SAN ANTONIO DISTRICT

PAVEMENT DESIGN REPORT

FOR

ATASCOSA COUNTY

FM 140

CSJ 0748-05-039,ETC.

BEGIN REF MRK: 0490+1.512
END REF MRK: 0504+0.077

LIMITS: From Bluntzer Rd To SH 16
LENGTH: 12.431 MI

PREPARED BY: Christie Lynn Hill, P.E. 7/17/13
Christie Lynn Hill, P.E. **Date**
Transportation Engineer

APPROVED BY: 7-18-13
Brett Haggerty, P.E. **Date**
Pavement Design Engineer

APPROVED BY: P.E. 7-18-13
Gina Gallegos, P.E. Date
Director of Construction

GENERAL PROJECT INFORMATION

This flexible pavement design is for the proposed construction of FM 140 from Bluntzer Rd to SH 16 in Atascosa County

The existing roadway consists of two 11 foot lanes with no shoulders. The proposed roadway consists of two 11' lanes and 3' shoulders. A project location map is shown as Exhibit A and typical sections are attached 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. The 20 year projected traffic is summarized below:

From Bluntzer Road to CR 343

2013 ADT:	700
2033 ADT:	1,000
18k ESALs:	228,000
Percent Trucks in ADT:	12.7
ATHWLD:	9,800
Percent Tandem Axles in ATHWLD:	50

From CR 343 to SH 16

2013 ADT:	800
2033 ADT:	1,200
18k ESALs:	389,000
Percent Trucks in ADT:	18.8
ATHWLD:	10,000
Percent Tandem Axles in ATHWLD:	40

Due to the increase truck traffic from the Eagle Ford Shale the ATHWLD was increased to 17,000 and the 18k ESALS were increased to 5,300,000.

Subgrade Material Properties

The *Soil Survey of Atascosa County, Texas* (March, 1977) indicates that the predominant soil type in the vicinity from Bluntzer Road to CR 343 consists of Hanis Sandy clay loam, and Webb fine sandy loam, 1 to 3 percent slopes. The predominant soil type in the vicinity from CR 343 to SH 16 is Webb fine sandy loam and Floresville fine sandy loam, 1 to 3 percent slopes. The USCS classification for Hanis is SC, CL and its AASHTO classification is A-4, A-6 and A-7. The USCS classification for Webb is SM, SM-SC and

its AASHTO classification is A-2, A-4. The USCS classification for Floresville is SM, SC, SM-SC and its AASHTO classification is A-2, A-4. The soil's average liquid limit is 25 and its average plasticity index is 7.

The Triaxial Classification of the subgrade soils, grouped by Soil Conservation Service Series, Research Report 3-05-71-035, is 4.8. A subgrade modulus of 10,800 psi was back calculated from Falling Weight Deflectometer data attached as Exhibit D.

Pavement Design Data

The pavement structure was designed using the FPS19 program and the design input values were selected using TxDOT guidelines. The TTI Modulus Analysis Summary Report is shown in Exhibit D. All design data is included in Exhibit E which is the FPS19 input and output. The selected FPS19 design was then checked with the Modified Triaxial Design Procedure and did not pass the Modified Triaxial Check. The design data for the Modified Triaxial Design is shown as Exhibit F. The Pavement Design was based on a 5 year design.

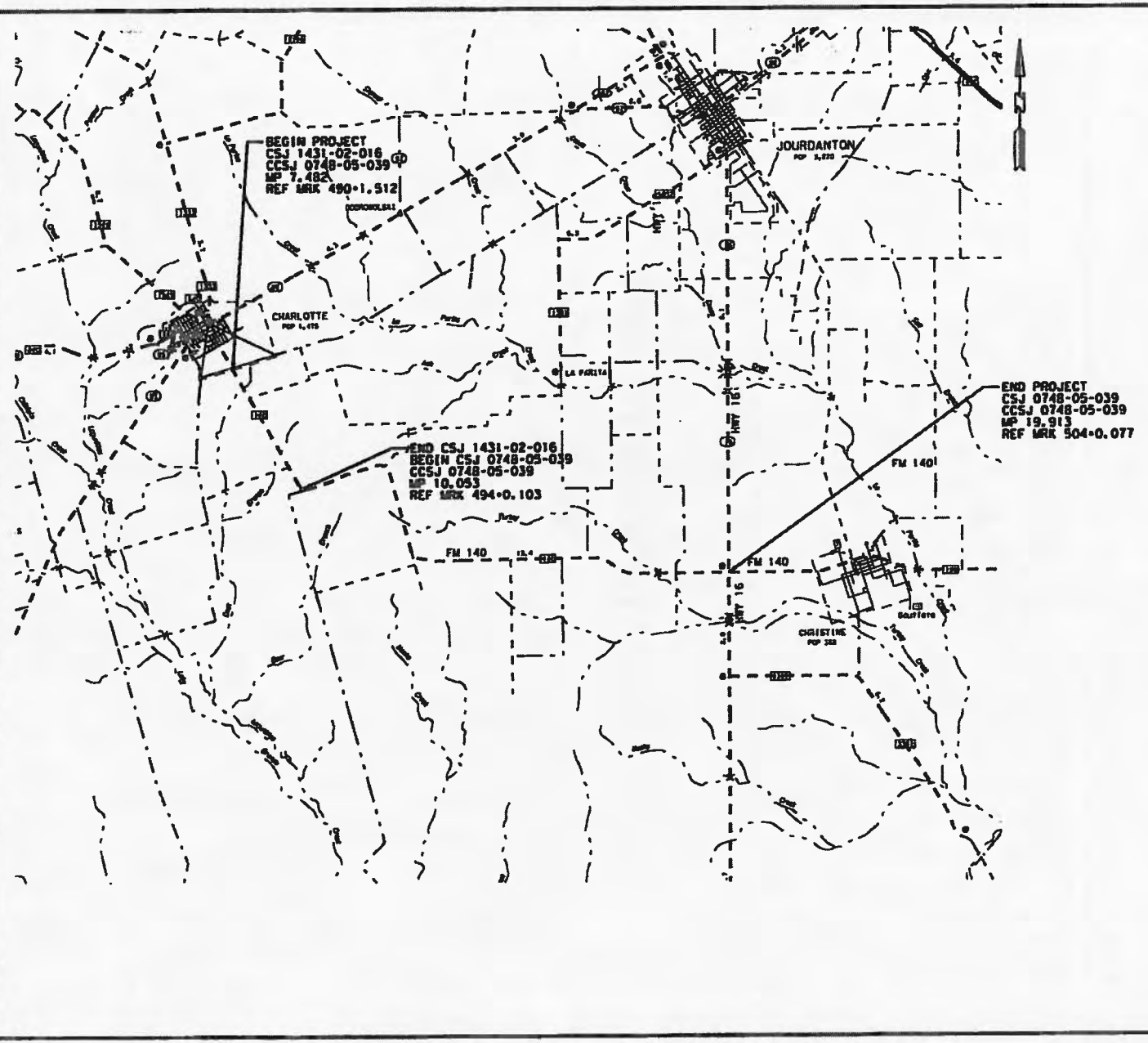
CONCLUSIONS

The pavement design from Bluntzer Rd to SH 16 will be as follows:

2-2" HMA (TY C)
6" REWORK BASE MATL (TY B)(6")(DENS CONT)
CEMENT TREAT (EXST MTL)(6") (for Base)
6" CEMENT TREAT (SUBGRADE)(6")

Exhibit A

Project Location Map



CHRISTIE LYNN HILL, P.E.

FM 140
LOCATION
MAP

NOT TO SCALE

SHEET 1 OF 1

DIST	COUNTY	CONT	SECT	JOB	HIGHWAY
SAT	ATASCOSA	0748	05	038, ETC.	FM 140

SHEET NO. 13

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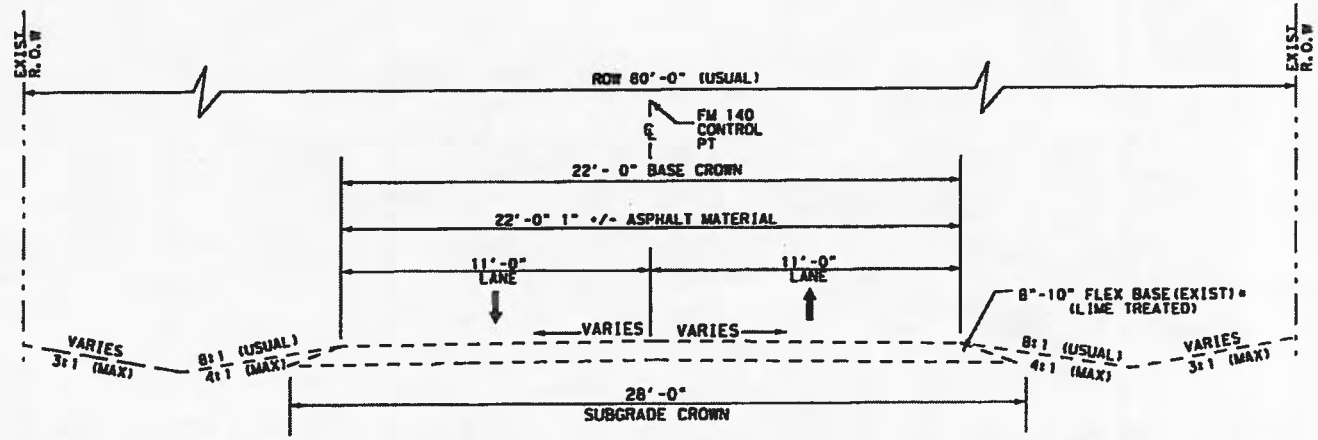
Exhibit B

Existing and Proposed Typical Sections



FM 140
EXISTING TYPICAL SECTION

* AREAS OF DIFFERENT MATERIALS MAY BE ENCOUNTERED

NOT TO SCALE

CHRISTIE LYNN HILL, P.E.

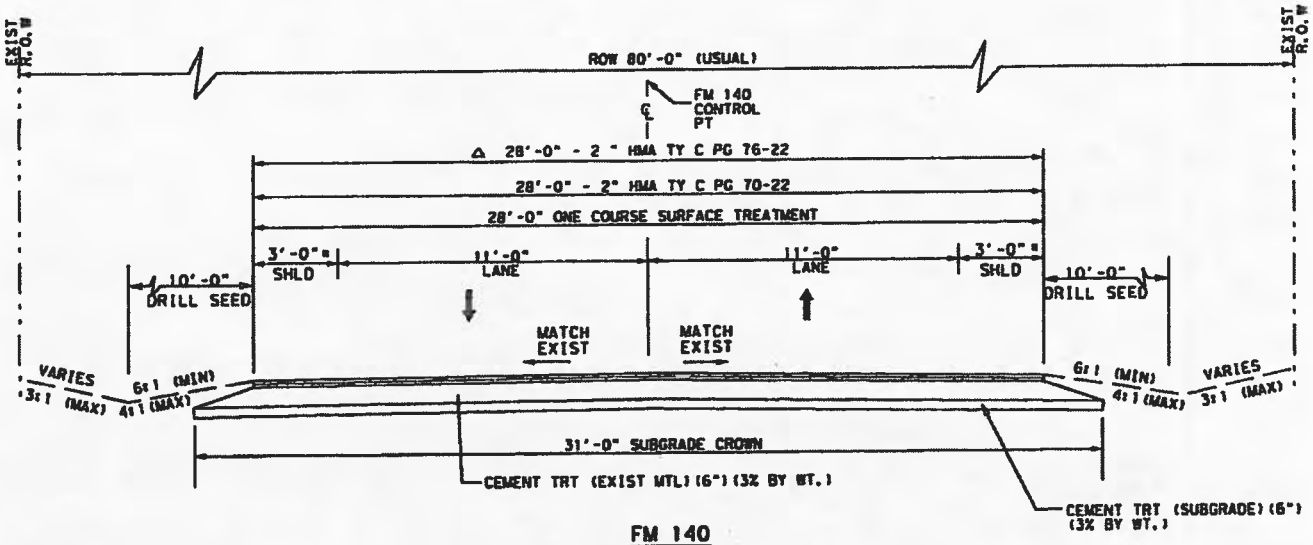
FM 140
EXISTING
TYPICAL SECTION

Texas Department of Transportation

SHEET 1 OF 2

DIST	SECT	JOB	HIGHWAY
0748	05	039, ETC.	FM 140
DIST	COUNTY		SHEET NO.
BAT	ATASCOSA		14

DATE: 07/16/2013 03:25 PM



FM 140
PROPOSED TYPICAL SECTION
STA 50+71.40 TO STA 707+03.03

* SHOULDER WIDTH IS 4' BETWEEN THE FOLLOWING STATIONS:
STA. 225+17.43 TO STA. 235+02.70; STA. 272+51.75 TO STA. 290+73.42;
STA. 373+46.97 TO STA. 386+98.64; STA. 560+47.17 TO STA. 581+89.44;
STA. 595+17.67 TO 610+92.67. THERE IS A 100' TRANSITION
BETWEEN THE 3' AND 4' SHOULDER.

△ ONE COURSE SURFACE TREATMENT WILL CONSIST OF
ASPH(RC-250) AND AGGR (TY B GR 5 SAC B)
SEE SEAL COAT MATERIAL SELECTION TABLE SHEET

NOT TO SCALE

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FM 140
PROPOSED
TYPICAL SECTIONS

Texas Department of Transportation
SHEET 2 OF 2

CONT	SECT	JOB	HIGHWAY
0748	05	039, ETC.	FM 140
DIST	COUNTY		SHEET NO.
SAT	ATASCOSA		15

DATE: 07/16/2013 04:27 PM

Exhibit C

TP&P Traffic Analysis for Highway Design

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

November 2, 2012

San Antonio District

Description of Location	Average Daily Traffic		Base Year				ATHWLD	Percent Tandem Axes in ATHWLD	Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033)			
			Dir Dist	K	Percent Trucks				Flexible Pavement	S N	Rigid Pavement	SLAB
	2013	2033	%	Factor	ADT	DHV						
FM 140 From Bluntzer Road To County Road 343 Atascosa County	700	1,000	51 - 49	13.5	12.7	9.5	9,800	50	228,000	3	258,000	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	% of DHV
Light Duty	87.3	90.5
Medium Duty	9.6	7.2
Heavy Duty	3.1	2.3

TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

October 18, 2012

San Antonio District

Description of Location	Average Daily Traffic		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
	2013	2033										
FM 140 From CR 343 To SH 16 Atascosa County	800	1,200	66 - 34	11.6	18.8	14.1	10,000	40	389,000	3	440,000	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	81.2	85.9
Medium Duty	13.9	10.4
Heavy Duty	4.9	3.7

Exhibit D

Falling Weight Deflectometer Data

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

District:15 (San Antonio)
County :7 (ATASCOSA)
Highway/Road: FM0140

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum
Pavement:	0.50	663,400	663,400
Base:	10.50	5,000	250,000
Subbase:	0.00		
Subgrade:	172.17(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 Dpth to ERR/Sens	Bedrock	
0.400	10,141	37.68	24.52	12.91	8.02	5.67	4.49	3.52	663.4	54.8	0.0	7.1	7.49	300.0	
0.800	11,059	29.64	18.90	10.46	6.33	3.99	2.85	2.24	663.4	73.8	0.0	10.5	5.15	153.2	
1.165	10,200	30.60	18.34	11.08	7.72	5.07	3.30	2.42	663.4	75.1	0.0	8.5	1.83	152.6	
1.608	10,117	34.21	20.35	10.59	6.38	4.11	3.22	2.36	663.4	52.3	0.0	9.2	6.50	177.2	
2.001	11,623	18.44	9.53	5.98	4.14	2.99	2.35	1.66	663.4	140.4	0.0	18.7	8.45	300.0	
2.414	9,632	58.09	30.96	10.49	5.80	4.14	3.34	2.67	663.4	19.5	0.0	7.7	13.77	57.6	
2.800	10,129	36.10	20.98	11.35	7.36	5.34	4.17	3.14	663.4	54.9	0.0	8.1	6.71	300.0	
3.203	11,388	19.48	9.59	5.22	3.29	2.09	1.52	1.25	663.4	93.5	0.0	22.3	1.82	146.2	
3.605	11,241	18.60	10.61	5.83	3.95	2.99	2.42	1.93	663.4	129.2	0.0	17.8	7.89	300.0	
4.416	10,411	35.32	23.74	13.71	8.70	5.87	4.35	3.31	663.4	67.4	0.0	7.0	4.74	266.4	
4.811	10,725	26.53	15.78	9.56	6.17	4.03	3.10	2.14	663.4	88.7	0.0	10.8	3.21	184.2	
5.207	11,805	15.29	10.35	6.59	4.75	3.46	2.59	1.94	663.4	250.0	0.0	15.6	4.31	248.6	*
6.011	11,281	19.83	13.05	8.91	6.36	4.37	3.65	2.51	663.4	198.1	0.0	10.9	4.87	262.3	
6.404	10,884	17.37	11.98	6.47	4.17	2.77	2.07	1.62	663.4	144.5	0.0	16.0	5.80	196.0	
6.805	10,272	39.59	25.44	14.64	9.12	6.04	4.86	3.28	663.4	55.7	0.0	6.5	5.96	233.3	
7.203	10,498	32.39	19.38	10.23	5.81	3.55	2.87	2.04	663.4	55.8	0.0	10.4	7.34	134.9	
8.008	10,395	30.01	16.79	8.18	5.60	3.47	3.18	2.50	663.4	59.4	0.0	11.5	8.34	300.0	
8.379	10,494	28.06	15.90	9.30	6.04	4.45	3.60	2.75	663.4	79.7	0.0	10.4	6.60	300.0	
8.809	10,423	25.69	17.29	10.95	7.13	4.55	3.02	1.96	663.4	102.2	0.0	9.1	3.48	163.4	
9.222	10,872	25.31	14.80	8.24	5.51	3.96	3.09	2.44	663.4	90.9	0.0	12.1	6.01	300.0	
9.603	10,129	37.04	22.01	10.32	6.09	4.27	3.32	2.66	663.4	44.6	0.0	9.1	8.51	193.6	
10.006	10,141	22.72	14.31	8.79	5.98	4.38	3.45	2.76	663.4	119.0	0.0	10.1	5.58	300.0	
10.420	10,073	31.28	18.53	9.45	5.86	4.03	3.04	2.33	663.4	57.9	0.0	10.0	6.16	293.2	
10.813	10,558	31.20	18.57	9.78	5.93	4.12	3.26	2.58	663.4	62.8	0.0	10.3	6.70	247.0	
11.204	9,891	38.61	22.04	9.21	5.04	3.64	2.82	2.25	663.4	35.8	0.0	9.8	10.44	105.2	
11.621	10,312	42.80	21.76	9.89	5.65	3.93	3.15	2.46	663.4	33.0	0.0	9.6	8.12	148.8	
12.002	9,843	30.61	19.50	10.76	6.35	3.84	2.70	2.07	663.4	60.7	0.0	9.2	7.31	130.6	
12.478	9,493	46.97	27.81	12.37	6.85	4.57	3.49	2.74	663.4	29.8	0.0	7.2	9.28	130.7	
12.800	10,506	14.81	10.38	6.68	4.51	3.02	2.13	1.56	663.4	215.6	0.0	14.6	1.70	207.7	
13.203	9,708	48.89	23.26	9.55	4.83	3.20	2.44	1.88	663.4	23.3	0.0	9.7	11.10	87.6	
13.610	10,161	47.22	18.97	7.62	4.63	3.03	2.29	1.83	663.4	24.1	0.0	12.0	5.87	82.6	
14.003	9,895	40.43	18.83	8.96	5.37	3.24	2.54	2.04	663.4	32.0	0.0	10.3	5.01	125.6	
14.443	9,783	61.45	35.44	17.92	10.80	5.78	4.61	3.39	663.4	24.7	0.0	5.3	7.71	101.1	
Mean:		32.49	18.78	9.76	6.07	4.06	3.13	2.37	663.4	80.3	0.0	10.8	6.48	183.2	
Std. Dev:		11.66	6.08	2.65	1.57	0.95	0.76	0.55	0.0	56.5	0.0	3.7	2.63	90.6	
Var Coeff(%):		35.88	32.40	27.16	25.84	23.42	24.34	23.37	0.0	70.4	0.0	34.2	40.53	51.7	

Exhibit E

FPS Input and Output Data

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

FP S21-1.3 — *FLEXIBLE PAVEMENT SYSTEM* — Release:6-1-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB	DIST.-15	COUNTY- 7	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
1	San Antonio	ATASCOSA	0748	05	039	FM140	7/17/2013	1

COMMENTS ABOUT THIS PROBLEM

BASIC DESIGN CRITERIA

LENGTH OF THE ANALYSIS PERIOD (YEARS)	20.0
MINIMUM TIME TO FIRST OVERLAY (YEARS)	5.0
MINIMUM TIME BETWEEN OVERLAYS (YEARS)	5.0
DESIGN CONFIDENCE LEVEL (95.0%)	C
SERVICEABILITY INDEX OF THE INITIAL STRUCTURE	4.5
FINAL SERVICEABILITY INDEX P2	2.5
SERVICEABILITY INDEX P1 AFTER AN OVERLAY	4.0
DISTRICT TEMPERATURE CONSTANT	31.0
SUBGRADE ELASTIC MODULUS by COUNTY (ksi)	10.80
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)	700.
ADT AT END OF TWENTY YEARS (VEHICLES/DAY)	1000.
ONE-DIRECTION 20YEAR 18 kip ESAL (millions)	5.300
AVERAGE APPROACH SPEED TO THE OVERLAY ZONE(MPH)	65.0
AVERAGE SPEED THROUGH OVERLAY ZONE (OVERLAY DIRECTION)(MPH)	40.0
AVERAGE SPEED THROUGH OVERLAY ZONE (NON-OVERLAY DIRECTION) (MPH)	40.0
PROPORTION OF ADT ARRIVING EACH HOUR OF CONSTRUCTION (PERCENT)	6.0
PERCENT TRUCKS IN ADT	12.7

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB	DIST.-15	COUNTY- 7	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
1	San Antonio	ATASCOSA	0748	05	039	FM140	7/17/2013	2

INPUT DATA CONTINUED

CONSTRUCTION AND MAINTENANCE DATA

MINIMUM OVERLAY THICKNESS (INCHES)	1.5
OVERLAY CONSTRUCTION TIME (HOURS/DAY)	12.0
ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)	1.90
ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)	200.0
WIDTH OF EACH LANE (FEET)	11.0
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	MATERIALS CODE	NAME	COST PER CY	E MODULUS	POISSON RATIO	MIN. DEPTH	MAX. DEPTH	SALVAGE PCT.
1	B	DENSE-GRADED HMA T	115.00	500000.	0.35	4.00	4.00	30.00
2	M	FLEXIBLE BASE	37.00	130000.	0.25	6.00	6.00	75.00
3	P	CEMENT STABILIZED	45.00	35000.	0.30	6.00	6.00	70.00
4	T	SUBGRADE	2.00	10800.	0.40	172.20	172.20	90.00

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

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

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB	DIST.-15	COUNTY- 7	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
1	San Antonio	ATASCOSA	0748	05	039	FM140	7/17/2013	3

C. LEVEL C SUMMARY OF THE BEST DESIGN STRATEGIES
IN ORDER OF INCREASING TOTAL COST
1

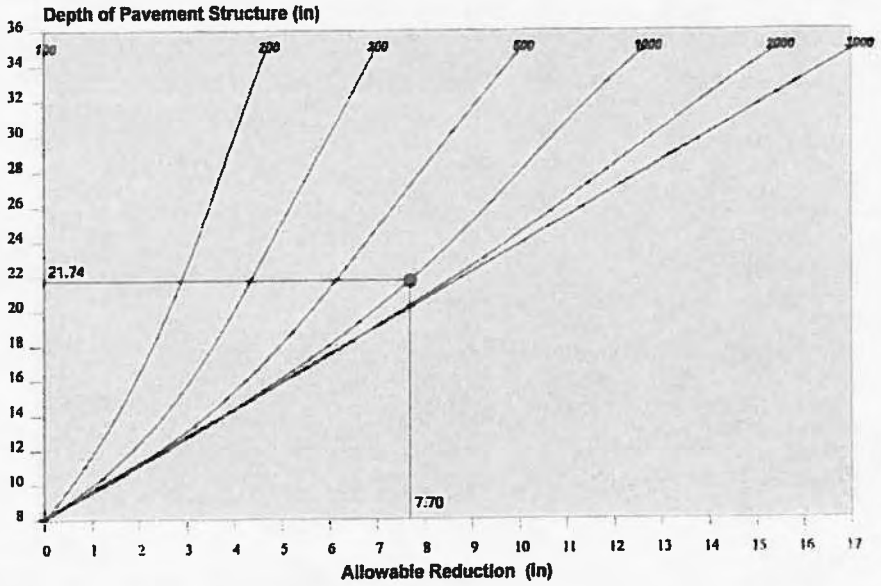
MATERIAL ARRANGEMENT	BMP
INIT. CONST. COST	26.44
OVERLAY CONST. COST	3.04
USER COST	0.00
ROUTINE MAINT. COST	0.00
SALVAGE VALUE	-3.91
TOTAL COST	25.57
NUMBER OF LAYERS	3
LAYER DEPTH (INCHES)	
D(1)	4.00
D(2)	6.00
D(3)	6.00
NO.OF PERF.PERIODS	2
PERF. TIME (YEARS)	
T(1)	11.
T(2)	21.
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)	
O(1)	2.0

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 1

Exhibit F

Modified Triaxial Design Procedure

	Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
DENSE-GRADED HMA Thin	4.00	500.00	0.35	DENSE-GRADED HMA Thin
FLEXIBLE BASE	6.00	100.00	0.25	FLEXIBLE BASE
CEMENT STABILIZED BASE	6.00	35.00	0.30	CEMENT STABILIZED BASE
SUBGRADE	172.20	10.80	0.40	SUBGRADE
Bed Rock		1080.00	0.15	Bed Rock



Thickness Reduction Chart for Stabilized Layers

INPUT PARAMETERS:

The Heaviest Wheel Loads Daily (ATHWLD)	17000.0 (lb)
Percentage of Tandem Axles	49.0 (%)
Modified Cohesionmeter Value	1000.0
Design Wheel Load	17000.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	4.80
User Input TTC based on historical TEX-117-E	

RESULT:

Triaxial Thickness Required	21.7 (in)
The FPS Design Thickness	16.0 (in)
Allowable Thickness Reduction	7.7 (in)
Modified Triaxial Thickness	14.0 (in)

TRIAXIAL CHECK CONCLUSION:

The Design OK !

FPS 21 Triaxial Design Check Output (FPS21-1.3Release:6-1-2012)			
Highway	FM140	Problem	1
C-S-J	0748 - 05 - 039	Date	7/17/2013
District	San Antonio	County	ATASCOSA
Design Type:User Defined Pavement Design			

Exhibit G

Surface Aggregate Selection Form

Surface Aggregate Selection Form

Form 2088
(Rev 05/12)
Page 1 of 1

CSJ: 0748 - 05 - 039 **Date:** 01/24/13

Highway: FM 140

Limits: From Bluntzer Road To SH 16

County: Atascosa

District: San Antonio

Designer's Name: Christie Lynn Hill, P.E.

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				16		
***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				23		
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:
Given an Overall Frictional Demand of Moderate I chose an Aggregate Classification of "B". I base this decision on the high volume of Trucks and the Moderate horizontal curves and speed.

Christie Lynn Hill, P.E. 1/24/13