Chapter 10: Predictive Method for Rural Two-Lane, Two-Way Roads

### Site Conditions

<table>
<thead>
<tr>
<th>Approach</th>
<th>Functional Classification</th>
<th>AADT (veh/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE 42/Seven Hickories Road</td>
<td>Rural Major Collector</td>
<td>7,711</td>
</tr>
<tr>
<td>DE 15/Brenford Road</td>
<td>Rural Major Collector</td>
<td>2,171</td>
</tr>
<tr>
<td>Seeneytown Road</td>
<td>Rural Local</td>
<td>1,688</td>
</tr>
</tbody>
</table>

Intersection Skew: 90°
Left Turn Lanes: SB Brenford Road
Right Turn Lanes: None
Lighting: SW and SE quadrants
Analysis Year: 2012

Predictive Model for Intersections (Equation 10-3):

\[ N_{predicted,int} = N_{SPF,int} \times C_i \times (CMF_{1i} \times CMF_{2i} \times CMF_{3i} \times CMF_{4i}) \]

Safety Performance Function for Four-Leg, Stop-Controlled Intersections (Equation 10-9):

\[ N_{SPF,AST} = \exp[-8.56 + 0.60 \times \ln(AADT_{maj}) + 0.61 \times \ln(AADT_{min})] \]

**NOTE:** Since side streets have two different AADT volumes, use the greater value.

\[ N_{SPF,AST} = \exp[-8.56 + 0.60 \times \ln(7,711) + 0.61 \times \ln(2,171)] \]

\[ N_{SPF,AST} = 4.47 \text{ crashes/year} \]

Inclusion of Crash Modification Factors (CMFs):

Skew (Base Condition = 90°):
\[ CMF_{1i} = \exp(0.0054 \times \text{skew}) \]
\[ CMF_{1i} = 1.00 \]

Left Turn Lanes (Base Condition = None)
**NOTE:** Left turn lanes on side street approaches have no effect on the CMF, therefore it can be disregarded.
\[ CMF_{2i} = 1.00 \]

Right Turn Lanes (Base Condition = None)
\[ CMF_{3i} = 1.00 \]
Lighting (Base Condition = None)

\[ CMF_{4i} = 1 - 0.38 \times p_{ni} \]
\[ CMF_{4i} = 1 - 0.38 \times 0.244 \quad \text{(Table 10-15)} \]
\[ CMF_{4i} = 0.91 \]

Inclusion of Calibration Factor \((C_i)\):
\[ C_i = 1.00 \]

NOTE: DelDOT is in the process of formulating local calibration factors. Until a formal set of calibration factors has been issued by the Department, the value of \(C_i\) is assumed to be 1.00.

Inclusion in Predictive Model:

\[ N_{predicted, int} = 4.47 \times 1.00 \times (1.00 \times 1.00 \times 1.00 \times 0.91) \]

\[ N_{predicted, int} = 4.06 \text{ crashes/year} \]
Safety Performance Function for Four-Leg, Signalized Intersections (Equation 10-10):

\[ N_{SPF,ASG} = \exp[-5.13 + 0.60 \times \ln(AADT_{maj}) + 0.20 \times \ln(AADT_{min})] \]

NOTE: Since side streets have two different AADT volumes, use the greater value.

\[ N_{SPF,ASG} = \exp[-5.13 + 0.60 \times \ln(7,711) + 0.20 \times \ln(2,171)] \]
\[ N_{SPF,ASG} = 5.91 \text{ crashes/year} \]

Inclusion of Crash Modification Factors (CMFs):

Skew (Base Condition = 90°):
\[ CMF_{1i} = \exp(0.0054 \times \text{skew}) \]
\[ CMF_{1i} = 1.00 \]

Left Turn Lanes (Base Condition = None)
NOTE: Left turn lanes on side street approaches have no effect on the CMF, therefore it can be disregarded.
\[ CMF_{2i} = 1.00 \]

Right Turn Lanes (Base Condition = None)
\[ CMF_{3i} = 1.00 \]

Lighting (Base Condition = None)
\[ CMF_{4i} = 1 - 0.38 \times p_{nl} \]
\[ CMF_{4i} = 1 - 0.38 \times 0.286 \quad \text{(Table 10-15)} \]
\[ CMF_{4i} = 0.89 \]

Inclusion of Calibration Factor (C_i):
\[ C_i = 1.00 \]

Inclusion in Predictive Model:
\[ N_{predicted, int} = 4.47 \times 1.00 \times (1.00 \times 1.00 \times 1.00 \times 0.89) \]
\[ N_{predicted, int} = 5.26 \text{ crashes/year} \]
Predicted Crash Type Distribution Comparison for All Severities (Table 10-6):

<table>
<thead>
<tr>
<th>Collision Type</th>
<th>All Severities</th>
<th>Stop-Controlled</th>
<th>Signalized</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td># Crashes</td>
<td>%</td>
</tr>
<tr>
<td>Single Vehicle Crashes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal</td>
<td>1.0%</td>
<td>0.04</td>
<td>0.2%</td>
</tr>
<tr>
<td>Bicycle</td>
<td>0.1%</td>
<td>0.00</td>
<td>0.1%</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>0.1%</td>
<td>0.00</td>
<td>0.1%</td>
</tr>
<tr>
<td>Overturn</td>
<td>0.5%</td>
<td>0.02</td>
<td>0.3%</td>
</tr>
<tr>
<td>Run Off Road</td>
<td>12.2%</td>
<td>0.50</td>
<td>6.4%</td>
</tr>
<tr>
<td>Other</td>
<td>0.8%</td>
<td>0.03</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Total Single Vehicle Crashes</strong></td>
<td>14.7%</td>
<td>0.60</td>
<td>7.6%</td>
</tr>
<tr>
<td>Multi-Vehicle Crashes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angle</td>
<td>43.1%</td>
<td>1.75</td>
<td>27.4%</td>
</tr>
<tr>
<td>Head On</td>
<td>4.0%</td>
<td>0.16</td>
<td>5.4%</td>
</tr>
<tr>
<td>Rear End</td>
<td>24.2%</td>
<td>0.98</td>
<td>42.6%</td>
</tr>
<tr>
<td>Sideswipe</td>
<td>10.1%</td>
<td>0.41</td>
<td>11.8%</td>
</tr>
<tr>
<td>Other</td>
<td>3.9%</td>
<td>0.16</td>
<td>5.2%</td>
</tr>
<tr>
<td><strong>Total Multi-Vehicle Crashes</strong></td>
<td>85.3%</td>
<td>3.46</td>
<td>92.4%</td>
</tr>
<tr>
<td><strong>Total Crashes</strong></td>
<td>100.0%</td>
<td>4.06</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Chapter 14: Crash Modification Factors (CMFs) for Intersections

Crash Summary, 1/1/2012 to 12/31/2012 (0.1-mile along all legs of intersection)
7 Crashes
5 Property Damage Only
2 Personal Injury
0 Fatality
3 Angle
2 Rear End
1 Left Turn
1 Other (Single Vehicle Crash)

Treatment #1: Convert Four-Leg Stop-Controlled Intersection to Four-Leg Signalized Intersection

Table 14-7: Rural Four-Leg

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>CMF</th>
<th># Crashes (2012)</th>
<th>Predicted # Crashes per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Angle</td>
<td>0.23</td>
<td>3</td>
<td>0.7</td>
</tr>
<tr>
<td>Left Turn</td>
<td>0.4</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Rear End</td>
<td>1.58</td>
<td>2</td>
<td>3.2</td>
</tr>
<tr>
<td>All Types</td>
<td>0.56</td>
<td>7</td>
<td>3.9</td>
</tr>
</tbody>
</table>

By using the CMF method for this specific treatment, we can conclude that this intersection will experience approximately 4 crashes per year.

Treatment #2: Convert Four-Leg Stop-Controlled Intersection to Four-Leg, All-Way Stop Intersection

Table 14-5: Rural, Assume all MUTCD warrants met

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>CMF</th>
<th># Crashes (2012)</th>
<th>Predicted # Crashes per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Types</td>
<td>0.52</td>
<td>7</td>
<td>3.6</td>
</tr>
</tbody>
</table>

By using the CMF method for this specific treatment, we can conclude that this intersection will experience approximately 4 crashes per year.
Treatment #3: Convert Four-Leg Stop-Controlled Intersection to Modern Roundabout

Table 14-4: Rural, Assume One-Lane

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>CMF</th>
<th>Predicted # Crashes (2012)</th>
<th>Predicted # Crashes per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Types</td>
<td>0.29</td>
<td>7</td>
<td>2.0</td>
</tr>
</tbody>
</table>

By using the CMF method for this specific treatment, we can conclude that this intersection will experience approximately 2 crashes per year.
Crash Rates for Historical Countermeasures

At the intersection of DE 42 (Seven Hickories Road) & DE 15 (Brenford Road)/Seeneytown Road, two historical crash countermeasures have been implemented:

- Lighting on the southeast and southwest quadrants was installed on 1/5/2009.
- Solar-Powered, Flashing Red Beacons were installed on both STOP signs in the northbound and southbound directions on 11/8/2010.

<table>
<thead>
<tr>
<th>Base Condition</th>
<th>Countermeasure</th>
<th>Study Period</th>
<th># Years in Study Period</th>
<th># Crashes in Study Period</th>
<th>Crash Rate (crashes per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatment</td>
<td>Install Lighting</td>
<td>1/5/2006 - 1/5/2009</td>
<td>3.00</td>
<td>8</td>
<td>2.67</td>
</tr>
<tr>
<td>Lighting</td>
<td>Install Flashing Beacons</td>
<td>1/6/2009 - 11/8/2010</td>
<td>1.84</td>
<td>8</td>
<td>4.35</td>
</tr>
<tr>
<td>Flashing Beacons</td>
<td>Present</td>
<td>11/9/2010 - 7/19/2013</td>
<td>2.70</td>
<td>16</td>
<td>5.93</td>
</tr>
</tbody>
</table>
Chapter 12: Predictive Method for Urban and Suburban Arterials

Site Conditions

<table>
<thead>
<tr>
<th>Approach</th>
<th>Functional Classification</th>
<th>AADT (veh/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Broad Street</td>
<td>Urban Arterial</td>
<td>7,842</td>
</tr>
<tr>
<td>East Green Street</td>
<td>Urban Local</td>
<td>2,000</td>
</tr>
<tr>
<td>West Green Street</td>
<td>Urban Local</td>
<td>2,000</td>
</tr>
</tbody>
</table>

- Stop-controlled on side streets
- Intersection Skew: 90°
- Left Turn Lanes: All approaches
- Right Turn Lanes: All approaches
- Lighting: All quadrants
- Analysis Year: 2012
- 2 Bus Stops within 1,000 ft of intersection
- No Schools within 1,000 ft of intersection
- No Alcohol Sales Establishments within 1,000 ft of intersection
- Pedestrian Volume (PedVol): 40 Peds/day
- Maximum # of lanes for pedestrian crossing ($n_{lanes}$): 6

Determine the predicted number of crashes at the existing stop-controlled intersection and a proposed signalized intersection.
**Determine the predicted number of crashes at the existing stop-controlled intersection.**

Safety Performance Function for Multi-Vehicle Crashes at Four-Leg, Stop-Controlled Intersections

\[
N_{bimv,AST} = \exp[a + b \times \ln(AADT_{maj}) + c \times \ln(AADT_{min})]
\]  \hspace{1cm} \text{(Equation 12-21)}

\text{NOTE: If side streets have two different AADT volumes, use the greater value.}

Use Table 12-10 to find SPF coefficients for 4ST.

\[
N_{bimv,AST} = \exp[-8.90 + 0.82 \times \ln(7,842) + 0.25 \times \ln(2,000)]
\]

\[
N_{bimv,AST} = 1.42 \text{ crashes/year}
\]

If desired, find the number of multi-vehicle crashes based on severity level: Fatal/Injury (FI) and Property Damage Only (PDO). Use Equation 12-21 with appropriate crash severity coefficients from Table 12-10.

**Fatal/Injury Crashes**

\[
N'_{bimv(FI),AST} = \exp[-11.13 + 0.93 \times \ln(7,842) + 0.28 \times \ln(2,000)]
\]

\[
N'_{bimv(FI),AST} = 0.51 \text{ crashes/year}
\]

**Property Damage Only Crashes**

\[
N'_{bimv(PDO),AST} = \exp[-8.74 + 0.77 \times \ln(7,842) + 0.23 \times \ln(2,000)]
\]

\[
N'_{bimv(PDO),AST} = 0.91 \text{ crashes/year}
\]

Therefore, in order to assure that \(N_{bimv(FI),AST}\) and \(N_{bimv(PDO),AST}\) sum to \(N_{bimv(total),AST}\),

\[
N_{bimv(FI),AST} = N_{bimv(total),AST} \times \left( \frac{N'_{bimv(FI)}}{N'_{bimv(FI),AST} + N'_{bimv(PDO),AST}} \right)
\]  \hspace{1cm} \text{(Equation 12-22)}

\[
N_{bimv(FI),AST} = 1.42 \times \left( \frac{0.51}{0.51 + 0.91} \right)
\]

\[
N_{bimv(FI),AST} = 0.51 \text{ crashes/year}
\]

And thus,

\[
N_{bimv(PDO),AST} = N_{bimv(total),AST} - N_{bimv(FI),AST}
\]  \hspace{1cm} \text{(Equation 12-23)}

\[
N_{bimv(PDO),AST} = 1.42 - 0.51
\]

\[
N_{bimv(PDO),AST} = 0.91 \text{ crashes/year}
\]
Safety Performance Function for Single-Vehicle Crashes at Four-Leg, Stop-Controlled Intersections

\[ N_{bislv,AST} = \exp[a + b \times \ln(AADT_{maj}) + c \times \ln(AADT_{min})] \]  
(Equation 12-24)

NOTE: if side streets have two different AADT volumes, use the greater value.

Use Table 12-12 to find SPF coefficients for 4ST.

\[ N_{bislv,AST} = \exp[-5.33 + 0.33 \times \ln(7,842) + 0.12 \times \ln(2,000)] \]
\[ N_{bislv,AST} = 0.23 \text{ crashes/year} \]

Add results from both crash type totals.

\[ N_{SPF, int} = N_{bislv,AST} + N_{bislv,AST} \]  
(Equation 12-7)
\[ N_{SPF, int} = 1.42 + 0.23 \]
\[ N_{SPF, int} = 1.65 \text{ crashes/year} \]

If desired, find the number of single-vehicle crashes based on severity level: Fatal/Injury (FI) and Property Damage Only (PDO). Use Equation 12-24 with appropriate crash severity coefficients from Table 12-12.

Fatal/Injury Crashes

**NOTE: No models are available for Fatal/Injury crashes for 4ST. Instead, use:

\[ N_{bislv(FI), AST} = N_{bislv(total)} \times (f_{bislv}) \]  
(Equation 12-27)

Where

\[ f_{bislv} = \text{proportion of fatal & injury crashes for combined sites} = 0.28 \text{ for 4ST} \]

Therefore,

\[ N'_{bislv(FI), AST} = 0.23 \times (0.28) \]
\[ N'_{bislv(FI), AST} = 0.06 \text{ crashes/year} \]

Property Damage Only Crashes

\[ N'_{bislv(PDO), AST} = \exp[-7.04 + 0.36 \times \ln(7,842) + 0.25 \times \ln(2,000)] \]
\[ N'_{bislv(PDO), AST} = 0.16 \text{ crashes/year} \]

Therefore, in order to assure that \( N_{bislv(FI), AST} \) and \( N_{bislv(PDO), AST} \) sum to \( N_{bislv(total), AST} \),
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\[ N_{b_{\text{vis}}(FI),AST} = N_{b_{\text{vis}}(\text{total}),AST} \times \left( \frac{N'_{b_{\text{vis}}(FI)}}{N'_{b_{\text{vis}}(FI)} + N'_{b_{\text{vis}}(PDO)}} \right) \]  
(Equation 12-25)

\[ N_{b_{\text{vis}}(FI),AST} = 0.23 \times \left( \frac{0.06}{0.06 + 0.15} \right) \]
\[ N_{b_{\text{vis}}(FI),AST} = 0.07 \text{ crashes/year} \]

And thus,

\[ N_{b_{\text{vis}}(PDO),AST} = N_{b_{\text{vis}}(\text{total}),AST} - N_{b_{\text{vis}}(FI),AST} \]  
(Equation 12-23)

\[ N_{b_{\text{vis}}(PDO),AST} = 0.23 - 0.07 \]
\[ N_{b_{\text{vis}}(PDO),AST} = 0.16 \text{ crashes/year} \]

Inclusion of Intersection Crash Modification Factors (CMFs):

Intersection Left Turn Lanes (Table 12-24)

NOTE: Left turn lanes on side street approaches have no effect on the CMF for stop-controlled intersections, therefore these two approaches can be disregarded.

\[ CMF_{1i} = 0.53 \]

Intersection Left-Turn Phasing (Table 12-25)

Note: This CMF is only applicable to signalized intersections. For unsignalized intersections, use 1.00.

\[ CMF_{2i} = 1.00 \]

Intersection Right Turn Lanes (Table 12-26)

NOTE: Right turn lanes on side street approaches have no effect on the CMF for stop-controlled intersections, therefore these two approaches can be disregarded.

\[ CMF_{3i} = 0.74 \]

Right Turn on Red

Note: This CMF is only applicable to signalized intersections. For unsignalized intersections, use 1.00.

\[ CMF_{4i} = 1.00 \]

Lighting (Table 12-27)

\[ CMF_{5i} = 1 - 0.38 \times p_{ni} \]  
(Equation 12-36)
\[ CMF_{5i} = 1 - 0.38 \times (0.229) \]
\[ CMF_{5i} = 0.91 \]
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Red-Light Cameras
*Note: This CMF is only applicable to signalized intersections. For unsignalized intersections, use 1.00.*

\[ CMF_{6i} = 1.00 \]

**There are no pedestrian-vehicle CMFs for intersection type 4ST. To determine pedestrian and bicycle crash rates for 4ST, use the following:**

\[ N_{bi} = N_{SPF,int} \times (CMF_{1i} \times ... \times CMF_{6i}) \]  
\[ N_{bi} = (1.65) \times (0.53) \times (1.00) \times (0.74) \times (1.00) \times (0.91) \times (1.00) \]
\[ N_{bi} = 0.59 \text{ crashes/year} \]

\[ N_{pedi} = N_{bi} \times (f_{pedi}) \]  
\[ N_{pedi} = 0.59 \times (0.022) \]
\[ N_{pedi} = 0.01 \text{ crashes/year} \]

\[ N_{bikel} = N_{pedi} \times (f_{bikel}) \]  
\[ N_{bikel} = 0.01 \times (0.018) \]
\[ N_{bikel} = 0.00 \text{ crashes/year} \]

Inclusion of Calibration Factor \( C_i \): 

\[ C_i = 1.00 \]

*NOTE: DelDOT is in the process of formulating local calibration factors. Until a formal set of calibration factors has been issued by the Department, the value of \( C_i \) is assumed to be 1.00.*

Inclusion in Predictive Model:

\[ N_{predicted,int} = C_i \times (N_{bi} + N_{pedi} + N_{bikel}) \]  
\[ N_{predicted,int} = 1.00 \times (0.59 + 0.01 + 0.00) \]
\[ N_{predicted,int} = 0.60 \text{ crashes/year} \]
**Determine the predicted number of crashes at the intersection, should a signal be installed.**

**Safety Performance Function for Multi-Vehicle Crashes at Four-Leg, Signalized Intersections**

\[ N_{bimv,ASG} = \exp[a + b \times \ln\left(AADT_{maj}\right) + c \times \ln\left(AADT_{min}\right)] \]  

(Equation 12-21)

NOTE: If side streets have two different AADT volumes, use the greater value.

Use Table 12-10 to find SPF coefficients for 4SG.

\[ N_{bimv,ASG} = \exp[-10.99 + 1.07 \times \ln(7,842) + 0.23 \times \ln(2,000)] \]

\[ N_{bimv,ASG} = 1.42 \text{ crashes/year} \]

If desired, find the number of multi-vehicle crashes based on severity level: Fatal/Injury (FI) and Property Damage Only (PDO). Use Equation 12-21 with appropriate crash severity coefficients from Table 12-10.

**Fatal/Injury Crashes**

\[ N'_{bimv(FI),ASG} = \exp[-13.14 + 1.18 \times \ln(7,842) + 0.22 \times \ln(2,000)] \]

\[ N'_{bimv(FI),ASG} = 0.44 \text{ crashes/year} \]

**Property Damage Only Crashes**

\[ N'_{bimv(PDO),ASG} = \exp[-11.02 + 1.02 \times \ln(7,842) + 0.24 \times \ln(2,000)] \]

\[ N'_{bimv(PDO),ASG} = 0.98 \text{ crashes/year} \]

Therefore, in order to assure that \( N_{bimv(FI),ASG} \) and \( N_{bimv(PDO),ASG} \) sum to \( N_{bimv(total),ASG} \),

\[ N_{bimv(FI),ASG} = N_{bimv(total),ASG} \times \left( \frac{N'_{bimv(FI),ASG}}{N'_{bimv(FI),ASG} + N'_{bimv(PDO),ASG}} \right) \]  

(Equation 12-22)

\[ N_{bimv(FI),ASG} = 1.42 \times \left( \frac{0.44}{0.44 + 0.98} \right) \]

\[ N_{bimv(FI),ASG} = 0.44 \text{ crashes/year} \]

And thus,

\[ N_{bimv(PDO),ASG} = N_{bimv(total),ASG} - N_{bimv(FI),ASG} \]  

(Equation 12-23)

\[ N_{bimv(PDO),ASG} = 1.42 - 0.44 \]

\[ N_{bimv(PDO),ASG} = 0.98 \text{ crashes/year} \]
Safety Performance Function for Single-Vehicle Crashes at Four-Leg, Signalized Intersections

\[ N_{bisv,ASG} = \exp[a + b \times \ln(AADT_{maj}) + c \times \ln(AADT_{min})] \]  \hspace{1cm} (Equation 12-24)

*NOTE: If side streets have two different AADT volumes, use the greater value.*

Use Table 12-12 to find SPF coefficients for 4SG.

\[ N_{bisv,ASG} = \exp[-10.21 + 0.68 \times \ln(7,842) + 0.27 \times \ln(2,000)] \]
\[ N_{bisv,ASG} = 0.13 \text{ crashes/year} \]

Add results from both crash types.

\[ N_{SPF,int} = N_{bimv,ASG} + N_{bisv,ASG} \]  \hspace{1cm} (Equation 12-7)
\[ N_{SPF,int} = 1.42 + 0.13 \]
\[ N_{SPF,int} = 1.55 \text{ crashes/year} \]

If desired, find the number of single-vehicle crashes based on severity level: Fatal/Injury (FI) and Property Damage Only (PDO). Use Equation 12-24 with appropriate crash severity coefficients from Table 12-12.

**Fatal/Injury Crashes**

\[ N'_{bisv(FI),ASG} = \exp[-9.25 + 0.43 \times \ln(7,842) + 0.29 \times \ln(2,000)] \]
\[ N'_{bisv(FI),ASG} = 0.04 \text{ crashes/year} \]

**Property Damage Only Crashes**

\[ N'_{bisv(PDO),ASG} = \exp[-11.34 + 0.78 \times \ln(7,842) + 0.25 \times \ln(2,000)] \]
\[ N'_{bisv(PDO),ASG} = 0.09 \text{ crashes/year} \]

Therefore, in order to assure that \( N_{bisv(FI),ASG} \) and \( N_{bisv(PDO),ASG} \) sum to \( N_{bisv(total),ASG} \),

\[ N_{bisv(FI),ASG} = N_{bisv(total),ASG} \times \left( \frac{N'_{bisv(FI)}/N_{bisv(PDO)}}{N'_{bisv(FI)} + N'_{bisv(PDO)}} \right) \]  \hspace{1cm} (Equation 12-25)

\[ N_{bisv(FI),ASG} = 0.13 \times \left( \frac{0.04}{0.04 + 0.09} \right) \]
\[ N_{bisv(FI),ASG} = 0.04 \text{ crashes/year} \]

And thus,

\[ N_{bisv(PDO),ASG} = N_{bisv(total),ASG} - N_{bisv(FI),ASG} \]  \hspace{1cm} (Equation 12-23)
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\[ N_{blv(PDO),ASG} = 0.13 - 0.04 \]
\[ N_{blv(PDO),ASG} = 0.09 \text{ crashes/year} \]

Inclusion of *Intersection* Crash Modification Factors (CMFs):

**Intersection Left Turn Lanes (Table 12-24)**

\[ CMF_{1i} = 0.66 \]

**Intersection Left-Turn Phasing (Table 12-25)**

*Note: Protected/Permissive left-turn phasing is assumed for this intersection.*

\[ CMF_{2i} = 0.99 \]

**Intersection Right Turn Lanes (Table 12-26)**

\[ CMF_{3i} = 0.85 \]

**Right Turn on Red**

*Note: Assume right turns on red are permitted on all approaches.*

\[ CMF_{4i} = 1.00 \]

**Lighting (Table 12-27)**

\[ CMF_{5i} = 1 - 0.38 \times p_{ni} \]
\[ CMF_{5i} = 1 - 0.38 \times (0.235) \]
\[ CMF_{5i} = 0.91 \]

*Equation 12-36*

**Red-Light Cameras**

*Note: Assume no red-light cameras will be in use at this intersection.*

\[ CMF_{6i} = 1.00 \]

Therefore,

\[ N_{bi} = N_{SPF,int} \times (CMF_{1i} \times \ldots \times CMF_{6i}) \]
\[ N_{bi} = 1.55 \times (0.66 \times 0.99 \times 0.85 \times 1.00 \times 0.91 \times 1.00) \]
\[ N_{bi} = 0.78 \text{ crashes/year} \]

*Equation 12-6*
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Inclusion of Pedestrian Crash Modification Factors (CMFs):

Bus Stops (Table 12-28)

\[ CMF_{1p} = 2.78 \]

Schools (Table 12-29)

\[ CMF_{2p} = 1.00 \]

Alcohol Sales Establishments (Table 12-30)

\[ CMF_{3p} = 1.00 \]

To determine pedestrian and bicycle crash rates for 4SG, use the following:

\[ N_{\text{pedt}} = N_{\text{pedbase}} \times CMF_{1p} \times CMF_{2p} \times CMF_{3p} \]  
(Equation 12-28)

Where:

\[ N_{\text{pedbase}} = \exp(a + b \times \ln(AADT_{\text{total}}) + c \times \ln\left(\frac{AADT_{\text{min}}}{AADT_{\text{maj}}}\right) + d \times \ln(\text{PedVol}) + e \times n_{\text{lanes}} \]  
(Equation 12-29, Table 12-14)

\[ N_{\text{pedbase}} = \exp(-9.53 + 0.40 \times \ln(9,842) + 0.26 \times \ln\left(\frac{2,000}{7,842}\right) + 0.45 \times \ln(40) + 0.04 \times (6) \]

\[ N_{\text{pedbase}} = 0.01 \text{ crashes/year} \]

Therefore,

\[ N_{\text{pedt}} = 0.01 \times (2.78) \times (1.00) \times (1.00) \]

\[ N_{\text{pedt}} = 0.04 \text{ crashes/year} \]

And therefore,

\[ N_{\text{bikel}} = N_{\text{bi}} \times f_{\text{bikel}} \]  
(Equation 12-31)

Use Table 12-17 to determine \( f_{\text{bikel}} \)

\[ N_{\text{bikel}} = 0.78 \times (0.015) \]

\[ N_{\text{bikel}} = 0.01 \text{ crashes/year} \]
Inclusion of Calibration Factor $C_i$:

$C_i = 1.00$

*NOTE: DelDOT is in the process of formulating local calibration factors. Until a formal set of calibration factors has been issued by the Department, the value of $C_i$ is assumed to be 1.00.*

Inclusion in Predictive Model:

$$N_{predicted, int} = C_i \times (N_{bi} + N_{pedi} + N_{bikei})$$

$$N_{predicted, int} = 1.00 \times (0.78 + 0.04 + 0.01)$$

$$N_{predicted, int} = 0.83 \text{ crashes/year}$$

**Final Results:**

$$N_{predicted, int, AST} = 0.60 \text{ crashes/year}$$

$$N_{predicted, int, ASG} = 0.83 \text{ crashes/year}$$