Low-Cost Safety Improvements:  
Focus on Unsignalized Intersection and Roadway Departure Treatments

Road Safety: A “National Epidemic”

Road Safety Performance in the United States
- Over 40,000 Americans killed each year on public roads
- Nearly 2.5 million injuries annually
- Societal cost of nearly $300 Billion per year
Indiana’s Road Safety Experience

- Leading cause of death of Indiana citizens aged 1 to 64
- Roughly 900 killed and 70,000 injured each year
- SHSP identifies 13 Emphasis Areas
  - Reduce High-Risk Rural crashes
  - Minimize likelihood and reduce consequences of ROR crashes
  - Improve safety at intersections
The Focus on Indiana

- The Opportunity to Make a Difference – Here
  - 70% of MV-related fatalities occur on Rural Roads
  - 66% of All crashes occur on County or Local roads
  - 57% of Incapacitating Injury & Fatal crashes occur on County or Local roads

Intersection Fatal Crashes Represent
22% of All Fatal Crashes

Non-Intersection 78%

Intersection - Unsignalized 14%

Intersection - Signalized 8%

(FARS 2007)
Why ‘Unsignalized’ Intersections?

2006 INTERSECTION FATALITIES

<table>
<thead>
<tr>
<th>Type</th>
<th>Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signalized</td>
<td>2,718</td>
</tr>
<tr>
<td>Unsignalized</td>
<td>5,715</td>
</tr>
<tr>
<td>Other/Unknown</td>
<td>364</td>
</tr>
</tbody>
</table>

Source: FARS, National Highway Traffic Safety Administration
Unsignalized Intersections

Indiana’s Experience

- 896 total fatalities (all locations)
- 26% occur at intersections
  - Approx. ¾ of these are attributed to Unsignalized

Objectives and Strategies for Improving Safety at Unsignalized and Signalized Intersections

![Unsignalized Intersection Images]

http://safety.fhwa.dot.gov/intersections/intsafestratbro/

<table>
<thead>
<tr>
<th>SAFETY CONCERN</th>
<th>Low</th>
<th>Moderate</th>
<th>Moderate-High</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>High frequency of right-angle crashes</td>
<td>A2,B12,C1,C2,C4</td>
<td>A1</td>
<td>B8</td>
<td>B13,F3</td>
</tr>
<tr>
<td>nearby driveways</td>
<td>B12,C1,C2,C4,D2</td>
<td>D1</td>
<td>B8</td>
<td>B16,C3,F3</td>
</tr>
<tr>
<td>traffic from minor street</td>
<td>C1,C2,C4,H3</td>
<td>D1</td>
<td>C3,F3</td>
<td></td>
</tr>
<tr>
<td>skewed intersection</td>
<td>D2,H3</td>
<td>D1</td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>poor sight distance</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>drivers misjudging gaps</td>
<td>E1,E5,E9,E10,E11</td>
<td>E3</td>
<td>E2</td>
<td>B14,F3</td>
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<tr>
<td>not enough gaps for drivers</td>
<td>F2</td>
<td></td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>driver unaware of intersection</td>
<td>G1</td>
<td></td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>nighttime conditions</td>
<td>F1,F3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>failure to yield at stop or yield sign</td>
<td>H1,H2</td>
<td></td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>possible signal location</td>
<td>H3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>heavy but balanced traffic flow</td>
<td>H1,H2</td>
<td></td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>speed differentials of vehicles</td>
<td>H3</td>
<td></td>
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</tbody>
</table>

This key sheet and the accompanying intersection safety strategy guide sheets are available in the NCHRP Report 509 series on strategies to reduce crashes at unsignalized (volume 5) and signalized (volume 12) intersections.
**Selected Unsignalized Intersection Treatments**

- Intersection Sight Distance
- Positive-Offset Turn Lanes
- Intersection Lighting
- Improved Signing & Delineation
- Shoulder Widening at Intersections
- Geometric Treatments

**Intersection Sight Distance**

View to/from the stopped location to conflicting traffic must be clear

**BEFORE**

- Approx. CRF of 5% per quadrant
- Recommend minimum 50’-50’ sight triangles at rural intersections

**AFTER**
**INTERSECTION SIGHT DISTANCE**

**Typical Intersection**

Trim your hedge, bushes, and trees for safety’s sake

**OFFSET TURN LANES**

Left Turn Lanes CRF 28% (Rural 4-Legged)

Positive Offset
OFFSET TURN LANES

Right Turn Lanes CRF 14%
(Along Rural Major Leg)

INTERSECTION LIGHTING
INTERSECTION LIGHTING

Intersection Lighting
CRF ranges from 25% to 50% (nighttime crashes)

IMPROVED SIGNING & DELINEATION

Safety Benefits
- Double Stop Signs CRF 11%
- Advance Warning Signs CRF 40%
- Adding Flashing Beacons CRF 39%
IMPROVED SIGNING & DELINEATION
SHOULDER WIDENING

CRF 2.8% per foot

CHANNELIZATION

Concepts 1+2 - Major and Minor Road Approaches
Concepts 1+2 - Major and Minor Road Approaches
CHANNELIZATION

MODERN ROUNDBOUTS

Superior Performance

- CRF 40% (All Crashes)
- CRF 70-80% (Serious Crashes)
- Reduce Delay, Emissions & Fuel Consumption
Low-Cost Countermeasures for RD Crashes

- Roadway Departure crashes make up approx. 60% of all fatal crashes
- Basic Geometric Improvements
- Next Generation of Rumble (Strips and Stripes)
- Eliminating Paved Edge Drop-Offs

Geometric Improvements

Improving Shoulders
- Widen from 0’ to 2’: CRF 16%
- Widen from 0’ to 4’: CRF 29%
- Widen from 0’ to 8’: CRF 49%

Widen Clear Zone
- Add 5’ CZ: CRF 13%
- Add 10’ CZ: CRF 25%
- Add 20’ CZ: CRF 44%
Rumble Strips & Stripes

Shoulder Rumble on Rural Roads

- CRF 13% (All), CRF 18% (Severe)
Rumble Strips & Stripes

Edgeline Rumble Stripes
- Edgeline location allows for coincident marking and greater overall effectiveness

DAYTIME NIGHTTIME
Rumble Strips & Stripes

Centerline Rumble Stripes
- CRF 14% (All); CRF 15% (Severe)
Combination Edgeline & Centerline Rumble

Eliminating Paved Edge Drop-Offs (PEDO)

- A PEDO-related crash has a higher likelihood of severe outcome
- PEDO-related crashes make up the majority of tort cases brought against road agencies
Eliminating Paved Edge Drop-Offs (PEDO)

Solution: The “Safety Edge”
Eliminating Paved Edge Drop-Offs (PEDO)

The Safety Edge

Line depicts extension of pavement surface

$30^\circ - 35^\circ$

Line depicts a plane parallel to pavement surface from the toe of the wedge surface

Graphic Source: Zimmer and Ivey, Texas Transportation Institute
Eliminating Paved Edge Drop-Offs (PEDO)

Questions or Comments?

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