

Safety Analysis Tool for Six-Lane and One-Way Urban Streets

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Transportation
Engineering and
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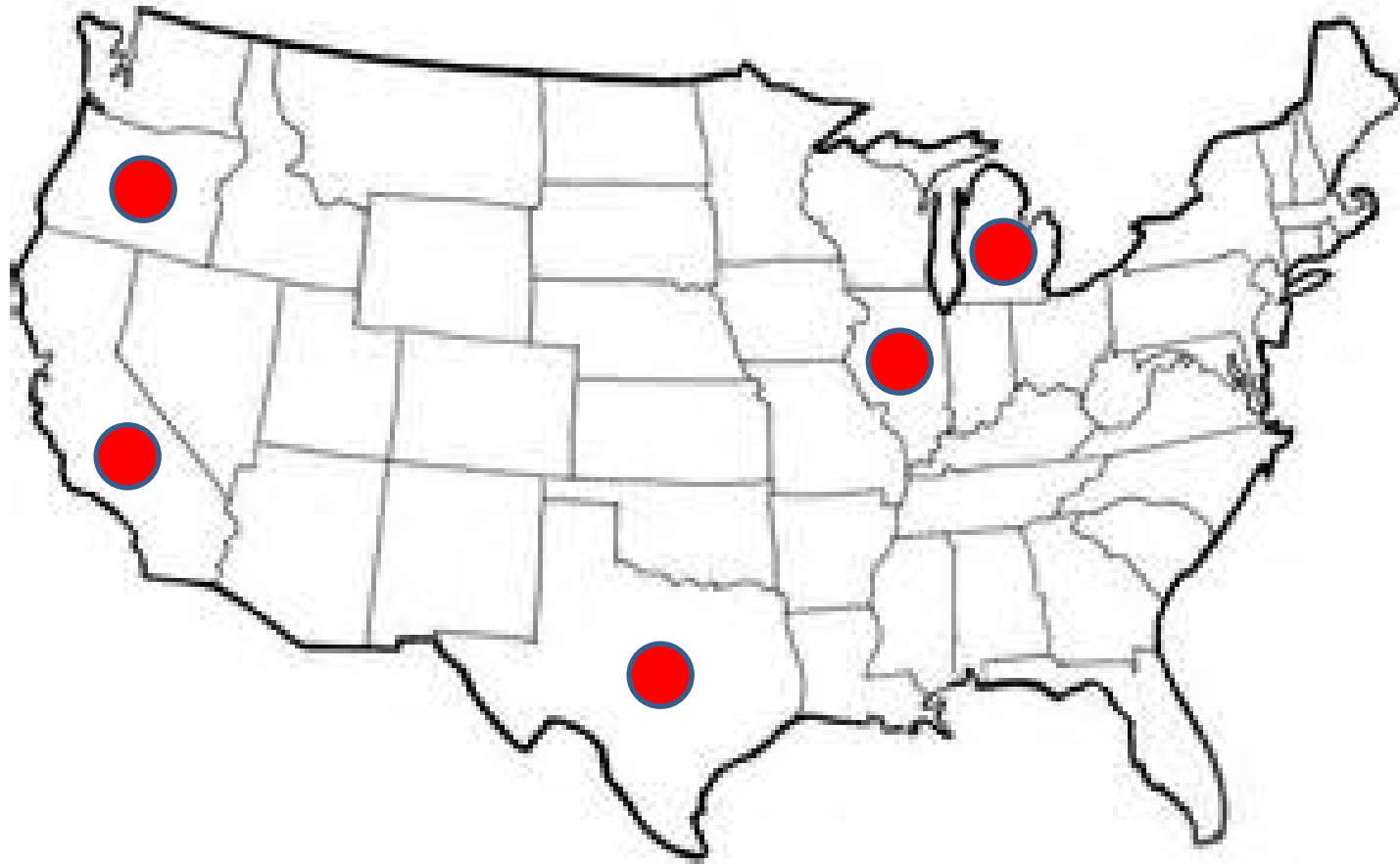




Background

- NCHRP Project 17-58
 - “Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials”
 - PI: Dominique Lord
 - Co-PI: Kay Fitzpatrick
 - Key products
 - Predictive methods to be added to HSM Chapter 12
 - Software implementation of methods

Database Assembly



Roadway Predictive Methods

Two-Way Arterials

- 6-lane undivided (6U)
 - 6-lane divided (6D)
 - 6-lane + TWLTL (7T)
 - 8-lane divided (8D)
- Multiple-Vehicle
 - Single-Vehicle
 - Vehicle-Pedestrian
 - Vehicle-Bike





Crash Modification Factors for Two-Way Segments

CMFs Produced:

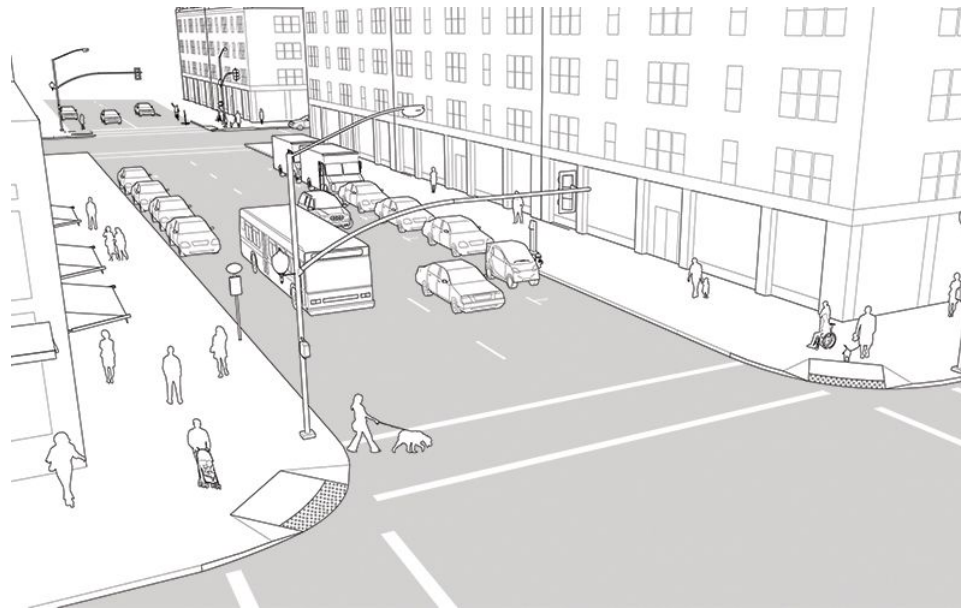
- Lane Width
- Outside Shoulder Width
- Median Width
- Median Barrier – MV crashes & SV crashes
- Major Commercial Driveways
- Major Industrial Driveways
- Minor Driveways
- Roadside Fixed Objects

Roadway Predictive Methods

One-Way Arterials

- 2-lane (20)
- 3-lane (30)
- 4-lane (40)

- Multiple-Vehicle
- Single-Vehicle
- Vehicle-Pedestrian
- Vehicle-Bike





Crash Modification Factors for One-Way Segments

CMFs Produced:

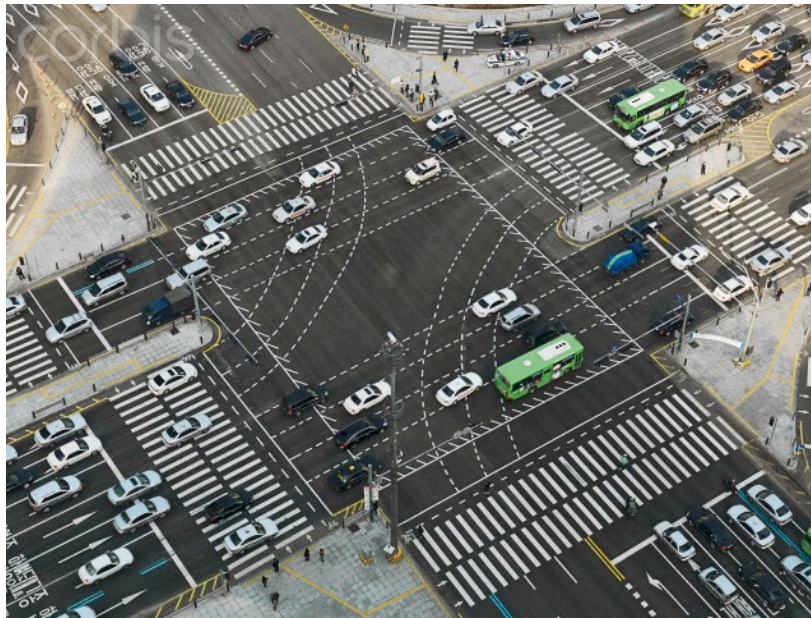
- Right Shoulder Width
- On-street Parking - Parallel and Angle
- Major Commercial Driveway
- Minor Driveway
- Roadside Fixed Objects

Intersection Predictive Methods

- **Two-Way Streets (2x2)**

- Three-Leg Signalized (3SG)
- Three-Leg Unsignalized (3ST)
- Four-Leg Signalized (4SG)
- Four-Leg Unsignalized (4ST)

- MV + SV
- Vehicle-Pedestrian
- Vehicle-Bike



Intersection Predictive Methods

- **One-Way Streets**

Signalized Intersections (3SG & 4SG)

One-way/Two-Way (1x2)

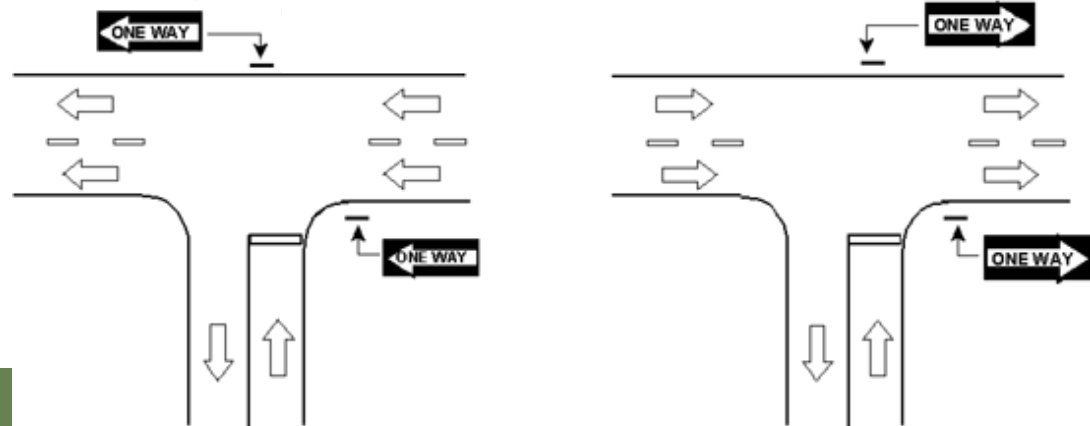
One-Way/One-Way (1x1)

Unsignalized Intersections (3ST & 4ST)

One-way/Two-Way (1x2)

One-Way/One-Way (1x1)

- MV + SV
- Vehicle-Pedestrian
- Vehicle-Bike





Crash Modification Factors for Intersections

2x2 Intersections

CMFs Produced:

- Left-turn signal phasing
- U-turn prohibition
- Right-turn channelization
- Number of lanes

CMFs Validated:

- Lighting
- RTOR prohibition

1x2/1x1 Intersections

CMFs Produced:

- Number of lanes

CMFs Validated:

- Lighting

Note:

2x2 or 1x1 intersections:

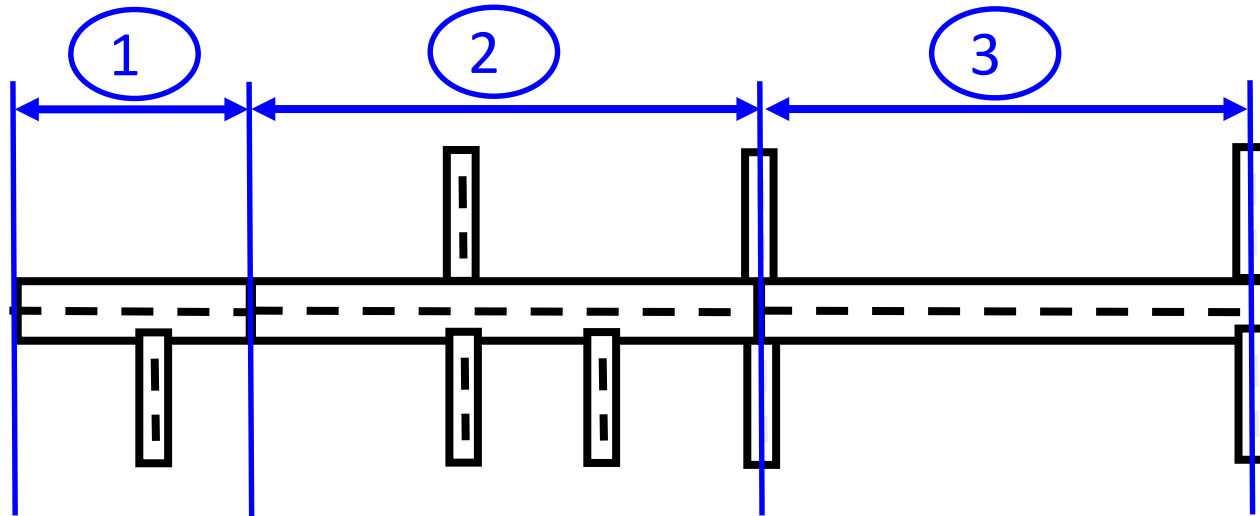
Major AADT > Minor AADT

1x2 intersections:

Major street = One-way

Segmentation Process

- Overview
 - Divide continuous roadway section into sites
 - Homogenous segments (same basic character for entire length)
 - Intersections



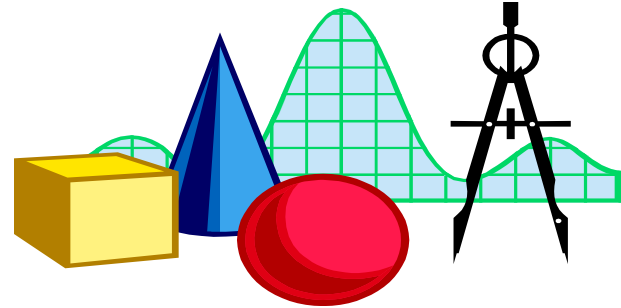


Segmentation Process

- Procedure

- Describe each site

- Geometry
 - Traffic control
 - Traffic volumes
 - Enter into Segments and Intersections worksheets



- Tabulate

- Use Totals worksheet
 - Compute predicted crash frequency

Software Tool

Safety Prediction Worksheet for Two-Way Urban and Suburban Arterial Segments									
<u>General Information</u>					<u>Site Information</u>				
Analyst	MPP				Street number	SH 1			
Agency	TTI				Street name	Main Street			
Date	6/3/2016				Segment number	1			
Location	City of Fillmore				Analysis year	2016			
Add to Totals worksheet			Restore equations			Reset input cells			
<u>Output Summary</u>			<u>Predicted crash frequency, crashes / year</u>			<u>Combined CMF</u>			
		<i>F+I</i>	<i>PDO</i>	<i>Total</i>		<i>F+I</i>	<i>PDO</i>		
Total crashes		3.146	4.301	7.447	Multiple-vehicle crashes	1.214	1.214		
Multiple-vehicle crashes		2.684	3.933		Single-vehicle crashes	1.238	1.238		
Single-vehicle crashes		0.295	0.368		<u>Severity distribution for F+I crashes</u>				
Vehicle-pedestrian crashes		0.109			<i>K</i>	<i>A</i>	<i>B</i>	<i>C</i>	
Vehicle-bicycle crashes		0.058			0.041	0.212	0.825	2.069	
<u>Input Data</u>					<u>Value</u>	<u>Advisory Messages</u>			
<u>Basic Roadway Data</u>									
Area type					Urban				

Two-way segments / One-way segments / Intersections / Totals

Individual 6U, 6D, 7T, and 8D roadway segments

Individual 20, 30, and 40 roadway segments

Individual

- 2x2 intersections with 6+ lanes
- 1x2 or 1x1 intersections

Adjacent roadway segments and intersections forming an arterial facility

Enter Data

Safety Prediction Worksheet for Two-Way Urban and Suburban Arterial Segments

General Information		Site Information	
Analyst	MPP	Street number	SH 1
Agency	TTI	Street name	Main Street
Date	6/3/2016	Segment number	1
Location	City of Baltimore	Analysis year	2016

	Predicted crash frequency, crashes / year			Combined CMF	
	F+I	PDO	Total	F+I	PDO
Total crashes	3.146	4.301	7.447		
Multiple-vehicle crashes	2.684	3.933		1.214	1.214
Single-vehicle crashes	0.295	0.368		1.238	1.238
Vehicle-pedestrian crashes	0.109				
Vehicle-bicycle crashes	0.058				

Severity distribution for F+I crashes

	K	A	B	C
	0.041	0.212	0.825	2.069

Input Data	Value	Advisory Messages
Basic Roadway Data		
Area type	Urban	.
Segment type	6D	.
Segment length, mi	0.3	.
Annual average daily traffic (AADT), veh/day	56000	.
Number of highway-rail grade crossings present	1	3 crossings per mile.
Posted speed limit, mi/h	45	.
Automated speed enforcement present?	No	.
Access Data		
Driveway count		
Major commercial	1	3 major comm. driveways per mile.
Major industrial	1	3 major industrial driveways per mile.
Minor	5	17 minor driveways per mile.
Cross Section Data		
Lane width, ft	12	.
Outside shoulder width, ft	4	.
Median width, ft	10	.
Median barrier present?	No	.
Roadside Data		
Roadside fixed object count	15	50 objects per mile.
Average roadside fixed object offset, ft	10	.
Calibration Factors		
	Value	Default Values
Local calibration factor (C)	1.000	1.000
Adjustment factor for pedestrians (f_{ped})	0.015	0.015
Adjustment factor for bicyclists (f_{bike})	0.008	0.008
Severity distribution calibration factor ($C_{sd,two}$)	1.000	1.000

Blue cells:
input data

Purple cells: results

Red text: notes

Yellow cells:
calibration factors



Example Problem

- Given
 - Six-lane divided arterial section
 - Study period: 2016
 - Area type: Urban
 - No crash data available
 - Segment length: 0.30 mi
 - Posted speed limit: 45 mph
 - Lane width: 12 ft
 - Outside shoulder width: 4 ft
 - Median width: 10 ft
 - Median type: curb
 - Automated speed enforcement: No
 - Highway-rail grade crossings: 1
 - Roadside fixed object offset: 10 ft
 - Roadside fixed object density: 50/mi
 - Major commercial driveways: 1
 - Major industrial driveways: 1
 - Minor driveways: 5
 - AADT (year 2016): 56,000 veh/day



Example Problem

- Question
 - What is the predicted crash frequency?
- Answer
 - 7.5 crashes / yr
- Follow-up question
 - What is the predicted crash frequency if the two major driveways are removed?
- Answer
 - 6.5 crashes / yr



Questions – Comments?





Thank You!

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