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Impact Calculator Workshop Format

- NCHRP 3-52 Background
- Software Review
  - Basis for Calculations
  - Structure – The “Tour”
  - Applications/Examples
NCHRP Project 3-52
Background
NCHRP Project 3-52
Study Purpose

- Quantify the Safety and Traffic Operation Impacts of Selected Access Management Techniques
NCHRP Project 3-52
Panel Members Represent:

- British Columbia Ministry of Transport
- Federal Highway Administration
- Florida DOT
- Illinois DOT
- New Jersey DOT
- Ohio DOT
- Oregon DOT
- Polytechnic University
NCHRP Project 3-52 Phase I:

- Identify Access Management Techniques
- Classify Techniques
- Recommend Priority Techniques for Further Analyses
- Survey Practitioners
- Prepare Study Plan
NCHRP Project 3-52
Phase II:

- Assemble Secondary Data and Collect Primary Data
- Analyze Data to Quantify Impacts of Priority Techniques
- Prepare Project Report
Access Management Techniques:

A. Policy
- Administrative & Regulatory Procedures 12
- Zoning & Subdivision Regulations 5
- Other 3

B. Design
- Interchanges 3
- Frontage Roads 5
- Medians – Left Turns 21
- Right Turns 7
- Access Location –Design 23
- Access Location - Retrofit 13
NCHRP Project 3-52 Priority Techniques

- Traffic Signal Spacing
- Integrated Median Techniques
- Unsignalized Access Spacing (including Corner Clearance)
- Left - Turn Lanes
- Access Spacing at Interchanges
- Frontage Roads
NCHRP Report 420 Contents

- Introduction & Research Approach
- Access Management Techniques & Impacts
- Traffic Signal Spacing
- Unsignalized Access Spacing
- Corner Clearances
- Median Alternatives
- Left-Turn Lanes
- U-Turns as Alternatives to Direct Left Turns
- Access Separation at Interchanges
- Frontage Roads
- Policy Considerations
Review of Impact Calculator
Impact Calculator Modules

- Traffic Signal Spacing
- Unsignalized Access Spacing - Safety
- Unsignalized Access Spacing - Operations
- Interchanges
- Economic Impact of Medians
Traffic Signal Spacing
Suggested speed estimation curves for Class I arterials using v/c ratio

NOTE: Curves shown are for estimating average peak hour speeds. See discussion in text for more information on origin of curves and variability in average speeds.
Suggested speed estimation curves for Class II & III arterials using v/c ratio

NOTE: Curves shown are for estimating average peak-hour speeds. See discussion in text for more information on origin of curves and variability in average speeds.
Travel time rates and speeds for 40 mph

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<td>21</td>
<td>19</td>
<td>16</td>
<td>13</td>
<td>9</td>
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Unsignalized Access Spacing - Safety
NCHRP Project 3-52
Safety Analysis

- Performed Synthesis of Prior Research
- Analyzed Crash Data for 8 States
  - 152 Urban/Suburban Segments
  - 89 Rural Segments
- Developed Data Base Representing 37,500 Crashes
Effect of Access Spacing on Accident Rates (Composite)
Composite Accident Rate Indices
Based on Literature Synthesis

Index: Ratio to 10 Access Points per Mile

Access Points per Mile

0 10 20 30 40 50 60

0 1 2 3 4 5

1.0 1.3 1.7 2.1 2.8 4.1
Estimated Accident Rates by Type of Median; Urban and Suburban Areas

- Undivided
- TWLTL
- Non-Traversable Median
Application Example

- **Current Condition on Segment**
  - Undivided roadway in urban area
  - 15 Access Points Per Mile
  - Crash Rate Unknown

- **Projected Conditions**
  - 35 Access Points Per Mile
  - Estimated Crash Rate Increase of 74%
    
    \[
    \frac{(8-4.6)}{4.6} \times 100
    \]
Estimated Accident Rates by Type of Median; Urban and Suburban Areas

- Undivided
- TWLTL
- Non-Traversable Median

Accident Rate per Million Vehicle-Mile

Total Access Points per Mile (Signalized and Unsignalized)
Estimated Accident Rates by Access Density; Urban and Suburban Areas

Total Unsignalized Access Points Per Mile

- > 6.0 Signals per Mile
- 4.1-6.0 Signals per Mile
- 2.1-4.0 Signals per Mile
- ≤ 2.0 Signals per Mile
Estimated Accident Rates by Type of Median; Rural Areas

- Undivided
- TWTL (Two Way, Two Lane)
- Non-Traversable Median

Graph showing accident rates per million vehicle-mile versus total access points per mile (signalized and unsignalized).
Unsignalized Access Spacing - Operations
NCHRP Project 3-52
Unsignalized Access Spacing

Operational Effects of Driveway Traffic:
- Impacts on Through Vehicles
- Influence Area
- Access Separation Guidelines
Establishing Unsignalized Access Spacing Guidelines

1. Identify % of Thru Vehicles that are Impacted
2. Determine Impact Lengths of Thru Vehicles That Are Impacted
3. Determine Influence Lengths of Thru Vehicles That Are Impacted
4. Consider Multiple Driveways
5. Establish Guidelines Based on % of Thru Traffic Impacted
6. Establish Guidelines Based on Spillback Rates
Measuring Impact Length

IMPACT LENGTH

- Upstream Driveway
- Driveway Width
- Driveway Spacing
- Impacted Vehicle at Moment of Impact
- Study Driveway
- Impact Length

RTI Vehicle
Estimating Influence Length

INFLUENCE LENGTH: IMPACT LENGTH + PIEV + CAR LENGTH

- D'way Width
- Upstream Driveway
- Vehicle at Start of PIEV
- D'way Spacing
- Study Driveway
- Car Length
- PIEV
- Influence Length
- Impact Length
Concept of Spillback

SPILLBACK:
INFLUENCE LENGTH > D'WAY SPACING - D'WAY WIDTH

D'way Width

Upstream D'way

Car Length

PIEV

Vehicle at Start of PIEV

Vehicle at Moment of Impact

Study Driveway

Influence Length

Impact Length

D'way Spacing
SINGLE DRIVEWAY CASE:
IMPACTS VS. RIGHT-TURN-IN VOLUME

% of Right Lane Through Vehicles Impacted by RTI

Right-Turn-In Volume (vph)

0% 10% 20% 30% 40% 50%

0 50 100 150 200 250
MULTIPLE DRIVEWAY CASE:
VEHICLES IMPACTED AT LEAST ONCE PER QUARTER MILE

% of Right Lane Thru Vehicles Impacted by RTI at Least Once per 1/4 Mile

- RTI > 91
- 61<RTI<90
- 31<RTI<60
- RTI < 30

Driveway Spacing (feet)
MULTIPLE DRIVEWAY CASE:
SPILLBACK RATES - AT LEAST ONCE PER 1/4 MI
POSTED SPEED = 45 MPH

<table>
<thead>
<tr>
<th>D'way Spacing (ft)</th>
<th>Right Turn In Volume (vph)</th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>RTI &lt; 30</td>
<td>31&lt;RTI&lt;60</td>
<td>61&lt;RTI&lt;90</td>
<td>RTI &gt; 91</td>
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<tr>
<td>100</td>
<td>27.3%</td>
<td>64.2%</td>
<td>82.1%</td>
<td>96.1%</td>
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<tr>
<td>150</td>
<td>19.1%</td>
<td>49.6%</td>
<td>68.2%</td>
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<td>200</td>
<td>14.6%</td>
<td>40.0%</td>
<td>57.5%</td>
<td>80.1%</td>
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<tr>
<td>250</td>
<td>11.3%</td>
<td>32.0%</td>
<td>47.5%</td>
<td>70.2%</td>
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<tr>
<td>300</td>
<td>7.8%</td>
<td>23.0%</td>
<td>35.3%</td>
<td>55.5%</td>
</tr>
<tr>
<td>350</td>
<td>4.4%</td>
<td>13.5%</td>
<td>21.2%</td>
<td>35.4%</td>
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<tr>
<td>400</td>
<td>2.6%</td>
<td>8.0%</td>
<td>12.9%</td>
<td>22.1%</td>
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<tr>
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<td>1.6%</td>
<td>5.1%</td>
<td>8.2%</td>
<td>14.4%</td>
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<tr>
<td>500</td>
<td>0.9%</td>
<td>2.9%</td>
<td>4.7%</td>
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<td>650</td>
<td>0.1%</td>
<td>0.4%</td>
<td>0.6%</td>
<td>1.1%</td>
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COMPARISON OF ACCESS SEPARATION CRITERIA
31<RTI<60

Driveway Spacing (feet)

Posted Speed (mph)

- 5% Spillback
- 10% Spillback
- 20% Spillback
- Colorado DOT
- NJ DOT
Interchanges – Spacing on Cross Roads
## Estimated weaving distances

<table>
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<tr>
<th>Weaving Volume (vph)</th>
<th>Speed (mph)</th>
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<tr>
<td>1,000</td>
<td>300</td>
</tr>
<tr>
<td>1,200</td>
<td>350</td>
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<tr>
<td>1,400</td>
<td>400</td>
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<tr>
<td>1,600</td>
<td>450</td>
</tr>
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<td>700</td>
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<td>2,400</td>
<td>800</td>
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<tr>
<td>2,600</td>
<td>900</td>
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</tbody>
</table>

**Notes:** Use 400 feet for values above solid line.

* Speeds are not attainable.
Economic Impacts of Closing a Median Opening

Before Median

After Median
Simplified Approach
Economic Analysis Factors

- Size and Type of Each Activity where Left-Turn Access will be Removed
- Reliance of Each Activity on Pass-by Traffic
- Number of Vehicles Turning Left into the Activity or Land Use
- Average Purchase Per Vehicle
Calculating Maximum Economic Impact

Maximum Economic Impact

\[ = \sum_{I}^{M} N_I P_I D_I \]

- Where: \( N_I = \) Number Turning Left at Location \( I \) Per Day
- \( P_I = \% \) Pass by at Location \( I \)
- \( D_I = \) Dollars/Purchase
- \( M = \) Number of Businesses with Left-Turn Access Removed
## Economic impact model

<table>
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<tr>
<th>Land Use</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
<td>1 Gasoline Service Station</td>
<td>55</td>
<td>ADT %</td>
</tr>
<tr>
<td>Convenience Mart</td>
<td></td>
<td>5,000 43</td>
</tr>
<tr>
<td>Small Retail &lt; 50,000 sq. ft.</td>
<td></td>
<td>10,000 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,000 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30,000 15</td>
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<tr>
<td></td>
<td></td>
<td>or more</td>
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<tr>
<td>Supermarkets</td>
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</tr>
<tr>
<td>Shopping Center</td>
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<td></td>
</tr>
<tr>
<td>50,000 - 100,000 sq. ft.</td>
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<tr>
<td>3 High Turnover sit-down restaurant</td>
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<td>4 Shopping Centers</td>
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<td>250,000 - 500,000 sq. ft.</td>
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<td>5 Shopping Centers</td>
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<td>Over 500,000 sq. ft.</td>
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IMPACT CALCULATOR
Impacts of
Access Management Techniques

NCHRP Report 420
Transportation Research Board
Washington, D.C.

Version 2.0.4