ENTECH
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COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599

November 27, 2024

COLA, LLC
555 Middle Creek Parkway, Suite 500
Colorado Springs, CO 80920

Attn: Richard A. Van Seenus

Re: Pavement Design Addendum
Trails at Aspen Ridge, Filing No. 3 Phase 2
Rainy Creek Trail, Triple Tree Street, and Turkey Flat Lane
El Paso County, Colorado
Entech Job No. 240367

Ref: Pavement Design Report, Entech Engineering, Inc. dated September 26, 2024, Entech Job No. 240367

Dear Mr. Seenus:

As requested, personnel of Entech Engineering, Inc. (Entech) completed a revised pavement design for the Trails at Aspen Ridge, Filing No. 3 Phase 2 interior roadways. Refer to our Pavement Design Report referenced above for information on the subsurface exploration program, laboratory testing, and pavement design parameters. Recommended mechanically stabilized base (MSB) pavement design sections are presented in this letter.

**Pavement Design**

The pavement sections were determined utilizing the *El Paso County Engineering Criteria Manual*, the CBR testing, Tensar Design Analysis, and default ESAL presented in our Pavement Design Report.

Due to the site subgrade materials and limited depths to utility infrastructure, a MSB layer consisting of recycled concrete base (RCB) and Tensar Nx750 composite polymer geogrid is recommended. Based on guidance from Tensar+ software, a structural layer coefficient of 0.236 was used for the MSB, refer to Figure 2.

Pavement sections utilizing MSB for the roadways in Trails at Aspen Ridge, Filing No. 3 Phase 2 are provided in Exhibit 1. The pavement design calculations are enclosed.

**Exhibit 1: Recommended Pavement Sections**

| Pavement Area | Design ESAL | Alternative |
|---|---|---|
| Local Urban Residential | 292,000 | 1. 5.0 inches HMA over 6.0 inches MSB |

ESAL = equivalent single axle loads; HMA = Hot Mix Asphalt; MSB = Mechanically Stabilized Base

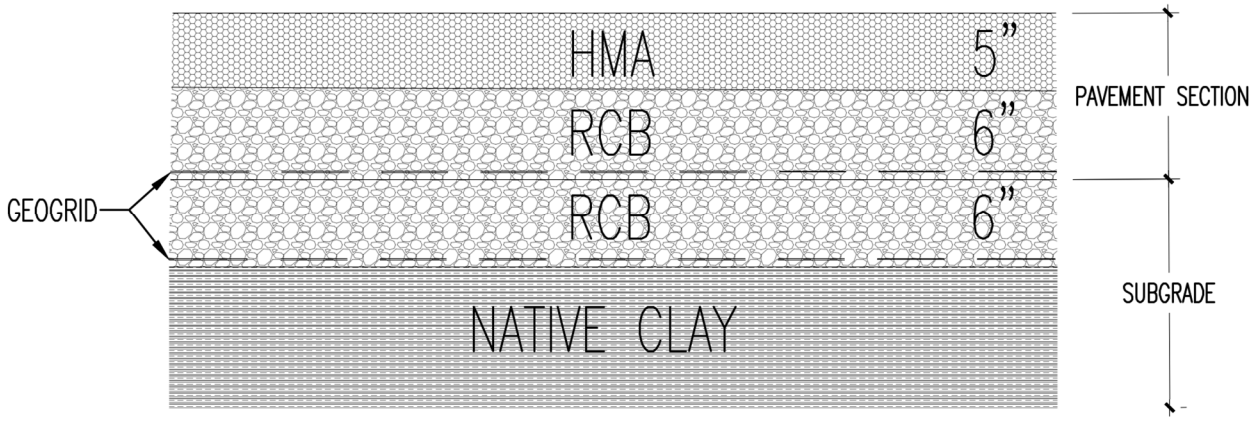
Notes:

1. All pavement alternatives meet the minimum sections required per City of Colorado Springs Pavement Design Criteria Manual.
2. The use of MSB will require a deviation request approval.
3. The MSB section should be placed on stabilized subgrade consisting of 6-inches of RCB with Nx750 geogrid.

**Subgrade Preparation**

Where MSB sections are used the native subgrade should be prepared and compacted in place to 95% of the Standard Proctor (ASTM D698) maximum dry density. A layer of Nx750 geogrid should then be placed directly on the native subgrade followed by 6-inches of RCB. Refer to Exhibit 2 for a roadway cross-section schematic. The compacted RCB surface should be proof-rolled with a fully loaded, tandem-axle, 10-yard dump truck or equivalent. Any areas that are delineated to be soft, loose, or yielding during proof-rolling should be removed and reconditioned or replaced. The MSB can then be placed on the subgrade material.

**Exhibit 2: Pavement and Subgrade Cross-Section**




**Mechanically Stabilized Recycled Concrete Base**

RCB materials shall conform to the *El Paso County Standard Specifications Manual*, Table D-6, Aggregate Base Course Materials. RCB materials should be compacted to a minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density at +/-2% of optimum moisture content.

A layer of geogrid, such as Tensar Nx750 or equivalent, should be at the base of the 6-inch RCB layer for stabilization. Where geogrid sections are spliced, there should be an overlap of 3 feet.

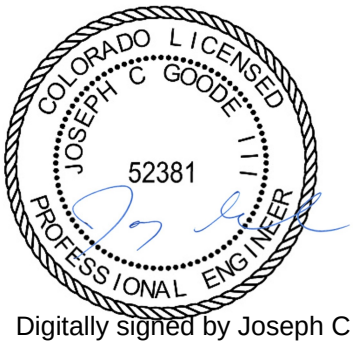
**Remarks:**

The recommendations provided in this letter are based upon the observed soil conditions, anticipated foundation loads, and accepted engineering procedures. The recommendations are intended to minimize differential movement resulting from the adverse subsurface conditions induced by the application of building loads. It must be recognized that the foundation may undergo movement. In addition, concrete floor slabs may experience movement; therefore, adherence to those recommendations which would isolate floor slabs from columns, walls, partitions or other structural components is extremely important, if damage to the superstructure is to be minimized. Any subsequent owners should be apprised of the soil conditions and advised to maintain good practice in the future with regard to surface and subsurface drainage, framing of partitions above floor slabs, drywall and finish work above floor slabs, etc.

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.




Digitally signed by Joseph C Goode III
Date: 11/27/24

Joseph C. Goode III, P.E.
Sr. Engineer

Encl.

LJM/jcg
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# FLEXIBLE PAVEMENT DESIGN

## PROJECT DATA

Project Location Trails at Aspen Ridge, Filing No. 3, Soil Type 1

Job Number: 240367

## DESIGN DATA

| | | |
|---|---|---|
| Equivalent (18-kip) Single Axle Load Applications (ESAL): | ESAL ($W_{18}$) = | 292,000 |
| Design CBR | CBR = | 2 |
| Standard Deviation | $S_o$ = | 0.45 |
| Loss in Serviceability | Δpsi = | 2.5 |
| Reliability | Reliability = | 80 |
| Reliability (z-statistic) | $Z_R$ = | -0.84 |
| Soil Resilient Modulus | $M_R$ = | 3,000 psi |

Required Structural Number (SN): → SN = 3.47

## DESIGN EQUATIONS

### Resilient Modulus

If using CBR:

$M_R$ = (CBR) x 1,500

If using R-Value:

$M_R = 10^{[(S_i + 18.72) / 6.24]}$ where: $S_i$ = [(R-value - 5) / 11.29] + 3

### Required Structural Number

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

### Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where: $C_1$ = Strength Coefficient - HMA

$C_2$ = Strength Coefficient - MSB

$D_1$ = Depth of HMA (inches)

$D_2$ = Depth of MSB (inches)

## RECOMMENED THICKNESSES

| Layer | Material | Coefficient | Thickness ($D^*_i$) | $SN^*_i$ | SN |
|---|---|---|---|---|---|
| 1 | HMA | $C_1$ = 0.44 | 5.0 inches | 2.200 | - |
| 2 | MSB | $C_2$ = 0.236 | 6.0 inches | 1.416 | |
| | | | SN* = | 3.616 | 3.47 |

Pavement SN > Required SN, Design is Acceptable

Asphalt Pavement
# Design Analysis

Tensar
A Division of CMC

| | | | |
|---|---|---|---|
| **Design** | | **Reference** | |
| **Project** | | **Location** | |
| **Customer** | | **Designer** | Joey Goode |
| **Company** | Entech Engineering | **Date** | November 22, 2024 |

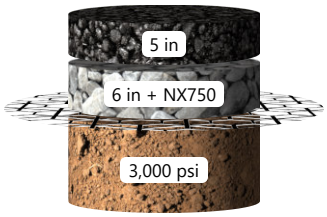
## Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

## Results

### Stabilized

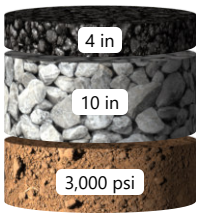
392,100 ESALs




| | Thickness | Coeff. | SN |
|---|---|---|---|
| **HMA layer 1** | 5 in | 0.440 | 2.200 |
| **Aggregate base (NX750)** | 6 in | 0.236 | 1.416 |
| **Structural number (SN)** | | | 3.616 |

### Unstabilized

106,100 ESALs




| | Thickness | Coeff. | SN |
|---|---|---|---|
| **HMA layer 1** | 4 in | 0.400 | 1.600 |
| **Aggregate base** | 10 in | 0.140 | 1.400 |
| **Structural number (SN)** | | | 3.000 |

## Parameters

**Project Information**

| Target ESALs | Subgrade resilient modulus | Reliability | Standard deviation | Serviceability | |
|---|---|---|---|---|---|
| | | | | Initial | Terminal |
| 292,000 | 3,000 psi | 80% | 0.45 | 4.5 | 2 |



FIG. 2