indicate visual appearance of specimen.

COLOR ..... Overall color, with modifiers such as light to dark or variation in coloration.

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HAND AUGER LOG

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, Virginia

Hand Auger Number: HA-1
Contract Number: 17C16038.00
Sheet: 1 of 1

Contractor: Not Applicable

Contractor Foreman: Not Applicable

Schnabel Representative: M. Spencer

Equipment: 3.25" Bucket Hand Auger

Method: Hand Auger

Dates Started: 6/1/17 **Finished:** 6/1/17

Location: See Location Plan

Plunge: **Bearing:**

Ground Surface Elevation: **Total Depth:** 3.0 ft

Water Level Observations

	Date	Time	Depth	Casing	Caved
Completion	6/1	10:20 AM	Dry	---	3.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Asphalt Pavement							2.75" Asphalt 8.75" Stonebase
	Crushed stone; moist, gray							Fill
1.0	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL		A			MC = 26.6%	GP < .5 inch GP < .5 inch
3.0								GP = .75 inch

Bottom of Hand Auger at 3.0 ft.
GP = Geostick Penetration

Schnabel ENGINEERING

HAND AUGER LOG

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, Virginia

Hand Auger Number: HA-2
Contract Number: 17C16038.00
Sheet: 1 of 1

Contractor: Not Applicable

Contractor Foreman: Not Applicable

Schnabel Representative: M. Spencer

Equipment: 3.25" Bucket Hand Auger

Method: Hand Auger

Dates Started: 6/1/17 **Finished:** 6/1/17

Location: See Location Plan

Plunge: **Bearing:**

Ground Surface Elevation: **Total Depth:** 3.0 ft

Water Level Observations

	Date	Time	Depth	Casing	Caved
Completion	6/1	9:50 AM	Dry	---	3.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Asphalt Pavement							3.25" Asphalt
	Crushed stone; moist, gray							8.75" Stonebase
1.0	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL		A			MC = 33.1%	Fill GP < 1 inch GP = 1 inch
3.0								GP = 2.25 inches Cobble at 3.0 ft

Bottom of Hand Auger at 3.0 ft.
GP = Geostick Penetration

Schnabel ENGINEERING

HAND AUGER LOG

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, Virginia

Hand Auger Number: HA-3
Contract Number: 17C16038.00
Sheet: 1 of 1

Contractor: Not Applicable

Contractor Foreman: Not Applicable

Schnabel Representative: M. Spencer

Equipment: 3.25" Bucket Hand Auger

Method: Hand Auger

Dates Started: 5/31/17 **Finished:** 5/31/17

Location: See Location Plan

Plunge: **Bearing:**

Ground Surface Elevation: **Total Depth:** 3.0 ft

Water Level Observations

	Date	Time	Depth	Casing	Caved
Completion	5/31	4:15 PM	Dry	---	3.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.4	Asphalt Pavement							4.0" Asphalt 8.0" Stonebase
	Crushed stone; moist, gray							Fill
1.0	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL		A			MC = 29.4%	GP < 1 inch
2.0	FILL, sampled as lean clay with sand; moist, brown, trace gravel	FILL						GP = 2.5 inches
2.5	FAT CLAY WITH SAND; moist, brown, trace gravel	CH		B				Residual
3.0								GP = 1.25 inches

Bottom of Hand Auger at 3.0 ft.
GP = Geostick Penetration

Schnabel ENGINEERING

HAND AUGER LOG

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, Virginia

Hand Auger Number: HA-4
Contract Number: 17C16038.00
Sheet: 1 of 1

Contractor: Not Applicable

Contractor Foreman: Not Applicable

Schnabel Representative: M. Spencer

Equipment: 3.25" Bucket Hand Auger

Method: Hand Auger

Dates Started: 6/1/17 **Finished:** 6/1/17

Location: See Location Plan

Plunge: **Bearing:**

Ground Surface Elevation: **Total Depth:** 3.0 ft

Water Level Observations

	Date	Time	Depth	Casing	Caved
Completion	6/1	9:17 AM	Dry	---	3.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Asphalt Pavement							2.5" Asphalt 10.0" Stonebase
	Crushed stone; moist, gray							Fill
1.0	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL		A			MC = 26.1%	GP < 1 inch At 1.6 ft, had small amount of topsoil with small roots Cobbles at 1.9 ft. GP < 1 inch
3.0								GP = 1.5 inches

Bottom of Hand Auger at 3.0 ft.
GP = Geostick Penetration

Schnabel ENGINEERING	HAND AUGER LOG	Project: Pheasant Run Crossing Pavement Evaluation Chickahominy Drive Blacksburg, Virginia	Hand Auger Number: HA-5 Contract Number: 17C16038.00 Sheet: 1 of 1

Contractor: Not Applicable

Contractor Foreman: Not Applicable

Schnabel Representative: M. Spencer

Equipment: 3.25" Bucket Hand Auger

Method: Hand Auger

Dates Started: 5/31/17 **Finished:** 5/31/17

Location: See Location Plan

Plunge: **Bearing:**

Ground Surface Elevation: **Total Depth:** 3.0 ft

Water Level Observations

	Date	Time	Depth	Casing	Caved
Completion	5/31	3:38 PM	Dry	---	3.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Asphalt Pavement							3.25" Asphalt 9.25" Stonebase
	Crushed stone; moist, gray							Fill
1.1	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL		A			MC = 31.5%	GP < 1 inch
2.0	FILL, sampled as lean clay with sand; moist, brown, trace gravel, contains root fragments	FILL						GP < .5 inch
2.5	FILL, sampled as fat clay with sand; moist, brown, trace gravel	FILL						GP = 1.5 inches
3.0								

Bottom of Hand Auger at 3.0 ft.
GP = Geostick Penetration

APPENDIX B

SOIL LABORATORY TEST DATA

Summary of Soil Laboratory Tests
Gradation Test Curve
Moisture Density Relation Test Curve
CBR Test Curves (2)

Summary Of Laboratory Tests

Project Number: 17C16038.00

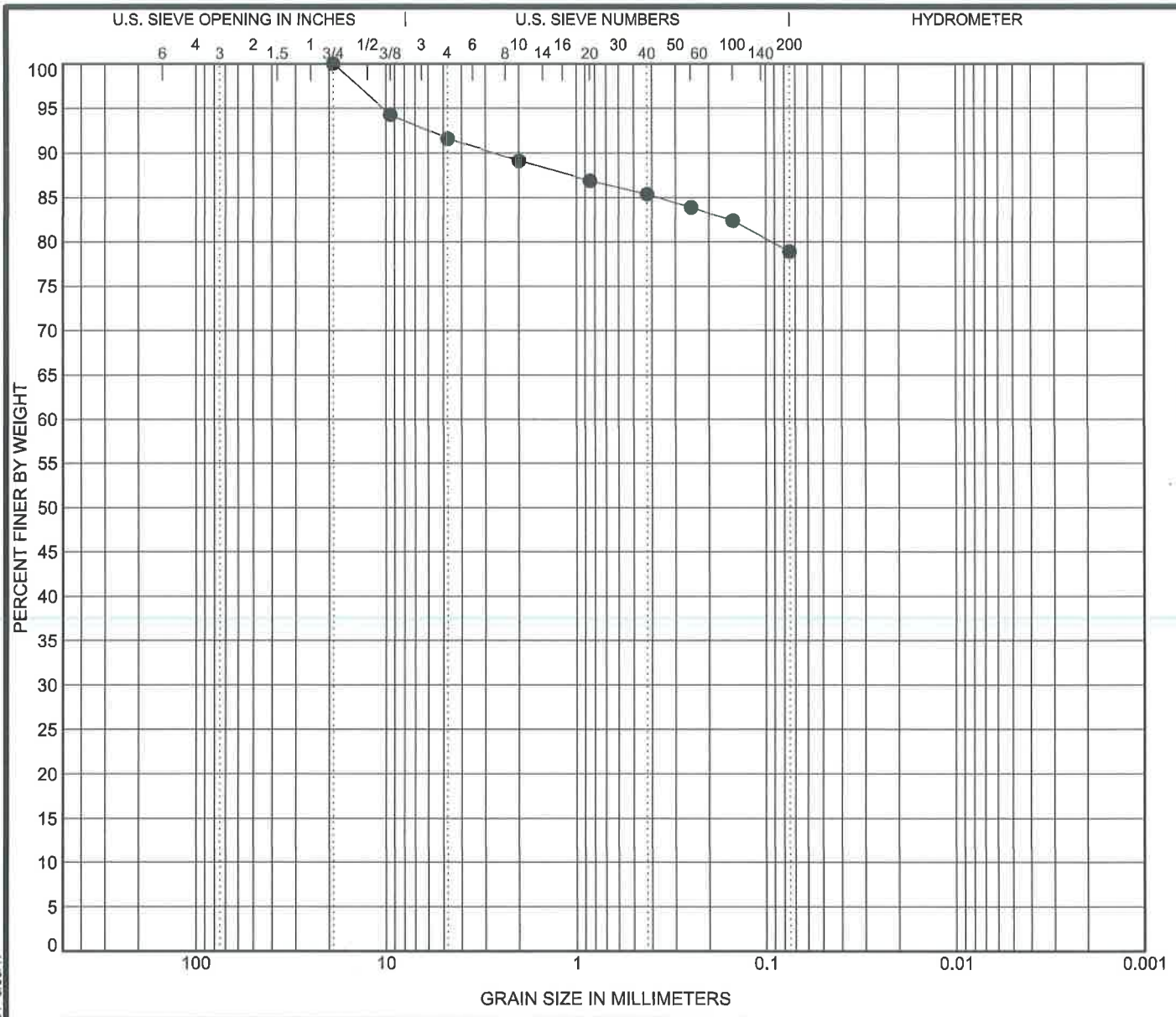
Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Percent Sand	Percent Gravel	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Proctor Test Method	CBR Dry Density At Compaction (pcf)	CBR Moisture Content (%)	CBR Value	CBR Surcharge Pressure (psf)	CBR Percent Swell
HA Composite	0.0	Bulk	FAT CLAY WITH SAND (CH), few gravel, orangish brown	54	25	29	78.9	12.7	8.4	102.0	20.6	698A	102.8 98.2	20.9 25.4	8.7 4.0	50 50	3.3 0.3

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; – indicates no test performed

Schnabel ENGINEERING

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, VA

DYNAMIC LAB SUMMARY 17C16038 HAND AUGER LOGS.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 7/18/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen	Sample Description	LL	PL	PI
● HA Composite 0.0 ft	**FAT CLAY WITH SAND (CH), few gravel, orangish brown**	**54**	**25**	**29**

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**8.4**	**12.7**	**78.9**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	78.9	82.4	83.9	85.4	86.9	89.1	91.6	94.3	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	6/15/17	RAS	MJF

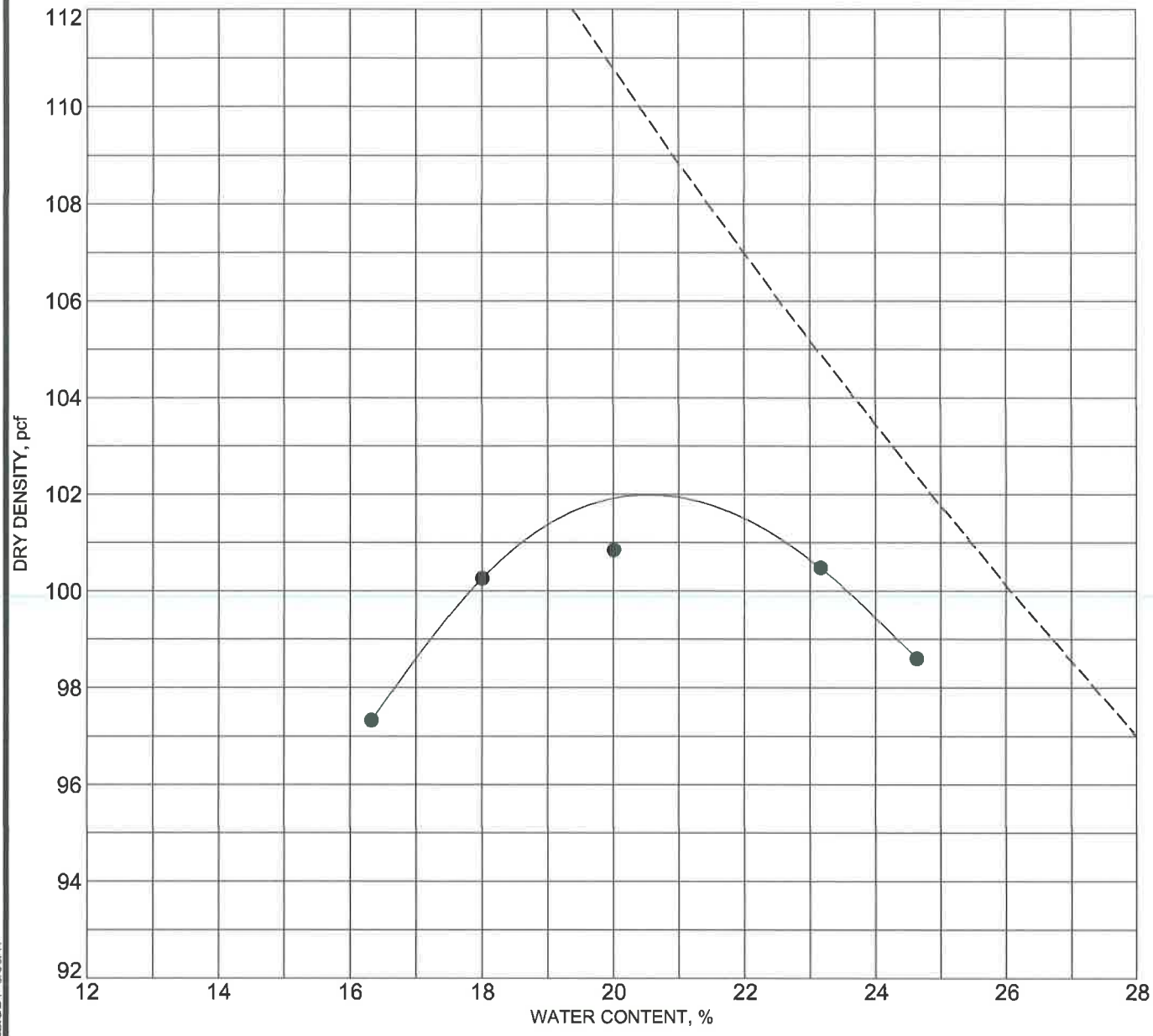
Schnabel ENGINEERING

GRADATION CURVE

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, VA

Contract: 17C16038.00 **Testing Lab:** BLAC

SIEVE 1/SHEET 17C16038 HAND AUGER LOGS.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 6/30/17



Sample Description:	FAT CLAY WITH SAND (CH), few gravel, orangish brown
Sample Source:	HA Composite, 0.0 ft
Test Methods:	ASTM D698 Method A
Oversize Fraction Sieve Size:	No 4
Percent Oversized Retained:	8.4%

Assumed Specific Gravity:	2.75
Uncorrected Max. Dry Density (pcf):	102.0
Uncorrected Opt. Moisture (%):	20.6
Assumed Oversize Specific Gravity:	2.75
Corrected Max. Dry Density (pcf):	105.6
Corrected Opt. Moisture (%):	19.0

Liquid Limit (LL):	54
Plasticity Index (PI):	29
% Retained #4 Sieve:	8.4
% Passing # 200 Sieve:	78.9

Comments:

Schnabel ENGINEERING

MOISTURE DENSITY RELATIONSHIP

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
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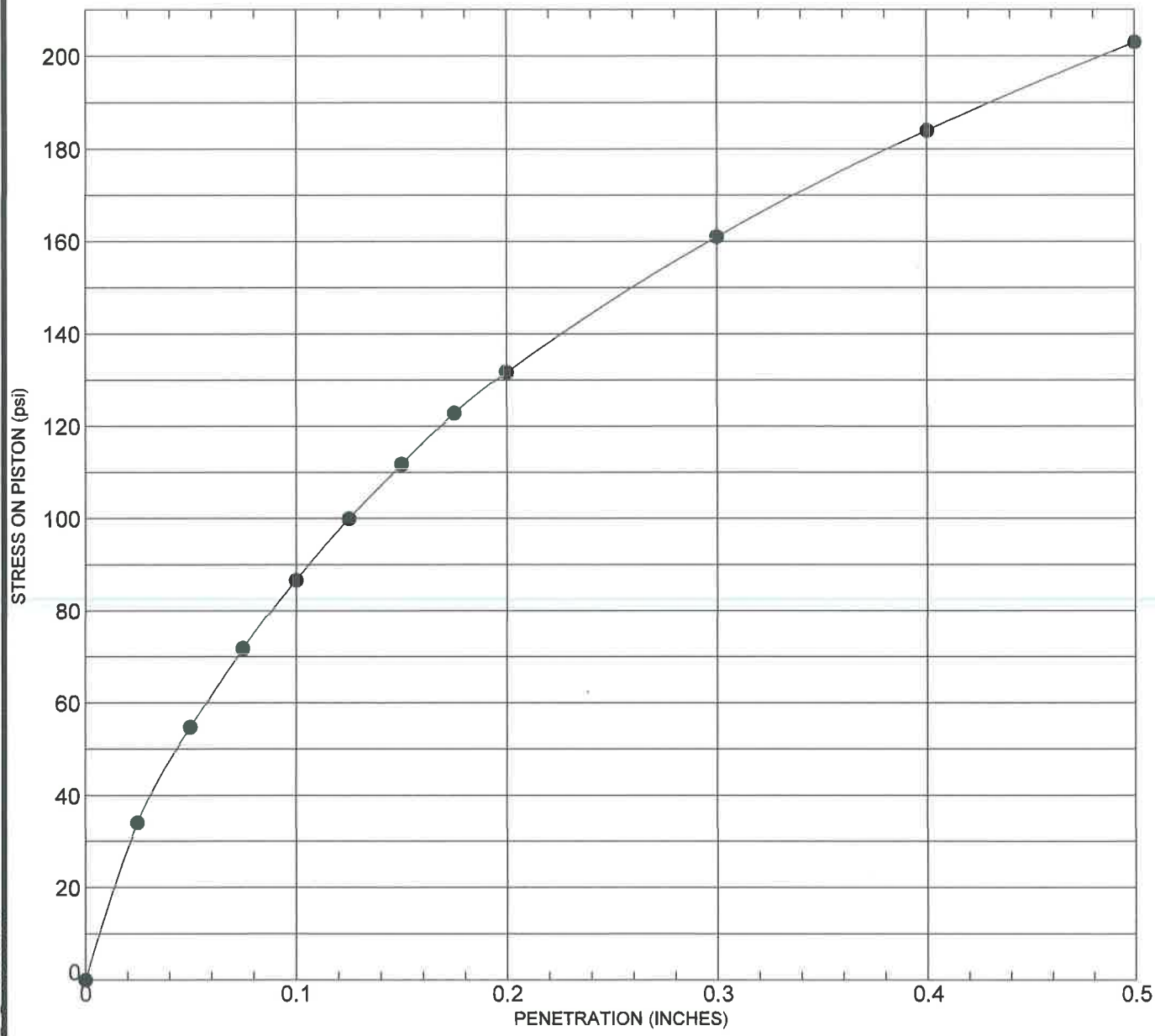


Sample Description:	FAT CLAY WITH SAND (CH), few gravel, orangish brown
Sample Source:	HA Composite
Sample Depth:	0.0 ft
Test Method:	VTM-8

Dry Density Before Soaking (pcf):	102.8
Dry Density After Soaking (pcf):	99.5
Maximum Dry Density (pcf):	102
Moisture Content Before Soaking (%):	20.9
Moisture Content After Soaking (Avg) (%):	23.9
Moisture Content Top Inch After Soak (%):	23.2
Optimum Moisture Content (%):	20.6

Liquid Limit (LL):	54
Plasticity Index (PI):	29
% Retained #4 Sieve:	8.4
% Passing # 200 Sieve:	78.9

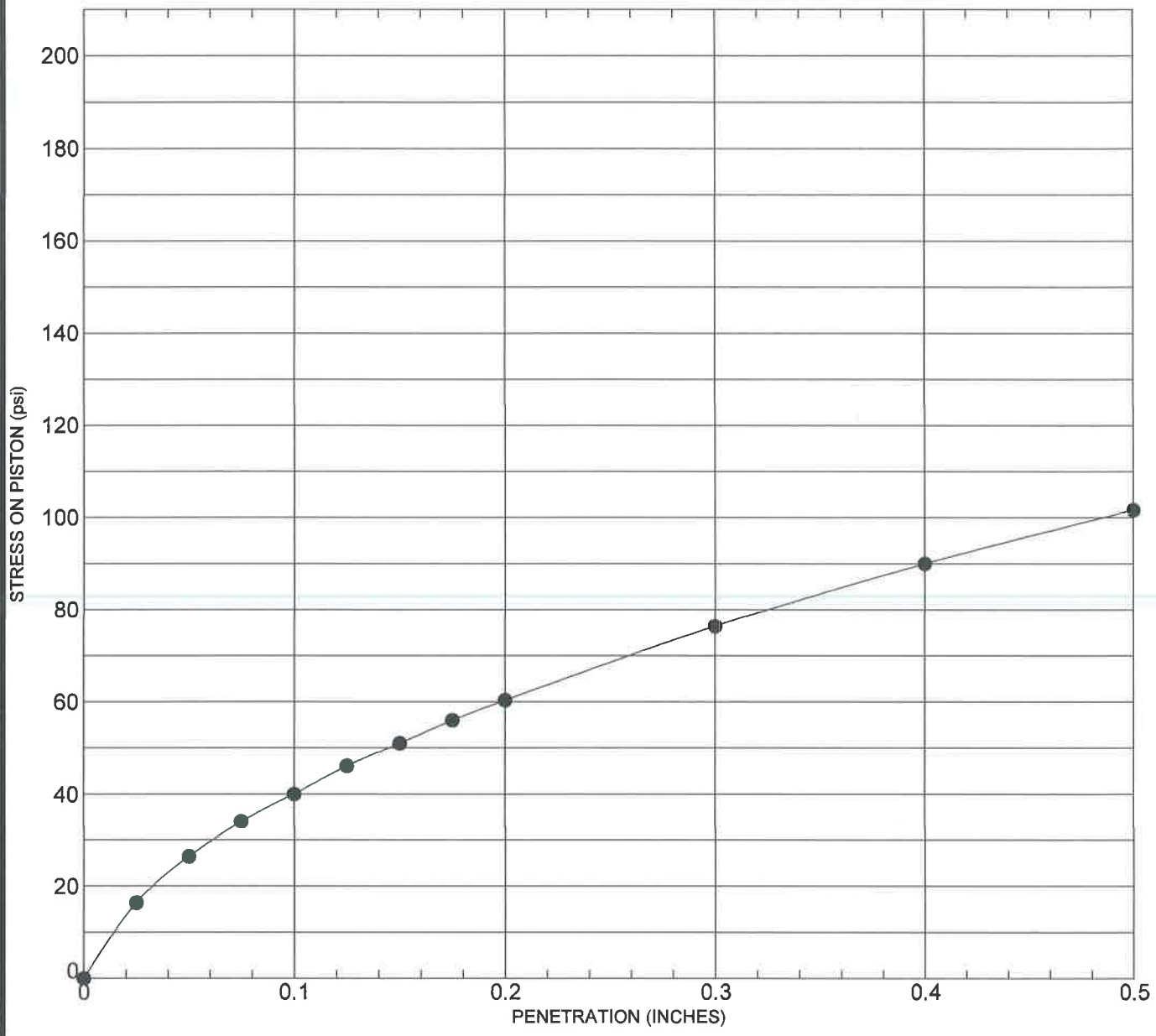
CBR:	8.7, Soaked
Surcharge (psf):	50
Swell (%):	3.3

Schnabel ENGINEERING

CALIFORNIA BEARING RATIO TEST

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, VA

Contract: 17C16038.00 **Testing Lab:** BLAC



Sample Description:	FAT CLAY WITH SAND (CH), few gravel, orangish brown
Sample Source:	HA Composite
Sample Depth:	0.0 ft
Test Method:	VTM-8

Dry Density Before Soaking (pcf):	98.2
Dry Density After Soaking (pcf):	98.0
Maximum Dry Density (pcf):	102
Moisture Content Before Soaking (%):	25.4
Moisture Content After Soaking (Avg) (%):	25.7
Moisture Content Top Inch After Soak (%):	26.1
Optimum Moisture Content (%):	20.6

Liquid Limit (LL):	54
Plasticity Index (PI):	29
% Retained #4 Sieve:	8.4
% Passing # 200 Sieve:	78.9

CBR:	4, Soaked
Surcharge (psf):	50
Swell (%):	0.3

Schnabel ENGINEERING

CALIFORNIA BEARING RATIO TEST

Project: Pheasant Run Crossing Pavement Evaluation
Chickahominy Drive
Blacksburg, VA

Contract: 17C16038.00 **Testing Lab:** BLAC