SAN ANTONIO DISTRICT

PAVEMENT DESIGN REPORT

FOR

McMULLEN COUNTY

SH 16

FROM: ATASCOSA/McMULLEN CO. LINE

TO: McMULLEN/DUVAL CO. LINE

CSJ 0517-02-040

&

CSJ 0517-03-030

LENGTH: 15.302 MI

Prepared By: Linda Cox, PE 7/17/13

Linda Cox, P.E. Date

Transportation Design Supervisor

Approved By: _____ _____

Brett T. Haggerty, P.E. Date

District Pavement Engineer

This document is released for the purpose of interim review and is not intended for bidding, construction, or permitting purposes.

GENERAL PROJECT INFORMATION

This pavement design is for the Proposed Widen Section and the Proposed Rehab Section of SH 16 From Atascosa/McMullen County Line to McMullen/Duval County Line.

The project location map is shown as Exhibit A and typical sections are shown as Exhibit B.

PROJECT DATA

Traffic Data

The traffic analysis report for pavement design from Transportation Planning and Programming Division (TP&P) is shown as Exhibit C.

CSJ 0517-02-040
From Atascosa/McMullen Co. Line to SH 72 West

2013 ADT: 5,100	Percent Trucks in ADT: 19.8
2033 ADT: 8,100	ATHWLD: 11,500
Flexible 18k ESALs: 4,928,000	Percent Tandem Axles in ATHWLD: 60

CSJ 0517-03-030
From SH 72 East to FM 1962

2013 ADT: 4,200	Percent Trucks in ADT: 19.5
2033 ADT: 6,100	ATHWLD: 11,200
Flexible 18k ESALs: 3,731,000	Percent Tandem Axles in ATHWLD: 60

Subgrade Material Properties:

CSJ 0517-02-040
From Atascosa/McMullen Co. Line to SH 72 West

The subgrade consists of Monteola Soils. Its Triaxial Classification, grouped by the Soil Conservation Service Series, Research Report 3-05-71-035, is 5.0 and Zapata-Quemado Soils. Its Triaxial Classification, grouped by the Soil Conservation Service Series, Research Report 3-05-71-035, is 3.8.

CSJ 0517-03-030
From SH 72 East to FM 1962

The subgrade consists of Monteola Soils. Its Triaxial Classification, grouped by the Soil Conservation Service Series, Research Report 3-05-71-035, is 5.0 and McAllen-Copita Soils. Its Triaxial Classification, grouped by the Soil Conservation Service Series, Research Report 3-05-71-035, is 4.5.

FLEXABLE PAVEMENT DESIGN DATA

The designs were performed with the FPS21 Pavement Design program and input values were selected using TxDOT guidelines. Design Data is included as Exhibit D, FPS21 Input and Output Data.

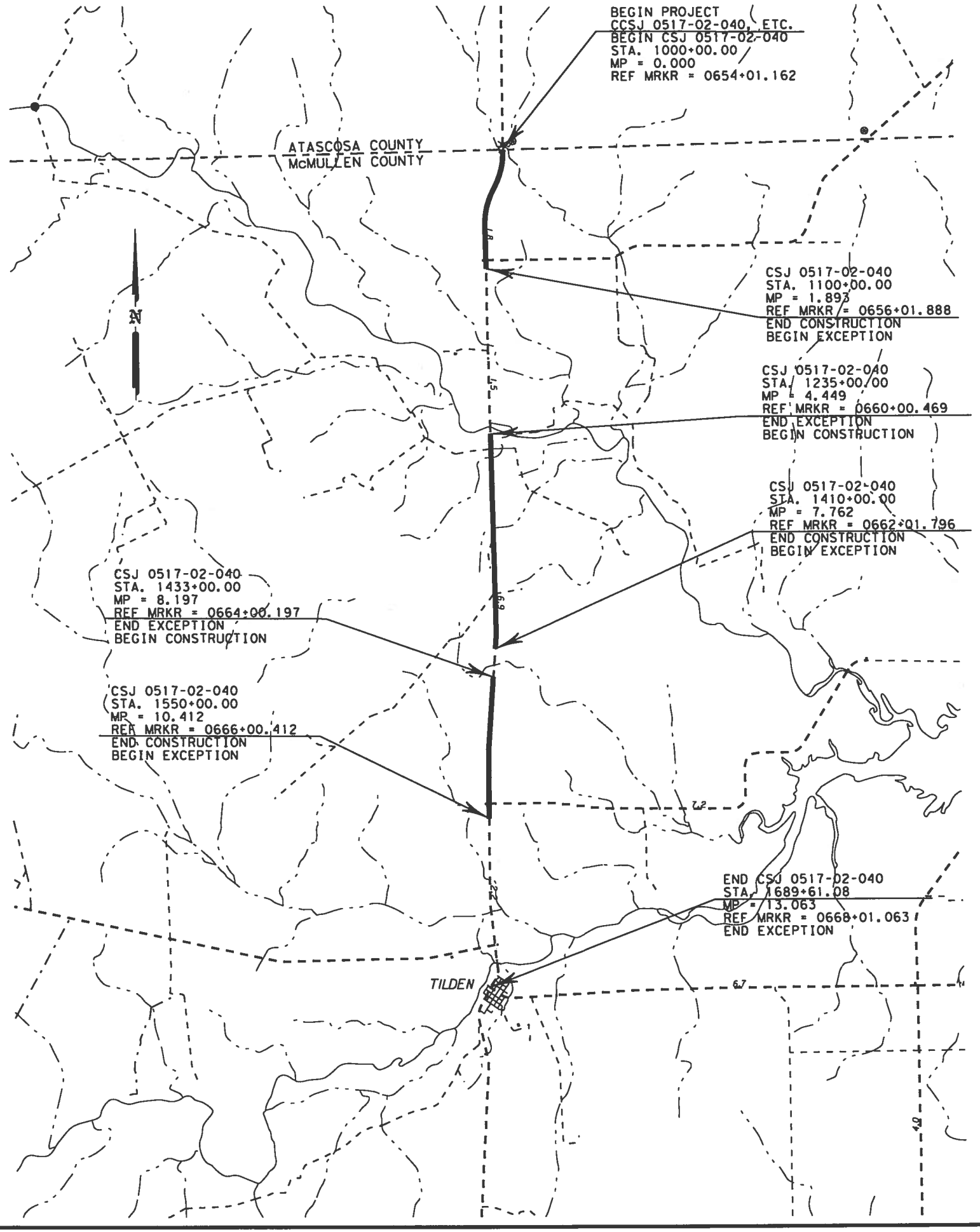
CONCLUSIONS

The approved pavement designs for this project are:

Widening Sections:
OCST (Full Width)
3" HMA Ty D SAC B PG70-22
OCST(Widened Area)
12" HMA Ty B SAC B PG64-22 (3 ~ 4" MATS)

Rehab Section:
3" HMA Ty D SAC B PG70-22 (2 ~ 1.5" MATS)
OCST
12" HMA Ty B SAC B PG64-22 (3 ~ 4" MATS)

Exhibit A - Project Layout and Vicinity Maps



SH 16
LOCATION MAP
CSJ 0517-02-040

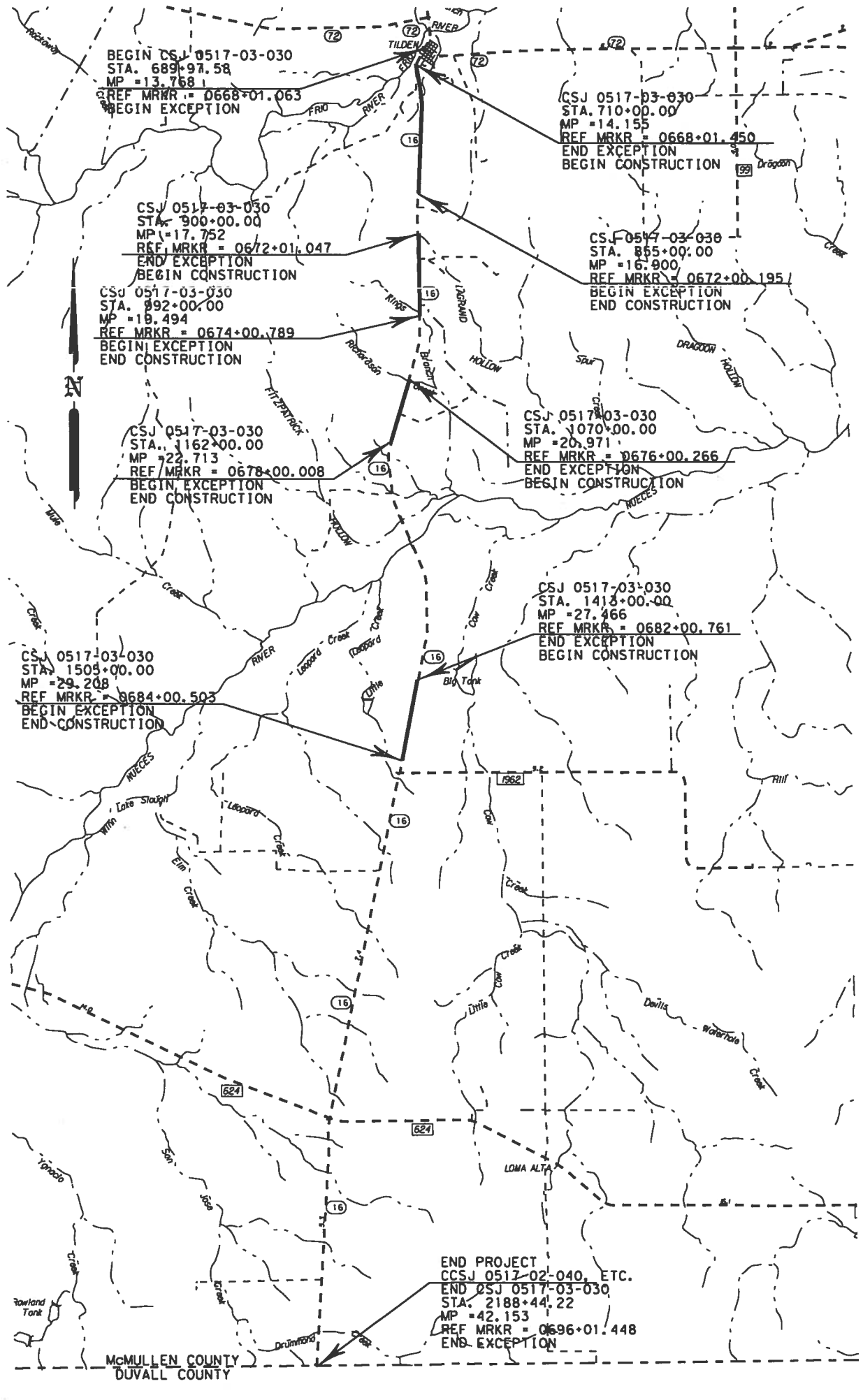
SCALE: 1" = 10,

© 2013 Texas Department of Tra

SHEET

FHWA TEXAS DIVISION	FEDERAL AID PROJECT NO.	
STATE	DISTRICT	COUNT
TEXAS	SAT	McMUL
CONTROL	SECTION	JOB
0517	02	040, ETC

FILE: c:\pwworking\txdot\pwsouth\mmarend\dms20581\Title Sheet 02.dgn
DATE: 4/3/2013 2:37:22 PM



SH 16
LOCATION MAP
CSJ 0517-03-030

SCALE: 1" = 10,0

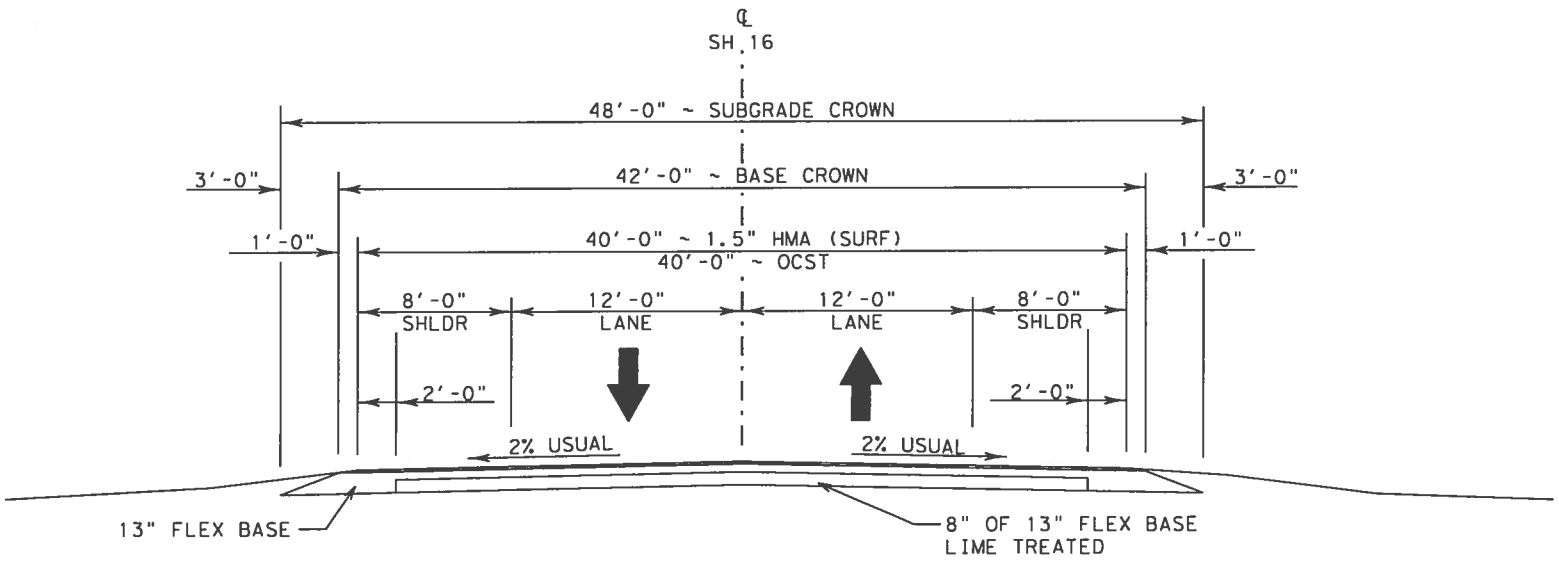
© 2013 Texas Department of Tra

SHEET

FHWA TEXAS DIVISION	FEDERAL AID PROJECT NO.	
STATE	DISTRICT	COUN
TEXAS	SAT	McMUL
CONTROL	SECTION	JOB
0517	02	040, ETC

FILE: c:\pwworking\txdot\pwsouth\mnarend\dms20581\Title Sheet 03.dgn
DATE: 4/3/2013 2:37:04 PM

Exhibit B - Existing and Proposed Typical Sections



EXIST TYPICAL SECTION

CSJ 0517-02-040

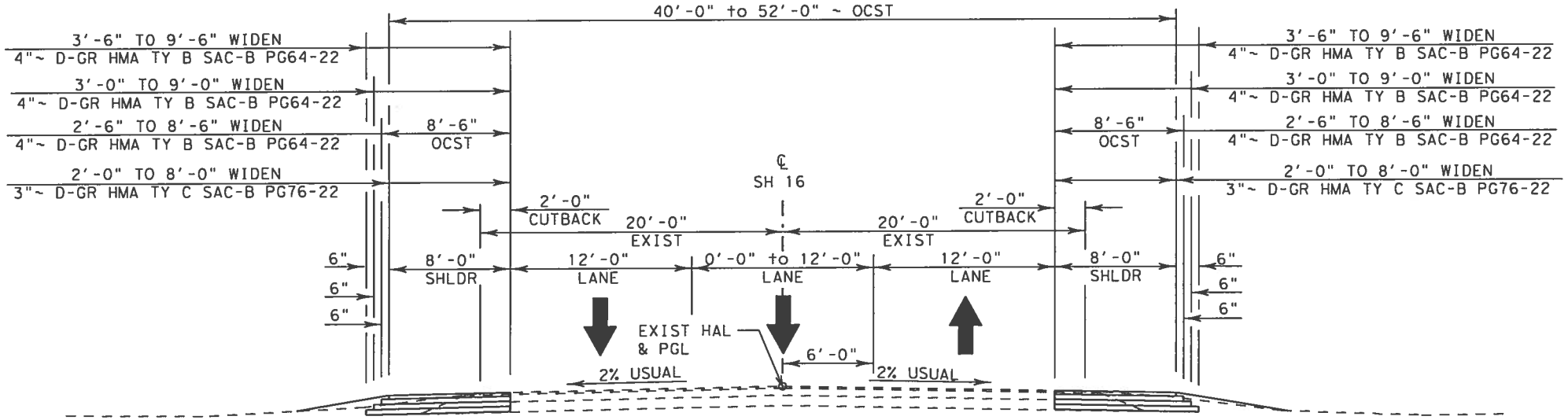
APPROX STA. 1000+00 TO STA. 1080+00
APPROX STA. 1235+00 TO STA. 1270+00
APPROX STA. 1270+00 TO STA. 1410+00
APPROX STA. 1433+00 TO STA. 1525+00

SH 16

TYPICAL SECTIONS

© 2013 Texas Department of Transportation

FHWA REGN. DIVISION	PROJECT NO.		SHEET NO.
STATE	DISTRICT	COUNTY	
TEXAS	SAT	McMULLEN	
CONTROL	SECTION	JOB	HIGHWAY NO.



PROPOSED TYPICAL SECTION

CSJ 0517-02-040 ~ PASSING LANE

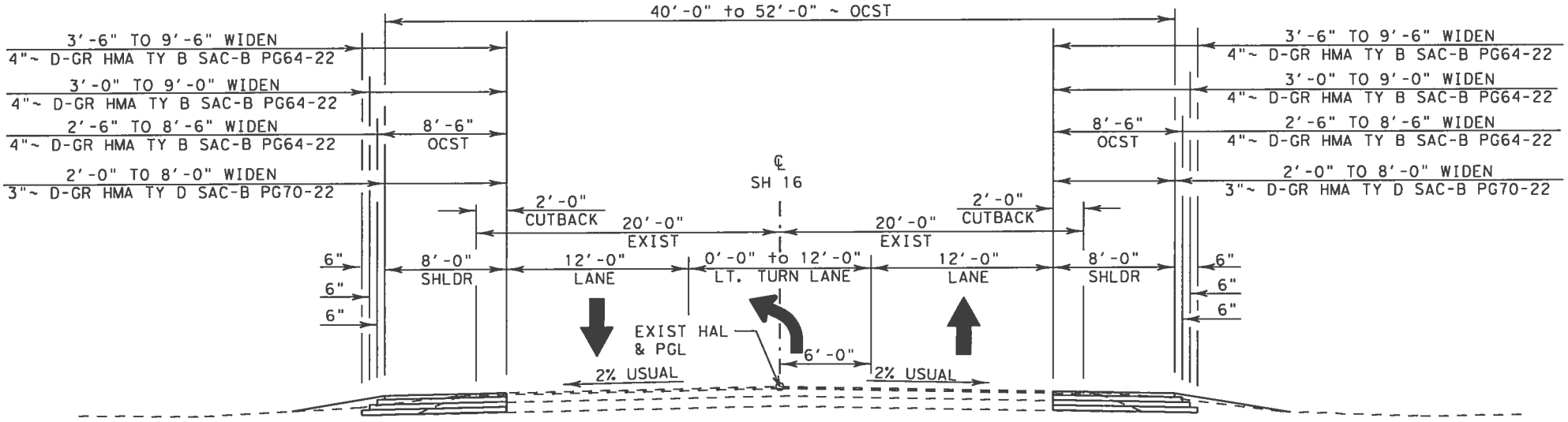
APPROX STA. 1000+00 TO STA. 1080+00 (NB PASSING LN)
APPROX STA. 1270+00 TO STA. 1410+00 (SB PASSING LN)
APPROX STA. 1433+00 TO STA. 1525+00 (NB PASSING LN)

SH 16

TYPICAL SECTIONS

Texas Department of Transportation

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN



PROPOSED TYPICAL SECTION

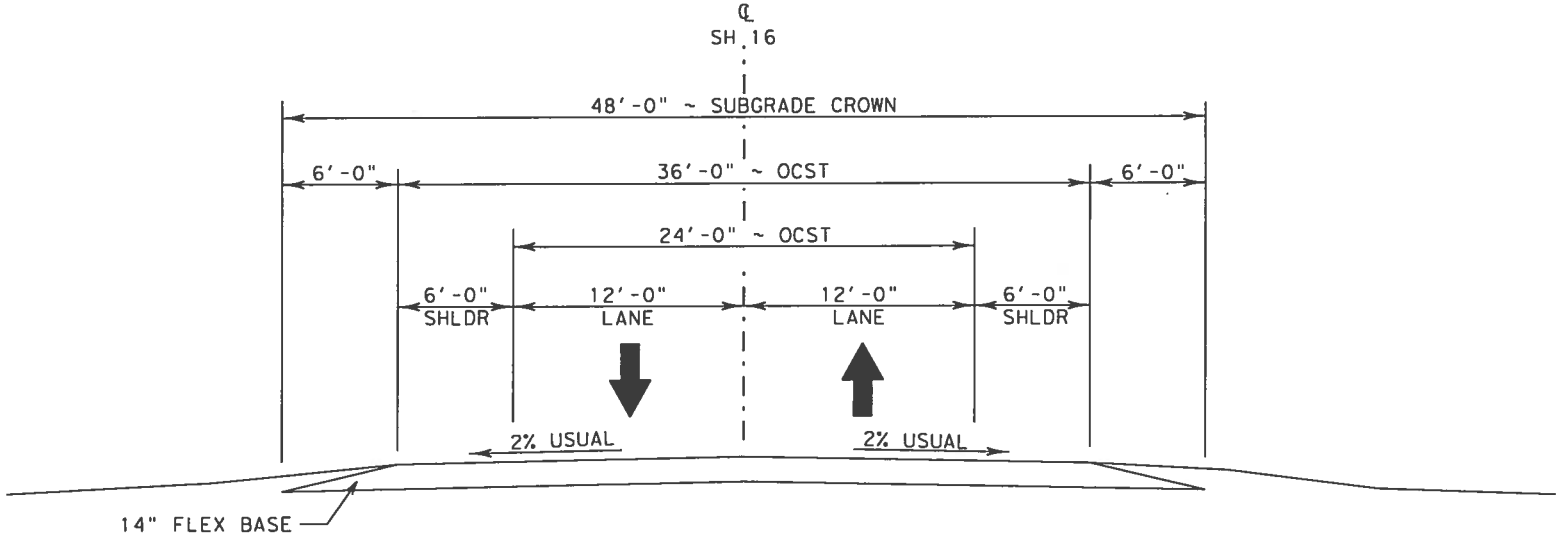
CSJ 0517-02-040 ~ LT. TURN LANE

APPROX STA. 1235+00 TO STA. 1270+00

SH 16

TYPICAL SECTIONS

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN



EXIST TYPICAL SECTION

CSJ 0517-03-030

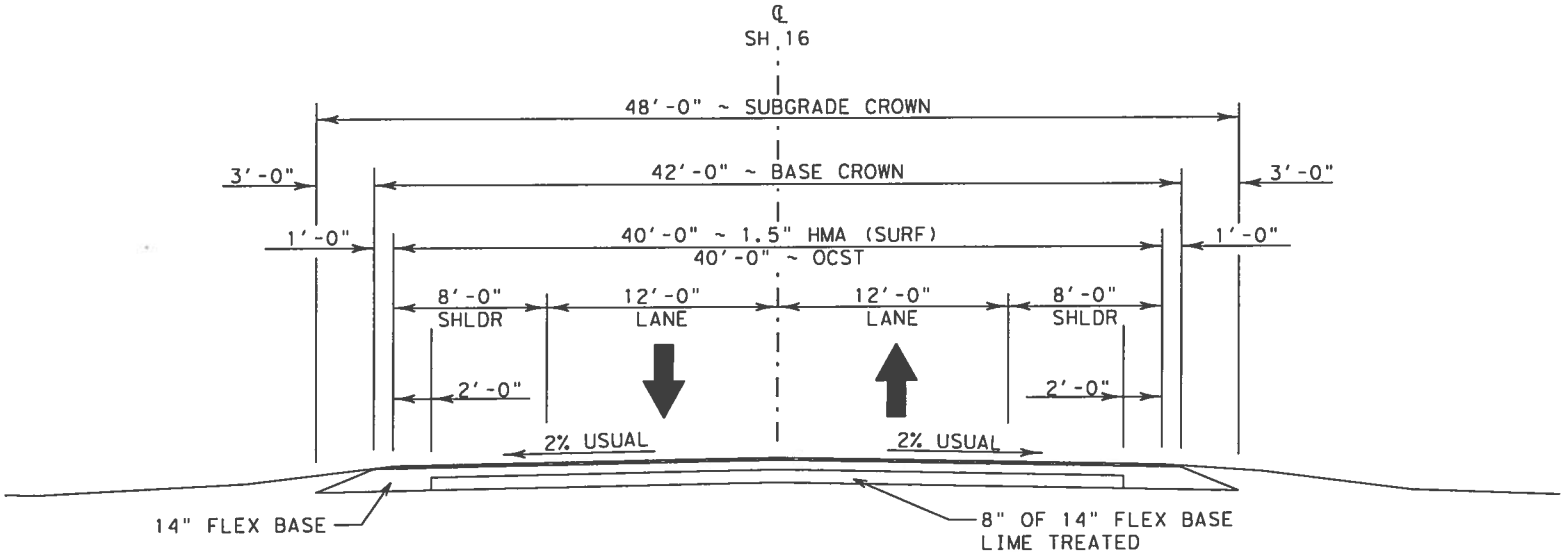
APPROX STA. 710+00 TO STA. 855+00

SH 16

TYPICAL SECTIONS

© 2013 Texas Department of Transportation

FHWA TEXAS DIVISION	PROJECT NO.		SHEET NO.
STATE	DISTRICT	COUNTY	
TEXAS	SAT	McMULLEN	
CONTROL	SECTION	JOB	HIGHWAY NO.



EXIST TYPICAL SECTION

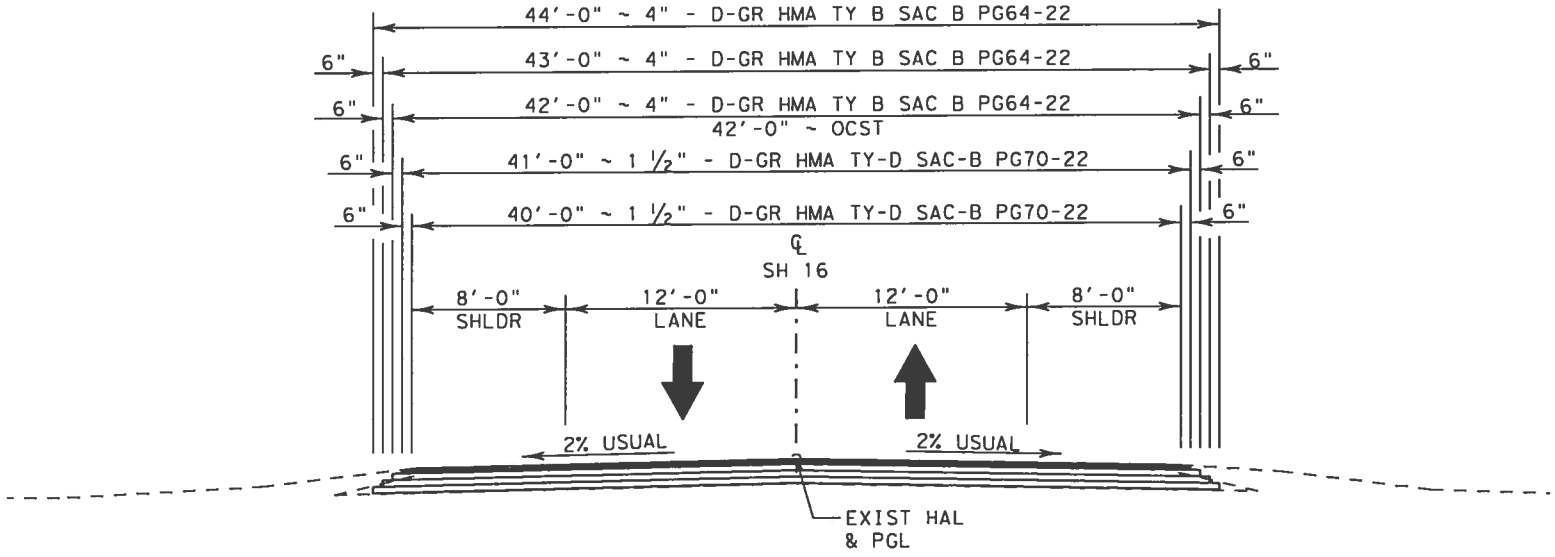
CSJ 0517-03-030

APPROX STA. 900+00 TO STA. 992+00
APPROX STA. 1070+00 TO STA. 1162+00
APPROX STA. 1413+00 TO STA. 1505+00

SH 16
TYPICAL SECTIONS

Texas Department of Transportation

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN



PROPOSED TYPICAL SECTION

CSJ 0517-02-030 ~ REHAB

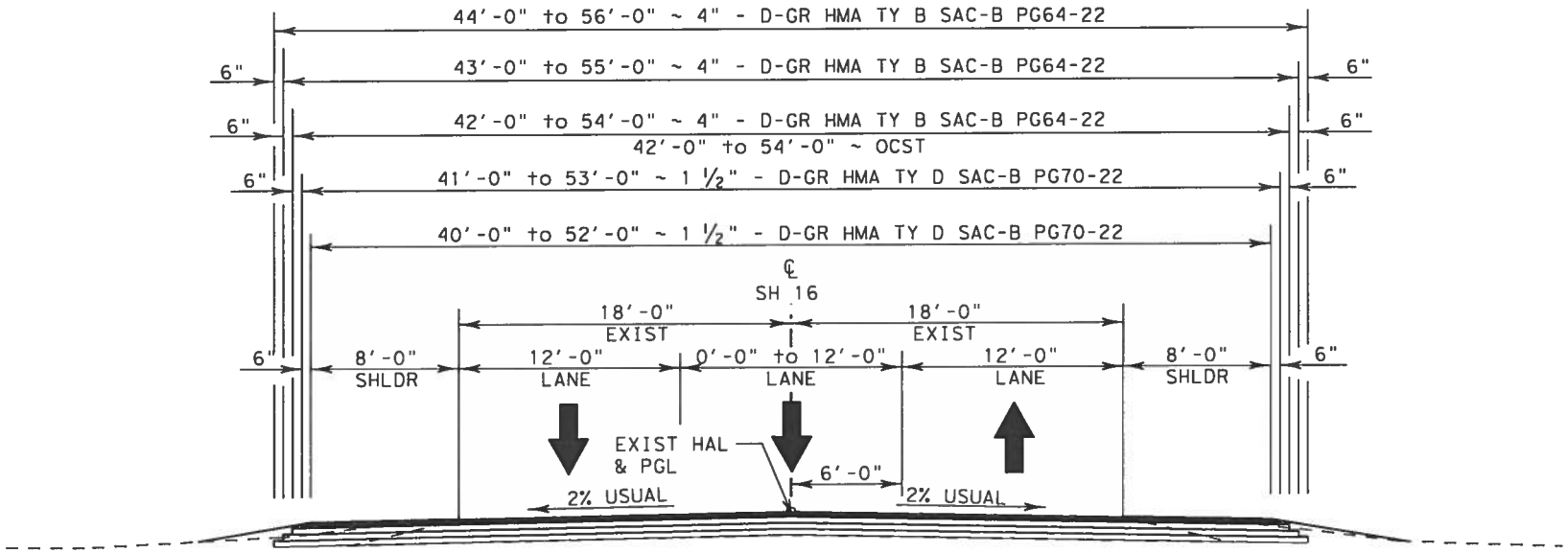
APPROX STA. 710+00 TO STA. 750+00

SH 16

TYPICAL SECTIONS

Texas Department of Transportation

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN



PROPOSED TYPICAL SECTION

CSJ 0517-03-030 ~ PASSING LANE AND REHAB

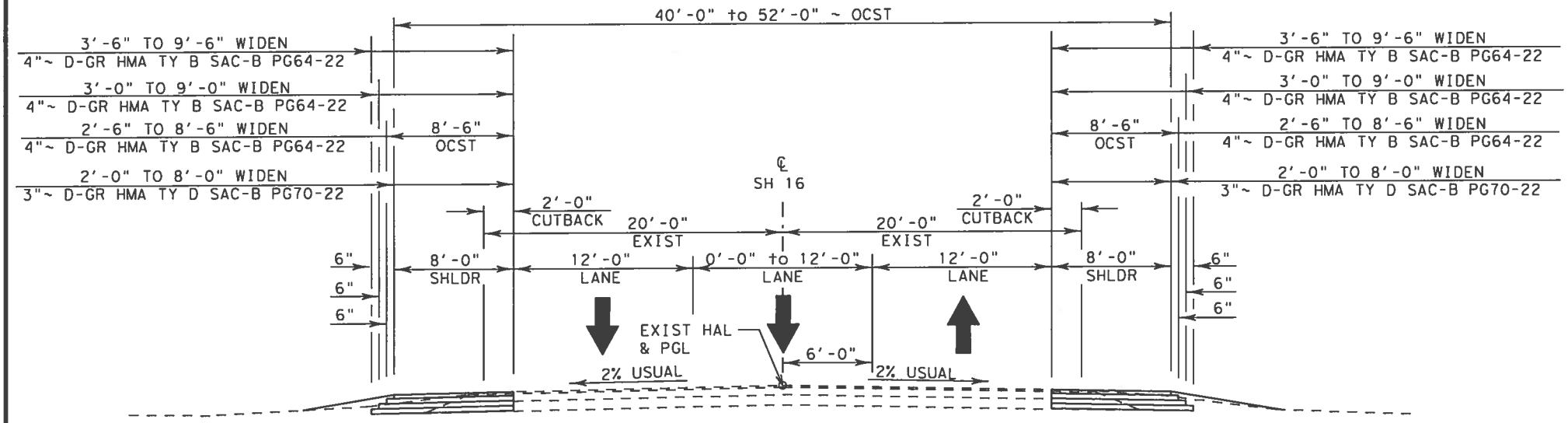
APPROX STA. 750+00 TO STA. 855+00 (SB PASSING LN)

SH 16

TYPICAL SECTIONS

© 2013 Texas Department of Transportation

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN



PROPOSED TYPICAL SECTION

CSJ 0517-03-030 ~ PASSING LANE

APPROX STA. 900+00 TO STA. 992+00 (NB PASSING LN)
APPROX STA. 1070+00 TO STA. 1162+00 (NB PASSING LN)
APPROX STA. 1413+00 TO STA. 1505+00 (SB PASSING LN)

SH 16

TYPICAL SECTIONS

STATE	DISTRICT	COUNTY
TEXAS	SAT	McMULLEN

Exhibit C - TP&P Traffic Analysis for Pavement Design

MEMORANDUM

2013 MAR -1 AM 9:20

TO: Mario Medina, P.E.
Julie Brown, P.E.

DATE: February 26, 2013

FROM: William E. Knowles, P.E.

SUBJECT: Traffic Data
CSJ: 0517-02-040
SH 16:
From Atascosa/McMullen County Line
To SH 72 East
McMullen County

Attached are tabulations showing traffic analysis for highway design for the 2013 to 2033 twenty year design period and the 2013 to 2043 thirty year design period for the described limits of the route. Also attached are tabulations showing data for use in air and noise analysis.

Due to significant differences in traffic volumes, this project was split into two sections:
Section 1: From Atascosa/McMullen County Line to SH 72 West
Section 2: From SH 72 West to SH 72 East

Please refer to your original memorandum dated January 31, 2013.

If you have any questions or need additional information, please contact Mollie Klenzendorf at (512) 486-5148.

Attachments

cc: Lorri Pavliska, San Antonio District
Design Division

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

February 25, 2013

San Antonio District

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2033	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 1 From Atascosa/McMullen County Line To SH 72 West McMullen County	5,100	8,100	55 - 45	11.6	19.8	13.1	11,500	60	4,928,000	3	7,139,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	80.2	86.9
Medium Duty	3.1	2.0
Heavy Duty	16.7	11.1

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2043	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2013 to 2043) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 1 From Atascosa/McMullen County Line To SH 72 West McMullen County	5,100	9,000	55 - 45	11.6	19.8	13.1	11,500	60	7,896,000	3	11,438,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

February 25, 2013

San Antonio District

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2033	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 2 From SH 72 West To SH 72 East McMullen County	8,800	13,900	55 - 45	11.6	16.5	10.9	11,800	60	7,067,000	3	10,234,000	8"

NOT INTENDED FOR CONSTRUCTION
BIDDING OR PERMIT PURPOSES
William Erick Knowles, P.E.
Serial Number 84704

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	83.5	89.1
Medium Duty	2.6	1.7
Heavy Duty	13.9	9.2

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2043	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2013 to 2043) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 2 From SH 72 West To SH 72 East McMullen County	8,800	15,600	55 - 45	11.6	16.5	10.9	11,900	60	11,394,000	3	16,500,000	8"

MEMORANDUM

2013 MAR -1 AM 9:20

TO: Mario Medina, P.E.
Julie Brown, P.E.

DATE: February 26, 2013

FROM: William E. Knowles, P.E.

SUBJECT: Traffic Data
CSJ: 0517-03-030
SH 16:
From SH 72 East
To McMullen/Duval County Line
McMullen County

Attached are tabulations showing traffic analysis for highway design for the 2013 to 2033 twenty year design period and the 2013 to 2043 thirty year design period for the described limits of the route. Also attached are tabulations showing data for use in air and noise analysis.

Due to significant differences in traffic volumes, this project was split into two sections:
Section 1: From SH 72 East to FM 1962
Section 2: From FM 1962 to McMullen/Duval County Line

Please refer to your original memorandum dated January 31, 2013.

If you have any questions or need additional information, please contact Mollie Klenzendorf at (512) 486-5148.

Attachments

cc: Corri Pavliska, San Antonio District
Design Division

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

February 25, 2013

San Antonio District

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2033	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 1 From SH 72 East To FM 1962 McMullen County	4,200	6,100	55 - 45	11.6	19.5	12.9	11,200	60	3,731,000	3	5,384,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	80.5	87.1
Medium Duty	3.4	2.2
Heavy Duty	16.1	10.7

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2043	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2013 to 2043) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 1 From SH 72 East To FM 1962 McMullen County	4,200	6,900	55 - 45	11.6	19.5	12.9	11,300	60	6,032,000	3	8,704,000	8"

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

February 25, 2013

San Antonio District

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2033	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 2 From FM 1962 To McMullen/Duval County Line McMullen County	1,700	2,500	55 - 45	11.6	28.3	18.7	10,900	70	2,206,000	3	3,185,000	8"

Data for Use in Air & Noise Analysis

Vehicle Class	Base Year % of ADT	Base Year % of DHV
Light Duty	71.7	81.3
Medium Duty	5.0	3.3
Heavy Duty	23.3	15.4

Description of Location	Average Daily Traffic 2013	Average Daily Traffic 2043	Base Year Dir Dist %	Base Year K Factor	Base Year Percent Trucks ADT	Base Year Percent Trucks DHV	ATHWLD	Percent Tandem Axles in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 30 Year Period (2013 to 2043) Flexible Pavement	S N	Rigid Pavement	SLAB
SH 16 Section 2 From FM 1962 To McMullen/Duval County Line McMullen County	1,700	2,800	55 - 45	11.6	28.3	18.7	11,000	70	3,545,000	3	5,119,000	8"

Exhibit D - FPS Moduli

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.0)

District:15 (San Antonio)
County :162 (MCMULLEN)
Highway/Road: H0016

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum
Pavement:	3.00	500,000	500,000
Base:	8.00	10,000	150,000
Subbase:	0.00		
Subgrade:	289.00(by DB)	10,000	

Poisson Ratio Values
H1: v = 0.35
H2: v = 0.35
H3: v = 0.00
H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute ERR/Sens	Dpth to Bedrock
0.000	10,991	36.89	26.56	15.91	9.34	6.04	4.34	3.35	500.0	36.6	0.0	7.6	6.24	178.4
0.800	10,574	22.93	16.25	10.22	6.98	5.10	3.95	3.28	500.0	104.1	0.0	10.0	3.18	300.0
1.201	10,212	19.23	10.86	6.28	4.23	3.10	2.39	1.92	500.0	74.5	0.0	16.2	5.34	300.0
1.673	10,808	18.39	11.93	7.97	5.74	4.35	3.41	2.73	500.0	150.0	0.0	12.8	5.77	300.0 *
1.960	10,173	21.38	11.38	5.81	3.30	2.10	1.43	1.13	500.0	37.3	0.0	19.4	5.57	147.0
2.400	9,970	20.90	11.89	6.36	4.14	3.16	2.56	2.04	500.0	56.4	0.0	15.4	6.41	300.0
2.801	10,324	12.47	7.93	5.11	3.56	2.67	2.00	1.47	500.0	150.0	0.0	20.6	7.75	266.2 *
3.201	10,141	17.33	8.61	4.31	2.85	2.05	1.52	1.15	500.0	55.4	0.0	23.3	4.41	300.0
3.954	9,668	29.46	18.21	9.32	5.84	4.24	3.29	2.64	500.0	31.8	0.0	10.3	4.16	300.0
4.498	9,811	27.21	17.46	11.08	7.79	5.82	4.41	3.50	500.0	70.3	0.0	8.4	4.89	300.0
4.777	9,843	30.86	18.32	9.17	5.35	3.58	2.57	2.01	500.0	23.8	0.0	11.4	2.67	173.0
5.200	9,887	25.28	16.08	9.60	6.50	4.73	3.54	2.77	500.0	62.5	0.0	10.1	3.49	300.0
5.600	10,034	20.89	13.17	7.63	4.97	3.42	2.59	2.06	500.0	70.1	0.0	13.4	1.95	300.0
6.000	10,538	29.55	19.20	11.00	6.93	4.74	3.64	2.90	500.0	45.3	0.0	9.9	2.35	277.5
6.400	10,427	36.44	25.41	15.24	9.50	6.45	4.84	3.82	500.0	38.2	0.0	7.1	2.54	254.7
6.837	9,791	44.57	29.34	15.07	8.63	5.81	4.35	3.06	500.0	15.1	0.0	7.0	2.94	148.8
7.200	10,395	34.58	23.32	12.92	8.07	5.70	4.37	3.46	500.0	35.2	0.0	8.2	3.16	300.0
7.571	10,415	18.87	14.52	10.04	6.70	5.02	3.80	2.91	500.0	150.0	0.0	10.3	3.78	300.0 *
8.036	10,419	28.17	15.91	7.66	4.69	3.42	2.69	2.15	500.0	30.0	0.0	13.6	4.27	274.7
8.399	10,645	18.93	12.55	7.72	5.30	3.76	2.83	2.23	500.0	114.3	0.0	13.5	2.40	300.0
8.801	10,324	29.54	17.23	8.87	5.48	3.89	3.05	2.50	500.0	32.0	0.0	11.8	3.07	300.0
9.200	10,006	46.83	30.25	15.24	8.69	5.70	4.29	3.47	500.0	13.2	0.0	7.1	2.99	144.7
9.601	10,026	32.85	21.46	11.47	7.30	4.72	3.40	2.62	500.0	30.8	0.0	9.0	2.76	178.0
10.000	10,439	20.66	11.78	6.15	3.85	2.83	2.27	1.78	500.0	55.3	0.0	17.0	4.67	300.0
10.087	10,566	13.07	7.46	4.05	2.57	1.74	1.26	0.96	500.0	106.7	0.0	27.4	1.34	260.3
10.402	10,399	22.95	13.55	8.07	5.60	4.03	3.09	2.41	500.0	70.1	0.0	12.6	5.20	300.0
10.782	10,510	17.93	9.32	4.54	3.00	2.16	1.66	1.29	500.0	56.7	0.0	22.6	4.05	300.0
11.203	10,081	37.89	24.86	14.17	9.06	6.34	4.78	3.69	500.0	30.7	0.0	7.2	2.07	300.0
11.600	10,093	38.23	25.51	14.57	8.95	6.36	4.78	3.78	500.0	29.6	0.0	7.2	2.22	279.2
12.039	10,304	29.89	21.00	13.11	8.80	6.37	4.73	3.64	500.0	64.5	0.0	7.7	2.27	300.0
13.090	10,407	15.95	9.89	5.49	3.58	2.56	1.98	1.56	500.0	99.3	0.0	19.1	3.78	300.0
Mean:		26.46	16.81	9.49	6.04	4.26	3.22	2.53	500.0	62.6	0.0	12.8	3.80	300.0
Std. Dev:		8.96	6.49	3.63	2.16	1.47	1.10	0.86	0.0	39.3	0.0	5.5	1.53	79.0
Var Coeff(%):		33.88	38.61	38.31	35.80	34.51	34.08	34.11	0.0	62.8	0.0	42.9	40.40	29.0

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 656 + 01.1 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
1	1	3'		ASPHALT.
	2	8'		BASE
	3	↓		SUBGRADE

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 660 + 01.9 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
2	1	3'		ASPHALT
	2	8 1/2'		BASE
	3	↓		SUBGRADE

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB), WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 664 + 0.5 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
3	1	3'		ASPHALT
	2	6'		BASE (SANDY)
	3	↓		SUB GRADE (CLAY BLACK)

LOGGED BY: DRILLED BY: RD DATE: 1-16-12
DRILL BIT TYPE & SIZE: PROJECT: ~~0517~~ 0517-03-030

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB), WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 670 + 01.2 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
4	1	1/2'		ASPHALT
	2	1		BASE 1
	3	4'		ASPHALT #2
	4	4 1/2'		ASB (ASPHALT STAB BASE)
	5	8'		BASE 2
	6	↓		SUB GRADE

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 674 + 0.00 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
5	1	3'		ASPHALT
	2	10'		BASE
	3	↓		SUBGRADE (CLAY)

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH16 LANE: K1 DIRECTION: NB, (SB), WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 676 + 01.3 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
6	1	2 1/2		ASPHALT
	2	10'		BASE
	3	↓		SUB GRADE (CLAY)

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RP DATE: 1-16-12
DRILL BIT TYPE & SIZE: PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH16 LANE: R1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 684 + 0.10 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
7	1	2'1/2'		ASPHALT
	2	12'		BASE
	3	↓		SUBGRADE

LOGGED BY: DRILLED BY: DATE:
DRILL BIT TYPE & SIZE: PROJECT:

LOCATION

COUNTY:
HWY: LANE: DIRECTION: NB, SB, WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION

Pavement Data From FWD and Bores

County	McMullen	**CSJ**	0517-03-040
Highway	SH 16		
Site Description	McMullen/Atascosa County Line to SH 72		
Distance	13.09		

Location Number	Layer Number	Depth (inches)	Description	Modulus (ksi)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
1	1	3	Asphalt	500	N/A	N/A	N/A	N/A
	2	8	Flexible Base	62.6	N/A	N/A	N/A	N/A
	3	289	Subgrade	12.8	N/A	N/A	N/A	N/A

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.0)

District:15 (San Antonio)
County :162 (MCMULLEN)
Highway/Road: SH0016

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	2.50	200,000	550,000	H1: v = 0.35
Base:	12.00	10,000	150,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	187.22(by DB)	10,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	ERR/Sens	Absolute Dpth to Bedrock
0.000	10,630	15.21	9.83	5.20	3.20	2.25	1.69	1.38	550.0	84.2	0.0	18.6	5.37	300.0 *
0.914	10,383	22.95	13.93	8.88	5.99	4.11	2.99	2.27	538.8	60.8	0.0	10.4	0.64	293.6
1.005	10,196	33.80	17.51	9.40	6.08	4.26	3.33	2.71	337.6	29.9	0.0	9.6	3.84	300.0
1.500	10,157	27.51	14.48	7.72	4.72	3.29	2.51	2.00	550.0	32.6	0.0	12.1	2.78	272.8 *
2.054	10,173	27.20	16.72	8.83	5.39	3.40	2.71	1.83	550.0	35.3	0.0	10.7	4.98	157.8 *
2.502	10,077	25.95	15.28	7.73	4.74	3.33	2.78	1.80	550.0	35.7	0.0	11.6	6.30	280.7 *
2.937	10,177	21.28	9.41	3.74	2.32	1.64	1.30	1.09	550.0	31.7	0.0	24.4	6.08	86.0 *
4.012	10,359	22.55	13.53	7.38	4.95	3.41	3.33	1.93	550.0	53.9	0.0	11.9	7.81	300.0 *
4.510	9,660	35.26	14.39	6.13	4.20	2.78	2.33	1.81	229.5	21.0	0.0	13.8	6.98	123.3
4.912	10,212	20.87	11.02	4.71	3.02	2.18	1.66	1.31	550.0	40.0	0.0	18.6	7.12	127.2 *
5.500	10,383	21.34	9.89	5.00	3.26	2.32	1.81	1.43	390.9	46.4	0.0	18.4	5.39	300.0
6.002	10,582	27.47	12.87	5.18	3.58	2.59	2.37	1.64	525.5	27.5	0.0	16.9	9.77	90.4
6.500	9,847	30.17	12.74	4.58	2.81	1.96	1.60	1.21	458.6	18.7	0.0	18.7	5.26	62.9 *
6.915	10,522	15.27	7.91	4.09	2.69	1.92	1.52	1.19	550.0	72.7	0.0	22.4	5.42	300.0 *
8.005	9,791	38.82	22.71	11.20	7.03	4.94	3.80	2.99	550.0	20.0	0.0	7.8	4.50	300.0 *
8.556	9,970	28.80	13.87	6.23	4.04	2.98	2.37	1.96	449.8	27.1	0.0	13.9	7.18	193.8
9.501	10,232	18.29	11.96	7.19	4.74	3.45	2.72	2.19	550.0	79.8	0.0	12.3	4.25	300.0 *
9.975	10,359	28.06	13.86	7.66	4.81	3.15	2.56	2.10	350.8	36.5	0.0	12.4	3.30	196.8
10.503	10,010	34.40	16.82	8.56	5.46	3.61	2.76	2.16	337.4	25.4	0.0	10.7	2.43	207.5
10.888	9,684	44.22	23.47	11.00	6.71	4.47	3.54	2.57	508.1	14.4	0.0	8.2	3.27	213.2
11.501	9,716	36.54	17.65	7.07	4.09	2.81	2.18	1.74	550.0	13.9	0.0	13.2	3.86	87.7 *
12.000	10,085	36.35	18.78	9.73	6.21	4.33	3.26	2.57	377.9	24.8	0.0	9.3	3.35	300.0
12.517	10,193	27.88	14.41	6.66	4.37	3.12	2.38	1.83	550.0	29.1	0.0	13.3	5.74	274.6 *
12.881	9,807	34.95	16.92	8.27	5.63	4.29	3.51	2.69	253.4	27.4	0.0	9.9	8.44	300.0
13.006	10,141	38.09	19.12	8.44	5.72	4.17	3.39	2.73	386.6	20.9	0.0	10.1	7.82	161.3
13.500	9,883	30.15	13.45	6.54	4.37	3.15	2.84	2.06	251.7	30.8	0.0	13.0	8.50	300.0
14.000	10,510	39.12	18.57	9.07	6.49	4.48	3.75	2.91	225.0	26.4	0.0	9.7	7.22	300.0
14.503	9,605	32.89	15.16	7.61	5.26	3.64	3.07	2.09	220.8	28.9	0.0	10.8	6.79	300.0
14.882	10,105	23.74	11.10	4.22	2.69	1.68	1.45	0.98	550.0	26.4	0.0	21.5	6.36	73.1 *
15.500	9,668	35.99	21.53	10.46	6.58	4.38	3.34	2.63	550.0	21.0	0.0	8.3	4.18	213.8 *
16.048	9,716	37.70	16.87	7.86	5.13	3.70	2.91	2.17	233.5	21.9	0.0	10.9	6.31	300.0
16.881	10,316	21.24	16.43	11.85	8.07	5.54	4.17	3.17	540.6	97.4	0.0	7.2	4.93	296.2
17.020	9,728	32.52	18.09	9.32	6.26	4.43	3.61	2.70	496.2	27.9	0.0	8.9	5.37	300.0
18.000	10,653	22.99	11.02	5.54	3.77	2.73	2.20	1.80	396.0	45.9	0.0	16.4	6.72	300.0
18.549	9,470	46.31	24.74	11.72	7.14	4.70	3.48	2.72	500.8	13.1	0.0	7.6	1.87	195.0
18.883	10,153	24.27	14.70	9.18	6.89	5.24	4.09	3.26	323.0	72.8	0.0	8.7	5.92	300.0
20.524	10,284	23.70	12.63	5.03	2.81	1.93	1.47	1.18	550.0	29.9	0.0	18.9	6.91	86.4 *
21.527	9,899	26.96	16.79	8.95	5.68	3.56	3.06	2.13	550.0	36.3	0.0	10.0	5.92	153.0 *
22.001	9,609	38.16	17.26	7.59	4.96	3.53	2.76	2.26	285.9	19.2	0.0	11.1	6.06	156.3
22.530	9,481	41.59	17.90	8.34	5.50	3.88	3.11	2.38	200.0	19.1	0.0	10.1	6.49	300.0 *
22.872	9,903	29.69	14.59	7.80	5.21	3.66	2.79	2.16	271.9	34.9	0.0	11.2	4.34	300.0
23.507	9,656	60.13	32.28	15.69	9.87	7.00	5.57	4.33	306.9	12.5	0.0	5.5	5.11	300.0
24.023	9,934	28.58	15.07	7.40	4.56	3.22	2.48	1.99	550.0	27.9	0.0	12.2	4.40	297.8 *
24.568	9,791	33.26	15.05	6.91	4.77	3.55	2.95	2.30	252.0	26.3	0.0	11.9	8.75	249.8
24.870	9,712	52.87	26.92	10.97	6.67	5.22	3.87	2.79	402.7	10.8	0.0	7.9	7.98	93.5
25.008	9,851	38.59	19.58	7.71	4.31	2.95	2.33	1.82	550.0	13.2	0.0	12.3	4.15	81.6 *

26.003	10,050	36.81	19.85	9.09	5.50	3.91	3.04	2.45	550.0	18.7	0.0	10.1	5.34	236.1 *
26.510	9,640	54.26	29.13	11.66	6.90	4.81	3.70	2.77	433.3	10.0	0.0	7.6	5.27	85.9 *
26.870	9,926	40.56	20.39	8.56	5.28	3.74	2.96	2.41	516.1	14.8	0.0	10.5	5.88	111.1
27.001	9,918	44.33	24.17	10.99	6.82	5.07	3.88	2.90	515.9	15.3	0.0	8.0	6.55	214.7
27.514	9,672	53.86	26.62	11.50	6.94	4.89	3.83	3.04	353.1	11.2	0.0	7.7	5.04	132.6
28.000	9,537	42.36	18.78	7.89	4.85	3.46	2.99	2.35	296.4	15.2	0.0	10.8	6.71	111.8
28.313	9,624	37.15	18.21	8.49	5.35	4.02	3.29	2.70	340.0	21.0	0.0	9.9	7.49	300.0
Mean:		32.80	16.84	8.03	5.14	3.61	2.87	2.21	435.3	31.1	0.0	12.1	5.68	201.7
Std. Dev:		9.91	5.07	2.39	1.52	1.08	0.83	0.64	122.8	19.5	0.0	4.2	1.83	107.4
Var Coeff(%):		30.21	30.10	29.81	29.66	30.01	28.94	29.02	28.2	62.8	0.0	34.6	32.29	58.4

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 656 + 01.1 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
1	1	3'		ASPHALT.
	2	8'		BASE
	3	↓		SUBGRADE

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 660 + 01.9 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
2	1	3'		ASPHALT
	2	8 1/2'		BASE
	3	↓		SUBGRADE

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1-16-13
DRILL BIT TYPE & SIZE: PROJECT: 0517-02-040

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB), WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 664 + 0.5 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
3	1	3'		ASPHALT
	2	6'		BASE (SANDY)
	3	↓		SUB GRADE (CLAY BLACK)

LOGGED BY: DRILLED BY: RD DATE: 1-16-12
DRILL BIT TYPE & SIZE: PROJECT: ~~OFST~~ 0517-03-030

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION:
RM # OR INTERSECTION: 670 + 01.2 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
4	1	1/2'		ASPHALT
	2	1		BASE 1
	3	4'		ASPHALT #2
	4	4 1/2'		ASB (ASPHALT STAB BASE)
	5	8'		BASE 2
	6	↓		SUB GRADE

LOG OF BORING /AUGGERING

LOGGED BY: DRILLED BY: RD DATE: 1/16/13
DRILL BIT TYPE & SIZE: PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH 16 LANE: K1 DIRECTION: (CIRCLE ONE) NB, (SB) WB, EB
SITE DISCRIPTION:
RM # OR INTERSECTION: 674 + 0.00 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
5	1	3'		ASPHALT
	2	10'		BASE
	3	↓		SUBGRADE (CLAY)

LOGGED BY: DRILLED BY: RD DATE: 1/16/13
DRILL BIT TYPE & SIZE: PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH16 LANE: K1 DIRECTION: (CIRCLE ONE) NB, (SB), WB, EB
SITE DISCRIPTION:
RM # OR INTERSECTION: 676 + 01.3 OFFSET DISTANCE:
TERAIN TYPE:

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
6	1	2 1/2		ASPHALT
	2	10'		BASE
	3	↓		SUB GRADE (CLAY)

LOG OF BORING /AUGGERING

LOGGED BY: _____ DRILLED BY: RD DATE: 1-16-12
DRILL BIT TYPE & SIZE: _____ PROJECT: 0517-03-330

LOCATION

COUNTY: McMullen
HWY: SH16 LANE: K1 DIRECTION: NB, (SB) WB, EB (CIRCLE ONE)
SITE DISCRIPTION: _____ OFFSET DISTANCE: _____
RM # OR INTERSECTION: 684 + 0.10
TERAIN TYPE: _____

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION
7	1	2'1/2'		ASPHALT
	2	12'		BASE
	3	↓		SUBGRADE

LOGGED BY: _____ DRILLED BY: _____ DATE: _____
DRILL BIT TYPE & SIZE: _____ PROJECT: _____

LOCATION

COUNTY: _____
HWY: _____ LANE: _____ DIRECTION: NB, SB, WB, EB (CIRCLE ONE)
SITE DISCRIPTION: _____ OFFSET DISTANCE: _____
RM # OR INTERSECTION: _____
TERAIN TYPE: _____

MATERIAL DESCRIPTION

LOCATION NO.	LAYER NO.	DEPTH	GROUP SYMBOL	DISCRIPTION

Pavement Data From FWD and Bores

County	McMullen	**CSJ**	0517-03-030
Highway	SH 16		
Site Description	SH72 to McMullen/Duval County Line		
Distance	28.313		

Location Number	Layer Number	Depth (inches)	Description	Modulus (ksi)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
1	1	2.5	Asphalt	455.3	N/A	N/A	N/A	N/A
	2	12	Flexible Base	31.1	N/A	N/A	N/A	N/A
	3	187.22	Subgrade	12.1	N/A	N/A	N/A	N/A

Exhibit E - FPS Input and Output Data

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.3 *FLEXIBLE PAVEMENT SYSTEM* *Release:6-1-2012*

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	02	040	SH 16	7/16/2013	1

COMMENTS ABOUT THIS PROBLEM

SH 16
HMA PAVEMENT STRUCTURE

BASIC DESIGN CRITERIA

LENGTH OF THE ANALYSIS PERIOD (YEARS)	20.0
MINIMUM TIME TO FIRST OVERLAY (YEARS)	8.0
MINIMUM TIME BETWEEN OVERLAYS (YEARS)	8.0
DESIGN CONFIDENCE LEVEL (95.0%)	C
SERVICEABILITY INDEX OF THE INITIAL STRUCTURE	4.2
FINAL SERVICEABILITY INDEX P2	3.0
SERVICEABILITY INDEX P1 AFTER AN OVERLAY	4.0
DISTRICT TEMPERATURE CONSTANT	31.0
SUBGRADE ELASTIC MODULUS by COUNTY (ksi)	12.80
INTEREST RATE OR TIME VALUE OF MONEY (PERCENT)	7.0

PROGRAM CONTROLS AND CONSTRAINTS

NUMBER OF SUMMARY OUTPUT PAGES DESIRED (8 DESIGNS/PAGE)	3
MAX FUNDS AVAILABLE PER SQ.YD. FOR INITIAL DESIGN (DOLLARS)	99.00
MAXIMUM ALLOWED THICKNESS OF INITIAL CONSTRUCTION (INCHES)	69.0
ACCUMULATED MAX DEPTH OF ALL OVERLAYS (INCHES) (EXCLUDING LEVEL-UP)	6.0

TRAFFIC DATA

ADT AT BEGINNING OF ANALYSIS PERIOD (VEHICLES/DAY)	5100.
ADT AT END OF TWENTY YEARS (VEHICLES/DAY)	8100.
ONE-DIRECTION 20YEAR 18 kip ESAL (millions)	18.928
AVERAGE APPROACH SPEED TO THE OVERLAY ZONE(MPH)	45.0
AVERAGE SPEED THROUGH OVERLAY ZONE (OVERLAY DIRECTION)(MPH)	45.0
AVERAGE SPEED THROUGH OVERLAY ZONE (NON-OVERLAY DIRECTION) (MPH)	45.0
PROPORTION OF ADT ARRIVING EACH HOUR OF CONSTRUCTION (PERCENT)	6.0
PERCENT TRUCKS IN ADT	19.8

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	02	040	SH 16	7/16/2013	2

INPUT DATA CONTINUED

CONSTRUCTION AND MAINTENANCE DATA

MINIMUM OVERLAY THICKNESS (INCHES)	2.0
OVERLAY CONSTRUCTION TIME (HOURS/DAY)	10.0
ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)	1.90
ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)	200.0
WIDTH OF EACH LANE (FEET)	12.0
FIRST YEAR COST OF ROUTINE MAINTENANCE (DOLLARS/LANE-MILE)	0.00
ANNUAL INCREMENTAL INCREASE IN MAINTENANCE COST (DOLLARS/LANE-MILE)	0.00

DETOUR DESIGN FOR OVERLAYS

TRAFFIC MODEL USED DURING OVERLAYING	2
TOTAL NUMBER OF LANES OF THE FACILITY	2
NUMBER OF OPEN LANES IN RESTRICTED ZONE (OVERLAY DIRECTION)	0
NUMBER OF OPEN LANES IN RESTRICTED ZONE (NON-OVERLAY DIRECTION)	1
DISTANCE TRAFFIC IS SLOWED (OVERLAY DIRECTION) (MILES)	0.60
DISTANCE TRAFFIC IS SLOWED (NON-OVERLAY DIRECTION) (MILES)	0.60
DETOUR DISTANCE AROUND THE OVERLAY ZONE (MILES)	0.00

PAVING MATERIALS INFORMATION

LAYER	CODE	MATERIALS NAME	COST PER CY	E MODULUS	POISSON RATIO	MIN. DEPTH	MAX. DEPTH	SALVAGE PCT.
1	A	ASPH CONC PVMT	115.00	500000.	0.35	3.00	3.00	30.00
2	B	ASPH STAB BASE	100.00	500000.	0.35	12.00	24.00	90.00
3	C	SUBGRADE(200)	2.00	12800.	0.40	289.00	289.00	90.00

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	02	040	SH 16	7/16/2013	3

C. LEVEL C SUMMARY OF THE BEST DESIGN STRATEGIES
IN ORDER OF INCREASING TOTAL COST

	1	2
MATERIAL ARRANGEMENT	AB	AB
INIT. CONST. COST	42.92	55.42
OVERLAY CONST. COST	3.55	0.00
USER COST	0.02	0.00
ROUTINE MAINT. COST	0.00	0.00
SALVAGE VALUE	-8.99	-11.40
TOTAL COST	37.49	44.01
NUMBER OF LAYERS	2	2
LAYER DEPTH (INCHES)		
D(1)	3.00	3.00
D(2)	12.00	16.50
NO.OF PERF.PERIODS	2	1
PERF. TIME (YEARS)		
T(1)	12.	20.
T(2)	25.	
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)		
O(1)	2.5	

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 25

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.3 — FLEXIBLE PAVEMENT SYSTEM — Release:6-1-2012

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	03	030	SH 16	7/16/2013	1

COMMENTS ABOUT THIS PROBLEM

SH 16
HMA PAVEMENT STRUCTURE

BASIC DESIGN CRITERIA

LENGTH OF THE ANALYSIS PERIOD (YEARS)	20.0
MINIMUM TIME TO FIRST OVERLAY (YEARS)	8.0
MINIMUM TIME BETWEEN OVERLAYS (YEARS)	8.0
DESIGN CONFIDENCE LEVEL (95.0%)	C
SERVICEABILITY INDEX OF THE INITIAL STRUCTURE	4.2
FINAL SERVICEABILITY INDEX P2	3.0
SERVICEABILITY INDEX P1 AFTER AN OVERLAY	4.0
DISTRICT TEMPERATURE CONSTANT	31.0
SUBGRADE ELASTIC MODULUS by COUNTY (ksi)	12.10
INTEREST RATE OR TIME VALUE OF MONEY (PERCENT)	7.0

PROGRAM CONTROLS AND CONSTRAINTS

NUMBER OF SUMMARY OUTPUT PAGES DESIRED (8 DESIGNS/PAGE)	3
MAX FUNDS AVAILABLE PER SQ.YD. FOR INITIAL DESIGN (DOLLARS)	99.00
MAXIMUM ALLOWED THICKNESS OF INITIAL CONSTRUCTION (INCHES)	69.0
ACCUMULATED MAX DEPTH OF ALL OVERLAYS (INCHES) (EXCLUDING LEVEL-UP)	6.0

TRAFFIC DATA

ADT AT BEGINNING OF ANALYSIS PERIOD (VEHICLES/DAY)	4200.
ADT AT END OF TWENTY YEARS (VEHICLES/DAY)	6100.
ONE-DIRECTION 20YEAR 18 kip ESAL (millions)	17.379
AVERAGE APPROACH SPEED TO THE OVERLAY ZONE(MPH)	45.0
AVERAGE SPEED THROUGH OVERLAY ZONE (OVERLAY DIRECTION)(MPH)	45.0
AVERAGE SPEED THROUGH OVERLAY ZONE (NON-OVERLAY DIRECTION) (MPH)	45.0
PROPORTION OF ADT ARRIVING EACH HOUR OF CONSTRUCTION (PERCENT)	6.0
PERCENT TRUCKS IN ADT	19.5

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	03	030	SH 16	7/16/2013	2

INPUT DATA CONTINUED

CONSTRUCTION AND MAINTENANCE DATA

MINIMUM OVERLAY THICKNESS (INCHES)	2.0
OVERLAY CONSTRUCTION TIME (HOURS/DAY)	10.0
ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)	1.90
ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)	200.0
WIDTH OF EACH LANE (FEET)	12.0
FIRST YEAR COST OF ROUTINE MAINTENANCE (DOLLARS/LANE-MILE)	0.00
ANNUAL INCREMENTAL INCREASE IN MAINTENANCE COST (DOLLARS/LANE-MILE)	0.00

DETOUR DESIGN FOR OVERLAYS

TRAFFIC MODEL USED DURING OVERLAYING	2
TOTAL NUMBER OF LANES OF THE FACILITY	2
NUMBER OF OPEN LANES IN RESTRICTED ZONE (OVERLAY DIRECTION)	0
NUMBER OF OPEN LANES IN RESTRICTED ZONE (NON-OVERLAY DIRECTION)	1
DISTANCE TRAFFIC IS SLOWED (OVERLAY DIRECTION) (MILES)	0.60
DISTANCE TRAFFIC IS SLOWED (NON-OVERLAY DIRECTION) (MILES)	0.60
DETOUR DISTANCE AROUND THE OVERLAY ZONE (MILES)	0.00

PAVING MATERIALS INFORMATION

LAYER	CODE	MATERIALS NAME	COST PER CY	E MODULUS	POISSON RATIO	MIN. DEPTH	MAX. DEPTH	SALVAGE PCT.
1	A	ASPH CONC PVMT	115.00	500000.	0.35	3.00	3.00	30.00
2	B	ASPH STAB BASE	100.00	500000.	0.35	12.00	24.00	90.00
3	C	SUBGRADE(200)	2.00	12100.	0.40	187.20	187.20	90.00

PAVEMENT DESIGN TYPE # 3 -- ACP + ASPH STAB BASE OVER SUBGRADE

PROB	DIST.-15	COUNTY-162	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	MCMULLEN	0517	03	030	SH 16	7/16/2013	3

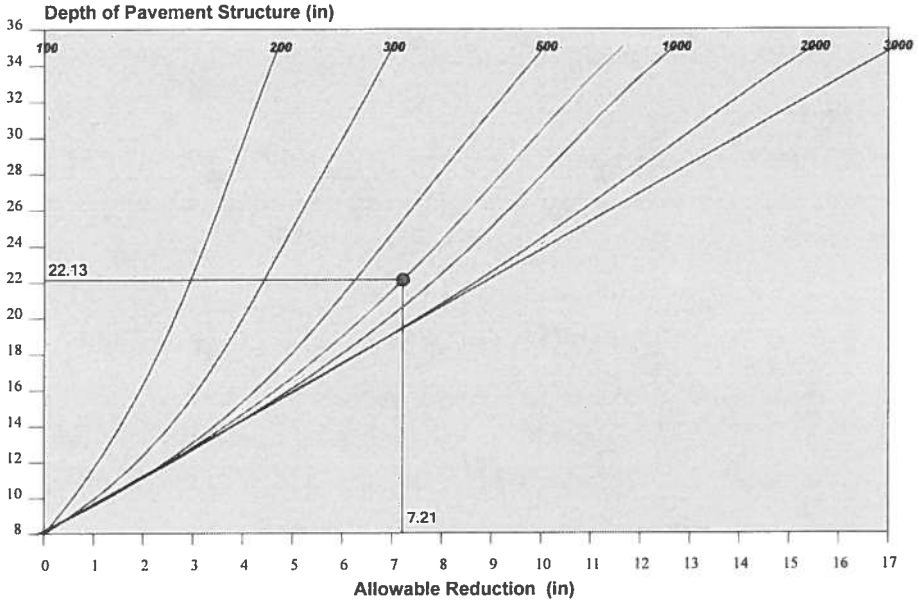
C. LEVEL C SUMMARY OF THE BEST DESIGN STRATEGIES
IN ORDER OF INCREASING TOTAL COST

	1	2
MATERIAL ARRANGEMENT	AB	AB
INIT. CONST. COST	42.92	54.03
OVERLAY CONST. COST	3.31	0.00
USER COST	0.01	0.00
ROUTINE MAINT. COST	0.00	0.00
SALVAGE VALUE	-8.99	-11.08
TOTAL COST	37.25	42.95
NUMBER OF LAYERS	2	2
LAYER DEPTH (INCHES)		
D(1)	3.00	3.00
D(2)	12.00	16.00
NO.OF PERF.PERIODS	2	1
PERF. TIME (YEARS)		
T(1)	13.	20.
T(2)	26.	
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)		
O(1)	2.5	

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 25

Exhibit F - Modified Triaxial Design Procedure

	Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
ASPH CONC PVMT	3.00	500.00	0.35	ASPH CONC PVMT
ASPH STAB BASE	12.00	500.00	0.35	ASPH STAB BASE
SUBGRADE(200)	289.00	12.80	0.40	SUBGRADE(200)
Bed Rock		1280.00	0.15	Bed Rock



Thickness Reduction Chart for Stabilized Layers

INPUT PARAMETERS:

The Heaviest Wheel Loads Daily (ATHWLD)	11500.0 (lb)
Percentage of TandemAxles	60.0 (%)
Modified Cohesionmeter Value	800.0
Design Wheel Load	14950.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	5.00

User Input TTC based on historical TEX-117-E

RESULT:

Triaxial Thickness Required	22.1 (in)
The FPS Design Thickness	15.0 (in)
Allowable Thickness Reduction	7.2 (in)
Modified Triaxial Thickness	14.9 (in)

TRIAXIAL CHECK CONCLUSION:

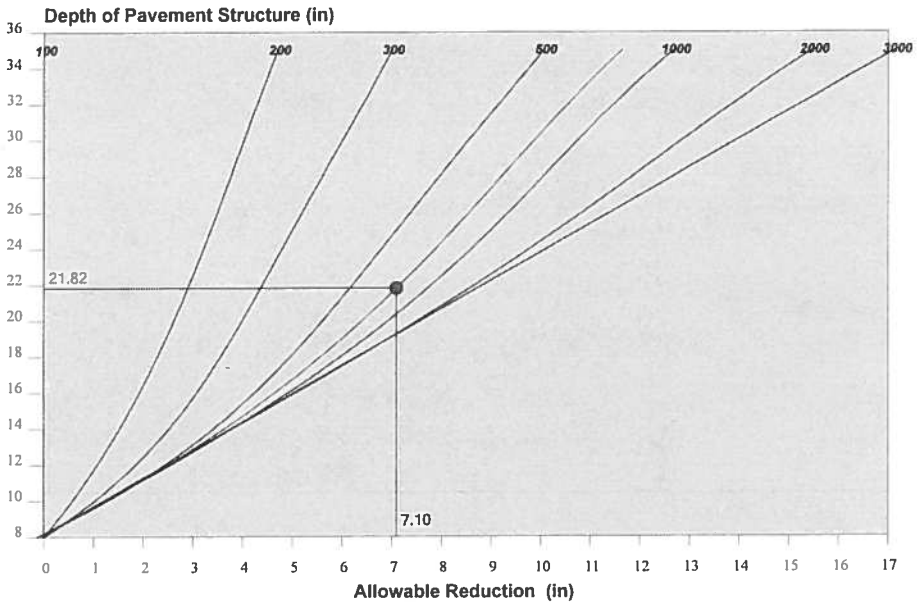
The Design OK !

FPS 21 Triaxial Design Check Output (FPS21-1.3Release:6-1-2012)

Highway	SH 16	Problem	001
C-S-J	0517 - 02 - 040	Date	7/16/2013
District	San Antonio	County	MCMULLEN

Design Type:Asphalt concrete + Asphalt Stabilized Base over Subgrade

	Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
ASPH CONC PVMT	3.00	500.00	0.35	ASPH CONC PVMT
ASPH STAB BASE	12.00	500.00	0.35	ASPH STAB BASE
SUBGRADE(200)	187.20	12.10	0.40	SUBGRADE(200)
Bed Rock		1210.00	0.15	Bed Rock



Thickness Reduction Chart for Stabilized Layers

INPUT PARAMETERS:

The Heaviest Wheel Loads Daily (ATHWLD)	11200.0 (lb)
Percentage of TandemAxles	60.0 (%)
Modified Cohesionmeter Value	800.0
Design Wheel Load	14560.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	5.00

User Input TTC based on historical TEX-117-E

RESULT:

Triaxial Thickness Required	21.8 (in)
The FPS Design Thickness	15.0 (in)
Allowable Thickness Reduction	7.1 (in)
Modified Triaxial Thickness	14.7 (in)

TRIAXIAL CHECK CONCLUSION:

The Design OK !

FPS 21 Triaxial Design Check Output		(FPS21-1.3Release:6-1-2012)	
Highway	SH 16	Problem	001
C-S-J	0517 - 03 - 030	Date	7/16/2013
District	San Antonio	County	MCMULLEN

Design Type:Asphalt concrete + Asphalt Stabilized Base over Subgrade

Surface Aggregate Selection Form

CSJ: 0517 - 02 - 040 **Date:** 03/04/13

Highway: SH 16

Limits: Atascosa/McMullen Co Line To McMullen/Duval Co

County: McMullen

District: SAT

Designer's Name: Mark Narendorf

Selection Guidelines for Bituminous Surface Aggregate Classification (SAC)

Demand for Friction	Low (1)	Moderate (2)	High (3)	DESIGNER'S RATING 1	2	3
Rain Fall (inches/year)	≤20	>20 ≤40	>40	☐	☒	☐
Traffic (ADT)	≤5000	>5000 ≤15,000	>15,000	☐	☒	☐
Speed (mph)	≤35	>35 ≤60	>60	☐	☐	☒
Trucks (%)	≤8	>8 ≤15	>15	☐	☐	☒
Vertical Grade (%)	≤2	>2 ≤5	>5	☐	☒	☐
Horizontal Curve (°)	≤3	>3 ≤7	>7	☐	☒	☐
Driveways (per mile)	≤5	>5 ≤10	>10	☒	☐	☐
Intersecting Roadways (ADT)	≤500	>500 ≤750	>750	☐	☐	☒
Wet Surface Crashes (%)	≤5	>5 <15	≥15	☒	☐	☐
Summary of Total Frictional Demand				19		
***Available Friction**	**Low (2)**	**Moderate (5)**	**High (8)**	**2**	**5**	**8**
Cross Slope (%)	<2	2 - 3	3 - 4	☐	☒	☐
Surface Design Life (years)	>10	>5 ≤10	≤5	☐	☒	☐
Macro Texture of proposed surface	Fine (Such as: HMAC Type 'D' and 'F')	Medium (Such as: HMAC Type 'C', CMHB, SuperPave, Microsurface)	Coarse (Such as: PFC, SMA, Seal Coat, NovaChip)	☐	☐	☒
Aggregate MicroTexture	SAC C	SAC B	SAC A	☐	☐	☒
Summary of Total Friction Available				26		
Does total available friction equal or exceed total frictional demand?				☒ Yes	☐ No	

*Parameters set by the designer that affect pavement friction.
Total friction available should always exceed total frictional demand.

Comments:

STATE OF TEXAS
LINDA COX
90090
LICENSED
PROFESSIONAL ENGINEER

Linda Cox, PE
7/17/13