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

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NCHRP Project 17-58

- “Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials”
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- Key products
  - Predictive method for 6+ lane and one-way street arterial facilities to be included in the revised HSM Chapter 12
  - Software implementation of method
Database Assembly
Roadway Predictive Methods

Two-Way Arterials

- 6-lane undivided (6U)
- 6-lane divided (6D)
- 6-lane + TWLTL (7T)
- 8-lane divided (8D)

- MV
- SV
- 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
- Highway-Rail Grade Crossing
- Major Commercial Driveways
- Major Industrial Driveways
- Minor Driveways
- Roadside Fixed Objects
Roadway Predictive Methods

One-Way Arterials
- 2-lane (2O)
- 3-lane (3O)
- 4-lane (4O)

• MV
• SV
• 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
  - 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)
    - Two-way/One-Way (2X1)
    - One-Way/One-Way (1X1)
  - Unsignalized Intersections (3ST & 4ST)
    - Two-way/One-Way (2X1)
    - 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
  – Tabulate (Totals worksheet)
  – Compute predicted crash frequency
## Software Tool

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

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Street number</td>
</tr>
<tr>
<td>Agency</td>
<td>Street name</td>
</tr>
<tr>
<td>Date</td>
<td>Segment number</td>
</tr>
<tr>
<td>Location</td>
<td>Analysis year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Add to Totals worksheet</th>
<th>Restore equations</th>
<th>Reset input cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Output Summary

<table>
<thead>
<tr>
<th></th>
<th>Predicted crash frequency, crashes / year</th>
<th>Combined CMF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F+I</td>
<td>PDO</td>
</tr>
<tr>
<td>Total crashes</td>
<td>3.146</td>
<td>4.301</td>
</tr>
<tr>
<td>Multiple-vehicle crashes</td>
<td>2.684</td>
<td>3.933</td>
</tr>
<tr>
<td>Single-vehicle crashes</td>
<td>0.295</td>
<td>0.368</td>
</tr>
<tr>
<td>Vehicle-pedestrian crashes</td>
<td>0.109</td>
<td></td>
</tr>
<tr>
<td>Vehicle-bicycle crashes</td>
<td>0.058</td>
<td></td>
</tr>
</tbody>
</table>

### Input Data

#### Basic Roadway Data

<table>
<thead>
<tr>
<th>Area Type</th>
<th>Value</th>
<th>Advisory Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Two-way segments

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

### One-way segments

- Individual 2O, 3O, and 4O roadway segments

### Intersections

- Individual
  - 2×2 intersections with 6+ lanes
  - 1×2 or 1×1 intersections

### Totals

- Adjacent roadway segments and intersecting forming an arterial facility
**Enter Data**

[Image of the Safety Prediction Worksheet for Two-Way Urban and Suburban Arterial Segments]

- **Blue cells**: input data
- **Purple cells**: results
- **Red text**: notes
- **Yellow cells**: Calibration factors

The worksheet includes sections for general information, site information, output summary, input data, access data, cross section data, roadside data, and calibration factors. Each section has specific data fields that need to be filled in with relevant information. The results are summarized in the output summary, which includes predicted crash frequency and crashes/year. Calibration factors are provided for various data points to adjust the predictions.

[Image of Texas A&M Transportation Institute logo]
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 highway-rail grade crossing can be grade-separated?

• Answer
  – 6.5 crashes / yr
Questions – Comments?