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

**Presented to: 2009 Purdue Road School**

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**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

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**Safe Roads for a Safer Future**

*Investment in roadway safety saves lives*
Unsignalized Intersections

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

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

Objectives and Strategies for Improving Safety at Unsignalized Intersections

<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 attributed to:</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate-High</td>
<td>High</td>
</tr>
<tr>
<td>nearby driveways</td>
<td>A2,B12,C1,C2,C4</td>
<td>A1</td>
<td>B8</td>
<td>B13,F3</td>
</tr>
<tr>
<td>traffic from minor street</td>
<td>B12,C1,C2,C4,D2</td>
<td>D1</td>
<td>B8</td>
<td>B16,F3</td>
</tr>
<tr>
<td>skewed intersection</td>
<td>C1,C2,C4,H3</td>
<td>D1</td>
<td>C3</td>
<td>F3</td>
</tr>
<tr>
<td>poor sight distance</td>
<td>D2,H3</td>
<td>D1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>drivers misjudging gaps</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not enough gaps for drivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>driver unaware of intersection</td>
<td>E1,E6,E9,E10,E11</td>
<td>E3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nighttime conditions</td>
<td>E10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>failure to yield at stop or yield sign</td>
<td>E1,E4,E9,E11</td>
<td>G1</td>
<td></td>
<td>F3</td>
</tr>
<tr>
<td>possible signal location</td>
<td></td>
<td></td>
<td></td>
<td>F1,F3</td>
</tr>
<tr>
<td>heavy but balanced traffic flow</td>
<td>F2</td>
<td></td>
<td></td>
<td>F3</td>
</tr>
<tr>
<td>speed differentials of vehicles</td>
<td>H3</td>
<td>H1,H2</td>
<td></td>
<td>F3</td>
</tr>
</tbody>
</table>
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**
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

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

Safety Benefits

- Double Stop Signs CRF 11%
- Advance Warning Signs CRF 40%
- Adding Flashing Beacons CRF 39%
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

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)
Edgeline Rumble Stripes

• Edgeline location allows for coincident marking and greater overall effectiveness
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)

END GATE

SCREED

SAFETY WEDGE
Questions or Comments?

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