Dallas – Fort Worth TexITE Joint Meeting, 2018
Planning and Simulating Roundabouts in North Texas
Stantec
Outline

Roundabout Planning

Roundabout Simulation
Roundabout Planning
Roundabout Planning

1. Simplifying & Explaining Pathing

2. Accounting for Large Vehicles

3. Showing how Roundabouts are Safer

4. Economic Benefits vs. Construction Costs
Explaining Roundabout Pathing

- Generally, lane changing within a roundabout should be avoided.
- For complex layouts, important to illustrate vehicle movements.
Signing

- Signing at roundabout entrances should direct driver to appropriate lane.
- Signing within circular roadway tells driver when to exit.

Source: Texas MUTCD
Trucks & Emergency Vehicles

- **WB-50** for *all* roundabouts (unless client requesting otherwise)
- Usually **WB-67** for suburban/rural roundabouts
- Find the largest emergency vehicle (usually fire truck) in respective town/city – they must use roundabout without driving on truck apron

*Source: AASHTO “Green Book”*
Safety

• Lots of research done on safety benefits of building roundabouts
• Studies done by NCHRP, FHWA, IIHS, others...
• Crash Modification Factors Clearinghouse gathers data on safety
  
  http://www.cmfclearinghouse.org/

Source: Crash Modification Factors Clearinghouse
# Running a Cost-Benefit Analysis

<table>
<thead>
<tr>
<th>Option</th>
<th>Construction Cost</th>
<th>Yearly Maintenance Cost</th>
<th>Yearly Cost</th>
<th>Delay Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing (Status Quo)</td>
<td>$0</td>
<td>$5,500</td>
<td></td>
<td>$767k</td>
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<tr>
<td>Roundabout</td>
<td>$3.1 million</td>
<td>$0</td>
<td></td>
<td>$287k</td>
</tr>
<tr>
<td>Signalization Option #1</td>
<td>$315k</td>
<td>$5,500</td>
<td></td>
<td>$516k</td>
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<tr>
<td>Signalization Option #2</td>
<td>$195k</td>
<td>$5,500</td>
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<td>$474k</td>
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</tbody>
</table>

- Typically, roundabouts are more expensive than traditional intersections, esp. if ROW is needed.
- This cost is offset slightly by not having to maintain a signal.
Running a Cost-Benefit Analysis

Cost Savings vs. Existing Condition (millions of $)

- Roundabout
- Signalization Option #1
- Signalization Option #2
- Status Quo (Existing)

Years

$5M

$4M

$3M

$2M

$1M

$0

-$1M

-$2M

-$3M

0 2 4 6 8 10 12 14
Roundabout Simulation
What are we trying to answer?

1. Will a roundabout operate better than a traffic signal or stop control?

2. When will the design “break down”? 
Modeling Tools

(Sidra)

(Synchro)

Reliance on the HCM

“True” Microscopic Simulation

PTV VISSIM

TransModeler

Stantec
HCM vs. Sidra Standard Capacity Models

**HCM 2010**
- Based on observations at American roundabouts
- More well-known and accepted (in USA)

**Sidra Standard**
- Takes roundabout geometry into account
- Follow-up headway & critical gap affected by circulating flow rate
- Over-capacity approaches affect circulating flow rate (i.e. result in less delay for downstream approaches)
HCM 2010 Methodology (brief)

**Input**
- Volumes
- Roundabout Geometry

**Calculations**
- Convert volume to demand flow rates
- Calculate capacity (by lane)
- Calculate v/c ratios

**Output**
- Delay (and LOS)
HCM 2010: Capacity

- Capacity is based on:
  - # of circulating lanes
  - conflicting flow rate
  - driver behavior

- Equations based on empirical observations (in USA)

- From HCM 2010:
  - “U.S. drivers presently seem to display more hesitation ..., which results in lower observed capacities [than that in other countries].”
Calibrating Roundabout Capacity

- HCM suggests calibrating driver behavior to local conditions
- **Problem**: budget rarely covers researching driver behavior
- **Alternative**: sensitivity analysis
Sensitivity Analysis (HCM)

- Sensitivity analysis done by adjusting the critical headway and follow-up headway
- 100% refers to the default parameters used by HCM
Sensitivity Analysis (Sidra)

- Using the Sidra capacity model, adjust the “Environment Factor” parameter
  - For the US, 1.20 is suggested
  - For Europe/Australia, 1.00 is suggested

Effect of Driver Behavior Adjustment on Delay

- **Environment Factor = 1.00**
- **Environment Factor = 1.20**
Why Vissim?

- Help visualize how the roundabout will work
- Client wants a video for public presentation
- Complex roundabout layouts
- Using signalization for roundabout metering (also in Sidra)
Vissim: Drawing Roundabout Links

- Strategy: avoid large conflict areas
- Generally avoid running connectors into links; instead, have two connectors join at beginning of link
Vissim: Priority Rules vs. Conflict Areas

- Generally, conflict areas are used in most cases. Priority rules are generally more of a “legacy” object.
- Using priority rules can allow for better control of critical gap on a per-lane basis.
- Takes longer than using conflict areas.
Level of Service Considerations

- LOS for Unsignalized Intersections is normally applied to roundabouts.
- HCM 2010: “At the time of publication...no research was available on travel perception of quality of service at roundabouts”.
- Sidra makes available its own LOS thresholds for roundabouts.

<table>
<thead>
<tr>
<th>Standard</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signalized Intersection</td>
<td>D</td>
</tr>
<tr>
<td>Roundabout (Sidra)</td>
<td>E</td>
</tr>
<tr>
<td>Unsignalized Intersection</td>
<td>F</td>
</tr>
</tbody>
</table>

Delay = 53s
Thank you!

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