



**ENTECH**  
ENGINEERING, INC.

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

July 29, 2021

Classic Communities  
2138 Flying Horse Club Drive  
Colorado Springs, Colorado 80921

Attn: Adam Doyle

Re: Pavement Recommendations  
Retreat at TimberRidge, Filing No.1 — Urban Lots  
El Paso County, Colorado

Dear Mr. Doyle:

As requested, Entech Engineering, Inc. obtained samples of the pavement subgrade soils from the proposed roadways at the above referenced site. Laboratory testing was performed in order to determine the pavement support characteristics of the soil. This letter presents the results of the laboratory testing and pavement recommendations for the roadways.

### **Project Description**

The project will consist of the paving of sections of Poco Road, Antelope Ravine Drive, Elk Antler Lane, Bison Valley Trail, and Rabbit Tail Place in the Retreat at TimberRidge, Filing No.1 subdivision in El Paso County, Colorado. A Subsurface Soil Investigation and laboratory testing were performed to determine the pavement support characteristics on the soils. The general layout of the site is presented in the Test Boring Location Map in Figure No. 1.

### **Subgrade Conditions**

A total of eight test borings were drilled along the roadways to depths of approximately 5 and 10 feet below the existing subgrade surface at the required sample frequency. At the time of our field investigation the subgrade was in good condition and adequate for vehicle traffic, including emergency vehicles.

The soils at the roadway subgrade depth primarily consisted of silty to clayey sand fill (Soil Type 1), native sandy clay (Soil Type 2), and silty sandstone (Soil Type 3). The Test Boring Logs are presented in Appendix A. Sieve Analyses and Atterberg Limit testing were performed on subgrade soil samples obtained from the test borings for the purpose of classification. The percent passing the No. 200 sieve for the Type 1 soils ranged from approximately 12 to 25 percent, with approximately 90 percent of the Type 2 soils passing, and approximately 13 percent of the Type 3 soils passing. Due to their similarity, the Type 1 and 3 soils will be grouped together. The Type 2 soils will require mitigation and will be replaced with Type 1 soils. The Type 1 values were used for calculating the pavement sections for all of the roadways.

The Type 1 and 3 soils classified as A-2-6 to A-1-b, which commonly exhibit fair to good pavement support characteristics. The Type 2 soils classified as A-6 soils, which exhibit poor pavement support characteristics. Groundwater was not encountered in the test borings. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight, indicating a negligible potential for below grade concrete degradation due to sulfate attack.

**El Paso County File No. SF-19-009**

Swell/Consolidation testing was required on the Type 2 soils due to the plastic index results. A Swell test on the Type 2 soils resulted in a volume change of 2.7 percent. The Type 2 Soil encountered in the vicinity of Test Boring No. 1 should be removed and replaced with approved Type 1 soils. The anticipated mitigation area is shown on Figure No. 1.

California Bearing Ratio (CBR) testing was performed on a representative subgrade sample of the Type 1 materials to determine the support characteristics of the subgrade soils for the roadway sections. The results of the CBR testing are presented in Appendix B and summarized as follows:

Soil Type 1 – Clayey Sand Fill  
CBR 1  
R @ 95% = 14.0  
R @ 90% = 26.0  
Use R = 26.0 for design

| <u>Classification Testing</u> |       |
|-------------------------------|-------|
| Liquid Limit                  | 39    |
| Plasticity Index              | 25    |
| Percent Passing 200           | 24.8  |
| AASHTO Classification         | A-2-6 |
| Group Index                   | 1     |
| Unified Soils Classification  | SC    |

### **Pavement Design**

CBR testing was used to determine pavement sections for the roadways. Pavement sections were determined utilizing El Paso County Engineering Criteria Manual. All roadways in this portion of the filing classify as Urban Local Roads, which used an 18K ESAL value of 292,000 for design purposes. Pavement sections were determined for asphalt on cement stabilized subgrade.

Design parameters used in the pavement analysis for the roadways are as follows:

|                                  |           |
|----------------------------------|-----------|
| Reliability                      | 80%       |
| $\Delta$ psi (Urban Local)       | 2.0       |
| “R” Value Subgrade (Soil Type 1) | 26.0      |
| Resilient Modulus (Soil Type 1)  | 6,010 psi |
| Hot Bituminous Pavement          | 0.44      |
| Cement Stabilized Subgrade       | 0.12      |

The pavement design calculations are presented in Appendix C. Pavement section alternatives for the roadway sections are presented below. Any additional grading may result in subgrade soils with different support characteristics. The following pavement sections should be re-evaluated if additional grading is performed.

**Pavement Sections – Urban Local**  
**ESAL = 292,000 – All Roadway Sections**  
**Soil Type 1**

| <u>Alternative</u>                  | <u>Asphalt (in)</u> | <u>Cement Stabilized Subgrade (in)</u> |
|-------------------------------------|---------------------|--|
| 1. Asphalt Over Stabilized Subgrade | 4.0                 | 10.0                                   |

-The calculations have full-depth sections provided. Full depth sections are currently not allowed by El Paso County.

**Roadway Construction – Cement Stabilized Subgrade**

Prior to placement of the asphalt, the subgrade may be stabilized by addition of cement to a depth of at least 10 inches. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade’s maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) and based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over a 10-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 10 inches of subgrade should be thoroughly moisture conditioned to the soil’s optimum water content or as much as 2 percent more than the optimum water content as necessary to provide a compactable soil condition. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95 percent of the subgrade maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). Satisfactory compaction of the subgrade shall occur within 90 minutes from the time of mixing the cement into the subgrade.

The following conditions shall be observed as part of the subgrade stabilization:

- Type I/II cement as supplied; a local supplier shall be used. All cement used for stabilization should come from the same source. If cement sources are changed a new laboratory mix design should be completed.
- Moisture conditioning of the subgrade and/or mixing of the cement into the subgrade shall not occur when soil temperatures are below 40° F. Cement treated subgrades should be maintained at a temperature of 40° F or greater until the subgrade has been compacted as required.
- Cement placement, cement mixing and compaction of the cement treated subgrade should be observed by a Soils Engineer. The Soils Engineer should complete in situ compaction tests and construct representative compacted specimens of the treated subgrade material for subsequent laboratory quality assurance testing.

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, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

Classic Communities  
Pavement Recommendations  
Retreat at TimberRidge, Filing No.1 — Urban Lots  
El Paso County, Colorado  
Page 4

We trust that this has provided you with the information you required. The pavement sections provided are based on general site soil types. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.



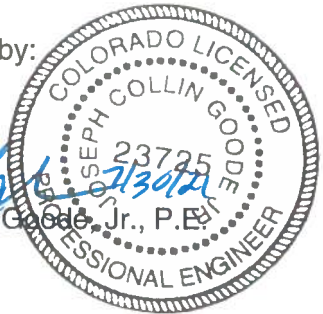
Daniel P. Stegman

DPS/bs

Encl.

Entech Job No. 211573  
AAprojects/2021/211573 pr

Reviewed by:



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

## TABLE

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

CLIENT CLASSIC COMMUNITIES  
PROJECT RETREAT AT TIMBERRIDGE, F-1  
JOB NO. 211573

| 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    | 2               | 0-3        |           |                   | 24.8                      | 39               | 25                |                | A-2-6         |                  | SC                     | FILL, SAND, CLAYEY            |
| 1         | 2               | 1-2        |           |                   | 24.4                      | 34               | 16                |                | A-2-6         |                  | SC                     | FILL, SAND, CLAYEY            |
| 1         | 3               | 1-2        |           |                   | 20.1                      | NV               | NP                |                | A-1-b         |                  | SM                     | FILL, SAND, SILTY             |
| 1         | 5               | 1-2        |           |                   | 11.9                      | NV               | NP                |                | A-1-b         |                  | SM-SW                  | FILL, SAND, SLIGHTLY SILTY    |
| 1         | 6               | 1-2        |           |                   | 20.9                      | NV               | NP                |                | A-1-b         |                  | SM                     | FILL, SAND, SILTY             |
| 1         | 7               | 1-2        |           |                   | 15.0                      | NV               | NP                |                | A-1-b         |                  | SM                     | FILL, SAND, SILTY             |
| 1         | 8               | 1-2        |           |                   | 19.3                      | NV               | NP                |                | A-1-b         |                  | SM                     | FILL, SAND, SILTY             |
| 2         | 1               | 1-2        | 19.9      | 101.8             | 89.5                      | 43               | 21                | <0.01          | A-6           | 2.7              | CL                     | FILL, SAND, SILTY CLAY, SANDY |
| 3         | 4               | 1-2        |           |                   | 12.6                      | NV               | NP                | <0.01          | A-1-b         |                  | SM                     | SANDSTONE, SILTY              |

**FIGURE**





## **APPENDIX A: Test Boring Logs**

TEST BORING NO. 1  
 DATE DRILLED 7/8/2021  
 Job # 211573

TEST BORING NO. 2  
 DATE DRILLED 7/8/2021  
 CLIENT CLASSIC COMMUNITIES  
 LOCATION RETREAT AT TIMBERRIDGE, F-1

REMARKS

DRY TO 10', 7/8/21

CLAY, SANDY, BROWN, VERY STIFF, MOIST

SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol              | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|---------------------|---------|----------------|----------------|-----------|
| 0-5'       | [Diagonal Hatching] |         | 35*            | 17.3           | 2         |
| 5-10'      | [Dotted]            |         | 50*<br>2"      | 6.5            | 3         |
| 10-15'     | [Dotted]            |         | 50*<br>6"      | 7.8            | 3         |

REMARKS

DRY TO 5', 7/8/21

FILL 0-5', SAND, CLAYEY, FINE TO COARSE GRAINED, DARK BROWN, VERY DENSE TO MEDIUM DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol              | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|---------------------|---------|----------------|----------------|-----------|
| 0-5'       | [Diagonal Hatching] |         | 50*<br>10"     | 8.9            | 1         |
| 5-10'      | [Dotted]            |         | 12*            | 9.8            | 1         |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE:

7/23/21

JOB NO.:  
 211573

FIG NO.:  
 A- 1

TEST BORING NO. 3  
 DATE DRILLED 7/8/2021  
 Job # 211573

TEST BORING NO. 4  
 DATE DRILLED 7/8/2021  
 CLIENT CLASSIC COMMUNITIES  
 LOCATION RETREAT AT TIMBERRIDGE, F-1

REMARKS

REMARKS

DRY TO 5', 7/8/21

FILL 0-5', SAND, SILTY, FINE TO MEDIUM GRAINED, DARK BROWN TO BROWN, MEDIUM DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5        |        |         | 25*            | 5.2            | 1         |
| 5          |        |         | 15*            | 3.6            | 1         |

DRY TO 5', 7/8/21

SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5        |        |         | 50*<br>6"      | 6.3            | 3         |
| 5          |        |         | 50*<br>2"      | 6.6            | 3         |



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TEST BORING LOG

DRAWN: DATE: CHECKED: *h* DATE: 7/29/21

JOB NO.: 211573

FIG NO.: A-2

TEST BORING NO. 5  
 DATE DRILLED 7/8/2021  
 Job # 211573

TEST BORING NO. 6  
 DATE DRILLED 7/8/2021  
 CLIENT CLASSIC COMMUNITIES  
 LOCATION RETREAT AT TIMBERRIDGE, F-1

REMARKS

REMARKS

DRY TO 5', 7/8/21

POSS. FILL 0-5', SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, DARK BROWN TO TAN, VERY DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5        |        |         | 50*            | 7.6            | 1         |
| 5-8"       |        |         | 50*<br>8"      | 3.7            | 1         |

DRY TO 10', 7/8/21

POSS. FILL 0-9', SAND, SILTY, FINE TO COARSE GRAINED, BROWN TO TAN, VERY DENSE TO MEDIUM DENSE, MOIST

SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, OLIVE BROWN, VERY DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-11"      |        |         | 50*<br>11"     | 7.3            | 1         |
| 5-18"      |        |         | 18*            | 8.7            | 1         |
| 10-16"     |        |         | 50*<br>6"      | 8.6            | 3         |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 7/23/21

JOB NO:  
 211573

FIG NO:  
 A-3

TEST BORING NO. 7  
 DATE DRILLED 7/9/2021  
 Job # 211573

TEST BORING NO. 8  
 DATE DRILLED 7/9/2021  
 CLIENT CLASSIC COMMUNITIES  
 LOCATION RETREAT AT TIMBERRIDGE, F-1

REMARKS

DRY TO 5', 7/9/21

FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, DARK BROWN, MEDIUM DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5        |        |         | 25*            | 5.9            | 1         |
| 5-10       |        |         | 26*            | 7.4            | 1         |

REMARKS

DRY TO 5', 7/9/21

FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, DARK BROWN, MEDIUM DENSE, MOIST

\* - DRIVES TAKEN WITH A 35lb HAMMER, BLOW COUNTS CONVERTED TO STANDARD 140lb HAMMER

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5        |        |         | 25*            | 6.0            | 1         |
| 5-10       |        |         | 24*            | 3.8            | 1         |



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TEST BORING LOG

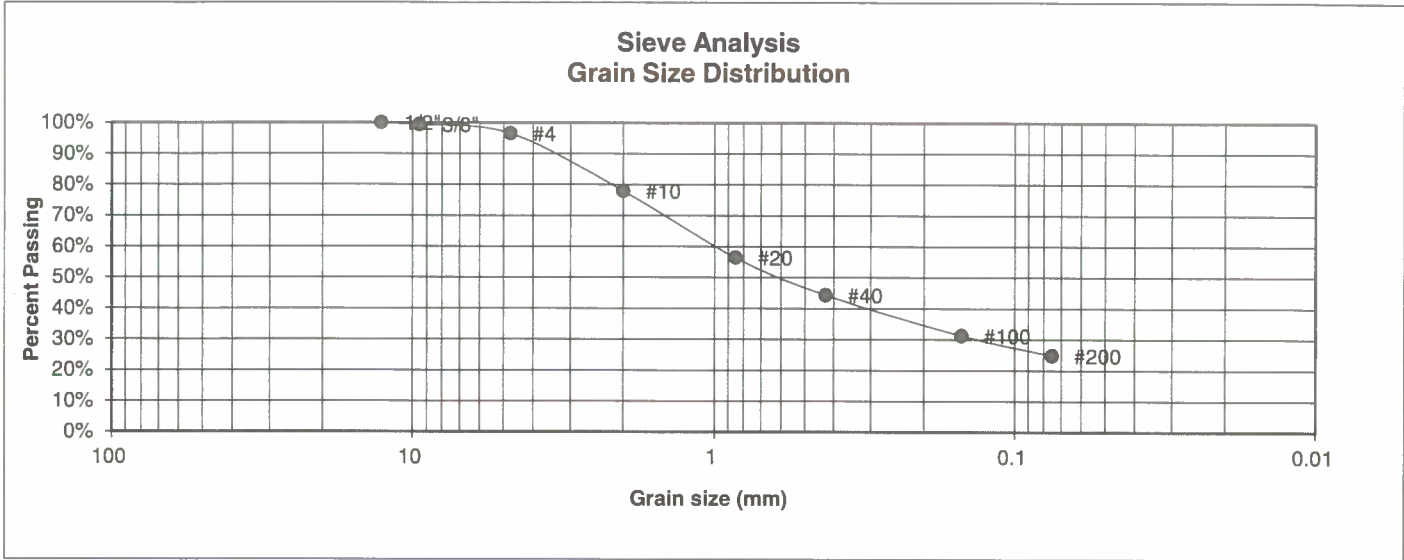
|        |       |                    |         |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED:           | DATE:   |
|        |       | <i>[Signature]</i> | 7/23/21 |

JOB NO.:  
 211573

FIG NO.:  
 A- 4

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

|                               |        |                    |                             |
|-------------------------------|--------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SC     | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1, CBR | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 2      | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 0-3    | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-2-6  | <u>GROUP INDEX</u> | 1                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                | 100.0%               |
| 3/8"                | 99.4%                |
| 4                   | 96.5%                |
| 10                  | 77.9%                |
| 20                  | 56.4%                |
| 40                  | 44.3%                |
| 100                 | 31.2%                |
| 200                 | 24.8%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | 14 |
| Liquid Limit            | 39 |
| Plastic Index           | 25 |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



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**LABORATORY TEST  
RESULTS**

DRAWN:

DATE:

CHECKED:

*[Signature]*

DATE:

2/23/21

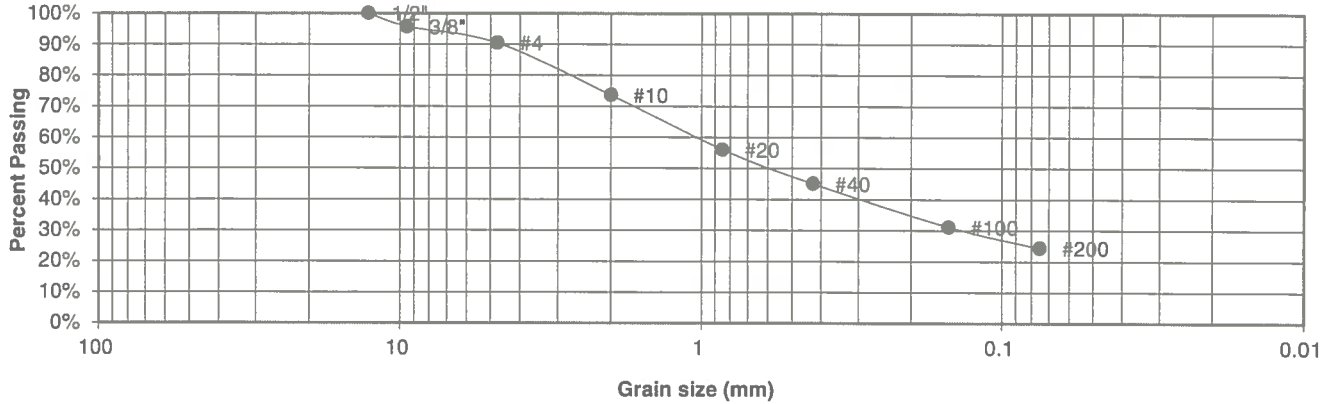
JOB NO.:

211573  
FIG NO.:

8-1

|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SC    | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 2     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-2-6 | <u>GROUP INDEX</u> | 1                           |

**Sieve Analysis  
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3"           |               |
| 1 1/2"       |               |
| 3/4"         |               |
| 1/2"         | 100.0%        |
| 3/8"         | 95.7%         |
| 4            | 90.4%         |
| 10           | 73.6%         |
| 20           | 56.0%         |
| 40           | 45.1%         |
| 100          | 31.1%         |
| 200          | 24.4%         |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | 18 |
| Liquid Limit            | 34 |
| Plastic Index           | 16 |

| <u>Swell</u>              |  |
|---------------------------|--|
| 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:   |
|        |       | <i>h</i> | 7/23/20 |

JOB NO.:

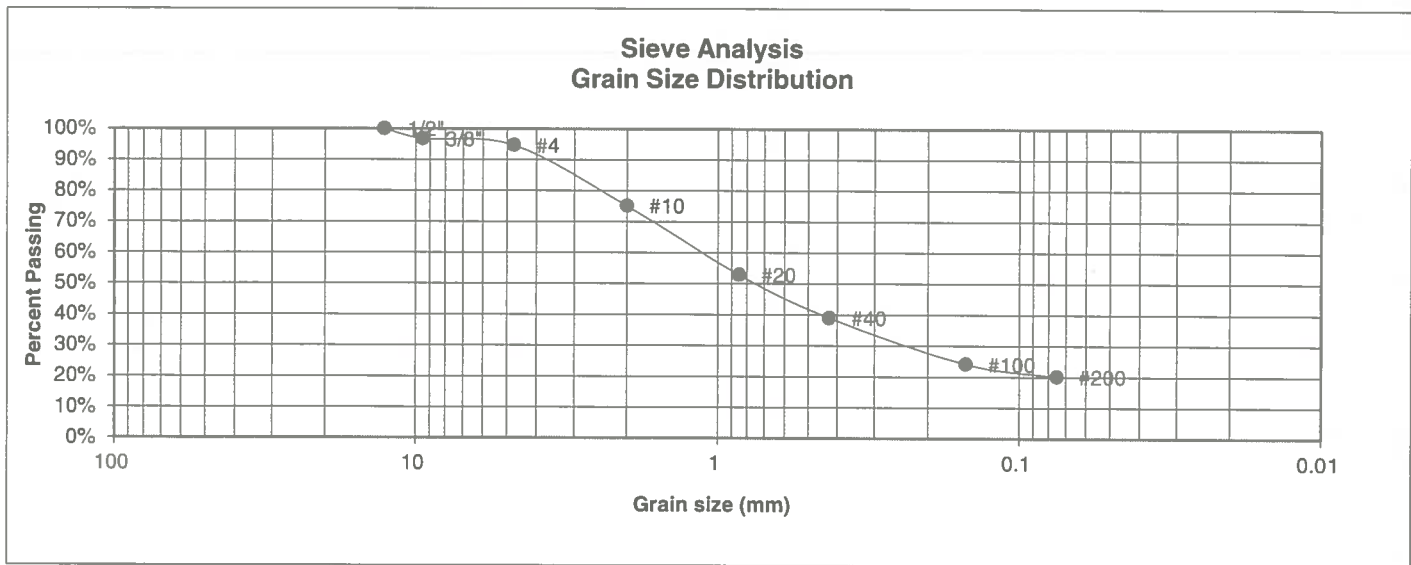
211573

FIG NO.:

*B-2*



|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM    | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 3     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-1-b | <u>GROUP INDEX</u> | 0                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                | 100.0%               |
| 3/8"                | 96.8%                |
| 4                   | 94.7%                |
| 10                  | 75.1%                |
| 20                  | 52.9%                |
| 40                  | 39.0%                |
| 100                 | 24.1%                |
| 200                 | 20.1%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | NP |
| Liquid Limit            | NV |
| Plastic Index           | NP |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

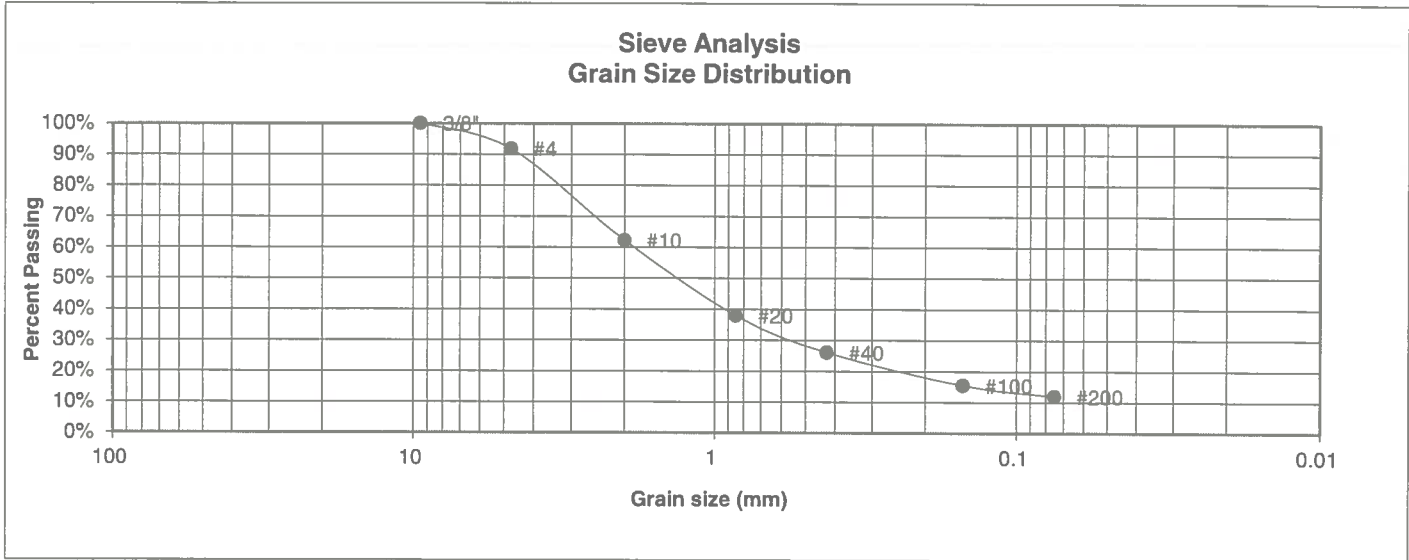
|        |       |                    |         |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED:           | DATE:   |
|        |       | <i>[Signature]</i> | 7/23/21 |

JOB NO.:

211573  
FIG NO.:

**B-3**

|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM-SW | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 5     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-1-b | <u>GROUP INDEX</u> | 0                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                |                      |
| 3/8"                | 100.0%               |
| 4                   | 91.8%                |
| 10                  | 62.3%                |
| 20                  | 38.0%                |
| 40                  | 26.0%                |
| 100                 | 15.5%                |
| 200                 | 11.9%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | NP |
| Liquid Limit            | NV |
| Plastic Index           | NP |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



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**LABORATORY TEST  
RESULTS**

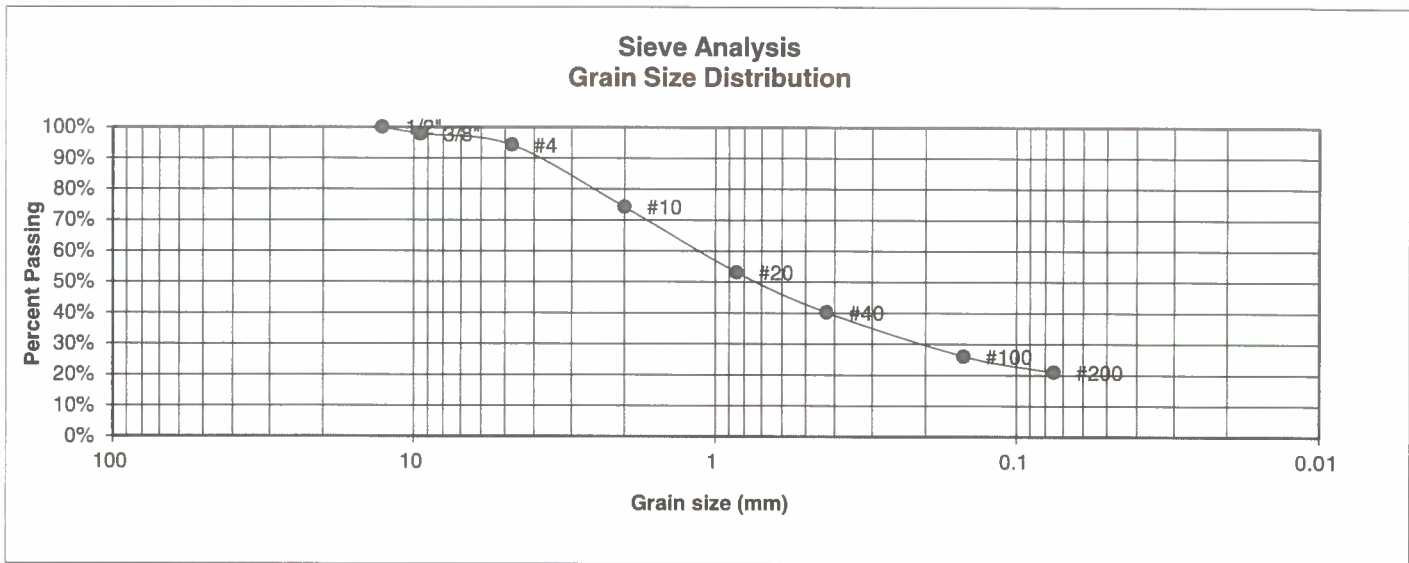
|        |       |           |        |
|--------|-------|-----------|--------|
| DRAWN: | DATE: | CHECKED:  | DATE:  |
|        |       | <i>BL</i> | 7/23/2 |

JOB NO.:

211573  
FIG NO.:

*B-4*

|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM    | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 6     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-1-b | <u>GROUP INDEX</u> | 0                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                | 100.0%               |
| 3/8"                | 97.8%                |
| 4                   | 94.3%                |
| 10                  | 74.3%                |
| 20                  | 53.1%                |
| 40                  | 40.2%                |
| 100                 | 26.1%                |
| 200                 | 20.9%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | NP |
| Liquid Limit            | NV |
| Plastic Index           | NP |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



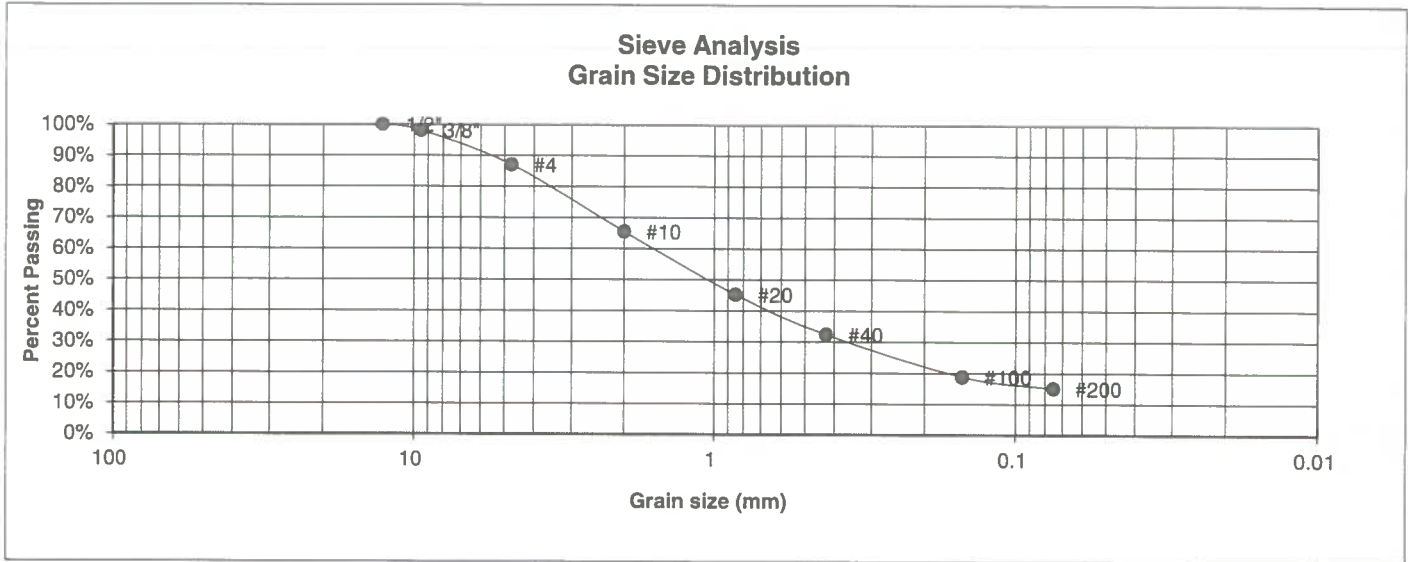
**ENTECH  
ENGINEERING, INC.**  
505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

|        |       |                   |               |
|--------|-------|-------------------|---------------|
| DRAWN: | DATE: | CHECKED: <i>h</i> | DATE: 7/23/21 |
|--------|-------|-------------------|---------------|

JOB NO.:  
211573  
FIG NO.:  
*B-5*

|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM    | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 7     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-1-b | <u>GROUP INDEX</u> | 0                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                | 100.0%               |
| 3/8"                | 98.1%                |
| 4                   | 87.1%                |
| 10                  | 65.5%                |
| 20                  | 45.3%                |
| 40                  | 32.4%                |
| 100                 | 18.8%                |
| 200                 | 15.0%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | NP |
| Liquid Limit            | NV |
| Plastic Index           | NP |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



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**LABORATORY TEST  
RESULTS**

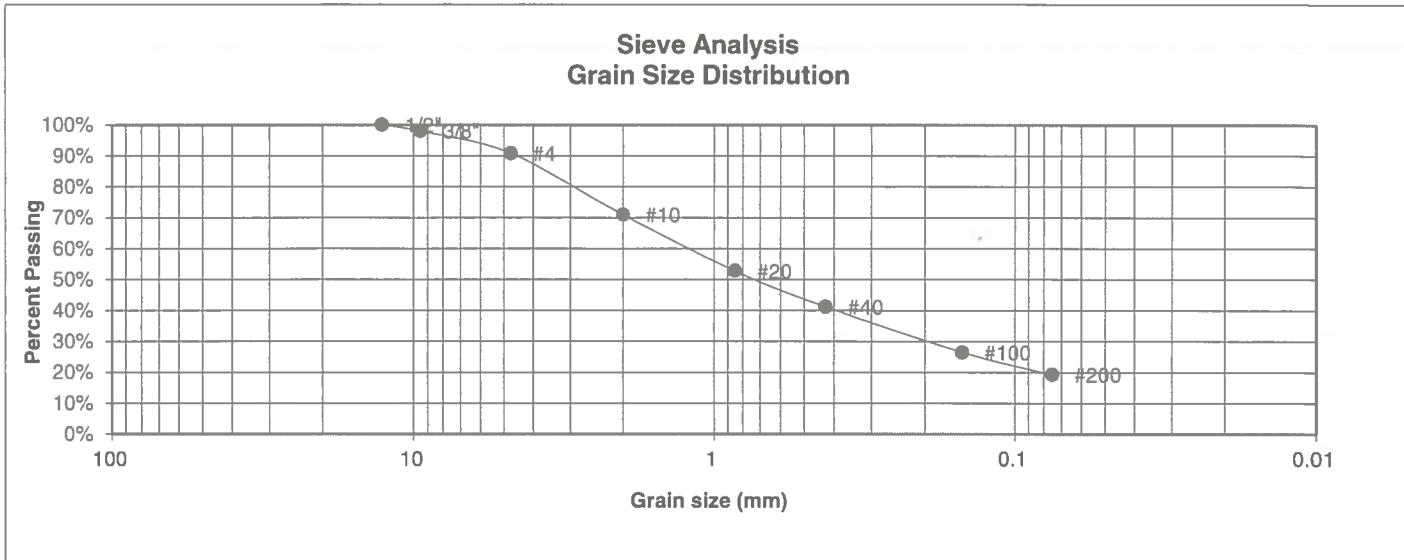
|        |       |                             |               |
|--------|-------|-----------------------------|---------------|
| DRAWN: | DATE: | CHECKED: <i>[Signature]</i> | DATE: 7/23/21 |
|--------|-------|-----------------------------|---------------|

JOB NO.:

211573  
FIG NO.:

*8-6*

|                               |       |                    |                             |
|-------------------------------|-------|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM    | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 1     | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 8     | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2   | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-1-b | <u>GROUP INDEX</u> | 0                           |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                | 100.0%               |
| 3/8"                | 98.0%                |
| 4                   | 90.8%                |
| 10                  | 70.9%                |
| 20                  | 52.7%                |
| 40                  | 41.2%                |
| 100                 | 26.5%                |
| 200                 | 19.3%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | NP |
| Liquid Limit            | NV |
| Plastic Index           | NP |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



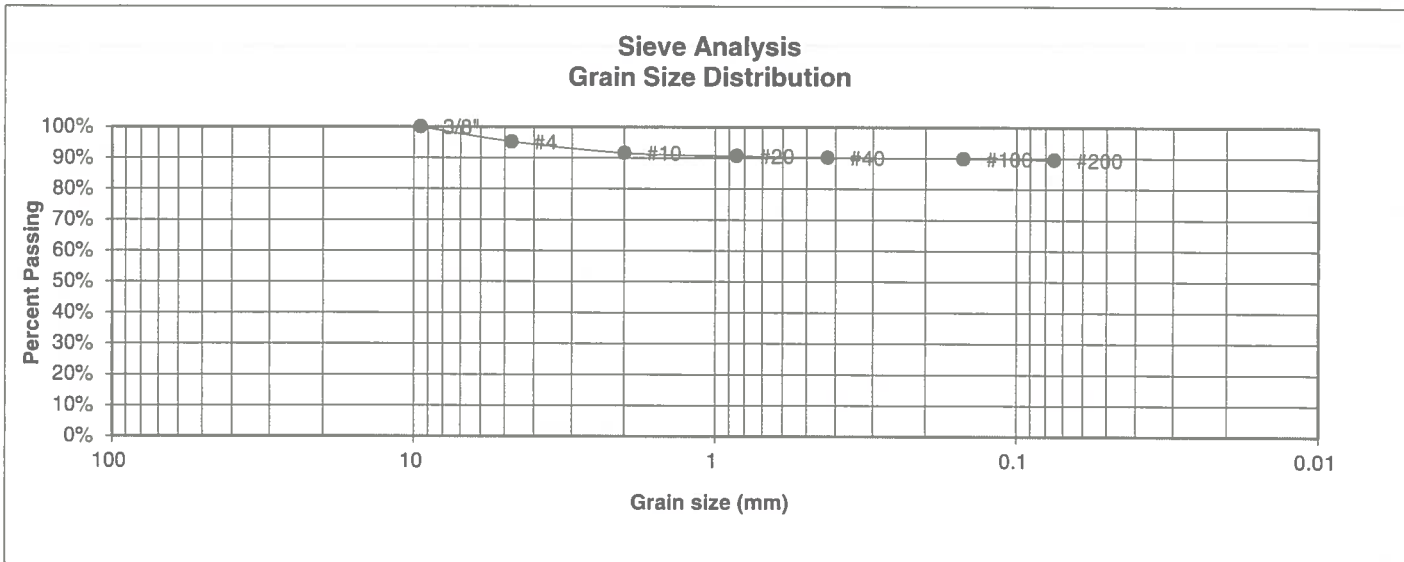
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505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

|        |       |                    |         |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED:           | DATE:   |
|        |       | <i>[Signature]</i> | 7/23/21 |

JOB NO.:  
211573  
FIG NO.:  
B-7

|                               |     |                    |                             |
|-------------------------------|-----|--------------------|-----------------------------|
| <u>UNIFIED CLASSIFICATION</u> | CL  | <u>CLIENT</u>      | CLASSIC COMMUNITIES         |
| <u>SOIL TYPE #</u>            | 2   | <u>PROJECT</u>     | RETREAT AT TIMBERRIDGE, F-1 |
| <u>TEST BORING #</u>          | 1   | <u>JOB NO.</u>     | 211573                      |
| <u>DEPTH (FT)</u>             | 1-2 | <u>TEST BY</u>     | BL                          |
| <u>AASHTO CLASSIFICATION</u>  | A-6 | <u>GROUP INDEX</u> | 20                          |



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3"                  |                      |
| 1 1/2"              |                      |
| 3/4"                |                      |
| 1/2"                |                      |
| 3/8"                | 100.0%               |
| 4                   | 95.2%                |
| 10                  | 91.6%                |
| 20                  | 90.6%                |
| 40                  | 90.2%                |
| 100                 | 89.9%                |
| 200                 | 89.5%                |

| <u>Atterberg Limits</u> |    |
|-------------------------|----|
| Plastic Limit           | 22 |
| Liquid Limit            | 43 |
| Plastic Index           | 21 |

| <u>Swell</u>              |  |
|---------------------------|--|
| Moisture at start         |  |
| Moisture at finish        |  |
| Moisture increase         |  |
| Initial dry density (pcf) |  |
| Swell (psf)               |  |



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505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

|        |       |          |         |
|--------|-------|----------|---------|
| DRAWN: | DATE: | CHECKED: | DATE:   |
|        |       | <i>h</i> | 7/23/12 |

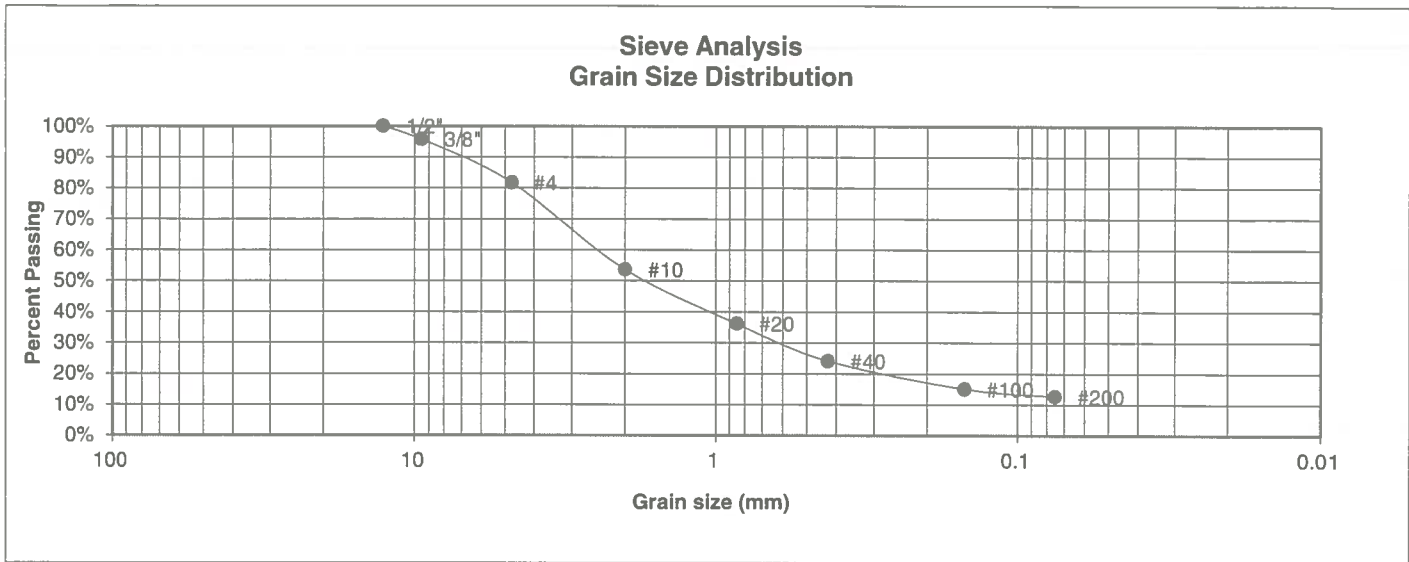
JOB NO.:

211573

FIG NO.:

*B-8*

|                        |       |             |                             |
|------------------------|-------|-------------|-----------------------------|
| UNIFIED CLASSIFICATION | SM    | CLIENT      | CLASSIC COMMUNITIES         |
| SOIL TYPE #            | 3     | PROJECT     | RETREAT AT TIMBERRIDGE, F-1 |
| TEST BORING #          | 4     | JOB NO.     | 211573                      |
| DEPTH (FT)             | 1-2   | TEST BY     | BL                          |
| AASHTO CLASSIFICATION  | A-1-b | GROUP INDEX | 0                           |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3"           |               |
| 1 1/2"       |               |
| 3/4"         |               |
| 1/2"         | 100.0%        |
| 3/8"         | 95.7%         |
| 4            | 81.8%         |
| 10           | 53.6%         |
| 20           | 36.2%         |
| 40           | 24.1%         |
| 100          | 15.0%         |
| 200          | 12.6%         |

**Atterberg Limits**

|               |    |
|---------------|----|
| Plastic Limit | NP |
| Liquid Limit  | NV |
| Plastic Index | NP |

**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: <i>CR</i> | DATE: 7/23/21 |
|--------|-------|--------------------|---------------|

JOB NO.:

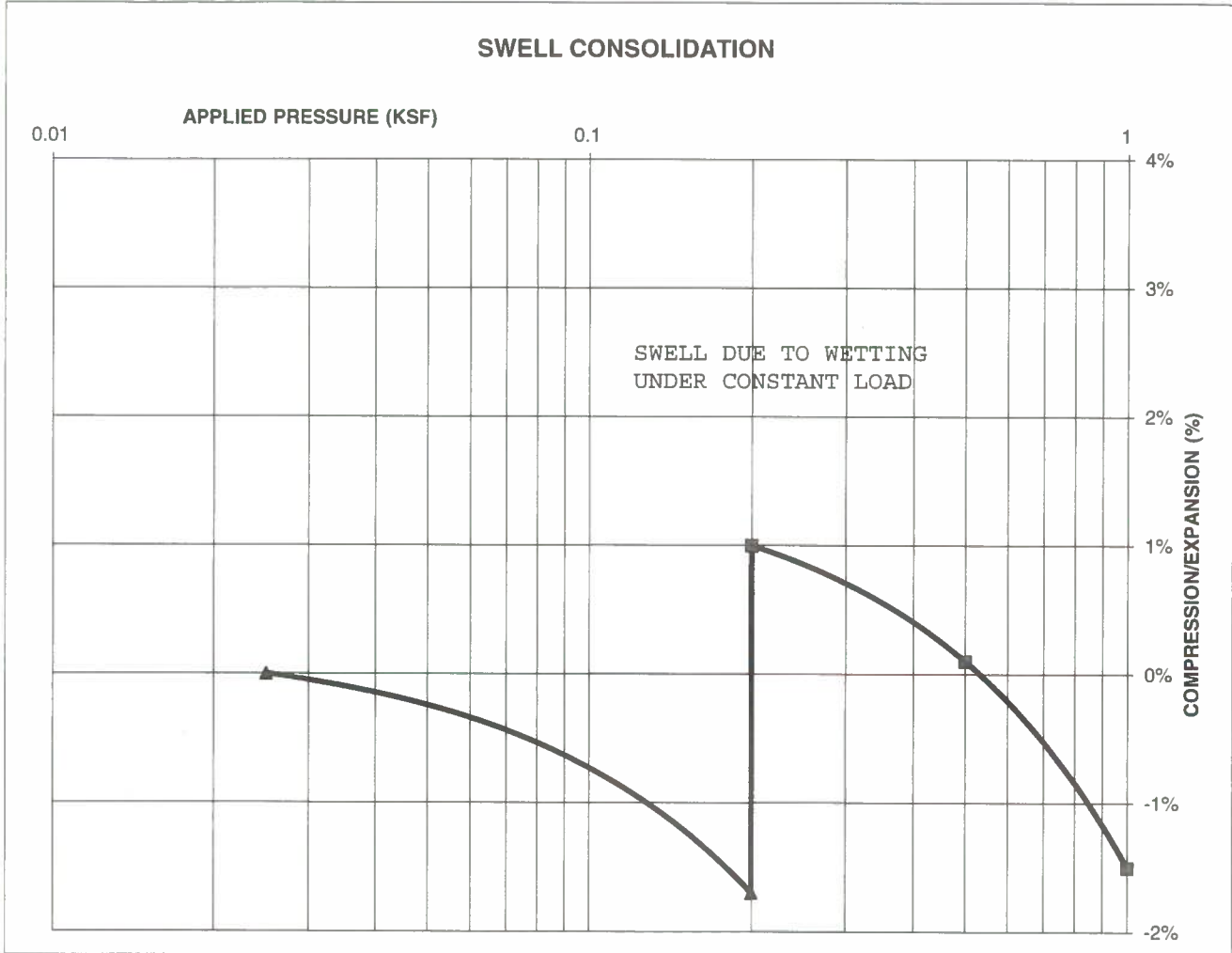
211573  
FIG NO.:

*B-9*

**CONSOLIDATION TEST RESULTS**

|                               |    |           |       |
|-------------------------------|----|-----------|-------|
| TEST BORING #                 | 1  | DEPTH(ft) | 1-2   |
| DESCRIPTION                   | CL | SOIL TYPE | 2     |
| NATURAL UNIT DRY WEIGHT (PCF) |    |           | 102   |
| NATURAL MOISTURE CONTENT      |    |           | 19.9% |
| SWELL/CONSOLIDATION (%)       |    |           | 2.7%  |

JOB NO. 211573  
 CLIENT CLASSIC COMMUNITIES  
 PROJECT RETREAT AT TIMBERRIDGE, F-1



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**ENGINEERING, INC.**

505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION  
 TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE: 7/29/21

JOB NO.: 211573

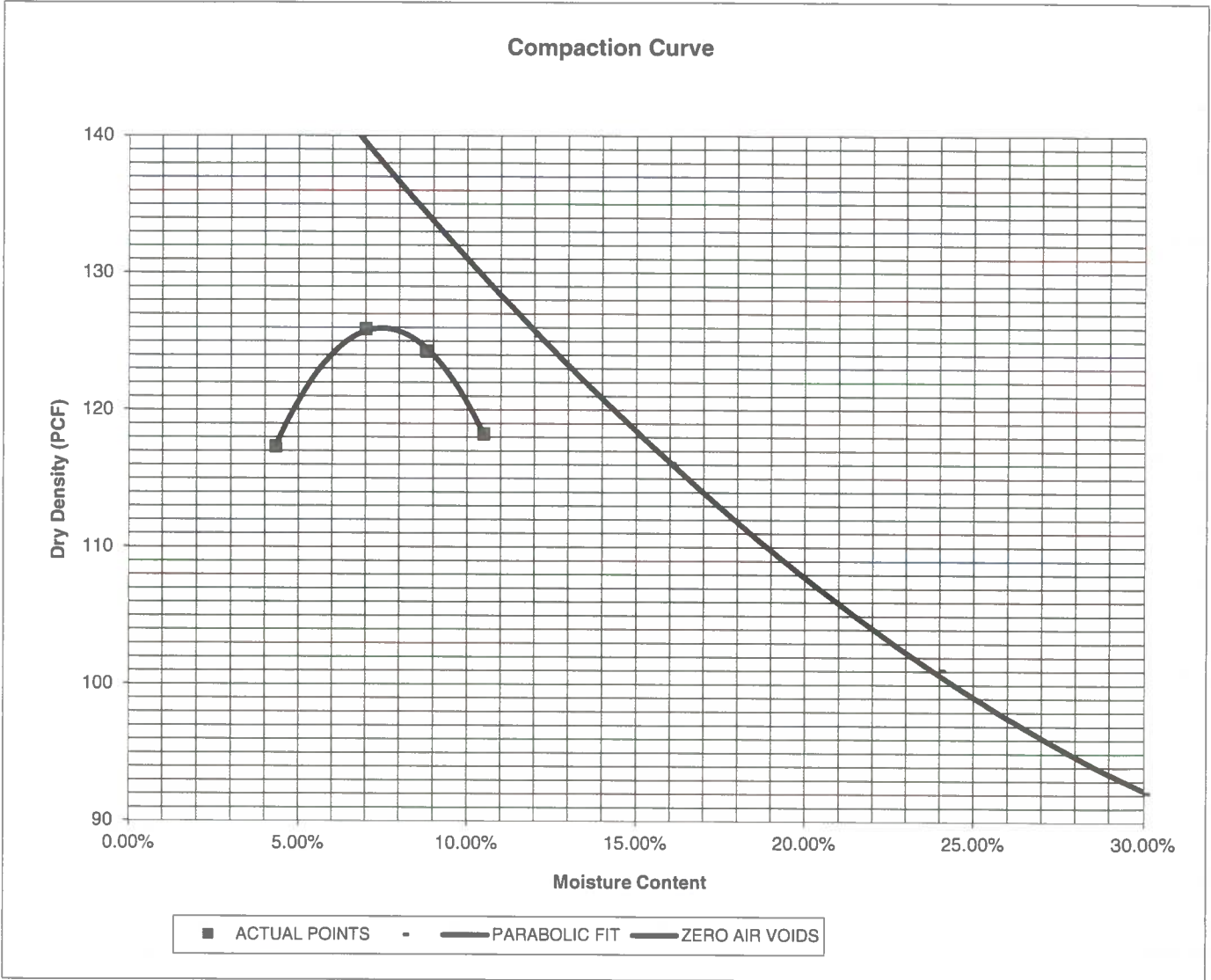
FIG NO.: B-10





|                         |                             |                |                     |
|-------------------------|-----------------------------|----------------|---------------------|
| <u>PROJECT</u>          | RETREAT AT TIMBERRIDGE, F-1 | <u>CLIENT</u>  | CLASSIC COMMUNITIES |
| <u>SAMPLE LOCATION</u>  | TB-2 @ 0-3'                 | <u>JOB NO.</u> | 211573              |
| <u>SOIL DESCRIPTION</u> | FILL, SAND, CLAYEY, BROWN   | <u>DATE</u>    | 07/16/21            |

|                                  |               |                          |      |
|----------------------------------|---------------|--------------------------|------|
| <u>IDENTIFICATION</u>            | SC            | <u>COMPACTION TEST #</u> | 1    |
| <u>TEST DESIGNATION / METHOD</u> | ASTM D-1557-A | <u>TEST BY</u>           | BL   |
| <u>MAXIMUM DRY DENSITY (PCF)</u> | 126.1         | <u>OPTIMUM MOISTURE</u>  | 7.5% |



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COLORADO SPRINGS, COLORADO 80907

**MOISTURE DENSITY RELATION**

DRAWN:

DATE:

CHECKED:

DATE:

7/23/21

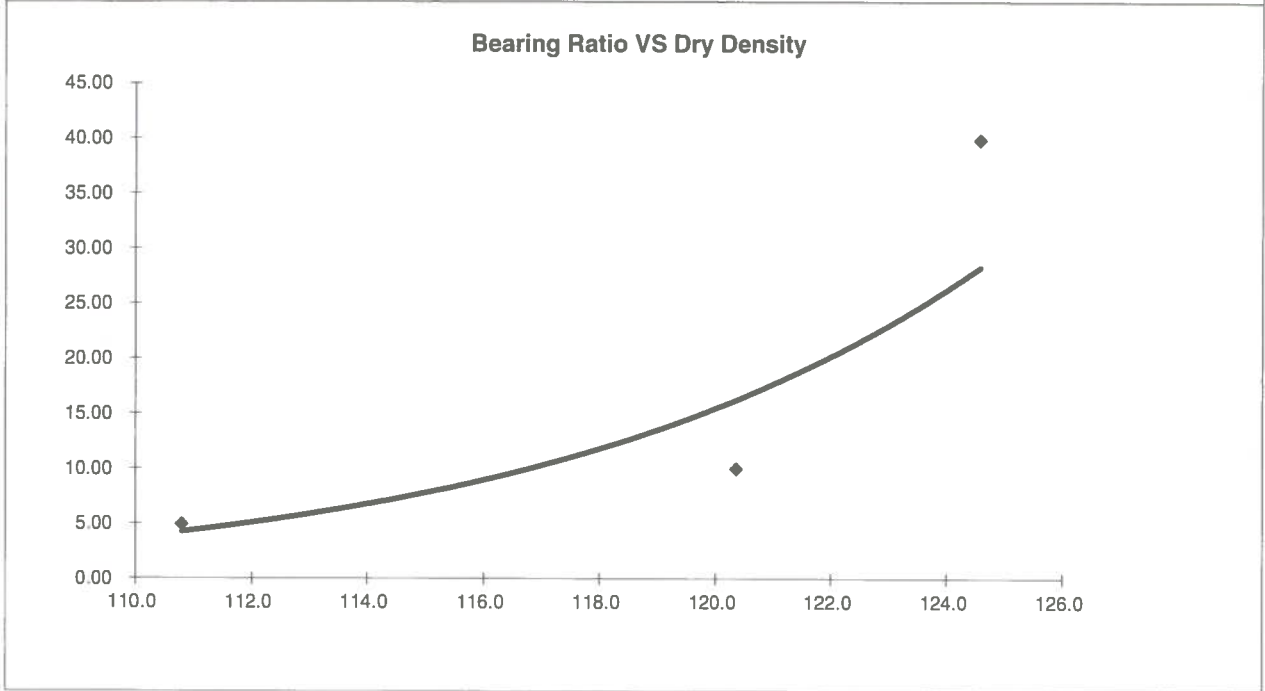
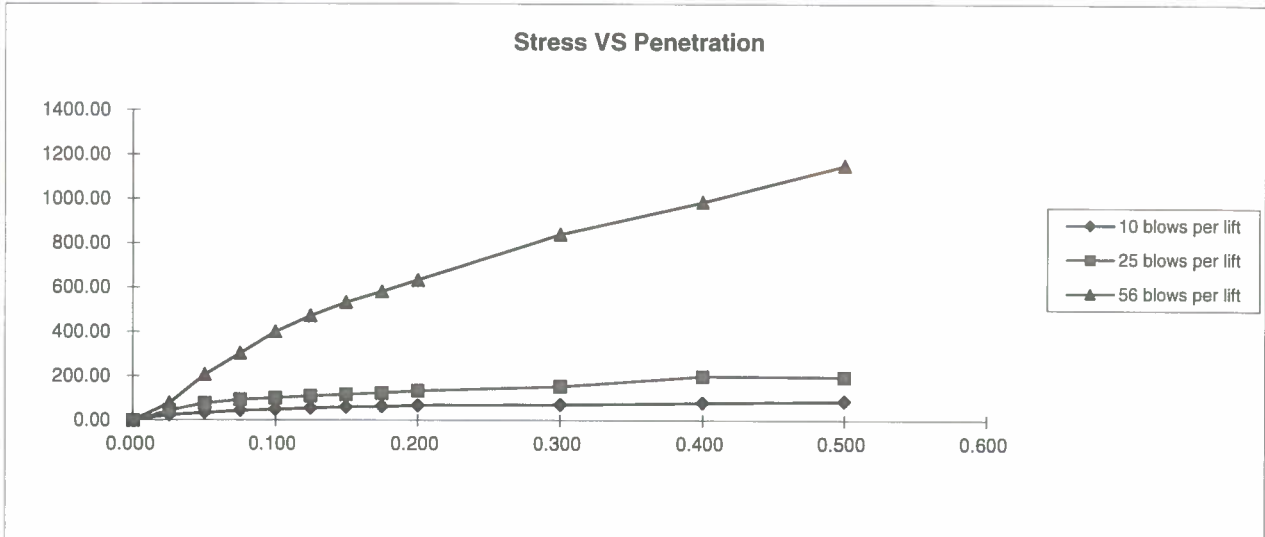
JOB NO.:

211573

FIG NO.:

B-12





|                                    |                |       |
|------------------------------------|----------------|-------|
| <u>BEARING RATIO AT 90% OF MAX</u> | 6.37 ~ R VALUE | 14.00 |
| <u>BEARING RATIO AT 95% OF MAX</u> | 9.72 ~ R VALUE | 26.00 |

JOB NO.: 211573  
 SOIL TYPE: I



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 505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

**CALIFORNIA BEARING RATIO**

|        |       |                   |               |
|--------|-------|-------------------|---------------|
| DRAWN: | DATE: | CHECKED: <i>h</i> | DATE: 7/23/21 |
|--------|-------|-------------------|---------------|

JOB NO.: 211573  
 FIG NO.: *B-14*

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

## FLEXIBLE PAVEMENT DESIGN

### DESIGN DATA

Classic Communities

Retreat at TimberRidge Filing No. 1 - Urban Local - Soil Type 1

|   |                     |         |
|---|---------------------|---------|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL ( $W_{18}$ ) = | 292,000 |
| Hveem Stabilometer (R Value) Results:                     | R =                 | 26      |
| Standard Deviation  | $S_o$ =             | 0.44    |
| Loss in Serviceability                                    | $\Delta\psi$ =      | 2.0     |
| Reliability   | Reliability =       | 80      |
| Reliability (z-statistic)                                 | $Z_R$ =             | -0.841  |
| Soil Resilient Modulus                                    | $M_R$ =             | 6010    |

Weighted Structural Number (WSN): ➔ WSN = 2.80

### 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)

|       |        |
|-------|--------|
| 50    | 0      |
| 60    | -0.253 |
| 70    | -0.524 |
| 75    | -0.674 |
| 80    | -0.841 |
| 90    | -1.282 |
| 95    | -1.65  |
| 97    | -1.88  |
| 98    | -2.05  |
| 99    | -2.33  |
| 99.9  | -3.09  |
| 99.99 | -3.75  |

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

|      |       |            |
|------|-------|------------|
| Left | Right | Difference |
| 5.47 | 5.47  | 0.0        |

Job No. 211573

Fig. No. C-1

## DESIGN CALCULATIONS

### CEMENT TREATED SECTIONS

#### DESIGN DATA

Classic Communities

Retreat at TimberRidge Filing No. 1 - Urban Local - Soil Type 1

|   |        |         |
|---|--------|---------|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = | 292,000 |
| Hveem Stabilometer (R Value) Results:                     | R =    | 26      |
| Weighted Structural Number (WSN):                         | WSN =  | 2.80    |

#### DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$  Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.12$  Strength Coefficient - Cement Stabilized Subgrade

$D_1 =$  Depth of Asphalt (inches)

$D_2 =$  Depth of Cement Stabilized Subgrade(inches)

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

$$D_1 = (WSN)/C_1 = 6.4 \text{ inches of Full Depth Asphalt}$$

Use 6.5 inches Full Depth

#### FOR ASPHALT + CEMENT STABILIZED SUBGRADE SECTION

$$\text{Asphalt Thickness (t)} = \boxed{4} \text{ inches}$$

$$D_2 = ((WSN) - (t)(C_1))/C_2 = 8.7 \text{ inches of Cement Stabilized Subgrade,}$$

use 10.0 inches

#### RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 10.0 inches of Cement Stabilized Subgrade, or
2. 6.5 inches of Full-Depth Asphalt

Job No. 211573

Fig. No. C-2



**ENTECH**  
ENGINEERING, INC.

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

July 29, 2021

Classic Communities  
2138 Flying Horse Club Drive  
Colorado Springs, Colorado 80921

Attn: Adam Doyle

Re: Cement Stabilized Subgrade Results - Laboratory Testing  
Retreat at TimberRidge, Filing No.1 — Urban Lots  
El Paso County, Colorado

Ref: Pavement Recommendations Report by Entech Engineering, Inc., dated July 29, 2021,  
Entech Job No. 211573.

Dear Mr. Doyle:

As requested, personnel of Entech Engineering, Inc. have performed strength testing on two sets of three soil/cement composite samples of Soil Type 1 for the above reference project. Testing was performed on soil samples prepared with 2% and 4% Portland Cement Type 1/2, from Martin Marietta, near Pueblo, Colorado.

A compression strength of 160 psi is recommended for cement stabilized subgrade. The 5-day average strength value of the 2% mix was 206 psi. The 5-day average strength value of the 4% mix was 212 psi. A 2% mix is recommended based on the laboratory test results. A summary of the testing results is attached.

Pending the results of the field density testing, microfracturing of the stabilized subgrade may be required. Soil strengths in excess of 200 psi require microfracturing.

We trust 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.

Daniel P. Stegman

DPS/bs

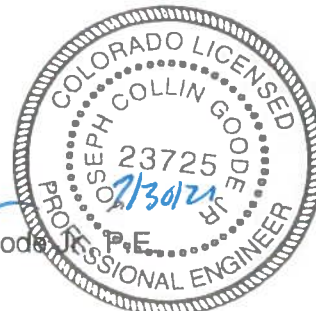
Encl.

Entech Job No. 211573

AAprojects/2021/211573 cssr - lab

Reviewed by:

Joseph C. Gooden  
President



**APPROVED**  
**Engineering Department**

08/03/2021 3:49:54 PM

*dsdnijkamp*

**EPC Planning & Community  
Development Department**



**SUMMARY OF CTS TEST RESULTS**  
**LAB TESTING**

CLIENT CLASSIC COMMUNITIES  
 PROJECT RETREAT AT TIMBERRIDGE, F-1  
 FIELD SAMPLE ID TB-2 @ 0-3'  
 SOIL ADDITIVE TYPE III CEMENT

JOB NO 211573  
 DATE 7/22/21  
 BY BL

| <i>ADDITIVE<br/>%</i> | <i>WATER<br/>%</i> | <i>DENSITY<br/>(dry)</i> | <i>AGE<br/>(days)</i> | <i>STRENGTH<br/>(psi)</i> |
|-----------------------|--------------------|--------------------------|-----------------------|---------------------------|
| 2                     | 7.5                | 119.5                    | 5                     | 200                       |
| 2                     | 7.5                | 119.9                    | 5                     | 203                       |
| 2                     | 7.5                | 119.7                    | 5                     | 214                       |
| AVERAGE:              |                    |                          |                       | <b>206</b>                |
| 4                     | 7.5                | 119.8                    | 5                     | 224                       |
| 4                     | 7.5                | 120.0                    | 5                     | 198                       |
| 4                     | 7.5                | 120.2                    | 5                     | 216                       |
| AVERAGE:              |                    |                          |                       | <b>212</b>                |

**CURING METHOD**

100° HUMIDIFIED OVEN