FDOT

SR 400 (I-4) Project Development and Environment (PD&E) Study
FM No.: 201210-2-22-01

Pavement Type Selection Report

Segment 5: West of SR 25/US 27 to West of CR 532 (Polk/ Osceola County Line)

Polk County (16320)

February 16, 2016

HNTB Corporation
610 Crescent Executive Court
Suite 400
Lake Mary, FL 32746

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Pavement Type Selection Report

SR 400 (I-4) Project Development and Environment (PD&E) Study

Segment 5: West of SR 25/US 27 to West of CR 532 (Polk/Osceola County Line) Polk County (16320), Florida

Contract Number:
Financial ID Number: 201210-2-22-01
Federal Aid Project Number: 0041 227 1

Prepared For
Florida Department of Transportation

February 16, 2016

ROBERT M. DENNEY LICENSE No. 58593 STATE OF FLORIDA PROFESSIONAL ENGINEER

Prepared by:

Robert Denney, PE — Date 2/16/2016
PE No. 58593

Concurrence by:

Bernie Masing, PE — Date
District Design Engineer, FDOT District 1

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1.0 INTRODUCTION

The Florida Department of Transportation (FDOT) is proposing to reconstruct and widen I-4 as part of the I-4 Beyond the Ultimate (BtU) concept. This involves the build-out of I-4 to its ultimate condition through Central Florida, including segments in Polk, Osceola, Orange, Seminole and Volusia Counties. The concept design proposes the addition of two new express lanes in each direction within the center median of I-4, resulting in the reconstruction of the existing six-lane divided urban interstate to a ten-lane divided highway. The roadway improvements also include reconstruction of 19 local service interchanges and four systems interchanges.

The SR 400 (I-4) Project Development and Environment (PD&E) Study is a reevaluation which addresses the revision from the original design concept showing two or four High Occupancy Vehicle (HOV) lanes, as recommended in the Environmental Assessment/Finding of No Significant Impact (EA/FONSI) for I-4 from West of Memorial Boulevard (SR 546) to CR 532 (Polk/Osceola County Line) and from CR 532 (Polk/Osceola County Line) to West of SR 528 (Beachline Expressway) and in the Final Environmental Impact Statement (FEIS) for I-4 from West of SR 528 (Beachline Expressway) to SR 472, to the current proposed design concept of four Express Lanes. The Express Lanes are tolled lanes and will extend the full length of the project. The proposed typical section will include three general use lanes, two express lanes, an auxiliary lane (in some areas, as needed) and shoulders in each direction, with provision for a 44' rail corridor in the median from SR 25/US 27 to SR 528. The express lanes and general use lanes will be separated by two 10- or 12- foot shoulders with a barrier wall in between the shoulders.

The overall SR 400 (I-4) BtU PD&E project limits include a total of approximately 43 miles of roadway improvements divided into two sections east and west of the I-4 Ultimate project. The approximate limits of improvement for the west section are from SR25/US 27 in Polk County to west of SR 435 (Kirkman Road) in Orange County and for the east section, from one mile east of SR 434 in Seminole County to east of SR 472 in Volusia County. For purposes of documentation of the SR 400 (I-4) PD&E study, the east and west sections are further subdivided into segments as shown in Table 1.

Table 1: SR 400 (I-4) PD&E Segment Limits

SR 400 (I-4) PD&E West Section	
Segment 1	W. of CR 532 (Osceola/Polk County Line) to W. of SR 528 (Beachline Expressway) in Osceola and Orange Counties (14.0 miles)
Segment 2	W. of SR 528 (Beachline Expressway) to W. of SR 435 (Kirkman Road) in Orange County (3.9 miles)
Segment 5	W. of SR 25/US 27 to W. of CR 532 (Osceola/Polk County Line) in Polk County (4.5 miles)
SR 400 (I-4) PD&E East Section	
Segment 3	1 mile E. of SR 434 to E. of SR 15/600,US 17/92 (Seminole/Volusia County Line) in Seminole County (10.2 miles)
Segment 4	E. of SR 15/600,US 17/92 (Seminole/Volusia County Line) to 1/2 mile E. of SR 472 in Volusia County (10.1 miles)

The majority of the proposed improvements (38 miles) are within District 5 and a small segment (4.9 miles) is within District 1. The entire corridor is part of the state's Strategic Intermodal System (SIS). As part of the SR 400 (I-4) PD&E Study, HNTB has prepared this Pavement Type Selection Report for I-4, Segment 5 (West of SR 25/US 27 to West of CR 532) in Polk County; a project location map is provided in Figure 1. The purpose of this report is to analyze, compare and select the most feasible pavement type for this project, utilizing the methods of the 1993 American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures, adopted by FDOT and described in detail in the FDOT Pavement Type Selection Manual (October, 2013).

2.0 PRINCIPAL FACTORS

2.1 Traffic

Pavement design for new alignment and reconstruction projects requires a structural loading forecast of the 18-KIP Equivalent Single Axle Load (ESAL). The accumulated 18-KIP ESALs are used to determine the Structural Number Required (SN_R) for flexible pavement and the Depth Required (D) for rigid pavement. While the total traffic volume is the main factor in determining roadway geometrics, the percent of commercial traffic and heavy load applications are the major influences in the structural pavement design. The I-4 Segment 5 corridor within the project area is expected to be utilized by local traffic and through traffic. To determine the ESALs for this project, traffic data was obtained from *the I-4 SAMR Update: Design Traffic Technical Memorandum January, 2013 (July, 2014 Update)*. Based on this memo, truck traffic percentages for the Segment 5 corridor range from 12.90 to 15.70 for year 2011. The truck factors for 2011 were reviewed for consistency by evaluating historical data provided by the FDOT Florida Traffic Online database. Based on these considerations, this project utilizes anticipated 24-hour truck traffic of 15.70% and a 20-year design. The future traffic volume projections used in the analysis are summarized in Table 2.

Table 2: Future Traffic Projections

	Year	AADT
Opening Year	2020	102,800
Mid-Design Year	2030	121,600
Design Year	2040	140,300

The 18-KIP ESAL for the roadway is 33,647,000 for flexible pavement and 47,474,000 for rigid pavement. Based on this information, either asphaltic concrete (AC) or Portland cement concrete (PCC) pavement would be sufficient. Traffic information and ESAL calculations are provided in Appendix A.

Figure 1: Project Location Map

2.2 Soil Characteristics

Geotechnical data near the study area was available from the report titled: *Final Roadway Soil Survey Report I-4 Interchange at S.R. 530 (U.S. 192), FPID: 242531-1*, which covers the I-4 Segment 1 section located immediately east of the I-4 Segment 5 corridor. The report included results of Limerock Bearing Ratio (LBR) testing on twenty five soil samples obtained along the project alignment. The LBR value of 15 was computed using both the FDOT Mean Method and 90 Percent Method for pavement design. Using an LBR of 15 yields a corresponding roadway embankment resilient modulus (M_R) of 6,000 psi. These values were used in preparing the PTSR for the I-4 Segment 5 project. The geotechnical engineering evaluation information from the I-4 Interchange at SR 530/US 192 (FPID: 242531-1) project is included in Appendix B.

2.3 Weather

High rainfall intensities are experienced in Florida during portions of the year. These rainfall conditions are expected to equally affect subsoil conditions for both flexible and rigid pavements; thus, the weather does not favor the placement of one type of pavement over the other. Additionally, cross slopes are designed to drain water off the pavement, and drainable base and edge drains were considered in the economic analysis to ensure the runoff would not negatively impact the concrete pavement. Therefore, either AC or PCC pavement type could be constructed with satisfactory wet weather performance and durability.

2.4 Construction Considerations

The interstate will be completely reconstructed. Staged construction will be necessary for either rigid or flexible type of pavement. The available right-of-way will allow for either type to be constructed satisfactorily.

2.5 Recycling

The existing roadway pavement is to be completely reconstructed; therefore, there is an opportunity to recycle the existing asphalt pavement in the initial construction. FDOT has successfully recycled rigid and flexible pavement, therefore, there are future recycling opportunities for both pavement types during rehabilitation of the pavements.

3.0 ECONOMIC ANALYSIS

The present worth method will be used to evaluate the cost of flexible pavement versus rigid pavement. All capital outlays for each alternative, including rehabilitation costs, are converted into today's dollars to compare the alternatives.

3.1 Basis of Comparison

The analysis will be based on the following assumptions:

Analysis Period: 40 years
Initial Pavement Design Life: 20 years
Discount Rate: 3.5%

The following baseline rehabilitation strategies were considered, as recommended in the Pavement Type Selection M*anual (October 2013)* for concrete pavement and from supporting data for lifecycles of asphalt pavement in Polk County:

Concrete Pavement – Limited Access (Mainline & Shoulder)
23 Year – Concrete Pavement Rehabilitation (3% Slab Replacement)*
33 Year – Concrete Pavement Rehabilitation (5% Slab Replacement)*
*Estimate is based on the percentage of slab area in the truck lane

Asphalt Pavement - Limited Access (Mainline & Shoulder)
13 Year – Mill 3 inches
4" Structural Asphaltic Concrete
26 Year – Mill 3 inches
4" Structural Asphaltic Concrete

3.2 Pavement Data

The initial pavement designs developed for this analysis for both rigid and flexible pavement were based on the following geometry:

# of Lanes=10 (3 GUL+2 SUL in each direction)
Lane Width=12 feet
GUL: Inside Shoulder Width=12 feet, Outside Shoulder Width=12 feet
SUL: Inside Shoulder Width=10 feet, Outside Shoulder Width=12 feet
Notes: GUL = general use lanes, SUL = special use lanes

The typical section used for this analysis is provided in Appendix C and the pavement design calculations are provided in Appendix D.

Rigid Pavement - This pavement design has been prepared in accordance with the most recent Rigid Pavement Design Manual (RPDM) (FDOT Document No. 625-010-006-e, January, 2009). This project is located in Polk County. Using the Mechanistic-Empirical Pavement Design Guide (MEPDG) Design Tables, the slab thickness should be 13.5".

Rigid Pavement Design Parameters
18-KIP ESAL=47,474,000
Modulus of Subgrade Reaction (K_G)=200 pci
Reliability (%R)=90%

Mainline
13.5" Concrete Depth
4" Optional Base Group 1 (Type B-12.5 Only)
12" Type B Stabilization

Shoulder
2.5" Type SP Structural Course (Traffic B)
Optional Base Group 9 (10" LBR 100)
12" Type B Stabilization

Asphalt Pavement - This pavement design has been prepared in accordance with the most recent Flexible Pavement Design Manual (FPDM) (FDOT Document No. 625-010-002-g, March, 2008).

Flexible Pavement Design Parameters
18-KIP ESAL=33,647,000 (Traffic Level E)
18-KIP ESAL for shoulders=3% of mainline=1,009,410 (Traffic Level B)
Resilient Modulus (M_R)=6,000 psi
Reliability (%R)=90%

Mainline
SNR=6.27
0.75" Friction Course FC-5 (PG76-22) (Not included in the Life Cycle Cost Analysis)
2" Type SP Structural Course (Traffic E) (PG76-22)
2" Type SP Structural Course (Traffic E) (PG76-22)
3" Type SP Structural Course (Traffic E)
Optional Base Group 12 (12.5" Limerock, LBR 100)
12" Type B Stabilization
SNC=6.29

Shoulder
SNR=3.78
2.5" Type SP Structural Course (Traffic B)
Optional Base Group 9 (10" LBR 100)
12" Type B Stabilization
SN_C=3.86

3.3 Cost Data for Economic Analysis

The unit prices used for this economic analysis are weighted averages obtained from FDOT's D5 estimates office and are summarized in Table 3.

Table 3: Pavement Unit Prices

Item	Price	Unit
Type B Stabilized (LBR 40)	$3.25	Sq. Yd
OBG-1, Type B-12.5	$20.00	Sq. Yd
OBG-9	$16.00	Sq. Yd
OBG-12	$15.00	Sq. Yd
Milling 1" Avg. Depth	$2.00	Sq. Yd
Milling 3" Avg. Depth	$2.25	Sq. Yd
Type SP Traffic Level B	$85.00	Ton
Type SP Traffic Level E	$90.00	Ton
Type SP Traffic Level E PG76-22	$95.00	Ton
JPCP	$60.00	Sq. Yd
CPR - Slab Replacement (3%)	$450.00	Cu. Yd
CPR - Slab Replacement (5%)	$450.00	Cu. Yd
Edgedrain (Draincrete)	$25.00	Ft
Edgedrain Outlet Pipe (4 in)	$32.00	Ft
Source: FDOT D5 estimates office.		

3.4 Cost Comparison

A life cycle economic analysis per mile of concrete pavement and asphalt pavement was performed using an analysis period of 40 years and a discount rate of 3.5%. Based on the life cycle cost analysis, the total present worth costs per mile for concrete pavement is $8,663,880 and for flexible pavement, $7,556,836. The results of the analysis are summarized in
Table 4. The details of the analysis are included in Appendix E.

4.0 SECONDARY FACTORS

4.1 Performance of Similar Pavements in the Area

The existing pavement sections, west and east of I-4, Segment 5 are both constructed with AC pavement. In general, these sections have not experienced any areas of premature distress and maintenance resurfacing is not excessively disruptive. The average age to rehabilitation for flexible pavements was reviewed. In Polk County, for the eight-year period from 2007 and ending in 2014, the average age to rehabilitation was 8.7 years to 15.8 years. In Osceola County, for the seven-year period from 2007 and ending in 2013, the average age to rehabilitation was 10.6 years to 15.6 years. With improvements made to FC-5 over the years, it is expected that an FC-5 flexible pavement will outperform previous FC-2 sections.

Performance of concrete pavement in Central Florida was also reviewed. In the Orlando area within Orange County, concrete pavement was originally constructed on I-4 through the downtown area. This

Table 4: Pavement Type Selection Economic Analysis (Cost per Mile)

Concrete Pavement (PCC)

			Cost		P / F		PRESENT WORTH
	Initial	2020	$8,035,175	*	1.00000	=	$8,035,175
23	Year	2043	$706,486	*	0.45329	=	$320,240
33	Year	2053	$959,926	*	0.32134	=	$308,465
					TOTAL AGENCY COSTS	**=**	**$8,663,880**
					USER COSTS	**=**	**N/A**
					SALVAGE VALUE	**=**	**N/A**
					TOTAL PRESENT WORTH LIFE-CYCLE COSTS	**=**	**$8,663,880**

Asphalt Pavement (AC)

			Cost		P / F		PRESENT WORTH
	Initial	2020	$5,435,632	*	1.00000	=	$5,435,632
13	Year	2033	$1,606,785	*	0.63940	=	$1,259,911
26	Year	2046	$1,606,785	*	0.40884	=	$805,592
39	Year	2059	$1,606,785	*	0.26141	=	$515,099
					TOTAL AGENCY COSTS	**=**	**$8,016,233**
					USER COSTS	**=**	**N/A**
					SALVAGE VALUE	**=**	**$459,397**
					TOTAL PRESENT WORTH LIFE-CYCLE COSTS	**=**	**$7,556,836**

concrete pavement section has been in service for approximately 50 years and has undergone two major rehabilitations. The average rehabilitation age for concrete pavement in Orange County was 26 years. Other concrete pavement sections in the Central Florida region were reviewed, including concrete pavement in adjacent Hillsborough County. This data showed that over a 3 year period between 2006 and 2008, the average age for the rehabilitation cycle for these pavements within Hillsborough County were 20 years, 25 years and 22 years. Pavement performance and rehabilitation data is provided in Appendix F.

4.2 Adjacent Existing Pavements

The existing roadway sections, adjacent to the I-4 Segment 5 section are both constructed with flexible pavements. In addition, recent widening and rehabilitation projects throughout the corridor have been constructed with flexible pavement. The I-4, Segment 1 section, immediately east of Segment 5, was also evaluated for pavement type selection as part of the SR 400 (I-4) PD&E reevaluation study.

4.3 Conservation of Materials and Energy

There are no significant differences in the energy consumption used to produce, transport or construct either type of pavement.

4.4 Availability of Local Materials or Contractor Capabilities

Materials are available locally for both pavement types. However, the majority of contractors in the Central Florida region are more familiar with asphalt pavement, since it is more commonly used in roadway projects in the area. FDOT also has prequalified contractors that have experience placing concrete pavement on major projects. Neither of the pavement types uses materials that are particularly scarce in Central Florida.

4.5 Traffic Safety

Current FDOT design guidelines and specifications for both the AC pavement and PCC pavement alternatives provide similar characteristics for wearing course, delineation through pavement and shoulder contrast, reflectivity under highway lighting and the maintenance of a nonskid surface.

4.6 Incorporation of Experimental Features

There are no experimental features included in this pavement type selection report.

4.7 Stimulation of Competition

Stimulation of competition is encouraged to avoid monopoly situations and improve products and methods in the projection of paving products. However, neither pavement type currently indicates a distinct advantage to provide more stimulation of competition over the other.

4.8 Municipal Preference, Participating Local Government Preference, and Recognition of Local Industry

No preferences apparent for pavement type by FDOT, which will be maintaining and operating this roadway facility.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding life cycle cost analysis and considering all other design factors evaluated in this report, AC pavement has a long term owner's cost advantage of 17%. Therefore, it is recommended that asphalt pavement be considered as the pavement type for the SR 400 (I-4) Segment 5 corridor.

APPENDICES

APPENDIX A

TRAFFIC INFORMATION

FLORIDA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION STATISTICS OFFICE
2013 HISTORICAL AADT REPORT

COUNTY: 16 - POLK

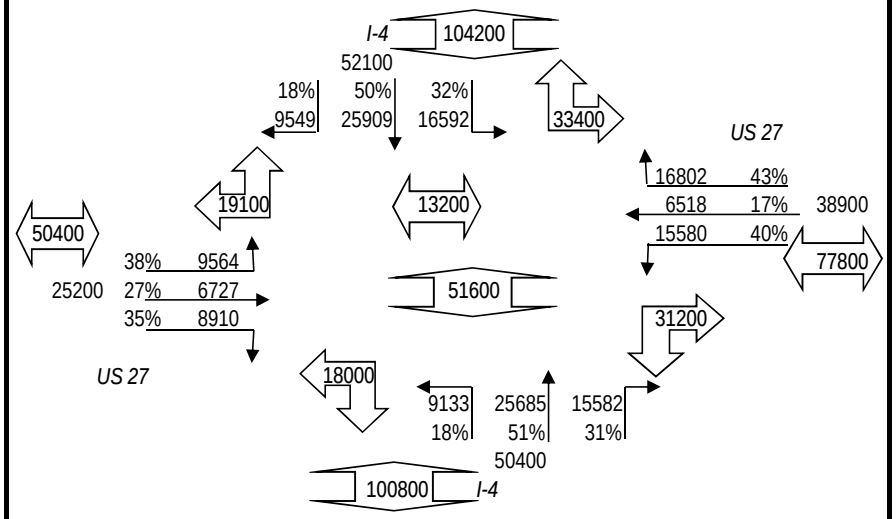
SITE: 0108 - SR 400/I-4 SW OF SR 25/US 27, POLK COUNTY

YEAR	AADT	DIRECTION 1	DIRECTION 2	*K FACTOR	D FACTOR	T FACTOR
2013	75500 C	E 37500	W 38000	9.00	52.80	15.70
2012	77500 C	E 39000	W 38500	9.00	51.90	13.80
2011	75500 C	E 38000	W 37500	9.00	53.00	15.70
2010	75000 C	E 37500	W 37500	8.65	52.38	15.70
2009	68500 C	E 34500	W 34000	8.68	51.90	17.50
2008	72000 C	E 36500	W 35500	8.81	52.63	16.80
2007	75500 C	E 37500	W 38000	10.82	52.45	14.00
2006	75500 C	E 38000	W 37500	8.18	54.35	15.10
2005	72000 C	E 34500	W 37500	12.20	58.90	17.90
2004	63000 F	E 31500	W 31500	7.80	52.60	17.90
2003	60000 C	E 30000	W 30000	7.90	54.00	17.90
2002	64000 C	E 32000	W 32000	8.00	55.00	17.30
2001	63500 C	E 32000	W 31500	8.40	52.50	17.30
2000	61500 C	E 30000	W 31500	8.20	53.50	17.80
1999	56500 C	E 28000	W 28500	9.90	57.40	17.40
1998	57000 C	E 29500	W 27500	7.70	51.10	15.80

AADT FLAGS: C = COMPUTED; E = MANUAL ESTIMATE; F = FIRST YEAR ESTIMATE
S = SECOND YEAR ESTIMATE; T = THIRD YEAR ESTIMATE; F = FOURTH YEAR ESTIMATE
V = FIFTH YEAR ESTIMATE; 6 = SIXTH YEAR ESTIMATE; X = UNKNOWN
*K FACTOR: STARTING WITH YEAR 2011 IS STANDARDK, PRIOR YEARS ARE K30 VALUES

PROJECT TRAFFIC FOR I-4 AT US 27: TO

2-WAY AADT TURNING MOVEMENTS IN YEAR 2019



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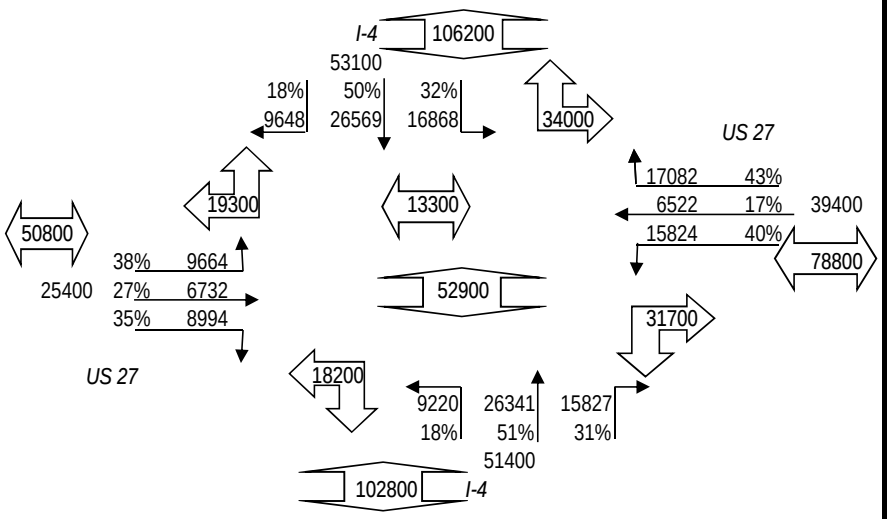

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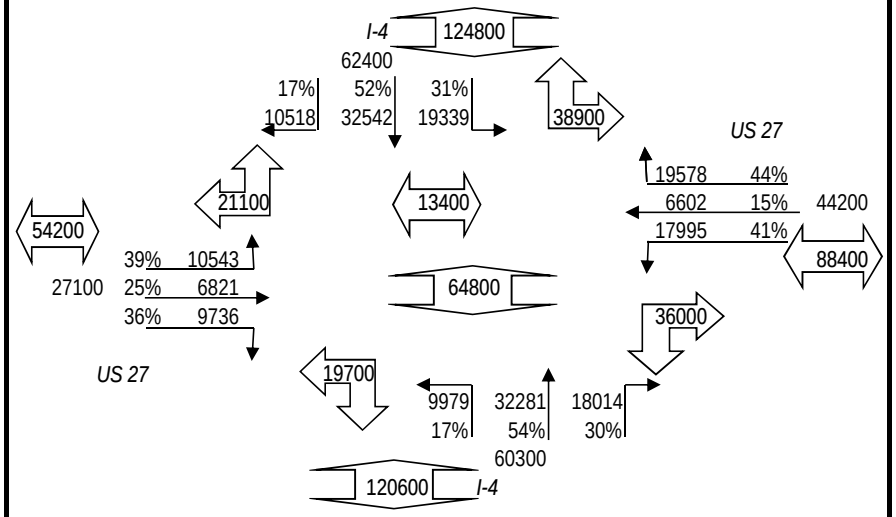

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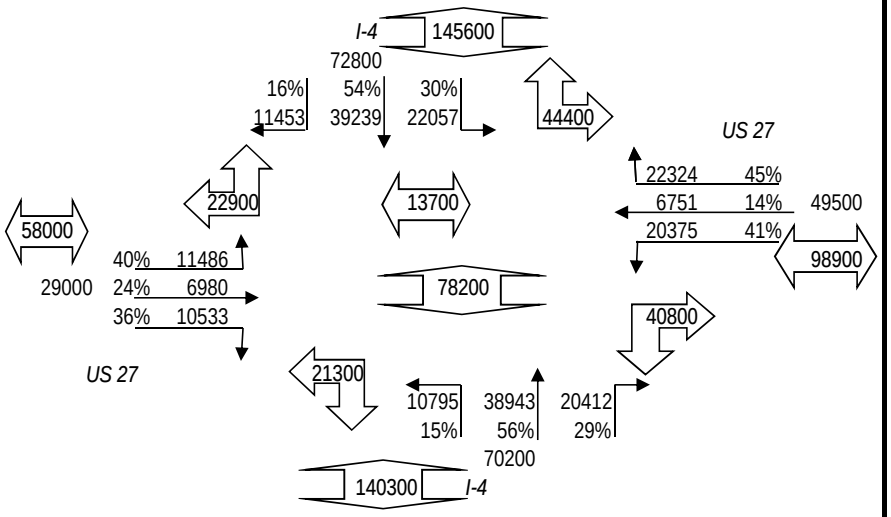


18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS

PROJECT TRAFFIC FOR PD&E and DESIGN ANALYSIS INFO / FACTORS

SECTION #: 16320000
SEGMENT #: ML
ITEM #: 0
PROJECT DESCRIPTION: SR 400 (I-4) - SW of SR 25/US 27

LOCATION #: 1

LOCATION DESCRIPTION: Mainline

GROWTH RATE FORMULA

A: Interpolation
B: Enter Growth Rate
C: Enter All AADTs
D: New Facility

If "A" select an interpolation function
If "B" enter rate as decimals (1%=1.01)
If ""C", or "D" continue to next section

Choose A, B, C, or D here: C

Linear Growth Rate ____ %
Compounded Growth Rate ____ %
Decaying Growth Rate ____ %
(select one)

DESIGN INFORMATION

		AADT
Existing Year	2011	75500
Opening Year	2020	102800
Mid-Design Year	2030	121600
Design Year	2040	140300

Daily Direction Split
(50% or 100%) 50%
Lanes in One Direction 3

T24 values
Existing to Opening Year 15.70%
Opening to Mid-Year 15.70%
Mid-Year to Design-Year 15.70%

1995 EQUIVALENCY FACTORS |u(1)|

(selected with an X)	FLEXIBLE PAVEMENT SN = 5/THICK		RIGID PAVEMENT SN = 12/THICK	
RURAL FREEWAY:	1.050		1.600	
URBAN FREEWAY:	0.900	X	1.270	X
RURAL HIGHWAY:	0.960		1.350	
URBAN HIGHWAY:	0.890		1.220	
OTHER (Enter Factor and X):				

(1) Equivalency Factors are based on Updated Pavement Damage Factors Memorandum, dated July 2, 1998.
Lane Factors developed by Copes equation.

I have reviewed the 18 kip Equivalent Single Axle Loads (ESAL's) to be used for pavement design on this project. I hereby attest that these have been developed in accordance with the FDOT Project Traffic Forecasting Procedure using historical traffic data and other available information.

ROBERT M. DENNEY — LICENSE — No. 58539 — STATE OF FLORIDA — PROFESSIONAL ENGINEER

Prepared by: HNTB — 610 Crescent Executive Ct, Suite 400, Lake Mary, FL 32746 — Robert Denney, PE — 10/31/2014
Org. Unit or Firm — Name — Date

Signature 2/18/16

Reviewed by: _____ — District 1 Design — FDOT - D1
Name — Title — Org. Unit or Firm — Date

Signature

18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS - LOCATION 1

PROJECT TRAFFIC FOR PD&E and DESIGN ANALYSIS INFO / FACTORS

YEARS: *2011 to 2040*

SECTION #: 16320000 **SEGMENT #:** ML **ITEM #:** 0

FLEXIBLE PAVEMENT URBAN FREEWAY 0.900

SN=5/THICK SR 400 (I-4) - SW of SR 25/US 27 C

YEAR	AADT	ESAL (1000S)	ACCUM (1000s)	D	T	LF	EF
2011	75500	1116	0	0.5	15.70%	0.573	0.900
2012	78500	1154	0	0.5	15.70%	0.570	0.900
2013	81500	1191	0	0.5	15.70%	0.567	0.900
2014	84600	1230	0	0.5	15.70%	0.563	0.900
2015	87600	1267	0	0.5	15.70%	0.561	0.900
2016	90600	1304	0	0.5	15.70%	0.558	0.900
2017	93700	1341	0	0.5	15.70%	0.555	0.900
2018	96700	1378	0	0.5	15.70%	0.552	0.900
2019	99700	1414	0	0.5	15.70%	0.550	0.900
2020	102800	1451	1451	0.5	15.70%	0.547	0.900
2021	104600	1473	2924	0.5	15.70%	0.546	0.900
2022	106500	1496	4420	0.5	15.70%	0.544	0.900
2023	108400	1518	5938	0.5	15.70%	0.543	0.900
2024	110300	1541	7479	0.5	15.70%	0.542	0.900
2025	112200	1563	9042	0.5	15.70%	0.540	0.900
2026	114000	1584	10626	0.5	15.70%	0.539	0.900
2027	115900	1607	12233	0.5	15.70%	0.537	0.900
2028	117800	1629	13862	0.5	15.70%	0.536	0.900
2029	119700	1651	15513	0.5	15.70%	0.535	0.900
2030	121600	1673	17186	0.5	15.70%	0.533	0.900
2031	123400	1694	18880	0.5	15.70%	0.532	0.900
2032	125300	1716	20596	0.5	15.70%	0.531	0.900
2033	127200	1738	22334	0.5	15.70%	0.530	0.900
2034	129000	1759	24093	0.5	15.70%	0.529	0.900
2035	130900	1781	25874	0.5	15.70%	0.527	0.900
2036	132800	1802	27676	0.5	15.70%	0.526	0.900
2037	134600	1823	29499	0.5	15.70%	0.525	0.900
2038	136500	1845	31344	0.5	15.70%	0.524	0.900
2039	138400	1866	33210	0.5	15.70%	0.523	0.900
2040	140300	1888	35098	0.5	15.70%	0.522	0.900

Opening to Mid-Design Year ESAL Accumulation (1000s): 15735

Opening to Design Year ESAL Accumulation (1000s): 33647

I have reviewed the 18 kip Equivalent Single Axle Loads (ESAL's) to be used for pavement design on this project. I hereby attest that these have been developed in accordance with the FDOT project historical traffic data and other available information.

ROBERT M. DENNEY LICENSE No. 58503 STATE OF FLORIDA PROFESSIONAL ENGINEER

Prepared by: HNTB 610 Crescent Executive Ct, Suite 400 Lake Mary, FL 32746 Robert Denney, PE 10/31/2014

Org. Unit or Firm Name Date

Signature 2/18/16

Reviewed by: District 1 Design FDOT - D1

Name Title Org.Unit or F Date

Signature

18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS - LOCATION 1

PROJECT TRAFFIC FOR PD&E and DESIGN ANALYSIS INFO / FACTORS

YEARS: *2011 to 2040*

SECTION #: 16320000 **SEGMENT #:** ML **ITEM #:** 0

RIGID PAVEMENT URBAN FREEWAY 1.270

SN=12/THICK SR 400 (I-4) - SW of SR 25/US 27 C

YEAR	AADT	ESAL (1000S)	ACCUM (1000s)	D	T	LF	EF
2011	75500	1574	0	0.5	15.70%	0.573	1.270
2012	78500	1628	0	0.5	15.70%	0.570	1.270
2013	81500	1681	0	0.5	15.70%	0.567	1.270
2014	84600	1735	0	0.5	15.70%	0.563	1.270
2015	87600	1787	0	0.5	15.70%	0.561	1.270
2016	90600	1839	0	0.5	15.70%	0.558	1.270
2017	93700	1893	0	0.5	15.70%	0.555	1.270
2018	96700	1944	0	0.5	15.70%	0.552	1.270
2019	99700	1995	0	0.5	15.70%	0.550	1.270
2020	102800	2048	2048	0.5	15.70%	0.547	1.270
2021	104600	2078	4126	0.5	15.70%	0.546	1.270
2022	106500	2110	6236	0.5	15.70%	0.544	1.270
2023	108400	2142	8378	0.5	15.70%	0.543	1.270
2024	110300	2174	10552	0.5	15.70%	0.542	1.270
2025	112200	2206	12758	0.5	15.70%	0.540	1.270
2026	114000	2236	14994	0.5	15.70%	0.539	1.270
2027	115900	2267	17261	0.5	15.70%	0.537	1.270
2028	117800	2298	19559	0.5	15.70%	0.536	1.270
2029	119700	2330	21889	0.5	15.70%	0.535	1.270
2030	121600	2361	24250	0.5	15.70%	0.533	1.270
2031	123400	2390	26640	0.5	15.70%	0.532	1.270
2032	125300	2421	29061	0.5	15.70%	0.531	1.270
2033	127200	2452	31513	0.5	15.70%	0.530	1.270
2034	129000	2482	33995	0.5	15.70%	0.529	1.270
2035	130900	2512	36507	0.5	15.70%	0.527	1.270
2036	132800	2543	39050	0.5	15.70%	0.526	1.270
2037	134600	2572	41622	0.5	15.70%	0.525	1.270
2038	136500	2603	44225	0.5	15.70%	0.524	1.270
2039	138400	2633	46858	0.5	15.70%	0.523	1.270
2040	140300	2664	49522	0.5	15.70%	0.522	1.270

Opening to Mid-Design Year ESAL Accumulation (1000s): 22202

Opening to Design Year ESAL Accumulation (1000s): 47474

I have reviewed the 18 kip Equivalent Single Axle Loads (ESAL's) to be used for pavement design on this project. I hereby attest that these have been developed in accordance with the FDOT Project Traffic Forecasting Procedure using historical traffic data and other available information.

ROBERT M. DENNEY — LICENSED — No. 58593 — STATE OF FLORIDA — PROFESSIONAL ENGINEER

Prepared by: HNTB — 610 Crescent Executive Ct, Suite 400, Lake Mary, FL 32746

Org. Unit or Firm — Robert Denney, PE (Name) — 10/31/2014 (Date)

Signature — 2/18/16

Reviewed by: Name — District 1 Design (Title) — FDOT - D1 (Org.Unit or Firm) — Date

Signature

APPENDIX B

GEOTECHNICAL INFORMATION

Final Roadway Soil Survey Report

I-4 INTERCHANGE AT S.R. 530 (U.S. 192)

Osceola County, Florida

Financial Project No. 242531-1

Section No. 92130

GEC Project No. 1324G

Geotechnical and Environmental Consultants, Inc.

January 12, 2004

URS Corporation
315 East Robinson Street, Suite 245
Orlando, Florida 32801

Attention: Ms. Yassi Myers, P.E.

Subject: Final Roadway Soil Survey Report
I-4 INTERCHANGE AT S.R. 530 (U.S. 192)
Osceola County, Florida
Financial Project No. 242531-1
Section No. 92130
GEC Project No. 1324G

Dear Ms. Myers:

Geotechnical and Environmental Consultants, Inc. (GEC) is pleased to present this Final Roadway Soil Survey Report for the above-referenced project. Our work was performed in general accordance with our Proposal No. 2080G dated March 30, 1999, revised on January 16, 2002. The purpose of our investigation was to explore subsurface conditions along the proposed roadway alignments, pond and box culvert locations and use the information obtained to develop geotechnical engineering recommendations to guide design and construction of the roadway improvements. This report describes our exploration procedures, exhibits the data obtained, and presents our conclusions and recommendations.

GEC appreciates the opportunity to be of service to URS Corporation and the Florida Department of Transportation (FDOT) on this project. If you should have any questions concerning the contents of this report, please contact us.

Very truly yours,

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.

Riad Touati, P.E. 1.14.04
Project Engineer
Florida Registration No. 57613

Gary L. Kuhns, P.E. 1/14/04
Senior Geotechnical Engineer
Florida Registration No. 38704

RT/GLK/aas

cc: Bert Woerner, P.E. - FDOT District 5 Geotechnical Office

1230 East Hillcrest Street, Orlando, FL 32803-4713
407/898-1818 Fax 407/898-1837 E-mail: gec@g-e-c.com
www.g-e-c.com

Table of Contents

8.1 Roadway Embankment Construction (Cont'd)

Location	Station	Offset (ft)	Depth (ft)	Comment
I-4	411+00	85 LT	4.5 - 7	TO REMAIN
	412+00	80 LT	5 - 7	TO REMAIN
	414+00	80 LT	4 - 5	TO REMAIN
U.S. 192	504+00	100 RT	0 - 1	TO REMAIN
	506+00	115 RT	0 - 0.5	TO REMAIN
	520+00	55 LT	9 - 13	TO REMAIN
	542+00	220 RT	4 - 9	TO REMAIN
	543+00	165 RT	0 - 3	TO REMAIN
	543+90	160 RT	2 - 3	TO REMAIN
	544+00	115 LT	2.5 - 4	TO REMAIN
	545+00	115 RT	3.5 - 5	TO REMAIN

All fill soils placed for new roadway construction should be selected in accordance with Index 505 of the FDOT Roadway and Traffic Design Standards. Stratum Nos. 1, 2 and 3 (A-3 and A-2-4) are Select (S) soils. However, Stratum Nos. 2 and 3 may retain excess moisture and be difficult to dry and compact. Stratum No. 4 (A-4, A-6, A-7-6) is Plastic (P), Stratum No. 5 (A-7-5, A-7-6) is High Plastic (H) material and Stratum No. 6 (A-8) is Muck (M).

Embankment fill should be placed and compacted in accordance with the FDOT Standard Specifications for Road and Bridge Construction. In-place density tests should be performed on fill soils to verify the specified degree of compaction. The minimum test frequency should be in accordance with the FDOT Materials, Sampling, Testing and Reporting Guide.

8.2 Pavement Design

Twenty-five Limerock Bearing Ratio (LBR) tests were performed on representative non-organic, non-plastic soil (Stratum Nos. 1 and 2) samples obtained along the project alignment. The FDOT Mean Method yielded an LBR value of 15, and the FDOT 90 Percent Method also yielded an LBR value of 15. Our design LBR calculations are included in the Appendix. The individual LBR test results are also contained in the Appendix. A design LBR Report was previously submitted on June 11, 2001.

After proper subsoil preparation, the pavement subgrade and base courses should be constructed in accordance with the FDOT Standard Specifications for Road and Bridge Construction. The distance between the bottom of the base course and estimated seasonal high levels should be greater than 2 feet throughout the proposed roadway alignment. Based on our review of the 90% submittal cross-sections, the locations where a 2-foot separation is not provided are summarized in the following table:

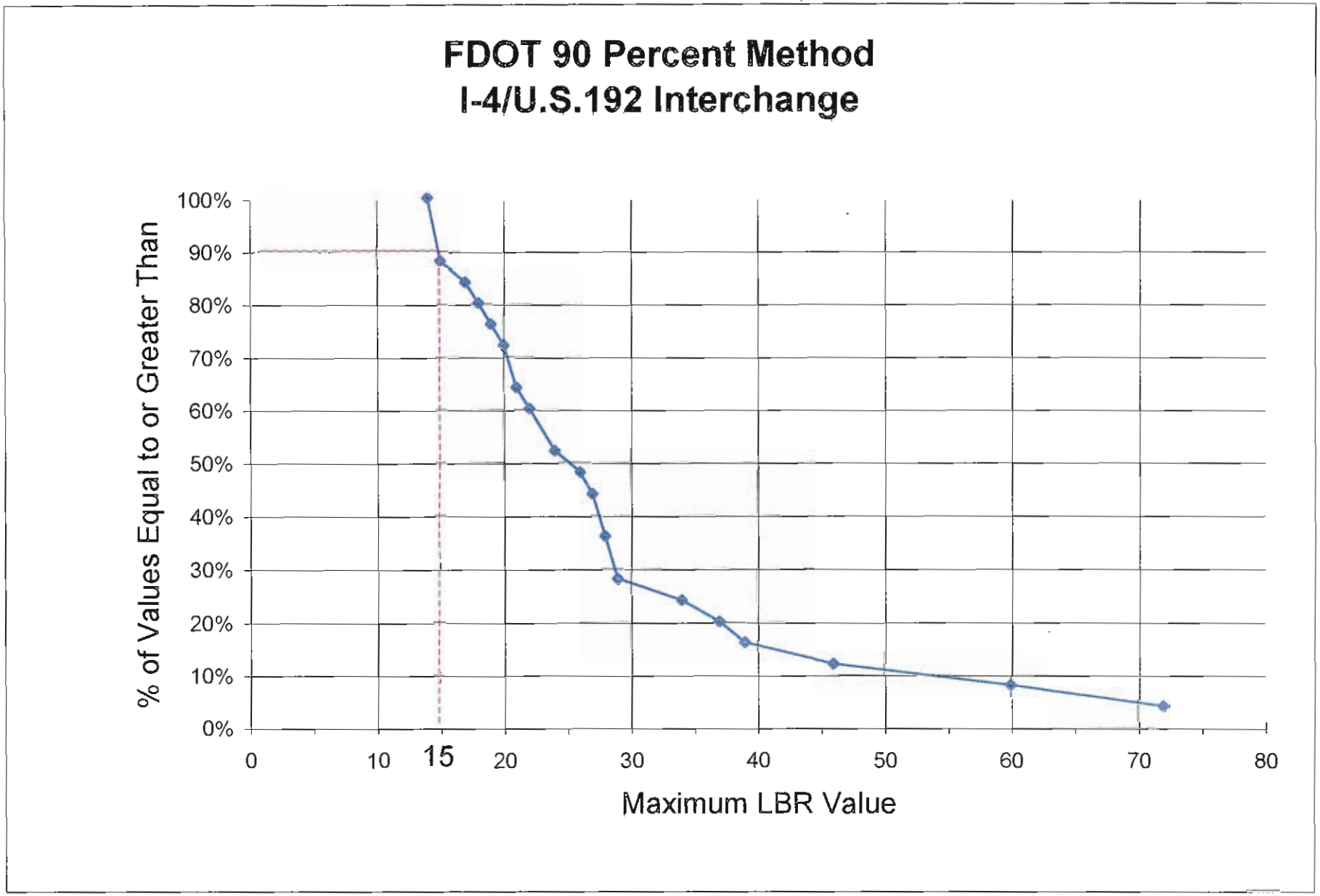
DESIGN LBR CALCULATIONS

Table 5
Design LBR - Mean Method
I-4/U.S. 192 INTERCHANGE
Financial Project No. 242531
GEC Project No. 1324G

SAMPLE NO	STATION	OFFSET (feet)	STRATUM NO	MAXIMUM LBR VALUE	LBR VALUE AT -2% OF MOISTURE AT MAXIMUM LBR	LBR VALUE AT +2% OF MOISTURE AT MAXIMUM LBR
1	295+00	215 LT	2	46	22	5
2	303+00	160 LT	1	28	13	11
3	311+00	100 RT	1	37	27	21
4	319+00	82 RT	2	18	13	15
5	327+00	170 LT	2	60	40	22
6	335+00	20 RT	2	29	21	6
7	343+00	90 LT	1	72	58	26
8	351+00	25 RT	2	22	13	11
9	359+00	70 LT	2	17	11	9
10	367+00	10 RT	2	20	12	12
11	375+00	25 LT	2	19	6	11
12	383+00	90 RT	1	26	23	21
13	391+00	155 LT	2	14	12	10
14	399+00	125 RT	1	28	23	6
15	406+00	80 LT	2	21	14	15
16	490+00	60 RT	1	14	10	8
17	496+00	75 LT	1	14	10	7
18	504+00	110 RT	1	22	19	14
19	511+00	80 LT	1	20	13	8
20	518+00	50 RT	1	39	28	18
21	525+00	CL	1	24	11	9
22	537+00	200 LT	2	34	21	7
23	544+00	160 RT	1	15	9	9
24	551+00	10 LT	2	27	18	12
25	558+00	65 LT	2	27	8	13
Mean LBR Value				27.7	18.7	12.2
					± 2 % Average = 15.2	

Table 6
Design LBR - 90 Percent Method
I-4/U.S. 192 INTERCHANGE
Financial Project No. 242531
GEC Project No. 1324G

SAMPLE NO	STATION	OFFSET (feet)	STRATUM NO	MAXIMUM LBR VALUE	NO. OF VALUES EQUAL TO OR GREATER THAN	% OF VALUES EQUAL TO OR GREATER THAN
13	391+00	155 LT	2	14	25	100%
16	490+00	60 RT	1	14	25	100%
17	496+00	75 LT	1	14	25	100%
23	544+00	160 RT	1	15	22	88%
9	359+00	70 LT	2	17	21	84%
4	319+00	82 RT	2	18	20	80%
11	375+00	25 LT	2	19	19	76%
10	367+00	10 RT	2	20	18	72%
19	511+00	80 LT	1	20	18	72%
15	406+00	80 LT	2	21	16	64%
8	351+00	25 RT	2	22	15	60%
18	504+00	110 RT	1	22	15	60%
21	525+00	CL	1	24	13	52%
12	383+00	90 RT	1	26	12	48%
24	551+00	10 LT	2	27	11	44%
25	558+00	65 LT	2	27	11	44%
2	303+00	160 LT	1	28	9	36%
14	399+00	125 RT	1	28	9	36%
6	335+00	20 RT	2	29	7	28%
22	537+00	200 LT	2	34	6	24%
3	311+00	100 RT	1	37	5	20%
20	518+00	50 RT	1	39	4	16%
1	295+00	215 LT	2	46	3	12%
5	327+00	170 LT	2	60	2	8%
7	343+00	90 LT	1	72	1	4%
90 Percent LBR Value = 15 (see attached graph)						


FDOT 90 Percent Method
I-4/U.S.192 Interchange
% of Values Equal to or Greater Than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
15
20
30
40
50
60
70
80
Maximum LBR Value

APPENDIX C

TYPICAL SECTION

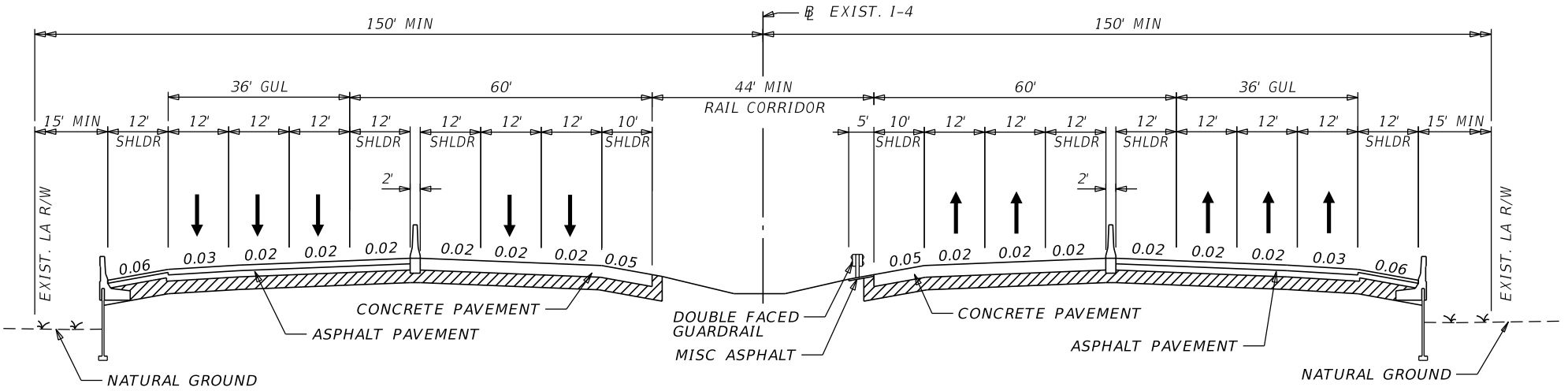
PROJECT IDENTIFICATION

FINANCIAL PROJECT ID 432100-1-22-01 FEDERAL AID PROJECT NO. N/A COUNTY NAME POLK (16320)

SECTION NO. 16320 ROAD DESIGNATION SR 400 (I-4) LIMITS/MILEPOST MP 28.814 - 32.022 (POLK)

PROJECT DESCRIPTION WIDENING SR 400 (I-4) FROM WEST OF SR 25/US 27 TO WEST OF SR 435 KIRKMAN ROAD AND FROM 1 MILE EAST OF SR 434 TO 1/2 MILE EAST OF SR 472.

PROPOSED ROADWAY TYPICAL SECTION



TYPICAL SECTION
SR 400 (I-4) WITH HIGH SPEED RAIL

DESIGN SPEED = 70 MPH

℄	STATION TO STATION
EXIST. SR 400 (I-4)	457+00.00 - 604+50.00

SHEET 1-1

APPROVED BY:	FDOT CONCURRENCE	FHWA CONCURRENCE
ROBERT M. DENNEY, P.E. Date Engineer Of Record 58593 HNTB CORPORATION 610 CRESCENT EXECUTIVE CT. SUITE 400 LAKE MARY, FL 32746 (407) 805-0355 CERT OF AUTH NO 6500	BERNIE MASING, P.E. Date FDOT District Design Engineer	FHWA Transportation Engineer Date

anmiller 1/16/2015 4:03:41 PM \\LKMw00\pmwork3\Jobs\59219 - I4 SAMR\TECHPROD\Typical Section Package\TYPDRD01.DGN

APPENDIX D

PAVEMENT DESIGN CALCULATIONS

TABLE A.4A

REQUIRED STRUCTURAL NUMBER (SN_R)
90% RELIABILITY (%R)
RESILIENT MODULUS (M_R) RANGE 4000 PSI TO 18000 PSI

RESILIENT MODULUS (M_R), (PSI x 1000)

M_R = 6.00

$ESAL_D$	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
100 000	3.02	2.77	2.59	2.44	2.31	2.21	2.12	2.04	1.97	1.91	1.86	1.81	1.76	1.72	1.68
150 000	3.23	2.97	2.77	2.61	2.47	2.36	2.27	2.19	2.11	2.05	1.99	1.94	1.89	1.84	1.80
200 000	3.39	3.11	2.90	2.73	2.60	2.48	2.38	2.30	2.22	2.15	2.09	2.03	1.98	1.94	1.89
250 000	3.52	3.23	3.01	2.84	2.69	2.57	2.47	2.38	2.30	2.23	2.17	2.11	2.06	2.01	1.97
300 000	3.62	3.33	3.10	2.92	2.78	2.65	2.55	2.46	2.37	2.30	2.24	2.18	2.12	2.07	2.03
350 000	3.71	3.41	3.18	3.00	2.85	2.72	2.61	2.52	2.44	2.36	2.30	2.23	2.18	2.13	2.08
400 000	3.79	3.49	3.25	3.07	2.91	2.78	2.67	2.58	2.49	2.42	2.35	2.29	2.23	2.18	2.13
450 000	3.87	3.56	3.32	3.13	2.97	2.84	2.73	2.63	2.54	2.46	2.39	2.33	2.27	2.22	2.17
500 000	3.93	3.62	3.38	3.18	3.02	2.89	2.77	2.67	2.59	2.51	2.44	2.37	2.31	2.26	2.21
600 000	4.05	3.73	3.48	3.28	3.12	2.98	2.86	2.76	2.67	2.58	2.51	2.45	2.39	2.33	2.28
700 000	4.14	3.82	3.57	3.36	3.20	3.05	2.93	2.83	2.73	2.65	2.58	2.51	2.45	2.39	2.34
800 000	4.23	3.90	3.64	3.44	3.27	3.12	3.00	2.89	2.80	2.71	2.63	2.57	2.50	2.44	2.39
900 000	4.31	3.97	3.71	3.51	3.33	3.18	3.06	2.95	2.85	2.76	2.69	2.62	2.55	2.49	2.44
1 000 000	4.38	4.04	3.78	3.57	3.39	3.24	3.11	3.00	2.90	2.81	2.73	2.66	2.60	2.54	2.48
1 500 000	4.65	4.30	4.03	3.81	3.62	3.46	3.33	3.21	3.10	3.01	2.92	2.85	2.78	2.71	2.65
2 000 000	4.85	4.50	4.21	3.99	3.79	3.63	3.49	3.36	3.25	3.16	3.07	2.99	2.91	2.85	2.78
2 500 000	5.01	4.65	4.36	4.13	3.93	3.76	3.62	3.49	3.38	3.27	3.18	3.10	3.02	2.95	2.89
3 000 000	5.14	4.77	4.48	4.25	4.05	3.88	3.73	3.60	3.48	3.37	3.28	3.19	3.12	3.04	2.98
3 500 000	5.25	4.88	4.59	4.35	4.14	3.97	3.82	3.69	3.57	3.46	3.36	3.28	3.20	3.12	3.06
4 000 000	5.35	4.98	4.68	4.44	4.23	4.06	3.90	3.77	3.65	3.54	3.44	3.35	3.27	3.19	3.12
4 500 000	5.44	5.06	4.76	4.52	4.31	4.13	3.98	3.84	3.72	3.61	3.51	3.42	3.33	3.26	3.19
5 000 000	5.52	5.14	4.83	4.59	4.38	4.20	4.04	3.90	3.78	3.67	3.57	3.47	3.39	3.31	3.24
6 000 000	5.66	5.27	4.96	4.71	4.50	4.32	4.16	4.02	3.89	3.78	3.67	3.58	3.49	3.41	3.34
7 000 000	5.78	5.38	5.07	4.82	4.61	4.42	4.26	4.12	3.99	3.87	3.77	3.67	3.58	3.50	3.43
8 000 000	5.88	5.48	5.17	4.91	4.70	4.51	4.35	4.20	4.07	3.95	3.85	3.75	3.66	3.58	3.50
9 000 000	5.97	5.57	5.26	5.00	4.78	4.59	4.43	4.28	4.15	4.03	3.92	3.82	3.73	3.65	3.57
10 000 000	6.06	5.65	5.33	5.07	4.85	4.66	4.50	4.35	4.22	4.10	3.99	3.89	3.79	3.71	3.63
15 000 000	6.39	5.97	5.64	5.37	5.14	4.95	4.77	4.62	4.48	4.36	4.25	4.14	4.05	3.96	3.88
20 000 000	6.63	6.20	5.86	5.59	5.35	5.15	4.98	4.82	4.68	4.55	4.44	4.33	4.23	4.14	4.06
25 000 000	6.82	6.38	6.04	5.76	5.52	5.32	5.14	4.98	4.84	4.71	4.59	4.48	4.38	4.29	4.20
30 000 000	6.98	6.53	6.18	5.90	5.66	5.45	5.27	5.11	4.96	4.83	4.71	4.60	4.50	4.41	4.32
35 000 000	7.12	6.66	6.31	6.02	5.78	5.57	5.38	5.22	5.07	4.94	4.82	4.71	4.61	4.51	4.42
40 000 000	7.24	6.78	6.42	6.13	5.88	5.67	5.48	5.32	5.17	5.04	4.91	4.80	4.70	4.60	4.51
45 000 000	7.34	6.88	6.52	6.22	5.97	5.76	5.57	5.41	5.26	5.12	5.00	4.88	4.78	4.68	4.59
50 000 000	7.44	6.97	6.61	6.31	6.06	5.84	5.65	5.49	5.34	5.20	5.07	4.96	4.85	4.76	4.66
60 000 000	7.61	7.13	6.76	6.46	6.21	5.99	5.79	5.62	5.47	5.33	5.21	5.09	4.98	4.88	4.79
70 000 000	7.76	7.27	6.90	6.59	6.33	6.11	5.91	5.74	5.59	5.45	5.32	5.20	5.09	4.99	4.90
80 000 000	7.88	7.40	7.01	6.70	6.44	6.22	6.02	5.85	5.69	5.55	5.42	5.30	5.19	5.09	4.99
90 000 000	8.00	7.51	7.12	6.80	6.54	6.31	6.11	5.94	5.78	5.64	5.51	5.39	5.28	5.17	5.08
100 000 000	8.10	7.60	7.21	6.90	6.63	6.40	6.20	6.02	5.86	5.72	5.59	5.47	5.35	5.25	5.15

$ESAL_D$ I-4 Mainline Shoulder = 1,009,410; SN_R = 3.78

$ESAL_D$ I-4 Mainline = 33,647,000; SN_R = 6.27

Pavement Design For New Pavement (Flexible)

Project: SR 400 (I-4) Mainline

Opening + 20 years = 2040

Given: $ESAL_D$ = 33,647,000 Traffic Level E page 2.5.0

M_R =6,000 psi

Assume a 90% reliability

1.0 From table 5.3 (or A.4A), the Structural Number Required (SN_R) = 6.27

2.0

SN_R	=	SN_C										
6.27	=	a_1	D_1	+	a_2	D_2	+	a_3	D_3	+	a_4	D_4
6.27	=	0	0.75	+	a_2	D_2	+	a_3	D_3	+	0.08	12
6.27	=		0.00	+	a_2	D_2	+	a_3	D_3	+		0.96
5.31	=				a_2	D_2	+	a_3	D_3			

3.0 With the following eqn. find the base group from table 5.9

5.31	=	a_2	D_2	+	a_3	D_3

Base group 12 yields a 7.00 inch structural course with an SN of 5.33

Note: the structural number found in table 5.9 must be slightly larger than the $a_2D_2 + a_3D_3$ ratio

4.0

Calculate the Structural number (SN_C), so that it is equal to or larger than SN_R.

Material	Thickness	Coefficient	SN_C	
Structural Course	7.00	0.44	3.08	see table 5.4
Base (OBG 12 - 12.5" LBR 100)	12.50	0.18	2.25	see table 5.6
Stabilization (LBR 40)	12.00	0.08	0.96	
Total thickness	31.50 inches		SN_C=	6.29

$SN_C \geq SN_R$

$6.29 \geq 6.27$

New Pavement Design (Modulus of Subgrade Reaction = 200) (Rigid)

REQUIRED DEPTH (D_R) FOR 90% RELIABILITY From table 3.2

ESAL 47,474,000

ESAL's (000) Depth Region: 1 Table E.3

47,500,000 **13"**

Table E-6 from the 2009 FDOT Rigid Pavement Design Manual - Based on MEPDG with Tied Concrete Shoulders

When an ashphalt shoulder is used, Mainline Slab thickness must be increased by 1/2" and a 14' wide slab used.

use: **13.5**

Pavement Design For New Pavement (Flexible)

Project: SR 400 (I-4) Mainline Shoulder

Opening Year 2020

Design Year 2040

Given: $ESAL_D$ = 1,009,410 Traffic Level B

M_R = 6,000 psi

Assume a 90% reliability

1.0 From table 5.3, the Structural Number Required (SN_R) = 3.78

2.0

SN_R	=	SN_C									
3.78	=	a_1	D_1	+	a_2	D_2	+	a_3	D_3	+	a_4 D_4
3.78	=	0	0.75	+	a_2	D_2	+	a_3	D_3	+	0.08 12
3.78	=	0.00		+	a_2	D_2	+	a_3	D_3	+	0.96
2.82	=				a_2	D_2	+	a_3	D_3		

3.0 With the following eqn. find the base group from table 5.9

2.82	=	a_2	D_2	+	a_3	D_3

Base group 9 yields a 2.50 inch structural course with an SN of 2.90

Note: the structural number found in table 5.9 must be slightly larger than the $a_2D_2 + a_3D_3$ ratio

4.0 Calculate the Structural number (SN_C), so that it is equal to or larger than SN_R.

Material	Thickness	Coefficient	SN_C	
Structural Course (Traffic Level B)	2.50	0.44	1.10	see table 5.4
Base (OBG 9 - 10" LBR 100)	10.00	0.18	1.80	see table 5.6
Stabilization (LBR 40)	12.00	0.08	0.96	

SN_C= 3.86

SN_C	≥	SN_R
3.86	≥	3.78

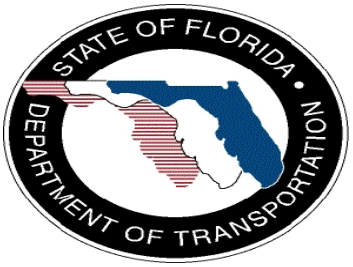
APPENDIX E

LIFE CYCLE COST ANALYSIS

FLORIDA DEPARTMENT OF TRANSPORTATION

PAVEMENT TYPE SELECTION SPREADSHEET
PROJECT DESCRIPTION:

Financial Project ID:	201210-2-22-01
State Road Number:	SR 400
County:	Polk
Project Length:	4.470 Miles
Roadway ID:	16320000
Begining MP:	
Ending MP:	
Transportation System:	
Type of Work	
Design Version	



201210-2-22-01				
LIST OF CONSTRUCTION ITEMS				
Pay Item	**Description**	**Mean Price**	**St. Deviation**	**Unit**
160 4	Type B Stabilized (LBR 40)	$3.25		Sq. Yd
285 7	OBG-1, Type B-12.5	$20.00		Sq. Yd
285 7	OBG-9	$16.00		Sq. Yd
285 7	OBG-12	$15.00		Sq. Yd
327 70	Milling 1" Avg. Depth	$2.00		Sq. Yd
327 70	Milling 3" Avg. Depth	$2.25		Sq. Yd
334 1	Type SP Traffic Level B	$85.00		Ton
334 1	Type SP Traffic Level E	$90.00		Ton
334 1	Type SP Traffic Level E PG76-22	$95.00		Ton
350 1	JPCP	$60.00		Sq. Yd
353 70	CPR - Slab Replacement (3%)	$450.00		Cu. Yd
353 70	CPR - Slab Replacement (5%)	$450.00		Cu. Yd
446 1	Edgedrain (Draincrete)	$25.00		Ft
446 71	Edgedrain Outlet Pipe (4 in)	$32.00		Ft

LIFE CYCLE COST ANALYSIS

JOINTED PLAIN CONCRETE PAVEMENT DESIGN (RIGID PAVEMENT)

Financial Project ID:201210-2-22-01, SR No.-SR 400, County:Polk

Project Length: 4.470 Miles, Roadway ID: 16320000

Begining MP: , Ending MP:

Definitions:

Length of Section:	5280	Ft			Analysis Period:	40	
Passing Lane Width:	12	Ft			Discount Rate:	3.5	
Travel Lane Width:	14	Ft			Initial Year of Construction:	2020	
Inside Shoulder Width:	22	Ft			No. of Passing Lanes:	3	
Outside Shoulder Width:	20	Ft			No. of Travel Lanes:	2	
Total Pavement Area:	675,840	Sq. Ft			No. of Travel Directions:	2	
Total Shoulder Area:	443,520	Sq. Ft	63,360	Long. Concrete Joints (Ft)	45,056	Trans. Concrete Joints (Ft)	

CONSTRUCTION ITEMS	THK.	QTY.	UNIT	UNIT PRICE	ST DEV	COST	PRESENT WORTH
INITIAL CONSTRUCTION IN YEAR:	**0**						
MAINLINE:							
JPCP	13.5	75,093.3	Sq. Yd	$60.00	$0.00	$4,505,600	$4,505,600
OBG-1, Type B-12.5	4	75,093.3	Sq. Yd	$20.00	$0.00	$1,501,867	$1,501,867
Type B Stabilized (LBR 40)	12	75,093.3	Sq. Yd	$3.25	$0.00	$244,053	$244,053
Edgedrain (Draincrete)	1	10,560.0	Ft	$25.00	$0.00	$264,000	$264,000
Edgedrain Outlet Pipe (4 in)	1	50.0	Ft	$32.00	$0.00	$1,600	$1,600
SHOULDER:							
Type SP Traffic Level B	2.5	6,699.0	Ton	$85.00	$0.00	$569,415	$569,415
OBG-9	10	49,280.0	Sq. Yd	$16.00	$0.00	$788,480	$788,480
Type B Stabilized (LBR 40)	12	49,280.0	Sq. Yd	$3.25	$0.00	$160,160	$160,160
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**23**						
MAINLINE:							
CPR - Slab Replacement (3%)	13.5	844.8	Cu. Yd	$450.00	$0.00	$380,160	$172,321
SHOULDER:							
Milling 1" Avg. Depth	1	49,280.0	Sq. Yd	$2.00	$0.00	$98,560	$44,676
Type SP Traffic Level B	1	2,679.6	Ton	$85.00	$0.00	$227,766	$103,243
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				

LIFE CYCLE COST ANALYSIS

JOINTED PLAIN CONCRETE PAVEMENT DESIGN (RIGID PAVEMENT)

Financial Project ID:201210-2-22-01, SR No.-SR 400, County:Polk

Project Length: 4.470 Miles, Roadway ID: 16320000

Begining MP: , Ending MP:

Definitions:

Length of Section:	5280	Ft		Analysis Period:	40
Passing Lane Width:	12	Ft		Discount Rate:	3.5
Travel Lane Width:	14	Ft		Initial Year of Construction:	2020
Inside Shoulder Width:	22	Ft		No. of Passing Lanes:	3
Outside Shoulder Width:	20	Ft		No. of Travel Lanes:	2
Total Pavement Area:	675,840	Sq. Ft		No. of Travel Directions:	2
Total Shoulder Area:	443,520	Sq. Ft	63,360 Long. Concrete Joints (Ft)	45,056	Trans. Concrete Joints (Ft)

CONSTRUCTION ITEMS	THK.	QTY.	UNIT	UNIT PRICE	ST DEV	COST	PRESENT WORTH
REHABILITATION IN YEAR:	**33**						
MAINLINE:							
CPR - Slab Replacement (5%)	13.5	1,408.0	Cu. Yd	$450.00	$0.00	$633,600	$203,603
SHOULDER:							
Milling 1" Avg. Depth	1	49,280.0	Sq. Yd	$2.00	$0.00	$98,560	$31,672
Type SP Traffic Level B	1	2,679.6	Ton	$85.00	$0.00	$227,766	$73,191
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**40**						
MAINLINE:							
SHOULDER:							
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:							

TOTAL INITIAL CONSTRUCTION COST (YEAR 2020):	$8,035,175
TOTAL PRESENT WORTH REHABILITATION COST:	$628,705
TOTAL PRESENT WORTH SALVAGE VALUE:	$0
PRESENT WORTH:	$8,663,880

LIFE CYCLE COST ANALYSIS

ASPHALT CONCRETE PAVEMENT DESIGN (FLEXIBLE PAVEMENT)

Financial Project ID:201210-2-22-01, SR No.-SR 400, County:Polk

Project Length: 4.470 Miles, Roadway ID: 16320000

Begining MP: , Ending MP:

Definitions:

Length of Section:	5280	Ft	Analysis Period:	40
Passing Lane Width:	12	Ft	Discount Rate:	3.5
Travel Lane Width:	12	Ft	Initial Year of Construction:	2020
Inside Shoulder Width:	22	Ft	No. of Passing Lanes:	5
Outside Shoulder Width:	24	Ft	No. of Travel Lanes:	
Total Pavement Area:	633,600	Sq. Ft	No. of Travel Directions:	2
Total Shoulder Area:	485,760	Sq. Ft		

CONSTRUCTION ITEMS	THK.	QTY.	UNIT	UNIT PRICE	ST DEV	COST	PRESENT WORTH
INITIAL CONSTRUCTION IN YEAR:	**0**						
MAINLINE:							
Type SP Traffic Level E PG76-22	2	7,656.0	Ton	$95.00	$0.00	$727,320	$727,320
Type SP Traffic Level E PG76-22	2	7,656.0	Ton	$95.00	$0.00	$727,320	$727,320
Type SP Traffic Level E	3	11,484.0	Ton	$90.00	$0.00	$1,033,560	$1,033,560
OBG-12	12.5	70,400.0	Sq. Yd	$15.00	$0.00	$1,056,000	$1,056,000
Type B Stabilized (LBR 40)	12	70,400.0	Sq. Yd	$3.25	$0.00	$228,800	$228,800
SHOULDER:							
Type SP Traffic Level B	2.5	7,337.0	Ton	$85.00	$0.00	$623,645	$623,645
OBG-9	10	53,973.3	Sq. Yd	$16.00	$0.00	$863,573	$863,573
Type B Stabilized (LBR 40)	12	53,973.3	Sq. Yd	$3.25	$0.00	$175,413	$175,413
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**13**						
MAINLINE:							
Milling 3" Avg. Depth	3	70,400.0	Sq. Yd	$2.25	$0.00	$158,400	$101,282
Type SP Traffic Level E PG76-22	4	15,312.0	Ton	$95.00	$0.00	$1,454,640	$930,103
SHOULDER:							
Milling 1" Avg. Depth	1	53,973.3	Sq. Yd	$2.00	$0.00	$107,947	$69,022
Type SP Traffic Level B	1	2,934.8	Ton	$85.00	$0.00	$249,458	$159,504
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				

LIFE CYCLE COST ANALYSIS

ASPHALT CONCRETE PAVEMENT DESIGN (FLEXIBLE PAVEMENT)

Financial Project ID:201210-2-22-01, SR No.-SR 400, County:Polk

Project Length: 4.470 Miles, Roadway ID: 16320000

Begining MP: , Ending MP:

Definitions:

Length of Section:	5280	Ft	Analysis Period:	40
Passing Lane Width:	12	Ft	Discount Rate:	3.5
Travel Lane Width:	12	Ft	Initial Year of Construction:	2020
Inside Shoulder Width:	22	Ft	No. of Passing Lanes:	5
Outside Shoulder Width:	24	Ft	No. of Travel Lanes:	
Total Pavement Area:	633,600	Sq. Ft	No. of Travel Directions:	2
Total Shoulder Area:	485,760	Sq. Ft		

CONSTRUCTION ITEMS	THK.	QTY.	UNIT	UNIT PRICE	ST DEV	COST	PRESENT WORTH
REHABILITATION IN YEAR:	**26**						
MAINLINE:							
Milling 3" Avg. Depth	3	70,400.0	Sq. Yd	$2.25	$0.00	$158,400	$64,760
Type SP Traffic Level E PG76-22	4	15,312.0	Ton	$95.00	$0.00	$1,454,640	$594,712
SHOULDER:							
Milling 1" Avg. Depth	1	53,973.3	Sq. Yd	$2.00	$0.00	$107,947	$44,133
Type SP Traffic Level B	1	2,934.8	Ton	$85.00	$0.00	$249,458	$101,988
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**39**						
MAINLINE:							
Milling 3" Avg. Depth	3	70,400.0	Sq. Yd	$2.25	$0.00	$158,400	$41,408
Type SP Traffic Level E PG76-22	4	15,312.0	Ton	$95.00	$0.00	$1,454,640	$380,261
SHOULDER:							
Milling 1" Avg. Depth	1	53,973.3	Sq. Yd	$2.00	$0.00	$107,947	$28,219
Type SP Traffic Level B	1	2,934.8	Ton	$85.00	$0.00	$249,458	$65,211
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**52**						

TOTAL INITIAL CONSTRUCTION COST (YEAR 2020):	$5,435,632
TOTAL PRESENT WORTH REHABILITATION COST:	$2,580,601
TOTAL PRESENT WORTH SALVAGE VALUE:	$459,397
PRESENT WORTH:	$7,556,836

FLORIDA DEPARTMENT OF TRANSPORTATION
PAVEMENT TYPE SELECTION
ECONOMIC ANALYSIS
COST PER MILE

Analysis Period: 40 Years Discount Rate: 3.5%

PCC PAVEMENT

		Cost		P / F		PRESENT WORTH
	Initial	$8,035,175	*	1.00000	=	$8,035,175
23	Year	$706,486	*	0.45329	=	$320,240
33	Year	$959,926	*	0.32134	=	$308,465
40	Year		*		=	
	Year					
				TOTAL AGENCY COSTS	=	**$8,663,880**
				USER COSTS	=	
		Remaining Service Life		**PW of Last Rehab at Year 40**		
SALVAGE VALUE		0 / 7	*	$242,451	=	**$0**
				TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$8,663,880**

AC PAVEMENT

		Cost		P / F		PRESENT WORTH
	Initial	$5,435,632	*	1.00000	=	$5,435,632
13	Year	$1,970,445	*	0.63940	=	$1,259,911
26	Year	$1,970,445	*	0.40884	=	$805,592
39	Year	$1,970,445	*	0.26141	=	$515,099
52	Year					
				TOTAL AGENCY COSTS	=	**$8,016,233**
				USER COSTS	=	
		Remaining Service Life		**PW of Last Rehab at Year 40**		
SALVAGE VALUE		12 / 13	*	$497,680	=	**$459,397**
				TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$7,556,836**

COST COMPARISON

DIFFERENCE IN TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$1,107,044**
AVERAGE TOTAL PRESENT WORTH	=	**$8,110,358**
PERCENT DIFFERENCE IN TOTAL PRESENT WORTH	=	**13.6%**
DIFFERENCE IN ESTIMATED INITIAL COSTS	=	**$2,599,543**
PERCENT DIFFERENCE IN ESTIMATED INITIAL COSTS	=	**47.8%**
TOTAL PRESENT WORTH COST OF REHAB FOR PCC PAVEMENT	=	**$628,705**
TOTAL PRESENT WORTH COST OF REHAB FOR AC PAVEMENT	=	**$2,580,601**
DIFFERENCE IN TOTAL PRESENT WORTH OF REHAB COSTS (LCCF)	=	**$1,951,896**

APPENDIX F

PAVEMENT PERFORMANCE DATA

Rehabilitation Age by Year

For Polk County
07AUG2014
Other Conditions: Pavement= Asphalt
Surface Type in (FC2, FC5)

Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2007	65.9	14.0	1.6
2008	23.6	8.7	1.6
2009	38.7	12.0	3.4
2010	109.7	15.8	1.9
2011	34.2	14.4	2.9
2012	77.1	12.8	3.6
2013	54.6	12.8	2.6
2014	51.9	14.4	2.1

Rehabilitation Age by Year

For Osceola County
22JAN2015
Other Conditions: Pavement= Asphalt

Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2007	30.5	14.5	4.2
2008	138.4	10.6	3.2
2009	66.0	12.3	3.3
2010	5.1	15.0	0.0
2011	4.2	14.0	0.0
2012	23.4	13.7	2.2
2013	20.0	15.6	0.5

Rehabilitation Age by Year

For Orange County
22JAN2015
Other Conditions: Pavement= Asphalt

Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2007	196.8	15.1	6.6
2008	177.4	10.0	3.2
2009	229.9	12.3	7.7
2010	142.5	16.0	10.1
2011	67.4	15.9	6.8
2012	122.2	11.7	3.1
2013	60.2	12.0	5.6
2014	56.6	10.6	6.3

13JUN2012

Deficient Rehabilitation age by Year

For Hillsborough County

Other Conditions: Pavement= Concrete

Surface Type in (CONC)

Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2006	10.8	20	0
2007	26.7	25	0
2008	9.3	22	0

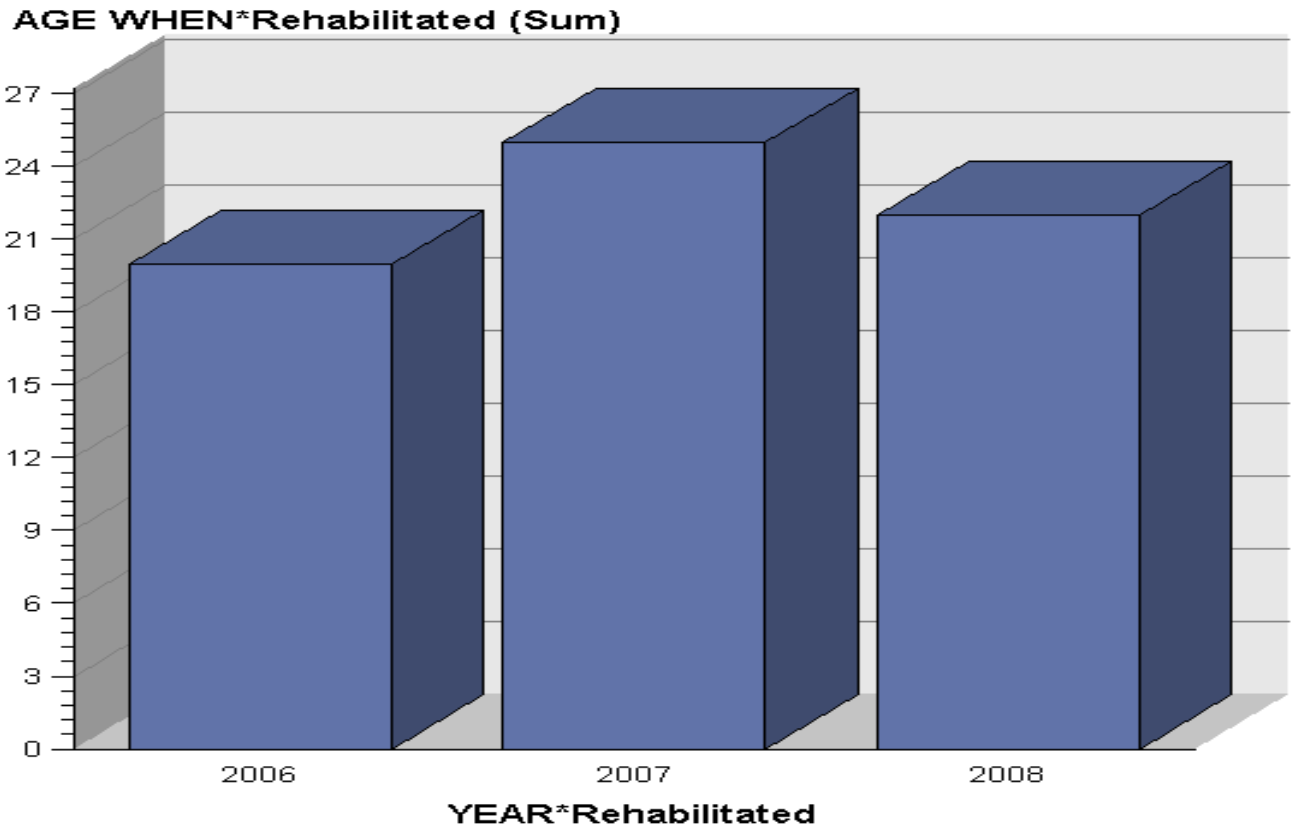
13JUN2012

Deficient Rehabilitation age by Year

For Hillsborough County

Other Conditions: Pavement= Concrete

Surface Type in (CONC)



Rehabilitation Age by Year

For Orange County
22JAN2015
Other Conditions: Pavement= Concrete
Surface Type in (CONC)

Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2008	9.3	26	0

APPENDIX G

QUALITY CONTROL CHECKLIST

PAVEMENT TYPE SELECTION

QUALITY CONTROL CHECKLIST

	Satisfactory Yes / No
Project Description	Yes
Financial Project ID / Annual Report	Yes
State Road No	Yes
County	Yes
Project Length	Yes
Transportation System	Yes
Flexible Pavement Design	
ESAL	Yes
Level of Reliability	Yes
Initial Design Period	Yes
Structural Number	Yes
Friction Course	Yes
Structural Thickness	Yes
Base Thickness	Yes
Number of Through Lanes	Yes
Lane Width	Yes
Shoulder Width	Yes
Rigid Pavement Design	
ESAL	Yes
Level of Reliability	Yes
Initial Design Period	Yes
Thickness	Yes

Base Thickness.....	Yes
Base Type.....	Yes
Number of Through Lanes.....	Yes
Lane Width.....	Yes
Shoulder Width.....	Yes
Design Method (AASHTO 1993 or MEPDG).....	Yes

PROJECT MILE ESTIMATES

Initial

Mainline Quantities.....	Yes
Shoulder Quantities.....	Yes
Unit Prices Reasonable.....	Yes

Rehabilitation

Mainline Quantities.....	Yes
Shoulder Quantities.....	Yes
Unit Prices Reasonable.....	Yes

Reviewer Signature

1/29/15
Date