

January 23, 2018  
Revised March 23, 2018



**ENTECH**  
ENGINEERING, INC.

505 ELKTON DRIVE  
COLORADO SPRINGS, CO 80907  
PHONE (719) 531-5599  
FAX (719) 531-5238

Tech Contractors  
3575 Kenyon Street, Suite 200  
San Diego, CA 92110

Attn: Raul Guzman

**Approved, EN**  
03/30/2018

Re: Pavement Recommendations  
Stonebridge at Meridian Ranch, Filing No. 3, Phase 3  
El Paso County, Colorado  
El Paso County Project No. SF-17-005

Dear Mr. Guzman:

As requested, Entech Engineering, Inc. has obtained samples of the subgrade soils Stone Peaks Way in the Stonebridge at Meridian Ranch Subdivision, Filing No. 3, Phase 3, in El Paso County, Colorado. Laboratory testing to determine the pavement support characteristics of the soils was performed. This letter presents the results of the laboratory testing and pavement recommendations for this roadway.

### Project Description

Stone Peaks Way is a short road section that will be primarily used by local traffic as this roadway does not connect to other roadways within the subdivision to provide an active thoroughfare. The site layout and the locations of the test borings are shown on the Test Boring Location Plan, Figure 1.

### Subgrade Conditions

Three exploratory test borings were drilled in the roadways to depths of 5 to 10 feet. The Boring Logs are presented in Appendix A. Sieve Analysis and Atterberg Limit testing were performed on soil samples obtained from the test borings for the purpose of classification. Sieve analyses performed indicated the percent passing the No. 200 sieve for the soils at subgrade depth ranged from approximately 28 to 57 percent. Atterberg Limit Tests performed on samples resulted in Liquid Limits ranging from 26 to 46 and Plastic Indexes ranging from 13 to 32. Soil Type 1 was predominantly exposed in the roadway subgrade in our test borings. Soil Type 2 was encountered in one test boring as a lens and should be mitigated from the roadway subgrade. The Type 3 sandstone soils were encountered at subgrade depth in one test boring which may require overexcavation to provide similar support characteristics as the site sand fills. Soil Type 1 consisted of clayey sand fill which classified as A-2-6 and A-2-7 soils based on the AASHTO classification system. The Type 1 soils consisted of A-2-4 soils using the AASHTO classification system. The Type 2 soils consisted of very sandy clay fill which classified A-6 soils based on the AASHTO classification system. The Type 3 soils consisted of clayey and silty sandstone which classified as a A-2-4 soils based on the AASHTO classification system. The

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Type 1 soils sampled in Phase 2 of this subdivision were grouped into the Type 1 category from this phase due to the similarity of the soils. Sulfate testing of the subgrade indicated that the soils exhibit a negligible potential for sulfate attack. Groundwater was not encountered in the test borings.

Swell testing was performed on several samples on the subgrade. Swell/Consolidation Tests conducted on the soils exhibited volume change ranging from 0.0 to 0.5 percent, which are below the levels in which mitigation is required. Mitigation of expansive soils is not required on this site. Laboratory test results are presented in Appendix B and are summarized on Table 1.

California Bearing Ratio (CBR) testing was performed on a representative sample of the subgrade soils to determine the support characteristic of the soils for the roadway sections. The results of the CBR testing are presented in Appendix B and summarized as follows:

Soil Type 1 – Clayey Silty Sand

R @ 90% = 40  
R @ 95% = 73  
Use R = 50 for design

Classification Testing

Liquid Limit	23
Plasticity Index	5
Percent Passing 200	31.6
AASHTO Classification	A-2-4
Group Index	0
Unified Soils Classification	SC-SM

**Pavement Design**

The CBR testing from Phase 2 was used to determine pavement sections for this site. The pavement sections were determined utilizing the El Paso County "Pavement Design Criteria and Report". An Updated Traffic Impact Analysis report was prepared for this site by LSC Transportation Consultants, Inc. dated March 20, 2017, LSC Job No. 174070. This report was used to assist in determining the roadway classifications. A layout showing the Recommended Street Classifications is attached in Appendix D. Stone Peaks Way classifies as a low volume urban local road, which used a 18K ESAL value of 36,500 to determine the pavement sections. Pavement sections for asphalt over aggregate base course sections are provided. Design parameters used in the pavement analysis are as follows:

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Reliability	80%
Serviceability Index Local Low Volume, Local (pavement Only)	2.0
Resilient Modulus	13,168 psi
"R" Value Subgrade	50
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Base Course	0.11

Pavement calculations are attached in Appendix C. Pavement sections recommended for the site are summarized as follows:

Pavement Sections

Low Volume Urban Local - ESAL = 36,500 – Stone Peaks Way

	<u>Asphalt</u> <u>(in)</u>	<u>Base Course</u> <u>(in)</u>
1. Asphalt Over Base Course	3.0*	6.0*

\* Minimum sections required per the El Paso County "Pavement Design Criteria and Report". Full depths sections are not allowed.

**Mitigation**

Mitigation for expansive soils will not be required for this phase and filing of Stonebridge at Meridian Ranch based on the laboratory testing; however, mitigation for isolated areas of subgrade soils consisting of lower bearing clay (Soil Type 2) and high bearing sandstone (Soil Type 3) will likely be required. To provide a uniform roadway subgrade it is recommended that 1.5 feet of Soil Type 1 underlies this roadway section, in the vicinity of Test Boring Nos. 1 and 2. In the vicinity of Test Boring No. 3, it is recommended that the roadway subgrade consists of a minimum of 1 foot of Soil Type 1 underlying the roadway due to the potential of shallow occurring sandstone in this area. The estimated transitions for overexcavation or removals to suitable underlying soils are shown in Figure 1. The actual transitions should be field determined. Personnel of Entech Engineering, Inc. should be on site to verify the locations and approximate depths of overexcavation, and fill material stockpiled to fill the overexcavated areas during the subgrade preparation. Density testing should be performed on all fill compacted within these roadway subgrade areas.

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**Roadway Construction - Full Depth Asphalt and Asphalt on Aggregate Base Course Alternatives**

Prior to placement of the asphalt, the subgrade should be proofrolled, scarified, moisture conditioned and compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at  $\pm 2$  percent of optimum moisture. Any high bearing, loose, or soft areas should be removed and replaced with suitable materials. Base course materials should be compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at  $\pm 2$  percent of optimum moisture content. Special attention should be given to areas adjacent to manholes, inlet structures and valves.

If significant grading is performed, the soils at subgrade may change. Modification to the pavement sections should be evaluated after site grading is completed.

In addition to the above guidance, the asphalt, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC


  
Stan C. Culp, P.E.  
Senior Engineer

SCC/sc

Encl.  
Entech Job No. 172016  
AAprojects/2017/172016 pr\_r



Reviewed by:

  
Joseph C. Goode, Jr., P.E.  
President

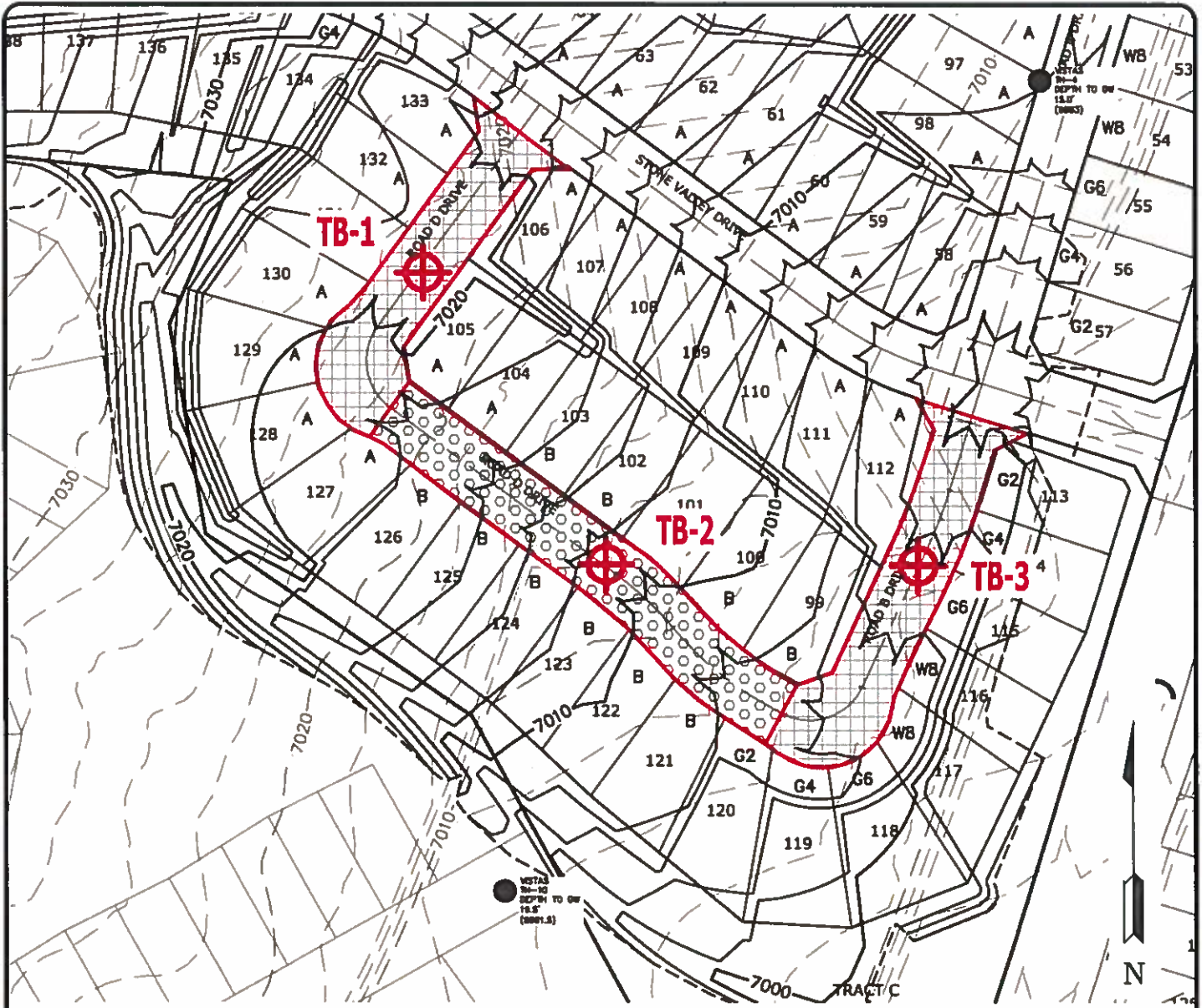
## TABLE

**TABLE 1**  
**SUMMARY OF LABORATORY TEST RESULTS**

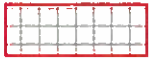
CLIENT TECH CONTRACTORS  
 PROJECT STONEBRIDGE, FILING 3  
 JOB NO. 172016

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	AASHTO CLASS.	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1, CBR #1	F3, P2	0-3			31.6	23	5		A-2-4		SC-SM	SAND, CLAYEY, SILTY
1	1	1-2			27.1	31	17		A-2-6		SC	FILL, SAND, CLAYEY
1	2	1-2	8.8	108.0	31.6	46	32	<0.01	A-2-7	0.0	SC	FILL, SAND, CLAYEY
2	1	0-3	13.6	112.3	57.4	33	20		A-6	0.5	CL	FILL, CLAY, VERY SANDY
3	3	1-2			27.5	26	13		A-2-6		SC	SANDSTONE, CLAYEY
3	2	10			22.5	21	4	0.01	A-2-4		SM	SANDSTONE, SILTY

**FIGURE**



SOIL TYPE 1 - SOIL MITIGATION LIKELY NOT REQUIRED PRIOR TO COUNTY SUBGRADE PREPARATION REQUIREMENTS. 3" OF ASPHALT ON 6" OF BASE COURSE. ACTUAL TRANSITIONS TO BE FIELD DETERMINED.



SOIL TYPES 2 & 3 - POTENTIAL SUBGRADE OVEREXCAVATION OF 1.5 FEET OR TO SUITABLE UNDERLYING SOILS DUE TO SHALLOW OCCURRING CLAY (SOIL TYPE 2), IN THE VICINITY OF TB-1, TO PROVIDE 1.5 FEET OF TYPE 1 SUBGRADE SOILS. PROVIDE A MINIMUM OF 1 FOOT OF SOIL TYPE 1 OVERLYING THE SANDSTONE (SOIL TYPE 3), IN THE VICINITY OF TB-3. REPLACE EXCAVATED SOILS WITH GRANULAR SOILS APPROVED BY ENTECH. 3" OF ASPHALT ON 6" OF BASE COURSE. ACTUAL TRANSITIONS TO BE FIELD DETERMINED.



TB-2- APPROXIMATE TEST BORING LOCATION AND NUMBER



TEST BORING LOCATION MAP  
 STONEBRIDGE F3, PHASE 3  
 EL PASO COUNTY, CO  
 FOR: TECH CONTRACTORS

JOB NO.:  
 172016  
 FIG. NO.:  
 1

DRAWN BY: WM	DATE DRAWN: 01/19/18	DESIGNED BY: SC	REVISION DATE: 03/23/18
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## **APPENDIX A: Test Boring Logs**

TEST BORING NO. 1  
 DATE DRILLED 1/4/2018  
 Job # 172016

TEST BORING NO. 2  
 DATE DRILLED 1/4/2018  
 CLIENT TECH CONTRACTORS  
 LOCATION STONEBRIDGE, FILING 3

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 1/4/18							DRY TO 10', 1/4/18						
FILL 0-3', SAND, CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST CLAY LENSE AT 3'				17	7.7	1	FILL 0-6', SAND, CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				13	9.7	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50 7"	4.8	3	SANDSTONE, SILTY, FINE TO COARSE GRAINED, BUFF, VERY DENSE, MOIST	5			13	8.8	1
	10							10			50 5"	5.4	1
	15							15					
	20							20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED:

SCC

DATE:

1/23/18

JOB NO:  
 172016

FIG NO:  
 A-1

TEST BORING NO. 3  
 DATE DRILLED 1/4/2018  
 Job # 172016

TEST BORING NO.  
 DATE DRILLED  
 CLIENT TECH CONTRACTORS  
 LOCATION STONEBRIDGE, FILING 3

REMARKS

REMARKS

DRY TO 5', 1/4/18  
 FILL 0-1, SAND, CLAYEY,  
 BROWN  
 SANDSTONE, CLAYEY, FINE  
 TO COARSE GRAINED, TAN,  
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0					1	0					
3			50	6.0	3	3					
5			50	12.3	3	5					
11"											
10						10					
15						15					
20						20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED:

DATE

SCC

1/23/18

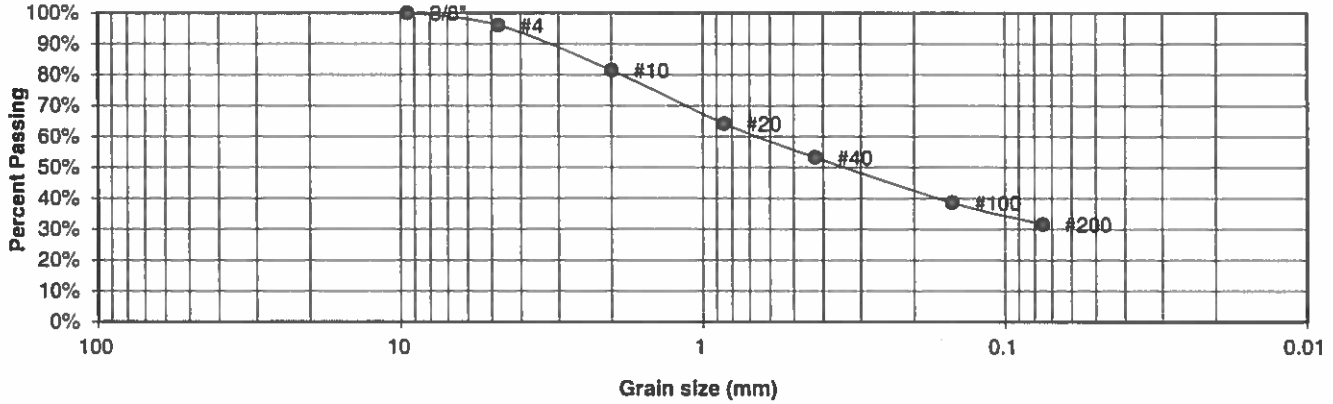
JOB NO.:  
 172016

FIG NO.:  
 A- 2

## **APPENDIX B: Laboratory Test Results**

<b>UNIFIED CLASSIFICATION</b>	SC-SM	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	1, CBR #1	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	F3, P2	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	0-3	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-2-4	<b>GROUP INDEX</b>	0

**Sieve Analysis  
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.0%
10	81.5%
20	64.2%
40	53.3%
100	38.6%
200	31.6%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	23
Plastic Index	5

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		SCC	5/23/18

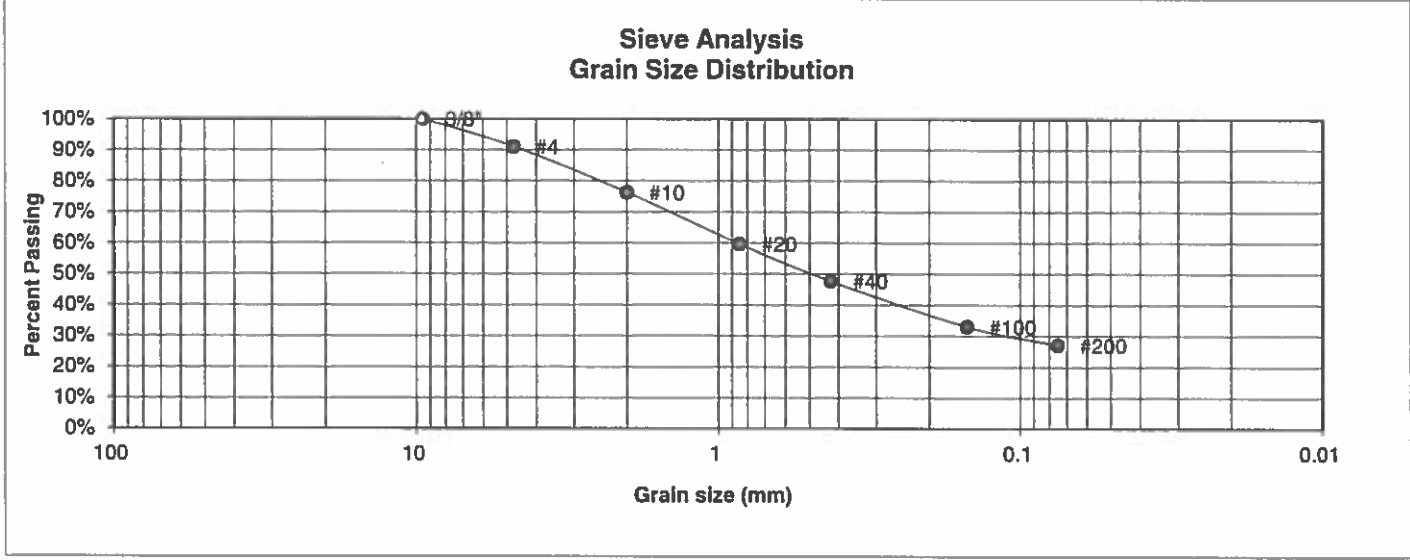
JOB NO.:

172016

FIG NO.:

B-1

<b>UNIFIED CLASSIFICATION</b>	SC	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	1	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	1	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	1-2	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-2-6	<b>GROUP INDEX</b>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	91.0%
10	76.3%
20	59.6%
40	47.7%
100	33.0%
200	27.1%

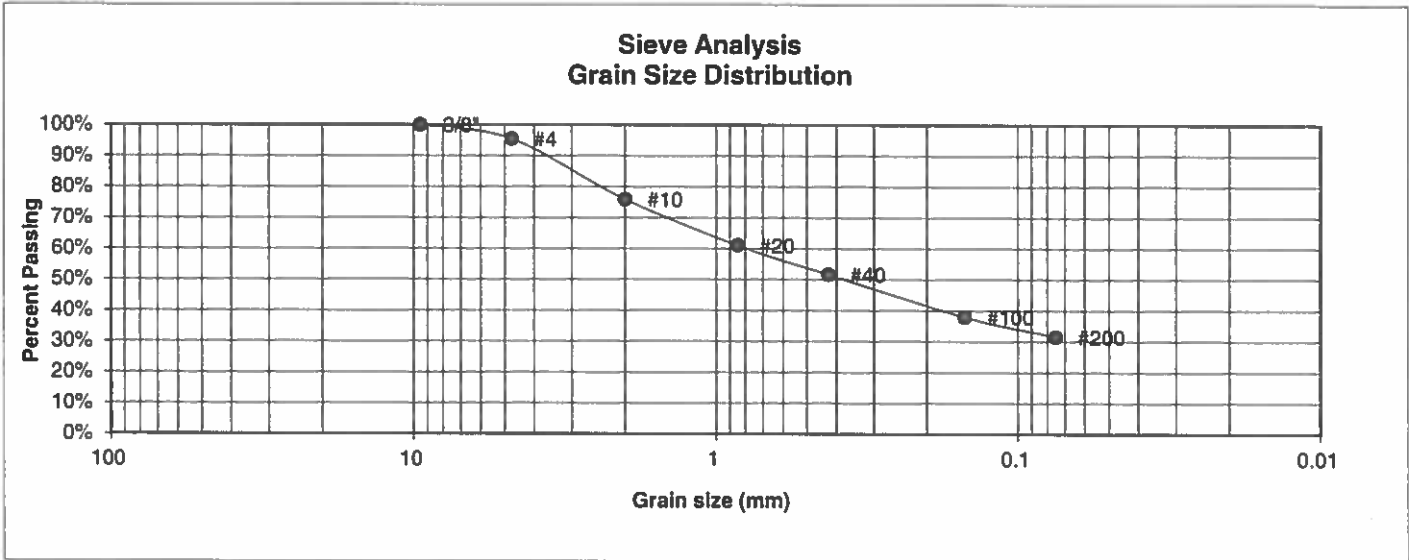
Atterberg Limits	
Plastic Limit	14
Liquid Limit	31
Plastic Index	17
Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



LABORATORY TEST RESULTS			
DRAWN:	DATE:	CHECKED:	DATE:
		SCC	1/23/18

JOB NO.:  
172016  
FIG NO.:  
B-2

<b>UNIFIED CLASSIFICATION</b>	SC	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	1	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	2	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	1-2	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-2-7	<b>GROUP INDEX</b>	3



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.5%
10	75.9%
20	61.1%
40	51.7%
100	37.9%
200	31.6%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	46
Plastic Index	32

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



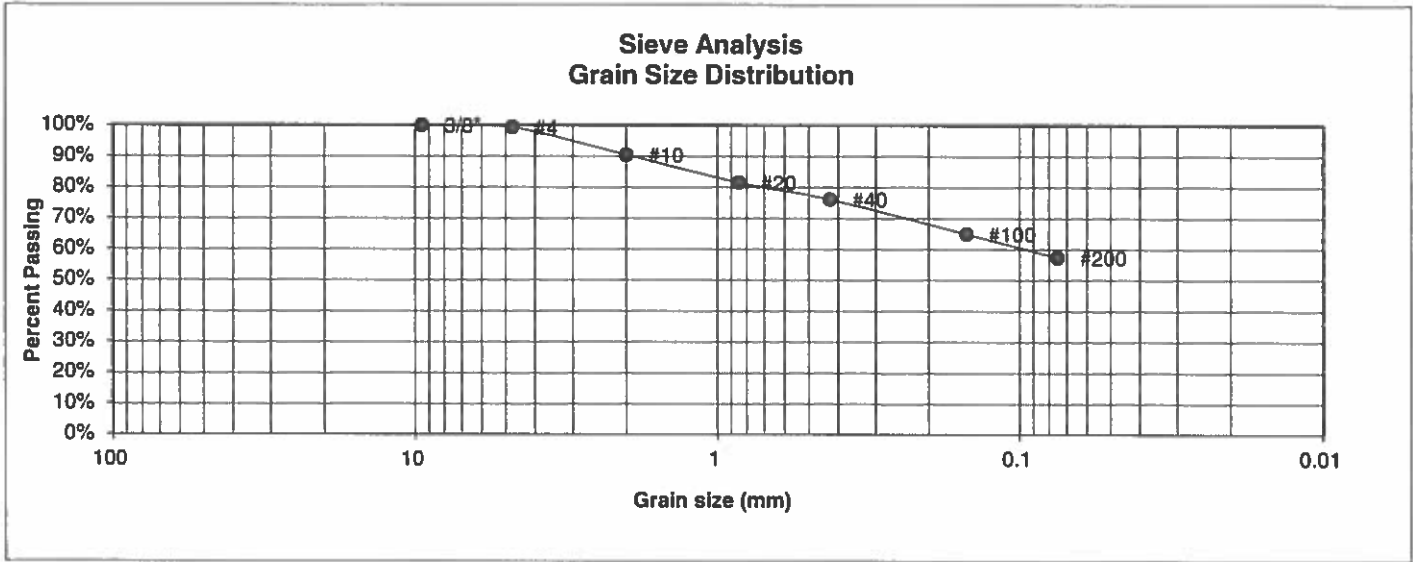
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**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		SCC	1/23/18

JOB NO.:  
172016  
FIG NO.:  
B-3

<b>UNIFIED CLASSIFICATION</b>	CL	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	2	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	1	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	0-3	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-6	<b>GROUP INDEX</b>	8



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	90.5%
20	81.6%
40	76.1%
100	65.0%
200	57.4%

Atterberg Limits	
Plastic Limit	13
Liquid Limit	33
Plastic Index	20

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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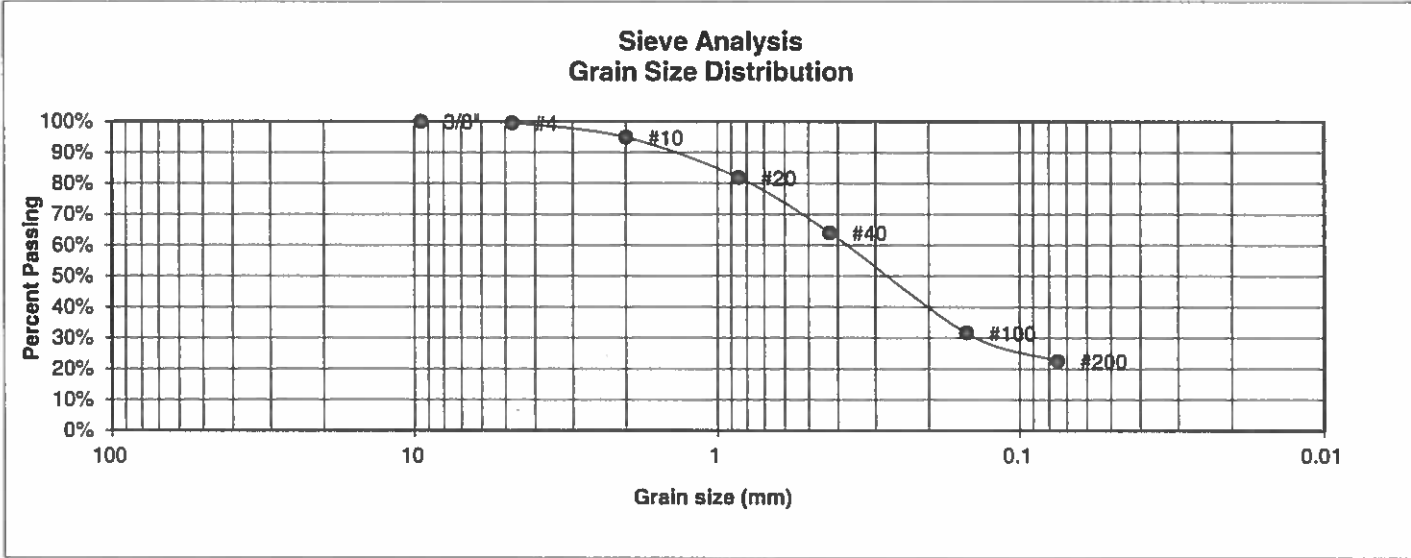
**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		SCC	3/23/18

JOB NO.:  
172016  
FIG NO.:  
B-4



<b>UNIFIED CLASSIFICATION</b>	SM	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	3	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	2	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	10	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-2-4	<b>GROUP INDEX</b>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	94.9%
20	81.8%
40	64.0%
100	31.6%
200	22.5%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	21
Plastic Index	4

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



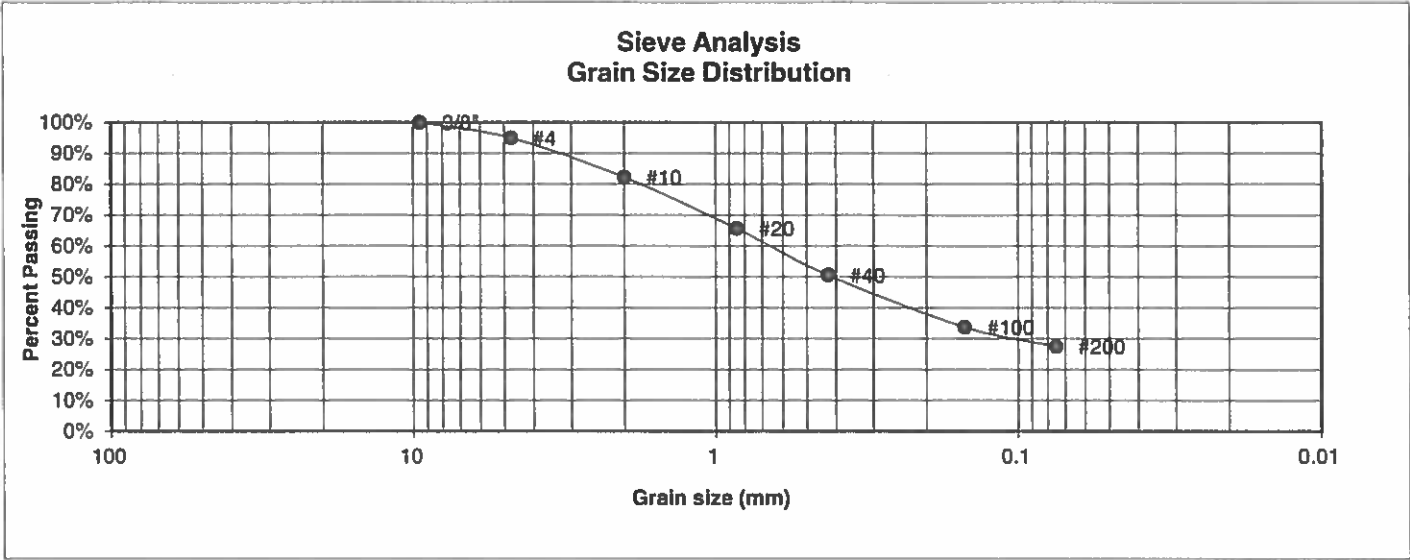
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**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED: SCC	DATE: 1/22/18
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JOB NO:  
172016  
FIG NO:  
B-5

<b>UNIFIED CLASSIFICATION</b>	SC	<b>CLIENT</b>	TECH CONTRACTORS
<b>SOIL TYPE #</b>	3	<b>PROJECT</b>	STONEBRIDGE, FILING 3
<b>TEST BORING #</b>	3	<b>JOB NO.</b>	172016
<b>DEPTH (FT)</b>	1-2	<b>TEST BY</b>	BL
<b>AASHTO CLASSIFICATION</b>	A-2-6	<b>GROUP INDEX</b>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.0%
10	82.3%
20	65.6%
40	50.6%
100	33.7%
200	27.5%

Atterberg Limits	
Plastic Limit	13
Liquid Limit	26
Plastic Index	13

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST  
 RESULTS**

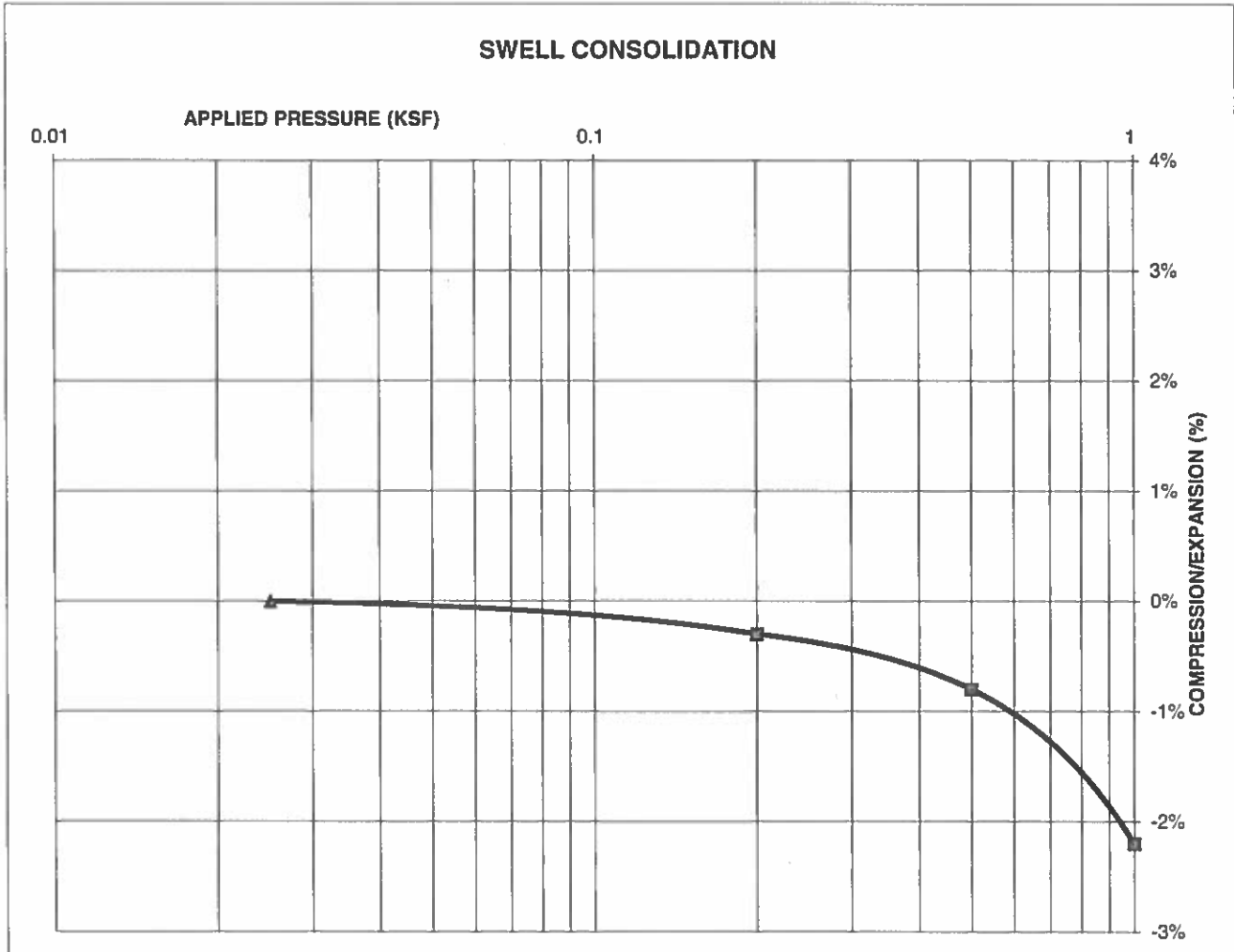
DRAWN:	DATE:	CHECKED:	DATE:
		SCC	1/23/18

JOB NO.:  
 172016  
 FIG NO.:  
 B-6

**CONSOLIDATION TEST RESULTS**

TEST BORING #	2	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			108
NATURAL MOISTURE CONTENT			8.8%
SWELL/CONSOLIDATION (%)			0.0%

JOB NO. 172016  
CLIENT TECH CONTRACTORS  
PROJECT STONEBRIDGE, FILING 3



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**SWELL CONSOLIDATION  
 TEST RESULTS**

DRAWN:

DATE:

CHECKED:  
*SCC*

DATE:  
*1/23/18*

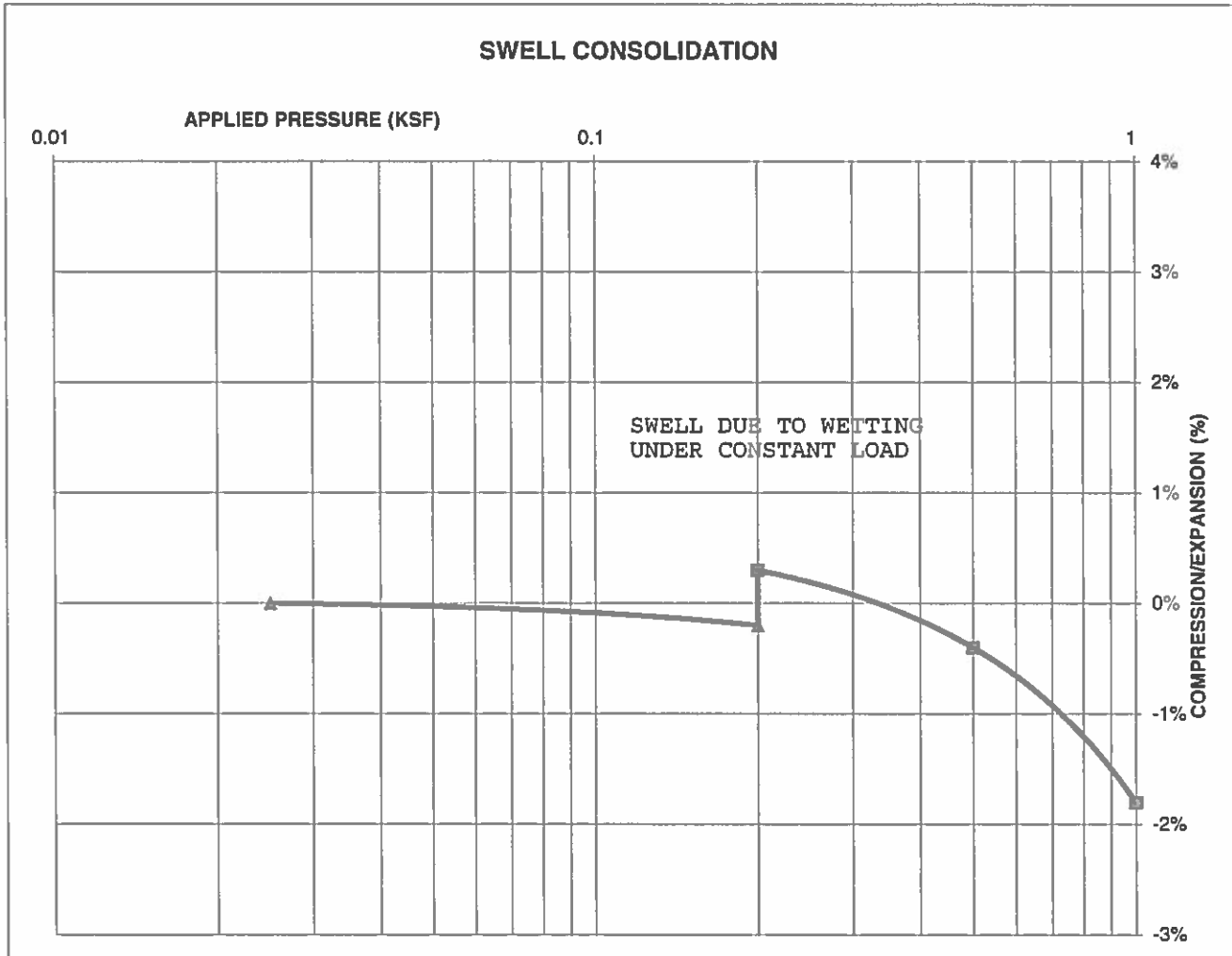
JOB NO:  
 172016

FIG NO:  
 B-7

**CONSOLIDATION TEST RESULTS**

TEST BORING #	1	DEPTH(ft)	0-3
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			112
NATURAL MOISTURE CONTENT			13.6%
SWELL/CONSOLIDATION (%)			0.5%

JOB NO. 172016  
CLIENT TECH CONTRACTORS  
PROJECT STONEBRIDGE, FILING 3



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505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

**SWELL CONSOLIDATION  
 TEST RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

*SCC*

*1/23/18*

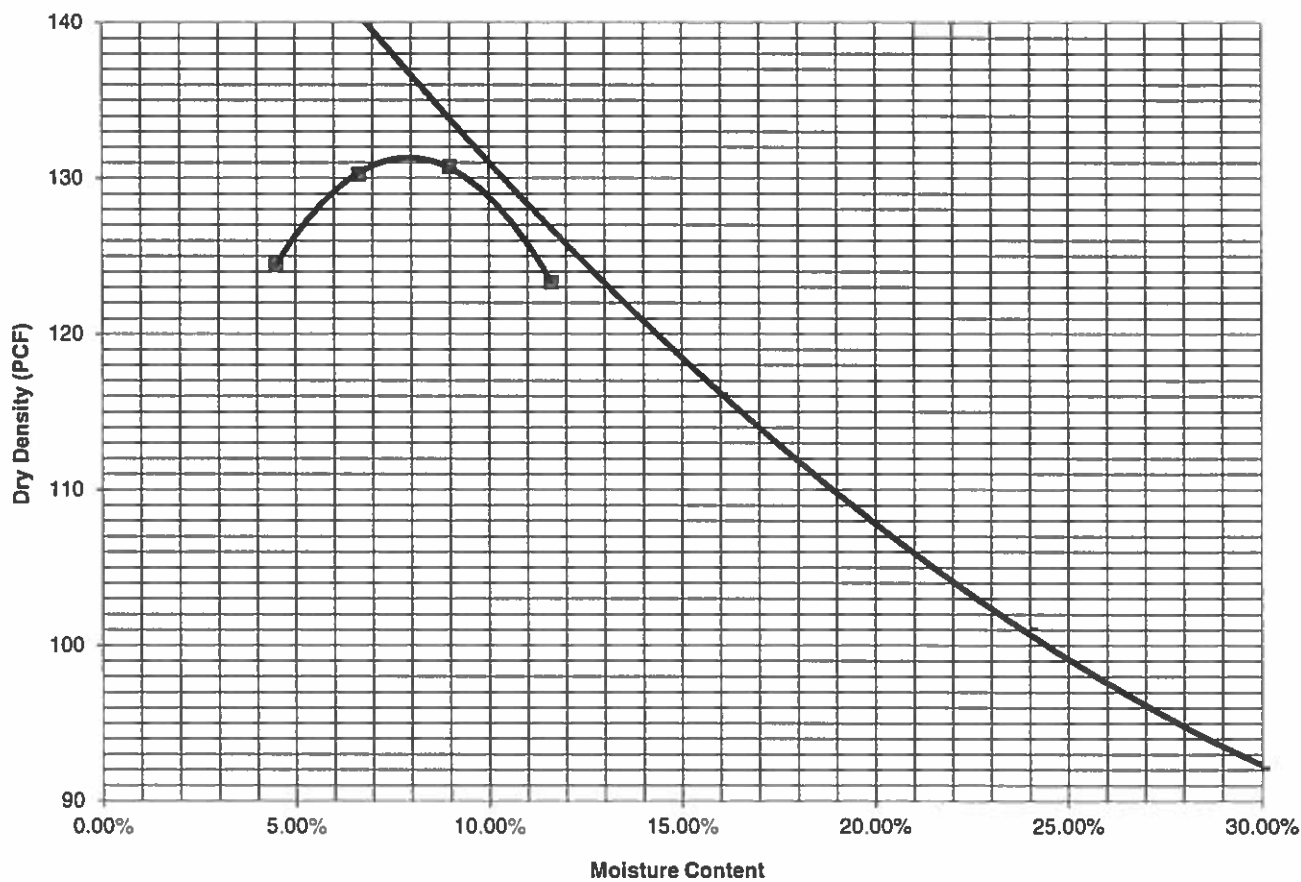
JOB NO:  
 172016

FIG NO:  
 B-8

<b>PROJECT</b>	STONEBRIDGE, FILING 3	<b>CLIENT</b>	TECH CONTRACTORS
<b>SAMPLE LOCATION</b>	F-3, P-2 @ 0-3'	<b>JOB NO.</b>	172016
<b>SOIL DESCRIPTION</b>	SAND, CLAYEY, SILTY, BROWN	<b>DATE</b>	10/19/17

<b>IDENTIFICATION</b>	SC-SM	<b>COMPACTION TEST #</b>	1, SOIL TYPE #1
<b>TEST DESIGNATION / METHOD</b>	ASTM D-1557-A	<b>TEST BY</b>	DC
<b>MAXIMUM DRY DENSITY (PCF)</b>	131.3	<b>OPTIMUM MOISTURE</b>	8.0%

**Compaction Curve**



■ ACTUAL POINTS    -    — PARABOLIC FIT    — ZERO AIR VOIDS



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**MOISTURE DENSITY RELATION**

DRAWN

DATE

CHECKED:  
SCC

DATE  
1/23/18

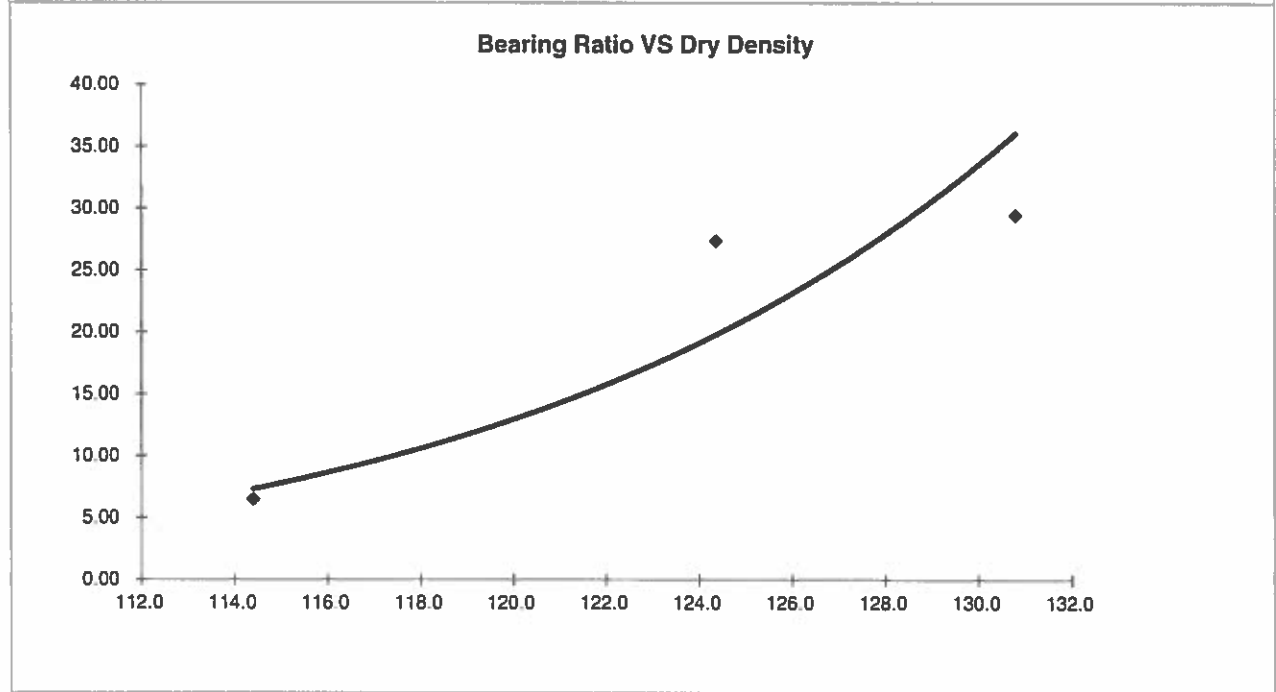
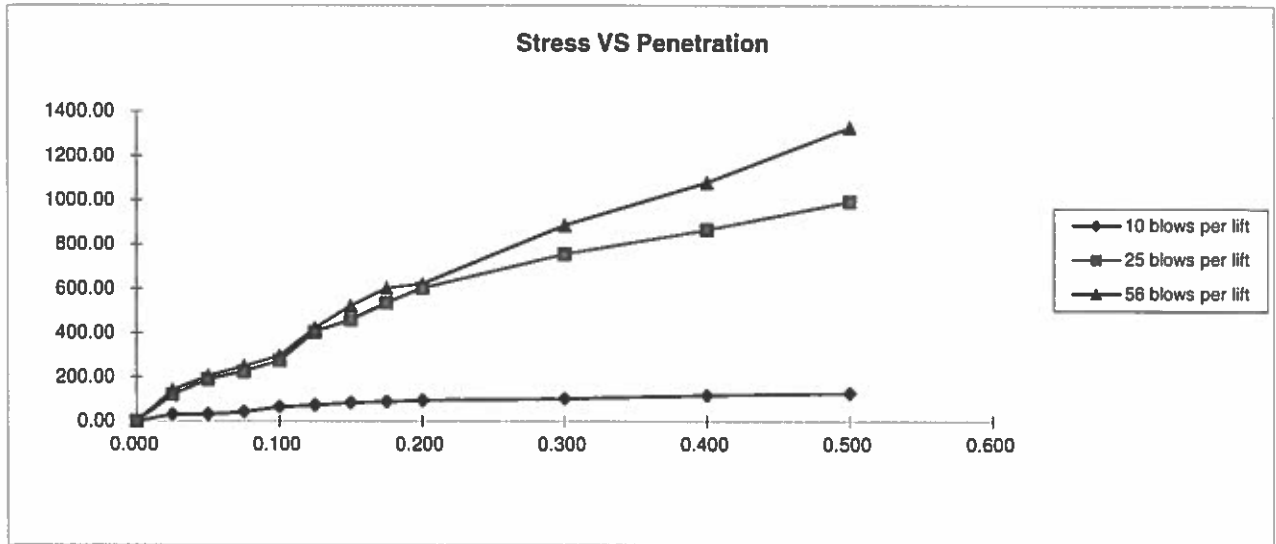
JOB NO.:

172016

FIG NO.:

B-9





BEARING RATIO AT 90% OF MAX	13.41 ~ R VALUE	40.00
BEARING RATIO AT 95% OF MAX	27.12 ~ R VALUE	73.00

JOB NO: 172016  
 SOIL TYPE: 1, CBR #1



**ENTECH**  
**ENGINEERING, INC.**

505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

**CALIFORNIA BEARING RATIO**

DRAWN:

DATE:

CHECKED:

DATE:

*SCC*

*1/23/18*

JOB NO: 172016

FIG NO: B-11





## **APPENDIX C: Pavement Design Calculations**

## FLEXIBLE PAVEMENT DESIGN

### DESIGN DATA

STONEBRIDGE @ MERIDIAN RANCH PHASE 3  
 LOW VOLUME- 36,500 ESAL  
 SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL ( $W_{18}$ ) =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
Standard Deviation	$S_o$ =	0.45
Loss in Serviceability	$\Delta\psi$ =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	$Z_R$ =	-0.84
Soil Resilient Modulus	$M_R$ =	13168

Weighted Structural Number (WSN): ➔ WSN = 1.46

### DESIGN TABLES AND EQUATIONS

$$S_1 = [(R - 5) / 11.29] + 3$$

$$M_R = 10^{[(S_1 + 18.72) / 6.24]}$$

$$k = M_R / 19.4$$

Where:

$M_R$  = resilient modulus (psi)

$S_1$  = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

Reliability (%)       $Z_R$  (z-statistic)

80	-0.84
85	-1.04
90	-1.28
93	-1.48
94	-1.56
95	-1.65
96	-1.75
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

$$\log_{10} W_{18} = Z_R \cdot S_o + 9.36 \cdot \log_{10} (SN+1) - 0.20 + \frac{\log_{10} \left[ \frac{\Delta \text{PSI}}{4.2 - 1.5} \right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \cdot \log_{10} M_R - 8.07$$

Left	Right	Difference
4.56	4.56	0.0

Job No. 172016  
 Fig. No. 1

## DESIGN CALCULATIONS

### DESIGN DATA STONEBRIDGE @ MERIDIAN RANCH PHASE 3

LOW VOLUME- 36,500 ESAL

SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL = 36,500
Hveem Stabilometer (R Value) Results:	R = 50
Weighted Structural Number (WSN):	WSN = 1.46

### DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$  Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$  Strength Coefficient - Aggregate Base Course

$D_1 =$  Depth of Asphalt (inches)

$D_2 =$  Depth of Base Course (inches)

### FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1 = 3.3$  inches of Full Depth Asphalt  
Use 4.0 inches Full Depth USE 4 INCHES MINIMUM

### FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) =  inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 1.3$  inches of Aggregate  
Base Course, use 6.0 inches

### RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 6.0 inches of Aggregate Base Course, or
2. 4.0 inches of Asphalt

Job No. 172016

Fig. No. 2

**APPENDIX D: Weighted Average Design ESAL's from  
Traffic Impact Analysis Report by LSC Transportation  
Consultants, Inc., dated March 20, 2017, Job No. 174017**

