Roundabouts - Unsignalized Intersections

General Information

Analyst: Analyst
Agency or Company: Agency or Company
Date Performed: Date Performed
Analyst Time Period: Analyst Time Period

Site Information

Interception: Intersection
Jurisdiction: Jurisdiction
Analysis Year: Analysis Year

Volume Adjustments

<table>
<thead>
<tr>
<th>Movement</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHF</td>
<td>v_1</td>
<td>v_4</td>
<td>v_7</td>
<td>v_10</td>
</tr>
<tr>
<td>LT Traffic Volume (veh/h)</td>
<td>247</td>
<td>103</td>
<td>143</td>
<td>254</td>
</tr>
<tr>
<td>Movement</td>
<td>v_2</td>
<td>v_5</td>
<td>v_8</td>
<td>v_11</td>
</tr>
<tr>
<td>TH Traffic Volume (veh/h)</td>
<td>308</td>
<td>393</td>
<td>207</td>
<td>94</td>
</tr>
<tr>
<td>Movement</td>
<td>v_3</td>
<td>v_6</td>
<td>v_9</td>
<td>v_12</td>
</tr>
<tr>
<td>RT Traffic Volume (veh/h)</td>
<td>105</td>
<td>123</td>
<td>77</td>
<td>152</td>
</tr>
<tr>
<td>PHF</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Variables used in this section and not defined in HCM

\( v_{LT} \): flow rate for LT traffic
\( v_{TH} \): flow rate for TH traffic
\( v_{RT} \): flow rate for RT traffic
\( VA_{LT} \): input table for Volume Adjustments of LT traffic
\( VA_{TH} \): input table for Volume Adjustments of TH traffic
\( VA_{RT} \): input table for Volume Adjustments of RT traffic

Flow rate

The flow rate is computed as the division of the Volume by the PHF.
The flow rates are shown after all data of the three traffic directions are input, as opposed to HCM. This is done in this worksheet only to save space, and make the worksheet fit in only one page.

\( i := 0 \ldots 3 \)

LT traffic

\( v_{LT_i} := \frac{VA_{LT0,i}}{VA_{LT1,i}} \)

TH traffic

\( v_{TH_i} := \frac{VA_{TH0,i}}{VA_{TH1,i}} \)
RT traffic

\[ v_{RT_i} := \frac{V_{AR}T_{0,i}}{V_{AR}T_{1,i}} \]

Results table

\[ V := \text{stack} \left( \begin{array}{c} v_{LT}^T \\ v_{TH}^T \\ v_{RT}^T \end{array} \right) \]

Flow rates used in Flow Computation equations

Create a vector of flow rates. The flow rates are sorted by approach, EB, WB, NB and SB. And within each approach, the flow rates are sorted by direction, LT, TH and RT.

In order to match the subscripts of the vector with the subscripts of the equations, the first element of the vector is 0 (subscript 0)

\[
v := 
\begin{align*}
&k \leftarrow 1 \\
&\text{for } i \in 0..3 \\
&\text{for } j \in 0..2 \\
&v_k \leftarrow v_{j,i} \\
&k \leftarrow k + 1 \\
&v
\end{align*}
\]

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\[ V = \]

Approach Flow Computation

<table>
<thead>
<tr>
<th>Approach Flow (veh/h)</th>
<th>( v_a ) (veh/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_{aE} := v_1 + v_2 + v_3 )</td>
<td>( v_{aE} = 660 )</td>
</tr>
<tr>
<td>( v_{aW} := v_4 + v_5 + v_6 )</td>
<td>( v_{aW} = 619 )</td>
</tr>
<tr>
<td>( v_{aN} := v_7 + v_8 + v_9 )</td>
<td>( v_{aN} = 427 )</td>
</tr>
<tr>
<td>( v_{aS} := v_{10} + v_{11} + v_{12} )</td>
<td>( v_{aS} = 500 )</td>
</tr>
</tbody>
</table>
Circulating Flow Computation

**Approach Flow (veh/h)**

\[
\begin{align*}
  v_{cE} &= v_4 + v_{10} + v_{11} \\
  v_{cW} &= v_1 + v_7 + v_8 \\
  v_{cN} &= v_1 + v_2 + v_{10} \\
  v_{cS} &= v_4 + v_5 + v_7
\end{align*}
\]

**\( v_a \) (veh/h)**

\[
\begin{align*}
  v_{cE} &= 451 \\
  v_{cW} &= 597 \\
  v_{cN} &= 809 \\
  v_{cS} &= 639
\end{align*}
\]

Variables used in this section and not defined in HCM

- \( t_{cUpper} \): upper bound critical gap
- \( t_{cLower} \): lower bound critical gap
- \( t_{fUpper} \): upper bound follow-up time
- \( t_{fLower} \): lower bound follow-up time

Critical gap and Follow-up times for roundabouts *(see Exhibit 17-37)*

**Critical gap**

\[
\begin{align*}
  t_{cUpper} &= 4.1 \\
  t_{cLower} &= 4.6
\end{align*}
\]

**Follow-up time**

\[
\begin{align*}
  t_{fUpper} &= 2.6 \\
  t_{fLower} &= 3.1
\end{align*}
\]

**Capacity (see Equation 17-70)**

The values of capacity are rounded to the nearest integer

**EB upper bound and lower bound**

\[
\begin{align*}
  c_{EBUpper} &= \text{round} \left( \frac{-v_{cE} t_{cUpper}}{3600} \right) \\
  c_{EBLower} &= \text{round} \left( \frac{-v_{cE} t_{fLower}}{3600} \right)
\end{align*}
\]

**WB upper bound and lower bound**

\[
\begin{align*}
  c_{WBUpper} &= \text{round} \left( \frac{-v_{cW} t_{cUpper}}{3600} \right) \\
  c_{WBLower} &= \text{round} \left( \frac{-v_{cW} t_{fLower}}{3600} \right)
\end{align*}
\]
Compute the v/c ratio as the ratio of the Approach Flow to the Capacity. A matrix is created with the upper bound and lower bound (rows) of v/c ratio for each approach, EB, WB, NB and SB (columns)

\[
\mathbf{v}/c = \begin{pmatrix}
\frac{v_aE}{c_{EUpper}} & \frac{v_aW}{c_{WUpper}} & \frac{v_aN}{c_{NUpper}} & \frac{v_aS}{c_{SUpper}} \\
\frac{v_aE}{c_{ELower}} & \frac{v_aW}{c_{WLower}} & \frac{v_aN}{c_{NLower}} & \frac{v_aS}{c_{SLower}}
\end{pmatrix}
\]

Create a matrix of capacities. The first row is the upper bound and the second row is the lower bound of each approach (EB, WB, NB and SB)

\[
\mathbf{C} := \begin{pmatrix}
c_{EUpper} & c_{WUpper} & c_{NUpper} & c_{SUpper} \\
c_{ELower} & c_{WLower} & c_{NLower} & c_{SLower}
\end{pmatrix}
\]

Results table

Results := stack(C, vc)