SAFETY PREDICTION METHODS WEBINAR

IMPLEMENTATION OF SAFETY PREDICTION METHODS DEVELOPED FOR TEXAS HIGHWAYS (5-7083)

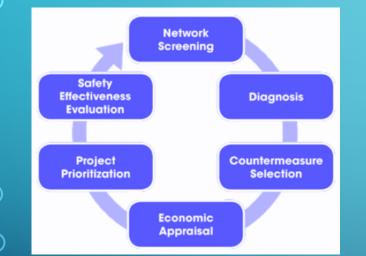
Texas *F*

portation



WELCOME

Introductions



- Introductory session
 - Objectives
 - Scope
 - Main points
 - Background
 - Agenda





INTRODUCTIONS

Course Instructors

- Srinivas Geedipally
- Mike Pratt
- Robert Wunderlich

Texas Department

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Participants

• Now it's your turn...



OBJECTIVES

To inform participants about. . Availability of safety predictive methods for all facility types in Texas

Availability of simple-to-easy tools to apply these methods



To demonstrate how to use these tools





OBJECTIVES

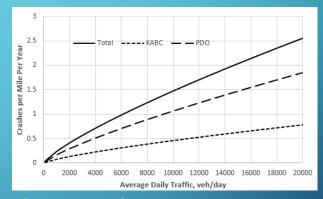
Course Elements

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How to estimate crash frequency using safety prediction methods





Use of spreadsheet tools and their data needs •

Highway Safety Manual Calculations for Texas

Developed by: Michael P. Pratt and Srinivas R. Geedipally Version 2

FOREWORD

This software can be used to estimate crash frequency on freeways, ramps, and frontage roads as a function of geometric, acc and traffic control data. It is intended for use by engineers and technicians responsible for roadway design and safety analysis

- This software is intended for use with the reports identified below. The analyst is encouraged to read the docur understanding of how best to use the software and interpret its output
- nentation of Highway Safety Manual models and data needs: Highway Safety Manual, First Edition, Supplement, Chapters 18 & 19
- American Association of State Highway and Transportation Officials, Washington, DC, 2014
- ation of the procedures to calibrate HSM models to Texas of way managed-tane facilities: Pratt, Michael P., Srinivas R. Geedipally, Minh Le, Lingtao Wu, Raul Avelar, Subasish Das, and Dominique Lord.
- Enhancing Freeway Safety Prediction Models Technical Report 0-7067-R1. Texas A&M Transportation Institute, College Station, Texas, 2022.
- tation of the procedures to calibrate HSM models to Texas conditions for rural freeways, ramps, and frontage roads. Geedpally, Stinixas, R., Karen K. Dixon, Raul Avelar, Subasish Das, Michael P. Pirati, Ioanan Tsapakis, Lingba OW, and Dominique Loud. Development of Harpiny Safety Meruma Safey Porformance Functions and Calibration Factors for Texas. Technical Report 0-7083-R1. Texas A&M Transportation Institute, College Station, Texas, 2022.
- Empirical Bayes analysis principles Bonneson, J. and K. Zimmerman. Procedure for Using Accident Modification Factors in the Highway Design Process Report 0-4703-P5. Texas Transportation Institute, College Station, Texas 2007
- The equations used in this software are documented in these reports. Analysts should refer to the report whenever they have questions about the modeling approach, assumptions, or limitations.

INSTRUCTIONS

This software consists of analysis worksheets for three types of roadway facilities. Key cells on these worksheets are color-conto indicate the type of data entered or displayed. The following list indentifies the meaning of each cell color

- Blue cells represent "input data." Each time the worksheet is used, the values in these cells should be changed to represent the Instructions Freeways Ramps Frontage Roads (+)



SCOPE

Intended Audience

Engineers and practitioners who want to incorporate safety performance into the network screening, design, and project development processes



Roadway Types

Rural Roads

- Two-lane undivided (2U)
- Four-lane undivided (4U),
- Four-lane divided (4D)
- Rural Intersections
- Freeways, frontage roads, and ramps

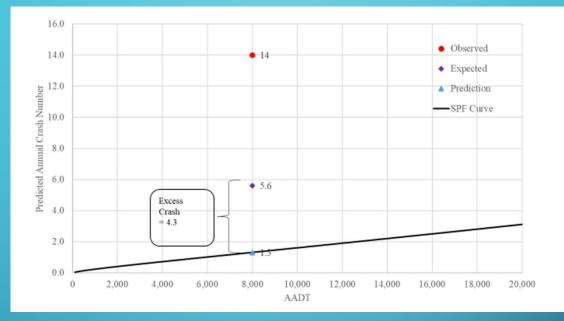
Urban Streets and Highways

- Two-lane undivided (2U)
- Two-lane with TWLTL (3T),
- 4U,
- 4D,
- Four-lane with TWLTL (5T)
- Urban Intersections
- Freeway, frontage roads, and ramps

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USE CRASH PREDICTION METHODS



• To:

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- Make Project-level decisions
- Compare various alternatives
- Screen the network for problem areas
- Aid in the project development process



BACKGROUND

Project 0-7067

- "Enhancing Freeway Safety Prediction Models"
 - Project Director: Khalid Jamil
 - Project Manager: Shelley Pridgen

Product:

- Research report
- Spreadsheet tool for urban freeways
 - General-purpose lanes
 - Managed lanes









BACKGROUND

Project 0-7083

- "Calibrating the Highway Safety Manual Predictive Methods for Texas Highways"
 - Project Director: Khalid Jamil
 - Project Manager: Jade` Adediwura

Product:

- Research report
- Spreadsheet Tools (0-7083-P1)
 - Rural Two-Lane Highways
 - Rural Multi-Lane Highways
 - Urban Arterials
 - Freeway Facilities



AGENDA

- Lesson 1: Safety Models
- Lesson 2: Spreadsheet Tools
 - Input data
 - Estimate crashes









Questions are encouraged

• Please ask them as they occur to you



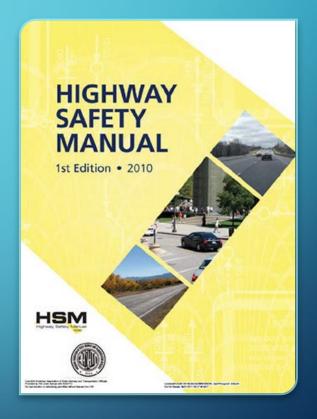






HIGHWAY SAFETY MANUAL BASED

Familiarity of Group with HSM

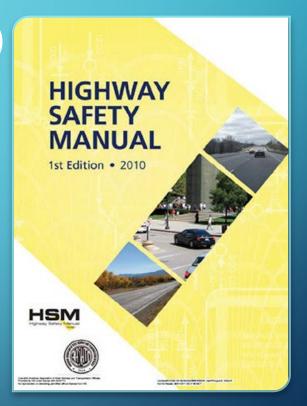






1. SAFETY MODELS

- Safety Performance Functions (SPFs)
- Crash Modification Factors
- Calibration to Texas
- Developing new SPFs
- Regional factors







SAFETY PERFORMANCE FUNCTION

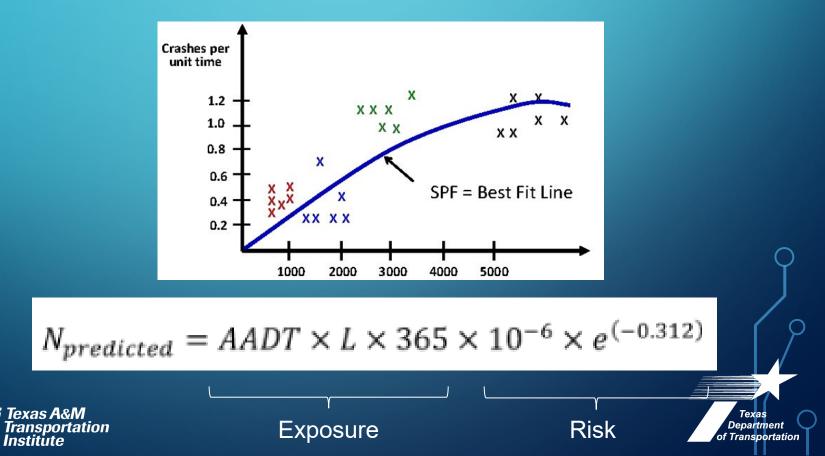
- Establishes statistical relationship between exposure and risk
- Exposure Traffic Volume and length (VMT)
- Risk likelihood of a crash



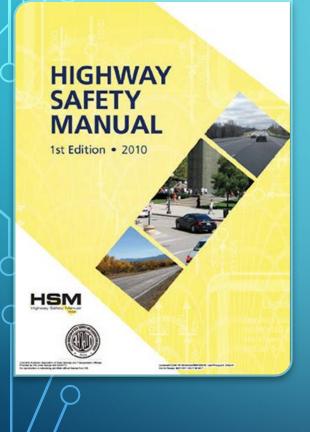


SAFETY PERFORMANCE FUNCTION

 A regression equation to determine the predicted crash frequency at a location



SAFETY PERFORMANCE FUNCTIONS FOR TEXAS CONDITIONS



- Calibration to Texas
- Developing new SPFs
- Regional factors





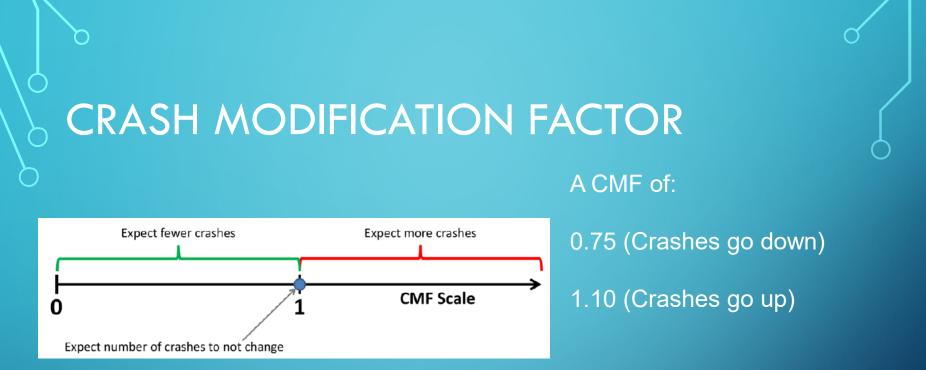
CRASH MODIFICATION FACTOR

 "an index of how much crash experience is expected to change following a modification in design or traffic control" (HSM, 2010)

 $CMF = \frac{Expected \ crash \ frequency \ if \ change \ is \ made}{Expected \ crash \ frequency \ if \ change \ is \ not \ made}$







Expected reduction in crashes = 100(1 - CMF)

A CMF of:

0.75 = 25% reduction 1.10 = 10% increase





CRASH MODIFICATION FACTOR

- Estimated based on statistical analysis of crash data using:
 - Before-after study
 - Cross-sectional study
- Recommended source: http://www.cmfclearinghouse.org/





Rural Two-Lane Highways (Chapter 10)

- Segments (2U)
- Intersections
 - Three-leg stop-controlled (3ST)
 - Four-leg stop-controlled (4ST)
 - Four-leg signal-controlled (4SG)





Rural Multi-Lane Highways (Chapter 11)

- Segments
 - Divided (4D)
 - Undivided (4U)
- Intersections
 - Three-leg stop-controlled (3ST)
 - Four-leg stop-controlled (4ST)
 - Four-leg signal-controlled (4SG)





Urban Arterials

(Chapter 12)

- Segments
 - Two-lane (2U)
 - Two-lane with TWLTL (3T)
 - Four-lane divided (4U)
 - Four-lane undivided (4D)
 - Four-lane with TWLTL (5T)
- Intersections
 - Three-leg stop-controlled (3ST)
 - Four-leg stop-controlled (4ST)
 - Three-leg signal-controlled (3SG)
 - Four-leg signal-controlled (4SG)





Freeways (Chapter 18)

- Mainline segments
- Speed-change lanes
- Severity distribution functions





Ramps (Chapter 19)

- Ramp segments
- Ramp terminals
- Severity distribution functions





CALIBRATION TO TEXAS

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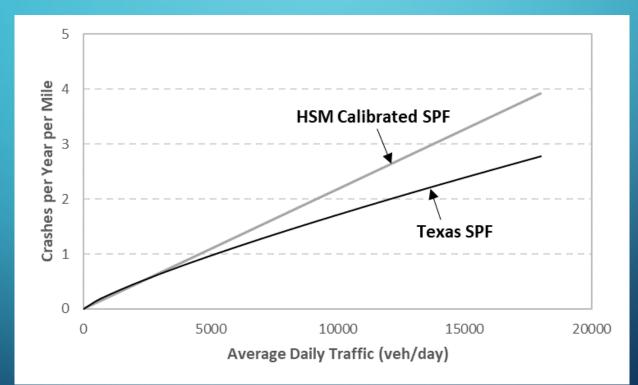
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Segment Type	Collision Type	Crash Count		Local Calibration Factor C
		Observed	Predicted	
R2U	All	232	284.63	0.82
R4D	All	1,046	1,154.70	0.91
R4U	All	685	989.55	0.69
U2U	MV	302	321.69	0.94
	SV	221	200.58	1.10
U3T	MV	255	416.71	0.61
	SV	118	79.93	1.48
U4D	MV	1,142	682.11	1.67
	SV	479	243.39	1.97
U4U	MV	1,157	865.06	1.34
	SV	289	192.84	1.5
U5T	MV	1,008	2,028.51	0.50
	SV	327	440.71	0.74



CALIBRATION TO TEXAS

Rural two-lane segments



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CALIBRATION TO TEXAS

Freeway segments



Urban







NEW SPFS

 HSM does not include SPFs for several segment types commonly used in Texas freeway corridors

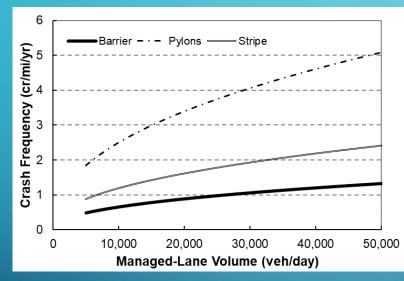
- Urban segments with more than 10 lanes
- Frontage roads
- Managed lanes
 - Reversible or non-reversible
 - Separated by barrier, pylons, or pavement stripes



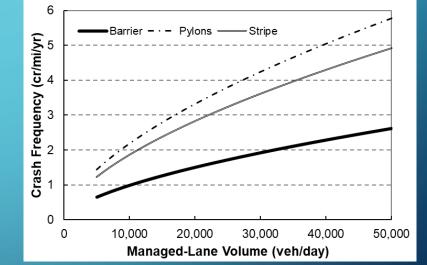




NON-REVERSIBLE MANAGED LANES NEW SPF



Single-vehicle Crashes



Multi-vehicle Crashes





NON-REVERSIBLE MANAGED LANES

Crash Modification Factors:
Shoulder width
Access point density









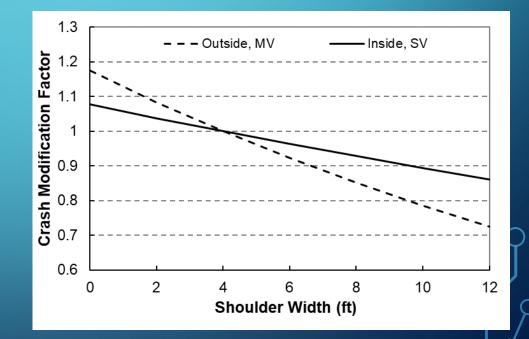
Crash Modification Factors:

✓ Shoulder width

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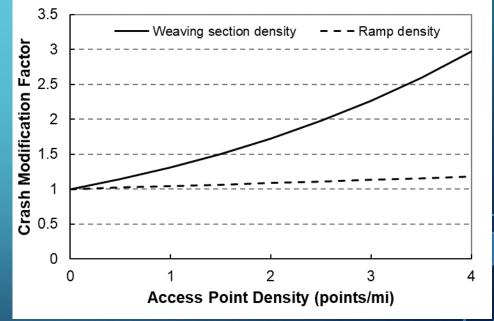
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Crash Modification Factors:

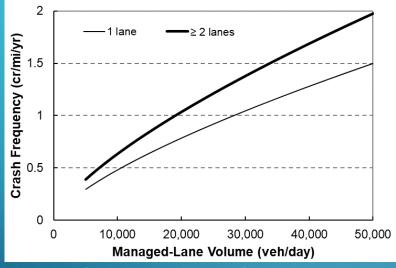
Access point density



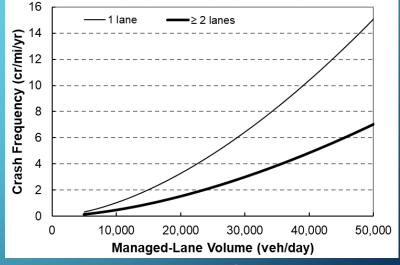




REVERSIBLE MANAGED LANES NEW SPFS



Single-vehicle Crashes



Multi-vehicle Crashes







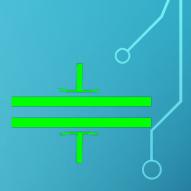


Crash Modification Factors:
✓ Shoulder width
✓ Access ramp density









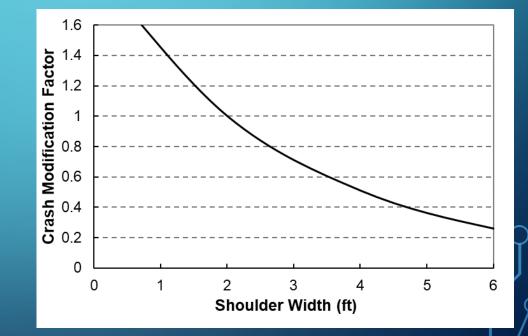
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REVERSIBLE MANAGED LANES

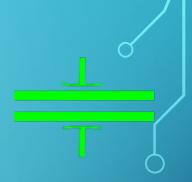
Crash Modification Factor:

✓ Shoulder width







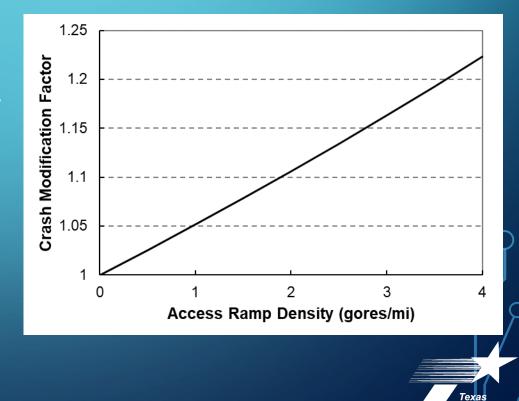


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Crash Modification Factor:

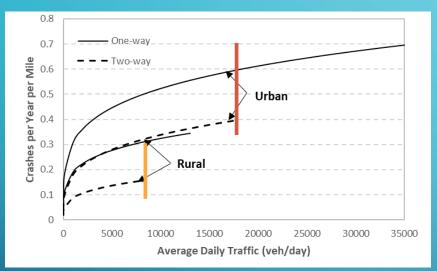
Access ramp density

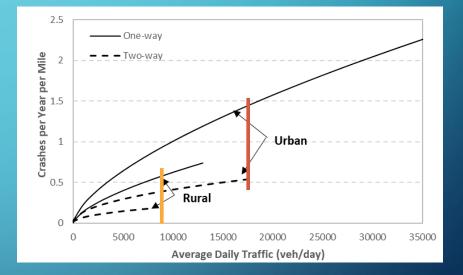




^d NEW SPFS

• Frontage roads





Single-vehicle Crashes

Multi-vehicle Crashes

Two –Way < One-Way

Only in range on graph Consider severity CMFs







Frontage roads

О

	On	e-way	Тм	/o-way
Severity	Rural	Urban	Rural	Urban
к	0.9%	0.4%	4.4%	0.6%
A	4.6%	1.3%	6.1%	0.6%
В	8.7%	10.4%	11.4%	10.3%
c /	13.3%	18.2%	16.7%	12.8%
0	72.4%	69.6%	61.4%	76.3%
14.2%		21.9%		





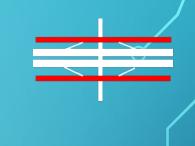
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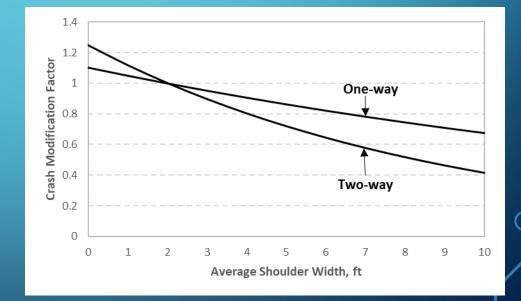
NEW SPFS

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Frontage roads

Crash Modification Factors:

✓ Shoulder width

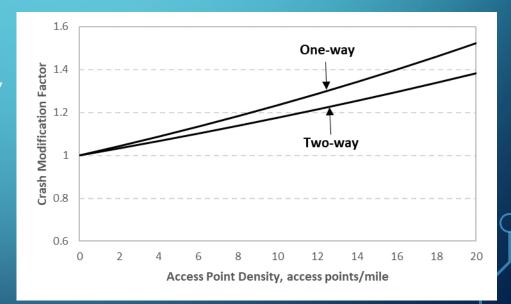






Crash Modification Factors:

Access point density





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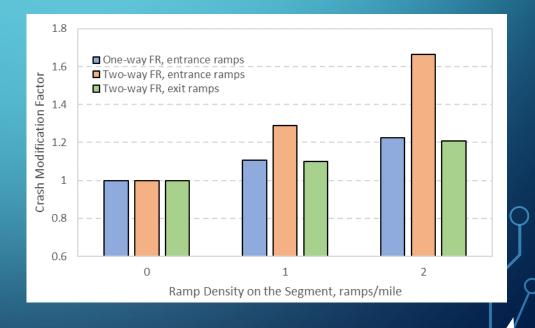
NEW SPFS

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Frontage roads

Crash Modification Factors:

✓ Ramp presence



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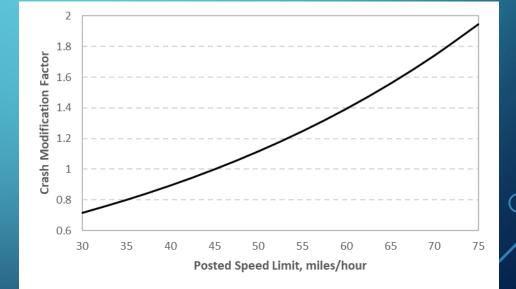




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Crash Modification Factors:

Posted speed limit

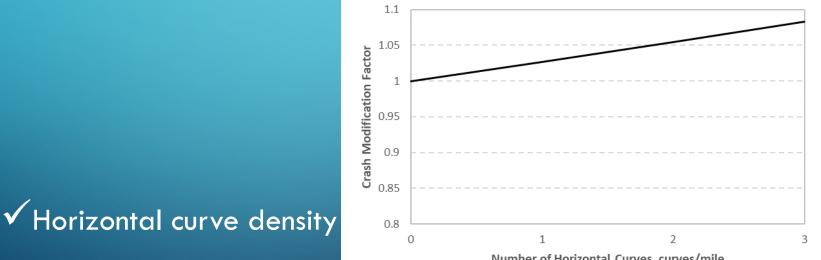








Crash Modification Factors:



Number of Horizontal Curves, curves/mile

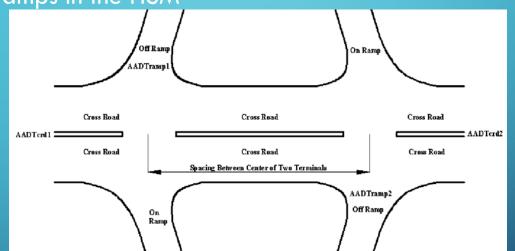






Ramps considered in HSM are different from ramps in Texas

Typical ramps in the HSM

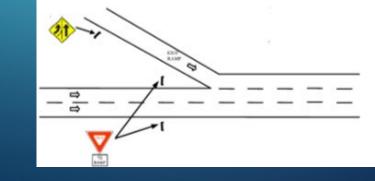


Typical ramps in Texas

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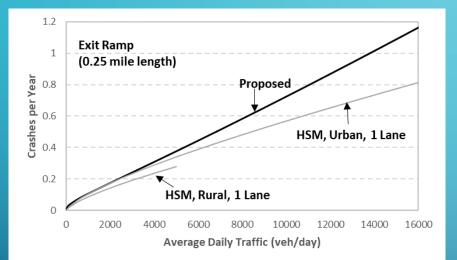
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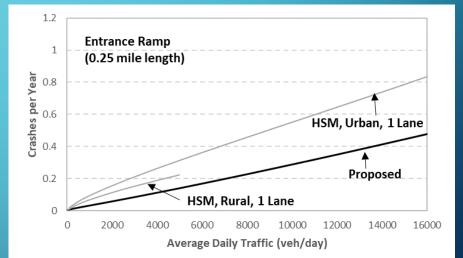




NEW SPFS

Ramps





Exit Ramp Entrance Ramp



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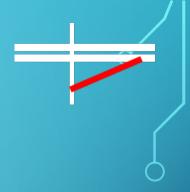
RAMPS SEVERITY DISTRIBUTIONS

		Ramp	Туре	
Severity	Exit		Entran	ce
К		0.4%		2.9%
A		3.3%		2.9%
В		10.7%		20.0%
с	1	15.6%	/	18.6%
0		70.1%		55.7%
14.4	%	25.8	/ %	









Crash Modification Factors:
 Shoulder width
 Horizontal curve density
 Barrier presence







Crash Modification Factor:

✓ Shoulder width

RAMPS





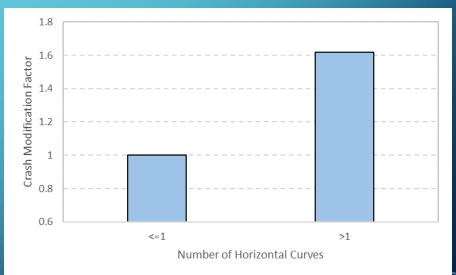
NEW SPFS

Ramps

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Crash Modification Factor:









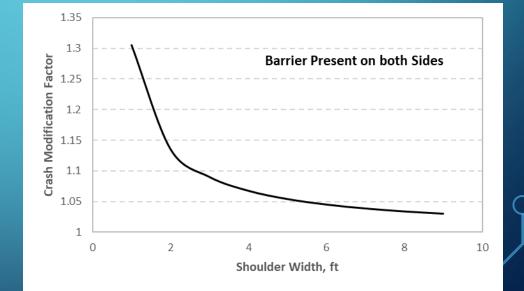
NEW SPFS

Ramps

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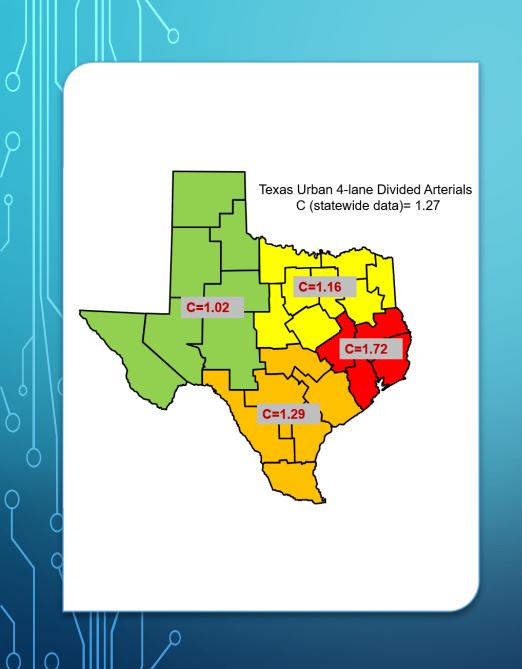
Crash Modification Factor:

✓ Barrier presence

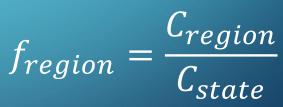


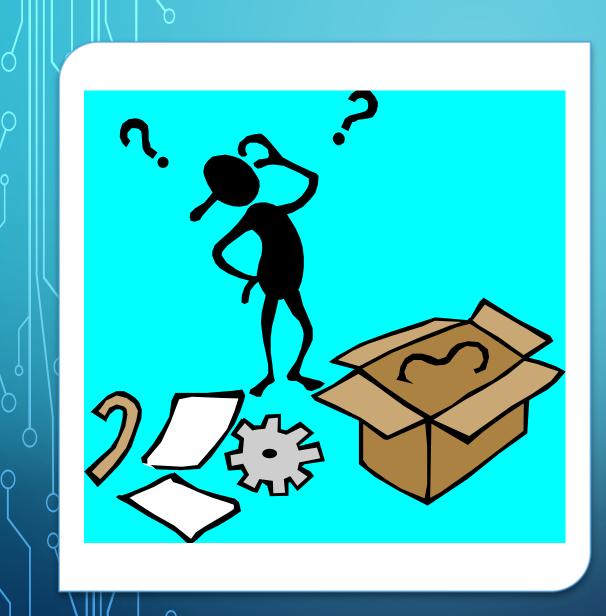
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REGIONAL FACTORS





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QUESTIONS?

2. SPREADSHEET TOOLS

Rural Two-Lane Highways

Rural Multi-Lane Highways

Urban Arterials

Freeways





SPREADSHEET TOOLS

https://cts.tti.tamu.edu/project/list-of-safety-tools/

NEWS

WORK WITH US



EVENTS

Center for Transportation Safety

PEOPLE

RESOURCES

Texas Department

of Transportation

List of Safety Tools

Screening Tools

HOME

- Statewide on-system segment tool (Download map files by district)
- Beaumont district segment and intersection tool

Evaluation and Design Tools

- Roadway design safety score tool rural segment (Download from TxDOT Design Tools)
- Roadway design safety score tool urban intersection (Download from TxDOT Design Tools)
- Texas-Specific Safety Performance Functions
 - Freeways, Frontage Roads and Ramps
 - Rural Two-Lane, Two-Way Roads
 - Rural Multilane Highways
 - Urban and Suburban Arterials
- Odessa district operation and safety evaluation tool (tool not available at this moment)
- TxDOT horizontal curve tool



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Highway Safety Manu	al 1st Edition, Vol	ume 2, Cha	pter 10	Predictiv	ve Method f	or Rural	Гwo₋Lane,	Two-Way	y Roads An	alysis Sp	readsheet	Summary				
	Upda	ted for Tex	as Roady	ways bas	ed on TxDC	T Resear	ch Projects	s 0-7083 8	5-7083							
				Relea	ase date: 1	11/2024	>									
Overview						/	Color Co	ding in th	ne Workshee	ts						
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rural two-lane highways									here input data							
was developed for trainin									cases, the sha				t			
that they obtain with the									In other cases							
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A user can evaluate an i							Color Us	ed	Type of In	formation	Required	l from User				
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			, in the second second					_	is available							
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	1D, and 1E								worksheets	1						
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Segment 2	Duplicate s	segment wor	ksheet fo	r additiona	al											
	highway se								Optional in	put data u	sed to desc	cribe the ana	lysis.			
		3										lation results				
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		ash trends a							Key output	data, incl	udina predi	cted crash				
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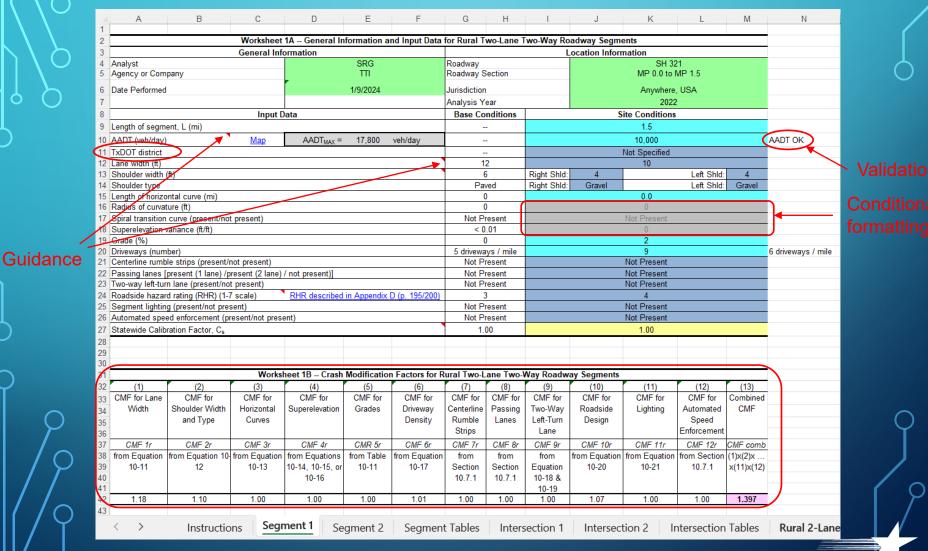
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2	Fighway Safety Manua		b) Volume 2, Chapter 10 – Predictive Method for Rural Two-Lane, Two-Way Roads – Analysis Spreadsheet Summ Updated for Texas Roadways based on TxDDT Research Projects 0.7083 & 5.7083 Release date: 1/11/2024 Color Coding in the Worksheets to demonstrate the predictive models for The worksheets include five specific color options to help use identify locations where input data is required or output data is required or output data is correctly represent their target analysis. specific numbers. In other cases the input is restricted to as set of options included in pull-down lists. The respective color is as follows: addisect tool and the HSM predictive methods. segment or intersection as well as analyze Dois. If more than one segment type requires in k worksheet and one segment type requires analyze. nk worksheet and name the worksheet accordingly. ase condition for each input variable. If the end is sacial provided in drop-down merus to the base condition for the variable. optional input data that can be used to supplement the analysis if this informat readsheet worksheets. optional input data that can be used to supplement the analysis if this informat quark case is condition for the variable. optional input data that can be used to supplement the analysis if this informat quark case is condition for the variable. optional input data that can be used to supplement the analysis if this informat quark case is condition for the variable. optional input data that can be used to supplement the			Summary										
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17	analysis, the user should	create a blank work	sheet and then co	py the conte	nts				Required i	nput data a	is identified	in the HSM	l.			
18	of the segment worksheet	t into the blank shee	t and name the wo	rksheet acc	ordingly.											
19																
20	The analysis worksheets	provide the base cor	ndition for each inp	ut variable.	lf the				Input data	required fro	om the user	but restrict	ed			
21	user does not have data to	o describe the site o	conditions for the va	ariable of inte	erest,				to options	provided in	drop-down	menus.				
22	he or she should enter a v	value equal to the ba	se condition for th	e variable.												
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24	The current contents of th	is spreadsheet inclu	ide the following w	orksheets:					supplement	nt the analy	/sis if this ir	nformation				
25																
26	Worksheet Name	Contents														
27																
28	Instructions												on			
29					n of											
30		color coding	included in the wo	rksheets.												
31													on			
32	Segment 1															
33													1			
34					0											
35			HSIVI WORKSheets a	re 1A, 1B, 1	υ,											
36 37		1D, and 1E.														
37	Segment 2	Duplicate es	amont workshoot	for additiona	1				instead of		elault value	s.				
39	Segment 2		•	ior additiona	1				Ontional in	nut data w	sod to dese	ribo tho one	alveie			
40		nignway seg	jinents.													
40	Segment Tables	Includes ser	ment tables used	for analysis	of HSM-				mese valu		anect calcul	acion result	o.			
41	Segment rables	provided cra	sh trends as well a	is locally-de	rived crach				Key outpu	t data inclu	udina predia	ted crash				
42																
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1	> Instructions	s Segment 1	1 Segment	2 500	T troom	ables	Intercost	ion 1	Interce	ction 2	Intor	oction T	ables	Rural 2	-Lane Sit	to Total
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)	45	A	В	С	D	E	F	G	Н	T	J	К	L	М	Ν	
	45 46			Worksh	eet 1C Roady	way Segmen	t Crashes for Rural	Two-I	ane Two-V	Vav Roadw	av Segments					
	47		(1)	(2)	(3)	, ,	(4)	1002	(5		(6)	(7)	(8))		
)	48	Crash Se	verity Level	N spf rs	Overdispersion k		Crash Severit Distribution	ty	N spf rs by Distrib	Severity	Combined CMFs	State/Region Adjustment, Cs * AFr	Predicted crash fre N _{predi} (crashe	average quency,		
	49			from Equation 10-6	from Equa	ation 10-7	from Table 10∹ (proportion)	3	(2)TOT/	AL x (4)	(13) from Worksheet 1 B		(5)×(6)x(7)		
	50	Total		2.566	0.24	17	1.000		2.5	66	1.40	1.00	3.5	84		
	51	Fatal and Injury	/ (FI)				0.344		0.8	83	1.40	1.00	1.2	33		
	52	Property Dama	ge Only (PDO)				0.656		1.6	83	1.40	1.00	2.3	51		
	53															
	54															
	55															
	56				· · · · ·		and Collision Type	for Rur	-		, i i i i i i i i i i i i i i i i i i i				<u> </u>	
	11		(1)	(2)	(3)		(4)		(5	1		6)	(7	<i>(</i>		
		Collis	ion Type	Proportion of Collision Type(TOTAL)	N predicted i (crashes		Proportion of Coll Type(FI)	lision	N predicto (crashe			of Collision a(pdo)	N predicted (crashe	• •		
	58			from Table 10-4	(8)TOTAL from W	/orksheet 1C	from Table 10-	4	(8)rı from V 10		from Ta	ible 10-4	(8)PDO from 1			
	60	Total		1.000	3.58	34	1.000		1.2		1.	000	2.3	51		
	61				(2)x(3)	TOTAL			(4)×	(5)fi			(6)x(7)PDO		
	62						SINGLE-VEHIC	LE								
	-	Collision with a		0.113	0.40		0.035		0.0			154	0.3			
		Collision with b		0.004	0.01		0		0.0			006 0	0.0			
	-	Collision with p Overturned	edestrian	0.000	0.00		0		0.0			0	0.0			
	_	Ran off road		0.000	1.89		0.635		0.0			0 475	1.1			
		Other single-ve	hicle collision	0.065	0.23		0.033		0.0			062	0.1			
		Total single-veh		0.712	2.55		0.741		0.9			697	1.6			
	70						MULTIPLE-VEHI	CLE								
	71	Angle collision		0.028	0.10	00	0.035		0.0	43	0.	025	0.0	59		
		Head-on collisi		0.045	0.10		0.035		0.0			049	0.1			
		Rear-end collis		0.057	0.20		0.071		0.0			049	0.1			
		Sideswipe colli		0.020	0.07		0.012		0.0			025	0.0			
			vehicle collision	0.138	0.49		0.106		0.1			154	0.3			
		Total multiple-v	ehicle crashes	0.288	1.03	32	0.259		0.3	19	0.	302	0.7	10		
	77	< >	Instructi	ons Segr	ment 1 Se	egment 2	Segment Tal	bles	Interse	ection 1	Intersec	tion 2 Ir	tersectior	Tables	Rural 2	-Lan

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	1										1	
Table 10-3: Distribution for Crash 9	everity Level on Ru				ed Values				SPF Coe	fficients		
Crash severity level			ige of total roadway segment					ived Values?	Yes			
Locally-Derived Values? Yes	H	SM-Provided Value	es Locally	-Derived Values	(Texas)			SM-Provided V			Ily-Derived Value	<u> </u>
Fatal		1.3		3.6			Constant	AADT	Overdispersion	Constant	AADT	Overdis
ncapacitating Injury		5.4		6.1			-0.312	1	0.236	-7.025	0.821	0.2
Vonincapacitating Injury		10.9		11.3								
Possible Injury		14.5		13.4								
Fotal Fatal Plus Injury		32.1		34.4						tment Factors		
Property Damage Only		67.9		65.6						Adjustment Factor	or	
TOTAL		100.0		100.0					Not Specified	1.00		
Note: HSM-provided crash severity data based or	HSIS data for Washingt	ton (2002-2006)							East	1.01		
									North	1.15		
									South	0.73		
Table 10-4: Default Distribution by (Collision Type for Sp						rived Values	N	West	1.00		
			centage of total roadway seg	ment crashes by								
		HSM-Provide			Locally-Derived							
Collision type	Total fatal and	d Property	TOTAL (all severity levels	Total fatal and	Property	TOTAL (all s	severity levels				Districts	and Regions
Locally-Derived Values? Yes	injury	damage only	combined)	injury	damage only	com	bined)				District	Regi
SINGLE-VEHICLE CRASHES											Not Specified	Not Specifi
Collision with animal	3.8	18.4	12.1	3.5	15.4	1	1.3				Abilene	West
Collision with bicycle	0.4	0.1	0.2	0.0	0.6	(0.4				Amarillo	West
Collision with pedestrian	0.7	0.1	0.3	0.0	0.0	(0.0				Atlanta	North
	3.7	1.5	2.5	0.0	0.0	(0.0				Austin	South
Dverturned	3.1		50.4				3.0				Beaumont	East
	54.5	50.5	52.1	63.5	47.5	5	13.0				Brownwood	North
Dverturned		50.5 2.9	2.1	63.5 7.1	47.5 6.2		6.5				Diowiwoou	_
Zverturned Ran off road	54.5					e					Bryan	East
Overturned Ran off road Dther single-vehicle crash	54.5 0.7	2.9	2.1	7.1	6.2	e	6.5					East West
Overturned Ran off road Other single-vehicle crash Fotal single-vehicle crashes	54.5 0.7 63.8 10.0	2.9	2.1	7.1	6.2	7	6.5				Bryan	
Overturned Ran off road Other single-vehicle crash Total single-vehicle crashes MULTIPLE-VEHICLE CRASHES	54.5 0.7 63.8	2.9 73.5	2.1 69.3	7.1 74.1	6.2 69.7	2	6.5 '1.2				Bryan Childress	West
Overturned Ran off road Other single-vehicle crash Fotal single-vehicle crashes MULTIPLE-VEHICLE CRASHES Angle collision	54.5 0.7 63.8 10.0	2.9 73.5 7.2	2.1 69.3 8.5	7.1 74.1 3.5	6.2 69.7 2.5	6 7 2 4	6.5 '1.2 2.8				Bryan Childress Corpus Christi	West South
Overturned Aan off road Dther single-vehicle crash Total single-vehicle crashes MULTIPLE-VEHICLE CRASHES Angle collision tead-on collision	54.5 0.7 63.8 10.0 3.4	2.9 73.5 7.2 0.3	2.1 69.3 8.5 1.6	7.1 74.1 3.5 3.5	6.2 69.7 2.5 4.9	6 7 2 4 8	5.5 11.2 2.8 4.5				Bryan Childress Corpus Christi Dallas	West South North
Overturned Van off road Dther single-vehicle crash oftal single-vehicle crashes WUTIPLE-VEHICLE CRASHES Angle collision tead-on collision Rear-end collision	54.5 0.7 63.8 10.0 3.4 16.4	2.9 73.5 7.2 0.3 12.2	2.1 69.3 8.5 1.6 14.2	7.1 74.1 3.5 3.5 7.1	6.2 69.7 2.5 4.9 4.9	6 7 2 4 5 2	5.5 1.2 2.8 4.5 5.7				Bryan Childress Corpus Christi Dallas El Paso	West South North West
Overturned Aan off road Other single-vehicle crash oftal single-vehicle crashes MULTIPLE-VEHICLE CRASHES Angle collision Tead-on collision Sideswipe collision Sideswipe collision	54.5 0.7 63.8 10.0 3.4 16.4 3.8	2.9 73.5 7.2 0.3 12.2 3.8	2.1 69.3 8.5 1.6 14.2 3.7	7.1 74.1 3.5 3.5 7.1 1.2	6.2 69.7 2.5 4.9 4.9 2.5	6 7 2 2 2 2 2 1	5.5 11.2 2.8 4.5 5.7 2.0				Bryan Childress Corpus Christi Dallas El Paso Fort Worth	West South North West North
Overturned Aan off road Dther single-vehicle crash Total single-vehicle crashes MULTIPLE-VEHICLE CRASHES Angle collision tead-on collision Rear-end collision Sideswipe collision Dther multiple-vehicle collision	54.5 0.7 63.8 10.0 3.4 16.4 3.8 2.6	2.9 73.5 7.2 0.3 12.2 3.8 3.0	2.1 69.3 8.5 1.6 14.2 3.7 2.7	7.1 74.1 3.5 3.5 7.1 1.2 10.6	6.2 69.7 2.5 4.9 4.9 2.5 15.4	2 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5.5 (1.2 2.8 4.5 5.7 2.0 3.8				Bryan Childress Corpus Christi Dallas El Paso Fort Worth Houston	West South North West North East
Overturned Aan off road Dther single-vehicle crash of catal single-vehicle crashes MULTIPLE-VEHICLE CRASHES Angle collision Rear-end collision Sideswipe collision Dther multiple-vehicle crashes	54.5 0.7 63.8 10.0 3.4 16.4 3.8 2.6 36.2 100.0	2.9 73.5 7.2 0.3 12.2 3.8 3.0 26.5 100.0	2.1 69.3 8.5 1.6 14.2 3.7 2.7 30.7 100.0	7.1 74.1 3.5 3.5 7.1 1.2 10.6 25.9 100.0	6.2 69.7 2.5 4.9 2.5 15.4 30.2 99.9	6 7 2 4 5 2 1 1 2 1 1 2 10	6.5 1.2 2.8 4.5 5.7 2.0 3.8 8.8 00.0				Bryan Childress Corpus Christi Dallas El Paso Fort Worth Houston Laredo	West South North West North East South
Overturned Aan off road Dther single-vehicle crash Ottal single-vehicle crashes VULTIPLE-VEHICLE CRASHES Angle collision Head-on collision Rear-end collision Sideswipe collision Dther multiple-vehicle collision Total multiple-vehicle crashes TotAL CRASHES	54.5 0.7 63.8 10.0 3.4 16.4 3.8 2.6 36.2 100.0	2.9 73.5 7.2 0.3 12.2 3.8 3.0 26.5 100.0	2.1 69.3 8.5 1.6 14.2 3.7 2.7 30.7 100.0	7.1 74.1 3.5 3.5 7.1 1.2 10.6 25.9 100.0	6.2 69.7 2.5 4.9 2.5 15.4 30.2 99.9	6 7 2 4 5 2 1 1 2 1 1 2 10	6.5 1.2 2.8 4.5 5.7 2.0 3.8 8.8 00.0				Bryan Childress Corpus Christi Dallas El Paso Fort Worth Houston Laredo Lubbock	West South North West North East South West
Overturned Aan off road Dther single-vehicle crash Ottal single-vehicle crashes VULTIPLE-VEHICLE CRASHES Angle collision Head-on collision Rear-end collision Sideswipe collision Dther multiple-vehicle collision Total multiple-vehicle crashes TotAL CRASHES	54.5 0.7 63.8 10.0 3.4 16.4 3.8 2.6 36.2 100.0	2.9 73.5 7.2 0.3 12.2 3.8 3.0 26.5 100.0	2.1 69.3 8.5 1.6 14.2 3.7 2.7 30.7 100.0	7.1 74.1 3.5 3.5 7.1 1.2 10.6 25.9 100.0	6.2 69.7 2.5 4.9 2.5 15.4 30.2 99.9	6 7 2 4 5 2 1 1 2 1 1 2 10	6.5 1.2 2.8 4.5 5.7 2.0 3.8 8.8 00.0				Bryan Childress Corpus Christi Dallas El Paso Fort Worth Houston Laredo Lubbock Lubbock	West South North West North East South West East
Overturned Aan off road Dther single-vehicle crash Ottal single-vehicle crashes VULTIPLE-VEHICLE CRASHES Angle collision Head-on collision Rear-end collision Sideswipe collision Dther multiple-vehicle collision Total multiple-vehicle crashes TotAL CRASHES	54.5 0.7 63.8 10.0 3.4 16.4 3.8 2.6 36.2 100.0 for Washington (2002-20	2.9 73.5 7.2 0.3 12.2 3.8 3.0 26.5 100.0 006); includes approxit	2.1 69.3 8.5 1.6 14.2 3.7 2.7 30.7 100.0	7.1 74.1 3.5 3.5 7.1 1.2 10.6 25.9 100.0 sideswipe and 30	6.2 69.7 2.5 4.9 2.5 15.4 30.2 99.9 99.9	e 7 2 2 1 1 2 10 10 0n sideswipe collis	6.5 1.2 2.8 4.5 5.7 2.0 3.8 8.8 8.8 0.0 0.0 0.0				Bryan Childress Corpus Christi Dallas El Paso Fort Worth Houston Laredo Lubbock Lufkin Odessa	West South North West North East South West East West





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Description Mage ADT Gas = 19:00 whitday 1000 ADT OK ware (whitday) Mage ADT Gas = 19:00 whitday 1000 ADT OK acce (whitday) 1000 ADT OK ADT OK ADT OK acce (whitday) 1000 ADT OK ADT OK ADT OK acce (whitday) 0 Skew for Leg 1(AI)) 30 Skew for Leg 2(4ST only) 30 act displation for incomposition approaches with a infortun inex (0, 1, 2, 3, 4) 0 0 0 0 0 action sighting (presenting presenter and infortun inex (0, 1, 2, 3, 4) 0 100 0 0 0 0 action sighting (presenting presenter and infortun inex (0, 1, 2, 3, 4) 0 100 100 0
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O Skew for Leg 1 (All) 30 Skew for Leg 2 (4ST only) 30 or of signalized or uncontrolled approaches with a light turn lane (0, 1, 2, 3, 4) 0 0 0 0 or of signalized or uncontrolled approaches with a light turn lane (0, 1, 2, 3, 4) 0 0 0 0 er of signalized or uncontrolled approaches with a light turn lane (0, 1, 2, 3, 4) 0 0 0 0 extion lighting (frequence) Net Present Present 0 0 0 wide Calibration Factors (C, _ 1.00 1.00 1.00 5.00
er of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4) 0 0 0 ection lighting (present/int present) 0 0 extend lighting (present) 0 0 extend lighting (present) 0 0 ext
Or of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4) 0 0 Not Present Present Present Present Present Present Present Present Skew Intersections
Not Present Present Present wide Calibration Factor, Ca 1.00 1.00 Skew Intersection: Worksheet 2B - Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections (i) (i) (ii) (iii) (iii) (iii) (iiii) (iii) (iiii) (iii) (iiii) (iii) (iii)
Worksheet 2B Crash Modification Factors for Rural Two-Lane Two Way Roadway Intersections (1) (2) (3) (4) (5) CMF for Intersection Skew Angle CMF for Left-Turn Lanes
Worksheet 2B Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections (1) (2) (3) (4) (5) CMF for Intersection Skew Angle CMF for Left-Turn Lanes CMF for Intersection Stew Angle CMF for Left-Turn Lanes CMF for Left-Turn Lan
(1) (2) (3) (4) (6) CMF for Intersection Skew Angle CMF 1, from Equations 10-22 or 10-23 CMF for Light-Turn Lanes CMF 3, from Table 10-13 CMF for Light-Turn Lanes CMF 3, from Table 10-13 CMF for Light-Turn Lanes CMF 3, from Table 10-14 CMF for Lighting from Table 10-14 CMF for Lighting CMF 4, from Equation 10-24 CMF for CMF (1)(2)(2)(3)(4) 1.13 1.00 1.00 0.90 1.02 Worksheet 2C - Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections (6) (7) (8) Predicted average crash frequency. N perform Equations 10-8, 10-9, or 10-10 Overdispersion from Section from Section from Section 10-10 (1) (2) (3) (4) (5) (6) (7) (8) Predicted average crash frequency. N performed a
(1) (2) (3) (4) (6) CMF for Intersection Skew Angle CMF 1, from Equations 10-22 or 10-23 CMF for Light Turn Lanes CMF 3, from Table 10-13 CMF for Light Turn Lanes CMF 3, from Table 10-13 CMF for Light Turn Lanes CMF 3, from Table 10-14 CMF for Light Turn Lanes CMF 4, from Equation 10-24 CMF for CMF for Light Turn Lanes CMF 3, from Table 10-13 CMF for Light Turn Lanes CMF 3, from Table 10-13 CMF for Light Turn Lanes CMF 3, from Table 10-14 CMF for Light Turn Lanes CMF 4, from Equation 10-24 CMF for Light Turn Lanes CMF 4, from Equation 10-24 CMF for Light Turn Lanes CMF 4, from Table 10-13 CMF for Light Turn Lanes CMF 3, from Table 10-13 CMF for Light Turn Lanes from Table 10-14 CMF for Light Turn Lanes CMF 4, from Table 10-16 CMF 5, from Table 10-16 CMF 5, from Table 10-16 CMF 5, from Table 10-16 C/// Turn Lanes from 5) of Worksheet 2B Meet ST, est or ess by Severity Distribution from 5) of Worksheet 2B State/Region Adjustment, C_s * AF, for (5) ('6) ('7) Meet ST, for (5) ('6) ('7) and Injury (FI) - 0.335 0.154 1.02 1.00 0.331 Updrage Only (PDO) - 0.666 0.307 1.02 1.00 0.331
CMF for Intersection Skew Angle CMF for Left-Turn Lanes CMF for Right-Turn Lanes CMF for Lighting Combined CMF CMF 1 CMF 2 CMF 2 CMF 3 CMF 4 CMF 2 CMF 2 from Table 10-13 from Table 10-14 from Table 10-14 from Table 10-14 (1)(2)(1)(4) (1)(2)(1)(4) 1.13 1.00 1.00 0.90 1.02 Worksheet 2C - Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections (1) (2) (3) (4) (5) (6) (7) (8) Crash Severity Level N spt 357, 457 or 450 Overdispersion Crash Severity Distribution Severity Level 1.00 0.461 0.405 1.002 1.00 0.468 Injury (FI) - 0.335 0.154 1.02 1.00 0.31 Upmaage Only (PDO) - - 0.665
CMF 1 CMF 2 CMF 3 CMF 4 CMF 4 CMF 2 CMF 2 from Equations 10-22 or 10-23 from Table 10-13 from Table 10-14 from Equation 10-24 (1)(1/2)'(2)'(4) 1.13 1.00 0.90 1.02 Worksheet 2C - Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections (1) (2) (3) (4) (5) (6) (7) Predicted average crash frequency. N Parameter, k Distribution Distribution Severity Institution Severity Institution Severity Institution Severity Institution Severity Institution Cash Severity Institution Cash Severity Institution Severity Institution Cash Severity Institution Institution Severity Instinution Severity Instinution
from Equations 10-22 or 10-23 from Table 10-13 from Table 10-14 from Equation 10-24 (1)*(2)*(3)*(4) 1.13 1.00 1.00 0.30 1.02 Worksheet 2C - Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections (1) (2) (3) (4) (5) (6) (7) (8) Crash Severity Level N spl 3ST. 45T or 456 Overdispersion Crash Severity Distribution Severity Distribution Combined CMFs State/Region Adjustment, Cs, * AFr Predicted average crash frequency. N Parameter, k from Section from Section from Section from (5) of Worksheet State/Region Adjustment, Cs, * AFr Predicted average crash frequency. N 0.461 0.405 1.000 0.461 1.02 1.00 0.468 and Injury (FI) 0.335 0.154 1.02 1.00 0.31 Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections
1.13 1.00 1.00 0.90 1.02 Worksheet 2C Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections (1) (2) (3) (4) (5) (6) (7) Predicted average crash frequency. N Predicted average crash frequency. N Distribution State/Region Adjustment, C ₂ * AFr Predicted average crash frequency. N Predicted int (5)*(6)*(7) 0.401 0.405 1.000 0.461 1.02 1.00 0.468 10-10 10.6.2 5 0.154 1.02 1.00 0.468 and Injury (FI) - 0.335 0.154 1.02 1.00 0.468 Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections 1.02 1.00 0.311
Worksheet 2C Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections Minimize
(1) (2) (3) (4) (5) (6) (7) (8) Crash Sevenity Level N spf 357, 457 or 456 Overdispersion Crash Sevenity N spf 357, 457 or 456 Overdispersion Combined CMFs Predicted average crash frequency, N predicted int from Equations 10-8, 10-9, or 10-10 from Equations 10-8, 10-9, or 10.6.2 from Table 10- 5 (2)rortAL * (4) from (5) of Worksheet 2B State/Region Adjustment, Cs * AFr Predicted int MGLE and Injury (FI) - 0.335 0.154 1.02 1.00 0.468 orly (PDO) - 0.665 0.307 1.02 1.00 0.311
(1) (2) (3) (4) (5) (6) (7) (8) Crash Seventy Level N spf 357, 457 or 456 Overdispersion Crash Seventy N spf 357, 457 or 456 Overdispersion Combined CMFs Predicted average crash frequency, N predicted int from Equations 10-8, 10-9, or from Eduction 10.6, 2 5 (2)rortal. *(4) from (5) of Worksheet State/Region Adjustment, Cs * AFr Predicted int MGLE and Injury (FI) - 0.335 0.154 1.02 1.00 0.468 orly (PDO) - 0.665 0.307 1.02 1.00 0.311
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Crash Severity Level N spf 3ST. 4ST or 4SG Overdispersion Parameter, k Crash Severity Distribution N spf 3ST. 4ST or 4SG Predicted average crash frequency, N perioded int Predicted average crash frequency, N predicted int Predicted average crash frequency, N perioded int 10-10 10.6.2 5 from Table 10. 2B Combined CMFs from (5) of Worksheet State/Region Adjustment, Cs * AFr Predicted average crash frequency, N predicted int Predicted average crash frequency, N (5)*(6)*(7) 0.461 0.405 1.000 0.461 1.02 1.00 0.468 and Injury (FI) 0.665 0.307 1.02 1.00 0.157 try Damage Only (PDO) 0.665 0.307 1.02 0.00 0.311
N spf 3ST, 4ST or 4SG Parameter, k Distribution Combined CMFs State/Region Adjustment, Cs * AFr Parameter, k Distribution Severity Distribution Combined CMFs State/Region Adjustment, Cs * AFr Predicated int AMGLE 10-10 10.62 5 (2)roTAL * (4) from (5) of Worksheet 2B 100 0.468 0.461 0.405 1.000 0.461 1.02 1.00 0.468 and Injury (FI) 0.665 0.307 1.02 1.00 0.311 Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections
Parameter, k Distribution Severity Distribution Combined CMFs predicted int predicted int from Equations 10-8, 10-9, or 10-10 from Table 10- 10.6.2 Combined CMFs from (5) of Worksheet 2B State/Region Adjustment, Cs * AFr predicted int (6)*(6)*(7) and Injury (FI) 0.335 0.154 1.02 1.00 0.468 and Injury (PDO) 0.665 0.307 1.02 1.00 0.311
from Equations 10-8, 10-9, or 10-10 from Table 10- 5 (2) _{TOTAL} * (4) from (5) of Worksheet 2B (5)*(6)*(7) 0.461 0.405 1.000 0.461 1.02 1.00 0.468 and Injury (FI) 0.335 0.154 1.02 1.00 0.157 rty Damage Only (PDO) - 0.665 0.307 1.02 1.00 0.311
10-10 10.5.2 5 2B 0.461 0.405 1.000 0.461 1.02 1.00 0.468 and Injury (FI) 0.335 0.154 1.02 1.00 0.157 rty Damage Only (PDO) 0.665 0.307 1.02 1.00 0.311
und Injury (FI) 0.335 0.154 1.02 1.00 0.157 rty Damage Only (PDO) 0.665 0.307 1.02 1.00 0.311 Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections
rty Damage Only (PDO) 0.665 0.307 1.02 1.00 0.311 Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections
Worksheet 2D Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections
Collision Type Proportion of N prediceed int (TOTAL) Proportion of Collision N prediceed inte (TP) (crashes/year) Proportion of Collision Type(PDO) N prediceed inte (PDO) (crashes/year)
Collision (crashes/year) Typern Typern (crashes/year)
> Instructions Segment 1 Segment 2 Segment Tables Intersection 1 Intersection 2 Intersection Tables Rural 2-Lane Site Total ···· + : •

Texas Department of Transportation



A	В	С	D	E	F	G	Н	I	J	К	L
2 3		Worksheet 3A Pred	distant and Obser	und Crashan bu	Severity and Si	to Tuno Using th	no Sito Specific E	P. Mothod			
4		Worksheet SA Pred	dicted and Obser	ved Crashes by	Seventy and Si	te Type Using ti	te site-specific E	5 Wethod			
5		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
	Site type and		(=)	(0)	(4)	Observed	Overdispersion	Weighted	Expected		
6						crashes,	Parameter, k	adjustment, w	average crash		
7			Predicted	average crash	frequency	Nobserved			frequency,		
8			Tredicted	(crashes/year)		(crashes/year)			Nexpected		
9			N predicted	N predicted	N predicted			Equation A-5	Equation A-4 from		
10			(TOTAL)	(FI)	(PDO)			from Part C	Part C Appendix		
11				V 7	(<i>i</i> /			Appendix			
2					AY SEGMENTS						
13	Segment 1	From worksheet	3.584	1.233	2.351	10	0.247	0.530	6.597		
14	Segment 2	From worksheet	0.302	0.104	0.198	2	0.247	0.931	0.419		
15	Segment 3								0.000		
16 17	Segment 4								0.000		
17	Segment 5								0.000		
19	Segment 6 Segment 7								0.000		
20	Segment 8		-						0.000		
21	e ognione o			INTER	RSECTIONS				0.000		
22	Intersection 1	From worksheet	0.468	0.157	0.311	3	0.405	0.841	0.872		
23	Intersection 2	From worksheet	2.535	0.826	1.708	2	0.599	0.397	2.212		
24	Intersection 3								0.000		
25	Intersection 4								0.000		
26	Intersection 5								0.000		
27	Intersection 6								0.000		
28	Intersection 7								0.000		
29	Intersection 8								0.000		
30	COMBINED (su	im of column)	6.889	2.320	4.569	17	- /	- \	10.100		
31											
32 33											
34			Worksheet	3B Site-Speci	ific EB Method S	ummary Result	s				
35				-							
36	Creat and the	(1)			(2)			(3)			
37	Crash severity	level			N predicted			N expected			
38	Total			(2) _{C0}	OMB from Workshe	et 3A	(8)c	MB from Workshe	eet 3A		
39	Estal and laive				6.889			10.1			
40	Fatal and Injury	(EI)		(3)c	OMB from Workshe	et 3A	(3)	готац * (2) _{FI} / (2) т	OTAL		
41	Property Dama	as Only (BDO)		10	2.320	at 24	(2)	3.4			
42 43	Froperty Dama	ge Only (PDO)		(4)c	OMB from Workshe	et SA	(3) _T	DTAL * (2)PDO / (2) 6.7	TOTAL		
43 //					4.569			0.7			
< >	Instructi	s A&M	gment 2 S	Segment Tab	les Interse	ection 1	ntersection 2	Intersection	on Tables 🤇 🤇	ural 2-Lane S	Site Total Texas Department
		portation ute									Transportation

RURAL MULTI-LANE HIGHWAYS

	A	В	С	D	E	F	G	H		J	K	L	M	N
			14/-		Conservation		Dete 6	D	dellara Divid	a d Da a dau	0			
						ormation and I	nput Data f	or Rurai Mi	litilane Divid		Location Info			
			Genera	al Information		0.0.0					Location into			
	Analyst Agency or C	ompony			-	SRG TTI		Roadway Roadway S	Contion				I 123 to MP 1.5	
					-									
	Date Perform	ned				1/9/2024		Jurisdiction Analysis Y					ere, USA 010	
			In	put Data					onditions			Z Site Conditi		
	Roadway typ	e (divided)	in						vided			Divided		
	Length of se											1.5		
	AADT (veh/d			Мар	AADT _{MAX} =	= 89,300	veh/day					10,000		
	TxDOT distri			map	A A MAX	-00,000	Johnady					Not Specifi	ied	
	Lane width (•		12			12		
	· · · · · ·	it shoulder width (ft)							8			0		
	Right should							Pa	aved			Paved		
	Median width	<u> </u>							30			20		
		sent/not present)							Present			Not Prese		
5		peed enforcement (sent)					Present			Not Prese	nt	
)	Statewide Ca	alibration Factor, C _s						1	.00			1.00		
)														
2			<u> </u>		3 (a) Crash	Modification		-		Roadway	_			
3		(1)		(2)		(3	,		(4)		(5)			6)
4 5		or Lane Width	CMF to	r Right Should	er Width	CMF for Me			or Lighting	CMF	for Automate Enforceme	nt	Combir	ned CMF
6		CMF 1rd		CMF 2rd		CMF			IF 4rd		CMF 5rd			comb
		Equation 11-16	f	rom Table 11-	17	from Tab			ation 11-17	fr	om Section 1	1.7.2		3)*(4)*(5)
5		1.00		1.18		1.0	02	1	.00		1.00		1.	.20
9														
) 														
			v	Vorksheet 10	(a) Roady	vay Segment (Crashes for	Rural Mult	ilane Divided	Roadway	Segments			
•	_	(1)		(2)	(a) Roady	vay beginent ((4)		5)	(6)	(7)
ſ	< >		Rural Divideo		Rural I	Jndivided Mu					ilane Interse		ersection Table	
		Instructions				Shalvided Ivid	itilarie Seg	Segmen	it tables	Rula Wul	liane interse		ersection rable	-5
	۲ ر													
		 Texas A&I Transporta Institute 	M ation											Texa Departi of Transp

URBAN ARTERIALS

1	А	В	С	D	E	F	G	Н	I	J	К	L	М	N	0
2				Works	heet 2A Ger	eral Informa	ation and Inpu	t Data for Urban a	nd Suburban	Arterial Inter	sections			1	
3			Ge	eneral Informa	tion					Loc	ation Inform				
	Analyst					SRG		Roadway					123		
	Agency or Co				-	TTI		Intersection					t 4th Avenue		
_	Date Perform	ed				1/9/2024		Jurisdiction					ere, USA		
7								Analysis Year					010		
8		(00 7 000	(07. (0.0)	Input Data				Base Cor				Site Conditio	ons		
		pe (3ST, 3SG	, 4ST, 4SG)									3SG			Signalize
	AADT _{major} (ve			Map	AADT _{MAX} =		veh/day					15,000			AADT OK
	AADT minor (ve			map	AADT _{MAX} =	16,400	veh/day					9,000			AADT OK
	TxDOT distric											Not Specifie	d		
		e for major roa										5T			Five-lane
		ghting (present						Not Pre				Present			_
		libration Factor	/ 2					1.0	0			1.00			_
16		nalized interse													_
17	Numbe	r of major-road	d approaches v	vith left-turn lane	es (0,1)			0				0			
18	Numbe	r of major-road	d approaches v	vith right-turn la	nes (0,1)			0				0			
19	Data for signa	lized intersect	tions only:												
20	Numbe	r of approache	es with left-turn	lanes (0,1,2)				0				2			
21	Numbe	r of approache	es with right-tur	n lanes (0,1,2)				0				2			
22	Numbe	r of approache	es with left-turn	signal phasing	(0,1,2)							2			
23	Type of	left-turn signa	al phasing for Le	eg #1				Permi	ssive			Protected / Perm	issive		
24	Type of	f left-turn signa	al phasing for Le	eg #2								Protected / Perm	issive		
25	Type of	f left-turn signa	al phasing for Le	eg #3 (if applica	ble)							Not Applicab	le		
26	Type of	f left-turn signa	al phasing for Le	eg #4 (if applica	ble)							Not Applicab	le		
27	Numbe	r of approache	es with right-tun	n-on-red prohib	ited (0,1,2)			0				0			
28			cameras (prese					Not Pre	esent			Not Presen	t		
29				nes (PedVol) (1,500			
30				by a pedestrian								4			
31			,	1,000 ft) of the i				0				2			
32				e intersection (p				Not Pre	esent			Present			
33	Numbe	r of alcohol sa	les establishm	ents within 300	m (1,000 ft) of t	he intersecti	on	0				6			_ /
34															
35															
36															
	$\langle \rangle$	Instruct	ions 🤇 Segr	ment 1 🔰 Se	egment 2	Segment 1	Fables 🤇 Int	ersection 1	ntersection	2 Interse	ection Table	es Urban S	Site Total	Urban Proje	ect Total
1	()														
/	Y														





URBAN ARTERIALS

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1	А	В	С	D	E	F	G	Н		J	K	L	М	Ν
2				Worksheet 1	A General	Information	and Input D	ata for Urban a	and Suburb	an Roadwa	v Seaments			
3				I Information		lineination	una inpaco				Location Info	rmation		
	Analyst		0011010			SRG		Roadway				SH 12	23	
	Agency or Com	ipany				тп		Roadway Sect	tion			MP 0.0 to	MP 1.5	
	Date Performed				•	1/9/2024		Jurisdiction				Anywhere	USA	
7								Analysis Year				2010		
8			Ini	out Data	1			Base Co				Site Condition		
9	Roadway type (2U, 3T, 4U, 4D, 51	· · · · ·					-	-			5T	>	
	Length of segm							-	-			1.5		
	AADT (veh/day)			Map	AADT _{MAX} =	= 53,800	veh/day		-			11,000		
-	TxDOT district				in ex			-	-			Not Specified		
3	Type of on-stree	et parking (none/pa	arallel/angle)					No	ne			Parallel (Comm/Ir	ıd)	
4	Proportion of cu	irb length with on-s	street parking					-	-			0.66		
5	Median width (ft	t) - for divided only						1	-			Not Present		
	Lighting (preser							Not Pr				Present		
-		ed enforcement (pr		esent)			,	Not Pr				Not Present		
		ial driveways (num ial driveways (num						-				0 10		
		/ institutional drive)				-				0		
		/ institutional drive						-				3		
-		al driveways (numb		/				-	-			2		
		al driveways (numb						-	-			15		
.4	Other driveways	s (number)						-	-			0		
	Speed Category							-			Posteo	l Speed Greater th	an 30 mph	
		object density (fixe)			,	0				10		
		de fixed objects (ft)					3	_			6		
-	Statewide Calib	ration Factor, C₅						1.(00			1.00		
29														
30 31														
2				Worksh	eet 1B Cra	sh Modificatio	on Factors f	or Urban and S	Suburban R	oadway Se	aments			
3		(1)		(2)		-	3)	(4			(5)	P	(6)
84 85	CMF for On-	Street Parking	CMF for F	Roadside Fixe	d Objects	CMF for Me	edian Width	CMF for	Lighting	CMF for a	Automated Spe	ed Enforcement	Combine	d CMF
6	CN	//F 1r		CMF 2r		CM	F 3r	CM	= 4r		CMF 5r		CMF c	omb
7	from Equ	ation 12-32	fror	n Equation 12	-33	from Tab	ble 12-22	from Equa	tion 12-34		from Section	12.7.1	(1)*(2)*(3))*(4)*(5)
8	1	.47		1.00		1.	00	0.	94		1.00		1.3	8
9														
0														
1														
	< >	Instructio	ons Seg	ment 1	Segment	2 Sean	nent Table	es Inters	ection 1	Interse	ection 2	Intersection	Tables	Urban Site
					2 sgmone	_ bogn		inters		interior				
		Texas A&N	tion											Texas Departm
		Transporta Institute												of Transpo
_		insulute												

URBAN ARTERIALS

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Input Data Analysis Year 2010 Intersection type (3ST, 3SG, 4ST, 4SG)				Works	neet 2A Gene	eral Inform	ation and Inpu	t Data for Urban an	d Suburban	Arterial Inter	sections			
Valyst gency or Company bate Performed SRG TTI 19/2024 Readway bursterion SRG bursterion Readway bursterion SR 1 3d Awaue bursterion SR 1 3d Awaue Awaue bursterion bate Performed Input Data Input Data Base Conditions Base Conditions State Conditions bate Performed Input Data Base Conditions Base Conditions State Conditions VADT may: (wh/day) Mag AADTuxx = 45,700 wh/day - 14,000 VADT may: (wh/day) Mag AADTuxx = 45,700 wh/day - Net Specified VADT may: (wh/day) - National Stateward Calibration Factors 14,000 Not Present Net Specified State wide Calibration Factors (bring (rosent/not present)) Not Present Net Specified - Number of major-road approaches with left-turn lanes (0,1) 0 10 10 Number of major-road approaches with left-turn lanes (0,12) - - - Number of approaches with left-turn lanes (0,12) - 0 0 Number of approaches with left-turn lanes (0,12) - - Not Applicable <t< th=""><th></th><th></th><th>Ge</th><th></th><th></th><th></th><th></th><th></th><th>u ouburbur</th><th></th><th></th><th>ion</th><th></th><th></th></t<>			Ge						u ouburbur			ion		
Agency of Company Til Intersection Main Sta 3/d Avenue Date Performed Input Date - 2010 Intersection type (strip 3SC, 4ST, 4SG) Magncy (veh/day) - 3ST ADT may (veh/day) Magncy (veh/day) - - 3ST ADT may (veh/day) Magncy targe (strip 4S, 2SG, 4ST, 4SG) - - 0.000 XDOT may (veh/day) Magncy targe (strip 4S, 2SG, 4ST, 4SG) - - 0.000 XDOT may (veh/day) Magncy targe (strip 4S, 2SG, 4ST, 4SG) - - 0.000 XDOT distict - - Not Specified 33T Statewide Calibration Factor, Ca 100 1.00 1.00 1.00 State runsing indigrad approaches with infet run lanes (0, 1) 0 1 - - Number of major-cada approaches with infet run lanes (0, 12) 0 0 0 0 Number of approaches with infet run lanes (0, 12) 0 0 0 0 0 Type of left-turn signal phasing for Log #2 - - Not Presont <t< td=""><td>Analyst</td><td></td><td></td><td></td><td></td><td>SRG</td><td></td><td>Roadway</td><td></td><td></td><td></td><td></td><td>123</td><td></td></t<>	Analyst					SRG		Roadway					123	
Date Performed 119/2024 Jurisdiction Analysis Year Analysis Year Date Section type (3ST, 3SG, 4ST, 4SG) Input Date Base Conditions State Conditions Date growtholdary) Map AADTmaxe 4 5,700 weh/day - 4,000 ADDT maye (veh/day) Map AADTmaxe = 45,700 weh/day - 4,000 ADDT maye (veh/day) Map AADTmaxe = 45,700 weh/day - 4,000 ADTmaxe (veh/day) - Map 4,000 - 0.000 Dott fisticit - - 3T - - Not Present Statewide Californic Factor, Cg 1,00 1,00 1 -		mpany						· · · · · · · · · · · · · · · · · · ·						
Input Data Base Conditions Size Cenditions Intersection type(1ST, 3SG, 4ST, 4ST, 4ST, 4ST, 4ST, 4ST, 4ST, 4ST						1/9/2024		Jurisdiction				Anywher	e, USA	
Intersection type(18)T, 380, 487, 480)								Analysis Year						
AADT mage (veh/day) Map AADTmack = 45,700 veh/day				Input Data				Base Cond	itions				5	
AADT mode (veh/day) Madp AADT _{MAC} = 9,300 veh/day - 4,000 TxDOT district - Not Specified Statused - Not Present Intersection lighting (present/not present) Not Present Not Present Not Present Statewide Calibration Factor, Cg 1.00 1.00 1.00 Data for unsignalized intersections only: - - - Number of major-road approaches with left-turn lanes (0,1) 0 0 0 Data for signalized intersections only: - - - Number of approaches with left-turn lanes (0,1.2) 0 0 0 Number of approaches with left-turn signal phasing (0,1.2) - - 0 Type of left-turn signal phasing for Leg #1 Permissive Nott Applicable - Type of left-turn signal phasing for Leg #1 Permissive Nott Applicable - Nott Applicable Type of left-turn signal phasing for Leg #1 Permissive Nott Applicable - Not Applicable Type of left-turn signal phasing for Leg #1 Permissive Nott Applicable - Not Applicable - Not Applicable			4ST, 4SG)								(>	
ADDTmaxe 9.300 veh/day 4.00 RodWay type for major road Not Present Not Present RodWay type for major road approaches with left-turn lanes (0,1) 0 1.00 1.00 Data for unsignalized intersections only: Number of major-road approaches with left-turn lanes (0,1) 0 0 1 Number of approaches with left-turn lanes (0,1.2) 0 0 0 Number of approaches with left-turn signal phasing for Leg #2 0 0 Number of approaches with left-turn signal phasing for Leg #2 Not Applicable 0 Type of left-turn signal phasing for Leg #2 Not Applicable 0 0 Type of left-turn signal phasing for Leg #2 Not Applicable 0 0 0 Number of approaches with ingit-turn-on-red prohibited (0, 1,2) 0	ADT _{major} (ve	eh/day)		Man	AADT _{MAX} =	45,700	veh/day					14,000		
Roadway type for major road	ADT minor (Ve	eh/day)		map	AADT _{MAX} =	9,300	veh/day					4,000		
Intersection lighting (present/not present) Not Present Not Present Statewide Calibration Factor, C _a 1.00 1.00 Data for unsignalized intersections only: Number of major-road approaches with left-turn lanes (0,1) 0 0 Data for unsignalized intersections only: Number of major-road approaches with right-turn lanes (0,1) 0 0 Data for unsignalized intersections only: Number of approaches with right-turn lanes (0,1.2) 0 0 Number of approaches with right-turn lanes (0,1.2) 0 0 Number of approaches with right-turn signal phasing for Leg #1 Permissive Not Applicable Type of left.turn signal phasing for Leg #1 Permissive Not Applicable Type of left.turn signal phasing for Leg #1 (f applicable) Not Applicable Type of left.turn signal phasing for Leg #1 (f applicable) Not Applicable Type of left.turn signal phasing for Leg #1 (f applicable) Not Applicable Number of approaches with right-turn everts (present/top tresent) Not Present Not Present Sum of all pedestrian crosing volumes (PedVol) (1 - 34.200) <td></td>														
Statewide Calibration Factor, Cs 1.00 1.00 Data for unsignalized intersections only: - - Number of major-road approaches with left-turn lanes (0,1) 0 0 Data for signalized intersections only: - - Number of approaches with right-turn lanes (0,1,2) 0 0 Number of approaches with night-turn lanes (0,1,2) 0 0 Number of approaches with night-turn lanes (0,1,2) 0 0 Number of approaches with night-turn lanes (0,1,2) 0 0 Number of approaches with night-turn lanes (0,1,2) 0 0 Number of approaches with night-turn lanes (0,1,2) - 0 Number of approaches with night-turn lanes (0,1,2) 0 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 (f applicable) - Not Applicable Type of left-turn signal phasing for Leg #3 (f applicable) - Not Applicable Number of approaches with night-turn-need problember (lo (1,2)) 0 0 0 Number of all pedestrian crossing volumes (PedVol) (1 - 34,200) -<														
Data for unsignalized intersections only: - - Number of major-road approaches with left-turn lanes (0,1) 0 1 Number of major-road approaches with left-turn lanes (0,1) 0 0 Data for signalized intersections only: - - Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn lanes (0,1,2) - 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 (f applicable) - Not Applicable Type of left-turn signal phasing for Leg #3 (f applicable) - Not Applicable Type of left-turn signal phasing for Leg #4 (f applicable) - Not Applicable Number of approaches with inght-turn-on-red prohibited (0,1,2) 0 0 Number of approaches with inght (mu-on-red prohibited (0,1,2) 0 0 Number of approaches with inght (mu-on-red prohibited (0,1,2) 0 0 Sum of a									ent					
Number of major-road approaches with left-turn lanes (0,1) 0 1 Number of major-road approaches with right-turn lanes (0,1) 0			-											
Number of major-road approaches with right-turn lanes (0,1) 0 0 Data for signalized intersections only: Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn signal phasing (0,1,2) 0 0 Number of approaches with left-turn signal phasing (0,1,2) 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 0 0 0 0 0 0 0 0 0 <td></td>														
Data for signalized intersections only: - - Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with left-turn signal phasing (0,1,2) 0 0 Number of approaches with left-turn signal phasing for Leg #1 0 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with ingit-turn-or-red prohibited (0,1,2) 0 0 Number of approaches with ingit-turn-or-red prohibited (0,1,2) 0 0 Number of approaches with ingit-turn-or-red prohibited (0,1,2) 0 0 Number of lapped cores (0,1,2) 0 0 0 Number of lapped cores (0,1,2) 0 0 0 Number of approaches with ingit-turn-or-red prohibited (0,1,2) 0 0 0 Number of lapped cores (0,1,2) 0 0 0 0 Number of lapped cores (0,1,2) 0 0 0 0 Sum of all pedestrian (rossing volumes, (Ped/V0,1,1,34,200) 0 0 Num					1.1.1			-						
Number of approaches with left-turn lanes (0,1,2) 0 0 Number of approaches with right-turn lanes (0,1,2) 0 0 Number of approaches with right-turn signal phasing (0,1,2) 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Number of approaches within 300 m (1,000 fl - 34,200) Not Present Not Present 0 Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 0 0 Number of alcohol sales setablishments within 300 m (1,000 fl) of the intersection 0 0 0 0 0 0 </td <td>Numbe</td> <td>r of major-road</td> <td>approaches w</td> <td>ith right-turn lar</td> <td>nes (0,1)</td> <td></td> <td></td> <td>0</td> <td></td> <td></td> <td></td> <td>0</td> <td></td> <td></td>	Numbe	r of major-road	approaches w	ith right-turn lar	nes (0,1)			0				0		
Number of approaches with right-turn lanes (0,1,2) 0 0 Number of approaches with left-turn signal phasing (0,1,2) 0 Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Intersection red light cameras (present/not present) Not Present Not Present Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 Maximum number of lanes crossed by a pedestrian (Puesex) 0 Number of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 Maximum number of lanes crossed by a pedestrian (Puesex) 0 Schools within 300 m (1,000 ft) of the intersection 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 </td <td>)ata for signa</td> <td>alized intersect</td> <td>ons only:</td> <td></td>)ata for signa	alized intersect	ons only:											
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Type of left-turn signal phasing for Leg #1 Permissive Not Applicable Type of left-turn signal phasing for Leg #2 Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Intersection red light cameras (present/not present) Not Present Not Present 0 Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 0 0 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 </td <td>Numbe</td> <td>r of approaches</td> <td>with right-turn</td> <td>n lanes (0,1,2)</td> <td></td> <td></td> <td></td> <td>0</td> <td></td> <td></td> <td></td> <td>0</td> <td></td> <td></td>	Numbe	r of approaches	with right-turn	n lanes (0,1,2)				0				0		
Type of left-turn signal phasing for Leg #2 Not Applicable Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) Not Present Not Present Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 Number of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 0 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 Number of all cohol subps within 300 m (1,000 ft) of the intersection 0 0 0 Schools within 300 m (1,000 ft) of the intersection 0 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 0 Image: Schools within 300 m (1,000 ft) of the intersection 0 0 0 0 0 0 Image: Schools within 300 m (1,000 ft) of the intersection <td>Numbe</td> <td>r of approaches</td> <td>with left-turn</td> <td>signal phasing</td> <td>(0,1,2)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td></td> <td></td>	Numbe	r of approaches	with left-turn	signal phasing	(0,1,2)							0		
Type of left-turn signal phasing for Leg #3 (if applicable) Not Applicable Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Intersection red light cameras (present/not present) Not Present Not Present Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 10 10 Maximum number of lanes crossed by a pedestrian (numexx) 0 0 Number of bus stops within 300 m (1,000 ft) of the intersection 0 0 0 Schools within 300 m (1,000 ft) of the intersection 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 Vorksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections 0 0 0 (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Light Cameras Combined CMF	Type of	f left-turn signal	phasing for Le	eg #1				Permissi	ive			Not Applicable		
Type of left-turn signal phasing for Leg #4 (if applicable) Not Applicable Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 0 Intersection red light cameras (present/not present) Not Present Not Present 0 Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 0 0 0 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 0 Number of bus stops within 300 m (1,000 ft) of the intersection (present/not present) 0 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection (present/not present) Not Present 0 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection (present/not present) Not Present 0	Type of	f left-turn signal	phasing for Le	eg #2								Not Applicable		
Number of approaches with right-turn-on-red prohibited (0,1,2) 0 0 Intersection red light cameras (present/not present) Not Present Not Present Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 10 10 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 Number of bus stops within 300 m (1,000 ft) of the intersection 0 0 0 Schools within 300 m (1,000 ft) of the intersection (present/not present) Not Present Not Present Not Present Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 0 Verksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections 0 0 0 0 (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Red Light Cameras Combined CMF	Type of	f left-turn signal	phasing for Le	eg #3 (if applica	ble)							Not Applicable		
Intersection red light cameras (present/not present) Not Present Not Present Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 10 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 0 Number of bus stops within 300 m (1,000 ft) of the intersection 0 0 0 0 Schools within 300 m (1,000 ft) of the intersection (present/not present) Not Present Not Present Not Present Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0	Type of	f left-turn signal	phasing for Le	eg #4 (if applica	ble)							Not Applicable		
Sum of all pedestrian crossing volumes (PedVol) (1 - 34,200) 10 Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 Number of bus stops within 300 m (1,000 ft) of the intersection 0 0 Schools within 300 m (1,000 ft) of the intersection (present/not present) Not Present Not Present Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 Worksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections 0 0 (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Lighting CMF for Light Cameras Combined CMF			<u> </u>		ted (0,1,2)							-		
Maximum number of lanes crossed by a pedestrian (n _{lanesx}) 0 Number of lanes crossed by a pedestrian (n _{lanesx}) 0 Number of bus stops within 300 m (1,000 ft) of the intersection 0 Schools within 300 m (1,000 ft) of the intersection (present/not present) Not Present Not Present Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 Worksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Lighting CMF for Light Cameras Combined CMF		<u> </u>	M					Not Pres	ent					
Number of bus stops within 300 m (1,000 ft) of the intersection 0 Schools within 300 m (1,000 ft) of the intersection (present/not present) Not Present Not Present Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 Worksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections 0 0 0 (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Leght Cameras Combined CMF														
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Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection 0 0 0 Image: Complex State in the intersection of the								-	1			9		
Worksheet 2B Crash Modification Factors for Urban and Suburban Arterial Intersections (1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Red Light Cameras Combined CMF							ion		ent			Not Present		
(1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Red Light Cameras Combined CMF	Numbe			ents within 500		ne mierseur	IOT	0				0		
(1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Red Light Cameras Combined CMF														
(1) (2) (3) (4) (5) (6) (7) CMF for Left-Turn Lanes CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Red Light Cameras Combined CMF														
CMF for Left-Turn Lanes CMF for Left-Turn Signal CMF for Right-Turn Lanes CMF for Right Turn on Red CMF for Lighting CMF for Red Light Cameras Combined CMF				W	orksheet 2B (Crash Modi	fication Facto	rs for Urban and Su	iburban Arte	erial Intersect	ions			
		(1)		(2)				(4)				(6)	((7)
	CMF for Le	ft-Turn Lanes			CMF for Right	-Turn Lanes	CMF for F	Right Turn on Red	CMF for	r Lighting	CMF for Red	Light Cameras	Combir	red CMF
	$\langle \rangle$	mour	ictions	Segment 1	Segmen	112 3	cyment ruc	les Intersec		Intersection		ersection ru		ban Site To
Instructions Segment 1 Segment 2 Segment Tables Intersection 1 Intersection 2 Intersection Tables Urban Site To		4 T												
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QUESTIONS – COMMENTS?









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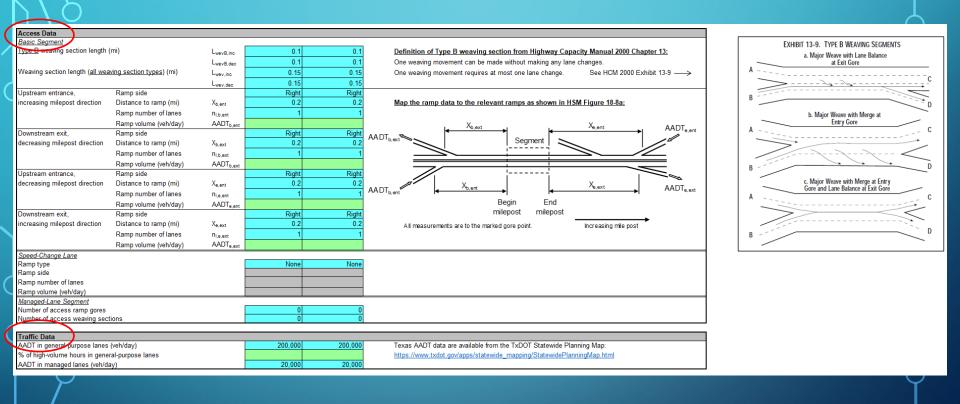
4 5

G н Highway Safety Manual Calculations for Texas Developed by: Michael P. Pratt and Srinivas R. Geedipally Version 3 (Release date: 7/31/2023) FOREWORD This software can be used to estimate crash frequency on freeways, ramps, and frontage roads as a function of geometric, access, and traffic control data following the Highway Safety Manual methodology. It is intended for use by engineers and technicians responsible for roadway design and safety analysis. This software is intended for use with the reports identified below. The analyst is encouraged to read the documents to obtain an understanding of how best to use the software and interpret its output. Full documentation of Highway Safety Manual models and data needs: Highway Safety Manual, First Edition, Supplement, Chapters 18 & 19. American Association of State Highway and Transportation Officials, Washington, DC, 2014. Documentation of the procedures to calibrate HSM models to Texas conditions for urban freeways and development of models for urban freeway managed-lane facilities: Pratt, Michael P., Srinivas R. Geedipally, Minh Le, Lingtao Wu, Raul Avelar, Subasish Das, and Dominique Lord. Enhancing Freeway Safety Prediction Models. Technical Report 0-7067-R1. Texas A&M Transportation Institute, College Station, Texas, 2022. Documentation of the procedures to calibrate HSM models to Texas conditions for rural freeways, ramps, and frontage roads: Geedipally, Srinivas, R., Karen K. Dixon, Lingtao Wu, Michael P. Pratt, Raul Avelar, Subasish Das, Ioannis Tsapakis, Dominique Lord, and Guneet Saini. Calibrating the Highway Safety Manual Predictive Methods for Texas Highways. Technical Report 0-7083-R1. Texas A&M Transportation Institute, College Station, Texas, 2022. Empirical Bayes analysis principles: Bonneson, J. and K. Zimmerman. Procedure for Using Accident Modification Factors in the Highway Design Process. Report 0-4703-P5. Texas Transportation Institute, College Station, Texas 2007. Definition of Type B weaving sections on freeways: Highway Capacity Manual, Fourth Edition, Chapter 13. Transportation Research Board, Washington, DC, 2000. The equations used in this software are documented in these reports. Analysts should refer to the report whenever they have questions about the modeling approach, assumptions, or limitations. INSTRUCTIONS sta of analysia workshasta for three types of ready ailitiaa Instructions Freeways Frontage Roads (\mathbf{f}) Ramps

SHUUG



$\langle \langle \rangle$									
General Information									
Analyst: MP		Highway Numbe					Color-Coding Legend		
Agency: TTI		Roadway Segmen				Blue = b	asic input cell (manual or drop-down m	enu)	
Date: August 16, 202 Notes:	23	Analysis Perio	d: 2018-2021				Green = optional input cell Rose = analysis results		
Notes.							Ruse – analysis results		
Output Summary									
Expected cras	h frequency (cr/yr)				nalysis Period	Combined CMFs	Crash Perio		
		MV FI or speed	-change lane:	22.102	17.376	M	/ FI or speed-change lane:	1.798 1.798	
	per of gener			6			8		8
Numb	per of mana	aged lane:	s				1		1
Mana	ged lane c	onfiguratio	on				Non-reversible	Non-reversi	ble
Input Dat Mana	ged lane s	eparation	type				Barrier	Bar	rier
Basic Roa	ent length	(mi)					1		1
Area type									
TxDOT district				Not specified	Not specified				
Number of general-purpo				8	8	×			
Number of managed lane				1	1 Non ann aible				
Managed lane configurat Managed lane separatior				Non-reversible Barrier	Non-reversible Barrier				
Segment length (mi)	туре			1	1				
Access Data									
<u>Basic Segment</u> Type <u>B</u> weaving section I	ongth (mi)			0.4	0.4	Definition of Trans Development of the	from Illinkows Consolity Manual 200	Charles 12	
Type D weaving section i	engun (mi)		LwevB,inc	0.1	0.1	Definition of Type B weaving section		U Chapter 13:	
			LwevB,dec	0.1	0.1	One weaving movement can be made wi			
Weaving section length (all weaving section ty	<u>(pes)</u> (mi)	Lwev,inc	0.15	0.15	One weaving movement requires at mos	t one lane change. See HCM 20	$000 \text{ Exhibit } 13-9 \longrightarrow$	
			L _{wev,dec}	0.15	0.15				
Upstream entrance,	Ramp side		v.	Right	Right	Man the same data to the coloured and			-
increasing milepost direc			X _{b,ent}	0.2	0.2	Map the ramp data to the relevant ra	mps as shown in HSM Figure 18-8a:)
	Ramp numb		n _{l,b,ent}	1	1				
	Ramp volum	ie (veh/day)	AADT _{b,ent}	D: 11	D : 1.1	X _{b,ext}	X _{e,ent}		
Downstream exit, decreasing milepost dire	Ramp side		v	Right 0.2	Right 0.2	AADT _{b,ext}	Segment		
			X _{b,ext}		0.2				
Instructions	Freeways Ram	nps Frontage F	Roads (÷			•		Ο
	C Texas A Transpo Instituto	\& M						Texas Department	







Geometric Data							
Total curve length (mi)	Lo	0.1	0.1				
Average curve radius (ft)	R	99999	99999				
Cross Section Data							
Lane width (ft)	WI	12	12				
Outside shoulder width (ft)	Ws	10	10				
Inside shoulder width (ft)	Wis	8	8				
Median width, including inside shoulders (ft)	Wm	30	30				
Continuous median barrier present?		Yes	Yes				
Short median barrier length (mi)	Lib	0	0				
Average short median barrier offset from inside shoulder edge (ft)	Wicb	2	2				
Average median barrier width (ft)	Wib	2	2				
Outside shoulder rumble strip proportion	Por	1	1				
Inside shoulder rumble strip proportion	Pir	1	1				
Roadside Data							
Clear zone width (ft)	Who	30	30				
Roadside barrier length (mi)	Lob	0	0				
Average roadside barrier offset from outside shoulder edge (ft)	Wocb	10	10				ļ
Crash Data					1		
Number of years of crash history data			Enter zero to analy	ze two segments or scenarios for a segment.		Predicted	Expected
MV FI or speed-change lane crash count		15			0.3345	22.102	17.376
MV PDO or speed-change lane crash count	50			0.2244	49.375	49.860	
MV managed-lane crash count		3			0.6476	1.183	1.823
SV FI crash count		2			0.7175	3.937	3.390
SV PDO crash count		9			0.5577	7.209	8.001
SV managed-lane crash count		2			0.8016	0.825	1.058





Ca	culations			
Sat	ety Performance Functions			
				Type k
	Base MV FI / SC lane crash frequency (cr/yr):	12.294	12.294	MV,FI 0.09
	Base MV PDO / SC lane crash frequency (cr/yr):	31.276	31.276	MV,PDO 0.07
	Base managed-lane MV crash frequency (cr/yr):	1.506	1.506	
	Base SV FI crash frequency (cr/yr):	5.264	5.264	
\mathcal{C}	Base SV PDO crash frequency (cr/yr):	10.682	10.682	
	Base managed-lane SV crash frequency (cr/yr):	0.889	0.889	SV 0.3
	sh Modification Factors		T	
MV	EL crashes and speed change lane crashes			
	1 Horizontal curve	1.000	1.000	
	2 L <mark>ane width</mark>	1.000	1.000	
	3 Inside shoulder width	0.966	0.966	5
	4 Median width	1.115	1.115	10,10
	5 Median barrier HSM CMF	1.022	1.022	f _{wev,dec} 1.221 1.221
	6 High volume	1.328	1.328	f _{ic.inc} 1.007 1.007
	7 Lane change numbers	1.230	1.230	f _{lo.dec} 1.007 1.007
	12 Ramp entrance			
	13 Ramp exit			
MV	PDO crashes and speed-change lane crashes			
	1 Horizontal curve	1.000	1.000	
\mathcal{C}	2 Lane width	1.000	1.000	
	3 Inside shoulder width	0.970	0.970	Lane change CMF terms
	4 Median width 0-7067 CMF	1.110	1.110	f _{wev.inc} 1.127 1.127
	5 Vedian barrier	1.029	1.029	f _{wev.dec} 1.127 1.127
\mathbf{C}	6 High volume	1.258	1.258	
	6 High volume equation	1.133	1.133	10,000
		1.155	1.100	lo,dec 1.005 1.005
	12 Ramp entrance (speed-change lanes) 13 Ramp exit (speed-change lanes) 13 Ramp exit (speed-change lanes)			
M	crashes (managed lanes)			
IN V	47 Non-reversible Outside shoulder width	0.786	0.786	
	48 Non-perersible Access weaving section	1.000	1.000	
	49 Non-reversible Access ramp	1.000	1.000	
	53 Reversible Number of lanes	1.000	1.000	
	54 Reversible Average shoulder width	0.095	0.095	
	55 Reversible Access ramp	1.000	1.000	





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SV FI	crashes	· ·								
ſ	1 Horizontal curve		1.000	1.000						
	2 Lane width		1.000	1.000						
	3 Inside shoulder width		0.966	0.966						
	4 Median width		0.964	0.964						
	5 Median barrier 6 High volume	HSM CMF	1.022 0.947	1.022 0.947						
	8 Cosside shoulder width		1.000	1.000						
	9 Shoulder rumble strip	/ numbers	0.830	0.830						
	10 Outside clearance		1.000	1.000						
	11 Outside barrier		1.000	1.000						
	<u>)O crashes</u>	-								
	1 Forizontal curve		1.000	1.000						
	2 Lane width	0-7067 CM	1.000	1.000						
	3 Inside shoulder width		0.970	0.970						
	4 Nedian width 5 Nedian barrier	equation	1.110 1.029	1.110 1.029						
	5 Niedian barrier 6 High volume		0.610	0.610						
	8 Outside shoulder width	numbers	1.000	1.000						
	11 Outside barrier		1.000	1.000						
SV cra	ashes (managed lanes)									
		Inside shoulder width	0.928	0.928						
		Access ramp	1.000	1.000						
		Number of lanes	1.000	1.000 1.000						
	55 Reversible	Access ramp	1.000	1.000						
Severi	ty Distribution Functions	(basic segments and speed-change lanes)								
		Expected crash frequency by severity (crAr)			Proportions		Syste	ematic component	ts	
		Fatal (K):	0.560	0.447	ĸ	0.022	0.022	Vĸ	-3.838	-3.838
		Incapacitating injury (A):	1.532	1.222	А	0.059	0.059	VA	-2.831	-2.831
		Non-incapacitating injury (B):	8.094	6.455	В	0.311	0.311	VB	-1.167	-1.167
		Possible injury (C):	15.852	12.642	c	0.609	0.609	C _{sdf}	1.64	1.64
_					-			201		
Interm	nediate calculations									
Po	Prepertion of length with	h curve	0.1	0.1 W _{ic}	cb Average median	barrier offset (ft)			6	6
P _{ib} Proportion of length with inside barrier		1	1 AADT _{b,ent} Volume of entrance ramp at Xb,ent (veh/day)					8900	8900	
Pob Proportion of length with outside barrier			0	0 AADT _{b.ext} Volume of exit ramp at Xb.ext (veh/day)					8900	8900
Phy Percentage of high-volume hours			0.81	0.81 AADT _{e.ent} Volume of entrance ramp at Xe,ent (veh/day)					8900	8900
PwevB,inc Type B weave proportion, increasing milepost direction			0.1	0.1 AADT _{e.ext} Volume of exit ramp at Xe,ext (veh/day)					8900	8900
PwevB.dec Type B weave proportion, decreasing milepost direction			0.1		DT _r Entrance ramp v				21200	21200
• wevB,d			V. I	0.1744		(ven/uay)			21200	21200





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General Information							
Analyst: MP	Highway Number:			Ca	olor-Coding Legend		
Agency: TTI	Roadway Segment:			Blue = basic inp	ut cell (manual or drop-do	wn menu)	
Date: August 16, 2023	Analysis Period: 2018-2021			Gre	en = optional input cell	, í	
Notes:					se = analysis results		
Output Summary							
Expected crash frequency (cr/yr)		Crash Period Ana	lysis Period	Combined CMFs	Crash	Period Analy	sis Period
	MV:	0.205	0.299		MV:	1.000	1.000
	SV:	0.030	0.042		SV:	1,143	1.143
	Total:	0.235	0.341			1.140	1.140
	rotal.	0.200	0.041				
Input Data							
Basic Roadway Data							
Ramp type		Entrance	Entrance				
TxDOT district		Not specified	Not specified	Entrance or Exit			
Ramp length (mi)		0.2	0.2				
Traffic Data							
Ramp AADT (veh/day)		10,000	10.000 If the	ramp volume is not available, leave the green i	innut cell blank & nonu	ate the cells in th	e next two roy
Ramp area type & number of lanes		10,000	10,000 II the	Tamp volume is not available, leave the green	input cen biank a popu	ate the cens in th	
AADT in general-purpose lanes (veh/day)							
AND I III general-purpose lanes (ven/day)							
Constate Date							
Geometric Data		-					
Number of horizontal curves on ramp	n _{he}	0	0				
Cross Section Data							
Right shoulder width (ft)	W _{rsw}	6	6				
Left shoulder width (ft)	Wlsw	2	2				
	V VISW	2	2				
Roadside Data							
Roadside barrier present?		Yes	Yes				
Average shoulder width where barrier is preser	nt (ft) W _{sw}	2	2				
Crash Data							
Number of years of crash history data		2 Ente	er zero to analyze tw	o segments or scenarios for a segment.	Weights	Predicted	Expected
MV crash count		1		· · · · ·	0.6801	0.205	0.299
SV crash count		1			0.9750	0.030	0.042
		-			•		
Instructions Freeways Ran	nps Prontage Roads (÷			•		
Texas A&M Transportation	on						Texas Department Transportatio

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QUESTIONS – COMMENTS?









WRAP-UP

• Thank you for your time!





