Multiple Account Evaluation of Intersection Traffic Control Alternatives

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A Division of EBA Engineering & Consultants
Presentation Outline

- Background
- Traffic Control Methods
- Modern Roundabouts
- Multiple Account Evaluation
- A Case Study
- Summary of Findings
Background

• Intersection Control Objectives
  – Define Right-of-Way
    • Mobility
    • Safety
    • Accessibility
    • Vehicle Priority

• Potential Impacts
  – Delay
  – Change in Type of Collisions
  – “Migration” of Collisions

Source: ICBC
Traffic Control Methods

• Conventional Control Methods
  – Unsignalized/Stop Controlled
  – Pedestrian “Half” Signal
  – Full Signals
  – Grade Separation/Interchange

• Standard Warrant Criteria
  – Volume
  – Delay
  – Operation
  – Safety

• Common Standards
  – US MUTCD
  – TAC MUTCD
  – Ministry Manual
Modern Roundabouts

• “Modern” Roundabout:
  – Urban Compact
  – Single Lane Urban
  – Multi Lane Urban
  – High Speed Rural
  – Signalized (UK)

• Standards Evolving

• Guidelines
  – FHWA Informational Guide
  – Kansas Roundabout Guide
  – BC TAC Design Supplement

Reduced Conflict Points

Source: FHWA
Why Roundabouts

- Traffic Calming
- Reduced Collision Severity
- Less Driver Distraction
- Landscaping/ Aesthetics
- Shared Right of Way
- No Control Hardware Required

Why They Work:

- Cars entering a roundabout must yield to those already in the circle.
- With all cars traveling in the same direction, roundabouts eliminate head-on collisions, as well as left turns, one of the most dangerous moves in an intersection.
- Because drivers are anxious about merging with roundabout traffic, they slow down, which helps reduce accidents.
- With no traffic lights to divert drivers’ attention upward, roundabouts keep motorists focused on the cars and pedestrians around them.
- In addition to improving traffic flow, roundabouts are often easy on the eye, with elegant landscaping.

Source: http://www.time.com/time/magazine
Challenges

- Additional Right-of-Way
- Construction Cost ($500,000~$1,000,000)
- Maintenance
- Illumination & Servicing
Roundabout Application

- Lack of Familiarity among Road Users
- Pedestrian Safety/ Distance
- Cyclists to Dismount
- Maneuverability for Trucks
- Vehicle Priority (Emergency, Transit)

Source: FHWA

Driver Opinion Survey on Roundabouts

| Source: Insurance Institute for Highway Safety |

![Survey Chart]
Intersection Control Assessment - A Case Study

Intersection: Hirst Avenue/McMillan Street
Parksville, British Columbia
Total Population = 11,000 (2006 Census)
Location
Hirst Avenue/McMillan Street
Parksville, B.C.
Study Area Location
Existing Configuration & Volumes

McMillan Street (N-S): Future Arterial
Hirst Avenue (E-W): Collector

AM (PM) Peak Hour
July 2008 Counts
Design Considerations

- Part of Hwy 4A Realignment to Promote McMillan St
- 20 Year Horizon (Significant Growth)
- Intersection Traffic Control Upgrades
- Need to Accommodate – Transit Routes, Trucks (WB20), Emergency
- Pedestrian/ Cyclist Facilities
- City’s Environmental Policy Promotes Sustainability
Multiple Account Evaluation Criteria

- **Traffic Operation**
  - Level of Service, Queuing, Transit Operation, Emergency Vehicle, Cyclist Accommodation

- **Safety**
  - Crash Frequency, Crash Severity, Driver Familiarity, Pedestrian Gap Judgement

- **Cost**
  - Construction, Operating/Maintenance, Land Requirement,

- **Environment**
  - Emissions, Fuel Consumption, Aesthetics

- **Other**
  - Future Expansions, Adjacent Access, Parking
Alternative Roundabout Concepts

- Single Lane Urban Roundabout
- Different Inscribed Circle Diameter

40 Metre to Accommodate Trucks

30 Metre to Fit RoW
## Operational Performance

### 2008 PM Peak Hour

<table>
<thead>
<tr>
<th>Parameter</th>
<th>30m Diameter</th>
<th>40m Diameter</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Approach</td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Degree of Saturation, v/c</td>
<td>0.48</td>
<td>0.68</td>
<td>0.45</td>
</tr>
<tr>
<td>Average Delay, sec/veh</td>
<td>4.8</td>
<td>7.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Queue</td>
<td>30 m</td>
<td>56 m</td>
<td>25 m</td>
</tr>
</tbody>
</table>
Turning Path Analysis
### Traffic Operation (contd.)

#### Peak Hour Performance (2008 PM)

<table>
<thead>
<tr>
<th>Index</th>
<th>30m Roundabout</th>
<th>40m Roundabout</th>
<th>Full Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Service</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Volume/Capacity</td>
<td>0.68</td>
<td>0.63</td>
<td>0.41</td>
</tr>
<tr>
<td>Delay, sec/veh</td>
<td>7.3</td>
<td>4.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Queue, m</td>
<td>56 (NB)</td>
<td>45 (NB)</td>
<td>33 (NB)</td>
</tr>
</tbody>
</table>

**Analysis Tools:**
- Sidra Intersection 3.0
- Synchro 7.0
- SimTraffic
- Vissim 5.10
# Traffic Operation

![Traffic Operation Diagram](image)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Roundabout</th>
<th>‘Full’ Signal</th>
<th>‘Half’ Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Service</td>
<td>●</td>
<td>✓</td>
<td>○</td>
</tr>
<tr>
<td>Queuing</td>
<td>✓</td>
<td>✓</td>
<td>○</td>
</tr>
<tr>
<td>Transit Operation</td>
<td>●</td>
<td>●</td>
<td>✓</td>
</tr>
<tr>
<td>Emergency Vehicle</td>
<td>✓</td>
<td>●</td>
<td>✓</td>
</tr>
<tr>
<td>Cyclist Accommodation</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

![Graph](image)

Legend:
- Green: Favourable
- White: Average
- Red: Unfavourable
## Safety Evaluation

<table>
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<tbody>
<tr>
<td>Crash Frequency</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Crash Severity</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Driver Familiarity</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Pedestrian Gap Judgement</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

### Crash Frequency
- 16 Favorable
- 32 Average

### Crash Severity
- 2 Favorable
- 4 Average
- 6 Unfavorable

### Driver Familiarity
- 8 Favorable
- 16 Average
- 24 Unfavorable

### Pedestrian Gap Judgement
- 4 Favorable
- 8 Average
- 12 Unfavorable
Environmental Evaluation

<table>
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<tr>
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<th>Roundabout</th>
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<th>‘Half’ Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions</td>
<td>●</td>
<td>●</td>
<td>○</td>
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<tr>
<td>Fuel Consumption</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Index

<table>
<thead>
<tr>
<th>Index</th>
<th>Roundabout</th>
<th>Full Signal</th>
<th>Pedestrian Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Efficiency, km/litre</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Fuel Consumption, litre/hour</td>
<td>110.8</td>
<td>126.1</td>
<td>125.9</td>
</tr>
<tr>
<td>HC Emission, gm/hour</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>COx Emission, gm/hour</td>
<td>1,268</td>
<td>1,477</td>
<td>1,841</td>
</tr>
<tr>
<td>NOx Emission, gm/hour</td>
<td>16</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

2008 PM Peak Hour
### Cost

<table>
<thead>
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<th>Roundabout</th>
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<th>‘Half’ Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Cost</td>
<td>☐</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Operating/Maintenance Cost</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Land Requirement</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### Other Considerations

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Future Expandability</td>
<td>☐</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Access, Parking Impact</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Scores are comparable for Roundabout (9.5) and Full Signal (10.0)
- Compared to Pedestrian Controlled Signal (7.0)
Local Considerations

- Road User Age (Pedestrians & Drivers)
  - E-W Pedestrian Crossing Demands vs. Heavy North-South Flow
  - Difficulty in Crossing Gap Assessment
  - Difficulty in Maneuvering around a Roundabout
  - Accessibility Needs
- Flow Along McMillan Street
- RoW Availability
- Interactions with Adjacent Intersections

Population Distribution by Age Group

Statistics Canada 2006 Census
Findings

• Stop control not currently a problem
• Pedestrian signals warranted in short term
• Future volumes compatible with single lane roundabout
• 40 m roundabout required to meet objectives
• Additional RoW required for 40 m roundabout
• MAE considered traffic operation, cost, safety, environment
• Roundabout and full signal receive comparable ratings
• Local considerations and objectives affect preferred outcome
  – Prioritize McMillan Street, Accommodate Trucks, Cyclists, Pedestrians
  – Elderly road users, traffic progression, RoW limitations
• Signalization will meet these requirements
Thanks!

Vissim Microsimulation Screen Capture