FDOT

SR 400 (I-4) Project Development and Environment (PD&E) Study
FM No.: 432100-1-22-01

Pavement Type Selection Report

Segment 2: SR 528 (Beachline Expressway) to SR 435 (Kirkman Road) - Orange County, Florida

April 18, 2014

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

4 EXPRESS

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Contract Number:
Financial ID Number: 432100-1-22-01
Federal Aid Project Number: 0041 227 1

Prepared For
Florida Department of Transportation
District 5
DeLand, Florida

April 18, 2014

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

Prepared by:

Robert Denney, PE — Date
PE No. 58593 — 4/18/2014

HNTB CORPORATION
610 Crescent Executive Ct, Suite 400
Lake Mary, Florida 32746
(407) 805-0355
CA No.: 6500

Concurrence by:

Annette K. Brennan, PE — Date
District Design Engineer, District 5

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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 Ultimate 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 three systems interchanges.

The SR 400 (I-4) Project Development and Environment (PD&E) Study is a reevaluation project which addresses the revision from the original design concept showing two High Occupancy Vehicle (HOV) lanes, as recommended in the Environmental Impact Statement (EIS) for I-4 from SR 528 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) and shoulders in each direction, with provision for a 44' rail corridor in the center median from 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) PD&E project limits include a total of approximately 41 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 US 27 in Polk County to west of SR 435 (Kirkman Road) in Orange County and for the east section, from 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	CR 532 (Osceola/Polk County Line) to W. of SR 528 (Beachline Expressway) in Osceola and Orange Counties (13.5 miles)
Segment 2	W. of SR 528 (Beachline Expressway) to W. of SR 435 (Kirkman Road) in Orange County (3.6 miles)
Segment 5	US 27 to CR 532 (Osceola/Polk County Line) in Polk County (3.2 miles)
SR 400 (I-4) PD&E East Section	
Segment 3	E. of SR 434 to E. of US 17/92 in Seminole County (10.2 miles)
Segment 4	E. of US 17/92 to E. of SR 472 in Volusia County (10.1 miles)

The majority of the proposed improvements (37.4 miles) are within District 5 and a small segment (3.2 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 2 (West of SR 528 to West of SR 435) in Orange 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 2 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)*. Based on this memo, truck traffic percentages for the Segment 2 corridor range from 4.60 to 5.40 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 5.40% 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	216,100
Mid-Design Year	2030	227,300
Design Year	2040	238,400

The 18-KIP ESAL for the roadway is 19,472,000 for flexible pavement and 27,469,000 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.

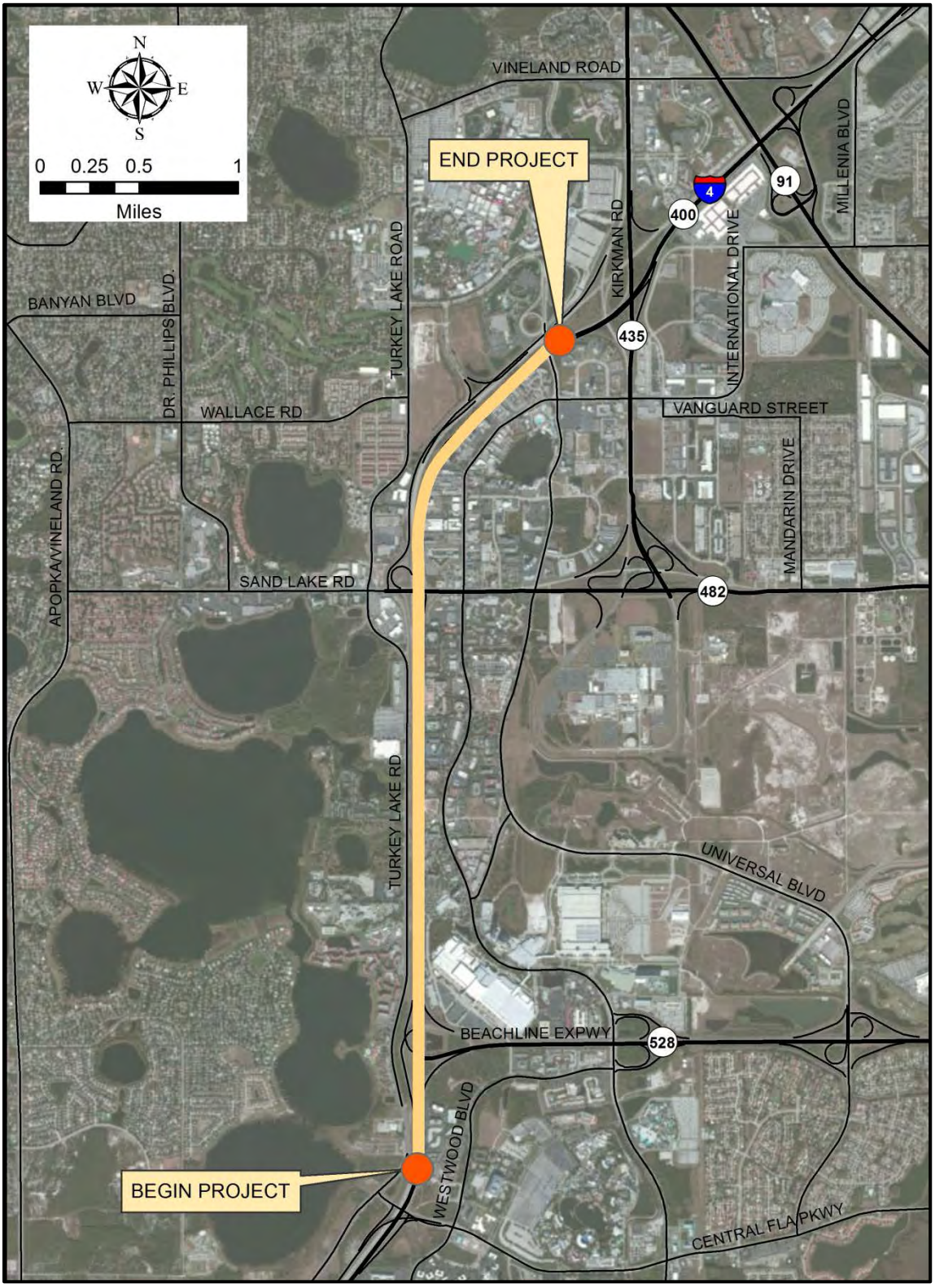


Figure 1: Project Location Map

2.2 Soil Characteristics

At the time of the writing of this report, the only geotechnical data available for the study area was from the report titled: *Final 30 Percent Geotechnical Report for Roadway SR 400 (I-4) From South of SR 435 (Kirkman Road) to South of SR 500/600 (Orange Blossom Trail), FPID: 242484-3-52-01*, which covers the I-4 Ultimate Section located immediately north of the I-4, Segment 2 project. The report included results of Limerock Bearing Ratio (LBR) testing on twenty four soil samples obtained at depths of 0.0 to 1.5 feet below the existing grade adjacent to existing flexible pavement and proposed pond areas in the study corridor. The recommended LBR value for pavement design was 25. Using an LBR of 25 yields a corresponding roadway embankment resilient modulus (M_R) of 8,750 psi. These values were used in preparing the PTSR for the I-4, Segment 2 project. The geotechnical engineering evaluation memo prepared for the S.R. 400 (I-4), FPID: 242484-3-52-01 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 Manual (October 2013)* for concrete pavement and from supporting data for lifecycles of asphalt pavement in Orange 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 = 10 feet, Outside Shoulder Width=12 feet
SUL: Inside Shoulder Width = 4 feet, Outside Shoulder Width=10 feet
Note: GUL = general use lane, SUL = special use lane

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 Orange County. Using the Mechanistic-Empirical Pavement Design Guide (MEPDG) Design Tables, the slab thickness should be 12".

Rigid Pavement Design Parameters
18-KIP ESAL=27,469,000
Modulus of Subgrade Reaction (K_G)=200 pci
Reliability (%R)=90%

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

Shoulder
1.5" Type SP Structural Course (Traffic B)
Optional Base Group 7 (8.5" 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=19,472,000 (Traffic Level D)
18-KIP ESAL for shoulders=3% of mainline=584,160 (Traffic Level B)
Resilient Modulus (M_R)=8,750 psi
Reliability (%R)=90%

Mainline
SN_R =5.18
0.75" Friction Course FC-5 (PG76-22) (Not included in the Life Cycle Cost Analysis)
2" Type SP Structural Course (Traffic D) (PG76-22)
3" Type SP Structural Course (Traffic D)
Optional Base Group 11 (12" Limerock, LBR 100)
12" Type B Stabilization
SN_C =5.32

Shoulder
SN_R=3.00
1.5" Type SP Structural Course (Traffic B)
Optional Base Group 7 (8.5" LBR 100)
12" Type B Stabilization
SN_C=3.15

3.3 Cost Data for Economic Analysis

The unit prices used for this economic analysis are weighted averages obtained from FDOT's statewide item average unit costs from 12/01/2012 to 11/30/2013 and, from D5 estimates, where available. The unit costs used are provided in Appendix E 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	$9.14	Sq. Yd
OBG-7	$16.21	Sq. Yd
OBG-11	$12.71	Sq. Yd
Milling - 1" Avg. Depth	$2.08	Sq. Yd
Milling - 3" Avg. Depth	$2.00	Sq. Yd
Type SP Traffic Level B	$85.00	Ton
Type SP Traffic Level D	$85.00	Ton
Type SP Traffic Level D PG76-22	$92.00	Ton
JPCP	$55.00	Sq. Yd
CPR - Slab Replacement (3%)	$400.00	Cu. Yd
CPR - Slab Replacement (5%)	$400.00	Cu. Yd
Edgedrain (Draincrete)	$26.72	Ft
Edgedrain Outlet Pipe (4 in)	$30.68	Ft
Source: FDOT, 12 month moving statewide averages and FDOT-D5 estimates.		

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 for concrete pavement is $6,827,147 and for flexible pavement, $5,528,097. 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 the I-4 Segment 2 section 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 FC-2 flexible pavements in Orange County was reviewed. The average age to rehabilitation over the last 7 years in Orange County ranged from 12 years to 16.9 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.

Table 4: Pavement Type Selection Economic Analysis

Concrete Pavement

			Cost		P / F		PRESENT WORTH
	Initial	2020	$6,335,199	*	1.00000	=	$6,335,199
23	Year	2043	$552,006	*	0.45329	=	$250,217
33	Year	2053	$752,255	*	0.32134	=	$241,732
					TOTAL AGENCY COSTS	=	**$6,827,147**
					USER COSTS	=	**N/A**
					SALVAGE VALUE	=	**N/A**
					TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$6,827,147**

Asphalt Pavement

			Cost		P / F		PRESENT WORTH
	Initial	2020	$3,918,908	*	1.00000	=	$3,918,908
13	Year	2036	$1,974,227	*	0.63940	=	$1,262,329
26	Year	2052	$1,974,227	*	0.40884	=	$807,138
					TOTAL AGENCY COSTS	=	**$5,988,376**
					USER COSTS	=	**N/A**
					SALVAGE VALUE	=	**$460,279**
					TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$5,528,097**

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 concrete pavement section has been in service for approximately 50 years and has undergone two major rehabilitations. Other concrete pavement sections in the Central Florida region were reviewed, including the average age to rehabilitation for concrete pavement in 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 2 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 west of Segment 2, is currently being evaluated for pavement type selection as part of the SR 400 (I-4) PD&E 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 District 5 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 Recoginition 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 19%. Therefore, it is recommended that asphalt pavement be considered as the pavement type for the SR 400 (I-4) Segment 2 corridor.

APPENDICES

APPENDIX A

TRAFFIC INFORMATION

FLORIDA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION STATISTICS OFFICE
2012 HISTORICAL AADT REPORT

COUNTY: 75 - ORANGE

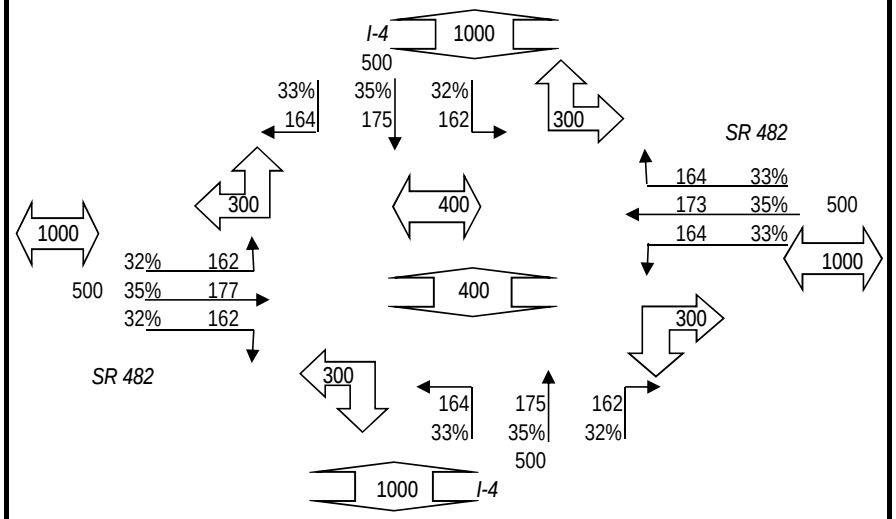
SITE: 0130 - SR-400/I-4,0.8 MI S OF SR-482,ORANGE CO.

YEAR	AADT	DIRECTION 1	DIRECTION 2	*K FACTOR	D FACTOR	T FACTOR
2012	164143 C	E 82326	W 81817	8.00	51.20	5.40
2011	164367 C	E 81773	W 82594	8.00	51.30	5.40
2010	163974 C	E 80710	W 83264	7.45	52.11	5.40
2009	157791 C	E 77642	W 80149	7.69	51.21	5.30
2008	159918 C	E 78729	W 81189	7.69	51.21	6.00
2007	166481 C	E 81799	W 84682	7.38	51.70	6.20
2006	168961 C	E 83131	W 85830	7.30	50.67	6.40
2005	167592 C	E 82263	W 85329	7.30	50.70	6.40
2004	161637 C	E 79364	W 82273	7.60	51.00	6.20
2003	155582 C	E 76136	W 79446	8.50	53.20	5.40
2002	142158 C	E 69814	W 72344	8.60	54.70	8.90
2001	139805 C	E 68167	W 71638	9.60	55.10	11.00
2000	143280 C	E 70466	W 72814	7.00	51.50	3.50
1999	141075 C	E 69902	W 71173	10.00	57.50	5.00
1998	137216 C	E 68656	W 68560	7.20	51.30	4.80
1997	131453 C	E 65641	W 65812	9.90	54.60	3.10

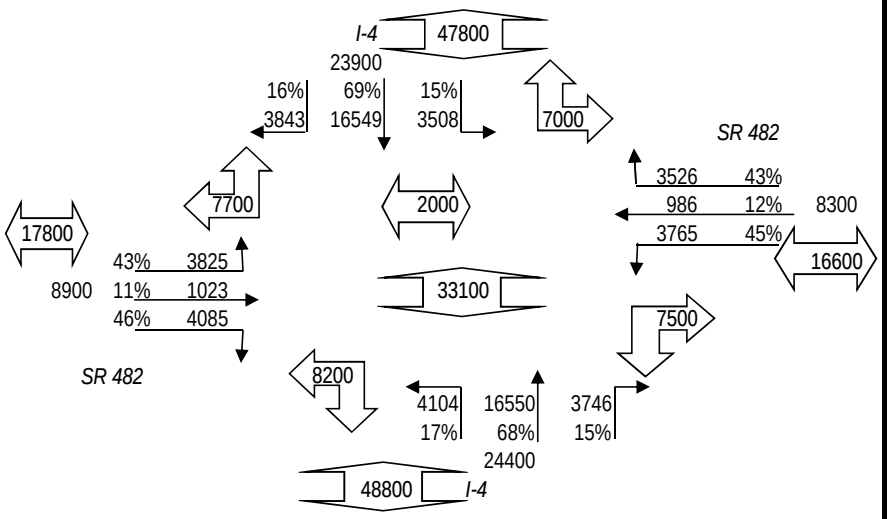
AADT FLAGS: C = COMPUTED; E = MANUAL ESTIMATE; F = FIRST YEAR ESTIMATE
S = SECOND YEAR ESTIMATE; T = THIRD YEAR ESTIMATE; X = UNKNOWN
*K FACTOR: STARTING WITH YEAR 2011 IS STANDARDK, PRIOR YEARS ARE K30 VALUES

PROJECT TRAFFIC FOR I-4 AT SR 482: TO

2-WAY AADT TURNING MOVEMENTS IN YEAR 2011



2-WAY AADT TURNING MOVEMENTS IN YEAR 2013



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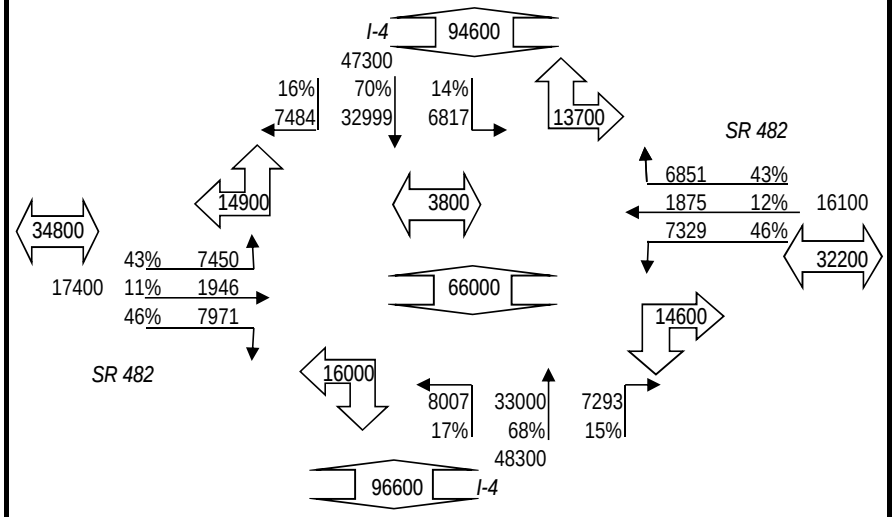
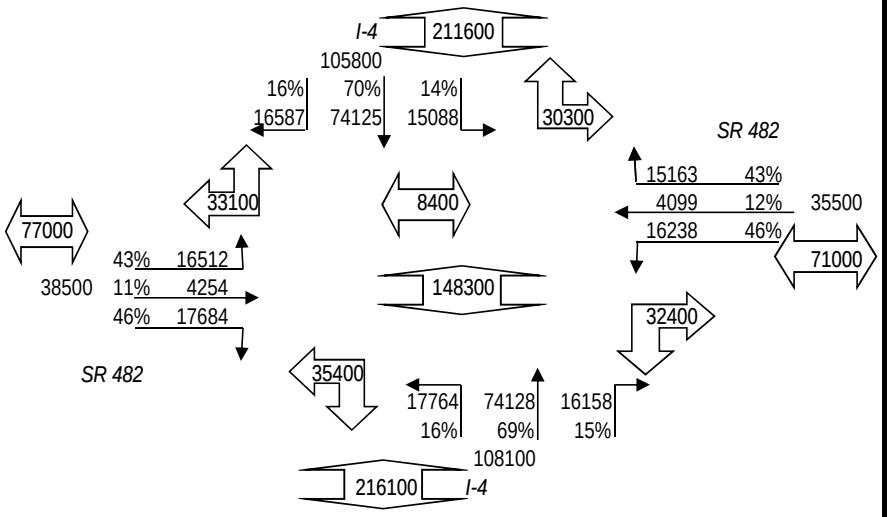
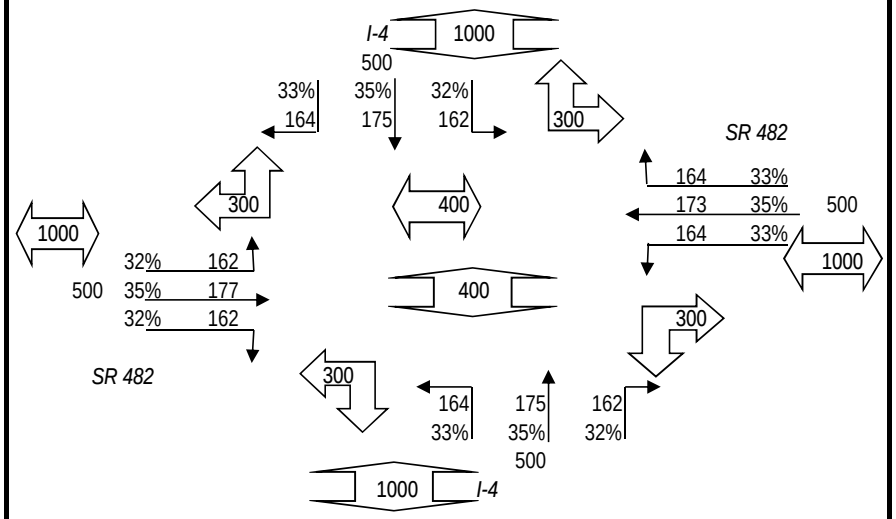


2-WAY AADT TURNING MOVEMENTS IN YEAR 2020

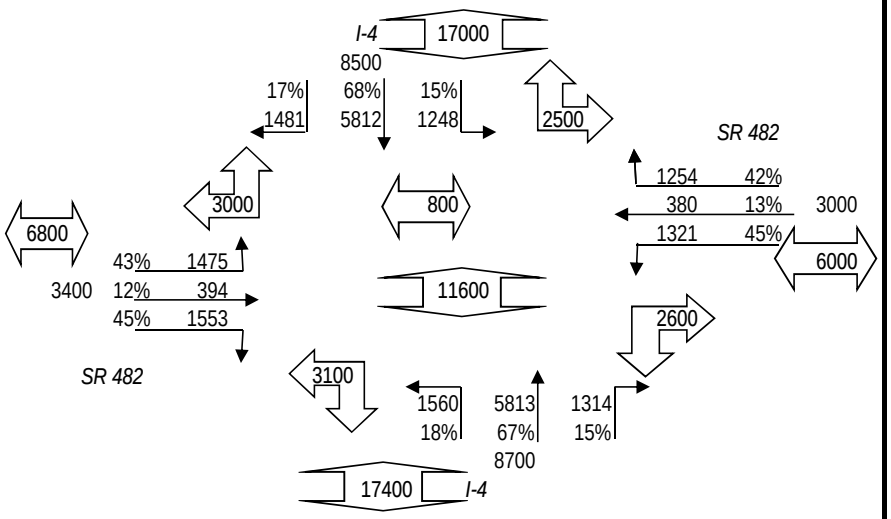


PROJECT TRAFFIC FOR I-4 AT SR 482: TO

2-WAY AADT TURNING MOVEMENTS IN YEAR 2011



2-WAY AADT TURNING MOVEMENTS IN YEAR 2013



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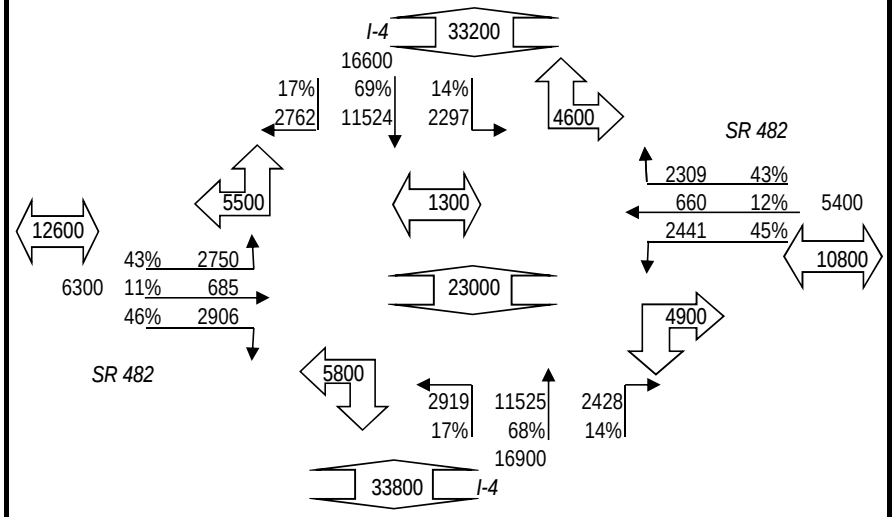
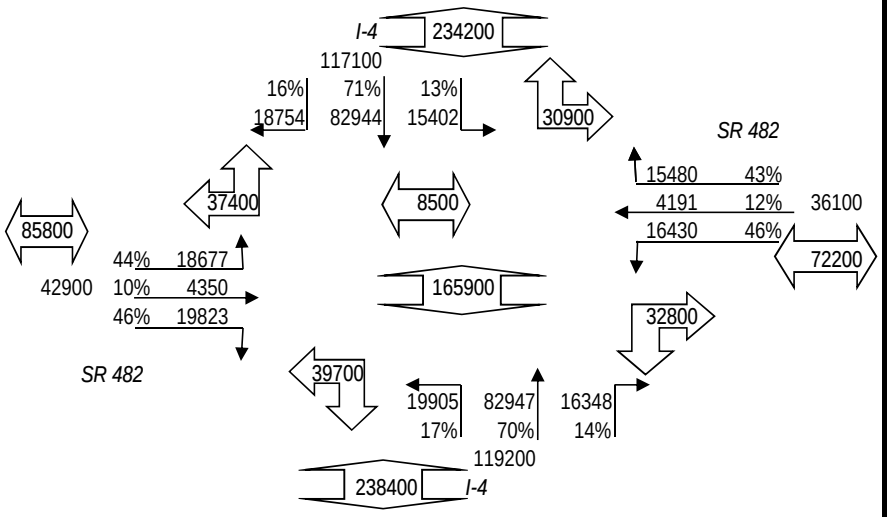


2-WAY AADT TURNING MOVEMENTS IN YEAR 2040



18 kip EQUIVALENT SINGLE AXLE LOAD ANALYSIS

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

SECTION #: 75280000
SEGMENT #: ML
ITEM #: 0
PROJECT DESCRIPTION: SR 400 (I-4) - S. of SR 482 (Sand Lake Rd.)

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	164367
Opening Year	2020	216100
Mid-Design Year	2030	227300
Design Year	2040	238400

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

T24 values
Existing to Opening Year: 5.40%
Opening to Mid-Year: 5.40%
Mid-Year to Design-Year: 5.40%

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.

Prepared by: HNTB — 610 Crescent Executive Ct, Suite 400, Lake Mary, FL 32746 — Robert Denney, PE — 2/12/2014
Org. Unit or Firm — Name — Date

Signature

Reviewed by: Mark Robinson, PE — District 5 Design — FDOT - D5
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 #: 75280000 **SEGMENT #:** ML **ITEM #:** 0

RIGID PAVEMENT URBAN FREEWAY 1.270

SN=12/THICK SR 400 (I-4) - S. of SR 482 (Sand Lake Rd.) C

YEAR	AADT	ESAL (1000S)	ACCUM (1000s)	D	T	LF	EF
2011	164300	1046	0	0.5	5.40%	0.509	1.270
2012	170100	1077	0	0.5	5.40%	0.506	1.270
2013	175800	1107	0	0.5	5.40%	0.503	1.270
2014	181600	1138	0	0.5	5.40%	0.500	1.270
2015	187300	1167	0	0.5	5.40%	0.498	1.270
2016	193100	1197	0	0.5	5.40%	0.495	1.270
2017	198800	1227	0	0.5	5.40%	0.493	1.270
2018	204600	1256	0	0.5	5.40%	0.490	1.270
2019	210300	1285	0	0.5	5.40%	0.488	1.270
2020	216100	1315	1315	0.5	5.40%	0.486	1.270
2021	217200	1320	2635	0.5	5.40%	0.486	1.270
2022	218300	1326	3961	0.5	5.40%	0.485	1.270
2023	219400	1331	5292	0.5	5.40%	0.485	1.270
2024	220500	1337	6629	0.5	5.40%	0.484	1.270
2025	221700	1343	7972	0.5	5.40%	0.484	1.270
2026	222800	1349	9321	0.5	5.40%	0.483	1.270
2027	223900	1354	10675	0.5	5.40%	0.483	1.270
2028	225000	1360	12035	0.5	5.40%	0.483	1.270
2029	226100	1365	13400	0.5	5.40%	0.482	1.270
2030	227300	1371	14771	0.5	5.40%	0.482	1.270
2031	228400	1377	16148	0.5	5.40%	0.481	1.270
2032	229500	1382	17530	0.5	5.40%	0.481	1.270
2033	230600	1388	18918	0.5	5.40%	0.481	1.270
2034	231700	1393	20311	0.5	5.40%	0.480	1.270
2035	232800	1399	21710	0.5	5.40%	0.480	1.270
2036	233900	1404	23114	0.5	5.40%	0.479	1.270
2037	235000	1409	24523	0.5	5.40%	0.479	1.270
2038	236100	1415	25938	0.5	5.40%	0.479	1.270
2039	237200	1420	27358	0.5	5.40%	0.478	1.270
2040	238400	1426	28784	0.5	5.40%	0.478	1.270

Opening to Mid-Design Year ESAL Accumulation (1000s): 13456

Opening to Design Year ESAL Accumulation (1000s): 27469

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.

610 Crescent Executive Ct, Suite 400

Prepared by: HNTB Lake Mary, FL 32746 Robert Denney, PE 2/12/2014

Org. Unit or Firm Name Date

Signature

Reviewed by: Mark Robinson, PE District 5 Design FDOT - D5

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 #: 75280000 **SEGMENT #:** ML **ITEM #:** 0

FLEXIBLE PAVEMENT URBAN FREEWAY 0.900

SN=5/THICK SR 400 (I-4) - S. of SR 482 (Sand Lake Rd.) C

YEAR	AADT	ESAL (1000S)	ACCUM (1000s)	D	T	LF	EF
2011	164300	742	0	0.5	5.40%	0.509	0.900
2012	170100	763	0	0.5	5.40%	0.506	0.900
2013	175800	785	0	0.5	5.40%	0.503	0.900
2014	181600	806	0	0.5	5.40%	0.500	0.900
2015	187300	827	0	0.5	5.40%	0.498	0.900
2016	193100	849	0	0.5	5.40%	0.495	0.900
2017	198800	870	0	0.5	5.40%	0.493	0.900
2018	204600	891	0	0.5	5.40%	0.490	0.900
2019	210300	911	0	0.5	5.40%	0.488	0.900
2020	216100	932	932	0.5	5.40%	0.486	0.900
2021	217200	936	1868	0.5	5.40%	0.486	0.900
2022	218300	940	2808	0.5	5.40%	0.485	0.900
2023	219400	944	3752	0.5	5.40%	0.485	0.900
2024	220500	948	4700	0.5	5.40%	0.484	0.900
2025	221700	952	5652	0.5	5.40%	0.484	0.900
2026	222800	956	6608	0.5	5.40%	0.483	0.900
2027	223900	960	7568	0.5	5.40%	0.483	0.900
2028	225000	964	8532	0.5	5.40%	0.483	0.900
2029	226100	968	9500	0.5	5.40%	0.482	0.900
2030	227300	972	10472	0.5	5.40%	0.482	0.900
2031	228400	976	11448	0.5	5.40%	0.481	0.900
2032	229500	980	12428	0.5	5.40%	0.481	0.900
2033	230600	983	13411	0.5	5.40%	0.481	0.900
2034	231700	987	14398	0.5	5.40%	0.480	0.900
2035	232800	991	15389	0.5	5.40%	0.480	0.900
2036	233900	995	16384	0.5	5.40%	0.479	0.900
2037	235000	999	17383	0.5	5.40%	0.479	0.900
2038	236100	1003	18386	0.5	5.40%	0.479	0.900
2039	237200	1007	19393	0.5	5.40%	0.478	0.900
2040	238400	1011	20404	0.5	5.40%	0.478	0.900

Opening to Mid-Design Year ESAL Accumulation (1000s): 9540

Opening to Design Year ESAL Accumulation (1000s): 19472

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.

Prepared by: HNTB — 610 Crescent Executive Ct, Suite 400, Lake Mary, FL 32746 — Robert Denney, PE — 2/12/2014

Org. Unit or Firm — Name — Date

Signature

Reviewed by: Mark Robinson, PE — District 5 Design — FDOT - D5

Name — Title — Org.Unit or Firm — Date

Signature

APPENDIX B

GEOTECHNICAL INFORMATION

Geotechnical Professional Associates, Inc.
GPA
Geotechnical & Environmental Consultants

December 9, 2003
File No.: 03-1010

Kimley-Horn & Associates, Inc.
Design Division
4431 Embarcadero Drive
West Palm Beach, Florida 33407

Attention: Murray D. Thornburg, Jr. P.E.

Subject: Design LBR Results
State Road 400 (Interstate 4)
From South of S.R. 435 (Kirkman Road)
to South of S.R. 500/600 (Orange Blossom Trail)
Orange County, Florida
FIN No.: 242484-3-32-01

Dear Mr. Thornburg:

As requested and authorized, we have completed design LBR calculations for the S.R. 400 project referenced above. The purpose of performing these analyses was to provide data for pavement design. This letter documents our findings and presents our engineering recommendations.

A total of 24 LBR tests were performed on selected bulk soil samples in accordance with the Florida Method of Tests for Limerock Bearing Ratios, designation FM-5-515. The samples were obtained at depths ranging from 0.0 to 1.5 feet below the existing grade adjacent to existing flexible pavement areas and from within proposed pond areas.

The design LBR value was calculated using the results of the LBR tests. Samples were obtained only for the proposed road as of this date. Results for all 24 LBR tests are presented in the following table.

	Roadway LBR Samples (1 - 24)
Mean Method	30
90% Method	32

Copies of the design LBR calculations are attached. LBR tests were conducted on near surface sandy soils. It should be noted that the majority of the pavement section will be placed on fill and that the actual LBR values of final embankment and/or subgrade soils may vary with the fill source. Therefore, we recommend using an LBR value of 25 for the pavement

5780 Hoffner Avenue • Suite 403
Orlando, Florida 32822
(407) 275-5959 FAX: (407) 275-5129

It has been a pleasure assisting you with this phase of the project. If you have any questions, or when we may be of further assistance to you, please do not hesitate to contact us.

Sincerely,
GEOTECHNICAL PROFESSIONAL ASSOCIATES, INC.

Brendan S. O'Brien. P.E.
Senior Project Engineer
Florida Registration No. 52047

Shelley B. Gisclar, P.E.
President

BSO/SBG/ks
\\Front\main c\2003 Projects\03-1010 I-4 Improvements\LBRs\LBR des let.wpd

cc: Mr. Carl Jones - Fla. Dept. Of Transportation - District V

APPENDIX C

TYPICAL SECTION

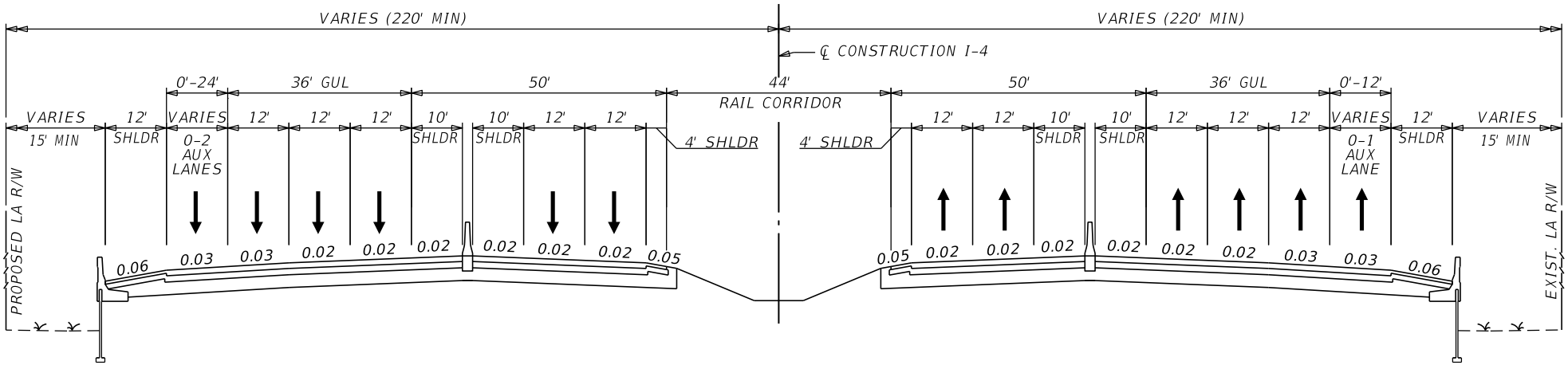
PROJECT IDENTIFICATION

FINANCIAL PROJECT ID 432100-1-22-01 FEDERAL AID PROJECT NO. N/A COUNTY NAME ORANGE

SECTION NO. 75820 ROAD DESIGNATION I-4 (SR 400) LIMITS/MILEPOST MP 5.650 - 9.249

PROJECT DESCRIPTION I-4 WIDENING FROM WEST OF SR 528 TO WEST OF KIRKMAN ROAD.

PROPOSED ROADWAY TYPICAL SECTION



TYPICAL SECTION
SR 400 (INTERSTATE 4)
MP 5.650 TO 5.990 (ORANGE COUNTY)
(STA. 1345+48.48 TO STA. 1363+42.85)

DESIGN SPEED = 70 MPH

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	ANNETTE K. BRENNAN, P.E. Date FDOT District Design Engineer	FHWA Transportation Engineer Date

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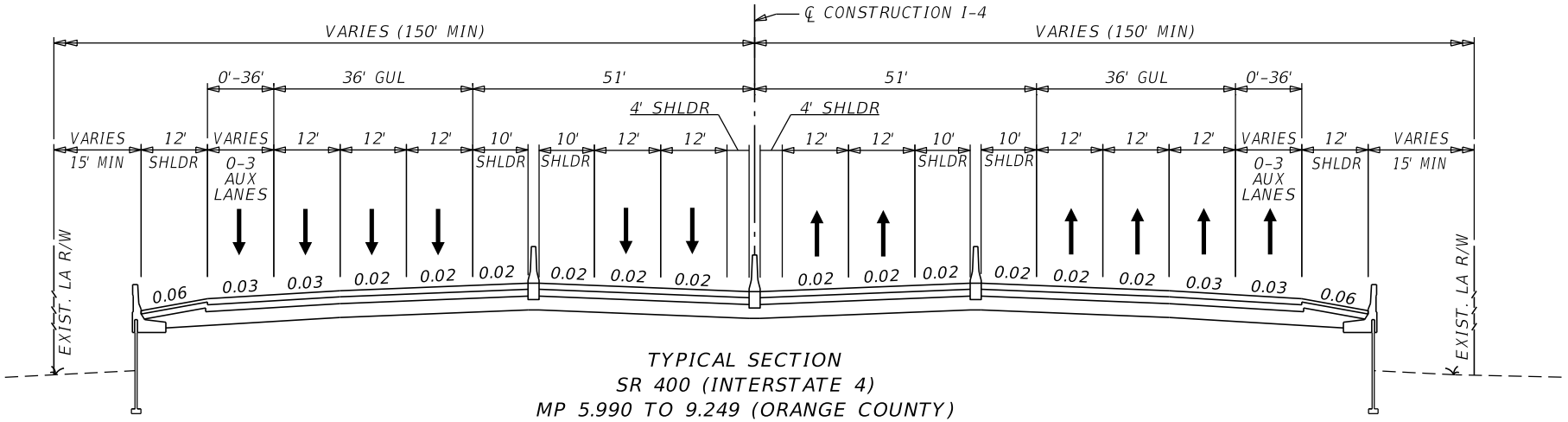
PROJECT IDENTIFICATION

FINANCIAL PROJECT ID 432100-1-22-01 FEDERAL AID PROJECT NO. N/A COUNTY NAME ORANGE

SECTION NO. 75820 ROAD DESIGNATION I-4 (SR 400) LIMITS/MILEPOST MP 5.650 - 9.249

PROJECT DESCRIPTION I-4 WIDENING FROM WEST OF SR 528 TO WEST OF KIRKMAN ROAD.

PROPOSED ROADWAY TYPICAL SECTION



TYPICAL SECTION
SR 400 (INTERSTATE 4)
MP 5.990 TO 9.249 (ORANGE COUNTY)
(STA. 1363+42.85 TO STA. 1550+23.13)

DESIGN SPEED = 70 MPH

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	ANNETTE K. BRENNAN, P.E. Date FDOT District Design Engineer	FHWA Transportation Engineer Date

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APPENDIX D

PAVEMENT DESIGN CALCULATIONS

Pavement Design For New Pavement (Flexible)

Project: SR 400 (I-4) Mainline

Opening + 20 years =

Given: $ESAL_D$ = 19,472,000 — Traffic Level D

M_R = 8,750 psi

Assume a 90% reliability

1.0 From table 5.3, the Structural Number Required (SN_R) = 5.18

2.0

SN_R	=	SN_C										
5.18	=	a_1	D_1	+	a_2	D_2	+	a_3	D_3	+	a_4	D_4
5.18	=	0	0.75	+	a_2	D_2	+	a_3	D_3	+	0.08	12
5.18	=		0.00	+	a_2	D_2	+	a_3	D_3	+		0.96
4.22	=				a_2	D_2	+	a_3	D_3			

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

4.22	=	a_2	D_2	+	a_3	D_3

Base group 11 yields a 5.00 inch structural course with an SN of 4.27

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	5.00	0.44	2.20	see table 5.4
Base (OBG 11 - 12" Limerock - LBR 100)	12.00	0.18	2.16	see table 5.6
Stabilization (LBR 40)	12.00	0.08	0.96	
Total thickness	29.00 inches	SN_C=	5.32	

$SN_C \geq SN_R$

$5.32 \geq 5.18$

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

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

ESAL 27,469,000

ESAL's	Depth	Region: 2 Table E.3
27,500,000	11.5"	Table E-7 from the 2009 FDOT Rigid Pavement Design Manual - Based on MEPDG with Tied Concrete Shoulders

use: **12"**

For Ashpalt Shoulders: When designing with MEPDG tables, Mainline Slab thickness must be increased by 1/2" and a 14' slab used

Pavement Design For New Pavement (Flexible)

Project: SR 400 (I-4) Mainline Shoulder

Opening Year 2020

Design Year 2040

Given: $ESAL_D$ = 584,160 Traffic Level B

M_R = 8,750 psi

Assume a 90% reliability

1.0 From table 5.3, the Structural Number Required (SN_R) = 3.00

2.0

SN_R	=	SN_C										
3.00	=	a_1	D_1	+	a_2	D_2	+	a_3	D_3	+	a_4	D_4
3.00	=	0	0.75	+	a_2	D_2	+	a_3	D_3	+	0.08	12
3.00	=	0.00		+	a_2	D_2	+	a_3	D_3	+	0.96	
2.04	=				a_2	D_2	+	a_3	D_3			

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

2.04	=	a_2	D_2	+	a_3	D_3

Base group 7 yields a 1.50 inch structural course with an SN of 2.10

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)	1.50	0.44	0.66	see table 5.4
Base (OBG 7- LBR 100)	8.50	0.18	1.53	see table 5.6
Stabilization (LBR 40)	12.00	0.08	0.96	

SN_C= 3.15

$SN_C \geq SN_R$

3.15 ≥ 3.00

APPENDIX E

LIFE CYCLE COST ANALYSIS

FLORIDA DEPARTMENT OF TRANSPORTATION

PAVEMENT TYPE SELECTION SPREADSHEET
PROJECT DESCRIPTION:

Financial Project ID:	Rural Limited Access 4-Lane Divided
State Road Number:	SR 400
County:	Orange
Project Length:	3.6 Miles
Roadway ID:	75280000
Begining MP:	
Ending MP:	
Transportation System:	
Type of Work	
Design Version	

Rural Limited Access 4-Lane Divided				
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	$9.14		Sq. Yd
285 7	OBG-7	$16.21		Sq. Yd
285 7	OBG-11	$12.71		Sq. Yd
327 70	Milling - 1" Avg. Depth	$2.08		Sq. Yd
327 70	Milling - 3" Avg. Depth	$2.00		Sq. Yd
334 1	Type SP Traffic Level B	$85.00		Ton
334 1	Type SP Traffic Level D	$85.00		Ton
334 1	Type SP Traffic Level D PG76-22	$92.00		Ton
350 1	JPCP	$55.00		Sq. Yd
353 70	CPR - Slab Replacement (3%)	$400.00		Cu. Yd
353 70	CPR - Slab Replacement (5%)	$400.00		Cu. Yd
446 1	Edgedrain (Draincrete)	$26.72		Ft
446 71	Edgedrain Outlet Pipe (4 in)	$30.68		Ft

LIFE CYCLE COST ANALYSIS

JOINTED PLAIN CONCRETE PAVEMENT DESIGN (RIGID PAVEMENT)

Financial Project ID:Rural Limited Access 4-Lane Divided, SR No.-SR 400, County:Orange

Project Length: 3.6 Miles, Roadway ID: 75280000

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:	14	Ft			No. of Passing Lanes:	3	
Outside Shoulder Width:	18	Ft			No. of Travel Lanes:	2	
Total Pavement Area:	675,840	Sq. Ft			No. of Travel Directions:	2	
Total Shoulder Area:	337,920	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	12	75,093.3	Sq. Yd	$55.00	$0.00	$4,130,133	$4,130,133
OBG-1, Type B-12.5	4	75,093.3	Sq. Yd	$9.14	$0.00	$686,353	$686,353
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	$26.72	$0.00	$282,163	$282,163
Edgedrain Outlet Pipe (4 in)	1	50.0	Ft	$30.68	$0.00	$1,534	$1,534
SHOULDER:							
Type SP Traffic Level B	1.5	3,062.4	Ton	$85.00	$0.00	$260,304	$260,304
OBG-7	8.5	37,546.7	Sq. Yd	$16.21	$0.00	$608,631	$608,631
Type B Stabilized (LBR 40)	12	37,546.7	Sq. Yd	$3.25	$0.00	$122,027	$122,027
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**23**						
MAINLINE:							
CPR - Slab Replacement (3%)	12	750.9	Cu. Yd	$400.00	$0.00	$300,373	$136,155
SHOULDER:							
Milling - 1" Avg. Depth	1	37,546.7	Sq. Yd	$2.08	$0.00	$78,097	$35,400
Type SP Traffic Level B	1	2,041.6	Ton	$85.00	$0.00	$173,536	$78,661
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				

LIFE CYCLE COST ANALYSIS

JOINTED PLAIN CONCRETE PAVEMENT DESIGN (RIGID PAVEMENT)

Financial Project ID:Rural Limited Access 4-Lane Divided, SR No.-SR 400, County:Orange

Project Length: 3.6 Miles, Roadway ID: 75280000

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:	14	Ft			No. of Passing Lanes:	3	
Outside Shoulder Width:	18	Ft			No. of Travel Lanes:	2	
Total Pavement Area:	675,840	Sq. Ft			No. of Travel Directions:	2	
Total Shoulder Area:	337,920	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%)	12	1,251.6	Cu. Yd	$400.00	$0.00	$500,622	$160,871
SHOULDER:							
Milling - 1" Avg. Depth	1	37,546.7	Sq. Yd	$2.08	$0.00	$78,097	$25,096
Type SP Traffic Level B	1	2,041.6	Ton	$85.00	$0.00	$173,536	$55,765
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):	$6,335,199
TOTAL PRESENT WORTH REHABILITATION COST:	$491,948
TOTAL PRESENT WORTH SALVAGE VALUE:	$0
PRESENT WORTH:	$6,827,147

LIFE CYCLE COST ANALYSIS

ASPHALT CONCRETE PAVEMENT DESIGN (FLEXIBLE PAVEMENT)

Financial Project ID:Rural Limited Access 4-Lane Divided, SR No.-SR 400, County:Orange

Project Length: 3.6 Miles, Roadway ID: 75280000

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:	14	Ft	No. of Passing Lanes:	5
Outside Shoulder Width:	22	Ft	No. of Travel Lanes:	
Total Pavement Area:	633,600	Sq. Ft	No. of Travel Directions:	2
Total Shoulder Area:	380,160	Sq. Ft		

CONSTRUCTION ITEMS	THK.	QTY.	UNIT	UNIT PRICE	ST DEV	COST	PRESENT WORTH
INITIAL CONSTRUCTION IN YEAR:	**0**						
MAINLINE:							
Type SP Traffic Level D PG76-22	2	7,656.0	Ton	$92.00	$0.00	$704,352	$704,352
Type SP Traffic Level D	3	11,484.0	Ton	$85.00	$0.00	$976,140	$976,140
OBG-11	12	70,400.0	Sq. Yd	$12.71	$0.00	$894,784	$894,784
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	1.5	3,445.2	Ton	$85.00	$0.00	$292,842	$292,842
OBG-7	8.5	42,240.0	Sq. Yd	$16.21	$0.00	$684,710	$684,710
Type B Stabilized (LBR 40)	12	42,240.0	Sq. Yd	$3.25	$0.00	$137,280	$137,280
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**13**						
MAINLINE:							
Milling - 3" Avg. Depth	3	70,400.0	Sq. Yd	$2.00	$0.00	$140,800	$90,028
Type SP Traffic Level D PG76-22	2	7,656.0	Ton	$92.00	$0.00	$704,352	$450,366
Type SP Traffic Level D	2	7,656.0	Ton	$85.00	$0.00	$650,760	$416,099
SHOULDER:							
Milling - 1" Avg. Depth	1	42,240.0	Sq. Yd	$2.08	$0.00	$87,859	$56,178
Type SP Traffic Level B	2	4,593.6	Ton	$85.00	$0.00	$390,456	$249,659
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				

LIFE CYCLE COST ANALYSIS

ASPHALT CONCRETE PAVEMENT DESIGN (FLEXIBLE PAVEMENT)

Financial Project ID:Rural Limited Access 4-Lane Divided, SR No.-SR 400, County:Orange

Project Length: 3.6 Miles, Roadway ID: 75280000

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:	14	Ft	No. of Passing Lanes:	5
Outside Shoulder Width:	22	Ft	No. of Travel Lanes:	
Total Pavement Area:	633,600	Sq. Ft	No. of Travel Directions:	2
Total Shoulder Area:	380,160	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	$2.00	$0.00	$140,800	$57,564
Type SP Traffic Level D PG76-22	2	7,656.0	Ton	$92.00	$0.00	$704,352	$287,966
Type SP Traffic Level D	2	7,656.0	Ton	$85.00	$0.00	$650,760	$266,055
SHOULDER:							
Milling - 1" Avg. Depth	1	42,240.0	Sq. Yd	$2.08	$0.00	$87,859	$35,920
Type SP Traffic Level B	2	4,593.6	Ton	$85.00	$0.00	$390,456	$159,633
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**39**						
MAINLINE:							
SHOULDER:							
DESIGN COSTS:			Subtotal				
MOT COSTS:			Subtotal				
CEI COSTS:			Subtotal				
REHABILITATION IN YEAR:	**52**						

TOTAL INITIAL CONSTRUCTION COST (YEAR 2020):	$3,918,908
TOTAL PRESENT WORTH REHABILITATION COST:	$2,069,468
TOTAL PRESENT WORTH SALVAGE VALUE:	$0
PRESENT WORTH:	$5,988,376

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	$6,335,199	*	1.00000	=	$6,335,199
23	Year	$552,006	*	0.45329	=	$250,217
33	Year	$752,255	*	0.32134	=	$241,732
40	Year		*		=	
	Year					
				TOTAL AGENCY COSTS	=	**$6,827,147**
				USER COSTS	=	
		Remaining Service Life		**PW of Last Rehab at Year 40**		
SALVAGE VALUE		0 / 7	*	$189,999	=	**$0**
				TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$6,827,147**

AC PAVEMENT

		Cost		P / F		PRESENT WORTH
	Initial	$3,918,908	*	1.00000	=	$3,918,908
13	Year	$1,974,227	*	0.63940	=	$1,262,329
26	Year	$1,974,227	*	0.40884	=	$807,138
39	Year		*		=	
52	Year					
				TOTAL AGENCY COSTS	=	**$5,988,376**
				USER COSTS	=	
		Remaining Service Life		**PW of Last Rehab at Year 40**		
SALVAGE VALUE		12 / 13	*	$498,635	=	**$460,279**
				TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$5,528,097**

COST COMPARISON

DIFFERENCE IN TOTAL PRESENT WORTH LIFE-CYCLE COSTS	=	**$1,299,050**
AVERAGE TOTAL PRESENT WORTH	=	**$6,177,622**
PERCENT DIFFERENCE IN TOTAL PRESENT WORTH	=	**21.0%**
DIFFERENCE IN ESTIMATED INITIAL COSTS	=	**$2,416,291**
PERCENT DIFFERENCE IN ESTIMATED INITIAL COSTS	=	**61.7%**
TOTAL PRESENT WORTH COST OF REHAB FOR PCC PAVEMENT	=	**$491,948**
TOTAL PRESENT WORTH COST OF REHAB FOR AC PAVEMENT	=	**$2,069,468**
DIFFERENCE IN TOTAL PRESENT WORTH OF REHAB COSTS (LCCF)	=	**$1,577,519**

Florida Department of Transportation
Item Average Unit Cost
From 2012/12/01 to 2013/11/30

Contract Type: CC STATEWIDE
Displaying: VALID ITEMS WITH HITS
From: 0102 1 To: 9999999

Item	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
0120 72	3	$78.08	$56,452.28	723.000	CY	N	GRAVEL FILL
0120 74	1	$10.00	$3,000.00	300.000	CY	N	SURCHARGE EMBANKMENT
0121 70	25	$117.27	$1,068,258.55	9,109.320	CY	N	FLOWABLE FILL
0125 1	6	$45.35	$746,136.64	16,453.000	CY	N	EXCAVATION FOR STRUCTURES
0125 3	1	$24.00	$12,192.00	508.000	CY	N	SELECT BEDDING MATERIAL
0142 70	1	$8.00	$244,776.00	30,597.000	CY	N	FILL SAND
0145 1	1	$2.80	$34,034.00	12,155.000	SF	N	GEOSYNTHETIC REINFORCED SOIL SLOPE
0145 2	5	$2.40	$229,567.54	95,489.000	SY	N	GEOSYNTHETIC REINF FND OVER SOFT SOIL
0145 71	4	$4.51	$114,157.00	25,289.000	SY	N	REINFORCEMENT GRID FOR SOIL STABILIZAT
0145 72	1	$36.00	$68,256.00	1,896.000	SY	N	CELLULAR CONFINEMENT FOR SOIL STABILIZAT
0160 4	91	$2.90	$9,209,039.24	3,175,666.600	SY	N	TYPE B STABILIZATION
0162 1 11	54	$.78	$1,392,783.57	1,789,858.900	SY	N	PREPARED SOIL LAYER, FINISH SOIL, 6"
0162 1 12	3	$6.73	$192,723.16	28,643.000	SY	N	PREPARED SOIL LAYER, FINISH SOIL, 12"
0162 1 33	2	$6.47	$19,914.72	3,078.000	SY	N	PREPARED SOIL LAYER, BLANKET, SPECIAL
0210 1 1	3	$.84	$15,497.22	18,428.000	SY	N	REWORKING LIMEROCK BASE, 6"
0210 1 8	1	$5.25	$7,612.50	1,450.000	SY	N	REWORKING LIMEROCK BASE, 4"
0210 1 9	2	$5.11	$27,265.79	5,330.600	SY	N	REWORKING LIMEROCK BASE, 3"
0210 2	3	$28.00	$25,730.61	919.000	CY	N	LIMEROCK-NEW MATERIAL FOR REWORKING BASE
0285701	61	$9.14	$2,552,912.05	279,227.300	SY	N	OPTIONAL BASE,BASE GROUP 01
0285702	9	$8.33	$1,098,688.77	131,946.000	SY	N	OPTIONAL BASE,BASE GROUP 02
0285703	4	$20.07	$424,418.92	21,145.000	SY	N	OPTIONAL BASE,BASE GROUP 03
0285704	20	$9.90	$3,108,391.62	313,968.600	SY	N	OPTIONAL BASE,BASE GROUP 04
0285705	6	$9.54	$314,141.27	32,932.500	SY	N	OPTIONAL BASE,BASE GROUP 05
0285706	21	$17.21	$2,161,346.02	125,594.000	SY	N	OPTIONAL BASE,BASE GROUP 06
0285707	7	$16.21	$588,736.20	36,314.000	SY	N	OPTIONAL BASE,BASE GROUP 07
0285708	4	$17.29	$128,881.10	7,454.000	SY	N	OPTIONAL BASE,BASE GROUP 08
0285709	50	$15.13	$9,050,910.62	598,203.000	SY	N	OPTIONAL BASE,BASE GROUP 09
0285710	15	$13.17	$3,215,051.65	244,208.000	SY	N	OPTIONAL BASE,BASE GROUP 10
0285711	16	$12.71	$9,097,582.24	715,591.000	SY	N	OPTIONAL BASE,BASE GROUP 11
0285712	11	$14.58	$3,604,357.56	247,243.000	SY	N	OPTIONAL BASE,BASE GROUP 12
0285713	9	$42.16	$1,412,490.07	33,504.000	SY	N	OPTIONAL BASE,BASE GROUP 13
0285714	1	$92.00	$69,828.00	759.000	SY	N	OPTIONAL BASE,BASE GROUP 14
0285715	19	$53.08	$7,900,891.59	148,858.500	SY	N	OPTIONAL BASE,BASE GROUP 15
0286 1	29	$11.55	$1,088,300.79	94,231.600	SY	N	TURNOUT CONSTRUCTION
0286 2	4	$136.00	$79,340.30	583.400	TN	N	TURNOUT CONSTRUCTION-ASPHALT
0287 1	1	$160.00	$929,600.00	5,810.000	CY	N	ASPHALT TREATED PERMEABLE BASE
0288001	1	$800.00	$357,600.00	447.000	CY	N	CEMENT TREATED PERMEABLE BASE
0327 70 1	62	$2.08	$3,371,283.27	1,620,037.000	SY	N	MILLING EXIST ASPH PAVT, 1" AVG DEPTH
0327 70 2	12	$2.15	$1,100,398.61	510,977.000	SY	N	MILLING EXIST ASPH PAVT,3 1/2" AVG DEPTH
0327 70 3	1	$6.25	$2,406.25	385.000	SY	N	MILLING EXIST ASPH PAVT,4 1/2" AVG DEPTH

Florida Department of Transportation
Item Average Unit Cost
From 2012/12/01 to 2013/11/30

Contract Type: CC STATEWIDE
Displaying: VALID ITEMS WITH HITS
From: 0102 1 To: 9999999

Item	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
0327 70 4	24	$2.00	$1,947,084.86	974,402.000	SY	N	MILLING EXIST ASPH PAVT, 3" AVG DEPTH
0327 70 5	38	$2.20	$4,209,995.91	1,909,682.000	SY	N	MILLING EXIST ASPH PAVT, 2" AVG DEPTH
0327 70 6	68	$1.65	$4,167,009.98	2,526,141.640	SY	N	MILLING EXIST ASPH PAVT,1 1/2" AVG DEPTH
0327 70 7	6	$3.81	$542,965.39	142,401.100	SY	N	MILLING EXIST ASPH PAVT, 4" AVG DEPTH
0327 70 8	24	$2.02	$2,160,405.76	1,071,764.000	SY	N	MILLING EXIST ASPH PAVT,2 1/2" AVG DEPTH
0327 70 11	19	$1.80	$3,095,293.95	1,720,353.000	SY	N	MILLING EXIST ASPH PAVT,2 1/4" AVG DEPTH
0327 70 12	8	$1.55	$186,218.46	119,866.000	SY	N	MILLING EXIST ASPH PAVT,1 1/4" AVG DEPTH
0327 70 13	19	$2.16	$1,287,118.40	596,456.000	SY	N	MILLING EXIST ASPH PAVT,1 3/4" AVG DEPTH
0327 70 15	17	$1.47	$2,178,084.95	1,479,418.000	SY	N	MILLING EXIST ASPH PAVT,2 3/4" AVG DEPTH
0327 70 16	7	$1.48	$172,079.97	116,349.000	SY	N	MILLING EXIST ASPH PAVT, 1/2" AVG DEPTH
0327 70 17	5	$1.99	$1,190,474.38	598,791.000	SY	N	MILLING EXIST ASPH PAVT,3 1/4" AVG DEPTH
0327 70 19	26	$1.48	$1,285,958.40	868,739.000	SY	N	MILLING EXIST ASPH PAVT, 3/4" AVG DEPTH
0327 70 20	4	$1.59	$319,032.36	200,917.000	SY	N	MILLING EXIST ASPH PAVT,3 3/4" AVG DEPTH
0327 70 21	1	$8.00	$8,632.00	1,079.000	SY	N	MILLING EXIST ASPH PAVT, 7" AVG DEPTH
0327 70 22	2	$2.46	$22,249.15	9,061.000	SY	N	MILLING EXIST ASPH PAVT,4 1/4" AVG DEPT
0327 70 23	1	$7.45	$72,607.70	9,746.000	SY	N	MILLING EXIST ASPH PAVT, 6" AVG DEPTH
0327 70 26	2	$3.16	$51,215.01	16,197.000	SY	N	MILLING EXIST ASPH PAVT,4 3/4" AVG DEPTH
0327 70 30	1	$4.28	$64,957.56	15,177.000	SY	N	MILLING EXIST ASPH PAVT,11.5" AVG DEPTH
0334 1 11	14	$88.05	$1,338,400.29	15,200.090	TN	N	SUPERPAVE ASPHALTIC CONC, TRAFFIC A
0334 1 12	27	$80.30	$8,576,078.27	106,796.970	TN	N	SUPERPAVE ASPHALTIC CONC, TRAFFIC B
0334 1 13	69	$82.87	$58,366,261.83	704,300.840	TN	N	SUPERPAVE ASPHALTIC CONC, TRAFFIC C
0334 1 14	8	$81.94	$7,867,076.97	96,009.700	TN	N	SUPERPAVE ASPHALTIC CONC, TRAFFIC D
0334 1 22	16	$87.73	$7,363,169.34	83,927.400	TN	N	SUPERPAVE ASPH CONC, TRAF B, PG76-22,PMA
0334 1 23	26	$88.47	$27,114,100.74	306,488.300	TN	N	SUPERPAVE ASPH CONC, TRAF C, PG76-22,PMA
0334 1 24	21	$89.64	$24,005,122.54	267,782.500	TN	N	SUPERPAVE ASPH CONC, TRAF D, PG76-22,PMA
0334 1 25	4	$82.67	$10,920,063.68	132,085.500	TN	N	SUPERPAVE ASPH CONC, TRAF E, PG76-22,PMA
0337 7 22	34	$119.11	$27,297,969.19	229,174.300	TN	N	ASPH CONC FC,INC BIT,FC-5,PG76-22,PMA
0337 7 24	2	$148.15	$925,548.50	6,247.300	TN	N	ASPH CONC FC, FC-5, PG 76-22, ARB
0337 7 40	14	$101.64	$3,797,296.10	37,360.000	TN	N	ASPH CONC FC,TRAFFIC B,FC-9.5,PG 76-22
0337 7 41	1	$83.08	$537,344.82	6,467.800	TN	N	ASPH CONC FC,TRAFFIC B,FC-12.5,PG 76-22
0337 7 42	8	$98.37	$6,188,539.15	62,912.000	TN	N	ASPH CONC FC,TRAFFIC C,FC-9.5,PG 76-22
0337 7 43	21	$99.46	$7,312,815.97	73,523.400	TN	N	ASPH CONC FC,TRAFFIC C,FC-12.5,PG 76-22
0337 7 45	7	$107.65	$1,426,399.09	13,250.000	TN	N	ASPH CONC FC,TRAFFIC D,FC-12.5,PG 76-22
0337 7 71	1	$115.00	$324,340.25	2,820.350	TN	N	ASPH CONC FC,TRAF B,FC-9.5,PG 76-22, ARB
0337 7 73	5	$94.89	$1,466,351.62	15,453.670	TN	N	ASPH CONC FC,TRAF C,FC-9.5,PG 76-22, ARB
0337 7 74	2	$96.73	$3,465,324.27	35,824.300	TN	N	ASPH CONC FC,TRAF C,FC-12.5,PG 76-22,ARB
0339 1	89	$160.05	$3,314,504.33	20,709.140	TN	N	MISCELLANEOUS ASPHALT PAVEMENT
0341 70	4	$6.01	$445,994.48	74,192.000	SY	N	ASPHALT RUBBER MEMBRANE INTERLAYER
0350 1 1	1	$50.00	$18,150.00	363.000	SY	N	PLAIN CEMENT CONC PAVT, 6"
0350 1 3	1	$55.00	$861,465.00	15,663.000	SY	N	PLAIN CEMENT CONC PAVT, 8"

Florida Department of Transportation
Item Average Unit Cost
From 2012/12/01 to 2013/11/30

Contract Type: CC STATEWIDE
Displaying: VALID ITEMS WITH HITS
From: 0102 1 To: 9999999

Item	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
0431 1 1	5	$106.03	$302,918.35	2,857.000	LF	N	PIPE LINER, OPTIONAL MATERIAL, 0-24"
0431 1 2	2	$146.39	$43,624.00	298.000	LF	N	PIPE LINER, OPTIONAL MATERIAL, 25-36"
0431 1 3	1	$275.00	$215,325.00	783.000	LF	N	PIPE LINER, OPTIONAL MATERIAL, 37-48"
0432 3 7	1	$3,000.00	$3,000.00	1.000	EA	N	CHEM GROUT REPAIR, PIPE,NON-TEST,42"
0433 1	1	$780.00	$35,880.00	46.000	EA	N	CHEM GROUT REPAIR, MANHOLE / INLET
0436 1 1	10	$144.83	$235,178.54	1,623.850	LF	N	TRENCH DRAIN, STANDARD
0440 1 10	1	$33.03	$40,759.02	1,234.000	LF	N	UNDERDRAIN, TYPE I
0440 1 20	5	$24.10	$209,565.63	8,694.000	LF	N	UNDERDRAIN, TYPE II
0440 1 50	1	$40.00	$10,400.00	260.000	LF	N	UNDERDRAIN, TYPE V
0440 1 60	1	$94.50	$10,395.00	110.000	LF	N	UNDERDRAIN, TYPE SPECIAL
0440 70	3	$1,181.27	$30,712.90	26.000	EA	N	UNDERDRAIN INSPECTION BOX
0440 73 1	3	$40.55	$4,744.04	117.000	LF	N	UNDERDRAIN OUTLET PIPE, 4"
0440 73 2	3	$18.46	$16,296.61	883.000	LF	N	UNDERDRAIN OUTLET PIPE, 6"
0440 73 3	1	$32.73	$7,233.33	221.000	LF	N	UNDERDRAIN OUTLET PIPE, 8"
0443 70 3	3	$148.41	$47,936.30	323.000	LF	N	FRENCH DRAIN, 18"
0443 70 4	7	$116.83	$1,025,962.00	8,782.000	LF	N	FRENCH DRAIN, 24"
0443 70 6	2	$170.95	$77,099.50	451.000	LF	N	FRENCH DRAIN, 36"
0444 70 11	3	$172.32	$41,356.60	240.000	LF	N	DEEP WELL- OPEN HOLE, 24"
0444 71 11	3	$186.16	$180,573.10	970.000	LF	N	DEEP WELL CASING, 24"
0444 72 11	1	$53.99	$16,197.00	300.000	LF	N	DEEP WELL CLEANING, 24"
0446 1 1	2	$26.72	$213,892.08	8,004.000	LF	N	EDGEDRAIN DRAINCRETE, STANDARD
0446 71 1	5	$30.68	$56,568.70	1,844.000	LF	N	EDGEDRAIN OUTLET PIPE, 4"
0448 73	2	$2,796,237.41	$5,592,474.82	2.000	LS	N	PUMPING STATION- DRAINAGE
0450 1251	1	$175.00	$253,750.00	1,450.000	LF	N	PREST BEAMS, INVERTED T FROM FIB, 26.5"
0450 2 36	8	$198.05	$3,581,784.20	18,085.000	LF	N	PREST BEAMS: FLORIDA-I BEAM 36"
0450 2 45	6	$201.47	$2,155,972.99	10,701.000	LF	N	PREST BEAMS: FLORIDA-I BEAM 45"
0450 2 54	2	$219.80	$1,522,740.00	6,928.000	LF	N	PREST BEAMS: FLORIDA-I BEAM 54"
0450 2 63	1	$215.00	$365,930.00	1,702.000	LF	N	PREST BEAMS: FLORIDA-I BEAM 63"
0450 2 84	1	$250.00	$332,250.00	1,329.000	LF	N	PREST BEAMS: FLORIDA-I BEAM 84"
0450 82	1	$175.00	$36,750.00	210.000	LF	N	BEAMS REPAIR
0450 83 1	2	$587.42	$56,392.40	96.000	EA	N	BEAM REPAIR, STRAND SPLICES
0450 88 20	1	$71.00	$127,161.00	1,791.000	SF	N	PRESTR SLAB UNITS TRANSV POST TENS, 20"
0451 70	3	$3,253.50	$1,063,894.32	327.000	EA	N	PREST SOIL ANCHORS
0451 70 1	3	$782.28	$32,073.55	41.000	EA	N	PREST SOIL ANCHOR, PERFORMANCE TEST
0451 70 2	3	$1,095.52	$29,579.03	27.000	EA	N	PREST SOIL ANCHOR, CREEP TEST
0455 14 3	2	$89.64	$520,335.80	5,805.000	LF	N	CONC SHEET PILING, 10"X30"
0455 14 4	1	$379.05	$191,041.20	504.000	LF	N	CONC SHEET PILING, 12"X30"
0455 18	10	$9,542.16	$314,891.21	33.000	LS	N	PROTECTION OF EXISTING STRUCTURES
0455 34 2	2	$72.14	$1,206,550.00	16,726.000	LF	N	PRESTRESSED CONCRETE PILING, 14" SQ.
0455 34 3	9	$70.25	$3,470,413.05	49,398.000	LF	N	PRESTRESSED CONCRETE PILING, 18" SQ

APPENDIX F

PAVEMENT PERFORMANCE DATA

Deficient Rehabilitation age by Year

13JUN2012

For Orange County

Other Conditions: Pavement= Asphalt
Surface Type in (FC2)

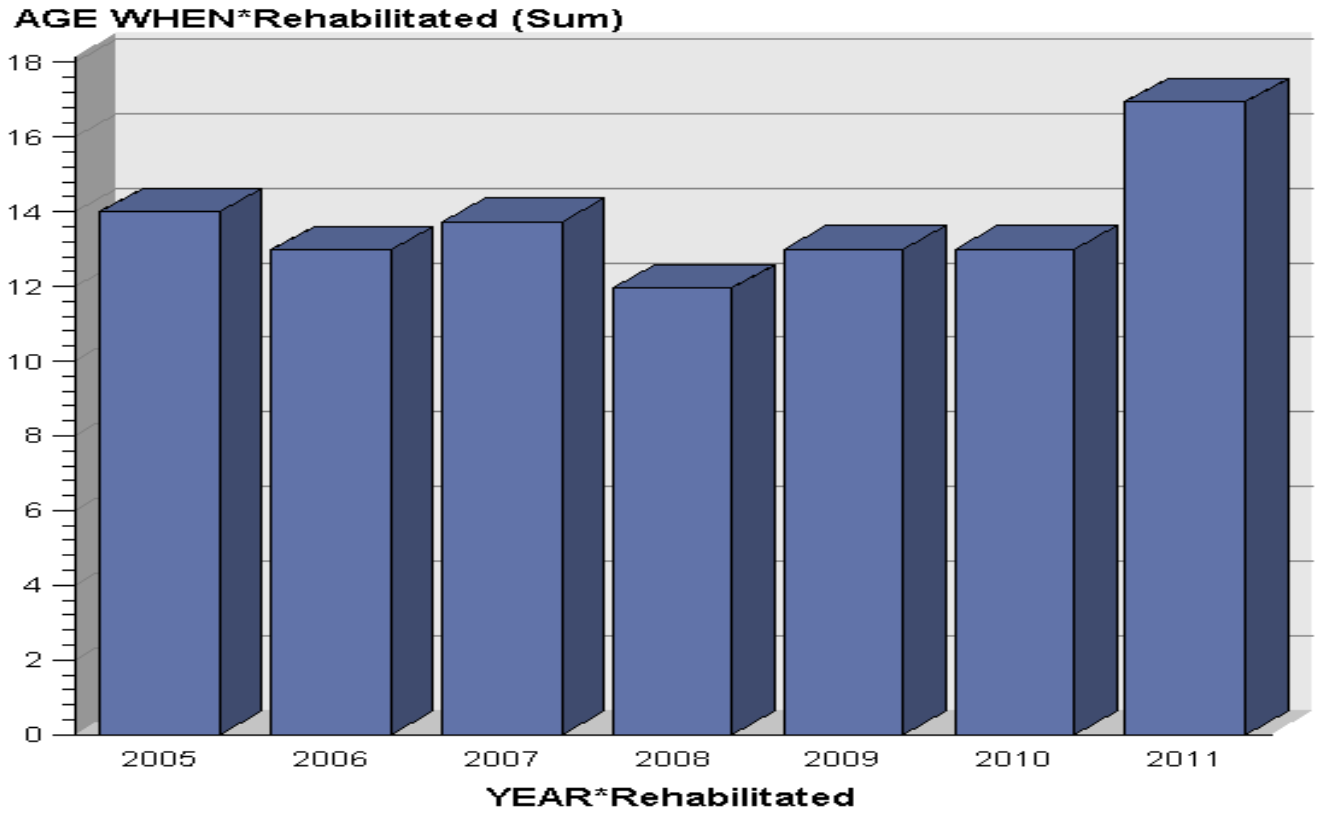
Year Rehabilitated	Lane Miles Rehabilitated	Average Rehabilitation Age	Standard Deviation
2005	5.0	14.0	0.0
2006	7.5	13.0	1.1
2007	62.6	13.7	2.6
2008	36.4	12.0	0.2
2009	35.6	13.0	0.0
2010	11.3	13.0	0.0
2011	27.8	16.9	3.1

Deficient Rehabilitation age by Year

13JUN2012

For Orange County

Other Conditions: Pavement= Asphalt
Surface Type in (FC2)



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

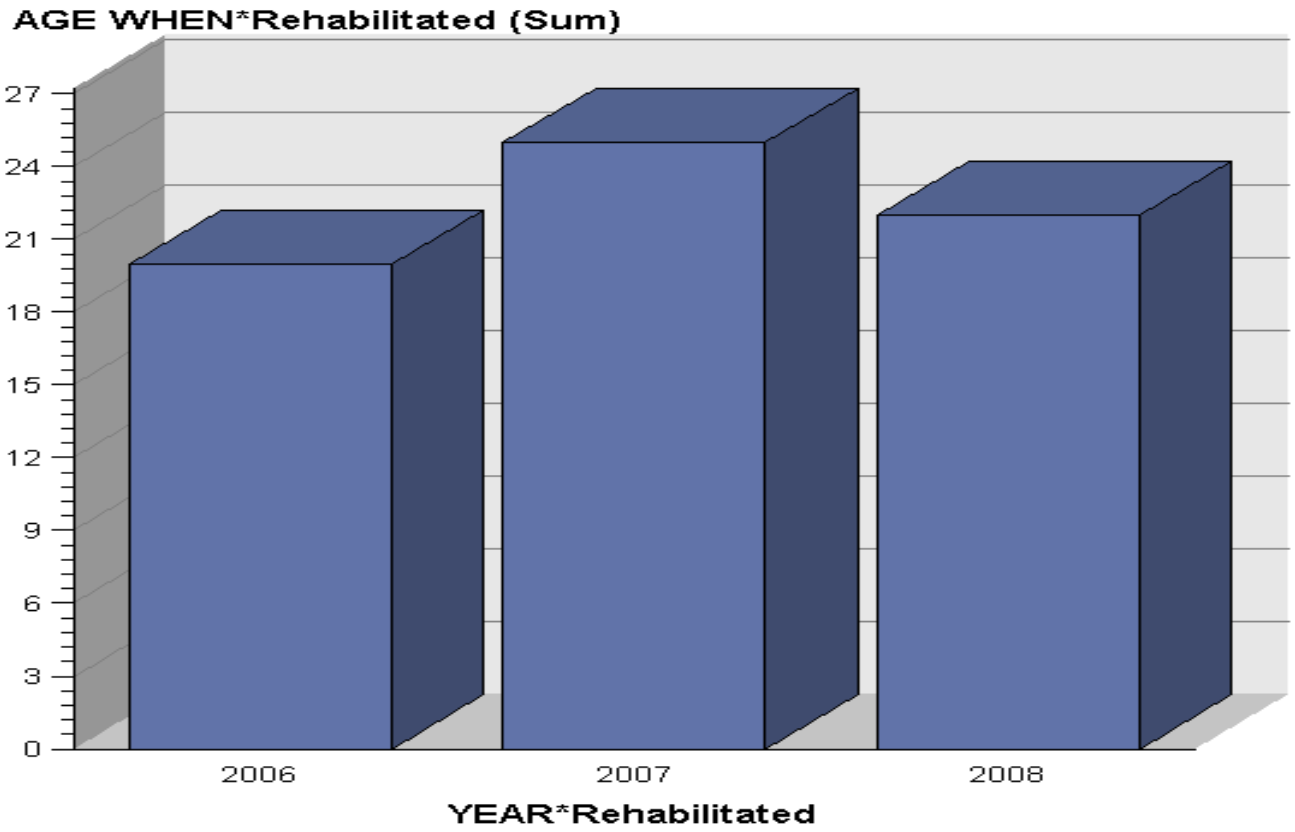
13JUN2012

Deficient Rehabilitation age by Year

For Hillsborough County

Other Conditions: Pavement= Concrete

Surface Type in (CONC)



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

4/18/14
Date