

FHWA's 2017 Update of the Proven Safety Countermeasures

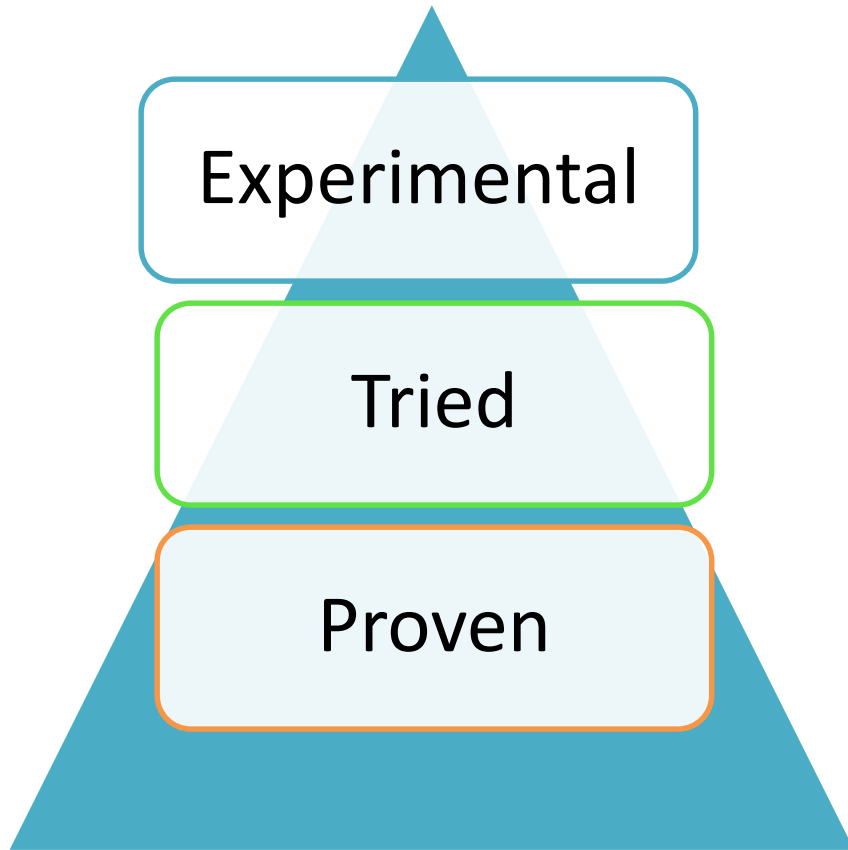
**Make Your Mark
A Local Safety Peer Exchange
March 26, 2019**



U.S. Department of Transportation
Federal Highway Administration

 **Safe Roads for a Safer Future**
Investment in roadway safety saves lives
<http://safety.fhwa.dot.gov>

Life Cycle of a Safety Countermeasure



FHWA's Proven Safety Countermeasures

Intersection

- Left- and Right-Turn Lanes at Two-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*

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*

Pedestrian

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

Crosscutting Strategies

- Road Safety Audits
- Local Road Safety Plans*
- US Limits*

PSCi – 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 Two-Way Stop-Controlled Intersections



Example of left-turn lanes.



Example of a right-turn lane.

SAFETY BENEFITS:

LEFT-TURN LANES

28-48%

Reduction in total
crashes

RIGHT-TURN LANES

14-26%

Reduction in total
crashes

Source: Highway Safety Manual

Backplates with Retroreflective Borders



Safety Benefit:

15%
Reductions in total crashes

Source: CMF Clearinghouse, CMF ID 1410.



Example of a signal backplate framed with a retroreflective border.

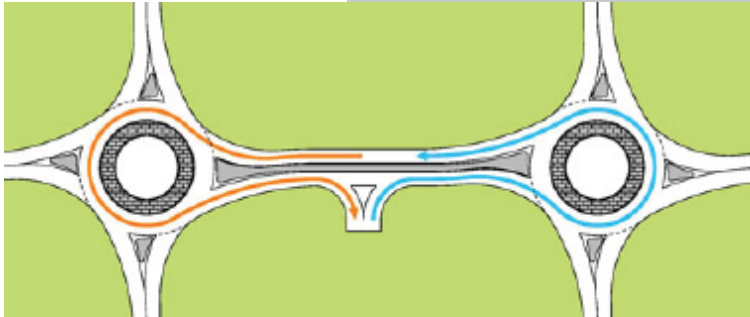
Corridor Access Management



This intersection design restricts left-turn movements to improve safety.



A raised median reduces conflict points along this roadway.



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

SAFETY BENEFITS:

5-23%

Reduction in total crashes along 2-lane rural roads

25-31%

Reduction in injury and fatal crashes along urban/suburban arterials

Source: Highway Safety Manual

Yellow Change Interval



Safety Benefits of Well-Timed Yellow Change Intervals:

36-50%

Reduction in red light running

8-14%

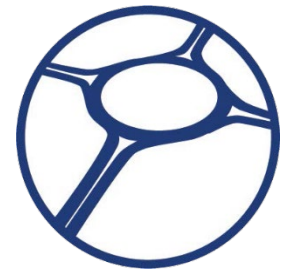
Reduction in total crashes

12%

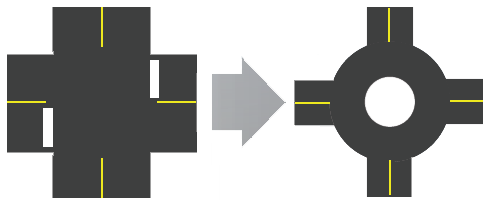
Reduction in injury crashes

Source: NCHRP Report 731, *Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections*.

Roundabouts



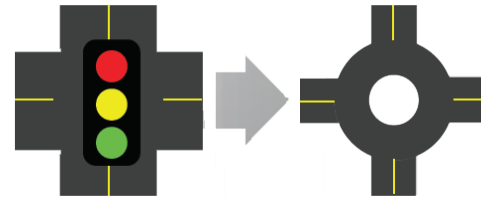
Two-Way Stop-Controlled Intersection to a Roundabout



82%

Reduction in severe crashes

Signalized Intersection to a Roundabout



78%

Reduction in severe crashes

Source: *Highway Safety Manual*

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

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.

Recommended CMFs from FHWA-HRT-17-086					
	Total	Fatal & Injury	Rear End	Right Angle	Nighttime
CMF	0.917	0.899	0.933	0.941	0.853

Systemic Approach for Stop Intersections

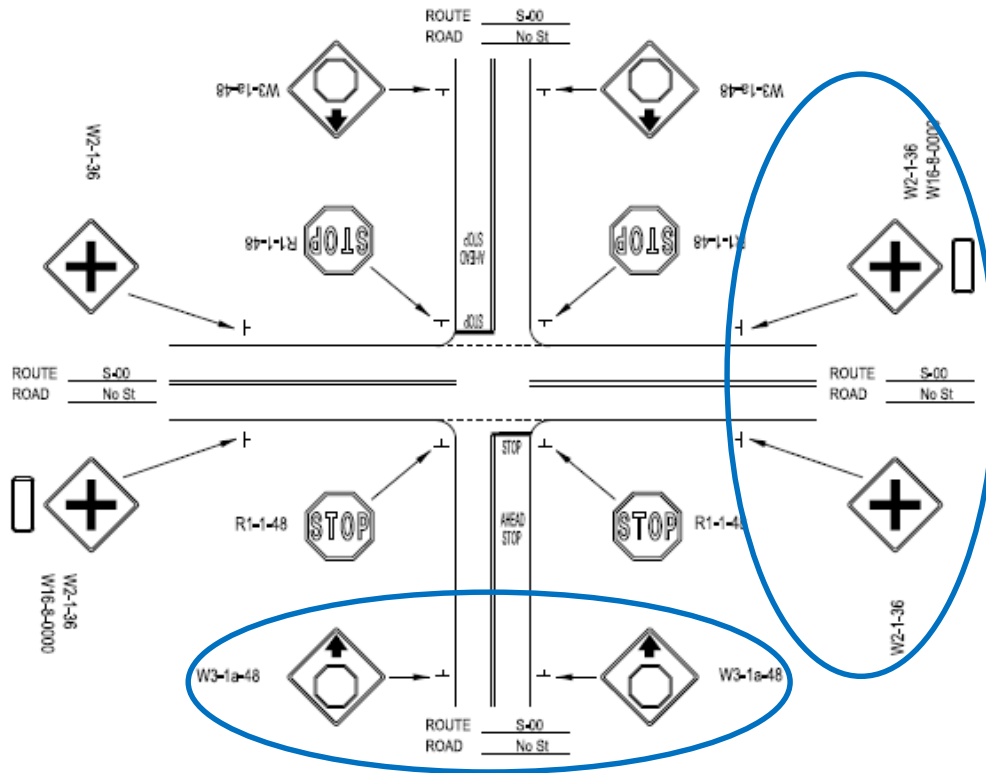
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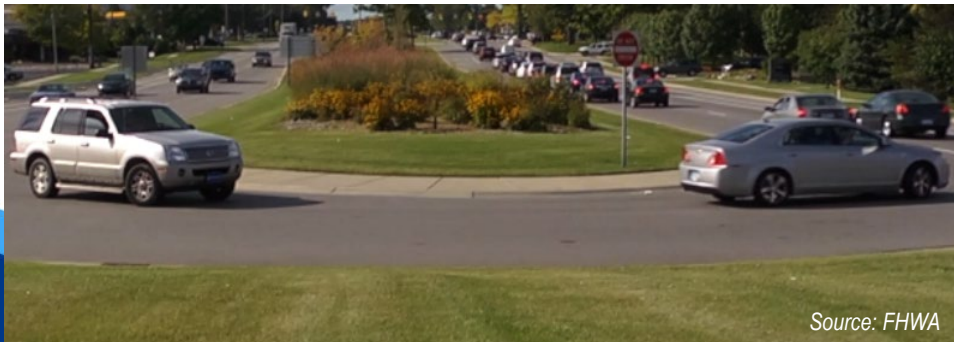
Systemic Approach for Stop Intersections



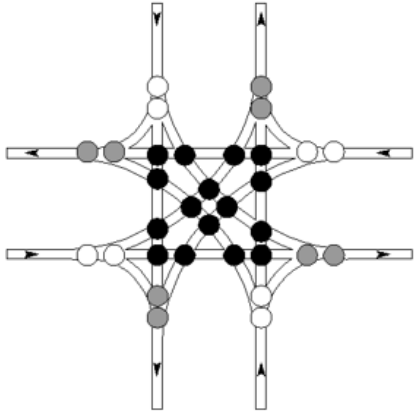
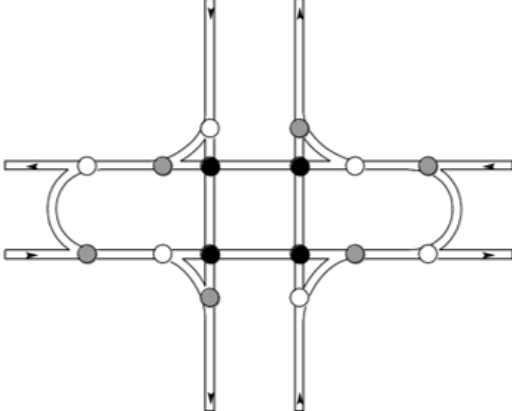
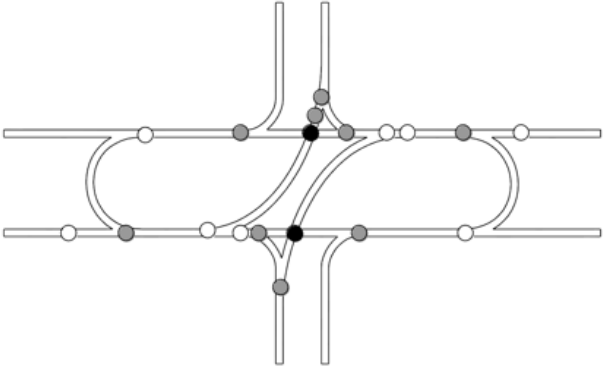
Reduced Left-Turn Conflict Intersections (MUT and RCUT)



- Geometric designs that alter how left-turn movements occur.
- Simplify and reduce or modify conflicts related to turning.
- Proven safety and operational benefits.

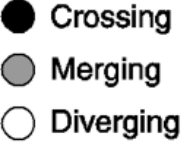
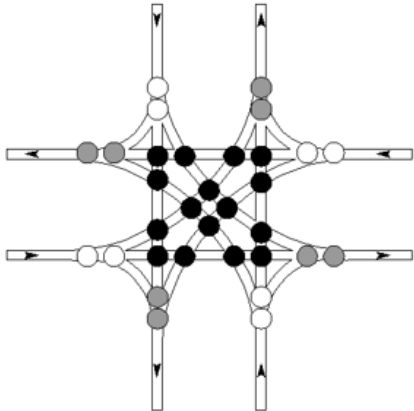
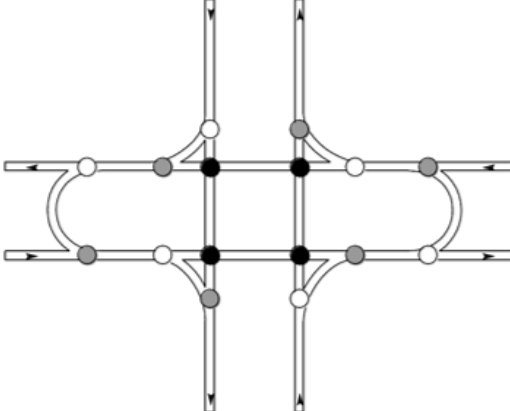
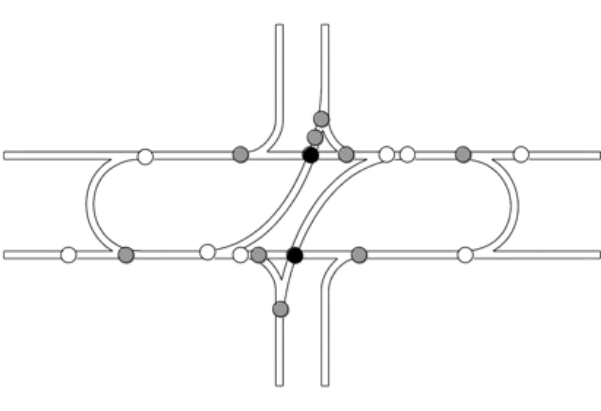


Reduced Left-Turn Conflict Intersections

Vehicle-Vehicle Conflict Points	<u>Conventional</u>	<u>MUT</u>	<u>RCUT</u>
<div> <div>● Crossing</div> <div>● Merging</div> <div>○ Diverging</div> </div>			
Crossing	16	4	2
Merging	8	6	6
Diverging	8	6	6
Total	32	16	14

Sources: FHWA-SA-14-069, FHWA-SA-14-070

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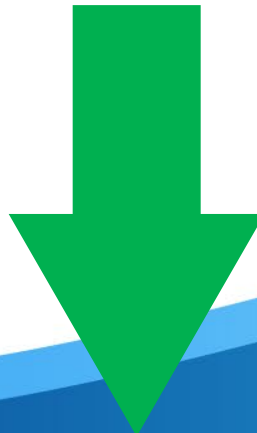
Sources: FHWA-SA-14-069, FHWA-SA-14-070

MUT Safety Performance

- 30% decrease F&I Crashes.
- 16% decrease All Crashes.

RCUT Safety Performance

- 54% decrease F&I Crashes.
- 35% decrease All Crashes.



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

Longitudinal Rumble Strips and Stripes



Shoulder rumble strips and center line rumble strips are installed on this roadway.



Example of an edge line rumble stripe.

SAFETY BENEFITS:

Center Line Rumble Strips 44-64%

Head-on, opposite-direction,
and sideswipe fatal and
injury crashes

Shoulder Rumble Strips 13-51%

Single vehicle, run-off-road
fatal and injury crashes

Source: NCHRP Report 641, *Guidance for the
Design and Application of Shoulder and Centerline
Rumble Strips*

Median Barrier



Median cable barrier prevents a potential head-on crash.

SAFETY BENEFITS:
Median Barriers Installed on
Rural Four-Lane Freeways

97%

Reduction in cross-median crashes

Source: NCHRP Report 794, *Median Cross-Section Design for Rural Divided Highways*

SafetyEdge_{SM}



Example of SafetyEdge_{SM} after backfill material settles or erodes.

SAFETY BENEFIT:

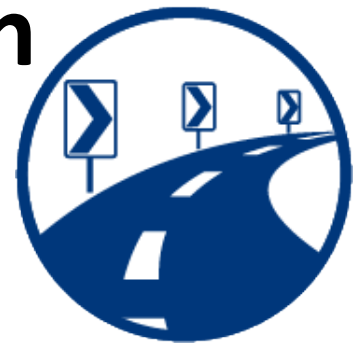
11%
Reduction in fatal and injury
crashes

Source: Safety Effects of the SafetyEdge_{SM}, FHWA-SA-17-044

SafetyEdgeSM CMFs

Drop-Off	0.655
ROR	0.790
Head-on	0.813
F+I	0.892
Total	0.989

Enhanced Delineation and Friction for Curves



Chevron signs installed along a curve.

SAFETY BENEFITS:

Chevron Signs

25%

Reduction in nighttime crashes

16%

Reduction in non-intersection
fatal and injury crashes

Source: CMF Clearinghouse, CMF IDs 2438 and 2439

SAFETY BENEFITS:

High Friction Surface Treatment

52%

Reduction in wet road crashes

24%

Reduction in curve crashes

Source: CMF Clearinghouse, CMF IDs 7900 and 7901



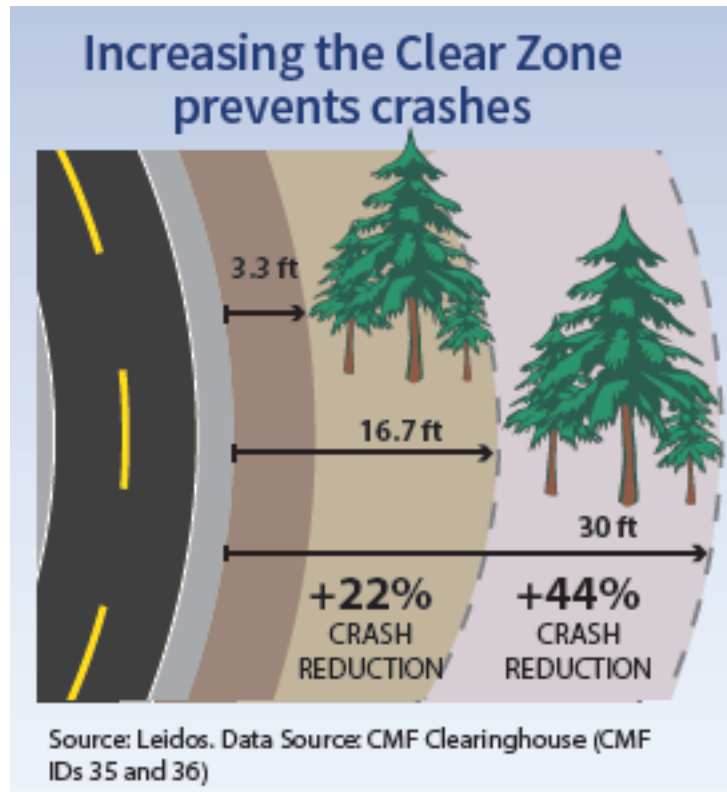
Roadside Design Improvements at Curves



- 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



27%
of all fatal crashes occur at
curves
80%
of all fatal crashes at
curves are roadway
departure crashes

PSCi – Pedestrians & Bicycles



Medians and Pedestrian Crossing
Islands in Urban and Suburban Areas



Pedestrian Hybrid Beacon



Road Diet



Walkways



Leading Pedestrian Intervals

Medians and Pedestrian Crossing Islands



Median and pedestrian crossing islands near a roundabout.



Example of a road with a median and pedestrian crossing islands.



Example of a pedestrian crossing island.

SAFETY BENEFITS:

Raised Median

46%

Reduction in pedestrian crashes

Pedestrian Crossing Island

56%

Reduction in pedestrian crashes

Source: Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11

Pedestrian Hybrid Beacons



Pedestrians cross the roadway at a PHB location.



Example of PHBs mounted on a mast arm.

Safety Benefits:

69%
Reduction in pedestrian crashes

29%
Reduction in total crashes

15%
Reduction in serious injury and
fatal crashes

Source: CMF Clearinghouse, CMF IDs: 2911, 2917, 2922

Road Diets



Road Diet project in Honolulu, Hawaii.

SAFETY BENEFIT:

**4-Lane → 3-Lane
Road Diet Conversions
19-47%
Reduction in total crashes**

Source: *Evaluation of Lane Reduction "Road Diet" Measures on Crashes*,
FHWA-HRT-10-053.

Walkways



Example of a shared use path.



Example of a sidewalk in a residential area.



Paved shoulder used as a walkway.

SAFETY BENEFITS:

Sidewalks 65-89%

Reduction in crashes involving pedestrians walking along roadways

Paved Shoulders 71%

Reduction in crashes involving pedestrians walking along roadways

Source: *Desktop Reference for Crash Reduction Factors*, FHWA-SA-08-011, Table 11

Leading Pedestrian Interval



- 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 vehicles have priority to turn left.

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.



PSCi – Crosscutting Strategies



Road Safety Audits



Local Road Safety Plans



USLIMITS2

Road Safety Audits



A road safety audit is a proactive formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team.



Multi-disciplinary team performs field review during an RSA

SAFETY BENEFIT:

10-60%

Reduction in total crashes

Source: Road Safety Audits: An Evaluation of RSA Programs and Projects, FHWA-SA-12-037; and FHWA Road Safety Audit Guidelines, FHWA-SA-06-06.

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.



USLIMITS2



- Free Web-based Tool
- Designed to help practitioners assess and establish safe, reasonable and consistent speed limits
- Supports customary engineering studies
- Produces unbiased and objective suggested speed limit value based on:
 - 50th and 85th percentile speeds
 - Traffic volumes
 - Roadway characteristics
 - Crash data

PSCi – Available Resources

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

- 1-pager marketing flyers.
- Slides from webinar and link to recorded session.
- Links to additional FHWA resources for each item.

PROVEN SAFETY COUNTERMEASURES

Corridor Access Management

Access management refers to the design, architecture, and control of entry and exit points along a roadway. This includes intersection design, signage, and other measures that manage the flow of traffic and provide a safe and efficient travel environment. The goal is to reduce the number and severity of crashes by controlling access to the roadway and providing a safe and efficient travel environment.

SAFETY BENEFITS:

- 5-23% Reduction in total crashes along a base rural road
- 25-31% Reduction in injury and total crashes along urban suburban arterials

ROADSIDE DESIGN IMPROVEMENTS AT CURVES

Increasing the Clear Zone prevents crashes

SAFETY BENEFITS:

- 27% of all fatal crashes at curves occur at curves
- 80% of all fatal crashes at curves occur at curves

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://safety.fhwa.dot.gov/provencountermeasures>

PROVEN SAFETY COUNTERMEASURES

Local Road Safety Plans

Local road safety plans (LRSPs) provide a framework for the strategic planning and prioritization of safety improvements on local roads. The LRSP development process involves a series of steps: 1. Identify the problem, 2. Set priorities, 3. Develop strategies, 4. Implement strategies, and 5. Evaluate and update. The LRSP is a living document that is updated as needed.

THE LRSP DEVELOPMENT PROCESS

1. Identify the problem
2. Set priorities
3. Develop strategies
4. Implement strategies
5. Evaluate and update

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SAFETY BENEFITS:

- 3x the fatality rate of the Interstate Highway System

Medians and Pedestrian Crossing Islands in Urban and Suburban Areas

Medians and pedestrian crossing islands in urban and suburban areas can reduce the number and severity of crashes by providing a safe and efficient travel environment. They can also provide a safe and efficient travel environment for pedestrians and cyclists.

SAFETY BENEFITS:

- 46% Reduction in pedestrian crashes
- 56% Reduction in pedestrian crashes

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://safety.fhwa.dot.gov/provencountermeasures>

PROVEN SAFETY COUNTERMEASURES

SafetyEdge

SafetyEdge is a technology that provides a safe and efficient travel environment for pedestrians and cyclists. It is a technology that provides a safe and efficient travel environment for pedestrians and cyclists.

SAFETY BENEFITS:

- 11% Reduction in total and injury crashes

USLIMITS2

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SAFETY BENEFITS:

- 27% Reduction in total and injury crashes

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Contacts for Further Information

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USLIMITS2 – Guan Xu guan.xu@dot.gov (202) 366-5892

Additional Resources

- Crash Modification Factors Clearinghouse
 - <http://www.cmfclearinghouse.org>
- Systemic Safety Project Selection Tool
 - <http://safety.fhwa.dot.gov/systemic>
- US Roadway Assessment Program
 - <http://www.usrap.org/>
- Pedestrian and Bicycle Crash Analysis Tool
 - http://www.pedbikeinfo.org/pbcat_us/

Time to Share!!!

- Which of these countermeasures have you tried in your jurisdiction?
 - Successes?
 - Challenges?
- Have adopted any of these countermeasures into agency policies or design standards?
- What other proven safety countermeasures have you tried in your jurisdiction?