# ATLANTA SAFER STREETS EDUCATION GUIDE

October 25, 2023

# INTRODUCTION

## WHAT IS VISION ZERO?

Vision Zero is a goal of no deaths or serious injuries on roadways. Vision Zero is the goal and the Safe System Approach is how we go about prioritizing safety in decision-making processes. The Safe System Approach is different from conventional ways of addressing traffic safety because it recognizes that while people make mistakes when using our streets, death and serious injury are not acceptable outcomes. Responsibility for a safe street system should be shared, proactive, and redundant to prevent people from being killed or seriously injured on roadways. Under Vision Zero, City leadership, policymakers, traffic engineers, designers, planners, local enforcement, and road users are all responsible for preventing roadway deaths and serious injuries.

The Safe System Approach is a holistic road safety strategy that recognizes humans make mistakes and aims to create a forgiving road system that reduces risk and eliminates fatal and serious injury crashes. The Safe System Approach is based on six foundational principles: deaths and serious injuries are unacceptable, humans make mistakes, humans are vulnerable, responsibility is shared, safety is proactive, and redundancy is crucial. Additionally, the Safe System Approach involves five key elements to achieve zero fatal and serious injury crashes: safe roads, safe speeds, safe vehicles, safe road users, and post-crash care.

The Federal Highway Administration (FHWA) has adopted the Safe System Approach to eliminate fatal and serious injuries for all road users. Similarly, the Institute of Transportation Engineers (ITE) promotes the advancement of the Safe System Approach to road system owners and operators to design, build, and operate safer roads. The framework for the Safe System Approach, its principles and key elements are summarized in Figure 1.

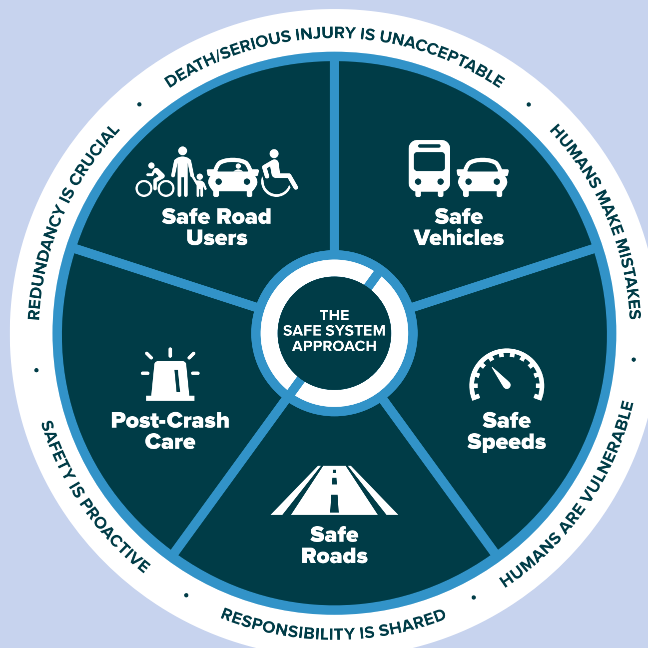



**Figure 1: The Safe System Approach. Source: FHWA**

## ATLANTA'S COMMITMENT TO VISION ZERO

In April 2020, the City of Atlanta made a commitment to Vision Zero to eliminate roadway deaths and serious injuries. The Atlanta Vision Zero Action Plan (the Action Plan) lays out steps that the City, working with the community and agency partners, will take to make its streets safer for all users and eliminate roadway deaths and serious injuries. The Atlanta Safer Streets Education Guide (the Education Guide) will support the Action Plan and the City's efforts to create safer streets. The Education Guide provides a menu of techniques that draw from proven safety countermeasures and national guidelines for the City to incorporate into the scoping, planning, design, and implementation of all roadway projects.

# PURPOSE OF THE EDUCATION GUIDE

The Education Guide presents safety countermeasures known to reduce crashes involving people walking, bicycling, rolling, or driving. The objectives of the Education Guide are to:

1. Inform stakeholders and the greater Atlanta community about road safety countermeasures and their appropriate uses and contexts.
2. Facilitate a shared understanding of these safety countermeasures among City staff, contractors, developers, and community members when discussing transportation safety improvements.
3. Assist in the decision-making process to identify the most appropriate safety countermeasures for a location based on the location's crash history and context.

The safety countermeasures presented in the Education Guide were selected based on stakeholder and community feedback gathered during the Vision Zero Action Plan development, as well as an understanding of the leading crash types and risk factors for fatal and serious injury crashes in Atlanta. Crash data from 2017 to 2021 was analyzed to identify a High-Injury Network (HIN) where there is a greater risk for fatal and serious injury crashes and identify leading crash types, and crash risk factors.  The leading crash types that lead to a fatality or serious injury on Atlanta's streets were[1]:

- Angle (other)
- Left angle
- Head-on
- Rear-end
- Motorist/pedestrian
- Sideswipe
- Right angle
- Motorist/bicyclist

A total of 51 safety countermeasures are presented in the Education Guide. Several of the safety countermeasures are from the FHWA Proven Safety Countermeasures initiative (PSCi) which documents specific design or operational changes to roads that have been shown to improve safety.[2] The remaining safety countermeasures are known to improve roadway conditions for the types of crashes or crash risk factors that Atlanta has experienced.

[1] Crash types are listed in descending order by the percent of the crash type that led to a fatality or serious injury.
[2] FHWA Proven Safety Countermeasures. https://highways.dot.gov/safety/proven-safety-countermeasures

# HOW TO READ THE EDUCATION GUIDE

The Education Guide presents a collection of roadway design safety countermeasures and outlines how each of them addresses safety and the expected reduction in crashes. The Education Guide also describes the applicable locations for each safety countermeasure and the relative estimated cost for implementation. The elements presented for each safety countermeasure are summarized below.

## Categories

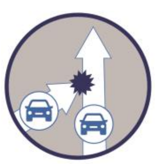
The safety countermeasures are categorized into the five categories below based on FHWA Proven Safety Countermeasures:

- **Pedestrian/Bicyclist**
- **Intersections**
- **Speed Management**
- **Roadway Departure**
- **Other Road Designs (Crosscutting)**

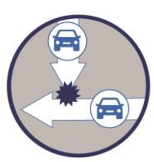
Within each category, the safety countermeasures are listed alphabetically, and each safety countermeasure is depicted in an illustration. Note the graphics are illustrative only and are not meant to depict fully engineered solutions specific for any location in the City of Atlanta.

## Crash Type

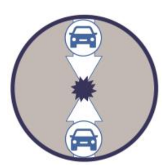
The safety countermeasures in the Education Guide were selected based on the leading types of crashes that lead to a fatality or serious injury on Atlanta's streets. The crash type(s) that the safety countermeasure is known to address is indicated for each countermeasure.



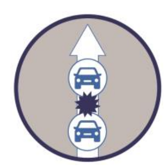
**Angle (Other)**



**Left angle**



**Head-on**



**Rear-end**

**Motorist/pedestrian**

**Sideswipe**

**Right angle**

**Motorist/bicyclist**

## Modes

The transportation mode that the safety countermeasure applies to is indicated throughout the Education Guide. The modes are categorized as follows:

| | |
|---|---|
| | **Bicyclist** |
| | **Pedestrian** |
| | **Motorist** |
| | **Motorcyclist** |

## Safe System Framework

The safety countermeasures presented in the Education Guide were selected through the Safe System Approach framework. The Education Guide lists the related Safe System Approach framework for each safety countermeasure as follows:

- **Separate Users in Space**
- **Separate Users in Time**
- **Increase Visibility**
- **Increase Attentiveness**
- **Reduce Speeds**
- **Reduce Impact Force**

## Revelant Roadway Type & Application

Roadways throughout the City of Atlanta have different characteristics based on the number of lanes, daily vehicles, travel speeds, and other factors. Therefore, different safety countermeasures may be appropriate on different roadways. In addition, some countermeasures are generally applied along segments, while others improve safety at intersections or address speeding motorists. The Education Guide indicates the type of location most appropriate to apply each safety countermeasures. Most safety countermeasures can be applied to several different types of locations. Based on the Safe System principle that *redundancy is critical*, it is important to consider implementing multiple safety countermeasures at one location.[3]

Locations for applying the safety countermeasures are categorized in the Education Guide based on the roadway classification of the corridor as follows:

- **Arterials (principal and minor arterials)**
- **Collectors**
- **Local streets**

Note, the land use context of the roadway is also a consideration for identifying the appropriate location for a safety countermeasure. The Atlanta Multimodal Street Guide categorizes Character Areas based on land use context and is an additional resource to understand appropriate street design by location.[4]

The relevant location(s) in the roadway corridor for the safety countermeasure to be applied are indicated as follows:

- **Signalized intersection**
- **Unsignalized intersection**
- **Midblock crossing**
- **Segment along corridor**

When planning and designing changes to the road network, the City of Atlanta will select the appropriate safety countermeasure for specific location and application only after an evaluation of the appropriateness of the countermeasure for the location's context.

There are some safety countermeasures that are recommended as proactive systemic safety countermeasures. These safety countermeasures can be installed on the HIN or proactively citywide wherever similar crash risk factors from the HIN exist that could lead to crashes. These safety countermeasures are indicated with a "systemic" label:

**Systemic**

See *Proactive Systemic Safety Countermeasures* section below for more information.

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[3] U.S. DOT. 2023 Safe System Approach. https://www.transportation.gov/NRSS/SafeSystem
[4] Streets Atlanta: A Design Manual for Multimodal Streets, City of Atlanta. 2018. https://atldot.atlantaga.gov/design-resources

## Cost & Effectiveness

Cost ranges are listed for each safety countermeasure to indicate estimates for planning, engineering, and installation of the safety countermeasure at a single typical location. If the safety countermeasure is linear, the cost assumes cost per mile. The assumptions on cost for each safety countermeasure are general and are not specific to a single location or area.

The cost categories and symbols used in the Education Guide are as follows:

| | |
|---|---|
| $ | **Low** – typically $5,000 or less |
| $$ | **Medium** – typically $5,000 to $100,000 |
| $$$ | **Moderate** – typically $100,000 to $300,000 |
| $$$$ | **High** – typically $300,000 or more |

The level of effectiveness is presented as a crash reduction factor, which is the estimated percent reduction in crashes. This percent is usually presented in a range based on findings from different research or different crash types and contexts. Most of the information on crash reduction is from the FHWA Crash Modification Factors Clearinghouse.[5]

Although researchers have estimated the reduction in crashes that can be achieved by implementing many safety countermeasures, crash reduction estimates do not exist for all countermeasures. When research has shown a reduction in crashes for a given safety countermeasure, it is noted in the Education Guide. The FHWA cautions that 1) crash reduction estimates should be regarded as general effectiveness and are not specific to any road or community, and 2) engineers must exercise judgment and consider site-specific factors when considering which safety countermeasures to apply.[6]

As the City of Atlanta plans and designs roadway projects, the effectiveness of these safety countermeasures will help in the decision-making process to identify which ones are best for different locations. The City can consult national research about the safety countermeasure's effectiveness to understand how the countermeasure may perform in the specific context of the location and the city's transportation network.

If a reduction has not yet been estimated for a safety countermeasure, it is noted in the Education Guide. Other research or qualitative findings were used in selecting the safety countermeasure, and the City should evaluate the effectiveness of these safety countermeasures in Atlanta. As the City deploys all of the safety countermeasures presented in the Education Guide, before and after data and analyses will help inform how well the countermeasures are working in Atlanta and allow the City to understand the effectiveness of these countermeasures in Atlanta's context. The City should develop an Atlanta-specific database of the effectiveness of each safety countermeasure.

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[5] US DOT. 2023. Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org/
[6] US DOT. 2008. Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes. https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa18041/

Safety countermeasures from the FHWA PSCi are included in the Education Guide to demonstrate safety countermeasures that are backed by national best practices and research demonstrating their effectiveness. These safety countermeasures are highlighted in the Education Guide with a "PSCi" label:

**PSCi**

## Resources

Additional information can be found for each safety countermeasure by visiting the resources provided in the Education Guide. These resources include both local/regional resources from organizations such as the Atlanta Regional Commission (ARC), and national resources and guidelines such as the FHWA, and National Association of City Transportation Officials (NACTO). In addition to these resources statewide resources should be consulted, including from the Georgia Department of Transportation (GDOT), such as the GDOT Design Policy Manual.[7] The specific resources for each safety countermeasure is listed on the individual pages below.

This Education Guide was developed based on information, goals, and strategies in existing City resources, plans, or guidelines, such as Streets Atlanta, and City Design.[8] [9] The Education Guide is not meant to replace these guidelines but be a dedicated resource that outlines specific ways the City can implement design changes to Atlanta's roads to improve safety.

[7] GDOT Design Policy Manual. https://www.dot.ga.gov/PartnerSmart/DesignManuals/DesignPolicy/GDOT-DPM.pdf
[8]Streets Atlanta: A Design Manual for Multimodal Streets. 2018. https://atldot.atlantaga.gov/design-resources
[9] The Atlanta City Design: Aspiring to the Beloved Community. 2017. https://www.atlcitydesign.com/

# LIST OF SAFETY COUNTERMEASURES

# PEDESTRIAN/BICYCLIST

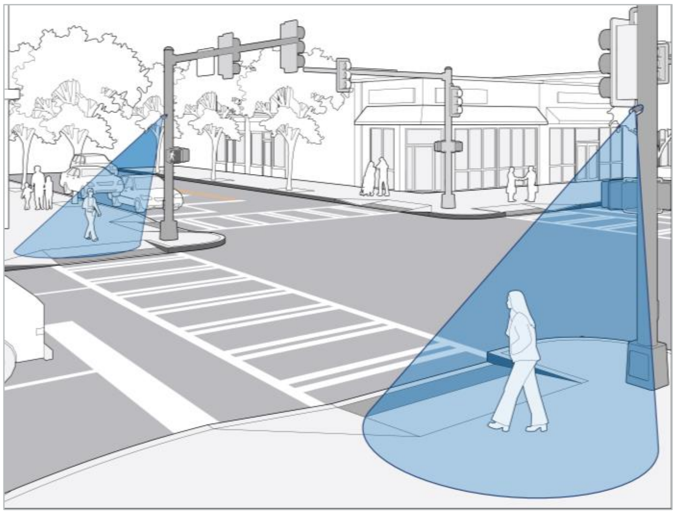
The Pedestrian/Bicyclist category presents design safety countermeasures known to create safer spaces for people walking, bicycling, rolling, or taking transit by separating them from drivers, or improving visibility and attentiveness of all road users.

The safety countermeasures in this category are:

- Automatic Pedestrian Recalls/Automatic Pedestrian Detectors
- Bicycle Boxes
- Buffered Bicycle Lanes
- Conventional Bicycle Lanes
- Curb Extensions and Bulb Outs
- Daylighting/Parking Restrictions at Crossings
- Exclusive Pedestrian Signal Phases
- Gateway Treatments
- Green Pavement Markings
- High Visibility Crosswalks
- Leading Pedestrian Intervals (LPIs)
- Neighborhood Greenways
- Pedestrian Hybrid Beacons (PHBs)
- Protected Intersections
- Raised Refuge Islands
- Rectangular Rapid Flashing Beacons (RRFBs)
- Road Diets
- Separated Bicycle Facilities
- Sidewalks
- Slip Lane Closures
- Two-Stage Turn Bicycle Boxes

# AUTOMATIC PEDESTRIAN RECALLS/DETECTORS

Automatic pedestrian recall systems provide a pedestrian interval during each traffic cycle and eliminate the need for people to push a pedestrian button. Automatic pedestrian detector devices detect people waiting to cross and automatically trigger a WALK signal. They reduce pedestrian crossing delay which can reduce unsafe crossing behavior.



## Safe System Framework

- Separate users in time
- Increase visibility
- Increase attentiveness

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- All locations with signalized intersections.

## Considerations

- Provide longer walk intervals and shorter cycle lengths (less than 90 seconds).
- Consider initially implemented during non-peak hours for drivers
- Consider concurrent signal phasing which give pedestrians more frequent crossing opportunities and less delay compared to exclusive signal phasing.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

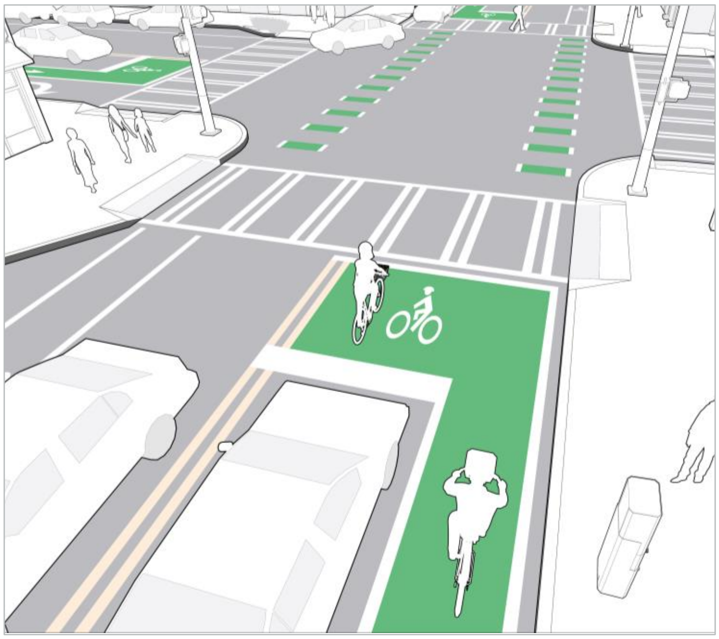
50% *(Elvik, R. and Vaa, T., 2004)*

## Additional Resources

- FHWA Traffic Signal Timing Manual
- GDOT Pedestrian and Streetscape Guide
- Manual on Uniform Traffic Control Devices (MUTCD)
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

# BICYCLE BOXES

Bicycle boxes are green-colored areas located at the head of a traffic lane at an intersection between the stop bar and the crosswalk, providing a designated space for bicyclists to prepare for and make a two-stage turn without needing to "take a lane" to make a left turn. They increase visibility of people on bicycles and can help prevent motorists from encroaching into crosswalks.



## Safe System Framework

- Increasing visibility
- Increasing attentiveness

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersections.
- All collectors and arterials.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Considerations

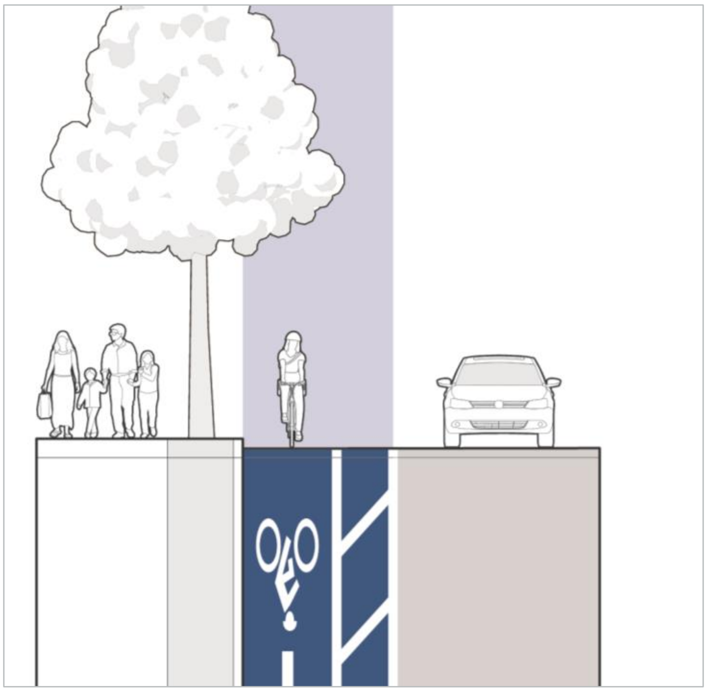
- Consider bicycle boxes use with an authorized request for interim approval per FHWA Interim Approval IA-18.
- Use with "no right turn on red" restrictions to ensure no vehicle movements conflict with the location of the bike box, as required per MUTCD.
- Use green-colored pavement as a background color for bicycle boxes to increase visibility and highlight potential conflicts. However, it can increase maintenance costs.

## Additional Resources

- NACTO Urban Bikeway Design Guide
- Evaluation of Bicycle-Related Roadway Measures: A Summary of Available Research

# BUFFERED BICYCLE LANES

Buffered bicycle lanes are bicycle lanes that include a buffered space that separates people bicycling from vehicular traffic or parking. The buffer consists of hashed or parallel pavement markings between the bicycle and general travel lanes, typically providing an additional 1 to 3 feet of space between the bicycle lane and the general-purpose travel lane. They allow for wider passing distances between bicyclists and motorists.



## Safe System Framework

- Separate users in space

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Along higher speed and higher volume corridors
- Collectors, and minor arterials with posted speed limits below 35 mph.

## Considerations

- Consider buffer between parked cars and the bicycle lane to decrease door zone conflicts.
- Consider transit stop locations to ensure that bicycle and transit user interactions are manageable.

## Cost & Effectiveness

**Cost per Mile**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

50%

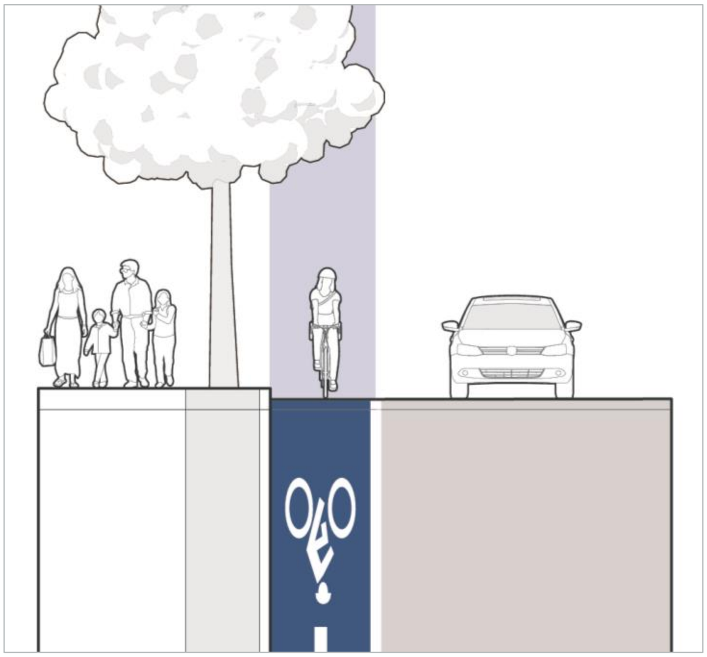
*(Burbidge and Shea, 2018)*

## Additional Resources

- FHWA Bikeway Selection Guide
- NACTO Urban Bikeway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities

# CONVENTIONAL BICYCLE LANES

Conventional bicycle lanes are designated sections of the road with signage, striping, and bicycle symbols, typically positioned along the curb. They channel bicyclists' movements and remind motorists of the presence of bicyclists. Because little separation is provided between drivers and people in the bicycle lane, conventional bicycle lanes are not typically recommended for streets with high automobile volumes. They can also reduce motorist speeding when implemented with a reduction in the number or width of vehicle travel lanes



## Safe System Framework

- Separate users in space

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Along low-volume corridors.
- Local and collector streets with posted speed limits below 35 mph.

## Considerations

- Consider deploying bicycle lanes as part of street maintenance/repaving projects.

## Cost & Effectiveness

**Cost per Mile**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

5% to 53%

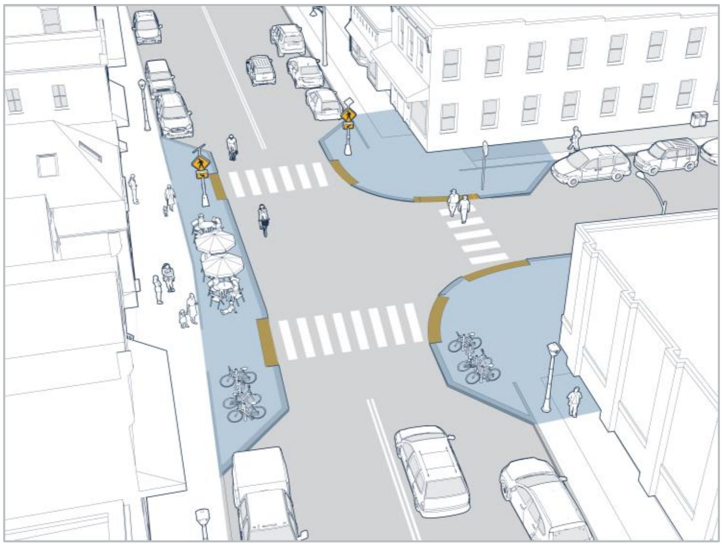
*(Fehr & Peers, et. al., 2018; Abdek-Aty et. al., 2014)*

## Additional Resources

- FHWA Bikeway Selection Guide
- NACTO Urban Bikeway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities
- BIKESAFE Bicycle Safety Guide and Countermeasure Selection System

# CURB EXTENSIONS & BULBOUTS

Extensions to a section of sidewalk into the roadway at intersections and other crossing locations. They shorten the crossing distance for people walking, reduce turning speeds, and improve sight distance between drivers and people crossing. Curb extensions/bulb outs can be installed as permanent curb reconfigurations, or through paint and post bulb outs.



## Safe System Framework

- Separate users in space
- Increase visibility
- Increase attentiveness

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized intersections and unsignalized intersections.
- All locals, collectors, and arterials.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Considerations

- Consider installation in parking lanes or wide shoulders.
- Use lower cost alternatives, such as bollards, temporary curbs, planters, or paint and striping.
- Limit planting and street furniture height within curb extensions to preserve sight lines.
- Consider expanding curb extensions at bus stops to produce bus bulbs.
- Consider curb extension installation on the one side of roadway even when conditions make installation infeasible or inappropriate on the other side (e.g.., no parking lane).

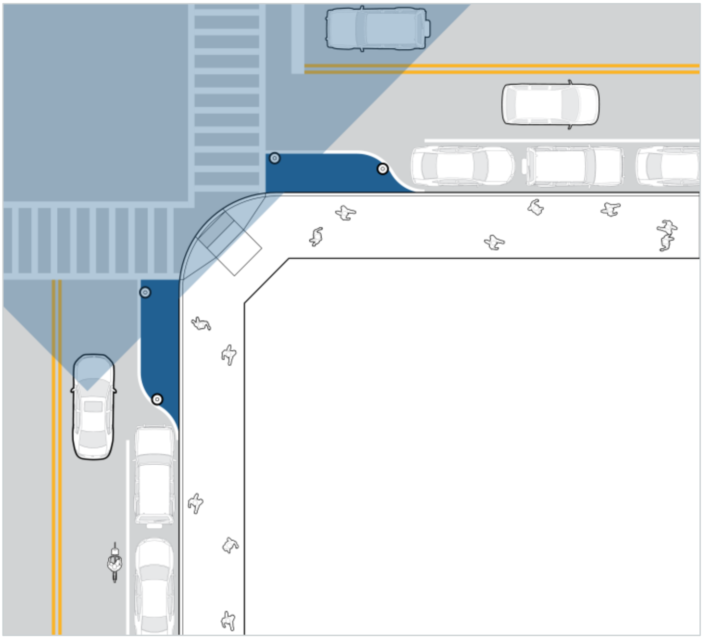
## Additional Resources

- NACTO Urban Street Design Guide
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

Systemic

# DAYLIGHTING/PARKING RESTRICTIONS AT CROSSINGS

Signs, pavement markings, curb extensions, planters, or vertical delineators that restrict on-street parking near a crossing or intersection. They improve sightlines between motorists and people crossing the street, that would otherwise be blocked by parked cars.



## Safe System Framework

- Separate users in space

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized and unsignalized intersections.
- All street types with on-street parking.

## Considerations

- Consider a physical barrier that prevents drivers from parking their cars too close to the crosswalk or markings that indicate the space is restricted from parking.
- Consider factors such as vehicle speeds, expected crossing road users, and other location-specific engineering factors when deciding the length of parking restrictions.
- Consider relocating roadside obstructions (signal cabinets, trees, etc.) to improve sight distance.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

30% *(Gan et. al., 2005)*

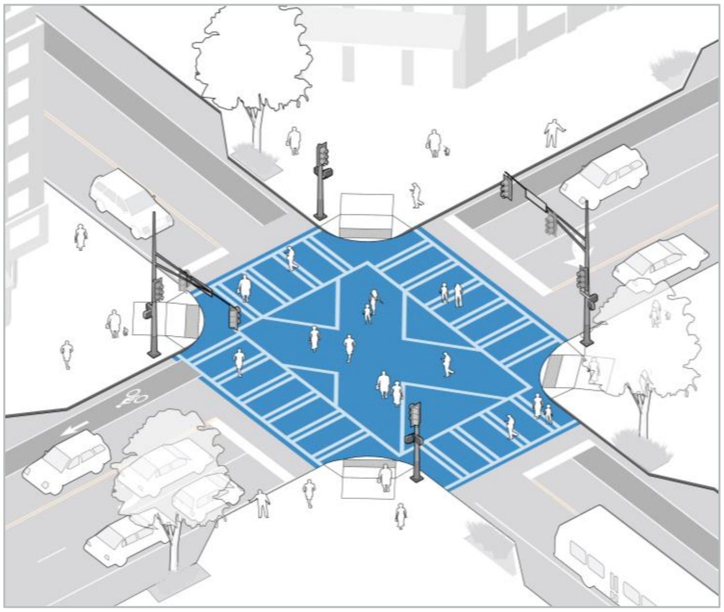
## Additional Resources

- Unsignalized Intersection Improvement Guide
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

Systemic

# EXCLUSIVE PEDESTRIAN SIGNAL PHASES

Intersections where the signal cycle includes a phase in which all drivers are stopped in all directions, and people walking can cross in all directions at the same time, including diagonally. They can help increase the visibility of people walking, reduce conflicts between drivers and pedestrians, and decrease waiting time for people wishing to cross in multiple directions. Also referred to as “Barnes Dance” or “Pedestrian Scramble”.



## Safe System Framework

- Separate users in space
- Separate users in time
- Increase visibility

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- All locals, collectors, and arterials.

## Considerations

- Consider at locations with high volumes of drivers wishing to turn and large numbers of people walking.
- Include audible pedestrian signals that create noise to let visually impaired pedestrians know when to cross.
- Install adequate signage and pavement markings to communicate how to use the intersection.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

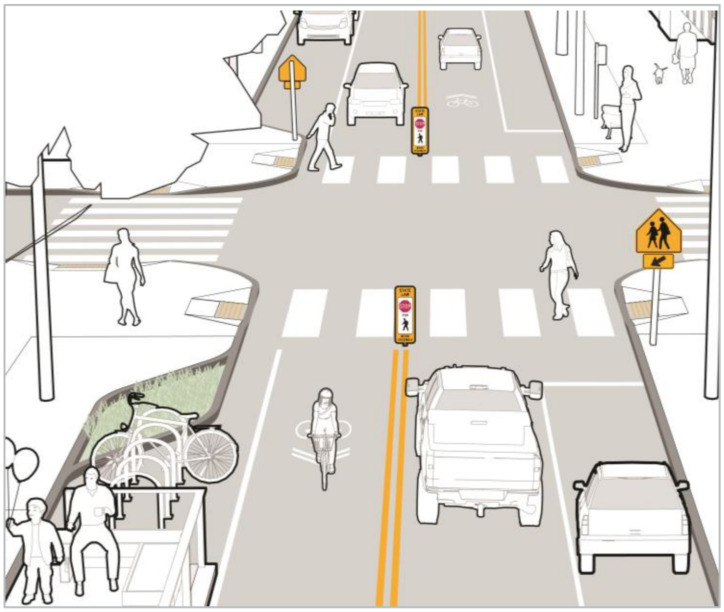
35% *(Chen, L. et. al., 2013)*

## Additional Resources

- FHWA Highway History — Where was the First Walk/Don't Walk Sign Installed? Addendum: The Barnes Dance

# GATEWAY TREATMENTS

"Stop for Pedestrian" signs (MUTCD R1-6a) are placed on in the center or left and right sides of all the roadway approaching a crosswalk to improve motorists' awareness of pedestrians crossing. They reduce drivers' speeds and increase drivers yielding at uncontrolled crosswalks. They may also reduce delay for pedestrian crossings due to increased motorist yielding and can reduce motorist speeds whether or not pedestrians are crossing.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Rear-end*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- All locals, and some collectors (lower speeds and vehicle volumes).

## Considerations

- Install signs with curb ramps and high-visibility crosswalk markings.
- Consider double-sided signs because they increase the likelihood that drivers will see a sign in heavy traffic.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

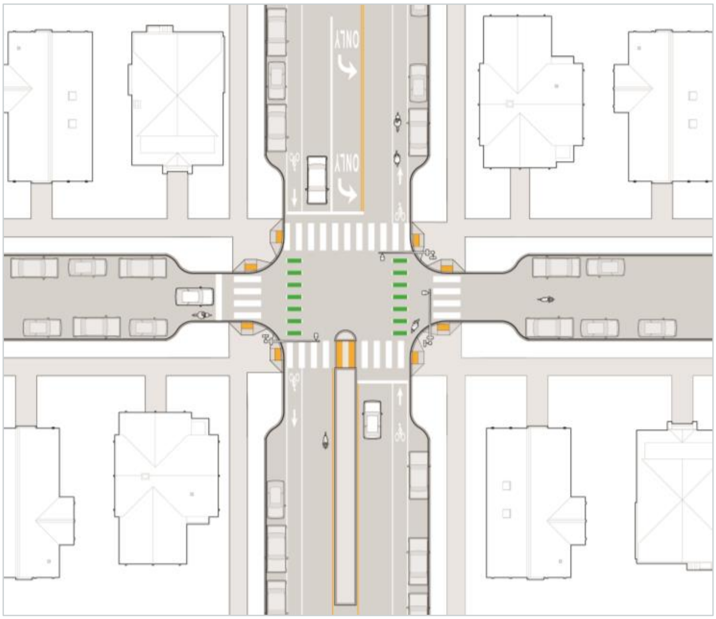
A crash reduction rate has not yet been determined.

## Additional Resources

- Manual on Uniform Traffic Control Devices (MUTCD)

# GREEN PAVEMENT MARKINGS

Green pavement markings placed at specific locations such as bicycle boxes, intersection crossings, driveways, and other potential conflict areas along on-street bikeways. The color green is not easily confused with other standard traffic control roadway markings.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Anywhere within on-road bikeways.
- At conflict areas such as intersections and driveways.
- All locals, collectors, and arterials

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

10% to 12% *(Fehr & Peers, 2018)*

## Considerations

- Reduce turning conflicts between bicyclists and drivers and increase driver yield behaviors.
- Consider green pavement markings require varying levels of maintenance and are generally more costly to maintain depending on the material used.

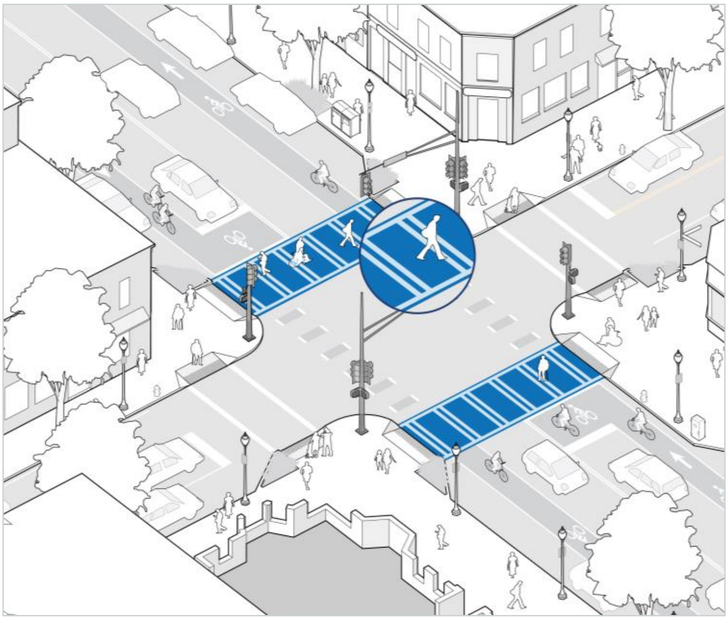
## Additional Resources

- NACTO Urban Bikeway Design Guide
- NACTO Baltimore Bicycle Facilities Education Guide
- Evaluation of Bicycle-Related Roadway Measures: A Summary of Available Research
- AASHTO Guide for the Development of Bicycle Facilities

Systemic

# HIGH VISIBILITY CROSSWALKS

High visibility crosswalks include painted patterns (i.e., bar pairs, continental, ladder) that are visible to both the driver and pedestrian from farther away compared to traditional transverse line crosswalks.  They help improve the visibility of people in crosswalks to approaching motorists and increase awareness of crosswalk locations. They also designate pedestrian right-of-way and may reduce pedestrian crossings at unmarked locations.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Rear-end*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized intersections and unsignalized intersections.
- All local, collectors, and arterials.

## Considerations

- Ensure the locations of high visibility crosswalks are convenient for pedestrian access.
- Consider crosswalk wider than 10 feet if placed in an area with high pedestrian or bicycling demand.
- Consider artistic crosswalks in the center of the intersection to add a unique design feature as a tactical change.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

40% *(Chen, L. et. al., 2012)*

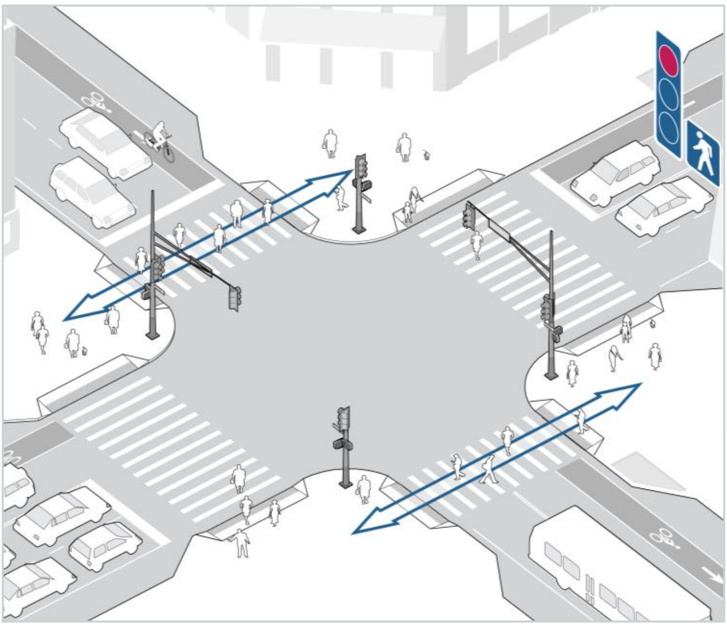
## Additional Resources

- Manual on Uniform Traffic Control Devices (MUTCD)
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- City of Atlanta Tactical Urbanism Guide

PSCi Systemic

# LEADING PEDESTRIAN INTERVALS (LPIs)

Programmed traffic signals that give people a 3-7 second head start to enter crosswalks. They give pedestrians priority within the intersection and allow them to enter an intersection first to establish presence before drivers begin moving. They increase visibility of crossing pedestrians and reduce potential conflicts between pedestrians and turning motorists.



## Safe System Framework

- Separate users in space
- Separate users in time
- Increase visibility

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- All locals, collectors, and arterials.

## Considerations

- Include audible pedestrian signals that create noise to let visually impaired pedestrians know when to cross.
- Consider installation with curb extensions to increase the effectiveness of LPIs and visibility of pedestrians.
- Consider head starts of up to 10 seconds could at intersections with higher pedestrian traffic volumes.
- Consider Leading Bicycle Intervals (LBIs) in locations in high-volume bicycle facilities and/or bicycle signals.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

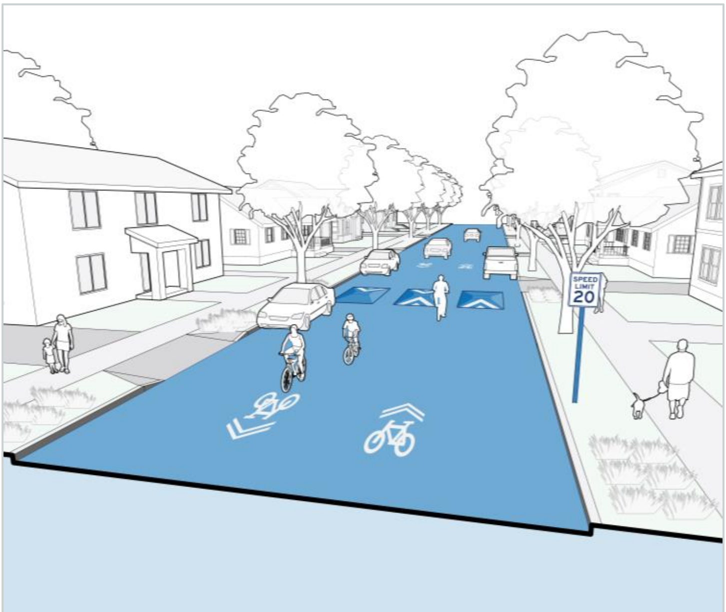
60% *(Fayish & Gross, 2010)*

## Additional Resources

- FHWA Proven Safety Countermeasures
- GDOT Pedestrian and Streetscape Guide
- NACTO Urban Street Design Guide
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

# NEIGHBORHOOD GREENWAYS

Neighborhood greenways, also known as “bicycle boulevards,” are designated bicycle-priority routes along low-speed, low-traffic residential streets. The traffic calming elements typically slow motorist speeds to a target of 22 mph (85th percentile speed). They are designed to offer convenient, low-stress access to local destinations, including transit stops and schools.




## Safe System Framework

- Separate users in space
- Reduce speeds
- Reduce impact force

## Crash Types

*Motorist/pedestrian*

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Local streets.

## Considerations

- Consider lower cost and quick implementation by relying on relatively simple modifications to existing streets such as pavement markings, flexible bollards, traffic calming devices, access management, and crossing treatments.
- Implement traffic calming measures throughout the street to self-enforce speed limits, including Chicanes, Corner/Turn Wedges, Traffic Circles, and Speed Humps/Speed Tables.

## Cost & Effectiveness

**Cost per Mile**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

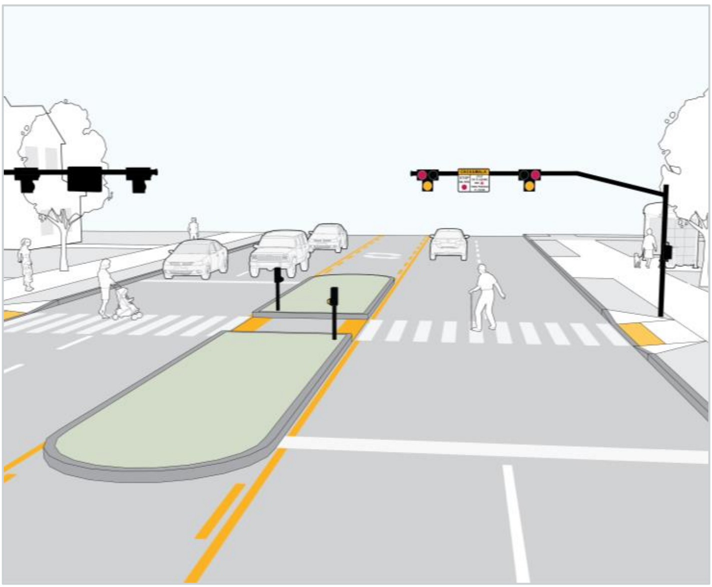
A crash reduction rate has not yet been determined.

## Additional Resources

- Atlanta Regional Commission Bike to Ride
- NACTO Urban Bikeway Design Guide

# PEDESTRIAN HYBRID BEACONS (PHBs)

A PHB is a traffic signal activated when someone walking, rolling, or bicycling presses the push button. When activated, the beacon turns from yellow to red, signaling drivers to stop and give people crossing the right of way. PHBs are also known as High intensity Activated crossWalK (HAWK) signals. They provide safe opportunities for crossing busy roads between signalized intersections, and are particularly useful where motorist speeds are too high, or gaps in traffic are too infrequent for pedestrians to cross safely.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Angle (other)* *Rear-end* *Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- All collectors and arterials.

## Considerations

- Consider implementing PHBs at transit stop locations that do not have an intersection within 200 feet.
- Consider outreach efforts to educate pedestrians, bicyclists, and drivers when implementing a PHB.

## Cost & Effectiveness

**Cost per Mile**

$ $$ **$$$** $$$$

**Crash Reduction Factor**

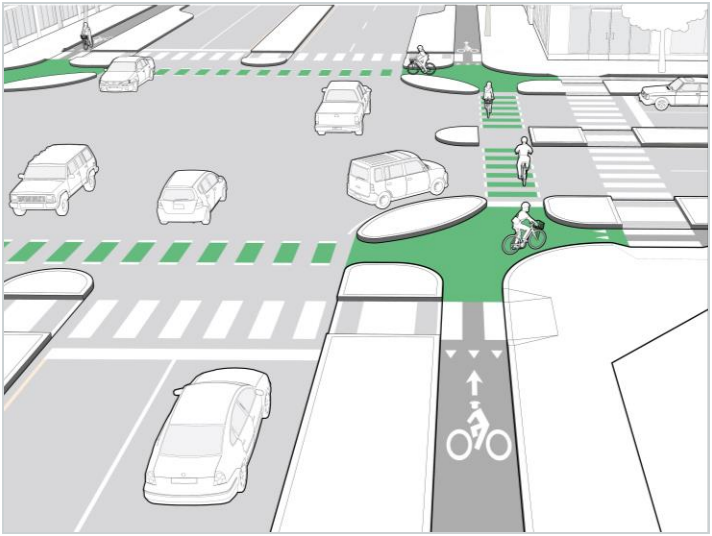
18% to 76% *(Zegeer et. al., 2017)*

## Additional Resources

- [FHWA Proven Safety Countermeasures]
- [Manual on Uniform Traffic Control Devices (MUTCD)]
- [FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations]
- [Pedestrian Hybrid Beacon Guide, Recommendations, and Case Study]
- [Safety Effectiveness of the HAWK Pedestrian Crossing Treatment]

# PROTECTED INTERSECTIONS

Intersections where the bikeway is offset from the parallel general purpose lane to give people bicycling a dedicated path through the intersection and the right of way over motorists turning. They improve the safety of people bicycling through intersections and reduces conflict points between pedestrians, bicyclists, and motorists.



## Safe System Framework

- Separate users in space
- Increase visibility
- Reduce speeds

## Crash Types

*Motorist/bicyclist*

## Relevant Roadway Type & Application

- Signalized and unsignalized intersections.
- Collectors and arterials

## Considerations

- Consider accessible paths for people with disabilities in the protected intersection.
- Separate bicycle crossings from pedestrian crossings and supplement bicycle crossings with green pavement to improve contrast.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ **$$$$**

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Additional Resources

- [NACTO Don’t Give Up at the Intersection]
- [Lessons Learned: Evolution of the Protected Intersection]

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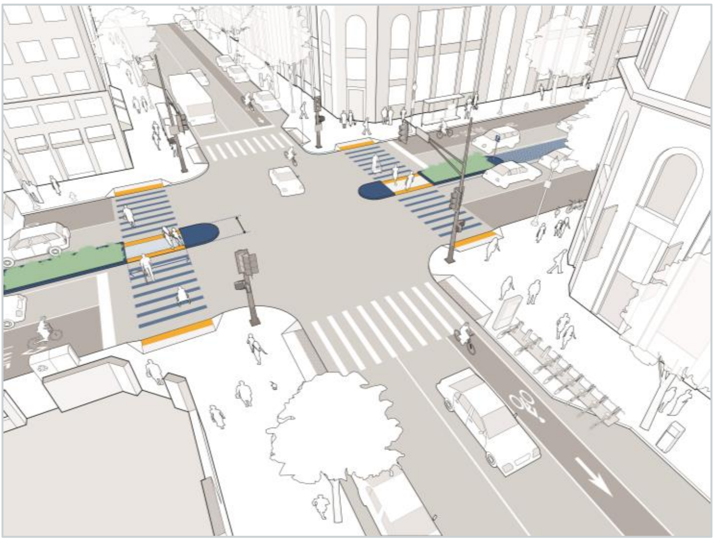
# RAISED REFUGE ISLANDS

Raised refuge islands are curbed sections in the center of a roadway that separate opposing directions of general-purpose lanes. They are particularly useful where motorist speeds are above 30 mph, and traffic volumes are above 9,000 vehicles per day.



## Safe System Framework

- Separate users in space

## Crash Types

*Motorist/pedestrian*

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized intersections and unsignalized intersections.
- Collector and arterial streets.

## Considerations

- Ensure landscaping does not obstruct visibility.
- Allow assurances for emergency vehicles to navigate around refuge islands by including mountable curbs or allowing travel in lanes of opposing directions of travel.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

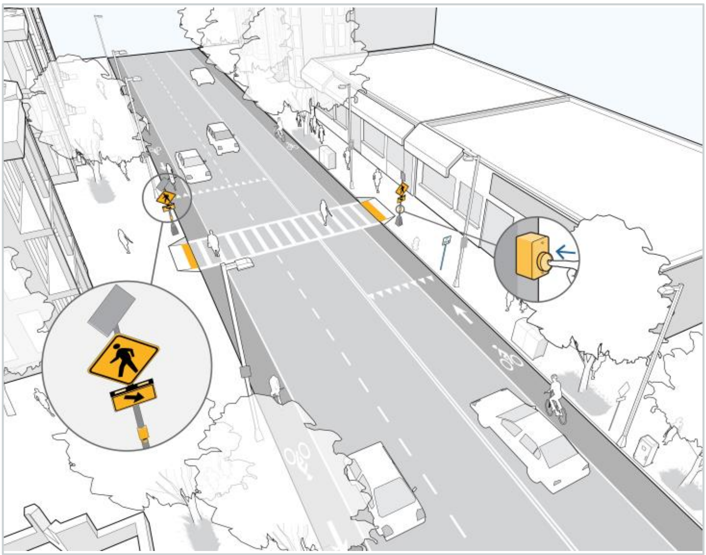
46% *(Bahar, G. et. al., 2007)*

## Additional Resources

- FHWA Proven Safety Countermeasures
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- Chapter 8 of Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design Guide

# RECTANGULAR RAPID FLASHING BEACON (RRFBs)

RRFBs are bright, irregularly flashing LEDs mounted with pedestrian crossing signs that activate when a person waiting to cross presses the push button. They can help increase driver yielding to people at uncontrolled crossings, and pedestrian/bicyclist visibility.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Vehicle/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Unsignalized intersections.
- Collectors where there are two or more lanes in one direction and all arterials.

## Considerations

- Consider RRFPs on roads where driver speeds are below 35 mph.
- Consider redesigning the roadway to address systemic safety challenges if multiple RRFBs are needed near each other.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

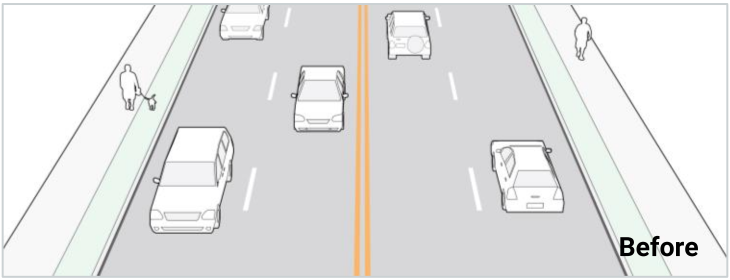
47% *(Zegeer et. al., 2017)*

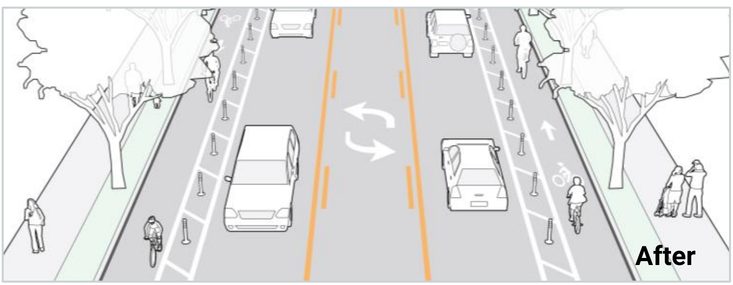
## Additional Resources

- Arlington County Marked Crosswalk Guidelines
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

# ROAD DIETS

A reduction in the number of lanes or general purpose lane width in order to reduce motorist speeds and/or repurpose roadway space. Roads may be a candidate for a road diet based on the daily traffic volume. They increase available space for pedestrian, bicycle, transit, or other infrastructure needs, and may reduce crossing distances by eliminating a lane or through provision of a pedestrian median island.




## Safe System Framework

- Increase attentiveness
- Reduce speeds

## Crash Types

*Rear-end* *Vehicle/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Collectors and arterials.

## Considerations

- Consider implementing as part of the City's programmatic roadway resurfacing efforts.
- Consider public engagement that leads with the safety need for the road diet.

## Cost & Effectiveness

**Cost per Mile**

$ $$ $$$ **$$$$**

**Crash Reduction Factor**

29% to 47%

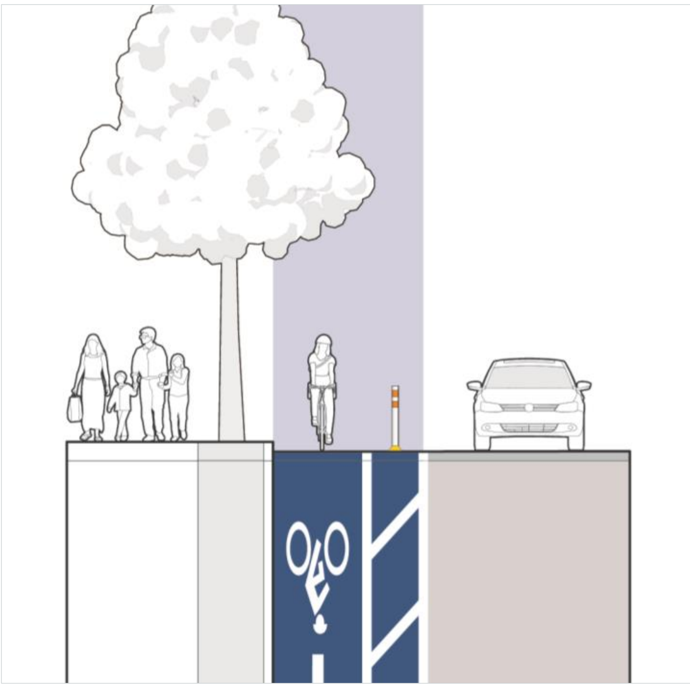
*(Persaud, et. al., 2010; Pawlovich, et. al. 2006)*

## Additional Resources

- Atlanta Regional Commission Regional Workbook for Complete Streets
- GDOT Pedestrian and Streetscape Guide
- FHWA Proven Safety Countermeasures
- Evaluation of Lane Reduction "Road Diet" Measures on Crashes
- USDOT Road Diet Informational Guide

# SEPARATED BICYCLE LANES

Also referred to as protected bicycle lanes, separated bicycle lanes provide physical separation between bicyclists and drivers using objects like flex posts, parking stops, planters, curbs, or concrete barriers. These lanes are generally located along corridors with few driveways or conflict points. They provide physical separation between the bicycle lane and travel lane and are preferred over conventional bicycle lanes for roads with high travel speeds, traffic volumes, and/or high transit or truck volumes.



## Safe System Framework

- Separate users in space
- Reduce impact forces

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Along higher speed and higher volume corridors.
- Collectors based on speed and volume and arterials.

## Considerations

- Consider the utility of separated bicycle lanes on corridors with multiple driveways, on-street parking, and other conflict points.

## Cost & Effectiveness

**Cost per Mile**

$ $$ **$$$** $$$$

**Crash Reduction Factor**

44% to 64%

*(Developing Crash Modification Factors for Separated Bicycle Lanes, FHWA, 2023)*

## Additional Resources

- NACTO Urban Bikeway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities
- BIKESAFE Bicycle Safety Guide and Countermeasure Selection System

# SIDEWALKS

Sidewalks provide space along the street for pedestrian travel that is separated from moving vehicles. They should be wide enough for two people to walk or roll side-by-side, maintained in good condition with minimal to no bumps or cracks (and with no cracks or bumps of 1/4 inch height or greater, per ADA Standards), kept clear of debris and overgrowing plants, and are built with curbs. They improve the safety and comfort of people walking or rolling by separating them from faster moving road users such as bicyclists and drivers.

## Safe System Framework

- Separate users in space
- Reduce impact forces

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- All locals, collectors, and arterials.

## Considerations

- Include a buffer zone between roadway and sidewalk to separates drivers from pedestrians, e.g., with trees and furniture

## Cost & Effectiveness

**Cost per Mile**

$ $$ **$$$** $$$$

*Varies due to material and topography*

**Crash Reduction Factor**

75% *(Gan et al., 2005)*

## Additional Resources

- FHWA Proven Safety Countermeasures
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- United States Access Board Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)

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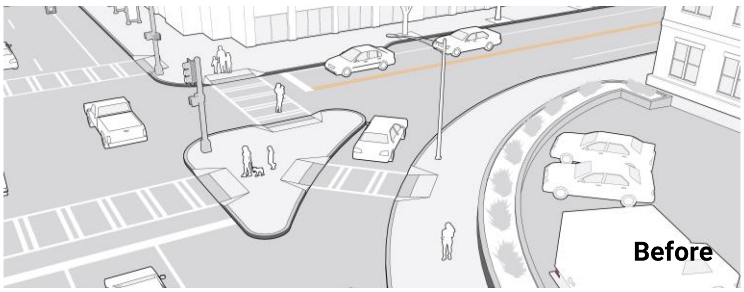
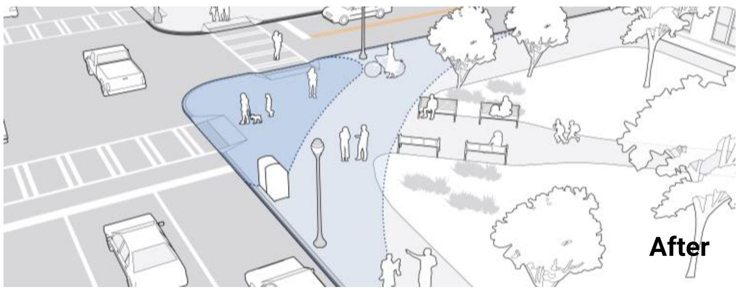
# SLIP LANE CLOSURES

Slip lanes are typically designed to allow motorists to make right turns without stopping at intersections. Closing or modifying slip lanes can make them safer by reducing motorists' speeding, increasing attentiveness's and visibility, and shortening crossing distances for people walking.




## Safe System Framework

- Increase visibility
- Increase attentiveness
- Reduce speeds

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- Unsignalized intersections.
- All locals, collectors, and arterials with existing slip lanes.

## Considerations

- Seek opportunities to repurpose previous slip lane area for landscaping and other streetscape amenities.
- Limit the installation of new slip lanes to intersections with skewed geometry that would otherwise result in significantly longer pedestrian crossing distances.
- Consider raised crosswalks and/or truck aprons to control the speed of turning drivers where slip lanes are necessary.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

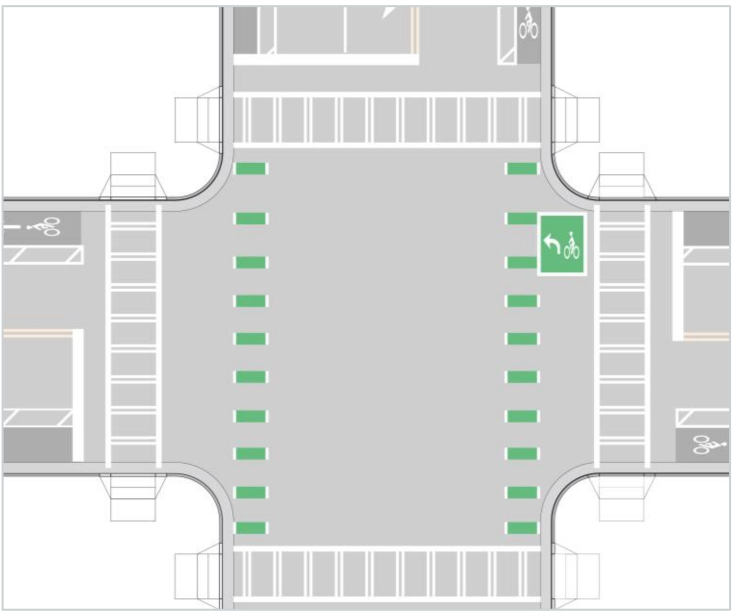
A crash reduction rate has not yet been determined.

## Additional Resources

- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- FHWA: Well Designed Right–Turn Slip Lanes

# TWO-STAGE TURN BICYCLE BOX

Two-stage turn bicycle boxes are green-painted boxes on the far right of an intersection that designate a dedicated space for people riding a bicycle to make left turns. These features allow people bicycling to split the left-turn maneuver into two stages by first proceeding straight to the far side of the intersection and then using the turn box to position themselves for a left turn when the signal changes to green. They allow for greater visibility between motorists and bicyclists.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Primarily at signalized intersections, however, can be added to unsignalized intersections where there is a high volume of people on bicycles making a left turn.
- Where a left turn is required to follow a bikeway.
- All collectors and arterials.

## Considerations

- Consider two-stage turn bicycle boxes use with an authorized request for interim approval per FHWA Interim Approval IA-18.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Additional Resources

- NACTO Urban Bikeway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities
- BIKESAFE Bicycle Safety Guide and Countermeasure Selection System

# INTERSECTIONS

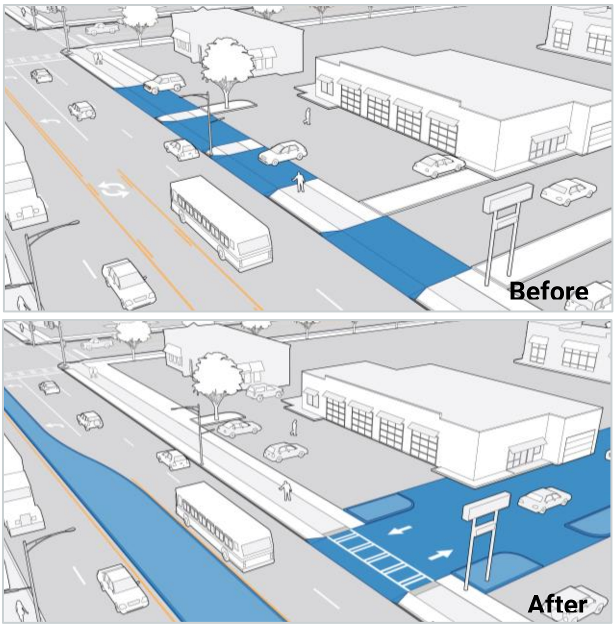
The Crossings and Signals category presents design safety countermeasures that address all road user types by separating users in space and time.

The safety countermeasures in this category are:

- Assess Management
- Corner/Turn Wedges
- Dedicated Turn Lanes
- Hardened Centerlines
- Intersection Geometry Improvements
- No Left Turn/U-Turn Restrictions
- Protected Turn Phases
- Raised Intersections/Crossings
- Retroreflective Signal Backplates
- Right Turn On Red Prohibitions
- Roundabouts
- Signal Clearances
- Stop Control
- Yellow Change Intervals

# ACCESS MANAGEMENT

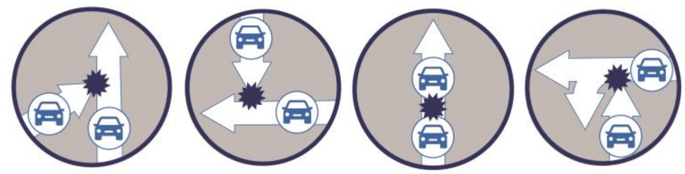
Access management refers to the design, application, and control of entry and exit points along a roadway, including intersections and driveways that serve properties. They reduce driveway density to create fewer conflict points among road users and beneficial for people walking, bicycling, rolling, or driving while also reducing trip delay and congestion.




## Safe System Framework

- Separate users in space

## Crash Types



*Angle (Other)* *Left Angle* *Rear-end* *Right Angle*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- All locals, collectors, and arterials.

## Considerations

- Consider including limits to allowable turning movements such as right-in/right-out only.
- Implement designs such as raised medians to limit across-roadway movements.
- Consider relocating driveways to parcels located at corners on the side road instead of mainline roads.
- Consider an access management ordinance which applies to all new construction and limits curb cuts per block (i.e. two per 0.25 miles or min distance 440 feet).

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

25% to 31% *(Elvik, R. and Vaa, T., 2004)*

## Additional Resources

- FHWA Proven Safety Countermeasures

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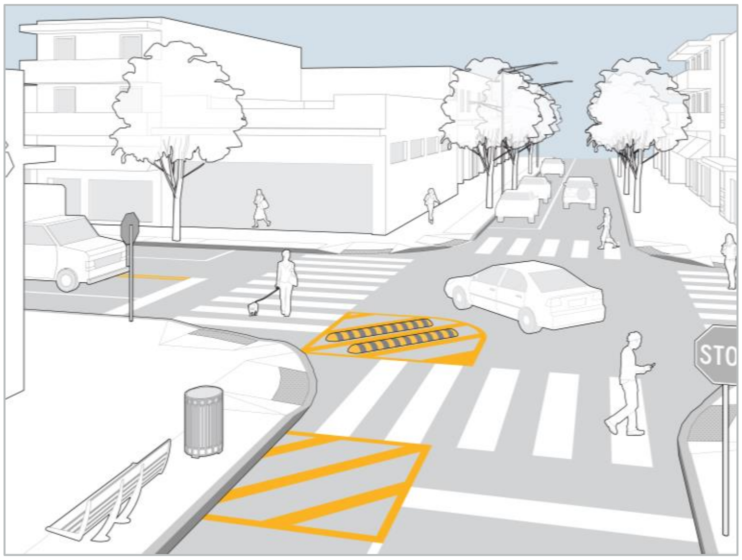
# CORNER/TURN WEDGES

Raised curbs or flexible delineators and pavement markings on both sides of a crosswalk at an intersection. Corner/turn wedges guide drivers to make wider turning angle for slower and more predictable turns without reducing traffic capacity. They reduce drivers' turning speed, increases visibility of pedestrians in crosswalk to turning drivers, and increase drivers yielding to people in the crosswalk.




## Safe System Framework

- Increase visibility
- Reduce speeds

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersection.
- All locals, collectors, and arterials.

## Considerations

- Can be constructed rapidly and inexpensively using markings and flexible delineators.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

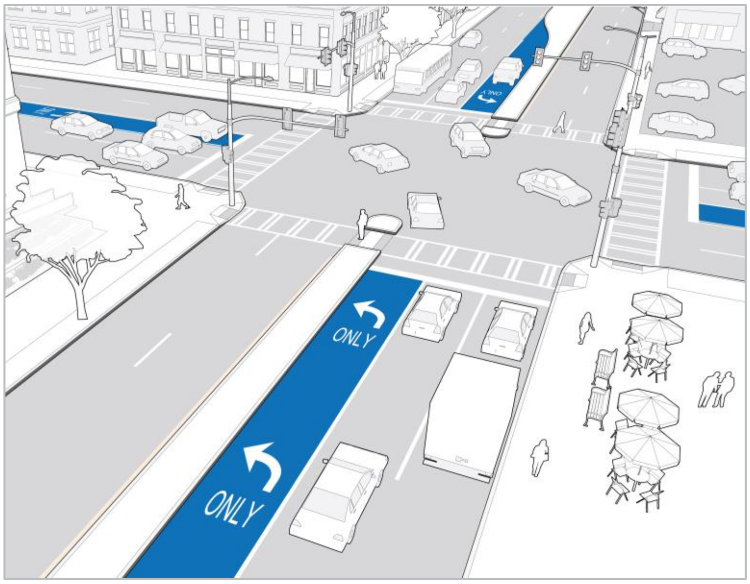
A crash reduction rate has not yet been determined.

## Additional Resources

- American Disabilities Act Accessibility Guidelines for Buildings and Facilities
- Chapter 8 of Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design Guide
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

# DEDICATED TURN LANES

Auxiliary turn lanes—either for left turns or right turns— dedicated for drivers making turns designed to provide deceleration prior to a turn, and for storage of vehicles that are stopped and waiting to complete a turn. They provide physical separation between drivers turning and adjacent through traffic, and can reduce left-angle and rear-end crashes.




## Safe System Framework

- Increase attentiveness

## Crash Types

*Left Angle*

## Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersection.
- Collectors and arterials.

## Considerations

- Consider installation on the major road approaches at three- and four-leg intersections with stop control on the minor road where significant turning volumes exist.
- Consider offset turn lanes which can increase visibility, particularly at higher speeds locations.
- Balance the needs of drivers and pedestrians by realizing left- and right-turn lanes lengthen crossing distances for pedestrians.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

14% to 30%

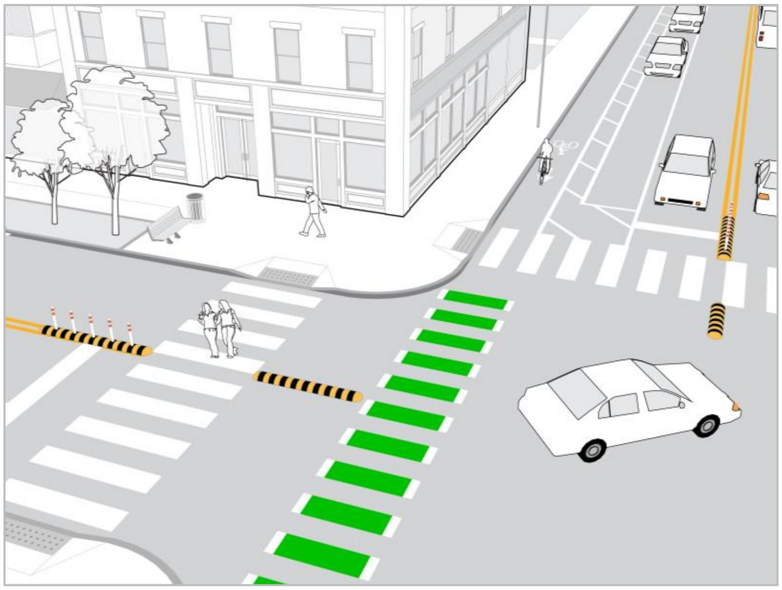
*(Harwood et. al., 2002; Persaud et. al., 2009)*

## Additional Resources

- FHWA Proven Safety Countermeasures

# HARDENED CENTERLINES

Flexible delineators placed between opposing travel lanes that guide drivers to make wider turns angle for safer and more predictable turns. They reduce the speed of drivers making left-turns without reducing traffic capacity and increase yielding drivers to people in the crosswalk.



## Safe System Framework

- Increase visibility
- Reduce speeds

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersection.
- Collectors and arterials.

## Considerations

- Construct rapidly and inexpensively using markings and flexible delineators as an alternative or initial safety countermeasure before raised medians.

## Cost & Effectiveness

**Cost per Mile**

$ $$ $$$ $$$$

**Crash Reduction Factor**

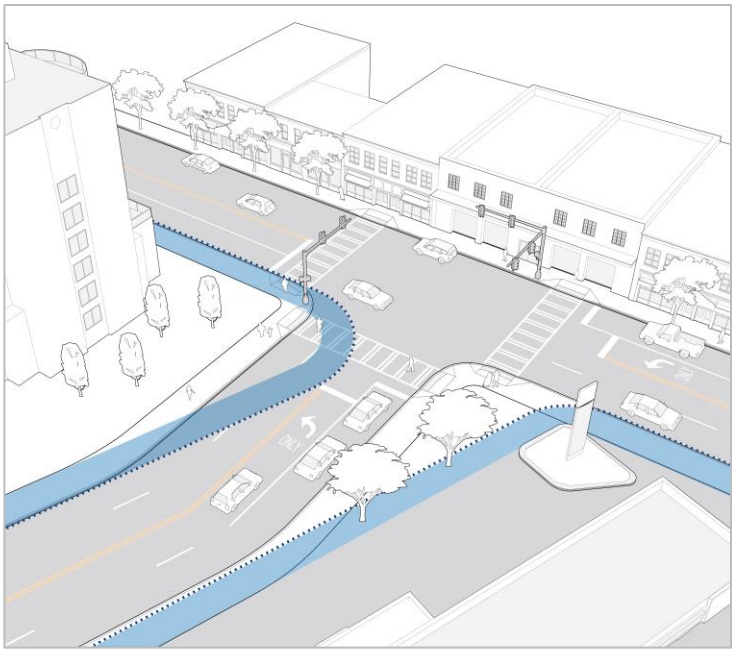
46% *(Bahar, G., et. al., 2007)*

## Additional Resources

- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- Chapter 8 of Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design Guide

# INTERSECTION GEOMETRY IMPROVEMENTS

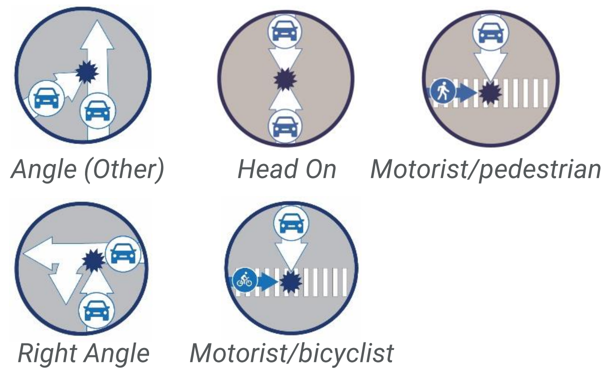
Realignment of at least one leg of an intersection approach to reduce or eliminate a skewed angle and create perpendicular angle at the intersection. Skewed intersections occur when streets intersect at angles other than 90 degrees which create complicated scenarios for pedestrians, bicyclists, and drivers.  They improve visibility and reduce conflict points for all road users.



### Safe System Framework

- Increase visibility

### Crash Types




### Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersection.
- All locals, collectors, and arterials.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ **$$$$**

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Considerations

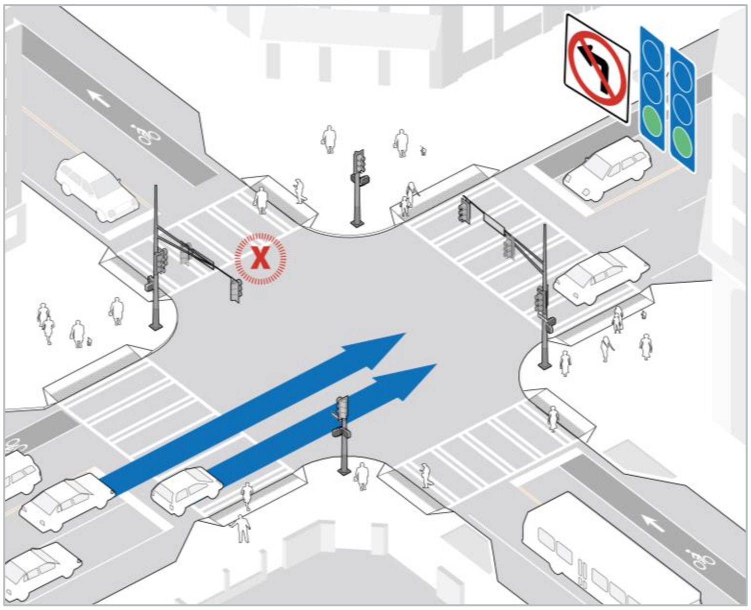
- Can reduce crossing distances for pedestrians and reduce exposure based on new geometry.
- May require additional right-of-way and impact neighboring property.
- Consider less impactful strategies at the location before considering intersection redesign.

## Additional Resources

- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- AASHTO Green Book
- AASHTO A Policy on Geometry Design of Highways and Streets

# NO LEFT TURN/U-TURN RESTRICTIONS

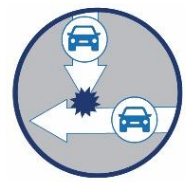
Signs, signals, or geometric designs such as diverters with raised medians that prohibit drivers from making left-turn or U-turn movement. They reduce potential conflict points between turning drivers and other drivers and people walking and bicycling at intersections. Most appropriate at locations with frequent left-turn movement crashes at minor streets.



## Safe System Framework

- Separate users in space
- Separate users in time

## Crash Types



*Left Angle*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- Some collectors based on traffic volume and arterials.

## Cost & Effectiveness

**Cost per Site**

$ $$ **$$$** $$$$

**Crash Reduction Factor**

64% to 77% *(Brich and Cottrell, 1994)*

## Considerations

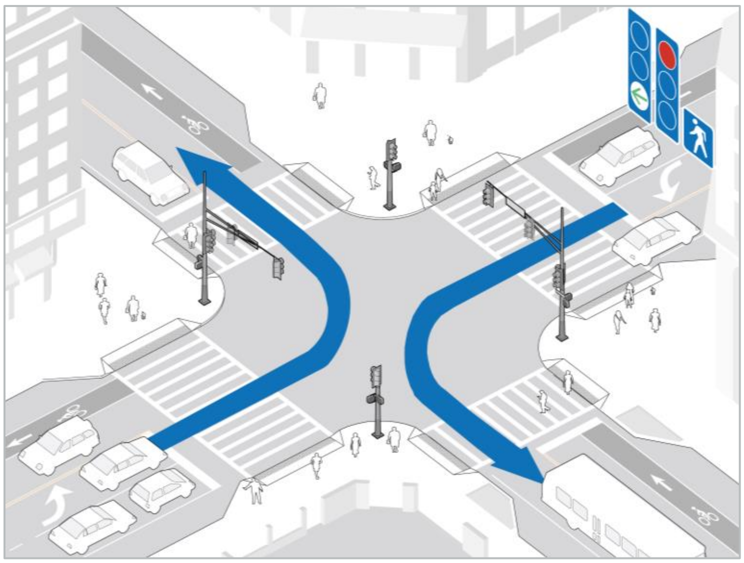
- May reduce through traffic on neighborhood streets to create a more comfortable street for people walking or bicycling.
- Ensure geometric designs used to physically prohibit driver left-turns allow for easy access by people walking or bicycling.
- Evaluate traffic patterns to determine whether other streets would be adversely affected due to an increase in right turns.
- Ensure strong community outreach and engagement before implementing the prohibitions.

## Additional Resources

- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

# PROTECTED TURN PHASES

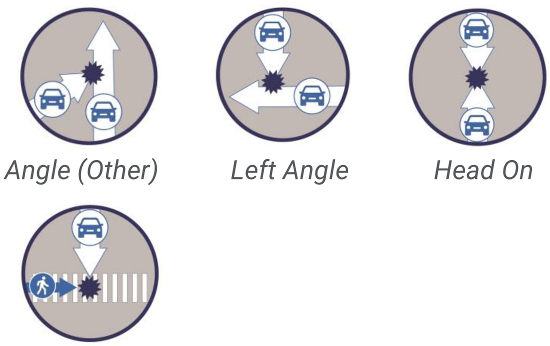
Green or red-arrow signal phases used to provide dedicated turning movements for drivers and restrict turning movements at other times. They reduce conflict points between turning drivers from other drivers and people walking and bicycling.



## Safe System Framework

- Separate users in time

## Crash Types



*Angle (Other)* *Left Angle* *Head On*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- Collectors and arterials.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

41% to 48% *(FHWA, 2020)*

## Considerations

- Consider concurrent signal phasing to keep cycle lengths low and decrease delay compared to exclusive or split signal phasing. Lower cycle lengths are especially beneficial for minimizing vehicular queuing and pedestrian delays.
- Evaluate the need for specific lane configurations and designations when implementing protected turn phases.

## Additional Resources

- [FHWA Low-Cost Safety Enhancements for Stop-Controlled and Signalized Intersections]
- [FHWA Traffic Signal Timing Manual, Chapter 4]

# RAISED INTERSECTIONS/CROSSINGS

Raised crosswalks or raised intersections are ramped speed tables spanning the entire width of the roadway or intersection. Crossings are elevated at least three inches above the roadway, and up to the sidewalk level. They reduce drivers' speeds, increase driver yielding, and improve crossing safety for people walking or bicycling.

## Safe System Framework

- Increase visibility
- Increase attentiveness
- Reduce speeds

## Crash Types

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized and unsignalized intersections.
- Local streets, collectors, and some minor arterials.

## Considerations

- Evaluate whether the raised crossing design require modifications to existing drainage.
- Place the raised crossings at sidewalk level to provide a continuous travel path for pedestrians with disabilities.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

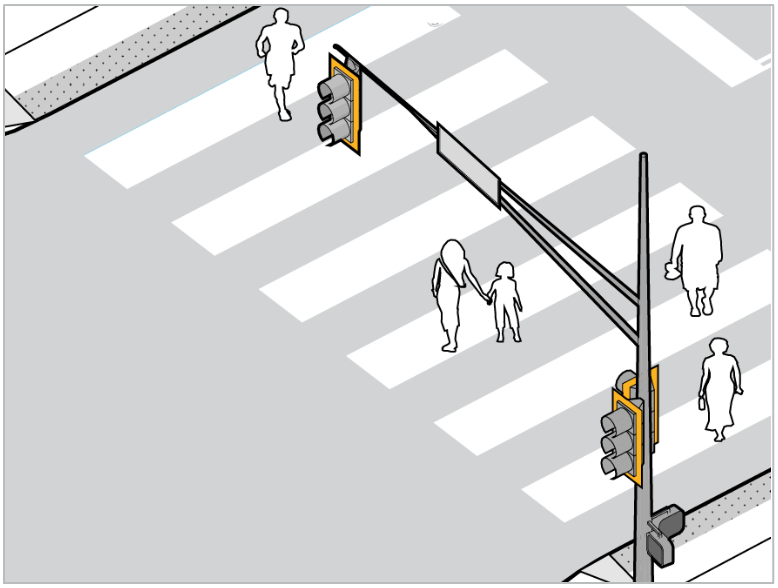
45% to 51% *(Schepers, J.P., et. al., 2011; Bahar, G., et. al., 2007)*

## Additional Resources

- [FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations]
- [PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System]

# RETROREFLECTIVE TRAFFIC SIGNAL BACKPLATES

Traffic signals are framed with a 1 to 3-inch wide retroreflective border. They improve the visibility of the illuminated face of the traffic signal in both day and nighttime conditions. Backplates help reduce risk of crashes caused by driver inattentiveness and poor visibility conditions such as at night, heavy fog, or heavy precipitation.



## Safe System Framework

- Increase attentiveness

## Crash Types

*Rear-end*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- All locals, collectors, and arterials.

## Considerations

- Consider implementing backplates with retroreflective borders systematically improve safety at all signalized intersections.
- Evaluate whether the design of the existing signal support structure is sufficient to support the added wind load.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

15% *(Sayed et. al., 2005)*

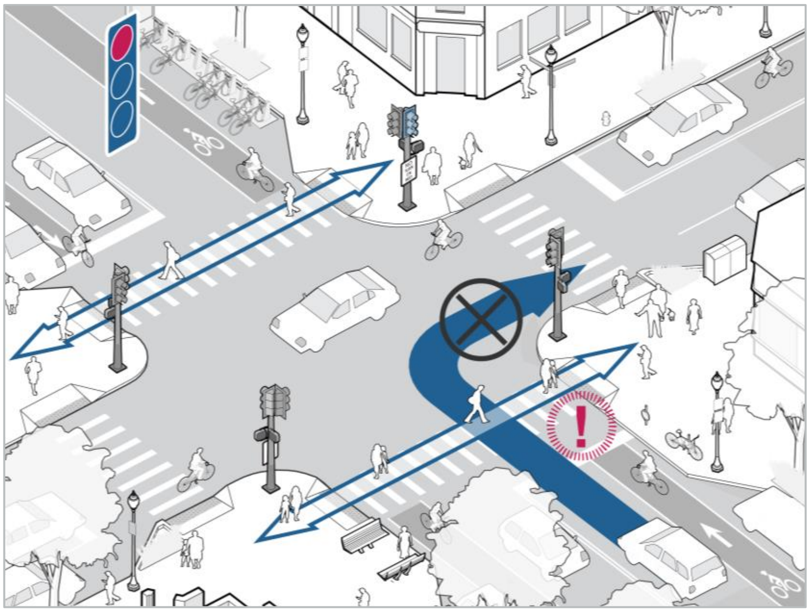
## Additional Resources

- [FHWA Proven Safety Countermeasures]
- [NHTSA Countermeasures that Work]

Systemic

# RIGHT TURN ON RED PROHIBITION

Signs or signals that prohibit drivers from making a right turn. Most appropriate at locations with high volumes of people walking or bicycling. They reduce potential conflict points between turning drivers and other drivers, and people walking and bicycling at signalized intersections.



## Safe System Framework

- Separate users in space
- Separate users in time

## Crash Types

*Motorist/pedestrian*

*Right Angle*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- All locals, collectors, and arterials.

## Considerations

- Consider right turn on red restrictions particularly in locations where sight distance may be restricted.
- Consider dynamic electronic signs to restrict right turns only during certain times of day or during certain signal phases.
- Use with LPI to address the increase in numbers of drivers turning right on green.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

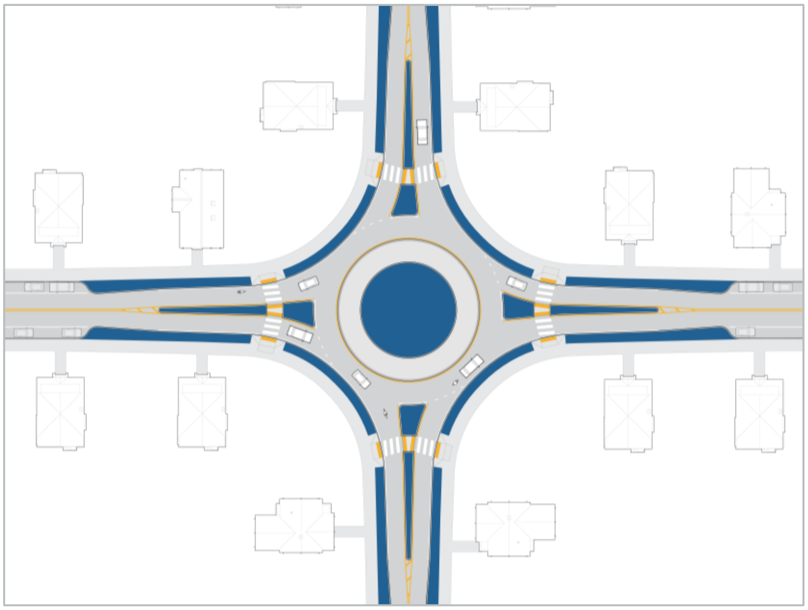
## Additional Resources

- [Manual on Uniform Traffic Control Devices (MUTCD)]
- [PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System]
- [AASHTO Highway Safety Manual]

PSCi

# ROUNDABOUTS

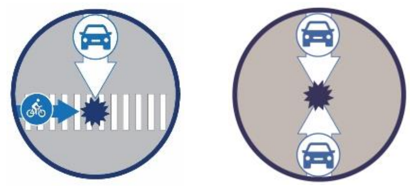
An intersection treatment in which all approaches must yield to traffic already within the roundabout. After yielding, drivers must circulate the center island before exiting to turn or continue straight. They reduce speeds and the number of conflict points at intersections while maintaining efficient traffic operations and continuous flow.



## Safe System Framework

- Increase attentiveness
- Reduce speed

## Crash Types



*Motorist/bicycle* *Head-on*

## Modes

## Relevant Roadway Type & Application

- Signalized and unsignalized intersections
- All locals, collectors, and arterials.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ **$$$$**

**Crash Reduction Factor**

78% to 82% *(Highway Safety Manual, 2010)*

## Considerations

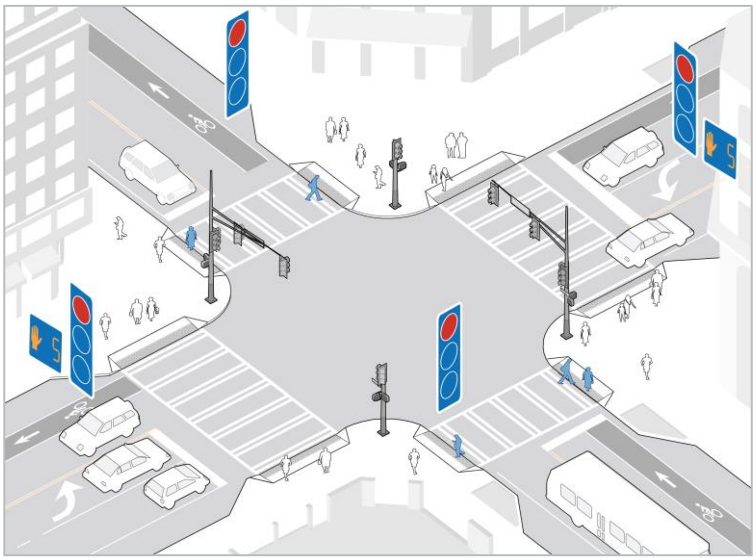
- Install signage that direct traffic flow and create awareness of roundabout rules.
- May include landscape with low shrubs or vegetation that does not impede visibility.
- Accommodate large vehicles such as emergency vehicles or school buses with mountable truck aprons.

## Additional Resources

- [FHWA Proven Safety Countermeasures]
- [PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System]

# SIGNAL CLEARANCES

Signal clearances or all-red phase is time when one direction of travel gets the red phase signal and the opposing direction get the green phase signal. The signal clearance is achieved by having an all-red phase where all directions rest on red. The all-red phase increases the time for intersections to be cleared before the opposing traffic is allowed to go and help minimize the chances of conflicting movements within the intersection.



## Safe System Framework

- Separate users in time

## Crash Types

*Angle (Other)*

*Left Angle*

*Head On*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Signalized intersections
- All locals, collectors, and arterials.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

3% to 20% *(Srinivasan, et. al., 2011)*

## Considerations

- Provide time to facilitate clearing of drivers turning at intersections and pedestrian crossing.
- Consider factors such as the number of lanes, presence of turn lanes, pedestrian crossings, speed limits, geometric features, and traffic volume to determine length of clearance time. The yellow signal phase duration leading up to the signal clearance time is critical. It should be long enough to alert drivers of the upcoming signal change and provide them with adequate time to respond

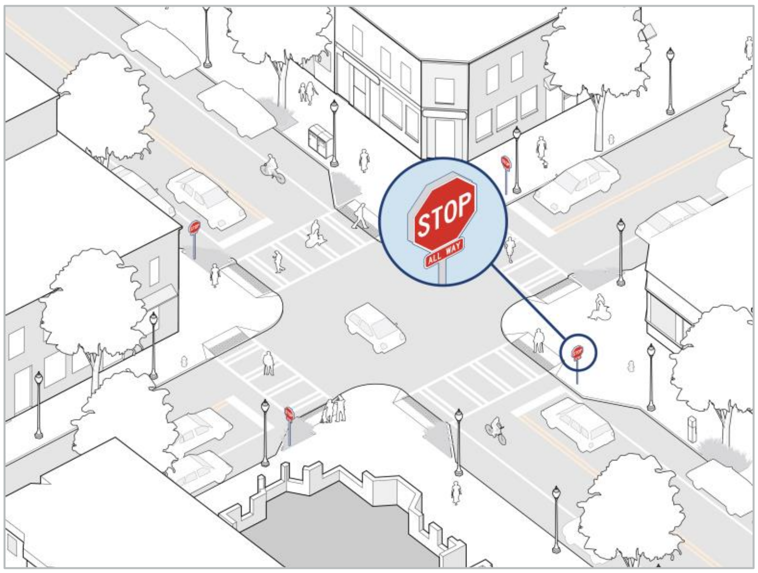
## Additional Resources

- [FHWA Traffic Signal Timing Manual]
- [Manual on Uniform Traffic Control Devices (MUTCD)]

PSCi

# STOP CONTROL

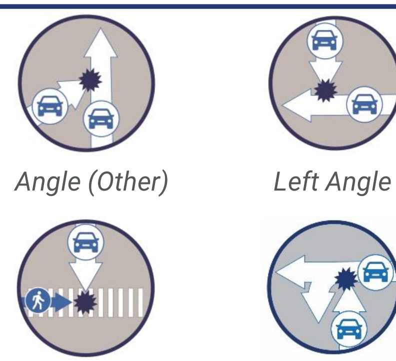
A type of traffic control using STOP signs and pavement markings. Minor intersections can be upgraded to all-way stop control Enhanced signing and pavement markings stop-controlled intersections can increase driver awareness and recognition of the intersections and potential conflicts.




## Safe System Framework

- Increase visibility
- Increase attentiveness
- Reduce speeds
- Reduce impact forces

## Crash Types



*Angle (Other)* *Left Angle*

*Motorist/pedestrian* *Right Angle*

## Modes

## Relevant Roadway Type & Application

- Unsignalized intersections.
- All locals, and collectors.

## Cost & Effectiveness

**Cost per Site**

**$** $$ $$$ $$$$

**Crash Reduction Factor**

22% *(Haleem and Abdel-Aty, 2010)*

## Considerations

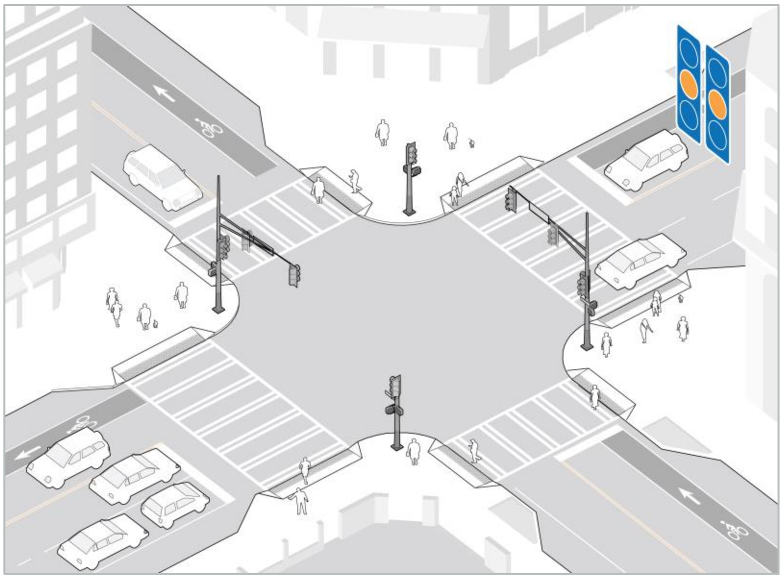
- Consider on the additional signage on approach to the intersection – doubled-up (left and right) signs, oversized advance intersection warning signs, with supplemental street name plaques.
- Consider retroreflective sheeting on signposts to increase contrast.

## Additional Resources

- FHWA Proven Safety Countermeasures

# YELLOW CHANGE INTERVALS

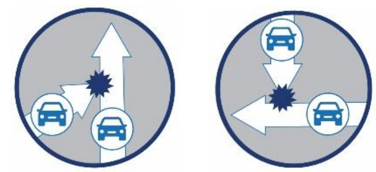
The yellow change interval is the length of time that the yellow signal indication is displayed before a green signal. They help improve driver compliance to signals and reduce red-light running. Properly timing the length of the yellow phase following MUTCD requirements is important to provide drivers enough time to safely stop in preparation for the red phase.



## Safe System Framework

- Separate users in time

## Crash Types



Angle (Other) Left Angle

## Modes

## Relevant Roadway Type & Application

- Signalized intersections.
- All locals, collectors, and arterials.

## Cost & Effectiveness

**Cost per Site**

$ $$ $$$ $$$$

**Crash Reduction Factor**

8% to 50% *(NCHRP Report 731, 2011)*

## Considerations

- Review and update traffic signal timing policies and procedures concerning yellow change interval.
- Consider factors such as the speed of approaching and turning vehicles, driver perception-reaction time, vehicle deceleration, and intersection geometry when retiming. Intervals that are too short may result in drivers being unable to stop safely and cause unintentional red-light running. Intervals too long may result in drivers treating the yellow as an extension of the green phase and invite intentional red-light running.

## Additional Resources

- FHWA Proven Safety Countermeasures
- Manual on Uniform Traffic Control Devices (MUTCD)

# SPEED MANAGEMENT

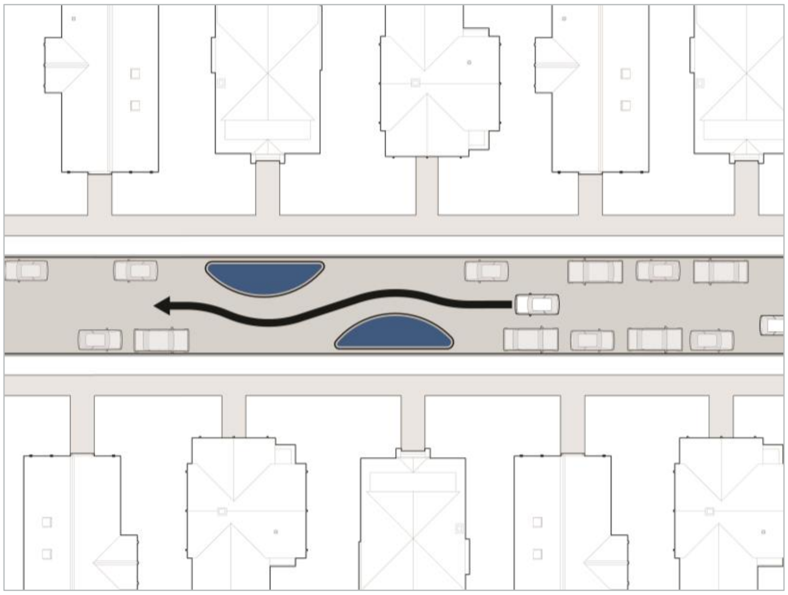
The Speed Management category presents design safety countermeasures known to create roadways where drivers operate at safe speeds.

The safety countermeasures in this category are:

- Chicanes
- Speed Humps/Speed Tables
- Speed Limit Reduction and Polices
- Speed Safety Cameras
- Traffic Circles
- Variable Speed Limits

# CHICANES

Horizontal treatments that force drivers to alter the vehicle movement and reduce speeds. Chicanes are often made of curb extensions or islands that create "S" curves along a roadway. They help improve driver attention to the roadway as they must navigate shifts in the lane.



## Safe System Framework

- Increase attentiveness
- Reduce speeds

## Crash Types

*Head On*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Local streets, and some collectors.

## Considerations

- Include signage and striping around chicanes that help ensure that drivers are aware of a shift in the lane.
- Consider landscaping within chicanes that are low vegetation or trees with high canopies to maintain visibility.
- Consider the effect on drainage along the roadway. If there is a concern, chicanes may be designed as edge islands with a 1–2-foot gap from the curb.
- Deploy on streets where speed limits are 35 mph or less.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

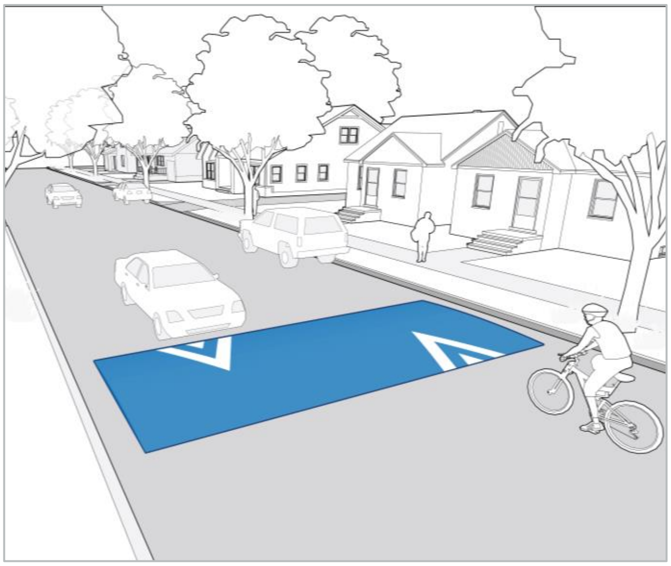
A crash reduction rate has not yet been determined.

## Additional Resources

- GDOT Pedestrian and Streetscape Guide
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- NACTO Urban Street Design Guide

# SPEED HUMPS/SPEED TABLES

A raised pavement area for vertical deflection to slow drivers. Speed tables have a flat top to limit disturbances to larger vehicles such as emergency response or transit vehicles. These are best used on streets with lower vehicle speeds (25 mph and under).



## Safe System Framework

- Reduce speeds

## Crash Types

*Head On* *Rear-end* *Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Local streets, and some collectors.

## Considerations

- Consider priority and delay of emergency response vehicles, buses, or heavy vehicles by including breaks in the speed humps/speed tables.
- Investigate feasibility of other traffic calming measures first.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

45% to 51%

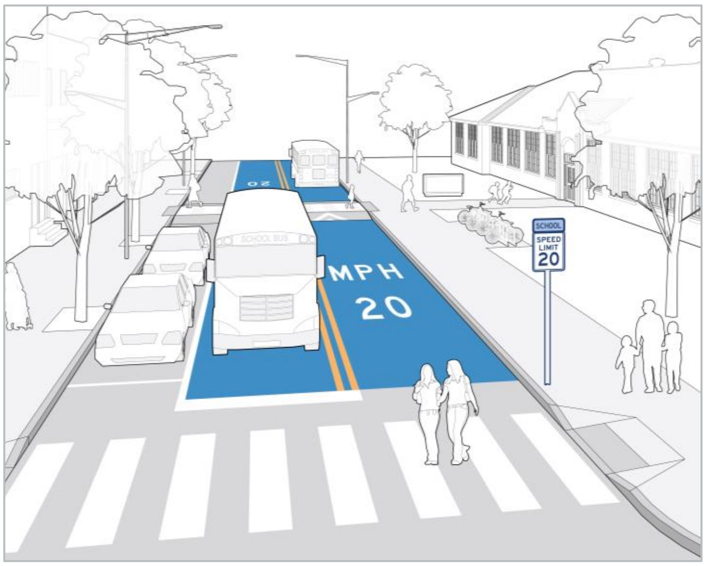
*(Elvik et. al., 2004; Schepers et. al., 2011)*

## Additional Resources

- AASHTO Guide for the Development of Bicycle Facilities
- GDOT Pedestrian and Streetscape Guide
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- Manual on Uniform Traffic Control Devices (MUTCD)

# SPEED LIMIT REDUCTION AND POLICIES

Set appropriate speed limits for all road users to reduce the significant risks drivers impose on others and themselves. In the event of a crash, fatalities, and serious injuries are much less likely if speeds are reduced. As a designated authority to set speed limits, the City of Atlanta can establish non-statutory speed limits or designate reduced speed zones.

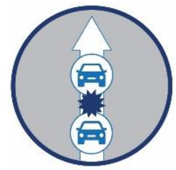



## Safe System Framework

- Reduce speeds

## Crash Types


*Head On*


*Rear-end*


*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- All streets and contexts.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Considerations

- Consider factors such as pedestrian and bicyclist volumes, land use context, intersection and driveway spacing, roadway geometry, roadway functional classification, and traffic volume.
- Deploy 20 mph (or lower) speed zones or speed limits in the urban core and other areas (e.g., schools, parks, or trails) with a high volume of people walking and/or bicycling.
- Implement other speed management strategies concurrently with setting speed limits, such as self-enforcing roadways, traffic calming, and speed safety cameras.

## Additional Resources

- FHWA Proven Safety Countermeasures
- FHWA Speed Management
- NACTO City Limits: Setting Safe Speed Limits on Urban Streets

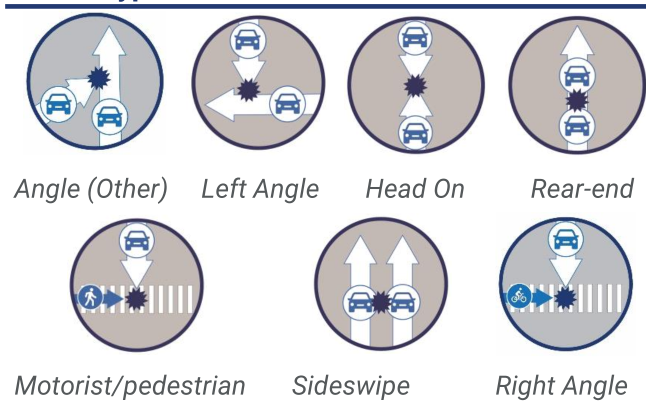
# SPEED SAFETY CAMERA

A type of automated enforcement technology that detects and records images of drivers traveling faster than the posted speed limit. The footage is then reviewed by the Police Department to issue a citation for the violation. They can help increase driver compliance to safe speeds.


## Safe System Framework

- Increase attentiveness
- Reduce speeds

## Crash Types




## Modes

## Relevant Roadway Type & Application

- All streets in school zones (based on current Georgia State law).

## Considerations

- Replace speed enforcement by physical policing and operates 24/7.
- Install signage warning drivers in advance of the first speed camera on a corridor.

## Cost & Effectiveness

**Cost per Site**

$ $$ **$$$** $$$$

**Crash Reduction Factor**

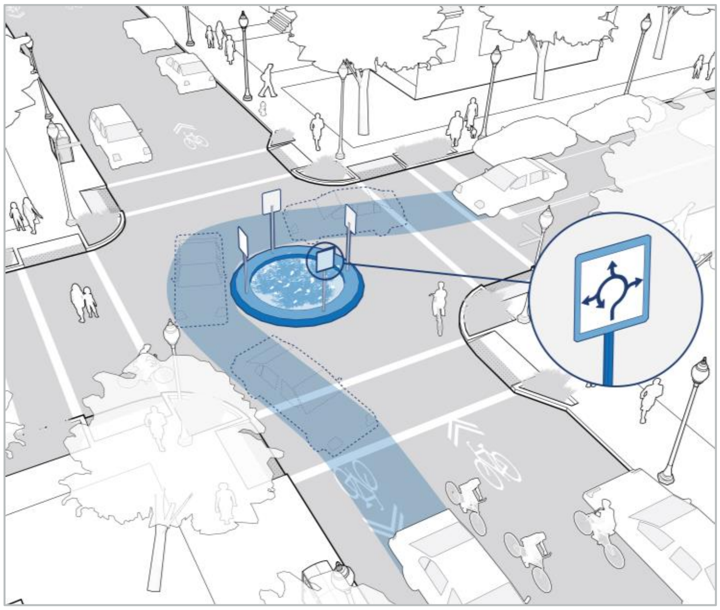
19% to 28% *(Li, et. al., 2013)*

## Additional Resources

- GDOT Rules of Permitted Automated Traffic Enforcement Safety Devices in School Zones
- FHWA Red Light Camera Systems Operational Guidelines
- NHTSA Countermeasures that Work

# TRAFFIC CIRCLES

Circular raised islands in the center of intersections. They are best used on neighborhood streets where a full-sized roundabout is not appropriate. They reduce driver speeds at uncontrolled intersections. Sometimes referred to as neighborhood traffic circles or mini circles.



## Safe System Framework

- Increase attentiveness
- Reduce speeds

## Crash Types

*Head On*

*Motorist/pedestrian*

## Modes

## Relevant Roadway Type & Application

- Unsignalized intersections.
- Local and some collectors.

## Considerations

- Install signage that direct traffic flow and make islands visible to drivers.
- Consider landscaping with low shrubs or vegetation that does not impede visibility.
- Restrict parking on approaches to the traffic circle and/or create mountable curbs on the outside of the traffic circle to allow for large vehicle access.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

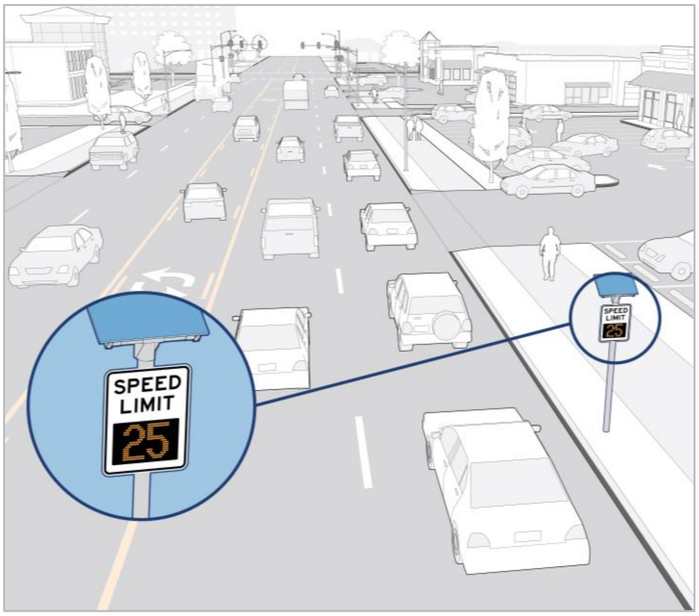
A crash reduction rate has not yet been determined.

## Additional Resources

- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- NACTO Mini-Roundabouts Technical Summary

# VARIABLE SPEED LIMITS

Variable speed limit signs use current information on the roadway conditions, like traffic speed, volumes, weather, and road surface conditions, to determine appropriate speed limits and display them to drivers in real-time using electronic signs. They are particularly effective on high-speed arterials with posted speed limits greater than 40 mph.




## Safe System Framework

- Increase attentiveness
- Reduce speeds

## Crash Types

*Rear-end*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Arterials.

## Considerations

- Can be applied to an entire roadway segment or individual lanes.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

34% to 65% *(Avelar, et. al., 2020)*

## Additional Resources

- FHWA Proven Safety Countermeasures

# ROADWAY DEPARTURE

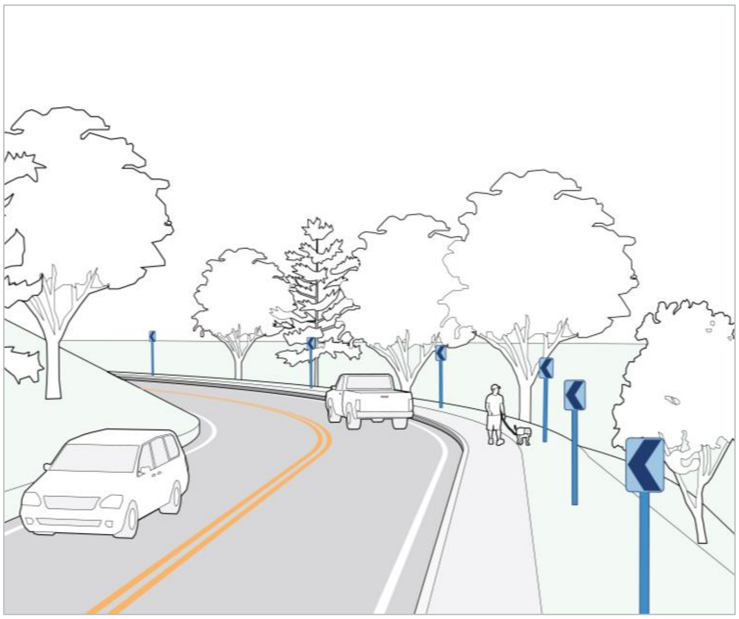
The Roadway Departure category presents design safety countermeasures known to help prevent drivers from driving off roadways.

The safety countermeasures in this category are:

- Enhanced Delineation for Horizontal Curves
- Longitudinal Rumble Strips
- Pavement Friction Management
- Roadside Design Improvements at Curves
- Safety Edges
- Wider Edge Lines

# ENHANCED DELINEATION FOR HORIZONTAL CURVES

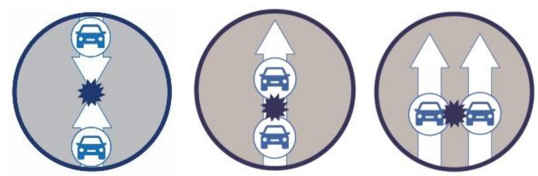
Enhanced delineation at horizontal curves includes a variety of design strategies and roadway features that can be implemented in advance of or within curves, in combination, or individually, including chevron signs, and pavement markings. They alert drivers to upcoming curves, the direction and sharpness of the curve, and appropriate operating speed. This safety countermeasure demonstrates the Safe System Approach that redundancy is crucial by layering on additional signs and markings at a single location.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types



*Head On* *Rear-end* *Sideswipe*

## Modes

## Relevant Roadway Type & Application

- Along corridors with curves.
- All locals, collectors, and arterials.

## Considerations

- Consider adding roadway features in advance of curves as well as within the curves.

## Cost & Effectiveness

### Cost per Site

$ **$$** $$$ $$$$

### Crash Reduction Factor

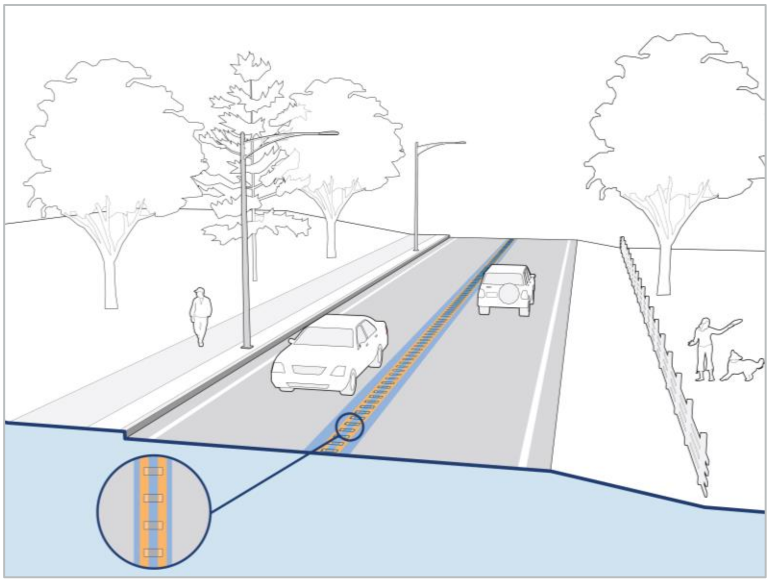
15% to 60% *(Lyon et. al., 2017)*

## Additional Resources

- **Error! Hyperlink reference not valid.**
- FHWA Horizontal Curve Safety
- Manual on Uniform Traffic Control Devices (MUTCD)

# LONGITUDINAL RUMBLE STRIPS

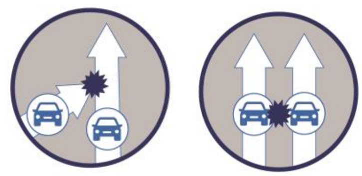
Longitudinal rumble strips are milled or raised elements on the pavement that create vibration and sound when driven over in an automobile. They alert drivers that they have traveled outside of the lane or roadway. They can be installed on the shoulder, edge line, or at or on the center line of an undivided roadway.



## Safe System Framework

- Increase attentiveness

## Crash Types



*Angle (other)* *Sideswipe*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Suburban and Rural/Production collectors or minor arterials.

## Considerations

- Can increase the visibility and durability of the pavement marking during wet, nighttime conditions when pavement markings are placed over the rumble stripes.
- Consider using an oscillating sine wave pattern that reduces noise outside of the vehicle (also known as ”mumble strips“)in areas where rumble strips cannot be placed due to noise concerns.
- Consider rumble strips with gaps for people riding bicycles.

## Cost & Effectiveness

**Cost per Mile**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

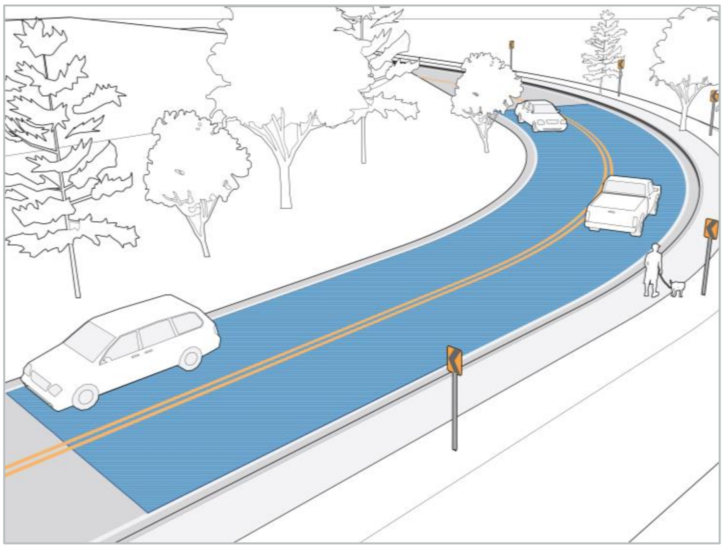
13% to 64% *(NCHRP Report 641, 2009)*

## Additional Resources

- [FHWA Proven Safety Countermeasures]

# PAVEMENT FRICTION MANAGEMENT

Targeting enhanced pavement friction treatments at locations where drivers are frequently turning, slowing, and/or stopping. High Friction Surface Treatment (HFST) is one treatment type that consists of a layer of durable, anti-abrasion aggregate over the roadway surface. They can help can prevent many roadway departure, intersection, and pedestrian-related crashes.



## Safe System Framework

- Increase attentiveness

## Crash Types

*Head On* *Motorist/pedestrian* *Sideswipe*

## Modes

## Relevant Roadway Type & Application

- Near signalized and unsignalized intersections, and curves.
- Collectors and arterials.

## Considerations

- Use Continuous Pavement Friction Measurement (CPFM) equipment to measure friction continuously to provide both network and segment level data. HFST is applied on existing pavement, so no new pavement is added.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

20% to 63%

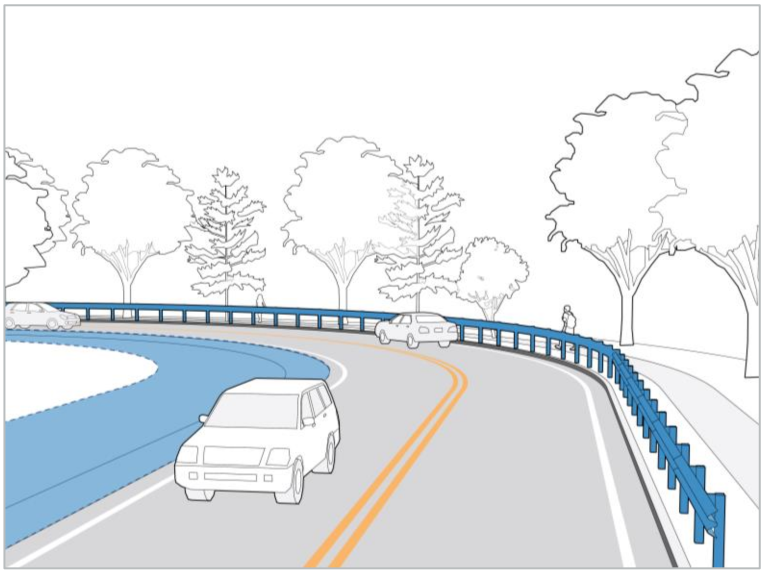
*(NCHRP Report 617, 2008; Merritt et. Al, 2020)*

## Additional Resources

- [FHWA Proven Safety Countermeasures]
- [FHWA High Friction Surface Treatment]

# ROADSIDE DESIGN IMPROVEMENTS AT CURVES

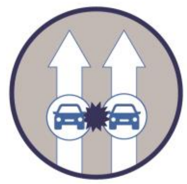
Several design improvements at curves that include widened shoulders, flattened side slopes, and expanded clear zones that provide safe recovery. Additionally, roadside barriers such as cable barriers, metal-beam guardrails, or concrete barriers can help mitigate crash severity. They provide drivers with a safer opportunity to regain control and re-enter the roadway and/or protect against unmovable objects or steep embankments.



## Safe System Framework

- Separate users in space

## Crash Types



*Sideswipe*

## Modes

## Relevant Roadway Type & Application

- Along corridors with curves.
- All locals, collectors, and arterials.

## Considerations

- Place longitudinal barriers between pedestrian or bicyclist facilities and the motor vehicle travel lanes.
- Provide a fence between pedestrian and bicyclist facilities and steep side slopes.

## Cost & Effectiveness

**Cost per Site**

$ $$ **$$$** $$$$

**Crash Reduction Factor**

8% to 44%

*(NCHRP Report 617, 2008; Elvik, R., and Vaa, T.,2004)*

## Additional Resources

- FHWA Proven Safety Countermeasures
- FHWA Low-Cost Treatments for Horizontal Curve Safety, 2016
- AASHTO Roadside Design Guide

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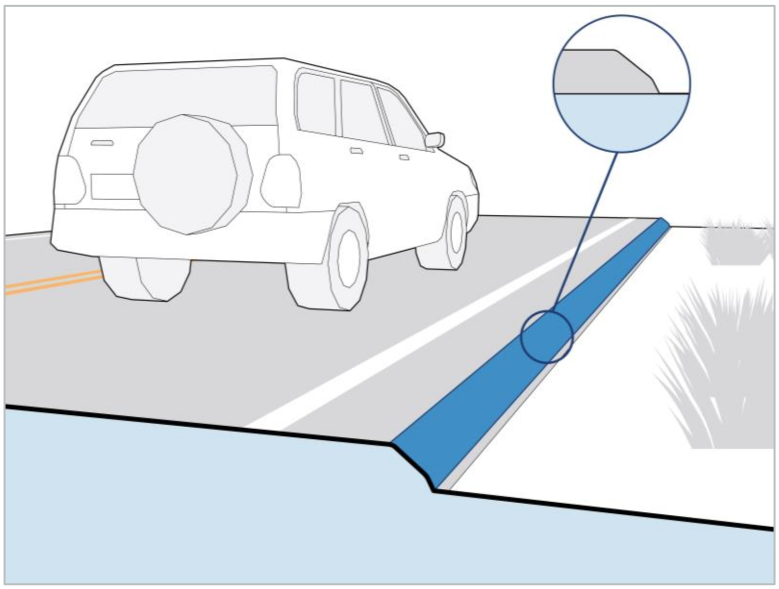
# SAFETY EDGES

The SafetyEdge technology shapes the edge of the pavement to a gradual angle to eliminate the potential for a vertical drop-off at the pavement edge on curb-less roads. During construction of new roads or resurfacing of existing roads. They help allow drivers to safely return to the roadway after they veer off. They can also improvement pavement durability by reducing edge raveling.



## Safe System Framework

- Separate users in space

## Crash Types

*Head On*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Suburban and Rural/Production roads without curbs.

## Considerations

- Develop standards for implementing the SafetyEdge systemwide on all new asphalt paving and resurfacing projects where curbs and/or guardrail are not present.

## Cost & Effectiveness

**Cost per Mile**

$ $$ $$$ $$$$

**Crash Reduction Factor**

11% to 21% *(Donnell et. al., 2017)*

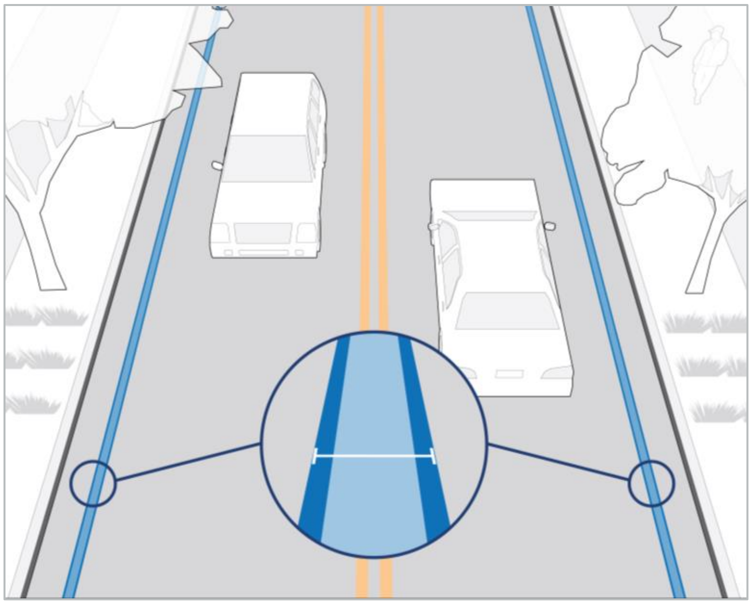
## Additional Resources

- [FHWA Proven Safety Countermeasures]
- [FHWA SafetyEdge]

PSCi

# WIDER EDGE LINES

Wider edge lines enhance the visibility of travel lane boundaries compared to traditional edge lines. Wider markings widths are 6 inches, up from the minimum normal line width of 4 inches. They help increase drivers' perception of the edge of the travel lane.



## Safe System Framework

- Increase visibility
- Increase attentiveness

## Crash Types

*Head On*

## Modes

## Relevant Roadway Type & Application

- Along corridors
- Suburban and Rural/Production roads without curbs.

## Considerations

- Consider implementing during maintenance procedures like re-striping and resurfacing, with the only cost increase being the additional material.

## Cost & Effectiveness

**Cost per Mile**

$ $$ $$$ $$$$

**Crash Reduction Factor**

22% to 37%

*(Park et. al., 2012; Abdel-Rahim et. al., 2018)*

## Additional Resources

- [FHWA Proven Safety Countermeasures]

# OTHER ROAD DESIGNS (CROSSCUTTING)

The Other Road Designs (Crosscutting) category presents additional safety countermeasures that are cover multiple types of modes and categories and cover multiple objectives.

The safety countermeasures in this category are:

- Bus Stop Improvements
- Floating Bus Stop/Bus Islands
- Lighting
- Raised Medians

Systemic

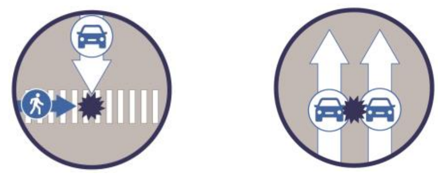
# BUS STOP IMPROVEMENTS

An area used for the waiting, boarding, and alighting of bus passengers and includes associated amenities for bus passengers, including a clear curb area and roadway area needed for the bus to safely service the stop. They create a safe, accessible, easily identifiable, and comfortable area for waiting, boarding, and alighting of bus passengers. They may also encourage the use of transit by improving access, safety, navigation, convenience, and comfort.

## Safe System Framework

- Separate users in space
- Increase visibility

## Crash Types



*Motorist/pedestrian* *Sideswipe*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Midblock crossings, signalized and unsignalized intersections
- All locals, collectors, and arterials with bus service.

## Cost & Effectiveness

**Cost per Site**

$ $$ **$$$** $$$$ *Varies due right-of-way and features*

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

## Considerations

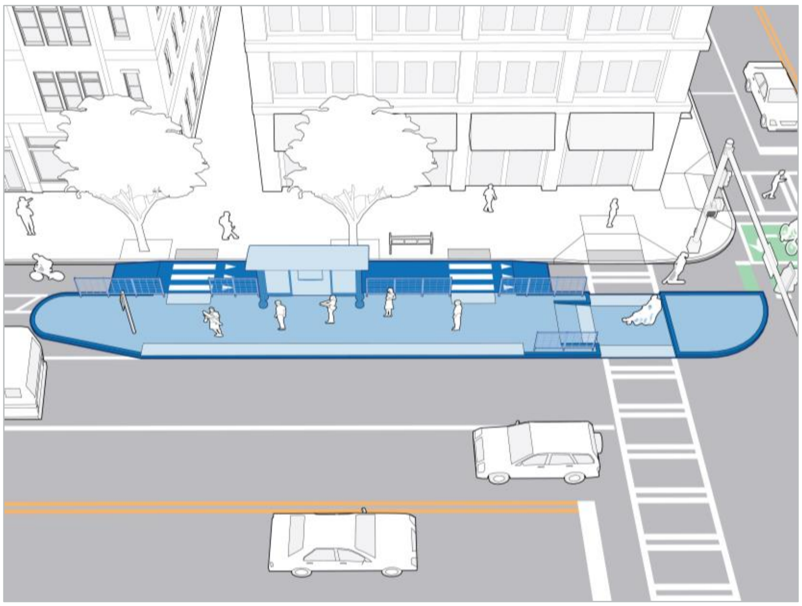
- Provide ADA accessible street crossings including crosswalks and curb ramps.
- Consider ridership and other criteria to a variety of other passenger amenities, such as static and real-time bus information, lighting, benches, shelters, trash receptacles, micro transportation hubs, and bus bulbs.
- Provide a bus bulb, a curb extension with a bus stop, to allow buses to stop in the travel lane, eliminating the need for buses to merge in and out of traffic at the stop, and providing more space for waiting passengers and people walking on the sidewalk.

## Additional Resources

- American Disabilities Act Accessibility Standards
- NACTO Transit Street Design Guide

# FLOATING BUS STOPS

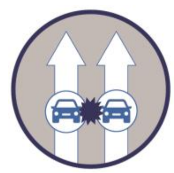
Waiting island located between travel lanes and bicycle lanes where transit passengers board and alight transit vehicles. Transit passengers cross the bicycle lane when traveling to or from the platform. They eliminate the conflict between people traveling in bicycle lanes and transit vehicles. Also called side boarding island bus stop.



## Safe System Framework

- Separate users in space
- Increase visibility

## Crash Types



*Sideswipe*

*Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Along corridors.
- Midblock crossings.
- Signalized and unsignalized intersections
- All locals, collectors, and arterials with bus service.

## Considerations

- Consider traffic control such as "Yield" or "Stop" along the bicycle lane before the bus stop to ensure people bicycling are aware of pedestrians may cross the bicycle lane.
- Provide easily navigable and safe access for visually impaired persons to access the bus stop.

## Cost & Effectiveness

**Cost per Site**

$ $$ **$$$** $$$$

*Varies due right-of-way and features*

**Crash Reduction Factor**

A crash reduction rate has not yet been determined.

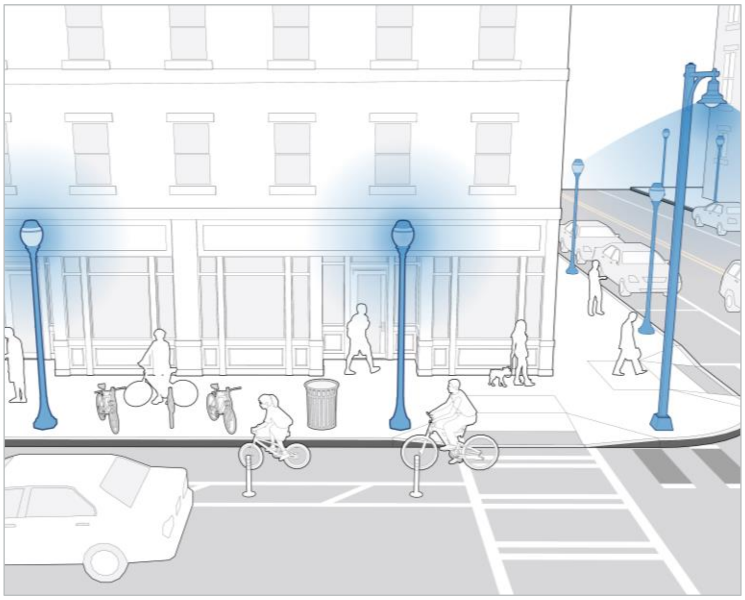
## Additional Resources

- [Atlanta Regional Commission Bike to Ride]
- [NACTO Transit Street Design Guide]

PSCi

# LIGHTING

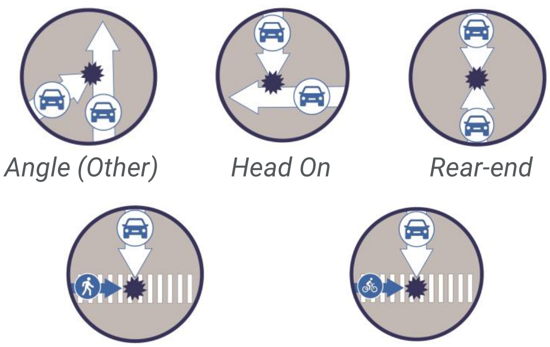
Overhead lighting to increase visibility for all road users, especially at crossings. Pedestrian-scale lighting illuminates sidewalks and crossings where light fixtures are shorter than roadway-scale light fixtures. They may increase yielding and compliance when used in conjunction with traffic control devices.



## Safe System Framework

- Increase visibility

## Crash Types



*Angle (Other)* *Head On* *Rear-end*

*Motorist/ pedestrian* *Motorist/bicyclist*

## Modes

## Relevant Roadway Type & Application

- Systemic
- Along corridors, intersections, and midblock crossings.
- All locals, collectors, and arterials.

## Considerations

- Provide lighting on crosswalk approaches. If a crossing has a crossing island, additional lighting may be provided.
- Consider adjustments in brightness or bulb type to existing street lighting.

## Cost & Effectiveness

**Cost per Site**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

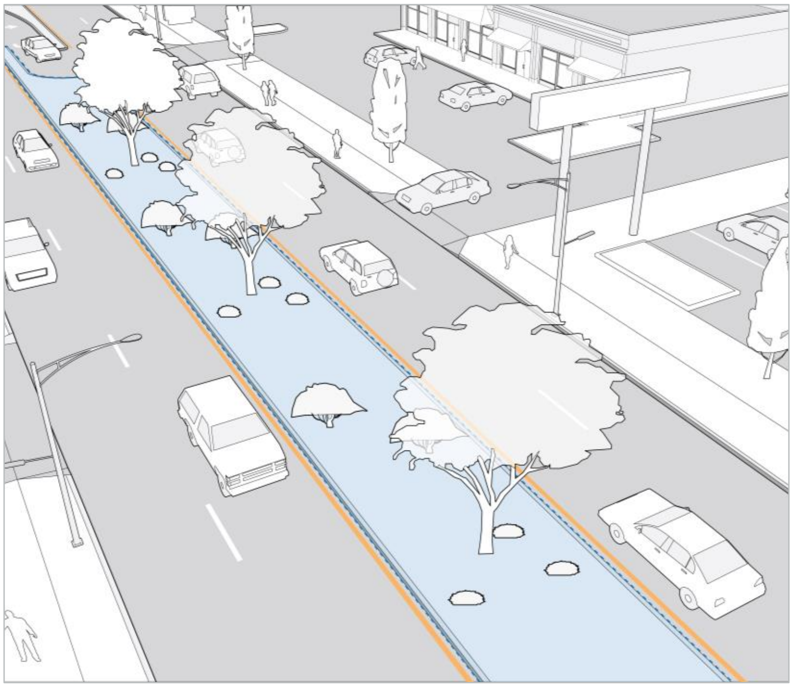
23% *(Harkey, et. al., 2008)*

## Additional Resources

- FHWA Proven Safety Countermeasures

# RAISED MEDIANS

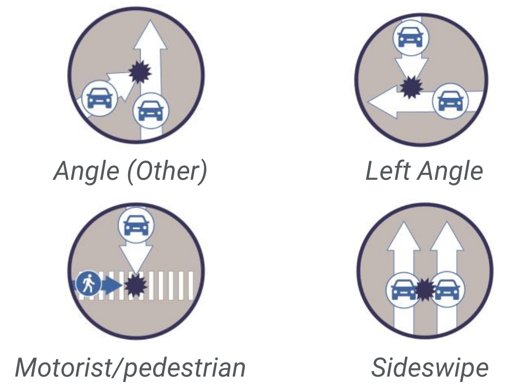
Curbed sections of the roadway in the median that separate opposing directions of travel lanes. They restrict motor vehicle turn movements and increase separation between drivers traveling in opposing directions.



## Safe System Framework

- Separate users in space

## Crash Types




## Modes

## Relevant Roadway Type & Application

- Midblock crossings.
- Signalized and unsignalized intersections.
- Along corridors.
- All locals, collectors, and arterials

## Cost & Effectiveness

**Cost per Mile**

$ **$$** $$$ $$$$

**Crash Reduction Factor**

46% *(Bahar, et. al, 2007)*

## Considerations

- Reduce potential conflict points by minimizing drivers' potential turning movements.
- Can improve driver safety where a continuous raised median replaces continuous two-way center turn lanes.
- Medians may be landscaped or paved with a material different to that of the roadway.
- Can be combined with raised refuge islands to provide safer crossings for people walking.

## Additional Resources

- FHWA Proven Safety Countermeasures
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

# NEXT STEPS

The Education Guide is intended to be used as a reference by the City of Atlanta's engineers, planners, elected officials, and the overall Atlanta community. This Education Guide helps create a shared understanding of different roadway design elements that the City can implement to eliminate roadway fatalities and serious injuries.

As the City observes and evaluates the types of crashes that are occurring on its streets, it can select safety countermeasures from this Education Guide to deploy at the appropriate locations. Safety countermeasures will be selected for specific locations in the city only after an evaluation of the appropriateness of the countermeasure for the location's context. Safety countermeasures may be first deployed on the HIN where there is a disproportionate number of crashes that led to a fatality or serious injury, and/or incorporated systemically across the city as other projects arise. Realizing that City resources are limited, projects can be deployed in a variety of ways including the development of an annual program budget for Vision Zero implementation, programming capital improvement funds, through land use development projects, or as part of roadway resurfacing/rehabilitation projects.

The City will use this Education Guide as a companion to the **Safer Streets Selection Tool** to assist in identifying the most appropriate safety countermeasures based on a location's crash history and context (including traffic volume and roadway geometry). The Selection Tool includes the design elements of the 51 safety countermeasures described in this Education Guide.

As the City deploys these safety countermeasures, a database of what countermeasures are deployed and where they are deployed will be kept by the City to track before-and-after data and evaluate the effectiveness of the countermeasures in the context of the city's roads and conditions. The City may adjust the safety countermeasures included in this Education Guide based on an evaluation of the countermeasure's effectiveness.

## PROACTIVE SYSTEMIC SAFETY COUNTERMEASURES

There are some safety countermeasures in the Education Guide that are recommended as proactive systemic safety countermeasures. The proactive systemic safety countermeasures would be installed first on the HIN, then in similar conditions where crashes could occur, and eventually citywide as budget and staff resources allow. These systemic safety countermeasures could also be implemented proactively as part of other street improvements, such as street reconstruction or as part of new land use development projects.

The proactive systemic safety countermeasures for Atlanta are:

- **Bus Stop Improvements***
- **Corner/Turn Wedges**
- **Daylighting/Parking Restrictions at Crossings***
- **Exclusive Pedestrian Signal Phases**
- **High Visibility Crosswalks**
- **Leading Pedestrian Intervals (LPIs)**
- **Right Turn on Red Prohibitions**
- **Slip Lane Closure**

** Safety countermeasures that are usually requested as part of new land use development projects*