

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 and 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	ESAL's
				Percentage	
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	Dry	Unconfined	Corresponding
	Content	Density	Compression	CBR Value
	(%)	(pcf)	(tsf)	
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,

MCEAC 9

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

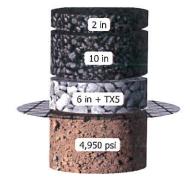
Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
4,950 psi	10,100,000	95%	0.49	4,2	2,5

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		

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(Zina)	(0.410)	0880
(Olni)	0.440	4400
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		(E 840
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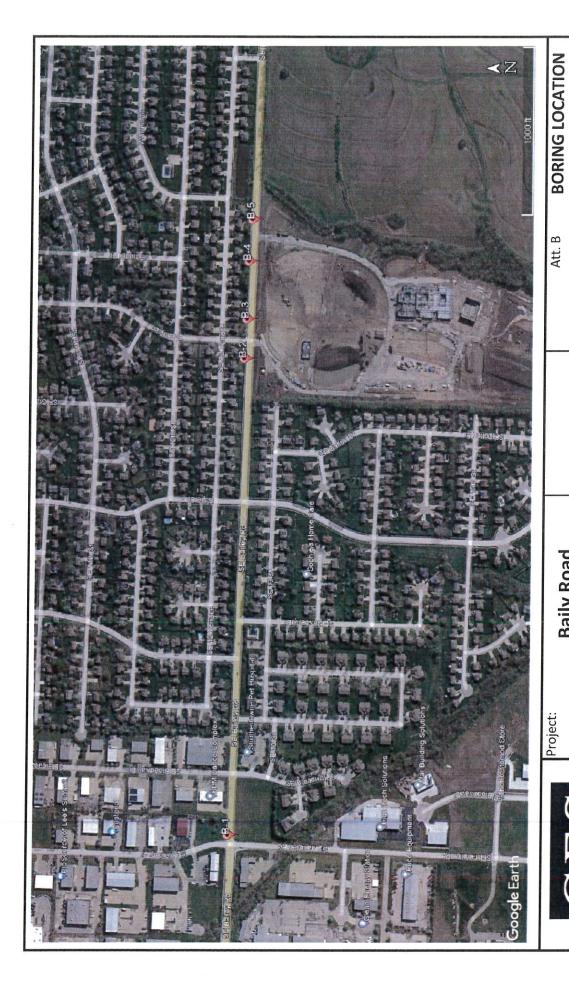




Limitations of this Report

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





Baily Road

Lee's Summit R-7 School Dist Client:

Date: 1100 W. Cambridge Circle Dr, Ste 700 Kansas City, Kansas 66103

Lee's Summit, MO

PLAN

Comments:

11/2/2021



<u>Unconfined Compression</u> (pg. 1)

Project: l	SMS- Middle	School #4	Job No	.: 20-1074
Location:			Sample Date	2:
Boring No.: B1		Sample No.:	ST1	}
Tested By: DSM		Test Date:	11/1/2021	_
epth De	escribe all soils fou scription ey Brown Clay	Log of Shelby Tube nd in tube. Note any transitions or chang	ges in color or soil type.	
		onfined Compression Sa	ample	Maistura Contant
Depth UC Sample Taken Fro <u>Height (in)</u>	m: 18 <u>Diameter</u>		Tulou	Moisture Content
			2235	ce entire specimen in oven after test)
<u>5.79</u> 1	*			ntain. ID:105
5.8				ontainer: 130 g
5.75			1	t. + wet: g
Average: 5.780	2.850		Cor	nt. + dry:674.7 g
H/D Ratio: 2.028				M/C: 24.3%
Weight: 1156.3 Volume: 36.87 Wet Density: 119.5 Dry Density: 96.1	pcf pcf	2.000 1.800 1.600 1.400 1.400 1.400 0.800		
Rate of Strain: 0.87% Strain at Failure: 13.84%	/min. 	0.600 0.400 0.200	,	
UC Strength: 1.753	_tsf	0.000	6.00% 8.00% 10 Strain (%)	.00% 12.00% 14.00% 16.00%
Shear Strength: 0.877	tsf			

Unconfined Compression (pg. 1)

(ASTM D2166-06)

5				
	LSMS- Middle	School #4	Job No.:	
Location:		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Sample Date:	
Boring No.:	B2	Sample No.:	ST1	*
Tested By:	DSM	Test Date:	11/1/2021	
18"-30"	Describe all soils fou Description Brown Black Gre	Log of Shelby Tube nd in tube. Note any transitions or chang ey Clay	ges in color or soil type.	
Double HC Commiss Tal	31 -71-1-1-1-1-1	onfined Compression Sa	ample	Moisture Content
Depth UC Sample Tak <u>Height (in</u>	•		(alass	
				entire specimen in oven after test)
5.8	12.81		Cont	tain. ID:156
5.75	2 2.81		Cor	ntainer:128.7 g
5.78	3 2.81		Cont.	. + wet:556 g
Average: 5.777	2.810	j e	Cont	t. + dry: 460.8 g
H/D Ratio: 2.056	Don't de constitue de la const			M/C: 28.7%
Weight:1 Volume:3 Wet Density:3 Dry Density:3 Rate of Strain:0	135.7 g 35.82 in ³ 120.8 pcf 93.9 pcf 0.87% /min.	1.200 1.000 1.000 1.000 0.400 0.200		
-	1.112 tsf 0.556 tsf	0.000 2.00% 4.	00% 6.00% 8 Strain (%)	3.00% 10.00% 12.00%



Unconfined Compression (pg. 1)

Project:		LSMS- Middle School #4		Jo	b No.:	20-1074	
Location:		2			Sample	Date:	
Boring No.:	Е	33		Sample No.:	ST1	<u> 2</u>	
Tested By:	DS	SM		Test Date:	11/1/202	1	
		Describe all soils fo		Shelby Tube any transitions or change	ges in color or soi	Ltype	
<u>epth</u>		<u>Description</u>		,	800 00.07 0. 00.	7,65.	
18"-39"		Grey Orange M	ottled Clay				
		319.					A CONTRACTOR OF NO. 10 CONTRACTOR OF THE CONTRAC
						W/S	
		Unc	onfined C	ompression S	ample r		
Depth UC:	Sample Taken	From:18	to	39		Mois	ture Content
	Height (in)	<u>Diamete</u>	er (in)			(place entire sp	ecimen in oven after test)
_	5.74	1 2.83	1			Contain. ID	:102
_	5.74	22.83	3			Container	: <u>129.3</u> g
-	5.75	3 2.82	2			Cont. + wet	:667.5 g
Average:	5.743	2.82	0			Cont. + dry	: 556.4 g
H/D Ratio:	2.037	<u> </u>				M/C:	: 26.0%
			2.500				
Wei	ight:118	1.8 g	2.300				
Volu	ıme: 35.8	37 in ³	2.000			***	
Wet Den	sity: 125	.5 pcf	6		MARAGE		
Dry Den	sity: 99.	6 pcf	ss 1.500	A CONTRACTOR OF THE PARTY OF TH			
20000			1.000 -	100			
Rate of S	train: 0.87	/% /min.	1.000	1			
Strain at Fa	-		0.500	<i></i>		9	
	-			1			
UC Stre	ngth: 2.04	7 tsf	0.000	0% 2.00% 4.00%	6.00% 9.00%	0/ 10 000/ 12 /	00% 14.00% 16.00%
Shear Stre	ngth: 1.02	.3 tsf	0.00	570 2.0070 4.00%	Strain	1 (%)	JU/0 14.00% 10.00%



Unconfined Compression (pg. 1)

Project:	LSMS- Middle	School #4	Job No.:	20-1074
Location:			Sample Date:	
Boring No.:	4	Sample No.:	ST1	
Tested By: DS	SM	Test Date:	11/1/2021	
	Describe all soils fou Description Dark Brown and	Log of Shelby Tube and in tube. Note any transitions or change Black	ges in color or soil type.	
Double IIC Commis Taken		onfined Compression Sa	ample	Moisture Content
Depth UC Sample Taken <u>Height (in)</u>	Diameter		/place	
5.75	1 2.8			entire specimen in oven after test)
	-			ain. ID:108
5.76	2 2.81			ntainer:128.4 g
5.76	3 2.82		1	+ wet:g
Average: 5.757	2.810)	Cont	. + dry: 619.2 g
H/D Ratio:2.049				M/C: 24.4%
Wet Density: 126 Dry Density: 102	70 in ³ .8 pcf .0 pcf	2.500 2.000 2.000 2.000		
Rate of Strain:0.87 Strain at Failure:11.29		0.500		
UC Strength: 2.08 Shear Strength: 1.04		0.000	00% 6.00% 8 Strain (%)	.00% 10.00% 12.00%



Shear Strength:

0.534

tsf

Unconfined Compression (pg. 1)

Project:	LSMS- Middle School						Jol	No.:	20-1074	
Location:							Sample	Date:		
Boring No.:	Е	35			Sample No	o.:	ST1			
Tested By:	DSM				Test Date	e:	11/1/2021			
			Lo	og of Sl	helby Tu	be				
epth		Describe all so			· · · · · · · · · · · · · · · · · · ·	//	s in color or soil	type.		
18"-39"		Brown Grey	Black Cla	У						
									mental land on the second seco	
		<u>u</u>	nconfin	ned Cor	mpressio	n Sar	mple _			a miles
Depth UC Sam	ple Taken	From:	18	to	39	_		Moistu	<u>ire Content</u>	
He	ight (in)	<u>Dian</u>	neter (in)					(place entire spec	imen in oven after test)
	5.75	1	2.83					Contain. ID:	173	
	5.75	2	2.83					Container:	127.4 g	
_	5.75	3	2.83					Cont. + wet:	687.3 g	
Average: 5	5.750	2	.830					Cont. + dry:	560.8 g	
H/D Ratio:2	2.032							M/C:	29.2%	
Weight	:112	9.1 g	1	200						
Volume:	36	17 in ³	1	000			MA	***		
Wet Density:		***	€0	.800		.36	A A A A A A A A A A A A A A A A A A A			
Dry Density:			ess (ts	.600		No.				
					No. of London					
Rate of Strair		/ <u>//</u> /min.	0	.400	1					
Strain at Failure	e: <u>11.3</u>	0%	0	.200	*					
UC Strength	n: 1.06	67 tsf	7 0.	.000	2.000/	4.000/	6.000/	2.00% 10.00%	12 00% 14 00%	
Shoar Strongth	-			0.00%	2.00%	4.00%	6.00% 8 Strain	3.00% 10.00% (%)	12.00% 14.00%	