New FHWA Proven Safety Countermeasures

Mark Doctor
FHWA’s “Focused Approach” to Safety

These three “focus areas” encompass about 88% of U.S. traffic fatalities and have the greatest potential for reducing highway fatalities using infrastructure-oriented improvements:

- Roadway departure crashes
- Intersection crashes
- Pedestrian/bicycle crashes

NOTE: Totals in the main and secondary pie charts do not add up to 100% and 11%, respectively, due to rounding.
In 2008, FHWA began promoting certain research-proven safety treatments and strategies to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways.

This became known as the Proven Safety Countermeasures initiative.

The list was updated in 2012 and again in 2017.
The list of Proven Safety Countermeasures has now reached a total of 20 treatments and strategies that practitioners can implement to accelerate the achievement of local, State, and National safety goals.

https://safety.fhwa.dot.gov/provencountermeasures/
What is your agency’s Safety Goal?

**A Road to Zero: A vision for achieving zero roadway deaths by 2050**


Double Down on What Works

“The United States has both an accumulated body of evidence-based countermeasures and a well-established network of experts who can deploy them.”
The Six New PSC (Version 3.0)

1. Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections.
2. Reduced Left-Turn Conflict Intersections.
3. Roadside Design Improvements at Curves.
4. Leading Pedestrian Intervals.
5. Local Road Safety Plans.
6. USLIMITS2.
Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

On the Through Approach
• Doubled up (left and right) and oversized advance intersection warning signs with street name plaques
• Enhanced edge line pavement markings to delineate through lane

On the Stop Approach
• Doubled up (left and right) and oversized advance Stop Ahead intersection warning signs
• “STOP AHEAD” pavement markings
• Doubled up (left and right) and oversized Stop signs on sign posts with retroreflective sheeting
• Properly placed stop bar
• Removal of any vegetation or obstruction that limits sight distance
• Double arrow warning sign at stem of T-intersections
Systemic Implementation

• Since this “family” of treatments is low-cost, they can be applied on a **systemic approach**

  • Particularly applicable when crashes are widely scattered over many intersections (e.g., in very rural areas)

  • Rather than implement after a severe crash has occurred (Reactive), a **systemic approach** implements based on the presence of certain risk factors (Proactive)
Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

SAFETY BENEFITS:

10% Reduction in injury and fatal crashes

15% Reduction in nighttime crashes

Evaluation Results from LCSI-PFS Study:

- Sample consisted of 434 treated sites and 568 reference sites across South Carolina.
- Included 2X2 (3-leg, 4-leg) and 4X2 (3-leg, 4-leg) sites.

<table>
<thead>
<tr>
<th>Recommended CMFs from FHWA-HRT-17-086</th>
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<tbody>
<tr>
<td>CMF</td>
</tr>
<tr>
<td>-----</td>
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<tr>
<td>CMF</td>
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</tbody>
</table>

Source: SCDOT
Reduced Left-Turn Conflict Intersections (RCUT and MUT)

- Geometric designs that alter how left-turn movements occur
- Simplify driver decisions and reduce or modify conflicts related to turning

Proven safety and operational benefits
Vehicle-Vehicle Intersection Conflict Points

Conflict points provide a means to compare the relative safety of intersection forms

Crossing conflict points (16)

- 12 crossing movements are associated with left-turning vehicles and collisions could occur if a vehicle attempting a left turn is struck by traffic passing through the intersection
- The remaining 4 crossing movements involve through movements on two adjacent approaches and angle collisions could result if a driver violates the traffic control device

Collisions associated with merging/diverging movements are rear-end and sideswipe collisions
“If you give drivers the opportunity to make a mistake, eventually they will.”
### Reduced Left-Turn Conflict Intersections

<table>
<thead>
<tr>
<th>Vehicle-Vehicle Conflict Points</th>
<th>Conventional</th>
<th>MUT</th>
<th>RCUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossing</td>
<td>16</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Merging</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Diverging</td>
<td>8</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

Sources: FHWA-SA-14-069, FHWA-SA-14-070
Restricted Crossing U-Turn (RCUT)
(also known as J-turns, Superstreets, Reduced Conflict Intersections, etc.)

At-grade intersections with directional medians so minor road traffic must turn right and make a U-turn to cross or make the left-turn maneuver.

Typically all movements from the major road are “normal” (some variations close the median and left-turns are made via U-turn maneuvers).

Source: Wisconsin DOT
Problem: Far-Side Right-Angle Collisions

Typical Divided Highway with Open Median Intersection
RCUT Distinguishing Features

- Cross street (minor road) traffic turns right, then accesses U-turn to proceed in desired direction.
- Main and U-turn intersections can be either signalized (“Superstreet”) or not (“J-Turn”)

Source: Wisconsin DOT
RCUT Safety Benefits

Studies show decreases in total crashes from 42-59%

&

Reductions in fatal and severe injury crashes of 60-88%

Sources:
https://connect.ncdot.gov/resources/safety/Tepl/TEPPL%20All%20Documents%20Library/A24_SSB.pdf
Unsignalized RCUTs

Turns can be STOP or YIELD controlled
Signalized RCUTs

- Signals on one side of arterial are independent of signals on other side
- Cross street through traffic turns right
- Cross street left turn traffic moves through
- Arterial traffic no different than conventional intersection
- Cross street traffic must turn right
- Cross street left turn and through traffic makes a U-turn in the wide median

Superstreets
Is there new development planned in your region?

Problem: Proliferation of Multi-Phase Signals
Got congestion? – Add more lanes!!!

“It’s the signals, stupid”
Signalized RCUTs Operate as “2-Phase”

• Signalized RCUTs typically operate with only 2-phases allowing more green time to the major street through

• Shorter cycle lengths than comparable multi-phase operations may be possible to reduce delays even more

RCUTs even offer an ability to have different cycle lengths in the two directions of the major street
Bi-Directional Progression

- Each direction may operate independently
- Directions can be progressed at different speeds and/or signal spacing

<table>
<thead>
<tr>
<th>Direction</th>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<tbody>
<tr>
<td>Right to left</td>
<td>Distance from previous signal, ft</td>
<td>750</td>
<td>650</td>
<td>1000</td>
<td>700</td>
<td>600</td>
<td>Not applicable</td>
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<tr>
<td></td>
<td>Offset to start of green, sec</td>
<td>74</td>
<td>59</td>
<td>46</td>
<td>26</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Left to right</td>
<td>Distance from previous signal, ft</td>
<td>Not applicable</td>
<td>600</td>
<td>850</td>
<td>1050</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Offset to start of green, sec</td>
<td>0</td>
<td>12</td>
<td>29</td>
<td>50</td>
<td>62</td>
<td>74</td>
</tr>
</tbody>
</table>

*Note: Assumed progression speed of 50 feet per second (34 mph) in both directions*
RCUT Feasible Traffic Volumes

- Applicable to a wide range of major street ADTs
- If minor street < 5,000 vpd, consider unsignalized RCUTs
- For minor street demands of more than 25,000 vpd, consider other alternative intersections (such as a MUT) that would generally serve the minor street more efficiently

Source: FHWA Restricted Crossing U-Turn Informational Guide
Reduced Left-Turn Conflict Intersections

Median U-Turn (MUT)

- Left-turns on major, minor, or both re-routed to downstream U-turns then right-turn
- Signal phasing/timing advantages can benefit all modes
Accommodating Truck Movements
RCUT Corridors
US 17 in Brunswick County, NC

View these Video Case Studies:
1. State Route 55 Bypass, Holly Springs NC
   https://www.youtube.com/watch?v=AxliLzv-GOA

2. U.S. Route 17 Corridor,
   Wilmington/Leland NC
   https://www.youtube.com/watch?v=LB5nTDSVEzs
Seven PSC for Intersections

Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections

Reduced Left-Turn Conflict Intersections

Roundabouts

Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections

Backplates with Retroreflective Borders

Yellow Change Interval

Corridor Access Management
New PSC – Roadway Departure

Roadside Design Improvements at Curves

• Several treatments that target the high-risk roadside environment along the outside of horizontal curves by providing for a safe recovery area or reducing the crash severity

• Can be implemented alone or in combinations
New PSC – Roadway Departure

Roadside Design Improvements at Curves
• Adding or widening shoulders at horizontal curves
New PSC – Roadway Departure

Roadside Design Improvements at Curves

- Increasing the clear zone at horizontal curves
  - Recommended by AASHTO Roadside Design Guide
  - Proven to reduce crashes

Horizontal Curve Adjustment Factor

<table>
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<tr>
<th>Radius (feet)</th>
<th>Design Speed (MPH)</th>
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<tbody>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>2,300</td>
<td>1.1</td>
</tr>
<tr>
<td>1,640</td>
<td>1.1</td>
</tr>
<tr>
<td>1,315</td>
<td>1.2</td>
</tr>
<tr>
<td>985</td>
<td>1.2</td>
</tr>
<tr>
<td>660</td>
<td>1.3</td>
</tr>
<tr>
<td>330</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Excerpted from AASHTO RDG Table 3-2
Roadside Design Improvements at Curves

**Flatten side slopes in curves**

Recent research suggests ESC is improving crash reductions in tangents, but not curves.
Roadside Design Improvements at Curves

Reconsider Barrier Installation Parameters

- Barrier on fill slopes is based on research for tangents.
- On curves, barrier may be appropriate even for slopes less than 3:1.

*Source: AASHTO RDG Figure 5-1(b). Comparative Barrier Consideration for Embankments (U.S. Customary Units) [15]*
Five PSC for Roadway Departure

- Roadside Design Improvements at Curves
- Longitudinal Rumble Strips and Stripes along Two-Lane Highways
- Median Barrier
- SafetyEdge\textsuperscript{SM}
- Enhanced Delineation and Friction for Horizontal Curves
New PSC – Pedestrians & Bicycles

Leading Pedestrian Interval (LPI)

• Pedestrians get “WALK” signal before vehicles get green light

• Provides pedestrians a 3-7 second head start before vehicles are given a green indication

• Allows pedestrians to establish presence in crosswalk before turning vehicles
Leading Pedestrian Interval (LPI)

At intersections with high turning-vehicle volumes and no turn on red (NTOR) control for traffic moving parallel to a marked crosswalk, a leading pedestrian interval (LPI), timed to allow slower walkers to cross at least one moving lane of traffic is recommended.

FHWA Handbook for Designing Roadways for the Aging Population

MUTCD Chapter 4E.06 Pedestrian Intervals and Signal Phases

At intersections with high pedestrian volumes and high conflicting turning vehicle volumes, a brief leading pedestrian interval, during which an advance WALKING PERSON (symbolizing WALK) indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic, may be used to reduce conflicts between pedestrians and turning vehicles.

Guidance:
If a leading pedestrian interval is used, the use of accessible pedestrian signals (see Sections 4E.09 through 4E.13) should be considered.

Support:
If a leading pedestrian interval is used without accessible features, pedestrians who are visually impaired can be expected to begin crossing at the onset of the vehicular movement when drivers are not expecting them to begin crossing.

Guidance:
If a leading pedestrian interval is used, it should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released.

If a leading pedestrian interval is used, consideration should be given to prohibiting turns across the crosswalk during the leading pedestrian interval.
Leading Pedestrian Interval

Benefits:

• 60% reduction in pedestrian-vehicle crashes at intersections

• Increased visibility of crossing pedestrians

• Reduced conflicts between pedestrians and vehicles

• Increased likelihood of motorists yielding
Five PSC for Pedestrians & Bicycles

- Leading Pedestrian Intervals
- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diets
- Walkways
PSC – Crosscutting Strategies

- Local Road Safety Plans
- USLIMITS2
- Road Safety Assessments
Why Local Road Safety Plans?

National data indicates 40-60% of fatalities occur on locally owned roadways.

Florida Data

- 46% Local VMT (2014)
- 54% State VMT (2014)
- 40% Local Fatalities
- 60% State Fatalities

Source: Florida Department of Transportation (2015).
What is a Local Road Safety Plan (LRSP)?

❖ A LRSP offers a framework for identifying, analyzing, and prioritizing safety improvements on local roads.

❖ The process and content can be tailored to local issues and needs.

❖ The process results in a prioritized “risk-based” list of actions and improvements that can reduce fatalities and serious injuries on the local road network.
Why would a local agency use a LRSP?

- Greater awareness of their particular road safety issues and risks (more focused than a State SHSP)
- Prioritize investments
- Support grant/funding applications
- Develop partnerships
- Achievable reductions in severe crashes
Local Road Safety Plans

Steps in the LRSP Development Process

• Step 1: Establish Leadership
• Step 2: Analyze the Safety Data
• Step 3: Determine Emphasis Areas
• Step 4: Identify Strategies
• Step 5: Prioritize and Incorporate Strategies
• Step 6: Evaluate and Update the LRSP
Local Road Safety Plans

Wednesday Morning
8:00 AM
USLIMITS2

- Web based expert system tool designed to help practitioners set reasonable, safe, and consistent speed limits for specific segments of roads.
- Applicable to all types of roads ranging from rural local roads and residential streets to urban freeways (but not applicable to school zones or construction zones).
- Of particular benefit to local communities and agencies without experience conducting studies for setting appropriate speed limits.

For experienced engineers, USLIMITS2 can provide an objective second opinion and increase confidence in speed limit setting decisions.
USLIMITS2

Benefits of USLIMITS2

• Easy to use web based tool for speed zoning
• Expert system with consideration of factors impacting speeds
• Consistent, credible, enforceable speed limits
• Increases transparency of the methods used to determine speed limits
• Supports motorists’ acceptance of and compliance with speed limits
• Helps in responding to public and political concerns
USLIMITS2

Benefits of USLIMITS2

“Since USLIMITS2 software became available in 2007, GDOT estimates it has used the tool to complement the State’s engineering speed studies on nearly 500 speed limits Statewide.”

“The USLIMITS2 tool takes out all the emotion and politics, and it provides us with something that we could show to others that is concrete and easy to understand.”
Implementation Progress Tracking

- Tracking the 6 **NEW** PSC using the *Every Day Counts* scale.

<table>
<thead>
<tr>
<th>State of Implementation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Implementing</td>
<td>The State is not currently using the innovation anywhere in the State and is not interested in pursuing the innovation.</td>
</tr>
<tr>
<td>Development Stage</td>
<td>The State is collecting guidance and best practices, building support with partners and stakeholders, and developing an implementation process.</td>
</tr>
<tr>
<td>Demonstration Stage</td>
<td>The State is testing and piloting the innovation.</td>
</tr>
<tr>
<td>Assessment Stage</td>
<td>The State is assessing the performance of and process for carrying out the innovation and making adjustments to prepare for full deployment.</td>
</tr>
<tr>
<td>Institutionalized</td>
<td>The State has adopted the innovation as a standard process or practice and uses it regularly on projects.</td>
</tr>
</tbody>
</table>
PSC – Available Resources

http://safety.fhwa.dot.gov/provencountermeasures

• Marketing flyers, recorded webinar sessions, contacts
• Links to additional FHWA resources for each item
Questions