Proven Safety Countermeasures
NACE conference
April 2018

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Office of Safety
Federal Highway Administration
Countermeasure Selection Process

2008 Countermeasures
1. Roadway Safety Audit 1.27**
2. Median Barriers
3. Walkways
4. Left and Right Turn Lanes at Stop-Controlled Intersections
5. Yellow Change Intervals
6. Rumble Strips and Rumble Stripes*
7. Roundabouts 1.23
8. Medians and Pedestrian Refuge Areas 1.17
9. Safety Edge 1.15

2012 Countermeasures
1. Roundabouts
2. Safety Edge
3. Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
4. Longitudinal Rumble Strips and Stripes on 2-lane Roads*
5. Corridor Access Management
6. Backplates and Retroreflective Borders
7. Enhanced Delineation and Friction for Horizontal Curves
8. Pedestrian Hybrid Beacon
9. “Road Diets”
The PSCI 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.
Reaffirming a Data-Driven Approach

“Our partners should continue to strengthen their evidence-based decision-making processes...and systemic planning approaches to make improved safety investment decisions.”

2017 PSCI Guidance Memo

FHWA will continue to support States and other safety partners’ efforts to:

• Conduct appropriate **analysis** of quality safety data.
• Use **evidence-based framework** for decision-making.
• Use the CMF Clearinghouse to choose **appropriate** countermeasures.
• **Consider** the proven safety countermeasures as viable options.
PSC\text{\textfty} – Intersections

- Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections
- Backplates with Retroreflective Borders
- Corridor Access Management
- Yellow Change Interval
- Roundabouts
- Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections
- Reduced Left-Turn Conflict Intersections
Left and Right turn lanes at Stop controlled intersections

• Provide physical separation between turning traffic and through traffic
• Provide Pedestrian and bicyclist safety
• provide measurable safety and operational benefits

Applications:
– At high speed free flowing major route traffic where crashes that do occur are often severe.
– where significant turning volumes exist, or where there is a history of turn-related crashes.

total crashes reduction:
• Left Turn Lanes 28-48%
• Right Turn Lanes 14-26%
Backplates with Retroreflective Borders

• Retroreflective strip added around the border of a signal backplate

• Documented 15% reduction in crashes of all types and severities at urban signalized intersections\(^1\)

• Consider as standard treatment for new and modernized signal projects, or as a systemic retrofit safety improvement

1. CMF Clearinghouse
Corridor Access Management

- Involves the design, implementation and control of entry and exit points along a roadway

- Reducing access points along urban/suburban corridor can reduce injury and fatal crashes by about 25%¹

- May be considered as a component of general corridor improvements or as its own project

¹ AASHTO Highway Safety Manual, Chapter 14

Use of roundabouts, raised median, and right-in/right-out driveways can be an effective access management plan.
Yellow Change intervals

• Reduce red-light running
• Factors that affect the yellow change interval:
  – speed of approaching vehicles,
  – driver perception-reaction time,
  – vehicle deceleration rates,
  – intersection width,
  – and roadway approach grades.
• Refer to the *MUTCD* for basic requirements
• Improper yellow interval timing can lead to unintentional red-light running

**Safety Benefits:**
36-50% Reduction in red light running
8-14% Reduction in total crashes
12% Reduction in injury crashes
Roundabouts

• Replaced two-way stop-controlled intersection and signalized intersection
• Modern designs are safer and more efficient than old circles and rotaries
• Reduce crashes resulting in injury or fatality by nearly 80%
• Should be considered as part of corridor or intersection improvement projects
• Highly adaptable, proven in both low-speed urban and high-speed rural environments

1 AASHTO Highway Safety Manual, Chapter 14
Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

• Mostly signing & pavement marking enhancements.
• Strategy relies on cost economy and treatment saturation.
• Best suited for intersections with under 20,000 AADT Total Entering.

Average Benefit/Cost Ratio 12:1
Systemic Approach for Stop Intersections
Systemic Approach for Stop Intersections

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.
• Range of 3-5 years before and after data.

<table>
<thead>
<tr>
<th>Recommended CMFs from FHWA-HRT-17-086</th>
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<td>Total</td>
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<td>CMF</td>
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Reduced Left-Turn Conflict Intersections w/ Median U-turn and Restricted Crossing U-turn

• Geometric designs that alter how left-turn movements occur.
• Simplify and reduce or modify conflicts related to turning.
• Proven safety and operational benefits.
## Reduced Left-Turn Conflict Intersections

**RCUT Safety Performance**
- 54% decrease F&I Crashes.
- 35% decrease All Crashes.

**MUT Safety Performance**
- 30% decrease F&I Crashes.
- 16% decrease All Crashes.

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

Sources: FHWA-SA-14-069, FHWA-SA-14-070
Reduced Left-Turn Conflict Intersections

Median U-Turn (MUT)

- Major route left-turns re-routed to downstream U-turns then right-turn.
- Minor route treatment optional.
- Signal phasing/timing advantages can benefit all modes.

### Typical Conventional Intersection Signal Cycle

- **Major Street**: Don’t Walk
- **Minor Street**: Walk/Flashing Don’t Walk

### MUT Intersection Signal Cycle

- **Major Street**: Don’t Walk
- **Minor Street**: Walk/Flashing Don’t Walk
Reduced Left-Turn Conflict Intersections

Restricted Crossing U-Turn (RCUT)

• Minor route TH and LT re-routed to downstream U-turns then right-turn.
• Major route treatment optional.
• Highly beneficial for divided high-speed highways with unsignalized at-grade intersections.
PSCi – Roadway Departure

Longitudinal Rumble Strips and Stripes along Two-Lane Highways

Median Barrier

SafetyEdgeSM

Enhanced Delineation and Friction for Horizontal Curves

Roadside Design Improvements at Curves

Roadway Departure Risk Management

1. Keep Vehicles on Roadway
2. Reduce Likelihood of Crashes
3. Minimize Severity
Longitudinal Rumble Strips and Stripes on 2-Lane Roads

• Alerts drivers with sound and vibration when vehicles cross the edge or center line.

• Reduction of Severe Crashes:
  – Rural Edge, Run Off Road: 36%
  – Rural Center, Head-ons: 44%
  – Urban Center, Head-ons: 64%
Median Barriers

• 3 types: Cable barriers, Concrete barriers and Beam guardrails
• Reduce the number and severity of cross-median crashes
• Head-on crashes composed of 8% of all fatalities on divided highways
• Safety Benefit – 97% reduction in cross-median crashes on rural 4-lane Freeways.
Safety Edge\textsuperscript{SM}

- Consolidating the pavement edge into $30^\circ$ shape during paving to provide stability for vehicles recovering from a roadway departure

- 6% reduction of total crashes

- B/C range: 4 to 63

- Implement as a standard practice for paving and resurfacing projects
Enhanced Delineation and Friction for Horizontal Curves

• Low-cost treatments

• Includes signs and markings that help drivers safely negotiate curves or...

• Additional pavement friction to address geometric deficiencies

Safety Impacts:
• Vary based on application
• Up to 43% reduction of all fatal crashes
Roadside Design
Improvements at Curves

• Increase clear zone at curves.
  – Recommended by AASHTO RDG.
  – Proven to reduce crashes.

• Improve traversability.
  – Adding or widening shoulders in curves.
  – flatter slopes at curves than in tangent sections.

• Reconsider when to install barrier
  – Reduce severity.
Roadside Design Improvements at Curves

Increase Clear Zone on the Outside of Curves

Horizontal Curve Adjustment Factor

<table>
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<tr>
<th>Radius (feet)</th>
<th>Design Speed (MPH)</th>
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Excerpted from AASHTO RDG Table 3-2
Roadside Design Improvements at Curves

• Improve Traversability
  ▪ Slope Flattening – increase driver’s ability to keep vehicle stable, regain control of vehicle, and avoid obstacles
  ▪ Adding or widening shoulders – provide more recovery areas for drivers to regain control during RwD event.
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 when fill slopes are not as steep.
- Flexible barrier is less severe than other types.
PSCi – Pedestrians & Bicycles

- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diet
- Walkways
- Leading Pedestrian Intervals

Pedestrian Safety Facts:
- Pedestrians represent over 12% of Highway Fatalities.
- Midblock locations account for over 70% of pedestrian fatalities.
- Over 80% of pedestrian fatalities hit by vehicles traveling at 40 mph or faster will die, while less than 10% die when hit at 20 mph or less.
Medians and Pedestrian Crossing Islands in Urban and Suburban Areas

- **Median** is between opposing lanes of traffic, excluding turn lanes (can be paint or concrete).

- Islands can be placed at intersections or midblock locations to separate crossing pedestrians from motor vehicles.

- Use in curbed sections of multi-lane roadways in urban areas with vehicular-pedestrian conflicts and med/high travel speeds.

Safety results:
- 46% reduction in pedestrian crashes
- 39% reduction in total crashes
Pedestrian Hybrid Beacon

- Pedestrian-activated beacon located on the roadside or on mast arms over major approaches to an intersection.
- Follow guidance in MUTCD Chapter 4F.

Safety results:
- 69% reduction in pedestrian crashes
- 29% reduction in total crashes
“Road Diet” (Roadway Reconfiguration)

- Conversion of four-lane undivided roadway into three lanes with two through-lanes and a center two way left turn.

- Best on Roadways with ADT of 20,000 or less.

Safety results:
- 29% reduction in all roadway crashes
Walkways

A defined pathway for pedestrians use - pedestrian walkways, shared use paths, sidewalks & shoulders

Improve safety and mobility of Pedestrians - reduced Pedestrian injuries (70,000/yr) and fatalities (5000/yr)

Reduction in crashes involving Pedestrian walking in roadways

• 65-89% with sidewalk provided
• 71% with paved shoulders provided
Leading Pedestrian Interval

• Pedestrians get “WALK” signal with a 3-7 s head start before vehicles get green light.
• Allows pedestrians to establish presence in crosswalk before vehicles have priority to turn left.

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.
PSCI – Crosscutting Strategies

- Road Safety Audits
- Local Road Safety Plans
- USLIMITS2
Road Safety Audits

• account for human factors and consider all road users’ capabilities,
• documented in a formal report, and require a formal response from the road owner.
• RSAs provide the following benefits:
  – Reduced number and severity of crashes.
  – Reduced costs: early identification and mitigation of safety issues before projects are built.
  – Improved awareness of safe design practices.
  – Increased opportunities to integrate multimodal safety strategies and PSCs.
  – Expanded ability to consider human factors in design.

SAFETY BENEFIT:
10-60% Reduction in total crashes
Local Road Safety Plans

• Developing an LRSP is an effective strategy to improve local road safety.
• Local roads experience 3X the fatality rate of the Interstate Highway System.
• provides a comprehensive framework for reducing fatalities and serious injuries on local roads.
• flexible and utilizes the 4 E’s as appropriate to establish and gain support for an agency’s local safety goals, objectives, and key emphasis areas.
Local Road Safety Plans

Benefits from developing an LRSP may include:

- Enhanced Safety Awareness among stakeholders.
- Establish partnerships representing the 4E’s – engineering, enforcement, education, and emergency medical services.
- Collaboration among municipal, county, Tribal, State and/or Federal entities.
- Identification of target crash types and countermeasures.
- Leverage Safety Funds.
- Informed Safety Priorities.
- Complements the State SHSP.
USLIMITS2

• Speed Limit Legal Framework: BASIC RULE; STATUTORY SPEEDS; SPEED ZONES (USLIMITS2)

• Why do we set speed limits?
  – Safety for all road users
  – Inform drivers of the maximum reasonable and safe operating speed under favorable conditions

• Why USLIMITS2?
  – Speed limits need to be enforceable and credible
  – Need a tool considering all factors impacting speed and safety of road users
  – Need for an Expert System to improve decision making process
  – FHWA supported, AASHTO funded (NCHRP project 3-67)
USLIMITS2

Benefits of USLIMITS2

• Easy to use web based tool for speed zoning;
• Decision rule expert system with consideration of factors impacting speeds;
• Consistent, credible, enforceable speed limits;
• Increases transparency in setting speed limits;
• Supports motorists’ acceptance of and compliance with speed limits; and
• Helps in responding to public and political concerns
Improving safety is a top priority for the U.S. Department of Transportation, and FHWA remains committed to redressing safety concerns along America’s highways. We are highly confident that certain processes, infrastructure design techniques, and high-visibility enhancements that reduce crashes and fatalities on roads are important safety recommendations.

In 2008, FHWA issued a "Guidance Memorandum on the Designation and Implementation of Proven Safety Countermeasures." Today, it is clear that certain countermeasures are needed to address specific crash patterns. Safety practitioners are encouraged to consider the recommendations as new best practices.

Click on each of the nine countermeasures below for more information and a downloadable fact sheet.

FHWA website: http://safety.fhwa.dot.gov/provencountermeasures
Questions and Answers
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