

SAN ANTONIO DISTRICT  
PAVEMENT DESIGN REPORT

FOR

ATASCOSA COUNTY

FM 791

FROM: US 281A

TO: KARNES/ATASCOSA COUNTY LINE

CSJ: 1739-02-015

LENGTH: 12.012 MI

PREPARED BY:

\_\_\_\_\_  
Jules B. Zinsmeyer, EIT  
Engineering Specialist

\_\_\_\_\_  
Date

\_\_\_\_\_  
Eddie Reyes, PE  
Area Engineer

\_\_\_\_\_  
Date

RECOMMEND  
FOR APPROVAL BY:

\_\_\_\_\_  
Brett Haggerty, PE  
District Pavement Engineer, Lic. No. 101098

\_\_\_\_\_  
Date

APPROVED BY:

\_\_\_\_\_  
Gina Gallegos, PE  
Director of Construction

\_\_\_\_\_  
Date

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 rehabilitation and widening of FM 791 from US 281A to the Karnes/Atascosa County Line for a project length of 12.012 miles. The existing roadway consists of two 12 foot lanes. The proposed project will widen the existing roadway to two 11 foot lanes with 3 foot shoulders. The project map is shown as Exhibit A and typical sections are shown as Exhibit B.

## PROJECT DATA

### Traffic Data

A traffic analysis report for pavement design from the Transportation Planning and Programming Division (TP&P) is shown as Exhibit C. The results of the report are summarized below:

2013 ADT: 1,700	Percent Trucks in ADT: 26.0
2033 ADT: 3,000	ATHWLD: 10,900
Flex 18k ESALs: 2,151,000	Percent Tandem Axles in ATHWLD: 60

Through guidance from the San Antonio District Lab, an additional 4,116,552 Flex 18k ESALs were added to the reported Flex 18k ESALs. Also, a minimum ATHWLD was set. Therefore, the pavement design will be based on the following information:

2013 ADT: 1,700	Percent Trucks in ADT: 26.0
2033 ADT: 3,000	ATHWLD: 14,000
Flex 18k ESALs: 6,268,000	Percent Tandem Axles in ATHWLD: 60

The subgrade consists of Monteola Soils. Its Triaxial Classification, grouped by the Soil Conservation Service Series, Research Report 3-05-71-035, is 5.00. Pavement Data Request Laboratory Results are shown as Exhibit D. Falling Weight Deflectometer (FWD) data is attached as Exhibit E. The subgrade modulus is 9,100 psi.

## FLEXIBLE PAVEMENT DESIGN DATA

The designs were performed with the FPS 21 program and input values were selected using TxDOT guidelines. The pavement design for this project will consist of the following:

10 inches of existing roadway material, consisting of seal coat materials and existing flexible base materials, will be removed and stockpiled. 8 inches of the remaining roadway material, consisting of remaining flexible base and existing subgrade material, will be removed and discarded. The existing stockpiled material will be used to reshape the roadway at the proposed width at a depth of 6.5 inches. This material will be cement treated, using proposed 3% cement, and compacted in place. This will be followed by a 6 inch layer of flexible base (TY A Grade 2 or Grade 5) placed in two equal lifts. A one course surface treatment (TIER II asphalt with grade 4 aggregate) will be placed over the flexible base. The asphalt and aggregate material will be selected from the Seal Coat Material Selection Table, Form 2388 (Exhibit F). Surface Aggregate Class Selection Form, Form 2088, is attached as Exhibit G. Following the one course surface treatment, 3.5 inches of Dense-Graded Hot Mix Asphalt TY-C PG 64-22 will be placed. This

will serve as a temporary driving course until the final 2 inches of Dense-Graded Hot Mix Asphalt TY-C PG 76-22 is placed.

All design data is included as Exhibit H, FPS input and output.

The selected FPS design was checked with the Modified Triaxial Design Procedure (Exhibit I). The FPS design meets the Modified Triaxial Design for both the temporary (6.5 inches of cement stabilized salvaged base, 6 inches of flex base, one course seal and 3.5 inches of dense-graded hot mix asphalt TY-C PG 64-22; 16 inches is greater than Modified Triaxial Thickness of 15.7 inches) and the final full pavement design.

#### CONCLUSIONS

The approved pavement design for this project is:

3.0 inches D-GR HMA(QCQA) TY-C PG 76-22

3.5 inches D-GR HMA(METH) TY-C PG 64-22

One Course Surface Treatment

6.0 inches Flexible Base (TY A, Grade 2 or Grade 5)

6.5 inches Cement Treated Existing Flexible Base (3% Cement)

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL

EXHIBIT A – PROJECT LOCATION MAP

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL

FEDERAL-AID PROJECT  
ATASCOSA COUNTY  
FM 791

PROJECT NO:  
CSJ: 1739-02-015

LIMITS: FROM US 281A TO KARNES/ATASCOSA COUNTY LINE  
PROJECT LENGTH: 63,423.36 FT = 12.012 MILES  
FOR WORK CONSISTING OF REHABILITATE AND WIDEN EXISTING  
ROADWAY TO ADD SHOULDERS

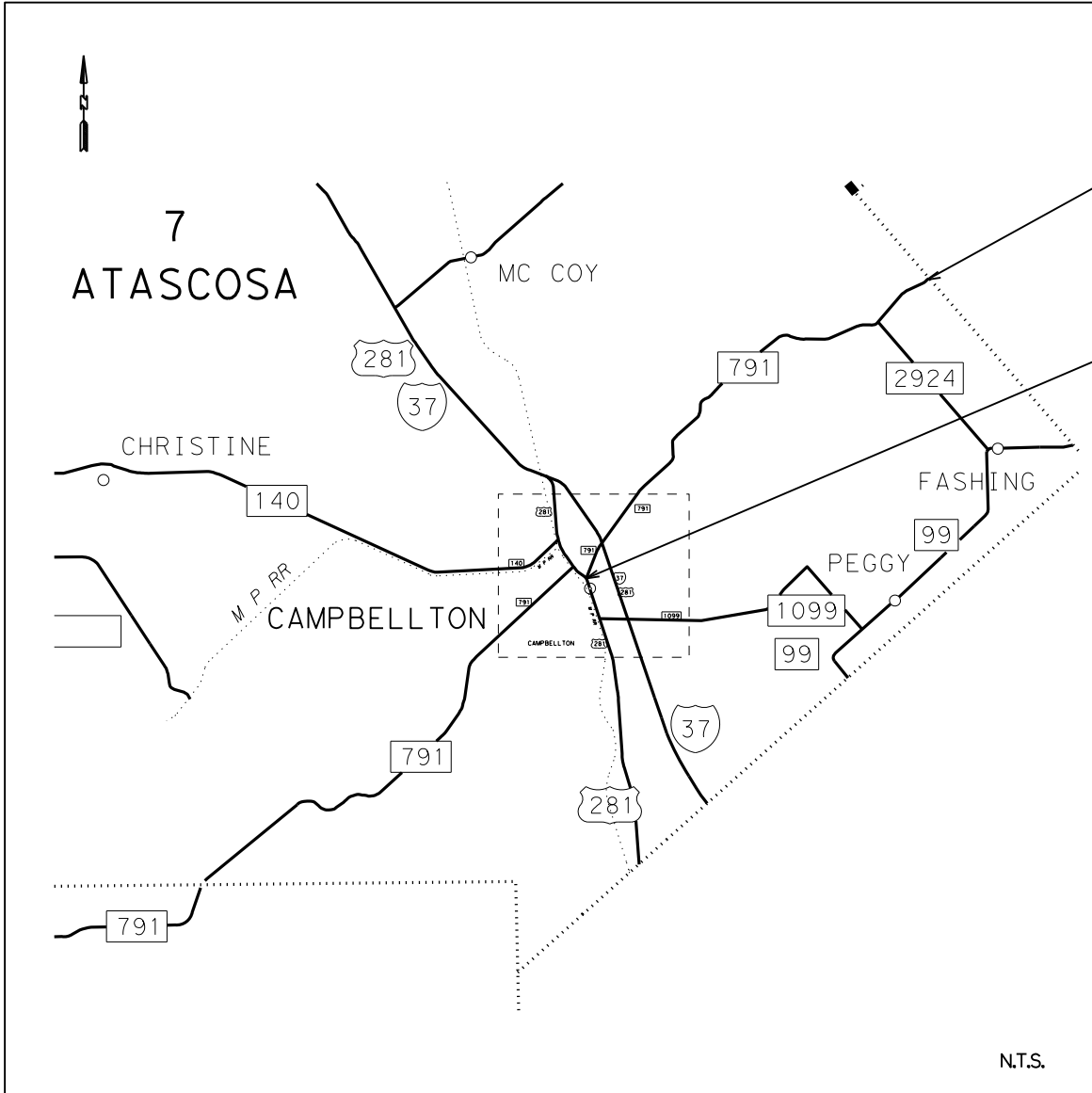
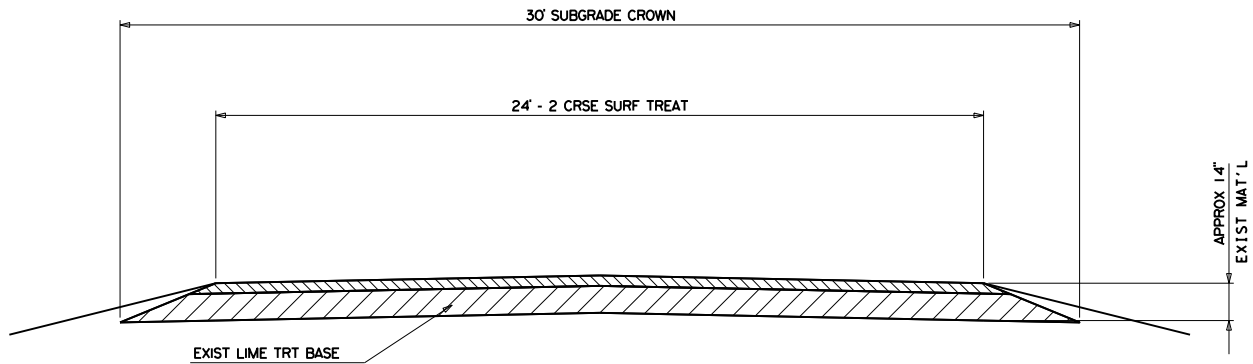
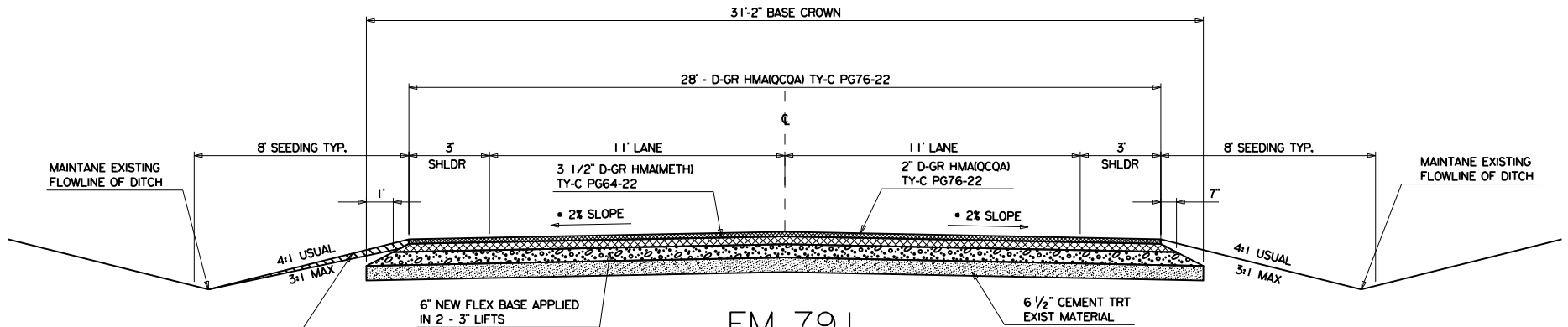


EXHIBIT B – TYPICAL SECTIONS

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL



FM 791  
EXISTING TYPICAL SECTION



FM 791  
PROPOSED TYPICAL SECTION

ITEM 134 BACKFILL (TY B)  
(EST. @ 3.16 CY PER STATION  
FOR CONTRACTORS INFORMATION ONLY)

**NOTES:**

REMOVAL OF EXISTING SUBGRADE MATERIAL SHALL BE PAID FOR BY ITEM 110 EXCAVATION.

ADDITIONAL NEW FLEX BASE NEEDED TO ACHIEVE 6 1/2" OF CEMENT TREATED EXISTING MATERIAL WILL NOT BE PAID FOR SEPARATELY BUT WILL BE CONSIDERED SUBSIDIARY TO ITEM 251 REWORKING BASE COURSES.

• FOR CONTRACTORS INFORMATION ONLY:  
ADDITIONAL FLEX BASE NEEDED TO ACHIEVE 6 1/2" CALCULATED AT 1.1 CY/100' STATION

**TYPICAL ROADWAY SEQUENCE OF WORK**

SCARIFY, SALVAGE AND STOCKPILE 10" OF EXISTING MATERIAL. EXCAVATE ADDITIONAL 8" OF EXISTING MATERIAL AND WIDEN SUBGRADE TO NEW LINES AND GRADES. REPLACE STOCKPILED MATERIAL & ADDITIONAL NEW FLEX BASE AS NEEDED TO ACHIEVE A DEPTH OF 6 1/2" AND CEMENT TREAT.

ADD ADDITIONAL 6" OF NEW FLEX BASE IN TWO 3" LIFTS TO LINES AND GRADES AS SHOWN ON PLANS. PLACE 3 1/2" HMA, PLACE 2" SURFACE COURSE HMA TO A WIDTH OF 28'.

EXHIBIT C – TP&P TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL





# MEMORANDUM

TEXAS DEPARTMENT  
OF TRANSPORTATION

2013 MAR -1 AM 9: 22

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

**DATE:** February 22, 2013

**FROM:** William E. Knowles, P.E.

**SUBJECT:** Traffic Data  
CSJ: 1739-02-015  
FM 791:  
From US 281A  
To Karnes/Atascosa County Line  
Atascosa County

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Attached is a tabulation showing traffic analysis for highway design for the 2013 to 2033 twenty year design period for the specified limits of the route. Also included is a tabulation showing data for use in air and noise analysis.

Please refer to your original memorandum dated January 18, 2013.

If you have any questions or need additional information, please contact George Petrek at (512) 486-5140.

Attachment

cc: ✓ Lorri Pavliska, SAT  
Design Division

A handwritten signature in black ink, appearing to read "William E. Knowles".

## TRAFFIC ANALYSIS FOR HIGHWAY DESIGN

San Antonio District

February 19, 2013

									Total Number of Equivalent 18k Single Axle Load Applications One Direction Expected for a 20 Year Period (2013 to 2033)			
Description of Location	Average Daily Traffic		Dir Dist %	K Factor	Percent Trucks		ATHWLD	Percent Tandem Axles in ATHWLD	Flexible Pavement	S N	Rigid Pavement	SLAB
	2013	2033			ADT	DHV						
	<b>FM 791</b>  From US 281A To Karnes/Atascosa County Line  Atascosa County	1,700			3,000	53 - 47						

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	74.0	80.5
Medium Duty	6.4	4.8
Heavy Duty	19.6	14.7

EXHIBIT D – PAVEMENT DATA REQUEST LABORATORY RESULTS

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL

**Pavement Data From FWD and Bores**

<b>County</b>	ATASCOSA	<b>CSJ</b>	1739-02-015
<b>Highway</b>	FM 791		
<b>Site Description</b>	TRM 506+2.114 TO TRM 520+0.109		
<b>Distance</b>	12.012		

Location Number	Layer Number	Depth (inches)	Description	Modulus (ksi)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
1	1	0.5	Seal Coat	663.4	N/A	N/A	N/A	N/A
	2	10.5	Flexible Base	88.2	N/A	N/A	N/A	N/A
	3	183.2	Subgrade	9.1	N/A	N/A	N/A	N/A

EXHIBIT E – FALLING WEIGHT DEFLECTOMETER DATA

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT)

(Version 6.0)

District:15 (San Antonio)  
 County :7 (ATASCOSA)  
 Highway/Road: FM0791

	Thickness(in)	MODULI RANGE(psi)		Poisson Ratio Values	
Pavement:	0.50	Minimum	Maximum	H1: v =	0.35
Base:	10.50	663,400	663,400	H2: v =	0.35
Subbase:	0.00	10,000	150,000	H3: v =	0.00
Subgrade:	135.82(by DB)	5,000		H4: v =	0.40

Station	Load (lbs)	Measured Deflection (mils):							Calculated Moduli values (ksi):				Absolute Dpth to	
		R1	R2	R3	R4	R5	R6	R7	SURF (E1)	BASE (E2)	SUBB (E3)	SUBG (E4)	ERR/Sens	Bedrock
0.000	9,712	27.69	17.48	10.60	6.96	4.73	3.41	2.64	663.4	89.2	0.0	7.5	4.27	263.9
1.200	10,057	32.40	18.46	7.72	4.37	2.94	2.24	1.70	663.4	45.8	0.0	11.2	10.34	103.0
1.604	9,624	47.93	27.04	10.22	5.04	2.96	2.07	1.59	663.4	24.9	0.0	8.2	16.45	70.2
1.846	9,891	20.03	12.73	9.49	6.46	4.84	3.35	2.33	663.4	150.0	0.0	8.8	8.97	190.4 *
3.405	10,284	26.66	21.03	17.31	13.59	10.24	7.76	4.86	663.4	145.6	0.0	4.9	16.36	146.6 *
3.826	10,375	26.46	21.48	16.53	11.93	8.26	5.85	4.30	663.4	150.0	0.0	5.1	8.22	252.2 *
4.605	9,493	45.50	28.58	14.80	8.67	5.66	4.13	3.33	663.4	39.2	0.0	5.6	7.08	205.5
5.406	10,220	21.04	13.60	9.41	6.61	4.65	3.50	2.73	663.4	150.0	0.0	8.8	7.33	300.0 *
5.900	10,490	14.83	10.95	7.76	5.37	3.52	2.30	1.65	663.4	150.0	0.0	12.4	11.08	148.1 *
6.207	9,160	56.54	24.33	7.74	3.97	2.87	2.40	2.09	663.4	17.1	0.0	9.4	15.11	55.2
7.404	10,153	28.59	19.20	14.90	11.72	8.90	6.61	5.04	663.4	150.0	0.0	5.0	11.29	300.0 *
7.837	9,998	24.89	18.00	12.91	9.04	6.67	4.87	3.66	663.4	150.0	0.0	5.9	6.07	300.0 *
8.200	9,926	24.04	13.60	7.71	4.82	3.51	2.65	2.13	663.4	87.2	0.0	11.2	7.23	300.0
8.607	9,692	24.73	11.70	5.90	3.55	2.60	1.94	1.52	663.4	60.0	0.0	14.6	7.70	210.6
9.013	9,942	21.45	15.69	12.06	8.65	6.09	4.19	3.02	663.4	150.0	0.0	6.7	9.76	196.7 *
9.411	10,149	41.28	22.37	11.01	6.57	4.72	3.40	2.55	663.4	40.9	0.0	7.9	8.16	218.3
9.812	9,914	33.91	20.12	11.15	7.08	4.65	3.30	2.59	663.4	59.9	0.0	7.6	4.35	201.8
10.224	10,169	24.86	14.09	7.73	4.83	3.21	2.22	1.60	663.4	80.0	0.0	11.8	3.92	195.9
10.745	9,517	51.27	24.93	9.59	4.82	3.20	2.45	2.02	663.4	22.1	0.0	8.4	11.27	73.5
11.062	9,763	26.86	13.29	5.87	3.12	2.23	1.63	1.31	663.4	49.0	0.0	14.7	7.51	97.9
11.400	10,069	25.26	14.03	6.52	3.03	2.26	1.81	1.55	663.4	58.6	0.0	14.7	11.04	70.6
11.826	9,640	40.24	22.97	9.27	4.13	3.05	2.44	1.86	663.4	31.6	0.0	9.3	14.25	68.9
11.935	10,030	23.07	14.13	9.35	6.33	4.52	3.15	2.20	663.4	128.4	0.0	8.7	5.84	192.9
Mean:		30.85	18.25	10.24	6.55	4.62	3.38	2.53	663.4	88.2	0.0	9.1	9.29	146.8
Std. Dev:		11.01	5.14	3.24	2.89	2.17	1.59	1.07	0.0	51.7	0.0	3.1	3.67	87.7
Var Coeff(%):		35.68	28.16	31.62	44.14	46.96	47.08	42.05	0.0	58.6	0.0	33.8	39.57	60.1

EXHIBIT F – SEAL COAT MATERIAL SELECTION TABLE – FORM 2388

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL



### Seal Coat Material Selection Table

Instructions to the Contractor:

- 1) Provide materials according to the alternates selected for the roadway tier designations specified at various roadway locations shown on the plans;
- 2) Alternately, supply selected binders from a higher tier, but only if the type of material is allowed for the designated tier; payment will only be made for the tier designated for the pavement;
- 3) Supply the aggregate type, grade and surface aggregate class that is shown to be allowed with the binder used; and
- 4) Adhere to the application season selected.

There are \_\_\_\_\_ working days allowed for this project. The latest roadway start work date is \_\_\_\_\_.

#### Tier I: Heavy Use (>5,000 ADT) - Use only the selected materials.

Type	Asphalt Rubber (A-R) <input type="checkbox"/> A-R Only	Asphalt Cement (AC) <input type="checkbox"/> AC Only
Asphalt	<input type="checkbox"/> A-R Ty II <input type="checkbox"/> SP 300- <input type="checkbox"/> A-R Ty III	<input type="checkbox"/> AC-20-5TR <input type="checkbox"/> AC-20XP <input type="checkbox"/> AC-15P <input type="checkbox"/> SP 300-
Aggregate Type	<input type="checkbox"/> Ty PA <input type="checkbox"/> Ty PB <input type="checkbox"/> Ty PC <input type="checkbox"/> Ty PD <input type="checkbox"/> Ty PE <input type="checkbox"/> Ty PL	<input type="checkbox"/> Ty PA <input type="checkbox"/> Ty PB <input type="checkbox"/> Ty PC <input type="checkbox"/> Ty PD <input type="checkbox"/> Ty PE <input type="checkbox"/> Ty PL
Aggregate Grade	<input type="checkbox"/> 3S <input type="checkbox"/> 4S <input type="checkbox"/> 3non-lw <input type="checkbox"/> 4 <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-	<input type="checkbox"/> 3S <input type="checkbox"/> 4S <input type="checkbox"/> 5 <input type="checkbox"/> 3non-lw <input type="checkbox"/> 4 <input type="checkbox"/> 5S <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-
Aggregate SAC	<input type="checkbox"/> A <input type="checkbox"/> B	<input type="checkbox"/> A <input type="checkbox"/> B

#### Tier II: Moderate Use (500-5,000 ADT) - Use these materials or any selected Tier I material combinations of the allowed types.

Type	Asphalt Cement (AC) <input type="checkbox"/> AC Only	Asphalt Emulsion <input type="checkbox"/> Emulsion Only
Asphalt	<input checked="" type="checkbox"/> AC-10-2TR <input type="checkbox"/> AC-5 w/2%SBR <input checked="" type="checkbox"/> AC-20XP <input type="checkbox"/> SP 300- <input type="checkbox"/> AC-10 w/2%SBR <input checked="" type="checkbox"/> AC-15P	<input checked="" type="checkbox"/> CHFRS-2P <input checked="" type="checkbox"/> CRS-2P <input checked="" type="checkbox"/> HFRS-2P <input type="checkbox"/> SP 300-
Aggregate Type	<input type="checkbox"/> Ty PA <input checked="" type="checkbox"/> Ty PB <input type="checkbox"/> Ty PC <input checked="" type="checkbox"/> Ty PD <input type="checkbox"/> Ty PE <input type="checkbox"/> Ty PL <input type="checkbox"/> Allow uncoated aggregate	<input type="checkbox"/> Ty A <input type="checkbox"/> Ty B <input type="checkbox"/> Ty C <input type="checkbox"/> Ty D <input type="checkbox"/> Ty E <input type="checkbox"/> Ty L
Aggregate Grade	<input type="checkbox"/> 3S <input checked="" type="checkbox"/> 4S <input type="checkbox"/> 5S <input type="checkbox"/> 3non-lw <input checked="" type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-	<input type="checkbox"/> 3S <input type="checkbox"/> 4S <input type="checkbox"/> 5S <input type="checkbox"/> 3non-lw <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-
Aggregate SAC	<input type="checkbox"/> A <input checked="" type="checkbox"/> B	<input type="checkbox"/> A <input type="checkbox"/> B

#### Tier III: Light Use (<500 ADT) - Use these materials or any selected Tier I or Tier II material combinations of the allowed types.

Type	Asphalt Cement (AC) <input type="checkbox"/> AC Only	Asphalt Emulsion <input type="checkbox"/> Emulsion Only
Asphalt	<input type="checkbox"/> AC-10 <input type="checkbox"/> SP 300- <input type="checkbox"/> AC-5	<input type="checkbox"/> CRS-2 <input type="checkbox"/> CRS-2H <input type="checkbox"/> HFRS-2 <input type="checkbox"/> SP 300-
Aggregate Type	<input type="checkbox"/> Ty PA <input type="checkbox"/> Ty PB <input type="checkbox"/> Ty PC <input type="checkbox"/> Ty PD <input type="checkbox"/> Ty PE <input type="checkbox"/> Ty PL <input type="checkbox"/> Allow uncoated aggregate	<input type="checkbox"/> Ty A <input type="checkbox"/> Ty B <input type="checkbox"/> Ty C <input type="checkbox"/> Ty D <input type="checkbox"/> Ty E <input type="checkbox"/> Ty L
Aggregate Grade	<input type="checkbox"/> 3S <input type="checkbox"/> 4S <input type="checkbox"/> 5S <input type="checkbox"/> 3non-lw <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-	<input type="checkbox"/> 3S <input type="checkbox"/> 4S <input type="checkbox"/> 5S <input type="checkbox"/> 3non-lw <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 3 lw <input type="checkbox"/> SP 302-
Aggregate SAC	<input type="checkbox"/> A <input type="checkbox"/> B	<input type="checkbox"/> A <input type="checkbox"/> B

#### Cool Weather Alternates: Use these materials for work in cooler conditions as directed/approved.

<input type="checkbox"/> CRS-2	<input checked="" type="checkbox"/> HFRS-2	<input checked="" type="checkbox"/> CRS-1P	<input type="checkbox"/> RS-1P	<input type="checkbox"/>
<input type="checkbox"/> RC-250	<input type="checkbox"/> MC-800	<input type="checkbox"/> AC-12-5TR	<input type="checkbox"/>	<input type="checkbox"/> SP 300-

#### Districtwide Seal Coat Project Seasons: Refer to Item 316 for temperature and weather restrictions.

Season 1: AMA, CHS, LBB	May 15 to Aug 31
Season 2: ABL, ATL, BWD, DAL, FTW, LFK, ODA, PAR, SJT, TYL, WAC, WFS	May 1 to Aug 31
Season 3: AUS, BMT, BRY, ELP, HOU, SAT, YKM	May 1 to Sept 15
Season 4: CRP, LRD, PHR	Apr 1 to Sept 30

Note: Seal coats on routine maintenance contracts must be completed by August 31 unless otherwise shown on the plans.



EXHIBIT G – SURFACE AGGREGATE CLASS SELECTION FORM – FORM 2088

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL



# Surface Aggregate Selection Form

**CSJ:** 1739 - 02 - 015  
**Highway:** FM 791  
**Limits:** From: US 281A To: Karnes/Atascosa County Line  
**County:** Atascosa  
**District:** San Antonio  
**Designer's Name:** Jules B. Zinsmeyer, E.I.T.

**Date:** 07/19/13

## Selection Guidelines for Bituminous Surface Aggregate Classification (SAC)

Demand for Friction	Low (1)	Moderate (2)	High (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
<b>Summary of Total Frictional Demand</b>			
*Available Friction	Low (2)	Moderate (5)	High (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
<b>Summary of Total Friction Available</b>			
Does total available friction equal or exceed total frictional demand?			

## DESIGNER'S RATING

1	2	3
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17		
2	5	8
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
17		
<input type="checkbox"/> Yes <input type="checkbox"/> No		

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

**Comments:**  
 SAC B aggregate or better will be utilized.

EXHIBIT H – FPS INPUT AND OUTPUT DATA

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL



TEXAS DEPARTMENT OF TRANSPORTATION  
 FLEXIBLE PAVEMENT SYSTEM

F P S21-1.3

Release:12-7-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB	DIST.-15	COUNTY- 7	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	ATASCOSA	1739	02	015	FM 791	7/19/2013	1

COMMENTS ABOUT THIS PROBLEM

Highway: FM 791 Limits: From US 281A to Karnes/Atascosa County Line  
 CSJ: 1739-02-015  
 County: Atascosa  
 Designed by: Jules B. Zinsmeyer, E.I.T.  
 Design Option 2: Use Modified ESALs developed by District

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	4.5
FINAL SERVICEABILITY INDEX P2	2.5
SERVICEABILITY INDEX P1 AFTER AN OVERLAY	4.2
DISTRICT TEMPERATURE CONSTANT	31.0
SUBGRADE ELASTIC MODULUS by COUNTY (ksi)	9.10
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)	99.0
ACCUMULATED MAX DEPTH OF ALL OVERLAYS (INCHES) (EXCLUDING LEVEL-UP)	6.0

TRAFFIC DATA

ADT AT BEGINNING OF ANALYSIS PERIOD (VEHICLES/DAY)	1700.
ADT AT END OF TWENTY YEARS (VEHICLES/DAY)	3000.
ONE-DIRECTION 20YEAR 18 kip ESAL (millions)	6.268
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	26.0



TEXAS DEPARTMENT OF TRANSPORTATION  
 FLEXIBLE PAVEMENT SYSTEM

F P S21-1.3

Release:12-7-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB	DIST.	COUNTY	CONT.	SECT.	JOB	HIGHWAY	DATE	PAGE
001	San Antonio	ATASCOSA	1739	02	015	FM 791	7/19/2013	2

INPUT DATA CONTINUED

CONSTRUCTION AND MAINTENANCE DATA

MINIMUM OVERLAY THICKNESS (INCHES)	2.0
OVERLAY CONSTRUCTION TIME (HOURS/DAY)	8.0
ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)	1.98
ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)	200.0
WIDTH OF EACH LANE (FEET)	11.0
FIRST YEAR COST OF ROUTINE MAINTENANCE (DOLLARS/LANE-MILE)	200.00
ANNUAL INCREMENTAL INCREASE IN MAINTENANCE COST (DOLLARS/LANE-MILE)	50.00

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	B DENSE-GRADED HMA	T115.00	500000.	0.35	2.00	2.00	30.00
2	C DENSE-GRADED HMA	T115.00	500000.	0.35	2.00	4.00	90.00
3	M FLEXIBLE BASE	37.00	50000.	0.35	6.00	12.00	75.00
4	P CEMENT STABILIZED	45.00	51300.	0.25	6.50	12.00	70.00
5	T SUBGRADE	2.00	9100.	0.40	135.80	135.80	90.00

TEXAS DEPARTMENT OF TRANSPORTATION  
 FLEXIBLE PAVEMENT SYSTEM

F.P.S21-1.3

Release:12-7-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB DIST.-15 COUNTY- 7 CONT. SECT. JOB HIGHWAY DATE PAGE  
 001 San Antonio ATASCOSA 1739 02 015 FM 791 7/19/2013 3

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

	1	2	3	4	5	6	7	8
MATERIAL ARRANGEMENT	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP
INIT. CONST. COST	33.46	31.86	33.92	34.03	34.14	34.25	34.36	33.86
OVERLAY CONST. COST	4.06	5.58	4.34	4.34	4.34	4.34	4.34	5.58
USER COST	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROUTINE MAINT. COST	0.70	0.69	0.69	0.69	0.69	0.69	0.69	0.69
SALVAGE VALUE	-6.63	-6.38	-6.65	-6.67	-6.68	-6.69	-6.71	-6.71
TOTAL COST	31.59	31.75	32.30	32.40	32.49	32.59	32.69	33.42
NUMBER OF LAYERS	4	4	4	4	4	4	4	4
LAYER DEPTH (INCHES)								
D(1)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
D(2)	4.00	3.50	3.50	3.50	3.50	3.50	3.50	3.00
D(3)	6.00	6.00	8.00	7.50	7.00	6.50	6.00	9.50
D(4)	6.50	6.50	6.50	7.00	7.50	8.00	8.50	6.50
NO.OF PERF.PERIODS	2	2	2	2	2	2	2	2
PERF. TIME (YEARS)								
T(1)	10.	8.	9.	9.	9.	9.	9.	8.
T(2)	22.	21.	20.	20.	20.	20.	20.	21.
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)								
O(1)	2.5	3.0	2.5	2.5	2.5	2.5	2.5	3.0

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 443

TEXAS DEPARTMENT OF TRANSPORTATION  
 FLEXIBLE PAVEMENT SYSTEM

F.P.S21-1.3

Release:12-7-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

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 001 San Antonio ATASCOSA 1739 02 015 FM 791 7/19/2013 4

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

	9	10	11	12	13	14	15	16
MATERIAL ARRANGEMENT	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP
INIT. CONST. COST	33.90	33.97	34.01	34.08	34.19	34.31	39.15	39.19
OVERLAY CONST. COST	5.58	5.58	5.58	5.58	5.58	5.58	4.34	4.34
USER COST	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROUTINE MAINT. COST	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
SALVAGE VALUE	-6.67	-6.72	-6.69	-6.73	-6.75	-6.76	-7.56	-7.53
TOTAL COST	33.50	33.52	33.60	33.62	33.72	33.81	36.63	36.70
NUMBER OF LAYERS	4	4	4	4	4	4	4	4
LAYER DEPTH (INCHES)								
D(1)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
D(2)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
D(3)	6.50	9.00	6.00	8.50	8.00	7.50	11.00	8.00
D(4)	9.00	7.00	9.50	7.50	8.00	8.50	9.50	12.00
NO.OF PERF.PERIODS	2	2	2	2	2	2	2	2
PERF. TIME (YEARS)								
T(1)	8.	8.	8.	8.	8.	8.	9.	9.
T(2)	20.	21.	21.	21.	21.	21.	20.	20.
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)								
O(1)	3.0	3.0	3.0	3.0	3.0	3.0	2.5	2.5

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 443

TEXAS DEPARTMENT OF TRANSPORTATION  
 FLEXIBLE PAVEMENT SYSTEM

F.P.S21-1.3

Release:12-7-2012

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB DIST.-15 COUNTY- 7 CONT. SECT. JOB HIGHWAY DATE PAGE  
 001 San Antonio ATASCOSA 1739 02 015 FM 791 7/19/2013 5

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

	17	18	19	20	21	22
MATERIAL ARRANGEMENT	BCMP	BCMP	BCMP	BCMP	BCMP	BCMP
INIT. CONST. COST	39.26	39.38	39.49	39.56	39.60	41.71
OVERLAY CONST. COST	4.34	4.34	4.34	4.34	4.34	5.58
USER COST	0.00	0.00	0.00	0.00	0.00	0.00
ROUTINE MAINT. COST	0.69	0.69	0.69	0.69	0.69	0.69
SALVAGE VALUE	-7.57	-7.59	-7.60	-7.64	-7.61	-8.08
TOTAL COST	36.73	36.83	36.92	36.95	37.02	39.90
NUMBER OF LAYERS	4	4	4	4	4	4
LAYER DEPTH (INCHES)						
D(1)	2.00	2.00	2.00	2.00	2.00	2.00
D(2)	3.00	3.00	3.00	3.00	3.00	2.50
D(3)	10.50	10.00	9.50	12.00	9.00	12.00
D(4)	10.00	10.50	11.00	9.00	11.50	12.00
NO.OF PERF.PERIODS	2	2	2	2	2	2
PERF. TIME (YEARS)						
T(1)	9.	9.	9.	9.	9.	8.
T(2)	20.	20.	20.	20.	20.	21.
OVERLAY POLICY(INCH) (INCLUDING LEVEL-UP)						
O(1)	2.5	2.5	2.5	2.5	2.5	3.0

THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS 443



**DESIGN - 1**

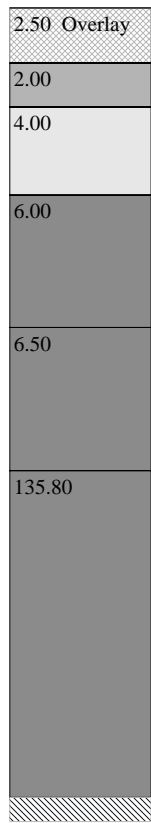
**DESIGN - 2**

**DESIGN - 3**

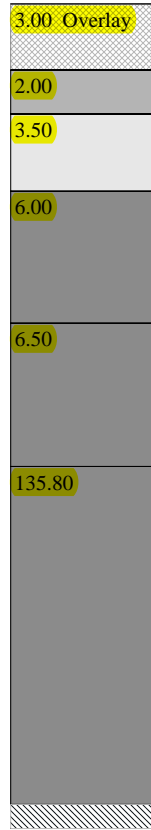
**DESIGN - 4**

**DESIGN - 5**

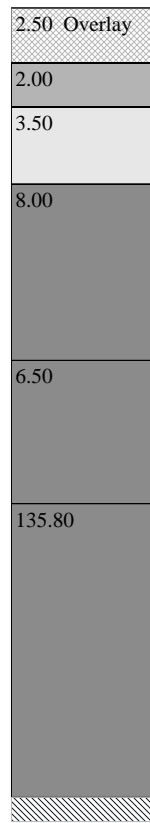
**DESIGN - 6**



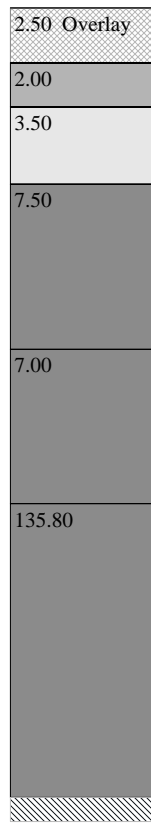
Life:9.7 y,21.6 y,  
Total Cost:31.6



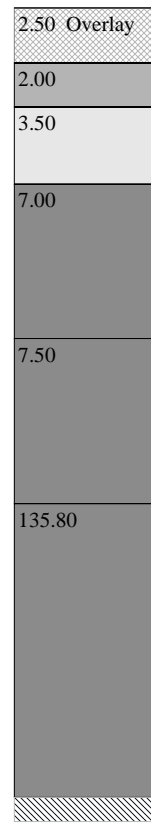
Life:8.3 y,21.2 y,  
Total Cost:31.7



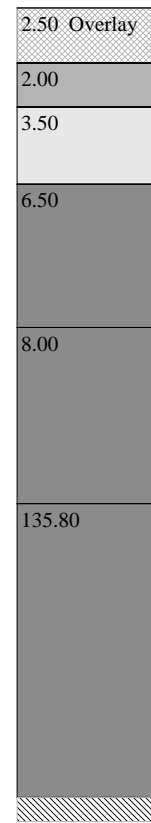
Life:8.9 y,20.1 y,  
Total Cost:32.3



Life:8.9 y,20.1 y,  
Total Cost:32.4

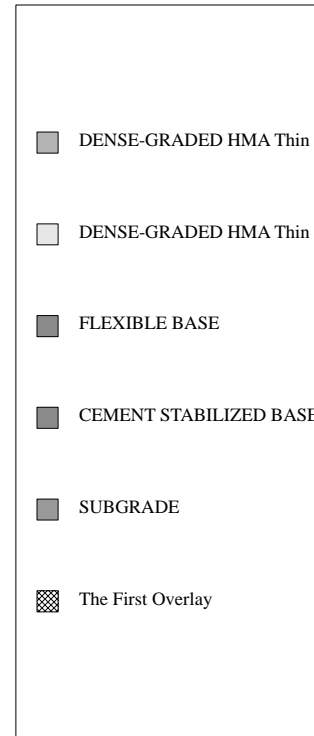


Life:9.0 y,20.2 y,  
Total Cost:32.5



Life:9.0 y,20.2 y,  
Total Cost:32.6

**LEGEND**



**FPS 21 Feasible Design Plotting Output (FPS21-1.3Release:12-7-2012)**

Highway	FM 791	Problem	001
C-S-J	1739 - 02 - 015	Date	7/19/2013
District	San Antonio	County	ATASCOSA

Design Type:User Defined Pavement Design

**DESIGN - 7**

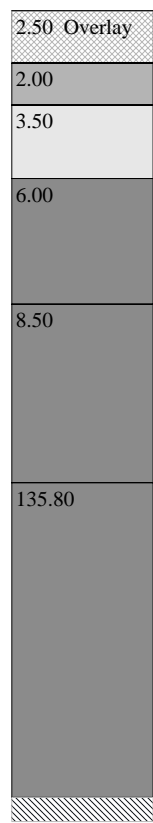
**DESIGN - 8**

**DESIGN - 9**

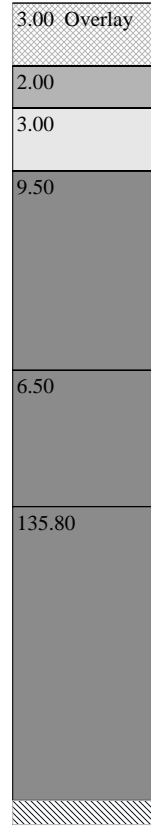
**DESIGN - 10**

**DESIGN - 11**

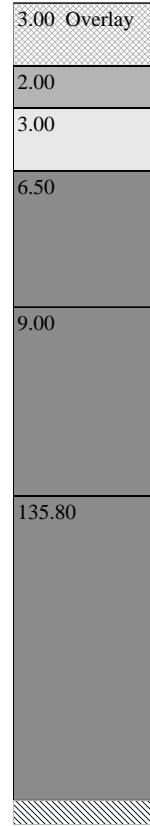
**DESIGN - 12**



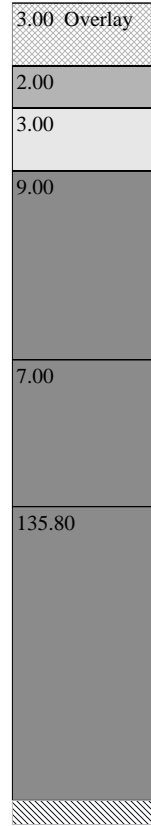
Life:9.0 y,20.3 y,  
Total Cost:32.7



Life:8.0 y,20.5 y,  
Total Cost:33.4



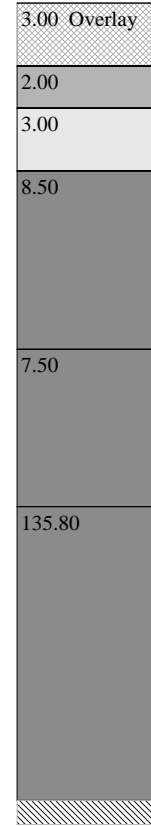
Life:8.0 y,20.5 y,  
Total Cost:33.5



Life:8.0 y,20.5 y,  
Total Cost:33.5

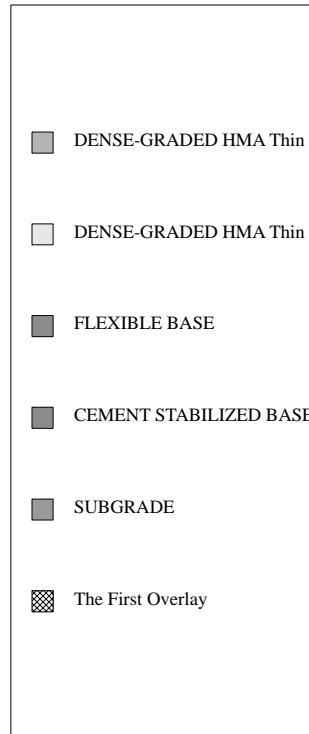


Life:8.0 y,20.5 y,  
Total Cost:33.6



Life:8.0 y,20.6 y,  
Total Cost:33.6

**LEGEND**

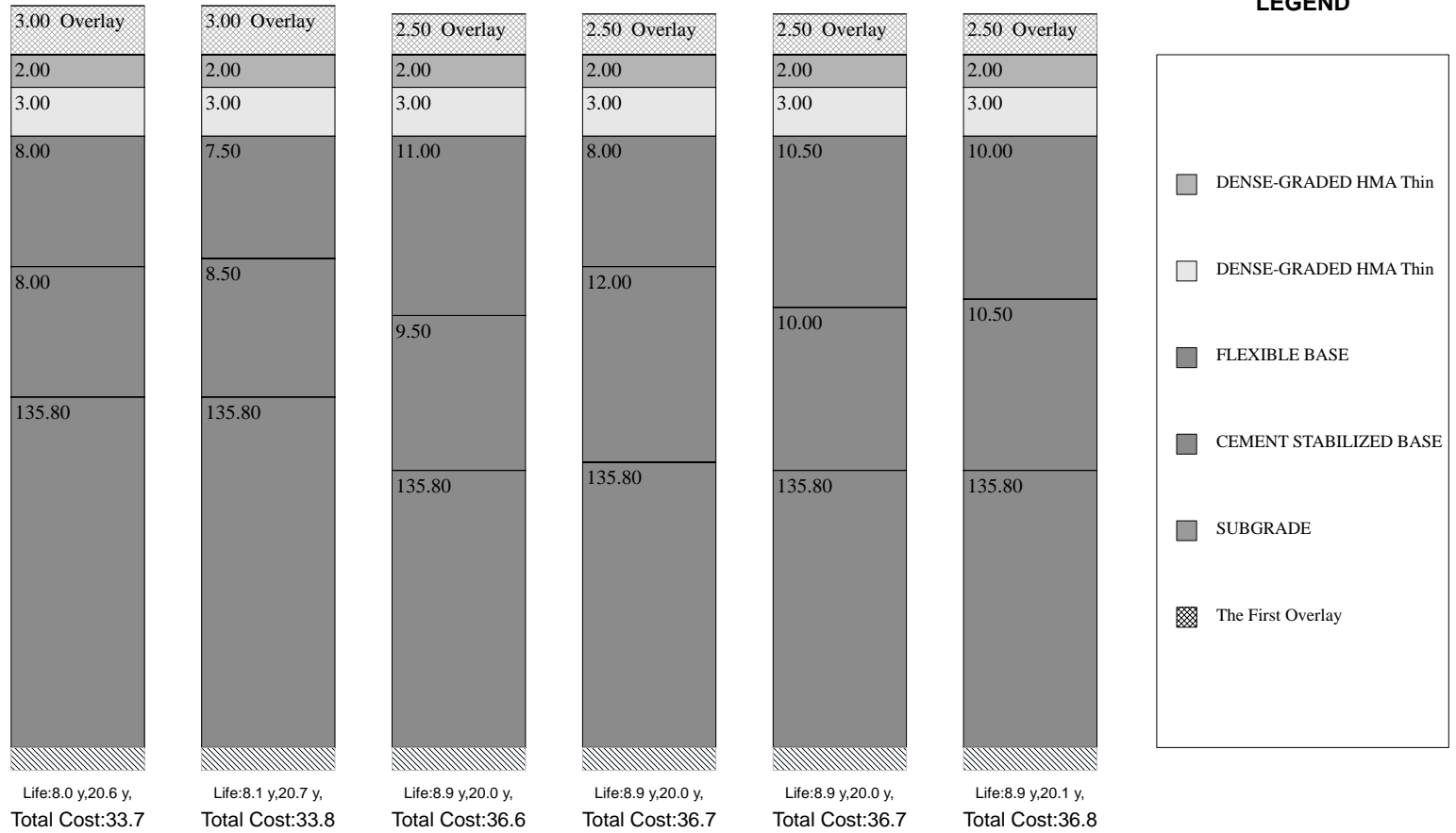


**FPS 21 Feasible Design Plotting Output (FPS21-1.3Release:12-7-2012)**

Highway	FM 791	Problem	001
C-S-J	1739 - 02 - 015	Date	7/19/2013
District	San Antonio	County	ATASCOSA

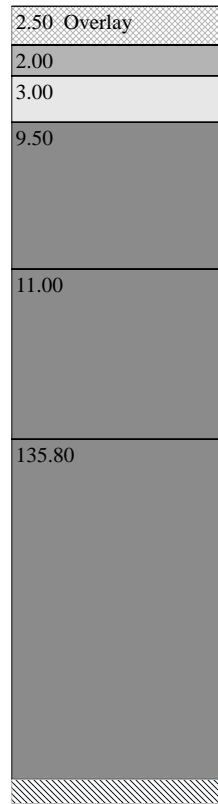
Design Type:User Defined Pavement Design

**DESIGN - 13    DESIGN - 14    DESIGN - 15    DESIGN - 16    DESIGN - 17    DESIGN - 18**



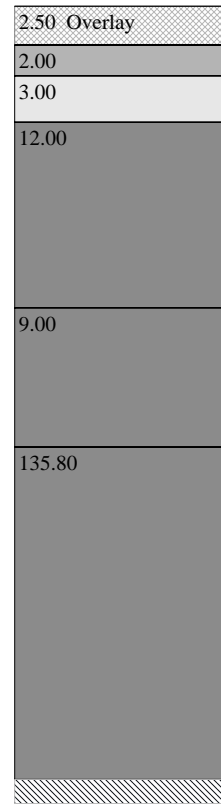
FPS 21 Feasible Design Plotting Output (FPS21-1.3Release:12-7-2012)			
Highway	FM 791	Problem	001
C-S-J	1739 - 02 - 015	Date	7/19/2013
District	San Antonio	County	ATASCOSA
Design Type: User Defined Pavement Design			

**DESIGN - 19**



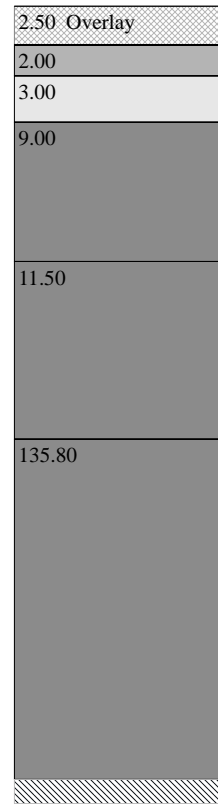
Life:8.9 y,20.1 y,  
Total Cost:36.9

**DESIGN - 20**



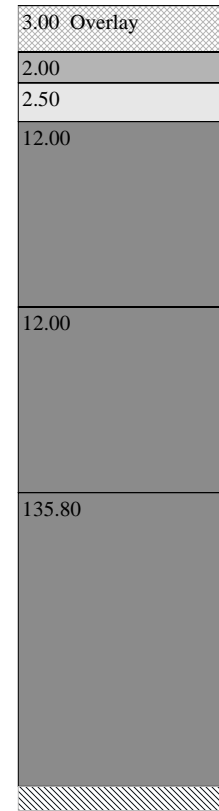
Life:8.9 y,20.1 y,  
Total Cost:36.9

**DESIGN - 21**



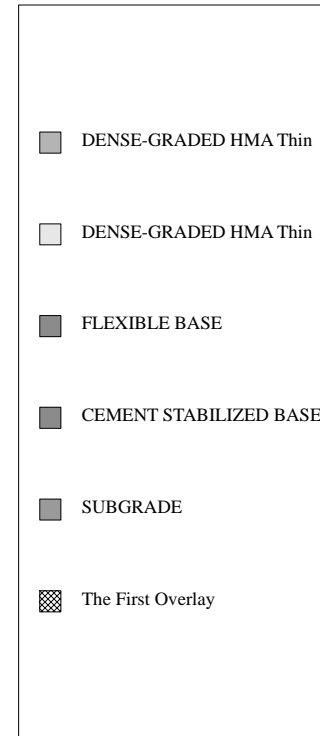
Life:8.9 y,20.1 y,  
Total Cost:37.0

**DESIGN - 22**



Life:8.0 y,20.5 y,  
Total Cost:39.9

**LEGEND**



**FPS 21 Feasible Design Plotting Output (FPS21-1.3Release:12-7-2012)**

Highway	FM 791	Problem	001
C-S-J	1739 - 02 - 015	Date	7/19/2013
District	San Antonio	County	ATASCOSA

Design Type:User Defined Pavement Design

EXHIBIT I – MODIFIED TRIAXIAL DESIGN PROCEDURE

VERBAL APPROVAL OBTAINED FROM DISTRICT LAB; PENDING OFFICIAL APPROVAL

	<b>Thickness (inches)</b>	<b>Modulus (ksi)</b>	<b>Poisson's Ratio</b>	<b>Material Name</b>
DENSE-GRADED HMA Thin	2.00	500.00	0.35	DENSE-GRADED HMA Thin
DENSE-GRADED HMA Thin	3.50	500.00	0.35	DENSE-GRADED HMA Thin
FLEXIBLE BASE	6.00	50.00	0.35	FLEXIBLE BASE
CEMENT STABILIZED BASE	6.50	51.30	0.25	CEMENT STABILIZED BASE
SUBGRADE	135.80	9.10	0.40	SUBGRADE
Bed Rock		910.00	0.15	Bed Rock

**INPUT PARAMETERS:**

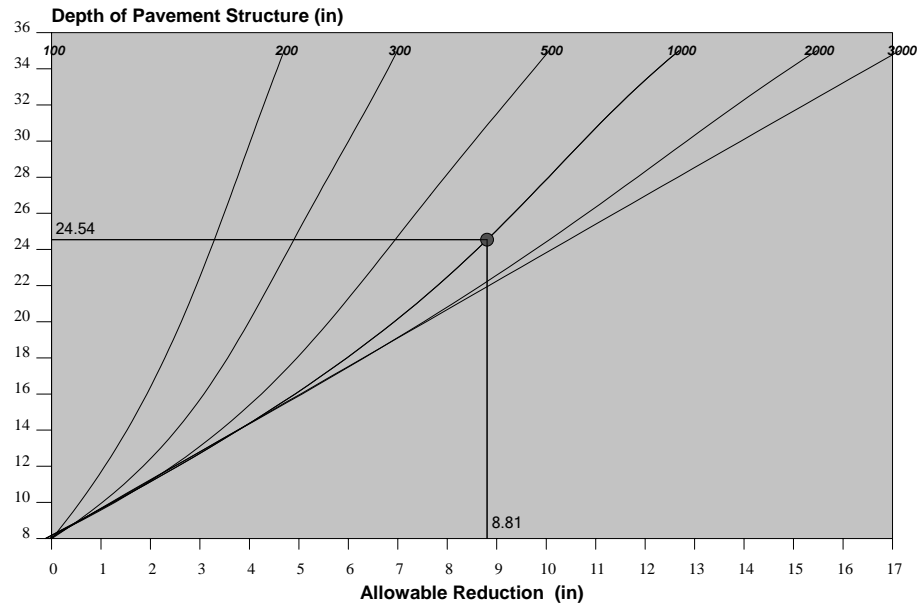
The Heaviest Wheel Loads Daily (ATHWLD)	14000.0 (lb)
Percentage of TandemAxles	60.0 (%)
Modified Cohesionmeter Value	1000.0
Design Wheel Load	18200.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	5.00
User Input TTC based on historical TEX-117-E	

**RESULT:**

Triaxial Thickness Required	24.5 (in)
The FPS Design Thickness	18.0 (in)
Allowable Thickness Reduction	8.8 (in)
Modified Triaxial Thickness	15.7 (in)

**TRIAxIAL CHECK CONCLUSION:**

The Design OK !



Thickness Reduction Chart for Stabilized Layers

FPS 21 Triaxial Design Check Output (FPS21-1.3Release:12-7-2012)			
Highway	FM 791	Problem	001
C-S-J	1739 - 02 - 015	Date	7/19/2013
District	San Antonio	County	ATASCOSA
Design Type: User Defined Pavement Design			