October
2025

# TRANSPORTATION SAFETY ACTION PLAN

## Countermeasure Toolkit Report

DUTCHESS COUNTY
TRANSPORTATION COUNCIL
Better ways from here to there

# Transportation Safety Action Plan

## Countermeasure Toolkit Report

prepared for

DUTCHESS COUNTY TRANSPORTATION COUNCIL

Better ways from here to there

prepared by

CAMBRIDGE SYSTEMATICS

date

October 2025

# Disclaimer

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

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## Table of Contents

# 1.0 Introduction

Dutchess County has experienced an increase in traffic crashes that result in fatalities and serious injuries, affecting the lives of residents and visitors. In response, the Dutchess County Transportation Council (DCTC) developed a Safety Countermeasure Toolkit as part of its Safety Action Plan (SAP).

The Toolkit provides a menu of traffic safety countermeasures that address a range of transportation safety needs across the county, as identified through a detailed data and crash analysis (see Crash Data Analysis Reports – Parts 1 & 2), public input, and stakeholder engagement. These countermeasures support the DCTC's commitment to creating safer streets by reducing crashes across all transportation modes, including pedestrians and bicyclists.

The Toolkit is intended to serve as a practical reference that agencies and decision makers can use to help streamline the safety planning and project development process. Each entry in the Toolkit includes an overview of a safety countermeasure with an illustration and critical information about how and where it is most effective.

# 2.0 Countermeasure Development Process

To align the Toolkit with national best practices and local needs, we selected traffic safety countermeasures based on a data-driven and community-based planning process that resulted in a customized set of tools tailored to Dutchess County. The countermeasures were selected based on a review of existing plans and policies, a comprehensive network analysis of traffic safety in the county, and input from stakeholders and the public.

The countermeasure development process used information collected throughout the development of the Safety Action Plan:

- **Review of key existing plans and policies:** Relevant documents were reviewed to ensure alignment with federal, state, and peer agency guidance. The countermeasures in the Toolkit are also aligned with the principles of the Safe Systems Approach.
- **Crash data analysis:** A two-part network screening analysis was conducted using crash data from New York State to identify the type of roads and intersections in the county with elevated safety concerns. Emphasis areas were identified based on roadway characteristics, crash types, and contributing factors to crashes.

| Safe System Element | Plan Emphasis Area |
|---|---|
| Safer Roads | Intersections<br>Roadway Departure |
| Safer Speeds | Speeding |
| Safer Vehicles | Motorcycle Safety<br>Large Trucks |
| Safer People | Vulnerable Road Users<br>Older Drivers<br>Distracted Driving<br>Impaired Driving<br>Aggressive Driving |

These emphasis areas account for the most frequent crash types, crash types that are increasing, or crashes that tend to be especially severe.

The analysis found that among urban roads, roads classified as “principal arterial-other” account for 30% of crashes and 30% of fatalities and serious injuries. Among rural roads, major collectors and “principal arterial-other” roads each accounted for 25-30% of crashes and fatalities/serious injuries. accounted for 25-30% of crashes and fatalities/serious injuries.

- **Stakeholder and public engagement:** We held several stakeholder interviews and a workshop for municipal staff, agency representatives, and community leaders to gather input on safety concerns, priorities, and opportunities for improvement. Public input was collected through an online survey, interactive maps, and a virtual public meeting to identify known safety issues and locations of concern.

  Among the key themes shared was the need for better infrastructure, such as better intersections, roadway design, and features to protect pedestrians, as well as concerns with aggressive and distracted driving. Many residents reported feeling unsafe when walking, cycling, or riding a motorcycle. An online interactive mapping tool showed speeding, turning conflicts, and poor sidewalk infrastructure as top issues.

We also hosted a March 2025 workshop in which stakeholders voted using stickers on poster boards to indicate the infrastructure safety countermeasures that they would like to see implemented in Dutchess County. Raised crosswalks, curb extensions, street trees, speed feedback signs, and roundabouts were especially popular.

## 2.1 Countermeasure Selection

Based on these findings, we identified 31 safety countermeasures that would improve traffic safety in Dutchess County and respond to the key risks and concerns.

An initial list of countermeasures was derived from the Federal Highway Administration's (FHWA) Proven Safety Countermeasures (PSC) inventory.[1] The PSC resource consists of 28 safety infrastructure countermeasures and strategies that have been validated by research. Additional countermeasures were added from published SAPs or Toolkits from peer agencies or municipalities. As Dutchess County includes a mix of urban, suburban, and rural areas, it was important to include countermeasures that represented the concerns and needs of a broad range of road types.

# 3.0 How to Use the Toolkit

This Toolkit was developed as a resource to support transportation safety planning across the county. The set of countermeasures is intended to serve as a reference for professionals, helping agencies and decision makers develop strategies to improve roadway safety for all users.

Planners and engineers identifying highway safety challenges at county locations can reference this toolkit to find infrastructure safety countermeasures to meet local needs.

Each safety countermeasure is presented as a profile with a standardized set of characteristics. These elements offer a concise overview of the treatment, its intended function, ideal application locations, and potential benefits. The layout of the countermeasure pages and the definitions for each element are provided below.

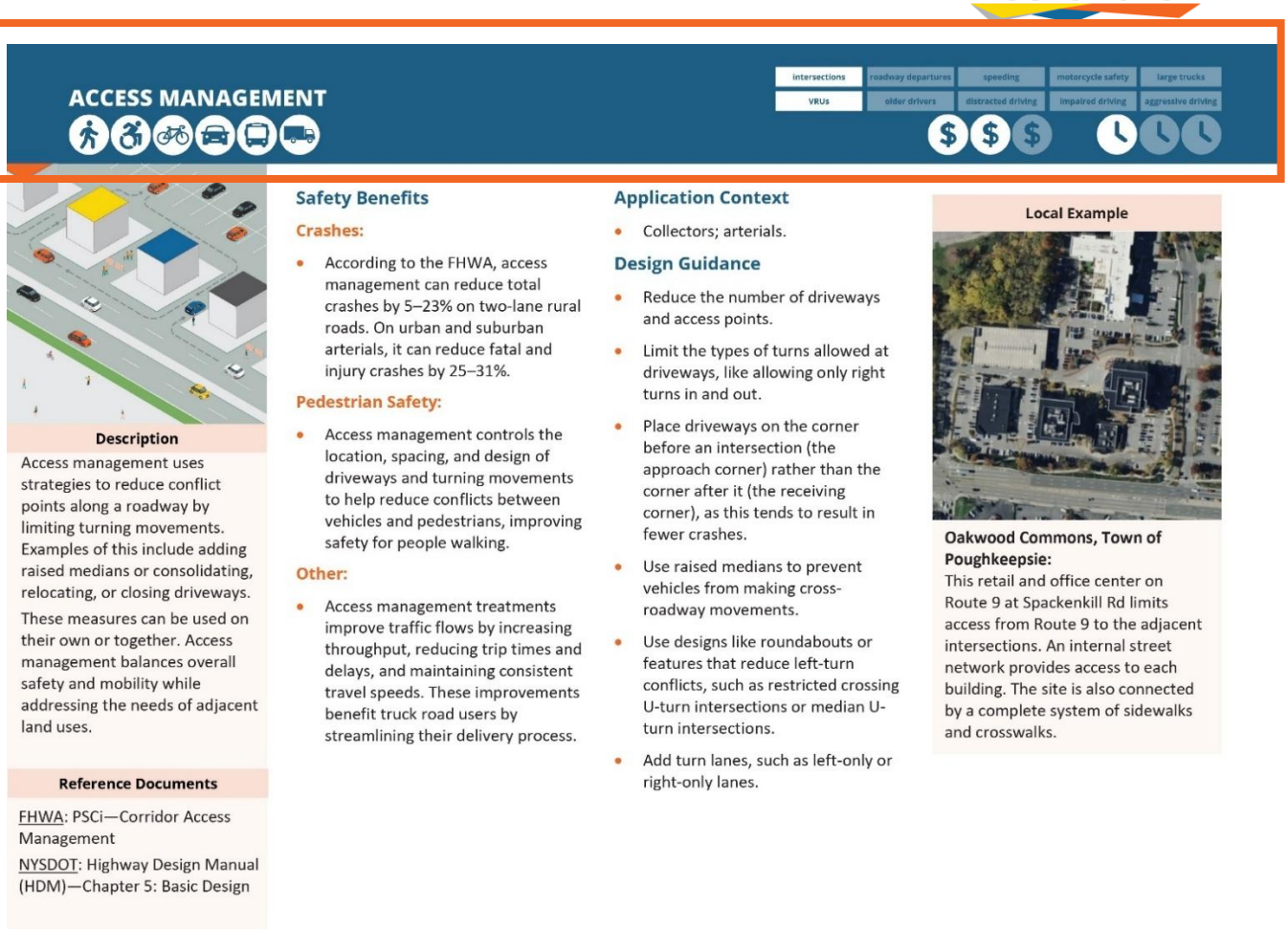
## 3.1 Countermeasure Profiles: Overview and General Context

The top blue portion of the page includes icons for the affected roadway users, relevant emphasis areas, cost estimate, and implementation time.

These four elements provide an at-a-glance overview to provide visual consistency for side-by-side comparisons with other countermeasures.

[1] U.S. DOT FHWA (Highway Safety Programs): Proven Safety Countermeasures | FHWA.

- **Countermeasure:** The name of the countermeasure.
- **Affected Roadway Users:** The road users who are expected to benefit from the countermeasure. User groups include pedestrians, people who use wheelchairs, cyclists, motor vehicles, buses, and trucks.
- **Emphasis Areas:** Indicates which SAP Emphasis Area(s) the countermeasure applies to:
  - Intersections: The countermeasure can mitigate crashes occurring at or near intersections.
  - Roadway Departures: The countermeasure can prevent crashes involving vehicles veering off the road.
  - Speeding: The countermeasure can reduce vehicle speeds or mitigate crashes involving unsafe speeds.
  - Motorcycle Safety: The countermeasure can prevent death and injury to motorcyclists.
  - Large Trucks: The countermeasure can prevent crashes involving large commercial vehicles.
  - Vulnerable Users: The countermeasures can improve the safety of vulnerable road users such as pedestrians, cyclists, children, and older adults.
  - Older Drivers: The countermeasure can increase the safety of older drivers, who may face physical or cognitive challenges while driving.
  - Distracted Driving: The countermeasure can reduce driver distraction.
  - Impaired Driving: The countermeasure can prevent or mitigate instances of driving under the influence of alcohol, drugs, or other substances.
  - Aggressive Driving: The countermeasure can prevent aggressive or reckless driving.
- **Cost Estimate:** A visual representation of the estimated cost of the countermeasure, categorized as low-cost ($), medium-cost ($$), or high-cost ($$$):
  - $: The countermeasure typically involves minimal work such as pavement markings, signage, or other surface-level changes.
  - $$: The countermeasure may require moderate reconstruction, such as curb extensions or paving, and may involve minor drainage or utility work.
  - $$$: The countermeasure would require substantial reconstruction of the roadway, including utility relocations, signal modifications, drainage modifications, etc.
- **Implementation Time:** A visual representation of the approximate time required to plan, design, and implement the treatment. Time is categorized as short-term (represented by one clock), medium-term (two clocks), or long-term (three clocks).

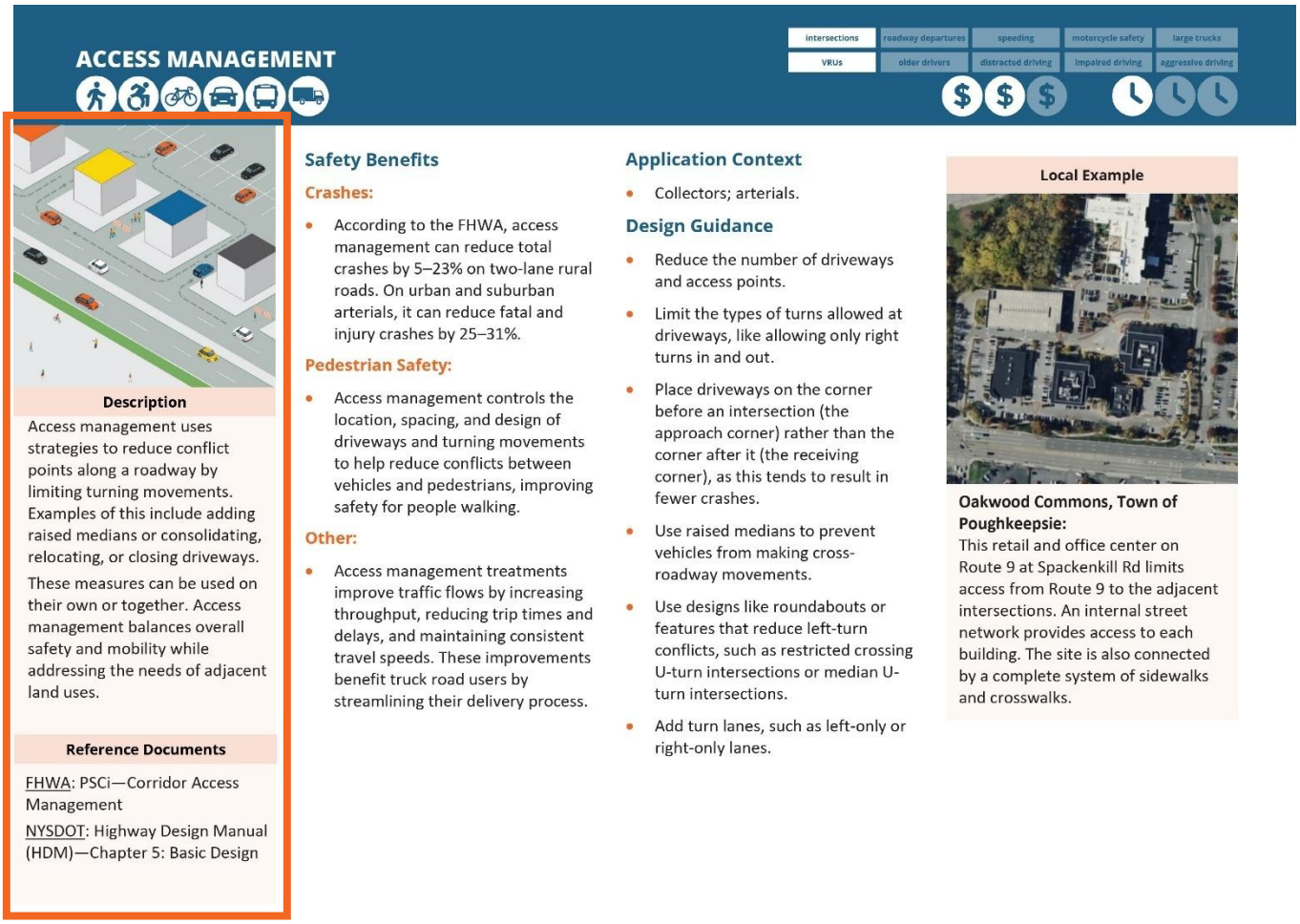



## 3.2 Countermeasure Profiles: Description and References

The left column of each page provides a visual and written description of the countermeasure, along with references to guidance documents.

The elements in this area include:

- **Illustration:** A visual representation of the countermeasure.
- **Description:** A brief explanation of the countermeasure and its intended outcome.
- **Reference Documents:** References for more detailed information about the countermeasure.




## 3.3 Countermeasure Profiles: Impacts and Implementation Guidance

The main body of each page provides information on safety benefits, the application context, and design guidance for the countermeasure.

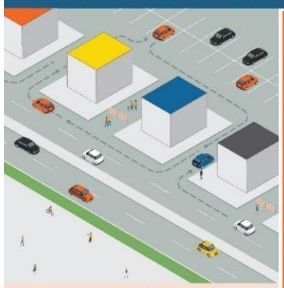
This portion of the page provides details on the countermeasure's effectiveness and applicability and includes design considerations for implementing the treatment.

- **Safety Benefits:** How the countermeasure would improve safety, based on statistics from peer-reviewed research. This specifies whether the countermeasure has the potential to reduce crashes, lower speeds, improve pedestrian safety, or other benefits. Where applicable, this section also provides the countermeasure's Crash Reduction Factor (CRF), which quantifies the countermeasure's effectiveness in reducing crashes. CRFs are provided by the FHWA's Crash Modification Factors (CMF) Clearinghouse.
- **Application Context:** Where the countermeasure is most appropriate to implement, including street types based on roadway functional classification (see also NYSDOT's interactive map of roads by functional classification).

- **Design Guidance:** Recommended dimensions and design considerations for the treatment. When developing plans, designers should supplement this information with professional engineering judgement and local context.

## ACCESS MANAGEMENT

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



**Description**

Access management uses strategies to reduce conflict points along a roadway by limiting turning movements. Examples of this include adding raised medians or consolidating, relocating, or closing driveways.

These measures can be used on their own or together. Access management balances overall safety and mobility while addressing the needs of adjacent land uses.

**Reference Documents**

FHWA: PSCi—Corridor Access Management

NYSDOT: Highway Design Manual (HDM)—Chapter 5: Basic Design

### Safety Benefits

**Crashes:**

- According to the FHWA, access management can reduce total crashes by 5–23% on two-lane rural roads. On urban and suburban arterials, it can reduce fatal and injury crashes by 25–31%.

**Pedestrian Safety:**

- Access management controls the location, spacing, and design of driveways and turning movements to help reduce conflicts between vehicles and pedestrians, improving safety for people walking.

**Other:**

- Access management treatments improve traffic flows by increasing throughput, reducing trip times and delays, and maintaining consistent travel speeds. These improvements benefit truck road users by streamlining their delivery process.

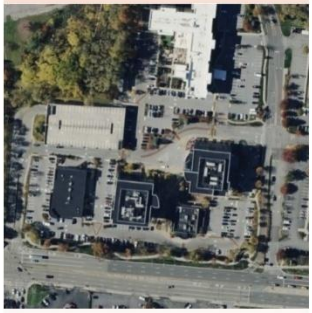
### Application Context

- Collectors; arterials.

### Design Guidance

- Reduce the number of driveways and access points.
- Limit the types of turns allowed at driveways, like allowing only right turns in and out.
- Place driveways on the corner before an intersection (the approach corner) rather than the corner after it (the receiving corner), as this tends to result in fewer crashes.
- Use raised medians to prevent vehicles from making cross-roadway movements.
- Use designs like roundabouts or features that reduce left-turn conflicts, such as restricted crossing U-turn intersections or median U-turn intersections.
- Add turn lanes, such as left-only or right-only lanes.

**Local Example**



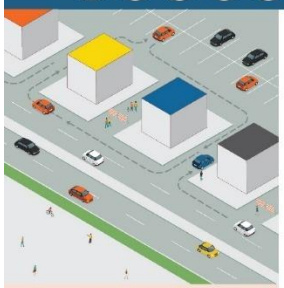
**Oakwood Commons, Town of Poughkeepsie:**
This retail and office center on Route 9 at Spackenkill Rd limits access from Route 9 to the adjacent intersections. An internal street network provides access to each building. The site is also connected by a complete system of sidewalks and crosswalks.

## 3.4 Countermeasure Profiles: Local Example

Local examples showcase real-world applications to help readers visualize how the treatment may look when implemented.

### ACCESS MANAGEMENT

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



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These measures can be used on their own or together. Access management balances overall safety and mobility while addressing the needs of adjacent land uses.

**Reference Documents**

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NYSDOT: Highway Design Manual (HDM)—Chapter 5: Basic Design

**Safety Benefits**

**Crashes:**

- According to the FHWA, access management can reduce total crashes by 5–23% on two-lane rural roads. On urban and suburban arterials, it can reduce fatal and injury crashes by 25–31%.

**Pedestrian Safety:**

- Access management controls the location, spacing, and design of driveways and turning movements to help reduce conflicts between vehicles and pedestrians, improving safety for people walking.

**Other:**

- Access management treatments improve traffic flows by increasing throughput, reducing trip times and delays, and maintaining consistent travel speeds. These improvements benefit truck road users by streamlining their delivery process.

**Application Context**

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**Design Guidance**

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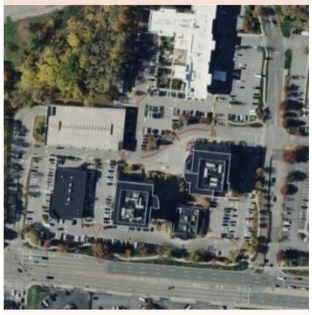
**Local Example**



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This retail and office center on Route 9 at Spackenkill Rd limits access from Route 9 to the adjacent intersections. An internal street network provides access to each building. The site is also connected by a complete system of sidewalks and crosswalks.

# 4.0 Countermeasure Toolkit

Below is the list of the safety countermeasures included in the Toolkit.

- Access Management
- ADA-Compliant Sidewalks and Curb Ramps
- All-Way Stops
- Automated Enforcement
- Bicycle Boulevards/Neighborhood Greenways
- Bike Lanes
- Centerline/Edge Line/Parking Lane Striping
- Curb Extensions
- Dedicated Left- and Right-Turn Lanes
- Flashing Stop Signs
- High-Friction Pavement
- High-Visibility Crosswalks
- Intersection Daylighting
- Lane Narrowing
- Leading Pedestrian Intervals (LPIs)
- Medians and Pedestrian Refuge Islands
- Pedestrian Warning Signs
- Raised Crosswalks/Intersections
- Rectangular Rapid Flashing Beacons (RRFB)
- Road Diets (Roadway Reconfiguration)
- Roundabouts
- Rumble Strips
- Signal Progression
- Speed Cushions/Humps/Tables
- Speed Limit Reduction
- Speed Radar/Feedback Signs
- Street Lighting
- Street Trees/Landscaping
- Traffic Signs and Markings
- Turn Hardening
- Turning Movement Restrictions

# ACCESS MANAGEMENT

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Access management uses strategies to reduce conflict points along a roadway by limiting turning movements. Examples of this include adding raised medians or consolidating, relocating, or closing driveways.

These measures can be used on their own or together. Access management balances overall safety and mobility while addressing the needs of adjacent land uses.

## Reference Documents

FHWA: PSCi—Corridor Access Management

NYSDOT: Highway Design Manual (HDM)—Chapter 5: Basic Design

## Safety Benefits

### Crashes:

- According to the FHWA, access management can reduce total crashes by 5–23% on two-lane rural roads. On urban and suburban arterials, it can reduce fatal and injury crashes by 25–31%.

### Pedestrian Safety:

- Access management controls the location, spacing, and design of driveways and turning movements to help reduce conflicts between vehicles and pedestrians, improving safety for people walking.

### Other:

- Access management treatments improve traffic flows by increasing throughput, reducing trip times and delays, and maintaining consistent travel speeds. These improvements benefit truck road users by streamlining their delivery process.

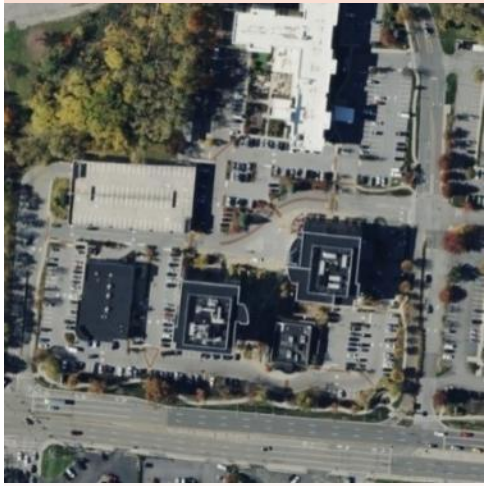
## Application Context

- Collectors; arterials.

## Design Guidance

- Reduce the number of driveways and access points.
- Limit the types of turns allowed at driveways, like allowing only right turns in and out.
- Place driveways on the corner before an intersection (the approach corner) rather than the corner after it (the receiving corner), as this tends to result in fewer crashes.
- Use raised medians to prevent vehicles from making cross-roadway movements.
- Use designs like roundabouts or features that reduce left-turn conflicts, such as restricted crossing U-turn intersections or median U-turn intersections.
- Add turn lanes, such as left-only or right-only lanes.

## Local Example



**Oakwood Commons, Town of Poughkeepsie:**
This retail and office center on Route 9 at Spackenkill Rd limits access from Route 9 to the adjacent intersections. An internal street network provides access to each building. The site is also connected by a complete system of sidewalks and crosswalks.

# ADA-COMPLIANT SIDEWALKS & CURB RAMPS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

**Description**

ADA-compliant sidewalks are grade-separated walkways, meaning they are raised above the road level. Curb ramps, usually installed at pedestrian crossings, allow wheelchair users to access the sidewalk from the road. A buffer between the sidewalk and travel lane is recommended whenever possible.

**Reference Documents**

FHWA: PSCi—Walkways
FHWA: Walkways, Sidewalks, and Paved Shoulders
FHWA: Guide for the Planning, Design, and Operation of Pedestrian Facilities
U.S. Access Board: Where Ramps and Curbs are Required
NYSDOT: HDM – Chapter 18
CMF: Install Sidewalk—ID 11246

## Safety Benefits

### Crashes:

- Per FHWA, sidewalks can reduce crashes involving pedestrians walking along roads by 65–89%.
- According to the Crash Modification Factor (CMF) Clearinghouse, sidewalks and walkways can reduce crashes by up to 40%.

### Pedestrian Safety:

- Well-designed sidewalks and walkways improve safety and access for pedestrians by providing a separated, direct, and connected network of walking routes to desired locations.

## Application Context

- Local roads; collectors; arterials

## Design Guidance

- Sidewalks are essential in urban areas, particularly near schools, transit stops and other locations with significant pedestrian activity.
- Sidewalks should be at least 5 feet wide (not including the curb) so two people can walk side-by-side or pass each other comfortably. In busy areas, sidewalks should be wider.
- In constrained areas, sidewalks can be 4 feet wide, but passing spaces are then required at least every 200 feet. Passing spaces must be a minimum of five-by-five feet.
- Sidewalks should be continuous along both sides of a street and fully accessible to all pedestrians, including those in wheelchairs.
- Curb ramps should be at least 36 inches wide and have a maximum slope of 1:12 (5%).
- To meet ADA requirements, sidewalks should have a maximum cross-slope of 2%.

**Local Example**


**Innis Ave (County Route 75), Town of Poughkeepsie:**

In 2023-2024, Dutchess County installed new sidewalks and ramps on Innis Ave to meet current accessibility standards. The sidewalks connect apartments on both sides of the street to a commercial plaza, bus stops, and destinations to the south in the City of Poughkeepsie.

# ALL-WAY STOPS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

All-way stops give equal crossing priority to drivers on all sides of an intersection and encourage yielding to other vehicles, cyclists, and pedestrians. They're usually used when traffic volumes on all roads entering the intersection are similar.

## Reference Documents

FHWA: Stop-Controlled Intersections
FHWA: PSCi—Systemic Application at Stop-Controlled Intersections
NCDOT: Evaluation of the Conversion from Two-Way Stop Sign Control to All-Way Stop Sign Control
FHWA: Signalized Intersections Informational Guide
CMF: Convert Minor-Road Stop Control to All-Way Stop Control—ID 315
MUTCD: Chapter 2B—Regulatory Signs

## Safety Benefits

### Crashes

- A study in North Carolina found that all-way stops can reduce total crashes by 68% and fatal and injury crashes by 77%.
- According to the Crash Modification Factor (CMF) Clearinghouse, converting minor-road stop control to all-way stop control can reduce crashes by up to 48%.
- Per FHWA, removing unwarranted traffic signals at urban intersections with high crash rates has been shown to decrease all types of crashes by 24% and pedestrian crashes by 17%.

## Application Context

- Local roads; minor collectors.

## Design Guidance

- A warrant study should be done to determine whether a stop sign should be installed, per the MUTCD Regulatory Signs Chapter 2B.
- Studies show that all-way stops placed where they aren't needed can lead to more speeding. Drivers may try to make up for the time they think they lost at an "unnecessary" stop sign.
- In some cases, signalized intersections can be replaced with all-way stops, based on criteria in the MUTCD.

## Local Example


**Lincoln St & E. Chester St, City of Kingston:**
The City of Kingston replaced several traffic signals with all-way stops at intersections that didn't meet the requirements for signals based on traffic volume and other factors. The new all-way stops are safer, reduce traffic delays, and save the City more than $5,000 per year in maintenance costs.

# AUTOMATED ENFORCEMENT

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

**Description**

Automated enforcement uses cameras to record vehicles that run red lights or speed. At signalized intersections, cameras take photos of vehicles that enter during a red light. Speed cameras take photos of vehicles going over the speed limit. Citations are then sent to the vehicle's registered owner.

**Reference Documents**

FHWA: Red Light Camera Systems—Operational Guidelines
FHWA: Successful Strategies for Adoption of Safety Cameras
NHTSA: Speed Safety Camera Enforcement
IIHS: Red Light Running
CMF: Install Automated Speed Enforcement System—ID 7711

## Safety Benefits

### Crashes

- Automated enforcement can reduce all injury crashes by 13-29% and right-angle injury crashes by 24% (IIHS).
- According to the Crash Modification Factor (CMF) Clearinghouse, automated enforcement can reduce crashes by up to 32%.
- In addition to reducing red light running and speeding, automated enforcement helps reduce right-angle crashes at intersections and crashes related to speeding.

### Speed

- 63% reduction in speeding in school zones during school hours (FHWA Successful Strategies).

### Congestion

- Automated enforcement reduces congestion that may result from traditional enforcement stops and from speeding-related crashes.

## Application Context

- Local roads; collectors; arterials

## Design Guidance

- Red light automated enforcement is recommended for intersections with observed red light running.
- Advance warning signage is recommended for the first red light or speed camera on a corridor.
- Speed cameras should be placed away from traffic signals, stop signs, yield signs, freeway ramps, curves with advisory speeds, or established speed transition zones.
- New York Vehicle & Traffic Law Section 1180-E allows automated speed enforcement in work zones. Specifically, it allows speed cameras to be used in construction or maintenance zones on New York State-controlled access highways and parkways.

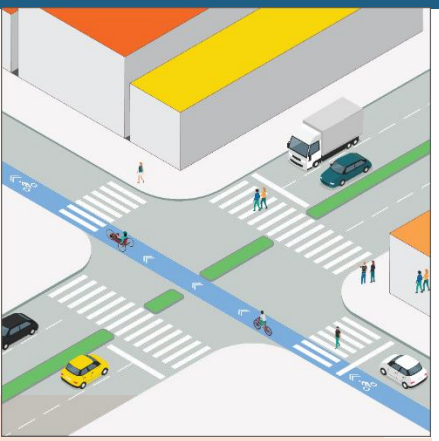
**Local Example**

**New York City:**
New York City has the nation's most robust camera- based traffic enforcement program. This includes red light cameras at hundreds of intersections and speed cameras in school zones that operate 24 hours/day, 7 days/week.

These programs have greatly reduced red-light running, speeding, crashes, injuries, and fatalities across the city, including a 94% reduction in speeding at speed camera locations.

# BICYCLE BOULEVARDS/NEIGHBORHOOD GREENWAYS

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



## Description

Bicycle boulevards are local streets modified to give priority to cyclists while still allowing cars to access the area. Neighborhood greenways are similar but prioritize pedestrians, cyclists, and small vehicles like scooters. These streets are usually quiet and slow, helping connect neighborhoods, parks, schools, and shopping areas.

## Reference Documents

SDOT: Neighborhood Greenways
FHWA: Bikeway Selection Guide
FHWA: 14.6 Bicycle Boulevards
Alta Planning & Design: Bicycle Boulevard
NYSDOT: Special Use Permits
CMF: Install Bicycle Boulevard—ID 3092

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, bicycle boulevards can reduce crashes by up to 63%.

### Speed

- Bicycle boulevards and neighborhood greenways lower vehicle speeds, which makes cycling more comfortable and reduces serious injuries if a crash happens.

### Pedestrian Safety

- Bicycle boulevards make walking safer when sidewalks and better crossings are added. They also help residents enjoy quieter, calmer streets.

## Application Context

- Local roads.

## Design Guidance

- Clear markings and signage (which can include unique branding) should communicate to all road users that they are on a bicycle boulevard, indicate that drivers should proceed with caution, and assist cyclists with wayfinding.
- Diverters can be placed at intersections to force vehicles to turn left or right instead of going straight. This stops cut-through traffic and breaks up long straight roads that can encourage speeding. Because traffic is diverted, an assessment of traffic flow may be necessary. Under Section 1684 of the Vehicle & Traffic Law, a Special Use Permit (PERM 33a) from NYSDOT is required to install a diverter on State roads.
- Design features that create a clear and comfortable experience for cyclists should be used, with a focus on measures that ensure safe crossings of major streets.

## Local Example


**North Tioga St, City of Ithaca:**
The City of Ithaca has a network of Bicycle Boulevards that connects schools, parks, and community centers using low-traffic streets. These boulevards include pavement markings and directional signs. The speed limit is 25 mph, and traffic calming features like speed humps help keep speeds low.

# BIKE LANES

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Bike lanes allocate part of the road specifically for bicycles, using stripes, signs, and pavement markings. To make roads safe and comfortable for riders of all ages and abilities, bike lane designs should be based on the road's features and local needs. On busy roads with higher speeds, separated bike lanes with a buffer between bikes and cars are recommended.

## Reference Documents

FHWA: PSCi—Bicycle Lanes
FHWA: Selecting Roadway Design Treatments to Accommodate Bicycles
NYSDOT: Highway Design Manual (HDM)—Chapter 17: Bicycle Facility Design
CMF: Install Bicycle Lanes—ID 11555

## Safety Benefits

### Crashes

- According to the FHWA, bike lanes can reduce total crashes on urban four-lane undivided collectors and local roads by up to 49%, and total crashes on urban two-lane undivided collectors and local roads by up to 30%.
- Per FHWA, converting traditional bike lanes to separated bike lanes with flexible delineator posts can reduce bicycle/vehicle crashes by up to 53%.
- According to the Crash Modification Factor (CMF) Clearinghouse, implementing bike lanes can reduce crashes by up to 43%.

### Pedestrian Safety

- By giving cyclists their own space, bike lanes can reduce riding on sidewalks and lower conflicts between pedestrians and cyclists.

## Application Context

- Local roads; minor arterials; collectors.

## Design Guidance

- A bike lane should be at least four feet wide, with a recommended width of six feet.
- On roads with two to four through-lanes, one-way bike lanes on each side of the street are preferred over a two-way separated bike lane on one side of the street because they: follow normal traffic flows, while two-way lanes can cause unexpected movements; make it easier to connect to other bike paths and facilities; and are less likely to require changes to traffic signals.
- Separated bike lanes can have different types of barriers or buffers to separate cyclists from traffic:
  - Flexible delineator posts offer the least separation and are appropriate as an interim solution.
  - Raised/curbed buffers provide the greatest level of separation from traffic but often require road reconstruction.
  - On-street parking offers a high degree of separation but may require raised buffer treatments at intersections.
  - Parking protection is best when there's a buffer between parked vehicles and bike lanes. If that's not possible, flexible posts, flex (rubber) curbs, or jersey barriers can be used instead.

## Local Example

**Broadway, City of Kingston:**
The City of Kingston converted a travel lane on Broadway into a two-way bike lane. On-street parking was moved from the curb to between the bike lane and travel lanes to create a buffer for cyclists. The project also included bike signals at intersections and green striping at driveways to alert drivers.

# CENTERLINE/EDGE LINE/PARKING LANE STRIPING

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | **distracted driving** | impaired driving | **aggressive driving**

**Description**

Striped centerlines, edge lines, and parking lanes make the road look narrower, which helps slow down traffic. They also guide drivers, helping prevent them from drifting into oncoming lanes or off the road.

**Reference Documents**

FHWA: Rural Roadway Department Countermeasure Pocket Guide

CMF: Place Edgeline and Centerline Markings—ID 101

MUTCD: Chapter 3B—Pavement and Curb Markings

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, edge line and centerline markings can reduce crashes by 24%.

### Speed

- Striping reduces the effective width of travel lanes, which helps slow down traffic. Studies show this can lower speeds by 1 to 5 mph (most commonly between 2 and 3 mph).
- The biggest speed reductions happen on narrow two-way streets that have parking on both sides.
- If half or more of the block doesn't have parked cars, parking lane striping won't slow vehicles much. In that case, curb extensions or chokers can be added to narrow the road and reduce speeds.

### Pedestrian Safety

- Edge line striping reduces the effective crossing distance for pedestrians. Edge line striping can also provide a buffer between moving vehicles and people on sidewalks, as well as cyclists in bike lanes.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

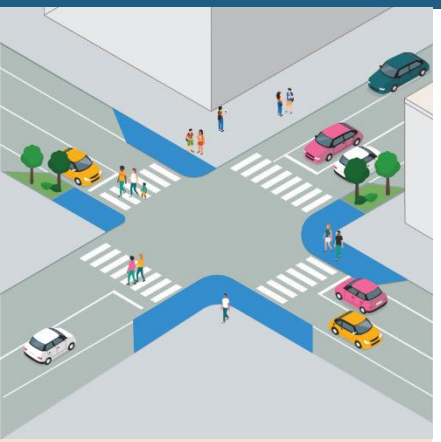
- The MUTCD provides standards and guidance for pavement striping (see Pavement and Curb Markings—Chapter 3B).
- For on-street parking, head-in and reverse angle parking requires 17 feet minimum depth, depending on the angle of the parking stall. Parallel parking requires seven feet minimum depth/width, though eight feet may be preferred for delivery trucks.

**Local Example**

**Mill Street, Town of Dover:**
In response to speeding concerns, the Town added a centerline on Mill Street in the Dover Plains hamlet. According to Town officials, the striping made the street feel narrower and they received fewer complaints about speeding.

# CURB EXTENSIONS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



## Description

Curb extensions, also called "bump outs" or "neckdowns," extend the curb outward, narrowing the roadway and shortening crosswalks at intersections or mid-block locations. At corners, they reduce the curb radius, which slows turning vehicles and improves safety for pedestrians and drivers.

## Reference Documents

FHWA: Traffic Calming ePrimer—Corner Extension/Bulbout

Arlington, VA: Curb Extensions

NYC DOT Street Design Manual: Curb Extension

CMF: Add Centerline and Move STOP Bar to Extended Curb Lines—ID 1692

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, curb extensions with a painted centerline can reduce crashes by 29%.
- Research indicates that curb extensions can increase driver yielding to pedestrians.

### Speed

- Curb extensions can reduce vehicle speeds by approximately 1 to 10 mph. This speed reduction occurs both on the approach to the intersection and through the intersection area.

### Pedestrian Safety

- Curb extensions shorten the pedestrian crossing distance and improve visibility between drivers and pedestrians.
- Curb extensions narrow the roadway, which slows traffic, reduces turning speeds, provides space for ADA curb ramps aligned with the crosswalk, and creates a physical barrier that prevents drivers from parking near crosswalks.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Curb extensions can be installed on streets with on-street parking. They may be placed on one or both sides of the street, either at intersections or mid-block.
- Curb extension width is typically about two feet less than the width of the parking lanes, and they should be at least as long as the width of the crosswalk. The maximum length of a curb extension can vary to accommodate sight lines, manage stormwater, support transit loading, or restrict parking.
- Curb extensions can be added at bus stops to create "bus bulbs," which let buses load and unload passengers without leaving the travel lane. This improves safety, accessibility, and transit efficiency.
- Temporary curb extensions can be made using pavement striping and flexible delineators. Permanent curb extensions use concrete curbing and may include vegetation or green infrastructure.

## Local Example


**Main St (Route 52), Village of Fishkill:**
Main St has a series of curb extensions at intersections. They make it easier for people to cross the street, contributing to the walkable nature of the village center.

- Plantings and street furniture on curb extensions should be less than 3 feet tall to maintain clear sight lines.
- Drainage and utility locations must be considered during the design of curb extensions.

# DEDICATED LEFT- AND RIGHT-TURN LANES

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Dedicated turn lanes provide space for vehicles to slow down or stop before turning, without blocking through traffic. This improves operations at the intersection and reduces the risk of rear-end and sideswipe crashes.

## Reference Documents

FHWA: PSCi—Dedicated Left- and Right-Turn Lanes at Intersections

FHWA: Safety Effectiveness of Intersection Left- and Right-Turn Lanes

FHWA: Handbook for Designing Roadways for the Aging Population—Chapter 2 Intersections

## Safety Benefits

### Crashes

- Left-turn lanes can reduce total crashes by 28-48%.
- Shifting opposing left turn lanes further left (called "positive offset" left-turn lanes) can improve visibility and reduce fatal and injury crashes by up to 36%.
- Right-turn lanes can reduce total crashes by 14-26%.
- Dedicated turn lanes improve safety, especially at two-way stop-controlled intersections, by reducing the risk of severe crashes involving turning vehicles.

### Speed

- Dedicated turn lanes, especially those with left- or right-turn signals, can reduce the speed of turning vehicles by bringing them to a stop before they turn.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Dedicated left- and right-turn lanes are appropriate for various intersection types based on volumes.
  - Turn lanes are typically considered at intersections where traffic volumes are moderate to high.
  - In rural areas, this usually applies when there is steady traffic on the main road and noticeable traffic turning from side roads.
  - In urban areas, lower traffic volumes may warrant turn lanes, especially where turning movements are frequent.
- Dedicated turn lanes should be installed with pedestrian and cyclist safety in mind, such as minimizing pedestrian crossing distances as much as possible.

## Local Example

**Route 376 & Lake Walton Rd/ Robinson Ln, Town of East Fishkill:** In 2018, in response to congestion and safety concerns, NYSDOT added left turn lanes and dedicated left-turn signals at each approach to this intersection, as well as a right-turn lane on the northbound approach.

# FLASHING STOP SIGNS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving


**Description**

Flashing stop signs are more visible than standard stop signs, especially at night, and can help reduce crashes. These signs reinforce the message that drivers must stop.

**Reference Documents**

Oregon Department of Transportation: Literature Review—Flashing LED Stop Signs

CMF: Estimating the Crash Reduction and Vehicle Dynamics Effects of Flashing LED Stop Signs—ID 6602

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, flashing stop signs can reduce crashes by up to 42%.
- Studies have shown that LED-enhanced stop signs can capture the attention of approaching drivers and reduce crashes at stop-controlled intersections.

## Application Context

- Local roads; collectors.

## Design Guidance

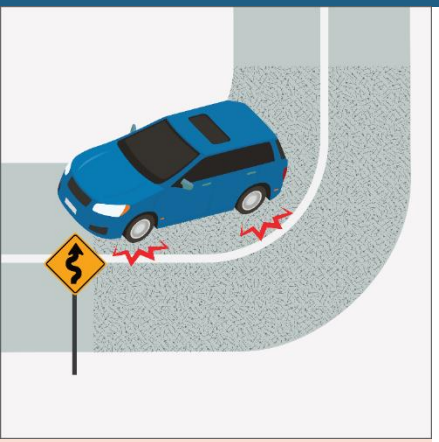
- Flashing stop signs typically flash 50 to 60 times per minute but may flash up to 120 times per minute. Flash rates between 5 and 30 times per minute are discouraged, as they may not effectively capture driver attention.
- The uniformity of flashing stop sign design must be maintained without reducing visibility, legibility, or driver comprehension under either daytime or nighttime conditions.

**Local Example**


**Bushwick Rd & Smith Rd, Town of LaGrange:**
The eastbound stop sign on Bushwick Rd at this intersection is often obscured by shadows from tall trees. To make the sign more visible, the Town installed solar-powered flashing lights on its perimeter.

# HIGH-FRICTION PAVEMENT

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



## Description

High-friction pavement improves vehicle traction, especially in wet conditions, through the application of high-quality aggregate to the pavement using a polymer binder. This restores pavement friction at existing or potential high-crash areas, including curves, ramps, and high-volume intersections, helping drivers maintain control in both dry and wet conditions.

## Reference Documents

FHWA: PSCi—Pavement Friction Management

FHWA: High Friction Surface Treatments (HFST)

FHWA: HFST Site Selection and Installation Guide

CMF: Improve Pavement Friction —ID 11316

## Safety Benefits

### Crashes

- According to research published by FHWA, high-friction pavement can reduce wet weather crashes by 83% and total crashes by 57%.
- According to the Crash Modification Factor (CMF) Clearinghouse, high friction pavement can reduce crashes by up to 56%.

## Application Context

- Local roads; collectors; arterials.
- High-friction pavement should be prioritized in the following locations:
  - Road segments with a high crash rate related to run-off-the- road crashes and wet-weather crashes.
  - Rural horizontal curves where drivers tend to take turns too fast and super elevations are inadequate.
  - Tight-radius freeway ramps.
- Other applications of high-friction pavement include high-volume intersections with pedestrian traffic.

## Design Guidance

- High friction surface treatment (HFST) limits outline how much material will be installed, as well as the associated cost and time requirement. This decision process is not standardized. Many agencies consider curve geometry in their decision. Others use in-person site observations, while some use crash diagrams and engineering judgement.
- Pavement type and texture should be considered. Open graded pavement is generally not recommended for HFST treatment as it requires more resin binder and leads to thermal incompatibility. For concrete surfaces, shotblasting is required for preparation prior to HFST installation.

## Local Example

**Slate Quarry Rd (County Route 19), Towns of Clinton and Rhinebeck:** Dutchess County DPW installed a high-friction top course on this road to address a pattern of wet weather crashes, especially on curves. Those crashes have decreased since the high friction pavement was applied.

# HIGH-VISIBILITY CROSSWALKS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

High-visibility crosswalks include patterns such as a "ladder" that are more visible to drivers than traditional "transverse line" crosswalks (two parallel lines). Other crosswalk visibility enhancements include improved lighting, enhanced signing ("Yield Here to Pedestrians" or "Stop Here for Pedestrians") and stop or yield bar pavement markings.

## Reference Documents

FHWA: PSCi—Crosswalk Visibility Enhancements

NYSDOT: Highway Design Manual (HDM)—Chapter 18: Pedestrian Facility Design

Alexandria, VA: Enhanced Visibility at Intersections

CMF: Install High-Visibility Crosswalk—ID 4123

## Safety Benefits

### Crashes

- High-visibility crosswalks can reduce pedestrian injury crashes by up to 40%.
- Advance yield or stop markings and signs can reduce pedestrian crashes by up to 25%.
- According to the Crash Modification Factor (CMF) Clearinghouse, crosswalk visibility enhancements can reduce crashes by up to 40%.

### Other

- High-visibility crosswalks promote safety by allowing drivers, pedestrians, and cyclists to see each other without obstructions.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- High-visibility crosswalks are generally suitable for streets with two lanes, speed limits of 30 mph or less, and moderate traffic volumes. They may also be considered on three-lane roads with speed limits up to 35 mph and lower traffic volumes, though extra caution should be used. On higher volume/higher speed roads, more substantial crossing improvements are needed.
- Signage, such as "Yield Here to Pedestrians", is appropriate on two- or three-lane roads where speed limits are 30 mph or less.
- On multilane roads, "Yield to Pedestrians" signs should be installed 20 to 50 feet in advance of a marked crosswalk to clearly indicate where drivers must stop or yield.
- Inlay or thermoplastic tape are the most durable and reflective crosswalk materials. Epoxy (used by NYSDOT) is also durable-- it can last up to three years. Paint fades quickly and is not recommended.

## Local Example

**East Main St (Route 9D), Village of Wappingers Falls:**
East Main Street runs through the heart of the village. High-visibility crosswalks and clear signs help drivers expect people crossing. Curb extensions and flashing beacons have been installed at several locations to further increase safety.

# INTERSECTION DAYLIGHTING

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Intersection daylighting limits parking and removes visual obstacles near intersections. This helps pedestrians and drivers see the crosswalk and curb more clearly when approaching the intersection.

Daylighting can also include physical features like curb extensions, planters, and safety bollards. This is referred to as “hardened daylighting”.

## Reference Documents

NACTO: Visibility/Sight Distance

NYCDOT: Daylighting and Street Safety: An Analysis

Lancaster, PA: What is Intersection Daylighting?

FHWA: Safe Transportation for Every Pedestrian (STEP)

## Safety Benefits

### Crashes

- According to the FHWA, restricting parking near crosswalks has been shown to reduce pedestrian crashes by 30%.
- According to NYCDOT, hardened daylighting (by adding planters or bollards) at an intersection is linked to about a 32% annual decrease in pedestrian injuries.
- According to NYCDOT, hardened daylighting created by curb extensions (neckdowns) at an intersection is associated with about a 70% annual reduction in pedestrian injuries.

### Other

- Intersection daylighting improves sightlines between motorists and pedestrians. For motorists, it makes it easier to see the entire crosswalk and to see around corners. For pedestrians, it makes it easier to see and avoid cars when approaching a crosswalk.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

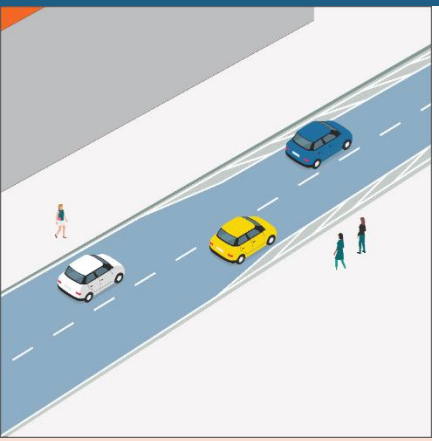
- 20-30 feet of daylighting on an intersection approach is often recommended.
- Fixed objects such as trees, buildings, signs, and street furniture can obstruct visibility and create safety concerns. However, they should not be removed without also considering safety measures like traffic speed reduction, visibility enhancement through curb extensions or geometric design changes, and supplementary warning signs.
- Traffic control devices in the intersection should be unobstructed and clear from tree cover or visual clutter.

## Local Example


**Main St, City of Beacon:**
The City of Beacon uses striping to prohibit parking near intersections along Main St. This helps people crossing see approaching traffic and helps drivers see people crossing. In some locations, physical curb extensions are also used.

# LANE NARROWING

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving



**Description**

Lane narrowing can encourage drivers to reduce their speeds.

Narrowing can be implemented through pavement striping or by more permanent infrastructure such as medians, curbing, or road diets.

**Reference Documents**

NACTO: Lane Width

CMF: Convert 12-Foot Lanes to 9-Foot or Less—ID 7823

NYSDOT: Local Highway Inventory Manual

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, lane narrowing can reduce crashes by up to 56%.

### Speed

- Narrower streets encourage slower driving speeds, which reduce the severity of crashes.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- According to the NYSDOT Local Highway Inventory Manual, the minimum width to be considered a two-lane road is 16 feet (two 8-foot lanes). On urban streets, 10-foot lanes can be appropriate. Streets used by buses or high proportions of trucks may need 11-foot lanes.
- On roads with multiple lanes where buses or trucks need extra space, the outside lane (next to the curb or parking) can be wider, and the inside lanes can be narrower.
- Additional lane width is often required at turning locations with tight curves, as vehicles occupy more horizontal space when navigating a curve compared to a straight section.

**Local Example**

**Clinton Ave, City of Kingston:**
The City of Kingston narrowed travel lanes on this street to 11 feet as part of a larger Uptown Transportation Improvements project. The narrower lanes help reduce speeds. A striped median was added in some areas to fill the extra space.

# LEADING PEDESTRIAN INTERVALS (LPIS)

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

A Leading Pedestrian Interval (LPI) gives pedestrians a 3 to 7 second head start to begin crossing at a signalized intersection. This increases the pedestrian's visibility to drivers and reinforces pedestrians' right of way over turning vehicles.

## Reference Documents

FHWA: PSCi—Leading Pedestrian Interval

NACTO: Phasing Examples

CMF: Modify Signal Phasing—ID 1993

MUTCD: Chapter2B—Regulatory Signs, Barricades, and Gates (R10-11)

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, Leading Pedestrian Intervals (LPIs) can reduce crashes by up to 59%.
- According to FHWA, LPIs are associated with a 13% reduction in pedestrian-vehicle crashes at intersections.

### Other

- LPIs improve safety by increasing the visibility of pedestrians, increasing motorist yielding, and providing additional crossing time for pedestrians.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- LPIs are often combined with high-visibility crosswalk markings, curb ramps, accessible pedestrian signals, and "No Right Turn on Red" signs (MUTCD R10-11) to further enhance pedestrian safety.
- LPIs are typically implemented at locations with a history of pedestrian-vehicle crashes and where both pedestrian volumes and turning vehicle volumes are high.

## Local Example


**Route 44/55 Arterials, City and Town of Poughkeepsie:**
NYSDOT added leading pedestrian intervals along Route 44/55 to help people cross more safely. In the location pictured (eastbound 44/55 at Raymond Ave), a 'no right turn on red' also helps protect people crossing from turning vehicles.

# MEDIANS AND PEDESTRIAN REFUGE ISLANDS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

**Description**

Medians narrow the roadway, which can slow speeds.

Pedestrian refuge islands, often incorporated into medians, enable staggered crossings, where pedestrians pause in the refuge island before completing the crossing.

**Reference Documents**

FHWA: PSCi—Medians and Pedestrian Refuge Islands in Urban and Suburban Areas

FHWA: Lesson 12—Midblock Crossings

NYSDOT: Highway Design Manual (HDM)—Chapter 18: Pedestrian Facility Design

CMF: Median Treatment for Bike/Ped Safety—ID 9120

## Safety Benefits

### Crashes

- Medians with marked crosswalks are associated with a 46% reduction in pedestrian crashes.
- Pedestrian refuge islands are associated with a 56% reduction in pedestrian crashes.
- According to the Crash Modification Factor (CMF) Clearinghouse, medians can reduce crashes by up to 14%.

### Pedestrian Safety

- Medians and/or pedestrian refuge islands help improve safety by allowing people to cross one direction of traffic at a time.
- Medians can be especially helpful for mid-block crossings. 74% of pedestrian crashes occur at non-intersection locations. Lesson 12

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

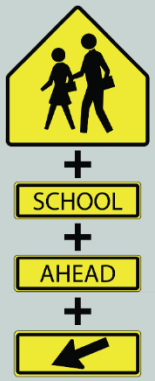
- Medians or pedestrian refuge islands are recommended on streets with more than 9,000 vehicles per day, speeds of 35 mph or greater, and significant pedestrian volumes. They are especially useful when people must cross three or more lanes of traffic.
- Pedestrian refuge islands should be at least six feet wide for accessibility.

**Local Example**

**Raymond Ave (Route 376), Town of Poughkeepsie:**
As part of a larger improvement near Vassar College, NYSDOT converted a striped median to a curbed concrete median. The median includes a refuge island for a mid-block crosswalk that connects the college and housing across the street.

# PEDESTRIAN WARNING SIGNAGE

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving




## Description

Pedestrian warning signs alert drivers to potential pedestrian activity and guide pedestrians to designated crossing areas. These signs are diamond-shaped with black symbols or text on a yellow background.

Common examples include the Advance Pedestrian Crossing sign, Pedestrian Crossing sign, Playground sign, School Crossing sign, and Advance School Crossing sign.

## Reference Documents

FHWA: PSCi—Crosswalk Visibility Enhancements

CMF: Install Advanced Yield or Stop Markings/Signs—ID 9019

MUTCD: Chapter 2C—Warning Signs and Object Markers

MUTCD: Part 7—Traffic Control for School Areas

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, pedestrian warning signage can reduce crashes by up to 20%.

### Speed

- Pedestrian warning signage can reduce vehicle speeds by alerting drivers to upcoming pedestrian activity.

### Pedestrian Safety

- Pedestrian warning signs increase driver awareness and encourage yielding, ultimately reducing pedestrian crashes and injuries.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- The Pedestrian Crossing sign (W11-2) is used to alert motorists to potential pedestrian conflicts. It should be installed in advance of a midblock crosswalk or any other location where drivers may not expect pedestrians to cross.
- To avoid information overload, advance pedestrian crossing signs should not be mounted with other signs (exception may include a supplemental distance sign or an advisory speed plate).
- The MUTCD specifies a standard sign size of 30 by 30 inches. However, a larger 36 by 36- inch sign may be used on higher-speed or wider arterial streets to improve visibility. For more guidance from the MUTCD, refer to Warning Signs and Object Markers—Chapter 2C and Traffic Control for School Areas—Part 7.

## Local Example

**Myers Corners Rd (County Route 93), Town of Wappinger:**
High visibility school crossing signs were installed near the Ketcham High School entrance to alert drivers to students crossing.

# RAISED CROSSWALKS/INTERSECTIONS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving


## Description

Raised crosswalks are constructed at the level of adjacent sidewalks. They can be installed mid-block or at an intersection. A raised intersection elevates the entire intersection.

Both treatments slow vehicle speeds and encourage drivers to yield to pedestrians. They sometimes incorporate brick or other textured materials to increase visibility.

## Reference Documents

NYC DOT: Raised Crosswalk

FHWA: Raised Crosswalk—Countermeasure Tech Sheet

NACTO: Raised Intersections

FHWA: Traffic Calming e-Primer—Module 3

CMF: Install High Visibility Crosswalk—ID 4123

MUTCD: Chapter 9B—Signs

## Safety Benefits

### Crashes

- Raised crosswalks can reduce pedestrian crashes by 45% and can lower overall crashes by 25-33%.
- According to the Crash Modification Factor (CMF) Clearinghouse, raised crosswalks can reduce crashes by up to 40%.

### Speed

- A raised crosswalk can reduce speeds to between 20 and 35 mph at the crossing. About 200 feet after a raised crosswalk, vehicle speeds gradually begin to increase. To maintain reduced speeds over a longer distance, a series of raised crosswalks or speed tables can be installed.

### Volume

- A single raised crosswalk causes minimal traffic diversion, but when raised crosswalks are installed in a series, traffic volumes can decrease by about 20%.

### Pedestrian Safety

- Raised crosswalks increase pedestrian visibility to drivers, improve driver yielding, and provide a flatter surface for pedestrians with disabilities.

## Application Context

- Local roads; collectors.

## Design Guidance

- Raised crosswalks and intersections are often demarcated with different paving materials and additional paint markings.
- Ramps should be placed on each vehicle approach.
- At raised crosswalks, crosswalk markings should be high-visibility and detectable warning strips should be installed at both sides of the crossing.
- At a raised intersection, crosswalks do not need to be marked unless they are not flush with the sidewalk.
- For a raised crosswalk, the applicable warning sign should be installed, based on the MUTCD (Chapter 9B Signs—Bicycle Crossing, Pedestrian Crossing, Trail Crossing, or School Crossing).

## Local Example


**Hasbrouck Ave, City of Kingston:** A raised crosswalk was installed near a small park to ensure that drivers slow as they approach the crosswalk. Yield markings and signs were included to draw additional attention to the crossing.

# RECTANGULAR RAPID FLASHING BEACON (RRFB)

| | | | | |
|---|---|---|---|---|
| intersections | roadway departures | speeding | motorcycle safety | large trucks |
| VRUs | older drivers | distracted driving | impaired driving | aggressive driving |

**Description**

Rectangular Rapid Flashing Beacons (RRFBs) use highly visible alternating flashing lights to alert drivers to people crossing at mid-block crosswalks. The lights can be activated by pedestrian pushbuttons or by passive (video or infrared) detection.

**Reference Documents**

FHWA: PSCi—Rectangular Rapid Flashing Beacons (RRFB)

Oregon Department of Transportation: Increasing Pedestrian Safety with Rectangular Rapid Flashing Beacons

CMF: Install Rectangular Rapid Flashing Beacon (RRFB) —ID 11158

MUTCD: Chapter 4A—Highway Traffic Signals

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, RRFBs can reduce crashes by up to 69%.

### Pedestrian Safety

- RRFBs alert drivers to people crossing the street and can reduce crashes between vehicles and pedestrians by increasing driver awareness.
- RRFBs can increase motorist yielding rates up to 98%, depending on the speed limit, number of lanes, crossing distance, and time of day

## Application Context

- Uncontrolled pedestrian crossings, including standard pedestrian, school or trail crossings.
- Multilane crossings with speed limits under 40 mph.

## Design Guidance

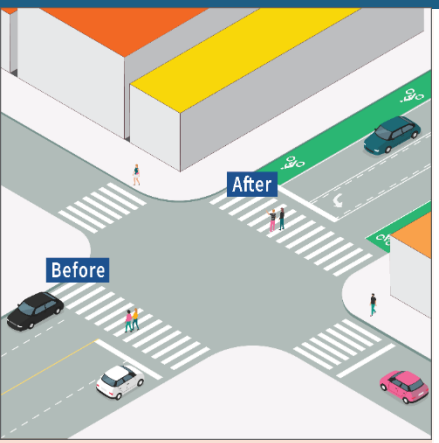
- RRFBs should be placed on both sides of an uncontrolled crosswalk.
- Per the MUTCD, depending on how the RRFB is mounted, other signs may be required, such as W11-2 (pedestrian), S1-1 (school), or W11-15 (trail) crossing warning signs. See Highway Traffic Signals—Chapter 4A for guidance.
- Where RRFBs are installed, other treatments should also be considered, such as curb extensions and high visibility crosswalks.

**Local Example**


**South Broadway (Route 9), Town of Red Hook:**
A solar powered RRFB was installed at this mid-block crosswalk, which connects a plaza with a popular ice cream shop to a movie theater and other destinations on the other side of the street.

# ROAD DIETS (ROADWAY CONFIGURATION)

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving




## Description

Road diets reduce the number and/or width of lanes and reallocate the space to pedestrians, cyclists, and/or turning vehicles.

## Reference Documents

FHWA: PSCi—Road Diets

FHWA: Pedestrian Safety Guide (PEDSAFE) and Countermeasure Selection System—Lane Reduction

FHWA: Evaluation of Lane Reduction "Road Diet" Measures on Crashes

AARP Livable Communities: Road Diets—A Livability Fact Sheet

CMF: Converting Four-Lane Roadways to Three-Lane Roadways—ID 2841

## Safety Benefits

### Crashes

- Where dedicated left-turn lanes are installed, rear-end and left-turn crashes are reduced.
- A reduction from four to three lanes reduces right-angle crashes, since motorists entering from side streets have to cross fewer lanes.
- According to the FHWA, road diets can reduce overall crashes by 47% on moderately traveled roads in small urban areas, and by 19% on corridors in suburban areas of larger cities.
- According to the Crash Modification Factor (CMF) Clearinghouse, road diets can reduce crashes by up to 47%.

### Speed

- Removing a travel lane can reduce high speeds caused by vehicles passing each other.
- Road diets can reduce speeds by 3 to 5 mph, with larger speed reductions on corridors with higher traffic volumes.

### Pedestrian Safety

- Lane reductions shorten pedestrian crossing distances and can provide space for wider sidewalks, median islands and pedestrian refuge islands, and curb extensions.

### Other

- Road diets free up space for bike lanes, turn lanes, on-street parking, transit lanes/stops, and landscaping.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Road diets are typically used on roads with traffic volumes of up to 24,000 vehicles per day.
- Outside travel lanes can be slightly wider to accommodate curbside uses.

## Local Example

**Raymond Ave (Route 376), Town of Poughkeepsie:**
NYSDOT worked with the Town, Vassar College, and local business district on this road diet, which converted a four- lane road to two lanes with a center median. Pedestrian scale lighting, landscaping, improved crosswalks and a series of roundabouts were also included. The project reduced speeds and crashes while also reducing intersection delay and improving walkability.

# ROUNDABOUTS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Roundabouts are raised circular islands in the center of unsignalized intersections that improve safety by reducing vehicle speeds and eliminating right-angle crashes.

Mini roundabouts can be used on smaller streets where there is not room for a standard roundabout.

## Reference Documents

FHWA: PSCi—Roundabouts

Insurance Institute for Highway Safety (IIHS)
Highway Loss Data Institute (HLDI): Roundabouts

CMF: Convert Signalized Intersection to Modern Roundabout—ID 4184

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, roundabouts can reduce crashes by up to 21%.
- Research shows that mini roundabouts can lower vehicle speeds and reduce crashes.

### Speed

- Roundabouts reduce vehicle speeds by requiring drivers to maneuver around the central island.
- Traffic speeds within a roundabout typically decrease by 1 to 13 mph.

### Pedestrian Safety

- Roundabouts reduce crossing distances and allow pedestrians to cross one direction of traffic at a time.
- Studies have found that roundabouts can reduce pedestrian crashes by 75%.

## Application Context

- Collectors; arterials.
- Roundabouts are appropriate at intersections with high crash rates, traffic delays, complex geometry, or frequent left-turn movements. They work best at locations with relatively balanced traffic flows.

## Design Guidance

- In a roundabout, yield control is preferred over stop control to maintain smoother traffic flow.
- Signs should be installed to direct drivers to travel to the right at the roundabout.
- Shared lane markings (sharrows) can be use at roundabouts to show that cyclists are permitted and expected in the travel lane.
- Roundabouts may include bike lanes if space allows.
- Roundabouts may be landscaped with low shrubs or vegetation that does not impede visibility.
- The circular island should include a mountable apron to provide additional space for large and heavy vehicles to navigate the roundabout safely.

## Local Example


**Route 376 & New Hackensack Rd (County Route 104) & All Angels Hill Rd (County Route 94), Town of Wappinger:**
This roundabout replaced two adjacent signalized intersections, which were confusing to drivers and often congested. The roundabout greatly simplified the traffic pattern, reduced delay and improved safety.

# RUMBLE STRIPS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Rumble strips alert drivers when they cross the edge line or centerline of a road. While commonly used in rural areas to prevent roadway departures, they can also be applied on urban roads based on the road design and surrounding conditions.

## Reference Documents

FHWA: State of the Practice for Shoulder and Center Line Rumble Strip Implementation on Non-Freeway Facilities

FHWA: Rumble Strips and Safety Management—Design and Construction

FHWA: PSCi—Longitudinal Rumble Strips and Stripes on Two-Lane Roads

CMF: Install Shoulder Rumble Strips—ID 7267

## Safety Benefits

### Crashes

- Centerline rumble strips can reduce head-on fatal and injury crashes on two-lane rural roads by 44-64%.
- Shoulder rumble strips can reduce single-vehicle run-off-road fatal and injury crashes on two-lane rural roads by 13-51%.
- According to the Crash Modification Factor (CMF) Clearinghouse, shoulder rumble strips can reduce crashes by up to 25%.

### Other

- Roadway departure crashes account for more than half of the fatal roadway crashes each year in the United States. Rumble strips are designed to address roadway departure crashes by alerting distracted, drowsy, or otherwise inattentive drivers who drift from their lane. They are most effective when deployed systemically.
- Centerline rumble strips are used to reduce head-on, opposite-direction sideswipe crashes, and roadway departures crashes to the left.
- Shoulder and edge line rumble strips are used to reduce roadway departure crashes to the right.

## Application Context

- Arterials.

## Design Guidance

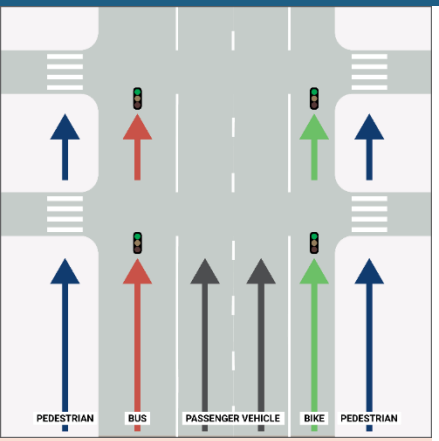
- Typical milled rumble strips are 5 to 7 inches wide, spaced about 12 inches apart, and cut about half an inch deep.
- Raised rumble strips are usually 2 to 12 inches wide and shaped like rounded or rectangular markers or strips.

## Local Example

**Salt Point Turnpike (Route 115), Town of Pleasant Valley:**
Rumble strips were installed in the centerline on stretches of Salt Point Turnpike, especially around curves. They alert drivers when they start to drift towards the centerline.

# SIGNAL PROGRESSION

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving




## Description

Signal progression is a signal timing tool used on corridors with multiple coordinated signalized intersections. The signal timing is adjusted to maintain continuous traffic flow at slower speeds.

## Reference Documents

FHWA: Traffic Signal Timing Manual

NACTO: Coordinated Signal Timing

## Safety Benefits

### Crashes

- Case studies show that speeding can be significantly reduced without major increases in vehicle delay by reducing signal cycle lengths, reducing progression speeds, dividing corridors into smaller coordination zones, or in some cases, removing signal coordination.
- Signal progression encourages drivers to travel at or below the posted speed limit and discourages speeding through yellow lights.

## Application Context

- Collectors; arterials.
- Typically applied on corridors with closely spaced intersections (1/4 mile or less).

## Design Guidance

- Signal progression speeds should be based on the overall street context, considering factors such as block length, crossing distances, and traffic volumes.
- Signal timing plans should account for cross-street progression, particularly on streets with high overall traffic volumes or significant transit use.

## Local Example


**Route 44/55 Arterials, City of Poughkeepsie:**
The traffic signals along the eastbound and westbound arterials are timed so that if drivers maintain a consistent speed of about 30 miles per hour, they will mostly avoid red lights. Green signs were added along the streets to educate drivers about the signal timing.

# SPEED CUSHIONS/HUMPS/TABLES

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving


## Description

Speed cushions and humps are raised areas across a road designed to slow vehicles. Speed cushions typically have a flatter top than a speed hump.

Speed tables are longer speed humps with a flat top and ramps at each end.

Speed cushions and humps can be designed so that emergency vehicles or buses, which have wider axles, straddle the cushions/humps and can traverse them at higher speeds.

## Reference Documents

Arlington, VA: Speed Humps, Raised Crossings, and Similar Raised Areas

FHWA: Traffic Calming ePrimer—Speed Management Safety

CMF: Install Speed Humps—ID 132

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, speed humps can reduce crashes by up to 40%.

### Speed

- A speed cushion can slow vehicle speeds by 15-20 mph, but speeds gradually increase again after it. A series of speed cushions can be used to keep speeds lower over a longer distance.
- A speed table can slow vehicle speeds to 25-35 mph when driving over it. Like speed cushions, speeds tend to increase again after the table. A series of speed tables can be used to retain lower speeds over a longer distance.

### Volume

- A single speed cushion, hump, or table diverts little traffic from the street. When installed as a series, volume reductions of up to 20% have been observed.

### Pedestrian Safety

- Speed cushions, humps, and tables reduce vehicle speeds and improve driver yielding to people crossing the street.

## Application Context

- Local roads; collectors.

## Design Guidance

- Speed humps and tables can be painted to warn motorists and to be visually pleasing.
- Speed humps can be placed periodically along a route to reinforce lower speeds.
- Well-designed speed humps, tables, and cushions allow vehicles and people riding bikes to proceed over the device at the intended speed with minimal discomfort.
- Speed humps and tables should be installed straight sections of roadway, not on curves.

## Local Example


**Wilkes St, City of Beacon:** Wilkes St provides access to a large park, middle school and high school, and connects two major streets. To address local concerns about speeding, the City of Beacon installed a series of speed humps, along with signage to alert drivers. A speed feedback sign was also installed to reinforce the speed limit.

# SPEED LIMIT REDUCTION

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | **aggressive driving**


## Description

Lower speed limits can reduce the number and severity of traffic crashes. Lower speeds give drivers more time to react to situations, reduce a vehicle's stopping distance, and reduce the severity of crashes when they occur.

## Reference Documents

Vision Zero Network: Understanding Why Speed Matters Most

Arlington, VA: Speed Limit Reduction and Policies

NYS LTAP: Who sets speed limits on local highways?

FHWA: PSCi—Appropriate Speed Limits for All Road Users

CMF: Lower Posted Speed—ID 11289

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, reducing speed limits can reduce crashes by up to 30%.

### Other

- Reduced speed limits create a more predictable environment for all road users, reduce the likelihood of crashes, and in the event of a crash, reduce the likelihood of fatalities and serious injuries.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Villages and Cities can set speed limits on their own roads, as can Towns with populations over 50,000 and 'Suburban' Towns (per the NYS Dept of State).
- To request a speed limit change on a Town or County road, the municipality must file a request with County Public Works. The County will review it and forward it to NYSDOT's Regional Office, which will conduct a speed study to determine if a speed limit reduction is warranted and should be implemented. Speed limits on State highways are set by NYSDOT, except that Villages and Cities may establish speed limits on State highways with written permission by NYSDOT.
- Speed limit reductions should be complemented by traffic calming strategies such as narrower lanes, roundabouts, speed humps, and medians. Self-enforcing street design embeds physical cues to encourage safe driving.

## Local Example


**Village of Tivoli:**
In 2023, the Village passed a local law to lower the village-wide speed limit to 25 mph.

Per a 2022 NYS law, Cities, Villages, and Suburban Towns (as defined by the NYS Dept. of State) can reduce their area-wide speed limits to 25 if supported by an engineering analysis.

# SPEED RADAR/FEEDBACK SIGN

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | **aggressive driving**


## Description

Dynamic Speed Feedback Signs display the speed of approaching vehicles and alert motorists when they are driving above the speed limit.

## Reference Documents

NHTSA: Dynamic Speed Display/Feedback Signs

USDOT: Effectiveness of Dynamic Speed Feedback Signs, Volume I: Literature Review and Meta-Analysis

CMF: Install Dynamic Speed Feedback Sign—ID 6885

## Safety Benefits

### Crashes

- Research has found a 5-7% reduction in crashes after installation of speed feedback signs on rural two-lane curves.
- According to the Crash Modification Factor (CMF) Clearinghouse, speed feedback signs can reduce crashes by up to 5%.

### Speed

- Studies show that speed feedback signs consistently reduce vehicle speeds. On average, passenger vehicles slow down by about 4 mph. Overall speed reductions of 2 to 4 mph are observed across all vehicle types.
- Evaluations show that these signs lower average speeds and reduce the number of vehicles exceeding speed limits. These reductions were sustained at 1, 12, and 24 months after installation at most locations.

## Application Context

- Local roads; collectors; arterials.
- Speed feedback signs are effective at reducing speeds when drivers recognize a reason to slow down, such as near schools, on curves, or in work zones.

## Design Guidance

- Speed feedback signs should be installed in locations with frequent speeding citations or speed issues.
- Speed feedback signs should be visible to traveling vehicles.
- Speed feedback signs should be implemented in conjunction with a speed enforcement program.

## Local Example


**Jackson St (County Route 34), Town of Fishkill:**
The Town installed solar-powered speed feedback signs on several roads identified as having speeding issues. For Jackson St, they coordinated with County DPW for approval and a highway work permit to install the sign.

Several other towns have also purchased portable speed feedback signs and placed them at various locations with speeding concerns.

# STREET LIGHTING

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Street lighting improves visibility for drivers, helping them see other vehicles, pedestrians, and obstacles from a distance.

Pedestrian-scale lighting focuses light downward at a lower height to better illuminate sidewalks, crosswalks, and other areas where people walk and wait, improving visibility for drivers and pedestrians.

## Reference Documents

FHWA: PSCi—Lighting

FHWA: Pedestrian Lighting Primer

FHWA: Lighting Handbook

CMF: Improve Street Lighting Illuminance and Uniformity—ID 11027

## Safety Benefits

### Crashes

- Lighting can lead to a 23% reduction in crashes involving injury.
- According to the Crash Modification Factor (CMF) Clearinghouse, street lighting can reduce crashes by up to 42%.

### Other

- Lighting increases pedestrian safety at crossings and improves their comfort level.
- Lighting also increases driver awareness, reduces the impacts of glare from approaching headlights or off-roadway lighting, and can improve yielding and compliance with traffic control devices.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- 3000K, fully shielded LED lights should be used to provide a less harsh light and reduce glare.
- Lighting should be consistent and uniform.
- The location of buildings and trees should be considered to reduce lighting spillover.
- Lighting should be installed in accordance with the Illuminating Engineering Society and Dark Sky guidelines.

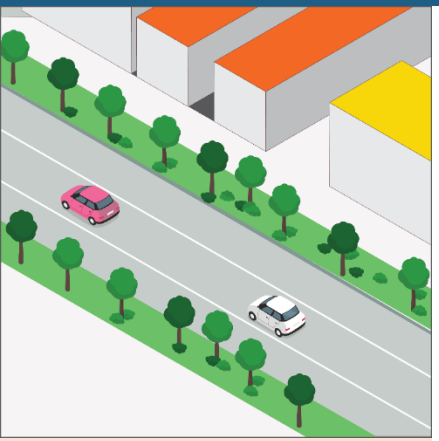
## Local Example

**Albany Post Rd (Route 9), Town of Hyde Park:**
The Town installed a series of pedestrian-scale lights along a portion of Route 9 as part of a sidewalk improvement project.

These lights increase safety for people using the new sidewalks and improve the aesthetics of the Town center.

# STREET TREES/LANDSCAPING

intersections | roadway departures | **speeding** | motorcycle safety | large trucks
VRUs | older drivers | **distracted driving** | impaired driving | **aggressive driving**



**Description**

Trees planted along the roadway provide a sense of enclosure and narrowing to the road, which can reduce speeding.

**Reference Documents**

NYSDOT: Trees and NYSDOT

National Complete Streets Coalition: Sustainable Complete Streets

Institute of Transportation Engineers (ITE): The Street Tree Effect and Driver Safety

CMF: Landscape Medians at Intersections—ID 5468

## Safety Benefits

### Crashes

- According to the Crash Modification Factor (CMF) Clearinghouse, street trees can reduce crashes by up to 18%.

### Speed

- One study found that the presence of trees in a suburban landscape reduced the speed of drivers by an average of 3 mph.

### Other

- Drivers tend to slow down when streets have tall trees or shrubs along the sides. Slower speeds make streets safer for both drivers and pedestrians.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Tree species should be selected to provide canopy and minimize maintenance costs.
- Each tree should have at least 800 cubic feet of unrestricted, unshared soil with a minimum depth of 36 inches to support healthy growth.
- Street trees grow better when they have access to permeable surfaces that allow water and air to reach their roots.
- Tree pits can be used in areas where sidewalks are wide. In urban areas, trees pits should be at least 5 feet wide. In less urban areas, continuous planting strips with vegetation are preferred.
- Street trees should be placed carefully to avoid conflicts with streetlights, overhead utilities, street furniture, and traffic signals.
- Construction impacts like trenching and soil compaction near tree roots should be minimized.

**Local Example**

**East Market St (Route 308), Village of Rhinebeck:**
Rhinebeck's Tree Commission works with property owners to improve street trees, including by removing dead or damaged trees and planting new trees appropriate to the climate and street context. They also have an online tree inventory with details about each street tree in the village.

# TRAFFIC SIGNS AND MARKINGS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving


## Description

Traffic signs provide visual cues to guide road users. This includes signs such as speed limits, turn restrictions, commercial vehicle or weight limits, and pedestrian crossings.

Pavement markings complement signs by clearly defining lanes, crosswalks, stop lines, bike lanes, and warnings—often using durable, retro-reflective materials for visibility.

## Reference Documents

Arlington, VA: Travel Lane Signs & Markings

MUTCD: Chapter 3B—Pavement and Curb Markings

MUTCD: Chapters 2B & 2C—Regulatory & Warning Signs

## Safety Benefits

### Crashes

- Traffic signs and markings can reduce speed-related crashes by 52-68%.

### Speed

- Traffic signs and markings can reduce average speeds by more than 7 mph and 85th percentile speeds up to 9 mph.

### Volume

- Certain signs, like turn restrictions or truck prohibition signs, can reduce traffic volumes.

### Other

- Traffic signs and markings improve roadway predictability by guiding users and enhancing safety at intersections and other conflict points.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- Design considerations vary based on the type of sign or marking installed. For guidance, refer to the MUTCD Part 2 (Signs) and Part 3 (Markings).

## Local Example


**North Quaker Ln (County Route 16), Town of Clinton:**
Dutchess County Public Works installs 'stop ahead' signs and pavement markings approaching intersections where drivers often fail to stop, such as North Quaker Ln approaching Hollow Rd, as shown.

# TURN HARDENING

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving

## Description

Turn hardening uses flexible bollards and curbs as well as pavement markings to reduce the speed of turning vehicles.

## Reference Documents

Insurance Institute for Highway Safety (IIHS) Highway Loss Data Institute (HLDI): Simple Infrastructure Changes Make Left Turns Safer for Pedestrians

Arlington, VA: Hardened Centerlines and Turn Wedges

NYC DOT: Turn Calming Program

## Safety Benefits

### Crashes

- Turn hardening can lead to a 46% reduction in crashes.

### Speed

- Turn hardening can reduce the average speed of turning vehicles by 7%.

### Pedestrian Safety

- Turn hardening improves pedestrian safety by making pedestrians in crosswalks more visible to turning drivers.

### Other

- Turn hardening slows down left-turning vehicles without reducing traffic capacity. It guides drivers to make safer, more controlled turns closer to a right angle.

## Application Context

- Local roads; collectors; arterials.
- Used at intersections with high crash rates related to turns and/or conflicts between pedestrians and turning vehicles.

## Design Guidance

- Bollards and curbs can be placed along the centerline of the street that a left-turning vehicle is entering. They can also be extended into the intersection to further reduce a vehicle's turning angle.

## Local Example

**New York City:**
The New York City Dept. of Transportation's Turn Calming program has installed low-cost treatments at more than 1,100 intersections since 2016. These treatments reduce left and right turn speeds, reduce the number of vehicles that cross the centerline when turning, and improve safety for people in the crosswalk.

# TURNING MOVEMENT RESTRICTIONS

intersections | roadway departures | speeding | motorcycle safety | large trucks
VRUs | older drivers | distracted driving | impaired driving | aggressive driving


**Description**

Turning movement restrictions use signs, pavement markings, and/or road design to prohibit left turns. These access management tools improve safety at stop-controlled intersections and driveways.

At signalized intersections, signs can prohibit right turns on red to improve pedestrian safety.

**Reference Documents**

FHWA: Safety Evaluation of Turning Movement Restrictions at Stop—Controlled Intersections

FHWA: Pedestrian Safety (PEDSAFE) Guide and Countermeasure Selection System—Right Turn on Red Restrictions

## Safety Benefits

### Crashes

- According to an FHWA study, converting full movement stop controlled intersections to right-in/right-out only reduced all crashes, intersection-related crashes, and fatal and injury intersection-related crashes.

### Volume

- Turning movement restrictions have little effect on through traffic volumes but may shift turning volumes to the next available turn.

### Other

- Limiting or banning certain turns reduces conflict points, which helps lower the risk of crashes.

## Application Context

- Local roads; collectors; arterials.

## Design Guidance

- A right-in/right-out restriction limits turning movements to right turns only for traffic entering or exiting an intersection or driveway. This can be done by installing a 'pork chop' island at the intersection or driveway and a curbed median along the centerline of the road.
- Turning restrictions are useful at intersections with limited visibility.
- Right turn on red restrictions should be considered at signalized intersections with high pedestrian volumes. These restrictions can be limited to certain hours.
- Turning movement restrictions should be considered by balancing property access needs, site-specific needs, and safety.

**Local Example**


**Cameli Dr, Town of Wappinger:** Left turns from Cameli Dr onto Middlebush Rd (County Road 93) are prohibited because a stone wall and curve limit visibility to the left.

Drivers wishing to turn left must use a parallel street with better visibility.

# 5.0 Standards and Guidance

Each of the countermeasures in this Toolkit should be implemented in accordance with relevant standards and guidance. Standards represent mandatory design or performance requirements, while guidance documents offer best practices and recommendations for applying those standards to specific countermeasures. The most applicable standards and guidance are included in the left column of each countermeasure page. Those resources are also listed below.

## Standards

| | |
|---|---|
| FHWA Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, 11th Edition (2024) | Jump to: All-Way Stops; Centerline/Edge Line/Parking Lane Striping; Leading Pedestrian Intervals; Pedestrian Warning Signage; Raised Crosswalks/Intersections; Rectangular Rapid Flashing Beacon (RRFB); Traffic Signs and Markings |

## Guidance and Additional Resources

### Crash Modification Factor (CMF) Clearinghouse Resources

| | |
|---|---|
| Add Centerline and Move STOP Bar to Extended Curb Lines – CMF ID 1692 | Jump to: Curb Extensions |
| Convert Minor-Road Stop Control to All-Way Stop Control – CMF ID 315 | Jump to: All-Way Stops |
| Convert Signalized Intersection to Modern Roundabout – CMF ID 4184 | Jump to: Roundabouts |
| Converting Four-Lane Roadways to Three-Lane Roadways – CMF ID 2841 | Jump to: Road Diets |
| Convert 12-Foot Lanes to 9-Foot or Less – CMF ID 7823 | Jump to: Lane Narrowing |
| Estimating the Crash Reduction and Vehicle Dynamics Effects of Flashing LED Stop Signs – CMF ID 6602 | Jump to: Flashing Stop Signs |
| Improve Pavement Friction – CMF ID 11316 | Jump to: High Friction Pavement |
| Improve Street Lighting Illuminance and Uniformity – CMF ID 11027 | Jump to: Street Lighting |
| Install Automated Section Speed Enforcement System – CMF ID 7711 | Jump to: Automated Enforcement |
| Install Dynamic Speed Feedback Sign – CMF ID 6885 | Jump to: Speed Radar/Feedback Sign |
| Install Bicycle Boulevard – CMF ID 3092 | Jump to: Bicycle Boulevards/Neighborhood Greenways |
| Install Bicycle Lanes – CMF ID 11555 | Jump to: Bike Lanes |

| | |
|---|---|
| Install High Visibility Crosswalk – CMF ID 4123 | Jump to: Raised Crosswalks/ Intersections; High Visibility Crosswalks |
| Install Rectangular Rapid Flashing Beacon (RRFB) – CMF ID 11158 | Jump to: Rectangular Rapid Flashing Beacon (RRFB) |
| Install Shoulder Rumble Strips – CMF ID 7267 | Jump to: Rumble Strips |
| Install Sidewalk – CMF ID 11246 | Jump to: ADA-Compliant Sidewalks and Curb Ramps |
| Install Speed Humps – CMF ID 132 | Jump to: Speed Cushions/Humps/Tables |
| Install Advanced Yield or Stop Markings and Signs – CMF ID 9019 | Jump to: Pedestrian Warning Signage |
| Landscape Medians at Intersections – CMF ID 5468 | Jump to: Street Trees/Landscaping |
| Lower Posted Speed – CMF ID 11289 | Jump to: Speed Limit Reduction |
| Median Treatment for Bike/Ped Safety – CMF ID 9120 | Jump to: Medians and Pedestrian Refuge Islands |
| Modify Signal Phasing – CMF ID 1993 | Jump to: Leading Pedestrian Intervals (LPIs) |
| Place Edgeline and Centerline Markings – CMF ID 101 | Jump to: Centerline/Edge Line/Parking Lane Striping |

**Federal Highway Administration (FHWA) Proven Safety Countermeasures Initiative (PSCi) Resources**

| | |
|---|---|
| PSCi: Appropriate Speed Limits for All Road Users | Jump to: Speed Limit Reduction |
| PSCi: Bicycle Lanes | Jump to: Bike Lanes |
| PSCi: Corridor Access Management | Jump to: Access Management |
| PSCi: Crosswalk Visibility Enhancements | Jump to: High Visibility Crosswalks; Pedestrian Warning Signage |
| PSCi: Dedicated Left- and Right-Turn Lanes at Intersections | Jump to: Dedicated Left- and Right-Turns |
| PSCi: Leading Pedestrian Interval | Jump to: Leading Pedestrian Intervals (LPIs) |
| PSCi: Lighting | Jump to: Street Lighting |
| PSCi: Longitudinal Rumble Strips and Stripes on Two-Lane Roads | Jump to: Rumble Strips |
| PSCi: Medians and Pedestrian Refuge Islands in Urban and Suburban Areas | Jump to: Medians and Pedestrian Refuge Islands |
| PSCi: Pavement Friction Management | Jump to: High-Friction Pavement |
| PSCi: Rectangular Rapid Flashing Beacons | Jump to: Rectangular Rapid Flashing Beacon (RRFB) |

| | |
|---|---|
| PSCi: Road Diets | Jump to: Road Diets (Roadway Reconfiguration) |
| PSCi: Roundabouts | Jump to: Roundabouts |
| PSCi: Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections | Jump to: All-Way Stops |
| PSCi: Walkways | Jump to: ADA-Compliant Sidewalks & Curb Ramps |

**Federal Highway Administration (FHWA) Other Resources**

| | |
|---|---|
| Bikeway Selection Guide | Jump to: Bicycle Boulevards/Neighborhood Greenways |
| Evaluation of Lane Reduction "Road Diet" Measures on Crashes | Jump to: Road Diets (Roadway Configuration) |
| Guide for the Planning, Design, and Operation of Pedestrian Facilities | Jump to: ADA-Compliant Sidewalks & Curb Ramps |
| Handbook for Designing Roadways for the Aging Population – Chapter 2: Intersections | Jump to: Dedicated Left- and Right-Turn Lanes |
| High Friction Surface Treatments | Jump to: High Friction Pavement |
| High Friction Surface Treatment: Site Selection and Installation Guide | Jump to: High Friction Pavement |
| Lighting Handbook | Jump to: Street Lighting |
| Lesson 12-Midblock Crossings | Jump to: Medians and Pedestrian Refuge Islands |
| Lesson 14—Shared Roadways: 14.6 Bicycle Boulevards | Jump to: Bicycle Boulevards/Neighborhood Greenways |
| Noteworthy Speed Management Practices – 6. Successful Strategies for Adoption of Safety Cameras | Jump to: Automated Enforcement |
| Pedestrian Lighting Primer | Jump to: Street Lighting |
| Pedestrian Safety (PEDSAFE) Lane Reduction (Road Diet) | Jump to: Road Diets (Roadway Configuration) |
| Pedestrian Safety (PEDSAFE) Right-Turn-On-Red Restrictions | Jump to: Turning Movement Restrictions |
| Raised Crosswalk - Countermeasure Tech Sheet | Jump to: Raised Crosswalks/Intersections |
| Red Light Camera Systems Operational Guidelines | Jump to: Automated Enforcement |
| Rural Roadway Departure Countermeasure Pocket Guide | Jump to: Centerline/Edge Line/Parking Lane Striping |

| | |
|---|---|
| Rumble Strips and Safety Management—Design and Construction | Jump to: Rumble Strips |
| Safe Transportation for Every Pedestrian (STEP) | Jump to: Intersection Daylighting |
| Safety Benefits of Walkways, Sidewalks, and Paved Shoulders | Jump to: ADA-Compliant Sidewalks & Curb Ramps |
| Safety Effectiveness of Intersection Left- and Right-Turn Lanes | Jump to: Dedicated Left- and Right-Turns |
| Safety Evaluation of Turning Movement Restrictions at Stop-Controlled Intersections | Jump to: Turning Movement Restrictions |
| Selecting Roadway Design Treatments to Accommodate Bicycles | Jump to: Bike Lanes |
| Signalized Intersections Informational Guide, Second Edition | Jump to: All-Way Stops |
| State of the Practice for Shoulder and Center Line Rumble Strip Implementation on Non-Freeway Facilities | Jump to: Rumble Strips |
| Stop-Controlled Intersections | Jump to: Turning Movement Restrictions |
| Traffic Calming ePrimer | Jump to: Curb Extensions; Speed Cushions/Humps/Tables |
| Traffic Signal Timing Manual | Jump to: Signal Progression |

**National Highway Traffic Safety Administration (NHTSA) Resources**

| | |
|---|---|
| Dynamic Speed Display/Feedback Signs | Jump to: Speed Radar/Feedback Sign |
| Speed Safety Camera Enforcement | Jump to: Automated Enforcement |

**New York State Resources**

| | |
|---|---|
| NYSDOT Highway Design Manual (HDM) | Jump to: Access Management; Bike Lanes; High Visibility Crosswalks; Medians and Pedestrian Refuge Islands |
| Trees and NYSDOT | Jump to: Street Trees/ Landscaping |
| NYSDOT Local Highway Inventory Manual | Jump to: Lane Narrowing |
| NYSDOT Special Use Permits | Jump to: Bicycle Boulevard/Neighborhood Greenways |
| NYS Local Technical Assistance Program Center (LTAP) - Who sets speed limits on local highways? | Jump to: Speed Limit Reduction |

**New York City Department of Transportation (DOT) Resources**

| | |
|---|---|
| NYCDOT Daylighting and Street Safety: An Analysis | Jump to: Intersection Daylighting |

| | |
|---|---|
| New York City DOT Street Design Manual: Curb Extension | Jump to: Curb Extensions |
| New York City DOT Street Design Manual: Turn Calming Program | Jump to: Turn Hardening |
| New York City DOT Street Design Manual: Raised Crosswalk | Jump to: Raised Crosswalks/ Intersections |

### National Association of City Transportation Officials (NACTO) Resources

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| Urban Street Design Guide: Coordinated Signal Timing | Jump to: Signal Progression |
| Urban Street Design Guide: Lane Width | Jump to: Lane Narrowing |
| Urban Street Design Guide: Phasing Examples | Jump to: Leading Pedestrian Intervals (LPIs) |
| Urban Street Design Guide: Raised Intersections | Jump to: Raised Crosswalks/ Intersections |
| Urban Street Design Guide: Visibility/Sight Distance | Jump to: Intersection Daylighting |

### U.S. Access Board

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| Where Ramps and Curb Ramps are Required | Jump to: ADA-Compliant Sidewalks & Curb Ramps |

### Other Resources

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| AARP: Road Diets – A Livability Fact Sheet | Jump to: Road Diets (Roadway Configuration) |
| Alta Planning + Design: Bike Boulevards | Jump to: Bicycle Boulevards/Neighborhood Greenways |
| Arlington, VA: Curb Extensions | Jump to: Curb Extensions |
| Arlington, VA: Hardened Centerlines and Turn Wedges | Jump to: Turn Hardening |
| Arlington, VA: Speed Humps, Raised Crossings, and Similar Raised Areas | Jump to: Speed Cushions/Humps/ Tables |
| Arlington, VA: Speed Limit Reduction and Policies | Jump to: Speed Limit Reduction |
| Arlington, VA: Travel Lane Signs and Markings | Jump to: Traffic Signs and Markings |
| Alexandria, VA: Enhanced Visibility at Intersections | Jump to: High-Visibility Crosswalks |
| Lancaster, PA: Vision Zero - What is Intersection Daylighting? | Jump to: Intersection Daylighting |
| Complete Streets Coalition: Sustainable Complete Streets | Jump to: Street Trees/Landscaping |

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| IIHS/HLDI: Simple Infrastructure Changes Make Left Turns Safer for Pedestrians | Jump to: Turn Hardening |
| IIHS/HLDI: Red Light Running and Effectiveness of Cameras | Jump to: Automated Enforcement |
| IIHS/HLDI: Roundabouts | Jump to: Roundabouts |
| ITE: The Street Tree Effect and Driver Safety | Jump to: Street Trees/Landscaping |
| NCDOT: Evaluation of the Conversion from Two-Way Stop Sign Control to All-Way Stop Sign Control at 53 Locations in North Carolina | Jump to: All-Way Stops |
| Oregon DOT: Increasing Pedestrian Safety with Rectangular Rapid Flashing Beacons | Jump to: Rectangular Rapid Flashing Beacon (RRFB) |
| Oregon DOT: Literature Review of Flashing LED Stop Signs | Jump to: Flashing Stop Signs |
| Seattle, WA Department of Transportation (SDOT): Neighborhood Greenways | Jump to: Bicycle Boulevards/Neighborhood Greenways |
| USDOT: Effectiveness of Dynamic Speed Feedback Signs, Volume 1: Literature Review and Meta Analysis | Jump to: Speed Radar/Feedback Sign |
| Vision Zero Network: Understanding Why Speed Matters Most | Jump to: Speed Limit Reduction |