



Cook, Flatt & Strobel Engineers  
1100 W. Cambridge Circle Drive, Suite 700  
Kansas City, Kansas 66103  
913.627.9040

November 2, 2021

Kyle Gorrell  
Lee's Summit R-7 School District

RE: Middle School #4 Baily Road Pavement Evaluation  
CFS Project # 20-1074

Mr. Gorrell,

CFS understands that the school district's proposed public road pavement for the widening of Baily Road, in association with the Lee's Summit Middle School #4, do not match the city of Lee's Summit's requirements for an arterial street. According to the city's APWA standards, if a traffic study and geotechnical evaluation of the sub-grade are performed, and the design meets the required design life of the pavement, the city may accept an alternative pavement design. Based on the traffic data provided by Olson, the anticipated equivalent single axle loads (ESAL's) for the 35 year life of the pavement of Baily Road are 10.1 million. The traffic study results are summarized in the table below.

Source	Roadway	2019 ADT	2056 AADT	Truck Percentage	ESAL's
City Counts	Baily Road	2,944	4,254	13%	10,098,412

CFS performed soils sampling at 5 locations along Baily Road in the areas of the proposed widening. Shelby tube samples were extracted at sub-grade elevation and returned to the laboratory for soils testing. The results are summarized in the table below.

Location	Moisture Content (%)	Dry Density (pcf)	Unconfined Compression (tsf)	Corresponding CBR Value
1	24.3	96.1	1.753	5
2	28.7	93.4	1.112	3
3	26.0	99.6	2.047	6
4	24.4	102.0	2.083	6
5	29.2	92.1	1.067	3

The proposed pavement section is summarized in the table below.

Material	Thickness (inches)
Geogrid	Yes
MODOT Type 5 Base Rock	6
APWA Type 1 Base Asphalt	10
APWA Type 3 Surface Asphalt	2

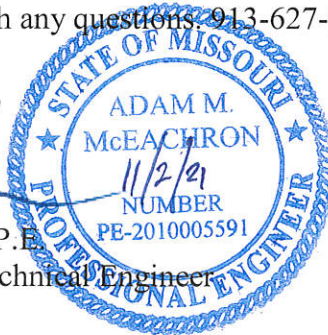
CFS utilized the Tensar Plus asphalt pavement program to evaluate the ESAL's of the proposed pavement section with the soils testing results. With the in-situ soil CBR value of 3, and utilizing the city's APWA requirements of a terminal serviceability of 2.5 and a reliability of 95%, the proposed pavement section produces a structural number of 6.478 with an anticipated ESAL's quantity of 16.1 million.

Please contact CFS with any questions. 913-627-9040

Respectfully submitted,



Adam M. McEachron, P.E.  
Associate/Senior Geotechnical Engineer



Attachments: Tensar Plus Design Analysis, Boring Location Plan, Laboratory Results

# Pavement Optimization Design Analysis

## Parameters

### Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
4,950 psi	10,100,000	95%	0.49	4.2	2.5

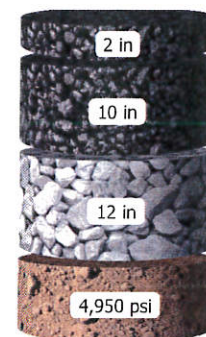
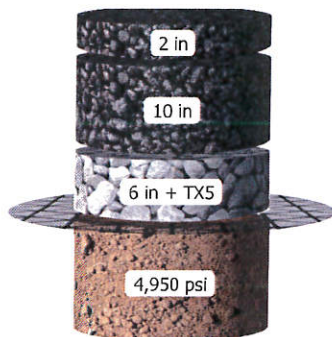
## Results

### TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	2 in	0.420	0.840
HMA layer 2	10 in	0.400	4.000
Mechanically stabilized layer	6 in	0.273	1.638
Structural number (SN)			6.478
Calculated traffic (ESALs)			16,179,700

### Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	2 in	0.420	0.840
HMA layer 2	10 in	0.400	4.000
Mechanically stabilized layer	12 in	0.273	1.638
Structural number (SN)			6.478
Calculated traffic (ESALs)			16,179,700



### Limitations of this Report

The designs, illustration, and other content included in this report are necessarily general and conceptual in nature and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Design	Middle School #4	Project	
Company	CFS Engineers	Location	
Designer	Adam McEachron	Date	11/2/2021





<div data-bbox="1153 1627 1347 1911"> </div> <div data-bbox="1372 1617 1437 1942"> <p>1100 W. Cambridge Circle Dr, Ste 700 Kansas City, Kansas 66103</p> </div>	<div data-bbox="1144 1480 1445 1585"> <p>Project: <b>Baily Road</b></p> </div>	<div data-bbox="1144 777 1445 1060"> <p>Att. B</p> </div>	<div data-bbox="1144 157 1445 777"> <p><b>BORING LOCATION PLAN</b></p> </div>
	<div data-bbox="1144 1060 1445 1585"> <p>Project Location: Lee's Summit, MO</p> </div>	<div data-bbox="1144 777 1445 1060"> <p>Comments:</p> </div>	
	<div data-bbox="1144 1060 1445 1585"> <p>Client: Lee's Summit R-7 School Dist</p> </div>		
	<div data-bbox="1144 1060 1445 1585"> <p>Date: 11/2/2021</p> </div>		





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## Unconfined Compression (pg. 1)

(ASTM D2166-06)

Project: LSMS- Middle School #4 Job No.: 20-1074  
Location: \_\_\_\_\_ Sample Date: \_\_\_\_\_  
Boring No.: B1 Sample No.: ST1  
Tested By: DSM Test Date: 11/1/2021

### Log of Shelby Tube

Describe all soils found in tube. Note any transitions or changes in color or soil type.

Depth	Description
<u>18"-30"</u>	<u>Grey Brown Clay</u>
_____	_____
_____	_____
_____	_____

### Unconfined Compression Sample

Depth UC Sample Taken From: 18 to 30

Height (in)      Diameter (in)

5.79      1      2.84

5.8      2      2.85

5.75      3      2.86

Average: 5.780      2.850

H/D Ratio: 2.028

Weight: 1156.3 g

Volume: 36.87 in<sup>3</sup>

Wet Density: 119.5 pcf

Dry Density: 96.1 pcf

Rate of Strain: 0.87% /min.

Strain at Failure: 13.84%

#### Moisture Content

(place entire specimen in oven after test)

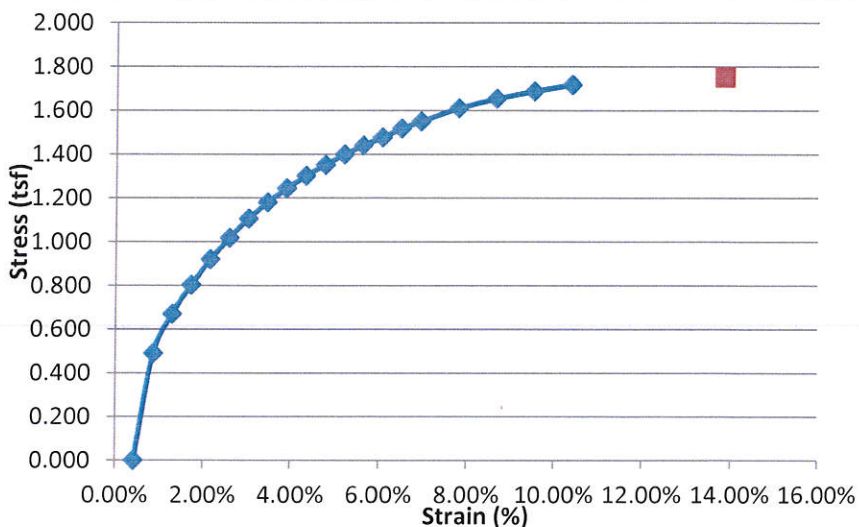
Contain. ID: 105

Container: 130 g

Cont. + wet: 807.1 g

Cont. + dry: 674.7 g

M/C: 24.3%



UC Strength: 1.753 tsf

Shear Strength: 0.877 tsf



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## Unconfined Compression (pg. 1)

(ASTM D2166-06)

Project: LSMS- Middle School #4 Job No.: 20-1074  
Location: \_\_\_\_\_ Sample Date: \_\_\_\_\_  
Boring No.: B2 Sample No.: ST1  
Tested By: DSM Test Date: 11/1/2021

### Log of Shelby Tube

Describe all soils found in tube. Note any transitions or changes in color or soil type.

Depth	Description
<u>18"-30"</u>	<u>Brown Black Grey Clay</u>
_____	_____
_____	_____
_____	_____

### Unconfined Compression Sample

Depth UC Sample Taken From: 18 to 30

Height (in)		Diameter (in)
<u>5.8</u>	<u>1</u>	<u>2.81</u>
<u>5.75</u>	<u>2</u>	<u>2.81</u>
<u>5.78</u>	<u>3</u>	<u>2.81</u>
Average: <u>5.777</u>		<u>2.810</u>

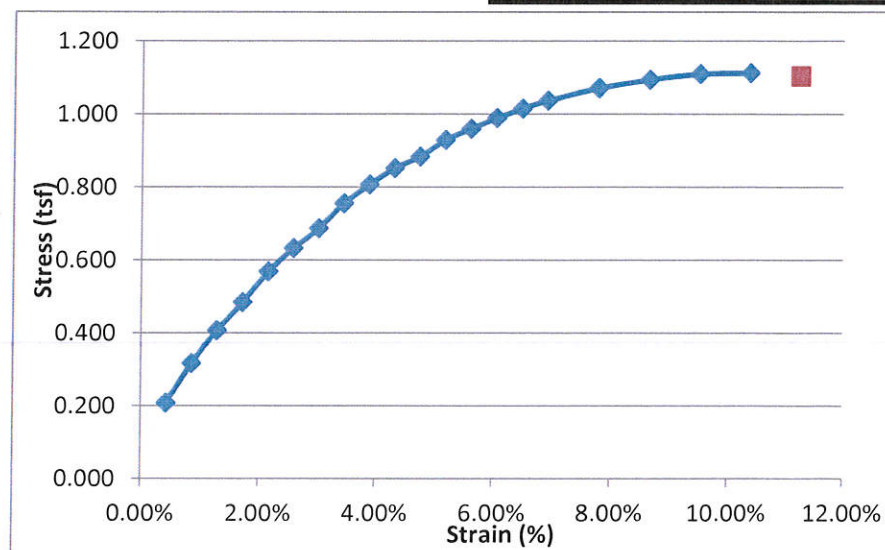
H/D Ratio: 2.056

#### Moisture Content

(place entire specimen in oven after test)

Contain. ID: 156  
Container: 128.7 g  
Cont. + wet: 556 g  
Cont. + dry: 460.8 g  
M/C: 28.7%

Weight: 1135.7 g  
Volume: 35.82 in<sup>3</sup>  
Wet Density: 120.8 pcf  
Dry Density: 93.9 pcf  
Rate of Strain: 0.87% /min.  
Strain at Failure: 10.39%



UC Strength: 1.112 tsf  
Shear Strength: 0.556 tsf



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## Unconfined Compression (pg. 1)

(ASTM D2166-06)

Project: LSMS- Middle School #4 Job No.: 20-1074  
Location: \_\_\_\_\_ Sample Date: \_\_\_\_\_  
Boring No.: B3 Sample No.: ST1  
Tested By: DSM Test Date: 11/1/2021

### Log of Shelby Tube

Describe all soils found in tube. Note any transitions or changes in color or soil type.

Depth	Description
<u>18"-39"</u>	<u>Grey Orange Mottled Clay</u>
_____	_____
_____	_____
_____	_____

### Unconfined Compression Sample

Depth UC Sample Taken From: 18 to 39

Height (in)      Diameter (in)

5.74      1      2.81

5.74      2      2.83

5.75      3      2.82

Average: 5.743      2.820

H/D Ratio: 2.037

Weight: 1181.8 g

Volume: 35.87 in<sup>3</sup>

Wet Density: 125.5 pcf

Dry Density: 99.6 pcf

Rate of Strain: 0.87% /min.

Strain at Failure: 11.32%

#### Moisture Content

(place entire specimen in oven after test)

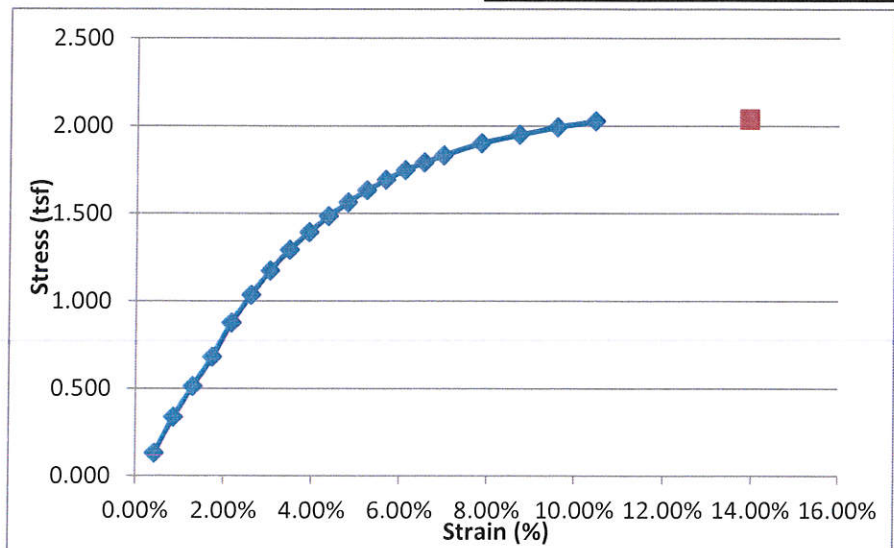
Contain. ID: 102

Container: 129.3 g

Cont. + wet: 667.5 g

Cont. + dry: 556.4 g

M/C: 26.0%



UC Strength: 2.047 tsf

Shear Strength: 1.023 tsf





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## Unconfined Compression (pg. 1)

(ASTM D2166-06)

Project: LSMS- Middle School #4 Job No.: 20-1074  
Location: \_\_\_\_\_ Sample Date: \_\_\_\_\_  
Boring No.: B4 Sample No.: ST1  
Tested By: DSM Test Date: 11/1/2021

### Log of Shelby Tube

Describe all soils found in tube. Note any transitions or changes in color or soil type.

Depth	Description
<u>18"-38.5"</u>	<u>Dark Brown and Black</u>
_____	_____
_____	_____
_____	_____

### Unconfined Compression Sample

Depth UC Sample Taken From: 18 to 38.5  

Height (in)		Diameter (in)
<u>5.75</u>	<u>1</u>	<u>2.8</u>
<u>5.76</u>	<u>2</u>	<u>2.81</u>
<u>5.76</u>	<u>3</u>	<u>2.82</u>

Average: 5.757 2.810  
H/D Ratio: 2.049

#### Moisture Content

(place entire specimen in oven after test)

Contain. ID: 108  
Container: 128.4 g  
Cont. + wet: 738.8 g  
Cont. + dry: 619.2 g  
M/C: 24.4%

Weight: 1188.3 g

Volume: 35.70 in<sup>3</sup>

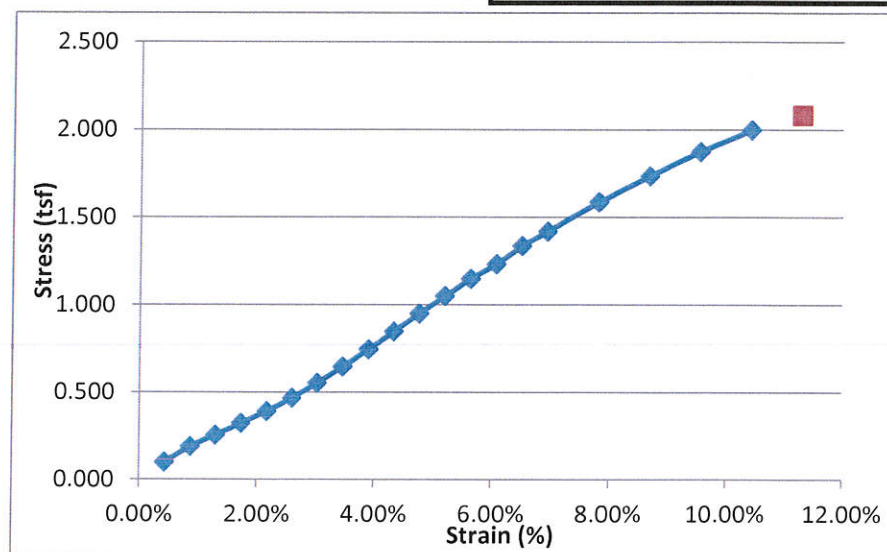
Wet Density: 126.8 pcf

Dry Density: 102.0 pcf

Rate of Strain: 0.87% /min.

Strain at Failure: 11.29%

UC Strength: 2.083 tsf  
Shear Strength: 1.042 tsf







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## Unconfined Compression (pg. 1)

(ASTM D2166-06)

Project: LSMS- Middle School #4 Job No.: 20-1074  
Location: \_\_\_\_\_ Sample Date: \_\_\_\_\_  
Boring No.: B5 Sample No.: ST1  
Tested By: DSM Test Date: 11/1/2021

### Log of Shelby Tube

Describe all soils found in tube. Note any transitions or changes in color or soil type.

Depth	Description
<u>18"-39"</u>	<u>Brown Grey Black Clay</u>
_____	_____
_____	_____
_____	_____

### Unconfined Compression Sample

Depth UC Sample Taken From: 18 to 39

Height (in)      Diameter (in)

5.75      1      2.83

5.75      2      2.83

5.75      3      2.83

Average: 5.750      2.830

H/D Ratio: 2.032

Weight: 1129.1 g

Volume: 36.17 in<sup>3</sup>

Wet Density: 118.9 pcf

Dry Density: 92.1 pcf

Rate of Strain: 0.87% /min.

Strain at Failure: 11.30%

#### Moisture Content

(place entire specimen in oven after test)

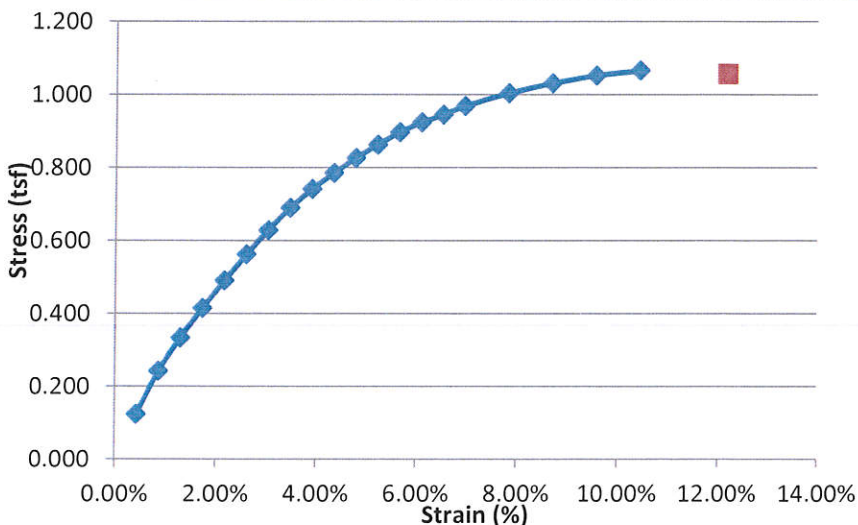
Contain. ID: 173

Container: 127.4 g

Cont. + wet: 687.3 g

Cont. + dry: 560.8 g

M/C: 29.2%



UC Strength: 1.067 tsf

Shear Strength: 0.534 tsf