



KENTUCKY TRANSPORTATION CABINET

PAVEMENT DESIGN SPREADSHEET



County Oldham Item No. 5-441.01 UPN

Road Louisville - Cincinnati Road Route No. US 42

Sta. to Sta. 100+00 to 151+75 MP to MP to

Consultant Hall-Harmon Engineers, Inc. Project Length 0.98 miles

Pavement Type Selection

Alternate Bid ☒

Asphalt: Max Asphalt ☒ Max Aggregate ☒

Concrete ☒

Design ESAL's 6,100,000

Current Letting Date

DOCUMENTATION

- | | |
|---|---|
| <input type="checkbox"/> Design Executive Summary | <input type="checkbox"/> Typical Sections and Details |
| <input type="checkbox"/> Pavement Design Schedule | <input type="checkbox"/> Comparison of Alternatives |
| <input type="checkbox"/> Special Notes and Provisions | <input type="checkbox"/> Initial Cost |
| <input type="checkbox"/> Pav Des Form Selection Summary | <input type="checkbox"/> Life Cycle Cost |
| <input type="checkbox"/> Geotechnical Information | <input type="checkbox"/> Other Documentation |
| <input type="checkbox"/> Traffic Information | List: |

SUBMITTED: Adam Ross Designer Date: 24-Oct-16

Version 5.07

Aug-2016

Project Description: 5-441.01 US 42 Oldham County Louisville - Cincinnati Road

Analysis Date:

Note: Fields in yellow require user input. Fields in orange/allow user input. Material type selection lists may be edited in the "Bid Items" Worksheet

Structural Design Inputs

Design CBR 2
 Design ESAL's 6,100,000
 Construction Year ADT 15,700
 Construction Year Truck Percentage 8
 Design Life (years) 20
 Analysis Period (years) 40
 Check if User will define layer thickness ☒

Length of Project (miles) 0.98
 Total Number of Lanes, One Direction 1.5
 Lane Width (feet) 12
 Number of Directions (1 or 2) 2
 Inside Paved Shoulder width (feet) 0
 Outside Paved Shoulder width (feet) 0
 Length of Initial Construction (Default 120 days) 120
 Daily User Cost (\$) 1000

Subgrade stabilization: ☒ None
☐ Lime ☐ Cement ☐ Rock & Fabric
 Stabilization Thickness = inches (Default thickness is 8 inches for lime/cement and 12 inches for rock)

Pavement Structural Design From Design Catalog

Required Structural Number 6.32
 Required JPC Pavement Thickness 10.00
 (Designed Pavement structure should satisfy Required Structural Number to within +/- 0.05)
 (Minimum Concrete Pavement Thickness is 8 inches)

Unit Costs for this project were provided by the Engineering Estimating Section

NOTE: Verify material types for each design to insure the cost calculations are correct.

Maximum Asphalt Design

	Default Layer Thickness (in.)				User Defined Thickness (in.)			Final Design Thickness (in.)		
	Design	SN	Nominal	SN	Mainline	Shoulder	SN	Mainline	Shoulder	SN
Surface	1.25	0.55			1.25		0.55	1.25	0.00	0.55
Base Total (in)	10.9									
Layer 1	3.65	1.46	3.50	1.40	3.00		1.20	3.00	0.00	1.20
Layer 2	3.64	1.46	3.75	1.50	3.00		1.20	3.00	0.00	1.20
Layer 3	3.64	1.46	3.75	1.50	3.00		1.20	3.00	0.00	1.20
Layer 4	0.00	0.00	0.00	0.00	3.25		1.30	3.25	0.00	1.30
Drainage Blanket-Ty II-Asphalt	4.00	0.84	4.00	0.84			0.84	0.00	0.00	0.00
DGA	4.00	0.56	4.00	0.56	6.00		0.84	6.00	0.00	0.84
Stabilized Roadbed	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
		6.32		SN 6.35			Total SN 6.29			Total SN 6.29

Maximum Aggregate Design

	Default Layer Thickness (in.)				User Defined Thickness (in.)			Final Design Thickness (in.)		
	Design	SN	Nominal	SN	Mainline	Shoulder	SN	Mainline	Shoulder	SN
Surface	1.25	0.55	1.25	0.55			0.00	0.00	0.00	0.00
Base Total (in)	7.3									
Layer 1	3.64	1.46	3.50	1.40			0.00	0.00	0.00	0.00
Layer 2	3.63	1.45	3.75	1.50			0.00	0.00	0.00	0.00
Layer 3	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00
Layer 4	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00
Drainage Blanket-Ty II-Asphalt	4.00	0.84	4.00	0.84			0.00	0.00	0.00	0.00
DGA	17.04	2.38	17.00	2.38			0.00	0.00	0.00	0.00
Stabilized Roadbed	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
		6.68		SN 6.67			Total SN 0.00			Total SN 0.00

Concrete Pavement Design

	Default Layer Thickness (in.)				User Defined Thickness (in.)			Final Design Thickness (in.)		
	Design	SN	Nominal	SN	Mainline	Shoulder	SN	Mainline	Shoulder	SN
JPC Pavement Thickness (in)	10.0		10.0		10.0			10.00	0.00	
AC Shoulder Surface										
AC Shoulder Base										
Layer 1								0.00		
Layer 2								0.00		
Layer 3								0.00		
Layer 4								0.00		
JPC Pavement Drainage Blanket	4.0		4.0					0.00	0.00	
DGA	4.0		4.0		4.00	4.00		4.00	4.00	

Maximum Asphalt Design

Initial Cost: 1,189,150				99.18% Greater than lowest initial cost alternate			
Driving Lane Material Selection				Shoulder Material Selection			
Item Code	Description	Unit Cost		Item Code	Description	Unit Cost	
22906ES403	CL 3 ASPH SURF 0.38A PG64-22	76.15		#N/A		#N/A	
Base							
Layer 1	214	CL 3 ASPH BASE 1.00D PG64-22	65.29	#N/A		#N/A	
Layer 2	214	CL 3 ASPH BASE 1.00D PG64-22	65.29	#N/A		#N/A	
Layer 3	214	CL 3 ASPH BASE 1.00D PG64-22	65.29	#N/A		#N/A	
Layer 4	214	CL 3 ASPH BASE 1.00D PG64-22	65.29	#N/A		#N/A	
Drainage Blanket	#N/A		#N/A				
Aggregate Base	3	Crushed Stone Base	22.48	3	Crushed Stone Base	22.48	
Stab. Roadbed	#N/A		#N/A	#N/A		#N/A	

Maximum Aggregate Design

Initial Cost: 9,800				-12034.19% Less than lowest initial cost alternate			
Item Code	Description	Unit Cost					
22906ES403	CL 3 ASPH SURF 0.38A PG64-22	76.15		#N/A	0		#N/A
Base							
Layer 1	223	CL 3 ASPH BASE 0.75D PG64-22	64.46	221	CL 2 ASPH BASE 0.75D PG64-22	74.95	
Layer 2	#N/A		#N/A	#N/A		#N/A	
Layer 3	#N/A		#N/A	#N/A		#N/A	
Layer 4	#N/A		#N/A	#N/A		#N/A	
Drainage Blanket	#N/A		#N/A	#N/A		#N/A	
Aggregate Base	3	Crushed Stone Base	22.48	3	Crushed Stone Base	22.48	
Stab. Roadbed	#N/A		#N/A	#N/A		#N/A	

Concrete Pavement Design

Initial Cost: 1,482,856				99.34% Greater than lowest initial cost alternate			
Item Code	Description	Unit Cost					
2069	JPC Pavement-10 inch	66.00	JPC Shoulder	#N/A		#N/A	
			Asphalt Shoulder Surface	#N/A		#N/A	
			Asphalt Shoulder Base				
Layer 1			#N/A			#N/A	
Layer 2			#N/A			#N/A	
Layer 3			#N/A			#N/A	
Layer 4			#N/A			#N/A	
Drainage Blanket	#N/A		#N/A			#N/A	
Aggregate Base	3	Crushed Stone Base	22.48	3	Crushed Stone Base	22.48	

Maximum Asphalt Design			Discount Rate												
			0		2		4		6		8		10		
YEAR	COST	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW		
0	PW OF CONSTRUCTION	1,189,150	1.00	1,189,150	1.00	1,189,150	1.00	1,189,150	1.00	1,189,150	1.00	1,189,150	1.00	1,189,150	
15	(MILL 1.25" & OVERLAY 1.25")	134,271	1.00	134,271	0.74	99,765	0.56	74,556	0.42	56,027	0.32	42,328	0.24	32,143	
20	N/A	0	1.00	0	0.67	0	0.46	0	0.31	0	0.21	0	0.15	0	
30	(MILL 1.25" & OVERLAY 3.25")	282,919	1.00	282,919	0.55	156,191	0.31	87,229	0.17	49,259	0.10	28,116	0.06	16,214	
40	PW OF SALVAGE	0	1.00	0	0.45	0	0.21	0	0.10	0	0.05	0	0.02	0	
PW Total Cost		1,606,340	1,606,340		1,445,107		1,350,935		1,294,436		1,259,594		1,237,507		
% Cost Difference															
Maximum Aggregate Design				73.54%		81.68%		87.34%		91.13%		93.64%		95.31%	
JPC Design				-11.21%		-15.42%		-18.19%		-20.02%		-21.24%		-22.09%	

Maximum Aggregate Design			Discount Rate													
			0		2		4		6		8		10			
YEAR	COST	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW			
0	PW OF CONSTRUCTION	9,800	1.00	9,800	1.00	9,800	1.00	9,800	1.00	9,800	1.00	9,800	1.00	9,800		
15	(MILL 1.25" & OVERLAY 1.25")	134,271	1.00	134,271	0.74	99,765	0.56	74,556	0.42	56,027	0.32	42,328	0.24	32,143		
20	N/A	0	1.00	0	0.67	0	0.46	0	0.31	0	0.21	0	0.15	0		
30	(MILL 1.25" & OVERLAY 3.25")	281,029	1.00	281,029	0.55	155,148	0.31	86,647	0.17	48,930	0.10	27,928	0.06	16,105		
40	PW OF SALVAGE	0	1.00	0	0.45	0	0.21	0	0.10	0	0.05	0	0.02	0		
PW Total Cost		425,100	425,100		264,713		171,002		114,757		80,056		58,049			
% Cost Difference																
Maximum Asphalt Design					-277.87%		-445.91%		-690.01%		-1027.98%		-1473.40%		-2031.84%	
JPC Design					-320.23%		-530.07%		-833.74%		-1253.81%		-1807.65%		-2502.77%	

JPC Design			Discount Rate												
			0		2		4		6		8		10		
YEAR	COST	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW	P/F	PW		
0	PW OF CONSTRUCTION	1,482,856	1.00	1,482,856	1.00	1,482,856	1.00	1,482,856	1.00	1,482,856	1.00	1,482,856	1.00	1,482,856	
25	JPC REPAIR & DIAMOND GRIND	303,546	1.00	303,546	0.61	185,020	0.38	113,865	0.23	70,726	0.15	44,323	0.09	28,016	
30	N/A	0	1.00	0	0.55	0	0.31	0	0.17	0	0.10	0	0.06	0	
40	PW OF SALVAGE	0	1.00	0	0.45	0	0.21	0	0.10	0	0.05	0	0.02	0	
PW Total Cost		1,786,402	1,786,402		1,667,877		1,596,722		1,553,582		1,527,180		1,510,873		
% Cost Difference															
Maximum Asphalt Design				10.08%		13.36%		15.39%		16.68%		17.52%		18.09%	
Maximum Aggregate Design				76.20%		84.13%		89.29%		92.61%		94.76%		96.16%	

DATE: 1/0/1900

Note: Fields in yellow require user input

I. PROJECT INFORMATION

Item No: 5-441.01 County: Oldham
Route: US 42
Project Length: 0.98 miles
Letting: 1/0/1900

II. TRAFFIC

ADT: 15,700
ESALs: 6,100,000
% Trucks: 8

III. COST ANALYSIS

	Concrete Alternate 10.00 inches	Asphalt Alternate 13.50 inches	% Difference
Initial Cost	1,482,856	1,189,150	19.81%
Agency LCCA (40-yr)	1,596,722	1,350,935	15.39%
Bid Adjustment Value*	113,865	161,785	

* This is the amount that would be added to a Contractor's bid to account for future agency costs in the initial bid.

IV. SPECIFIC ENGINEERING CONSIDERATIONS

V. DISTRICT COMMENTS

VI. Pavement Advisory Committee Comments

VII. State Highway Engineer Comments

This sheet is provided for use to submit a request for unit prices to the Engineering Estimating Section per the KYTC Pavement Type Selection Policy.
 (Note: Bid items and quantities will fill in automatically based on correct input on the "Thickness Design" worksheet)

DATE: 1/0/1900

Item No: 5-441.01

County: Oldham

Route: US 42

Length: 0.98 miles

Asphalt Alternate

Driving Lanes

<u>Code</u>	<u>Bid Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>
2906ES40	CL 3 ASPH SURF 0.38A PG64-22	Ton	1,423	
214	CL 3 ASPH BASE 1.00D PG64-22	Ton	13,945	
3	Crushed Stone Base	Ton	7,141	

Shoulders

<u>Code</u>	<u>Bid Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>
#N/A	0	Ton	0	
#N/A	0	Ton	0	
#N/A		Ton	0	
3	Crushed Stone Base	Ton	0	

Concrete Alternate

Driving Lanes

<u>Code</u>	<u>Bid Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>
2069	JPC Pavement-10 inch	Sq Yd	20,698	
3	Crushed Stone Base	Ton	4,760	

Shoulders

<u>Code</u>	<u>Bid Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>
#N/A		Ton	0	
#N/A		Ton	0	
#N/A		Ton	0	
3	Crushed Stone Base	Ton	0	

PAVEMENT DESIGN

4/12/16

Sheet 1

Pavement Design <20,000,000 ESALs
& Off the National Highway System

County Oldham Item 5-441.01 UPN 0
 Road Name Louisville - Cincinnati Road F.P.
 Description Widen and place modified curb and gutter on US 42

Traffic 15,700 2015 23,300 2035 ESAL 6,100,000 20-yr
 Existing: Type asphalt Thickness inches
 Length 0.98 Miles Design Speed M.P.H. Design CBR 2

Note:

FOR TYPICAL SECTION SEE ATTACHED SHEET(S)

ROADBED PREPARATION

PAVEMENT

Traffic Lanes:

3 Crushed Stone Base 6" depth
 214 CL 3 ASPH BASE 1.00D PG64-22 3.25" depth
 214 CL 3 ASPH BASE 1.00D PG64-22 3" depth
 214 CL 3 ASPH BASE 1.00D PG64-22 3" depth
 214 CL 3 ASPH BASE 1.00D PG64-22 3" depth
 22906ES4 CL 3 ASPH SURF 0.38A PG64-22 1.25" depth

Shoulders:

No Shoulder Pavement

Existing Pavement

22906ES4 CL 3 ASPH SURF 0.38A PG64-22 1.25" depth

SUBMITTED Alon Ross DATE 11/1/2016 Designer
 RECOMMENDED Suzanne Bateman DATE 11/1/2016 Project Manager
 APPROVED James L. Tucker DATE 11/1/2016 TEBM for Pavements

Asphalt Seal required from outside edge of paved shoulder to a point 2 feet down the ditch or fill slope. Two applications of the following:

103	ASPHALT SEAL COAT	2.40 lb/sy
100	ASPHALT SEAL AGGREGATE	20 lb/sy (Size No.8 or 9M)

PLAN NOTE NO.: 444b, 447

SPECIAL NOTE FOR:

SPECIAL PROVISION FOR:

US 42 Oldham County 5-441.01 Summary of Current Pavement Design

MAINLINE - US 42

1. The original Traffic Forecast prepared by Jordan, Jones & Goulding, Inc. was done in 2007. KYTC prepared a new (updated) Traffic Forecast in 2015. Both of these reports are attached to this email. The traffic quantities in these reports differ significantly and are summarized in the following table:

	JJ&G Report	KYTC Report
Construction Year ADT	21,730 (2012)	16,000 (2016)
Design ADT	39,200 (2032)	23,300 (2036)
%T (ADT)	11% (2032)	9% (2036)
20 year ESAL	17,000,000	6,100,000

2. Several different pavement design “options” were studied using the values in the KYTC report of 6,100,000 ESALs and Construction year ADT of 16,000. These pavement designs were derived utilizing the KYTC Pavement Design Guide and associated Spreadsheet, even though the ADT was greater than 15,000 (as limited by the Guide). Using the CBR of 2 from the geotechnical report and the 6,100,000 ESALs, the resulting required structural number(SN) is 6.32.
3. The current pavement design (“Option 3” was selected by KYTC in the 9-18-2015 email) is:
1.25” surface
3.25” base
3.25” base
3.25” base
3.25” base
6.00” CSB
and uses a modified curb and gutter of 14.25” thickness so that the curb and gutter sit directly on the CSB. The structural number of this pavement design is **6.59.**
4. Because the design SN (6.59) is greater than the required SN (6.32), the spreadsheet was used to back in and determine that the SN of 6.59 has an equivalent design ESALs of 8,600,000. This is considerably higher than the forecasted design ESALs of 6,100,000.
5. This widening project includes overlaying the existing pavement. The overlay includes leveling & wedging or milling & texturing as necessary to produce the designed mathematical grade. The surface course is 1.25” throughout both the overlay and the new pavement. The thickness of the existing pavement is unknown.

APPROACHES

1. ADT and ESALs for the approach roads were not included in either the JJ&G or the KYTC Traffic Forecast.
2. The thickness of the existing pavement is unknown.
3. Mainline pavement will be used to the back of the radius.
4. This table shows the length of the approach road from the back of the mainline radius to the tie in point:

Hunters Ridge Dr	River Bluff Rd	Hayfield Way (North side of US 42)	Hayfield Way (South side of US 42)	Old US 42 (ties to Hayfield Way East)
65'	114'	41'	50'	120'

5. Without traffic and ESAL information, several options for the pavement design of the approaches were considered.
 - a. Use mainline pavement, due to relatively short distances.
 - b. Use a modified mainline pavement by eliminating the bottom course of asphalt and reducing the CSB to 4.00". This will result in 11.00" of asphalt on 4.00" of CSB and produce a SN of 5.01. A modified curb and gutter (11.00" thick) would be used so that it sits directly on the CSB. Backing this SN into the spreadsheet produces relatively equivalent ESALs of 960,000. Using the equation on page 12 of the KYTC Pavement Design Guide, and making assumptions these ESALs have a very rough approximate equivalent ADT of 3,330.
 - c. Use a pavement design so that the top 3 layers of asphalt add up to 8", so that it works with the standard curb and gutter.
 - 1.25" surface
 - 3.25" base
 - 3.50" base
 - 6.00" CSBwith standard curb and gutter. The structural number of this pavement design is 4.09; it has equivalent ESALs of 220,000, and a very rough approximate equivalent ADT of 762.
 - d. Of course, the options are not limited to only these options.
 - e. Trying to back in a rough approximation of equivalent ADT from the ESALs is not very accurate, and was only done to be able to try to quantify different options since no traffic forecasts were available on these approach roads.