High-Capacity Roundabout Intersection Analysis: Going Around in Circles

David Stanek, PE & Ronald T. Milam, AICP

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Presentation Overview

- What is a high-capacity roundabout?
- What methods are used to analyze traffic operations?
- How are these methods applied to real-world problems?
- What are the differences in analysis results between methods?
- Which method should be used for a given set of conditions?
High-Capacity Roundabout

- Modern roundabout with yield entry
- Approaches with 2 or more lanes
- An alternative to traffic signals for high-volume locations
Roundabout Analysis Methods

• Highway Capacity Manual (TRB, 2000)
  – Only one-lane roundabouts
  – LOS thresholds are undefined

• Roundabouts: An Informational Guide (FHWA, 2000)
  – Equations for two-lane roundabouts
  – Design to v/c of 0.85
  – List of analysis software
Roundabout Analysis Methods

• Macroscopic Models (Isolated)
  – Analyze vehicle flows
  – Methods: RODEL & SIDRA

• Microscopic Models (System)
  – Analyze individual vehicles & drivers
  – Methods: SimTraffic, Paramics, & VISSIM
RODEL

• Barry Crown, UK
• Regression equations based on observations of UK intersections
• Design elements determine approach capacity (diameter, entry width, etc.)
• Interactive design / operations analysis
## RODEL

### National Roundabout Conference 2005 DRAFT

<table>
<thead>
<tr>
<th>Time</th>
<th>Flow (veh)</th>
<th>Capacity (veh)</th>
<th>Delay (mins)</th>
<th>Queue (veh)</th>
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<td></td>
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<td>1055</td>
<td>0.00</td>
<td>0</td>
</tr>
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<td></td>
<td>1060</td>
<td>2300</td>
<td>0.04</td>
<td>1</td>
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<td></td>
<td>932</td>
<td>1821</td>
<td>0.07</td>
<td>1</td>
</tr>
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<td></td>
<td>1638</td>
<td>0.08</td>
<td>0.07</td>
<td>1</td>
</tr>
</tbody>
</table>

### Time Period
- Min: 90
- Max: 60

### Flow Type
- PCU/veh

### Flow Ratio
- 1.11

### Flow Time
- 0 30 60

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**Fehr & Peers Transportation Consultants**
SIDRA

- Akcelik & Associates, Australia
- Intersection analysis similar to HCM
- Uses gap acceptance and lane utilization to determine capacity
- Can change headway values to calibrate to local conditions
SimTraffic

- Trafficware, USA
- Stochastic simulation model
- Uses Synchro for data input
- Driver behavior and vehicle characteristics
- Can change headway factors to calibrate to local conditions
SimTraffic

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Paramics

- Quadstone, UK
- Stochastic simulation model
- Driver behavior and vehicle characteristics
- Link/node network structure
- Automatically creates roundabout
VISSIM

- PTV, Germany
- Stochastic simulation model
- 3D animation features
- Link/connector network structure
- Specify gap acceptance parameters by lane for each approach
VISSIM
Review of Methods

• FHWA & RODEL
  – Based on British regression equations
  – Gap acceptance & lane configuration are not factors

• SIDRA & SimTraffic
  – Allow calibration of gap acceptance parameters to local conditions

• Paramics & VISSIM
  – Most flexible in modeling behavior
Case Study #1 - Description

- SR-99/East First Avenue in Chico, CA
- Design Year (2027) PM Peak Hour
- Other alternatives with signals analyzed with CORSIM
- Diamond interchange with roundabout ramp terminal intersections
Case Study #1 - Description
Case Study #1 - Results

- FHWA F / 59
- RODEL D / 28
- SIDRA F / 158
- SimTraffic F / 249
- Paramics F / 86
- VISSIM E / 48

- FHWA A / 5
- RODEL A / 4
- SIDRA D / 28
- SimTraffic F / 353
- Paramics C / 24
- VISSIM B / 11

- RODEL misses circulating roadway issue
- SIDRA shows delay also at NB Ramp
- FHWA shows capacity problem at SB Ramp
- VISSIM is more adjustable, able to serve more demand in peak hour
- Paramics has higher delays than VISSIM, LOS similar to SIDRA results
- SimTraffic does not allow conflicting movements within the roundabout
Case Study #2 - Description

- US-50/Placerville Dr. in Placerville, CA
- Design Year (2030) PM Peak Hour
- 5-leg roundabout at westbound ramp terminal intersection
Case Study #2 - Results

- RODEL & SIDRA report good LOS
- Difficult to model the geometry accurately
- VISSIM can model one-lane exits, lane restrictions, & gap acceptance factors
- Shows insufficient gaps for 3rd approach

<table>
<thead>
<tr>
<th>Method</th>
<th>LOS / Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>RODEL</td>
<td>B / 11</td>
</tr>
<tr>
<td>SIDRA</td>
<td>B / 15</td>
</tr>
<tr>
<td>VISSIM</td>
<td>F / 99</td>
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</table>
Recommendations

• FHWA, RODEL, & SIDRA
  – For uncongested conditions
  – For isolated locations

• SimTraffic
  – For congested conditions
  – For system-wide analysis
  – For restricted geometry (one-lane exits or forced right two-lane exits)
Recommendations

• Paramics & VISSIM
  – For congestion conditions
  – For system-wide analysis
  – For complex geometry, such as:
    • Weaving within the roundabout
    • Signalized intersections
    • Right-of-way constraints
    • Freeway ramps
    • Driveways
Questions?

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