Capital District Complete Streets Design Guide

CDTC
CAPITAL DISTRICT TRANSPORTATION COMMITTEE

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The Capital District Transportation Committee is the designated Metropolitan Planning Organization for the Albany, Schenectady, Troy, and Saratoga Springs, NY metropolitan areas, leading the four-county region in public transportation and infrastructure planning and programming.

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Introduction

The Capital District Transportation Committee assembled this document at the request of local governments and under the direction of its Complete Streets Advisory Committee. Many local governments rely heavily on the New York State Highway Design Manual to design their local streets. While that manual is often useful, it primarily functions to “provide requirements and guidance on highway design methods and policies” and to “assure uniformity of design practice throughout the New York State Department of Transportation.”[1]

While the implementation of complete streets elements on state routes is encouraged through the highway work permit process, the balance of mobility and complete streets elements must be considered on those roadways.

This document aims to fill in gaps where the context of local streets differs from that of state highways. It is important to remember that design guidance is constantly evolving and therefore information referenced in this document is subject to change.

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Complete Streets for the Capital District

Complete Streets are streets designed for all users, all modes of transportation, and all ability levels. They balance the needs of drivers, pedestrians, bicyclists, transit riders, emergency responders, and goods movement based on local context.

New York State passed a Complete Streets law in 2011, which requires that roadway improvement projects include safe accommodations for all users, including bicyclists, pedestrians, and transit riders. A number of local governments throughout the Capital Region have adopted Complete Streets policies, ordinances, or resolutions since 2009. This guide provides planning and design guidelines to support policy advancement and implementation of Complete Streets in the Capital District.

What are Complete Streets?

Complete streets are designed and operated to enable safe, convenient access for all users of all ages and abilities, including pedestrians, bicyclists, public transportation users, motorists, and the movement of goods.

Complete Streets are designed based on their unique community context, including surrounding land use patterns, who uses the street, and user needs. The purpose and function of a street is different from that of a highway. Highways serve an important function in our transportation network, providing an efficient means of moving high traffic volumes over longer distances. Street design practices and principles should differ from those that guide highway development. This guide provides direction on how to implement street design principles that fit local context and support livable, sustainable, and resilient communities.

Albany Shaker Trail in Colonie, NY

Why Complete Streets?

Planning and designing transportation systems and facilities with the needs of various users in mind is not a new concept. Consideration of multiple modes of transportation – motor vehicles, pedestrians, bicyclists, transit vehicles and users, and local delivery needs – in transportation planning, design, operation, and maintenance has been part of federal, state and local policy and practice for decades with growing success. Momentum has been building for better approaches, including policy, planning, design processes and implementation to "Complete our Streets."

A Complete Streets approach to transportation planning has many benefits for all who live, work, and play in the Capital District:

- Equity and Mobility
- Walkability and Connectivity
- Health
- Safety
- Environment and Transportation Choices
- Economic Vitality and Livability

River Street in Troy, NY

Equity and Mobility

In the Capital Region, over one-quarter of people do not have access to a vehicle at home.[2] In parts of the cities of Albany, Schenectady, and Troy, over 30% of households don't have a car available.[3] This includes people under the age of 16, people who have a disability that prevents them from being able to drive or would require a prohibitively expensive vehicle, and also people who don't have enough money to pay for a vehicle as well as gas and insurance, or who choose to spend their money elsewhere.

The percentage of seniors 65 years and older in the regional population is projected to grow by 57% between 2010 and 2040, from 14% to 22%.[4] The effects of aging amplify the impacts of physical barriers that may otherwise appear minor to younger or more able-bodied pedestrians. As people age, walking speed and reaction time can decrease. Physical mobility, vision, hearing, and cognition can deteriorate, causing various physical barriers to become insurmountable obstacles. Wide intersections can quickly move motorized traffic, but create an uncomfortable environment for pedestrians crossing at a slow walking speed. A bus stop sign in a patch of grass is uncomfortable, but without sidewalks and necessary curb ramps, it can be inaccessible to people with mobility challenges.

Over 11% of Capital Region residents report having a disability, with increased rates in Albany, Schenectady, and Troy as well as Watervliet and Cohoes. Unpaved surfaces and disconnected, narrow, or deteriorated sidewalks discourage wheelchair travel, and the lack of a curb ramp can force a pedestrian into the street. Intersections that use only visual crossing cues can lead to dangerous situations for pedestrians with limited vision. Many people with disabilities may prefer to use fixed-route transit, but an inaccessible street network can force them to use more costly paratransit service, or forgo trips altogether.

Incomplete streets have disproportionate impacts on people of color and those who have low incomes. In the Capital Region, people who are not white are 18% less likely to drive alone to work, 10% more likely to take transit, and more likely to walk. People whose household income falls below the poverty line are 20% less likely to drive alone, 11% more likely to commute via transit, and also more likely to walk to work.[5] Safe, comfortable, and affordable transportation options create a more equitable and economically mobile society.

Wolf Road in Colonie, NY

Walkability, Connectivity, and Land-Use

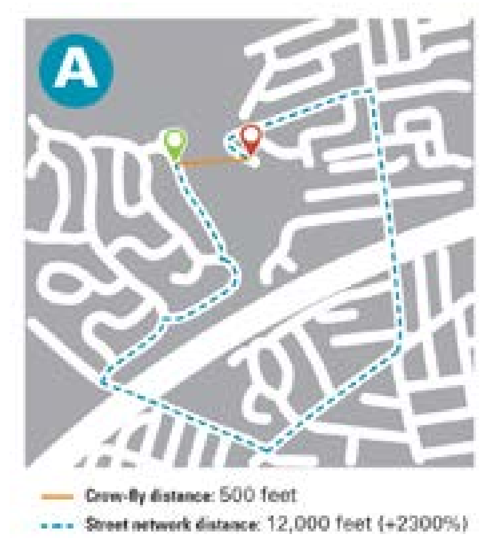
Land use strongly influences mobility choices and vice-versa. Destinations far apart from each other necessitate more investment in transportation to provide access to each destination. A transportation system designed only for automobiles requires wider roads, more parking, and more distance between origins and destinations.

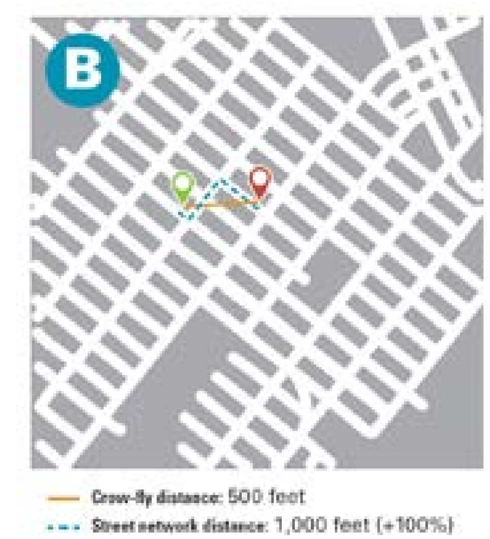
Because of the closeness of the relationship between land-use and transportation, land-use decisions are critical to determining transportation needs and costs. In this way, what are often private decisions (e.g., how to develop a lot, where to develop) become public concerns (e.g., roadway widening, new traffic signals, expanded utilities). It is in the public's interest for land use and transportation decisions to be planned together.

Example A shows the development pattern characteristic of typical suburban development patterns seen in the Capital Region following World War II. In this example, retail is located in a separate section of town from residential areas.

The residential area features a winding street pattern that discourages through traffic. A trip from one residence to a store is 2,300 percent longer on the street than the physical distance. Additionally, there is only one possible path to the store, funneling all traffic onto one road, placing increased burdens on this roadway. The long distances discourage non-motorized transportation, and the lack of central nodes makes transit difficult to operate.

Example B shows a more traditional grid street pattern found in many older communities in the Capital District. In this example, residential areas are either next to or mixed with commercial areas. A trip from one residence to a store can take many different paths, and the distance between these locations is far shorter than in Example A. This helps encourage the use of non-motorized transportation, like walking or bicycling. Additionally, because this development pattern features centralized nodes, transit service is more viable and more comfortable to use.





Health

One of the three priority areas of the Albany-Rensselaer Public Health Priority Workgroup (inclusive of local health departments, hospitals, and community partners) has been preventing obesity and diabetes, including by creating community environments that promote and support physical activity. The Health Improvement Plans list interventions, strategies, and activities that each county and hospital system will work to implement, including the number of Complete Streets policies.[6] This is because Complete Streets facilitate and encourage walking and bicycling. Streets that are designed only for cars discourage active transportation.

Streets that are designed only for cars discourage other modes of transportation, including walking and bicycling. Even where sidewalks do exist, large gaps in the sidewalk network, wide intersection crossings, speeding traffic, poor maintenance, and the lack of adequate accommodations for the mobility impaired can make walking unpleasant or unsafe.

To combat obesity and low levels of physical activity, the Centers for Disease Control promotes "built environment strategies that combine one or more interventions to improve pedestrian or bicycle transportation systems with one or more land use and environmental design interventions to increase physical activity."[7] Where it is comfortable and convenient, people are more likely to walk and ride a bicycle for everyday needs.

Shown below, the US Department of Health and Human Services' Community Preventive Services Task Force recommends built environment strategies combining transportation and land use elements.[8]

Delaware Avenue in Delmar, NY

Pedestrian and Bicycle Transportation System Intervention Component

- Street pattern design and connectivity
- Pedestrian infrastructure
- Bicycle infrastructure
- Public transit infrastructure and access

Land Use and Environment Design Intervention Component

- Mixed land use
- Increasing residential density
- Proximity to community or neighborhood destinations
- Parks and recreational facility access

Safety

Concerns about safety can deter people from walking, bicycling, and using transit. People who have an automobile will drive instead, but people who don't have an automobile or can't drive may be unable to access locations where they want to work, shop, or see a doctor. Many retail and medical facilities built in recent years are on busy arterial roadways designed to move large amounts of automobile traffic at fast speeds. In 2021, the Federal Highway Administration (FHWA) updated its list of Proven Safety Countermeasures, which are certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness to reduce serious injuries and fatalities. Three new strategies focus on speed, control of which is one of the most important methods to reduce death and serious injury. A number of the listed countermeasures aim to reduce crashes with pedestrians, including sidewalks, multi-use paths, and pedestrian crossings.[9] Safety treatments and strategies are included in this guide.

Vision Zero

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries while increasing safe, healthy, and equitable mobility for all. As of 2019, over 40 cities in the United States have committed to Vision Zero. Vision Zero recognizes that people make mistakes, so the road system and related policies should be designed to ensure those mistakes do not result in severe injuries or fatalities. This means that system designers and policymakers are expected to improve the roadway environment, policies (such as speed management), and other related systems to lessen the severity of crashes.[10]

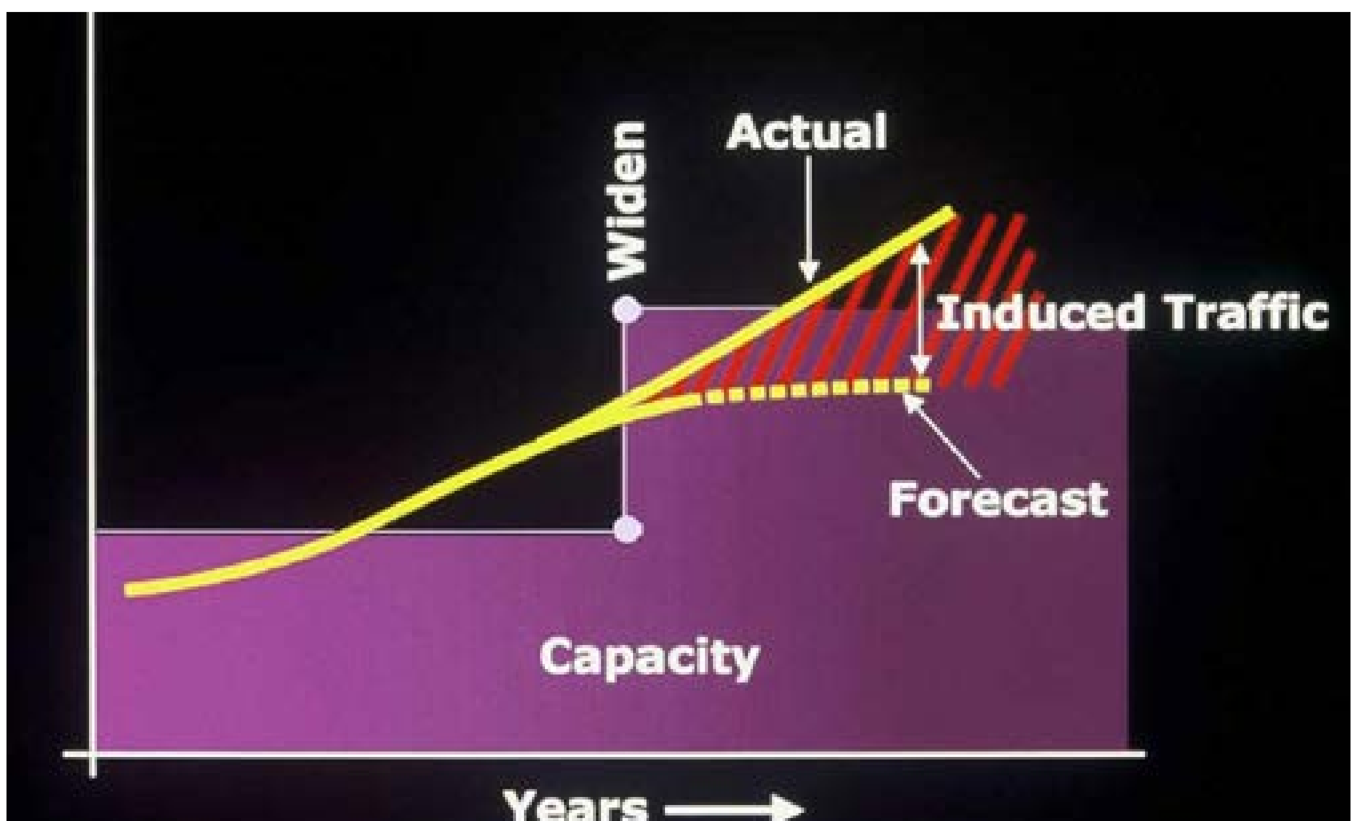
TRADITIONAL APPROACH		VISION ZERO
Traffic deaths are INEVITABLE		Traffic deaths are PREVENTABLE
PERFECT human behavior	VS	Integrate HUMAN FAILING into approach
Prevent COLLISIONS		Prevent FATAL & SEVERE CRASHES
INDIVIDUAL responsibility		SYSTEMS approach
Saving lives is EXPENSIVE		Saving lives is NOT EXPENSIVE

Environment and Transportation Choices

In the Capital Region, 40% of greenhouse gas emissions are from the transportation sector.[11] Not only do Complete Streets provide options for people who cannot drive or travel by automobile, but increasing the comfort and perceived safety of walking, bicycling, and taking transit can help people drive less. On the other hand, adding capacity to a road by adding lanes increases the amount of miles driven when comparing the previously forecast volume and the actual volume after widening, as shown in the graphic below.

The 2017 National Household Transportation Survey found that 49 percent of all trips in the Capital Region are 3 miles or less, and 28 percent of all trips are 1 mile or less—distances easily traversed by foot or bicycle. Even so, 46% of trips less than 1 mile in the region are made by automobile.[12] This presents an opportunity to improve not only transportation choices, but also the environment.

Many components of Complete Streets directly support a cleaner environment. Transit Signal Priority, allows buses to activate signals for extended green time, thereby reducing idling time for these large vehicles. Stormwater management helps reduce the frequency at which sewage treatment plants discharge untreated waste directly into the water system, and mitigate long-term capital infrastructure costs. Street trees clean the air, provide shade that reduces energy consumption, reduce the heat island effect, and create a pleasant environment for all street users.



Source: Congress for the New Urbanism 2020, Victoria Transport Policy Institute, and NACTO

Capital Region residents save an average of $8,390 per year by riding transit.[13, 14, 15, 16]

State Street in Schenectady, NY

State Street in Schenectady, NY

Economic Vitality and Livability

Complete Streets help create livable communities. Wide, attractive sidewalks and well-defined bicycle routes encourage healthy and active lifestyles. Creative repurposing of street space helps connect the community by providing fun and attractive public space for residents and visitors to gather. Streets that are attractive and accessible for all users help define a community's identity, encourage a vibrant street life, increase land values, and provide a sense of pride for residents and visitors.

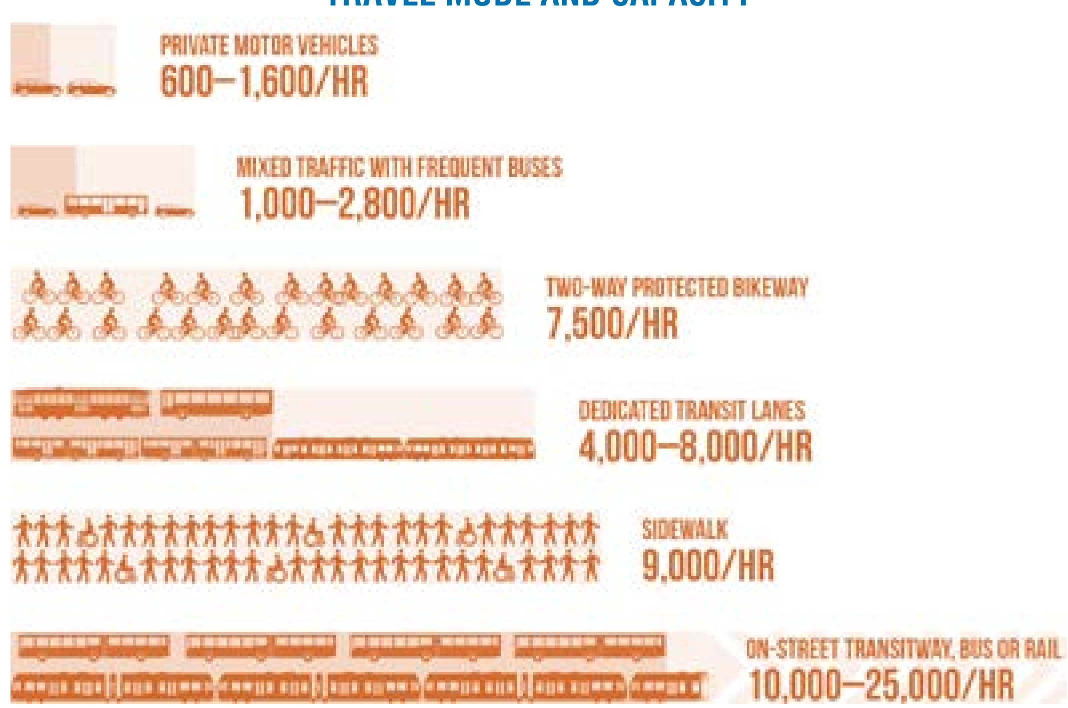
Development and Parking Minimums

Complete Streets create more economic vitality than automobile-only infrastructure, which requires a large area be devoted to parking lots or parking structures that push destinations apart. Minimum parking requirements for new buildings or rehabilitation projects ensure availability of public parking on-street or in parking lots; however, they also have the following negative impacts:

- Reduce walkability by reducing the number of destinations within walking distance and encouraging active driveways and curb cuts rather than trees and street furniture
- Encourage or necessitate car ownership and use,
- Subsidize car ownership,
- Reduce capital available for attractive storefront and residential facades
- Reduce affordability of housing, and goods and services from commercial establishments

In addition, travel lanes for automobiles can't transport as many people as those for other kinds of travel. NACTO's Travel Mode and Capacity graphic depicts the number of people that can be transported in an hour in a single travel lane.

TRAVEL MODE AND CAPACITY



Accessibility

Streets must accommodate safe travel for everyone, including those with disabilities. Many streets are difficult to access, navigate, or cross for people who use wheelchairs or who have diminished vision, hearing, or mobility. Most people will face at least one of these challenges in their lifetime. Complete and well-maintained sidewalk networks, accessible transit stops, properly placed and designed curb ramps, and other accessible features make it easier for all people to travel.

Relevant Legislation and Legal Precedent

The Americans with Disabilities Act (ADA) of 1990 prohibits discrimination against people with disabilities in several areas, including transportation. Title II of the ADA relates to nondiscrimination on the basis of disability in state and local government services, programs, and activities.

Curb Ramps

In 1993 the U.S. Court of Appeals for the Third Circuit in Kinney v. Yerusalem confirmed that the street and the curb are one facility and therefore alteration of the street requires the installation of curb ramps. In 2013, the US Departments of Justice and Transportation issued a Joint Technical Assistance memorandum that clarified that curb ramps must be made ADA accessible, not only when a facility is reconstructed or rehabilitated, but also when it is resurfaced.[17] Throughout this document the term "curb ramp" refers to both curb ramps and blended transitions, which have a grade of five percent or less.

Sidewalks

In 2002 the U.S. Court of Appeals for the Ninth Circuit in Barden v. Sacramento agreed with the Department of Justice's interpretation that sidewalks are encompassed by the ADA. This means that local governments must ensure that sidewalks are accessible.

Relevant Standards

The 1991 Standards, or "ADA Standards for Accessible Design," included standards for accessible curb ramps. They also included standards for parking, although they were silent about on-street parking. The Access Board released the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), which covers sidewalks, in 2011. The New York State DOT began updating its design standards in 2013 to conform to PROWAG, which apply to NYSDOT projects as well as federal or state-funded projects on roadways in New York State. PROWAG covers pedestrian access to sidewalks and streets, including crosswalks, curb ramps, street furnishings, pedestrian signals, on-street parking, and other components of public rights-of-way. Once these guidelines are adopted by the Department of Justice, they will become enforceable standards under title II of the ADA. As of this writing, the Department of Justice ADA standards (2010), which became mandatory on March 15, 2012, remain the enforceable standards. Nonetheless, this guide has been developed based on the PROWAG, which can be referenced for further details.

New projects and alterations must be constructed to current accessibility standards. Where existing physical constraints make it impracticable for alterations to fully comply with the requirements for new construction, compliance is required to the extent practicable within the scope of the project. Existing physical constraints include underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature. It should be noted that there is no similar exemption for financial impracticability or financial hardship.

General Requirements

This guide provides relevant standards for sidewalks, intersections, signage, transit, and parking, while this section addresses general accessibility topics.

Pedestrian Access Routes

A pedestrian access route is a continuous and unobstructed path of travel provided for pedestrians with disabilities. They must be provided within sidewalks, pedestrian street crossings including medians and refuge islands, and on bridges and underpasses. Pedestrian access routes in the public right-of-way are equivalent to accessible routes on sites in that they connect to accessible elements, spaces, and facilities in the public right-of-way. These elements include pedestrian signals and pushbuttons, street furniture, transit stops and shelters, on-street parking spaces and associated meters and pay stations, and passenger loading zones. Pedestrian access routes in the public right-of-way also connect to accessible routes at building and facility site arrival points.

An entire sidewalk, street crossing, bridge, or other pedestrian facility does not need to meet the requirements for the pedestrian access route. In other words, on a twenty-foot wide sidewalk, benches, trash cans, post office boxes, and decorative surface materials can be used (and themselves must be accessible), but they must remain outside of the pedestrian access route, which is recommended to be at least five feet wide. Areas outside of the pedestrian access route may also have surface materials that are not permissible within the pedestrian access route. Discussion about accessibility requirements for sidewalks later in the guide assumes that the sidewalk is the pedestrian access route.

Detectable Warnings

Detectable warnings are small truncated domes arranged in a grid or radial pattern on the walking surface. On pedestrian access routes, they indicate to people walking that they are at

Fuller Road in Guilderland

the boundary between pedestrian and vehicular routes. They should not be used at residential driveways but should be used at driveways that have yield or stop control, such as large commercial driveways. They are also required at pedestrian refuge islands longer than six feet, and at boarding platforms for buses, if the edge of the platform isn't protected. Boarding platforms are higher than sidewalk level bus stops.

Detectable warning strips must be at least two feet long in the direction of pedestrian travel, and extend the full width of the area that the pedestrian will walk across, such as the curb ramp. The surface of detectable warnings must contrast visually with the surrounding area, either light-on-dark or dark-on-light. It is recommended to use untreated cast iron detectable warnings. These naturally contrast with concrete and hold up well to the elements and snowplows. To reduce unnecessary vibrations for people traveling in a wheelchair, the domes can be oriented such that wheels will track through them. The PROWAG includes further details on detectable warnings.

Slopes

The cross slope of curb ramps, blended transitions, and turning spaces at pedestrian street crossings without yield or stop control and at midblock pedestrian street crossings can equal the street or highway grade (PROWAG R304.5.3). Clear spaces required at accessible pedestrian signals and pedestrian pushbuttons and at other accessible elements are permitted to have a running slope consistent with the grade of the adjacent pedestrian access route (PROWAG R404.2).[18]

Common Issues

Historic Districts

A sidewalk within a historic district does not normally remove accessibility requirements. If compliance with an accessibility standard could threaten or destroy historically significant features of a historic facility, a determination from the NYS Historic Preservation Office should be sought. It should be noted that it is relatively rare for the existing sidewalks to qualify as a historically significant feature.

Maintenance: Surface Cracking, Snow, and Debris

Surface materials used on all parts of pedestrian access routes and surfaces that connect required accessibility elements to pedestrian access routes must be firm, stable, slip resistant, and smooth. Only isolated or temporary interruptions are allowed, if they are a result of maintenance or repairs. This applies to the surfaces of sidewalks, curb ramps, crosswalks, and connections to elements such as pedestrian pushbuttons, building entrances, and accessible parking spaces. There must not be any cracks, gaps, or openings greater than ½ inch. This helps people traveling in a wheelchair to maintain control.

People who have disabilities rely on the quality and consistency of the transportation system at least as much as the general public. Over time, pedestrian access routes may erode and become noncompliant. Sun, freeze/thaw cycles, tree roots, and vehicles driving over sidewalks can cause them to heave, crack and crumble. Snowplows and weather can erode truncated domes off of detectable warnings on curb ramps. Passing vehicles and sun wear away crosswalk paint. Debris collects on pedestrian and bicycle infrastructure faster than on roadways, and can entirely prevent passage of pedestrians with low or no vision or who use mobility aids.

Regular maintenance programs should monitor and repair or improve accessible elements to at least the same degree as they monitor roadway pavements. Many municipalities implement an annual paving program to maintain smooth surfaces. Other infrastructure, such as sidewalks, can be included within such a program, or a municipality may consider a separate program.

Removal of snow, debris, and vegetation from pedestrian infrastructure is a particular challenge. A good minimum practice for debris and vegetation is to perform an annual review of all infrastructure and clean or trim away potential obstructions. If debris repeatedly collects in one location, there may be a drainage issue requiring further investigation. Slopes at intersections may need to be adjusted so that water doesn't collect at the bottom of curb ramps. At times, a larger repair to the drainage system itself may need to be scheduled.

Municipalities must also ensure that snow is cleared from the pedestrian access route and other accessible elements in a timely manner. Many local governments in the Capital Region pass on the responsibility of keeping sidewalks clear to the adjacent property owners or occupants. This approach may require additional education, inspection, enforcement, and administrative actions to be successful. However, the local government is ultimately still responsible for maintaining accessibility. While there is no definition of timely, local snow clearance laws for property owners or occupants range in time from 8 hours to 72 hours. Most frequently, local governments require clearance 24 hours after the snow falls or after the end of snowfall.

Cities and peer regions across Upstate New York are beginning to focus more heavily on municipal sidewalk plowing, shoveling, and salting, as well as on increased enforcement. Curb ramps and sidewalks must be cleared of snow, ice, and any other condition that renders them unusable by people who have disabilities. Special attention should be paid to bus stops and public facilities. Permeable pavement can be used to help prevent the ponding of water, reducing the likelihood of ice formation and the amount of salt needed.

Access During Construction

When construction occurs within or adjacent to the public right-of-way, public accessibility must be provided for people of all ages and abilities. While construction can disrupt mobility for all pedestrians, changes to the sidewalk travel flows and infrastructure can be particularly troublesome or hazardous for people with limited mobility. A closed sidewalk can cause hardship for pedestrians and someone in a wheelchair by forcing a long detour. This can be even more problematic for the visually impaired if there is not proper advanced warning signage and guidance. Such individuals might be used to navigating along a particular route and a disruption to this route can be dangerous.

Construction should not detour pedestrians from existing routes. If the pedestrian way is closed for construction or maintenance, a detectable alternate access route must be provided, along with advance notification. Unless an acceptable route that does not involve crossing the roadway can be provided, advance signing should direct pedestrians to cross to the opposite side of the roadway. If people who have visual disabilities regularly use the closed pedestrian way, a barrier detectable by a long cane must be placed along the full width of the closed facility. The following accommodations should be considered when laying out construction sites:

- Adequate illumination and reflectors
- Use of temporary accessible walkways
- Channeling and barricading to separate pedestrians from traffic

Local ordinances should be updated to define accessibility requirements.

Improper Construction Access

Proper Construction Access

Flexibility in Design

A flexible approach to design is a critical component of Complete Streets. The preeminent design manuals for use with state and federal projects emphasize the need for flexibility. This includes AASHTO's A Policy on Geometric Design of Highways and Streets Seventh Edition, commonly referred to as the "Green Book," which notes, "No project is exactly like another; therefore, no single set of design criteria can be applicable to or meet the needs of all, or even most, projects."

The foreword to the AASHTO Green Book describes the need for flexibility responsive to a project's context:

"This policy is not intended to be a prescriptive design manual that supersedes engineering judgment by the knowledgeable design professional. The design concepts and criteria in this policy are intended for use when designing new construction projects on new location or designing reconstruction projects on an existing location. Projects on existing roads particularly call for a flexible, performance-based approach to design. The policy also encourages flexible design, which emphasizes the role of the planner and designer in determining appropriate design dimensions based on project-specific conditions and existing and future roadway performance more than on meeting specific nominal design criteria."

The Green Book goes on to say that "flexibility should be exercised in order to better meet specific project goals or to work within defined constraints." "Exercise of design flexibility may, in some cases, involve leaving some design elements unchanged, if they are performing well, even if they do not fully meet the design criteria generally used in new construction. In some cases, it may be desirable to reduce the dimensions of some design elements so that other aspects of performance can be improved."[19]

The key to achieving greater flexibility is understanding all the guidance documents available (including this one) and applying appropriate designs to achieve desired outcomes. For example, the AASHTO "Green Book" (where many engineers and designers derive the "standard" 12-foot lane) recognizes the need for flexibility and states that lane width can be tailored to fit the roadway environment.

AASHTO states that lane widths may vary from 10 to 12 feet on most arterials rather than stating that 12 feet is the recommended width for all roads. For lower classification roadways, narrower widths are generally appropriate.

The New York State Highway Design Manual governs projects on state roadways and those funded or administered by NYSDOT. Minimum travel lane widths of 12' must be provided along all Designated Qualifying Highways. Minimum travel lane widths of 10' are required along Designated Access Highways and for routes within 1 mile of Qualifying Highways. NYSDOT's Office of Traffic Safety and Mobility maintains a listing of all designated highways in the publication Official Description of Designated Qualifying and Access Highways in New York State.[20]

Accessibility: Further Guidance

- *Manual on Uniform Traffic Control Devices Section 6:* https://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part6.pdf

FHWA Revised Rules for the National Highway System

In May 2016, the FHWA revised its criteria for the 10 rules controlling the design of projects on the National Highway System (NHS). The ten rules are as follows;

- Design Speed
- Lane Width
- Horizontal Curve Radius
- Superelevation Rate
- Stopping Sight Distance
- Maximum Grade
- Cross Slope
- Vertical Clearance
- Design Loading Structural Capacity

Before the rule change, all 10 controlling criteria applied to ALL NHS facility types. Under the new rule, ONLY "Design Loading Structural Capacity" and "Design Speed" apply to all NHS facility types. The remaining eight criteria are applicable only to "high-speed" (design speed over 50mph) NHS roadways.

At a federal level, this new rule provides greater flexibility in designing most roadways to the local context rather than rigid adherence to standards of highway design. However, NYSDOT continues to require the use of all 10 controlling design criteria, in addition to ADA compliance, for all NHS and non-NHS state-owned and maintained facilities and for projects funded through NYSDOT.[21] A map of roadways on the National Highway System in New York State is available on NYSDOT's website by selecting National Highway System at gis.dot.ny.gov/fc.

Importance of Networks

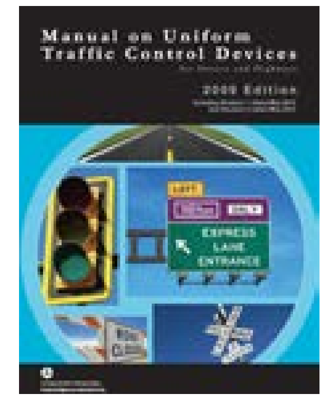
In areas with space constraints and limited public right-of-way, it may not be feasible to provide the highest quality facilities for all users on all streets. By viewing a street as part of a larger network, planners and engineers can identify parallel streets where a different balance of facility types helps provide mobility for all users and improves overall network efficiency. Effectively implementing the network approach requires local, county, and state jurisdictions to coordinate to develop a network plan, define the role of each street, and create a complete network for all roadway users.

Further, under the FAST Act, signed into law in December 2015, designs for projects on the National Highway System (except those on the Interstate System) MUST consider access for other modes of transportation as well as cost savings attained by utilizing design flexibility that exists in current design guidance and regulations. See 23 U.S. Code § 109(c)(1).

Additional Guidance

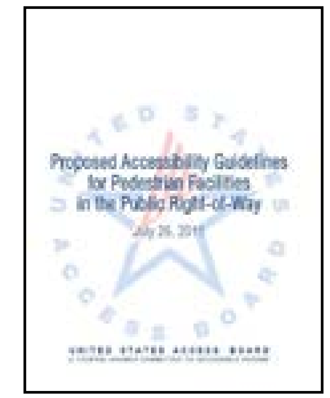
This design guide supplements existing manuals and standards. Design guides are subject to change. This compilation reflects those that should be followed most of the time and those that are optional.

Required



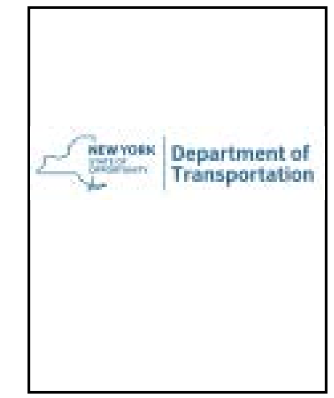
Manual on Uniform Traffic Control Devices
FHWA, 2012

The MUTCD defines the nationwide standards to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. Traffic control devices include road markings, highway signs, and traffic signals. In addition, New York publishes the NYS Supplement, with deviations to the MUTCD that must be followed in New York State.



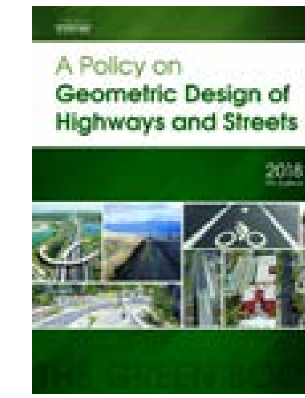
Public Rights of Way Accessibility Guidelines
U.S. Access Board, 2011

The PROWAG proposes accessibility guidelines for the design, construction, and alteration of pedestrian facilities in the public right-of-way. They are written to ensure that sidewalks, pedestrian street crossings, pedestrian signals, and other facilities for pedestrian circulation and use constructed or altered in the public right-of-way by state and local governments are readily accessible to and usable by pedestrians with disabilities. Because they have not been adopted at the federal level, compliance is not mandatory for all projects, however the NYS Department of Transportation has adopted PROWAG and integrated it into the Highway Design Manual. Therefore, compliance with PROWAG on state roadways and state-funded or administered projects is mandatory. Final federal adoption of the Guidelines may be with or without additions and modifications.



Highway Design Manual
NYS DOT

The HDM seeks to provide current requirements and guidance for highway design, and assure uniformity throughout NYSDOT and with AASHTO and FHWA. The HDM notes that it does not eliminate the need for other references, and that variations will be necessary for special or unusual conditions. Except for off-road bicycle or pedestrian projects, local governments must also adhere to the HDM when implementing projects funded or administered through NYSDOT, regardless of the project's location.



A Policy on Geometric Design of Highways and Streets, 7th Ed.
AASHTO, 2018

State highway departments and the FHWA work together to create this guide, available by purchase only, through the American Association of State Highway and Transportation Officials. The FHWA incorporates this guide in its requirements for the design of roadways on the National Highway System. The 7th Edition presents an updated framework for geometric design that is more flexible, multimodal, and performance-based than in the past.

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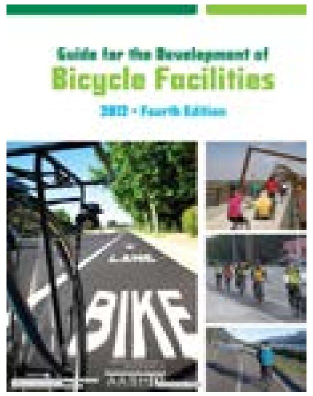
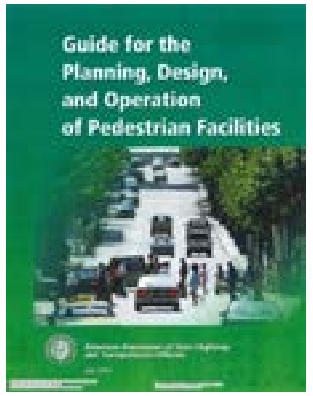


Guide for the Development of Bicycle Facilities, 4th Edition

AASTHO, 2012

This guide, available by purchase only, covers bicycle planning and design for bikeways, including fundamental operating characteristics of bicyclists and geometric design. The 5th Edition is expected to identify and evaluate new and existing types of bicycle facilities and treatments, including separated bicycle lanes.



Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st Edition

AASHTO, 2004

This guide, available by purchase only, is FHWA's primary national resource for the planning, designing, and operating of pedestrian facilities.

U.S. Department of Transportation Federal Highway Administration

[Bicycle Facilities and the Manual on Uniform Traffic Control Devices]

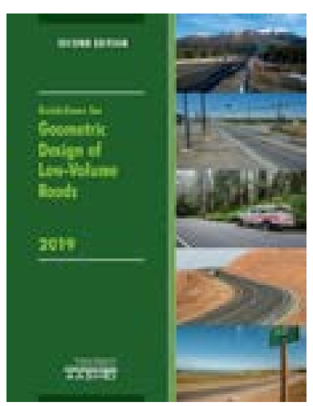
FHWA, 2013

This guidance table lists various bicycle-related signs, markings, signals, and other treatments and identifies their status (e.g., can be implemented, currently experimental) in the 2009 version of the MUTCD.

[Separated Bike Lane Planning and Design Guide]

FHWA, 2015

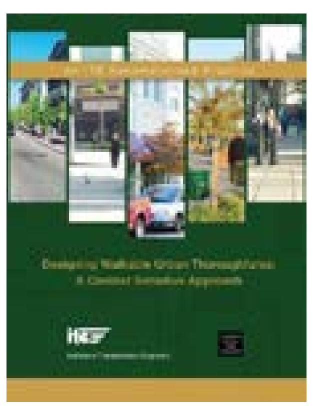
This guide outlines planning considerations for separated bike lanes and provides design options covering typical one and two-way scenarios. It highlights different options for providing separation, documents midblock design and intersection design information.



Guidelines for Geometric Design of Low Volume Roads

FHWA, 2019

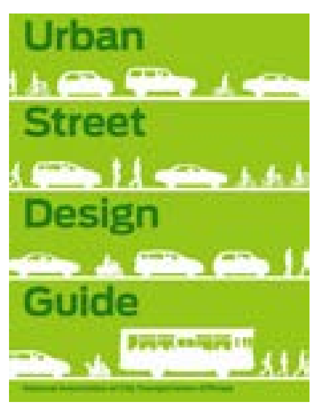
This guide, available by purchase only, presents a flexible approach to design of roads and streets with design volume of 2,000 vehicles per day or less.



[Designing Walkable Urban Thoroughfares: A Context Sensitive Approach]

ITE, 2010

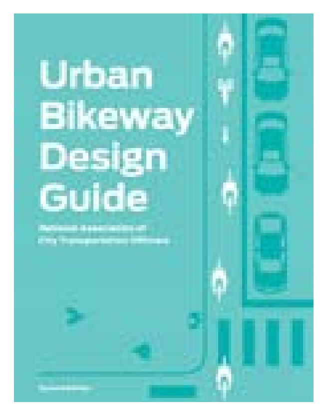
This report describes appropriate trade-offs to balance the needs of all users, adjoining land uses, and environment and community interests. FHWA supports use of this guide.



[Urban Street Design Guide]

NACTO, 2013

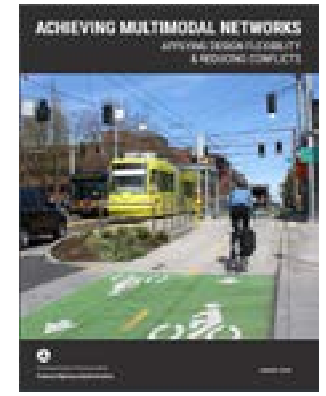
This guide focuses on the design of city streets and public spaces.



[Urban Bikeway Design Guide]

NACTO, 2014

This guide, supported by FHWA, provides cities with solutions that can help create complete streets that are safe and enjoyable for bicyclists.



[Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts]

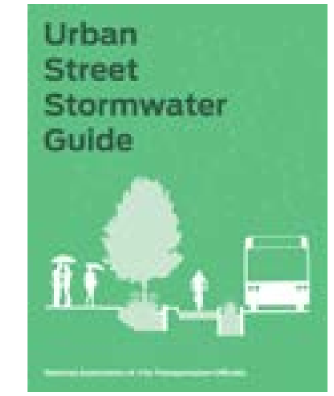
FHWA, 2016

This guide focuses on the need and opportunities for design flexibility found in current national design guidance, addressing common roadway design challenges and barriers. It focuses on reducing multimodal conflicts and achieving connected networks so that walking and bicycling are safe, comfortable, and attractive options for people of all ages and abilities.

[Transit Street Design Guide]

NACTO, 2016

This guide provides design guidance for the development of transit facilities on city streets, and for the design and engineering of city streets to prioritize transit, improve transit service quality, and support other goals related to transit. It sets a vision to harness the immense potential of transit to create active and efficient streets in neighborhoods and downtowns.



[Urban Street Stormwater Guide]

NACTO, 2017

This guide provides national best practices for stormwater management in the public right-of-way, including strategies for building inter-departmental partnerships around sustainable infrastructure and communicating the benefits of such projects. It provides approaches to starting and scaling up green infrastructure and proposes a framework for measuring the performance of streets comprehensively.

Capital District Regional Planning Commission

[Green Infrastructure Toolkit]

CDRPC

This toolkit provides customizable green alternatives to traditional stormwater management in urban areas and small sites to reduce volume, particularly in locations with combined sewers. It focuses on retention and infiltration to minimize combined sewer overflows.

Design Controls

Level of Service

Level of service (LOS) is a metric used to quantify the quality of a transportation service. It is a qualitative measure of the traveling public's general satisfaction with the performance of the service under given demand and operation conditions. LOS is presented on a scale from "A" to "F," representing from best to worst condition, respectively.

Traditionally, LOS analyses have focused on conditions for automobiles only, as a function of speed and delay. Signal timing adjustments, additional exclusive left-turn lanes, or additional through lanes may be implemented to improve automobile LOS. However, such measures to improve automobile LOS often worsen the traveling safety and comfort for walking, bicycling, and transit. For example, protected left-turn lanes create longer pedestrian crossing distances as well as additional pedestrian crossing delay.

For this reason, level of service analyses should not be used as the sole determinant of roadway design where users other than automobile drivers can be anticipated. A decrease in automobile level of service, for example a reduction in speed, may be acceptable or even desired. Local jurisdictions have flexibility in the use of motor vehicle LOS standards.[22] The AASHTO Green Book provides guidance for desirable LOS for different contexts and states that the designer has the latitude to choose an appropriate LOS.[23] USDOT regards these recommended values as guidance only. Further, FHWA does not have regulations or policies that require specific minimum LOS values for projects on the NHS.[24]

Multimodal Level of Service

Multimodal Level of Service (MMLOS) provides a broader snapshot of the quality of the transportation system, allowing a Complete Streets approach to transportation analysis. MMLOS generates separate LOS indicators for four modes of travel: automobile drivers, bus passengers, pedestrians, and bicyclists. This enables transportation planners, analysts, and engineers to assess how various design changes impact each mode differently, weigh the potential trade-offs in performance for each mode, and seek a balance appropriate to the context of the study area and user needs.

MMLOS is included in the 2010 update to the Highway Capacity Manual. The metric was developed for urban streets, which the methodology defines as a street with a traffic signal control device at least once every 2 miles. It is typically applied in more urban environments where there is more multimodal need and activity, and not in rural settings or on residential streets.

In 2019, CDTC analyzed bicycle level of service methodologies to determine a preferred methodology for CDTC-funded planning studies. These methodologies included: Level of Traffic Stress (LTS) developed by the Mineta Transportation Institute, the Bicycle Level of Service (BLOS) from the Highway Capacity Manual, the Bicycle Network Analysis created by People for Bikes, and the Bicycle Environmental Quality Index (BEQI) developed by the San Francisco Department of Public Health.

Based on this analysis, CDTC recommends using Level of Traffic Stress for network analysis and Bicycle Level of Service from the Highway Design Manual to evaluate design alternatives. These planning contexts are typical in CDTC's Transportation and Community Linkage Studies and will be CDTC's preferred methods in such studies unless stated otherwise. Factors such as planning context, availability of data, and resources played a significant role in this determination.

Bicycle Level of Traffic Stress Map

from the Bike Ironbound: Bicycle Plan for the City of Newark

The Bicycle Level of Traffic Stress (LTS) Analysis was used as part of the Bike Ironbound: Bicycle Plan for the City of Newark, New Jersey to demonstrate barriers to comfortable and continuous bicycling in Newark's Ironbound neighborhood. The existing LTS is shown in the map above. The analysis was used to demonstrate the impact that bicycle infrastructure improvements would have on creating low-stress bicycle connectivity in the neighborhood.

Design Speed

Speed is a critical factor in the occurrence of crashes and the severity of their outcomes. Street design in the latter half of the 20th century was grounded in highway design principles that focused on forgiving driver error and accommodating higher travel speeds. This approach has based design speed on the 85th-percentile of how fast drivers are actually driving rather than how fast they should drive. This causes design speed to be as high as practicable and increases the frequency of crashes and their severity, encourages speeding and reckless driving behavior, and puts drivers who are driving the speed limit and other roadway users at greater risk.

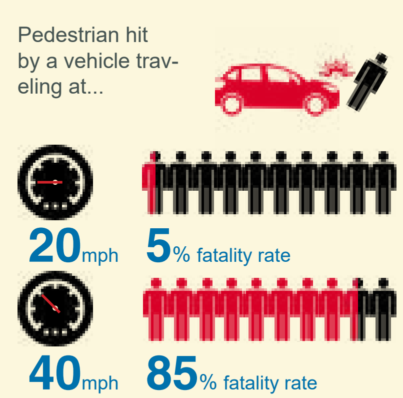
Target Speed

In urban areas, FHWA advises that the design of the street should generally be such that it limits the maximum speed at which drivers can operate comfortably, as needed to balance the needs of all users.[25] Designing for desired travel speed can help lower travel speeds, minimize injuries in crashes, and otherwise improve the built environment for all users. The Institute for Transportation Engineers recommends replacing design speed with target speed. It is important for the design of the roadway to encourage an actual operating speed that equals the target speed.

Target speed should be selected based on the context, consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a safe environment for pedestrians, bicyclists, and public transit users. Roadway elements should be selected and designed to support that speed. Where there are higher volumes of pedestrians, bicyclists, and transit users, roadway design should encourage a lower speed differential between modes. On most urban roads and main street areas, a target speed of between 10 and 30 mph is appropriate. Design factors that contribute to speed reduction include signal timing for moderate speeds, narrower travel lanes, on-street parking, small curb radii, and textured paving materials.[26]

Speed and Safety

Many studies have shown that slower vehicle speeds exponentially increase the survival rates for vulnerable road users. A pedestrian struck by a motor vehicle traveling 40 mph has an 85 percent chance of death. At 30 mph, this chance falls to 45 percent. At 20 mph, the fatality rate drops to just 5 percent.[27]



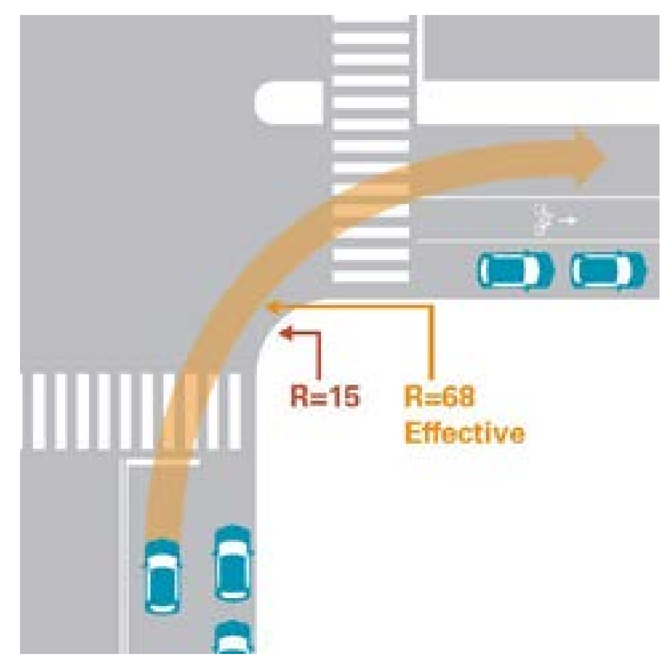
Design Vehicle

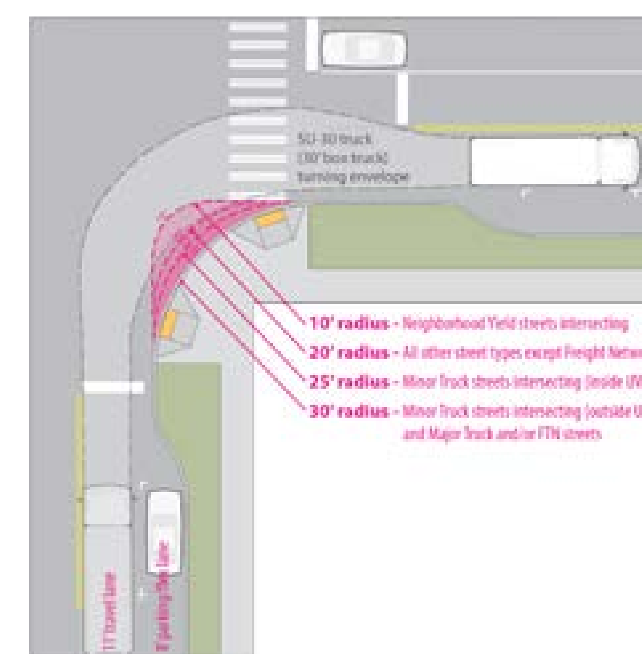
Design vehicles are vehicles that must be regularly accommodated without encroaching into opposing travel lanes when they turn. Some practitioners will conservatively select the largest design vehicle, such as a tractor-trailer, that could use a thoroughfare, regardless of the frequency. This reduces overall and everyday street safety by creating streets that accommodate and encourage higher vehicle speeds and longer pedestrian crossing distances.

Examples of appropriate design vehicles include a standard transit vehicle on a regularly scheduled bus route, or a semi-tractor trailer on a primary freight route. If there are no specific expectations, the practitioner should consider the use of a single-unit truck as an appropriate design vehicle. This allows corridors to be designed appropriately for vehicles frequenting a particular area, not for the occasional vehicle. The designer should determine the mix of traffic and frequency of large vehicles and estimate how this mix will change as context changes so that the design can maintain consistency with the community's long-range vision.

A useful concept is the "control vehicle"—one that makes infrequent use of a facility and must be accommodated, but for which encroachment into the opposing traffic lanes, multiple-point turns, or minor encroachment into the streetside is acceptable. Designing for a control vehicle is appropriate when occasional large vehicles turn at an intersection with low opposing traffic volumes (such as a moving van in a residential neighborhood or once-per-week delivery at a business) or when large vehicles rarely turn at an intersection with moderate to high opposing traffic volumes (such as emergency vehicles). Larger vehicles can be accommodated at intersections with narrower turning radii by moving the stop bar on the receiving street back to allow for wider turns.

As municipalities and other jurisdictions replace their fleet vehicles, they should consider purchasing smaller or more appropriate vehicles that match the context of their streets.





Design Hour

Similar to the principles of the design vehicle, streets are often designed to reduce congestion and maintain a specific LOS for vehicles during the one busiest hour of the day. A street's uses, demands, and activities, however, change throughout the day. A street at rush hour has different needs than a street at lunch hour. It is important to understand the needs of all modes and roadway functions during peak and non-peak times. When a street is designed purely to accommodate automobile volumes in one peak hour of the day, it often fails to provide a safe and attractive environment for other users throughout the day. A street that is overbuilt for automobiles presents safety challenges to pedestrians and bicyclists, and does not support economic vibrancy or the surrounding context. At a minimum, multimodal data should be collected over the 2 to 3 hours of peak traffic to better understand traffic behavior throughout the entire peak period.

The busiest hour for all vehicles may be different than the busiest hour for pedestrians, transit vehicles, or bicyclists. For example, the peak pedestrian hour on a street with student dormitories may coincide with class times or weekend evenings. Likewise, a neighborhood commercial area with numerous restaurants may experience its peak vehicular hour at traditional commute times but its peak pedestrian hour in the evening. Bus ridership can indicate the peak hour for transit riders and can also determine whether bus lanes would increase the throughput of people.

The TRB Highway Capacity Manual 2010 provides for flexibility when considering analysis results. Specifically, it states that "the existence of a LOS F condition does not, by itself, indicate that action must be taken to correct the condition" and goes on to say that other issues should be considered, such as safety and pedestrian and bicyclist needs.[28] For example, road diets may meet off-peak needs and provide safety benefits that outweigh anticipated increases in delay or travel time during the peak hour. Besides, overall corridor travel time is often a more useful and understandable performance measure than the level of service at individual intersections.

Broadway in Albany, NY

Albany, NY

Consider the ability of a whole network to move and diffuse traffic at the peak period and throughout the day. Travel times between origins and destinations tend to be similar across different routes within one network, meaning that if one route becomes congested, users will often choose a different route. Measures such as turn restrictions and 1-way to 2-way conversions can serve to channel and disperse traffic throughout the network toward preferred routes.

Design Year

Public officials, transportation planners, and engineers routinely make investments and recommendations that consider how infrastructure will respond to future growth and development. The chosen design year used for roadway projects includes an estimation of future traffic demand and volume that often assumes steady traffic growth. These projections often stand at odds with recent policy, demographic, and travel trends.

Traffic Growth Projections

A conventional roadway design approach is to build and operate a facility to accommodate for vehicle traffic forecasts that could occur during the design life of a facility. However, in many cases "the streets were built to accommodate a projected volume that never materialized," resulting in streets that have underutilized vehicle travel lanes and may not support community goals (e.g., safety, economic activity, livability).[29]

Additionally, designers historically developed trip generation estimates based on data collected from suburban car-oriented developments. The

2012 ITE Trip Generation Manual has new techniques for estimating trip generation for all modes and for mixed-used developments. Research is ongoing regarding the best practices for trip generation estimates for a larger variety of land uses and modes of travel.

In the Capital Region, long-term trends have indicated that traffic growth has slowed down significantly since 2005 following years of steady growth. While in the past many travel models assumed 1 to 2 percent annual growth in vehicle volumes, CDTC's travel demand model for federal-aid roads reflects current, Capital Region - specific trends in population and employment growth. CDTC bases growth forecasts on the Capital District Regional Planning Commission's population forecasts, which show 5% growth region-wide between 2015 and 2050. CDTC incorporates the potential benefits of improved land use decisions, growth in other modes, and overall shifts in mobility choices in its forecasts.

Future analysis should begin with a vision for the future function of the street or area and identify design treatments that will achieve that goal. In addition, land use policy and the provision of parking, especially free parking, should be coordinated with the desired function of the area. It is important for designers to recognize that transportation patterns and habits across the country are changing: fewer Americans are driving alone to work, the number of miles driven per capita is stabilizing, and rates of walking, bicycling, and transit use are up. These trends should be factored into decisions about future vehicle volume estimates.

Induced Demand

A study conducted by ITE found that between 50 and 100 percent of new roadway capacity is absorbed by traffic three or more years after expansion. The principle of induced demand means that the addition of roadway capacity along a particular route induces travelers to choose that route, thereby utilizing most or all of the additional capacity. Furthermore, expanded roadways can degrade the pedestrian environment and increase space between land uses, reducing the ability of people to walk to destinations and making transit services less viable. If a project is determined to require an increase in roadway capacity, induced demand should be considered a negative externality and other strategies should be considered to mitigate the projected demand.

Retrofitting streets for pedestrians, cyclists, and transit may require reducing or reallocating roadway vehicle capacity. While conventional perception is that reduced vehicular capacity leads to congestion, research suggests that the opposite is often true. This is related to the inverse of induced demand, known as "traffic evaporation," which means that when road capacity is reduced, vehicle volumes can respond by decreasing in a similar proportion. Displaced traffic may be absorbed by the surrounding street network, shift to another mode, or the trip is altered. In this way, travel behavior reflects the conditions of the transportation system.

Mode targets for transit, walking, or bicycling within a set time frame are a useful framework to show the connection between infrastructure investments and mode share.

2
Integrating Complete Streets into the Planning and Design Process

Integrating Complete Streets principles into design from project inception is critical to efficient and cost-effective project delivery, and creating an optimal street design. Changes to the design late in the process can lead to contract change orders, costly rework, and a less cohesive overall design.

All relevant stakeholders should be involved in planning and project scoping so that the process adequately assesses and captures the needs of all users and all modes for integration into the project design. Defining the needs of all users at this first step helps mitigate the potential for changes in scope at later phases. With a clear definition of the project purpose and need in place, the project team can develop integrated, multi-modal design alternatives that fit the context and address the needs of all users.

I. Implementing Complete Streets at the New York State Department of Transportation

NYSDOT's transportation project design process considers potential project impacts on all transportation system users, including the elderly, people with disabilities, transit users, pedestrians and bicyclists. The Highway Design and Project Development Manuals provide guidance for providing safe facilities for pedestrians, bicyclists and transit users. They also include information on how to make these facilities safer by integrating traffic calming, landscape architecture, and community design.

New York Complete Streets Law

Governor Andrew M. Cuomo signed the NYS Complete Streets Act[30] (Chapter 398, Laws of New York) on August 15, 2011, requiring state, county and local agencies to consider the convenience and mobility of all users when developing transportation projects that receive state and federal funding. NYSDOT must show how it has institutionalized Complete Streets by addressing and incorporating its design features in planning, project scoping, design and implementation of transportation projects.

NYSDOT Complete Streets Checklist

NYSDOT uses the NYSDOT Capital Projects Complete Streets Checklist to evaluate project-level issues and opportunities. Completion of the checklist begins in the earliest phases of a project and is refined as the project progresses and more detailed information becomes available. At the beginning of the project, during the Initial Project Proposal phase, the checklist considers pedestrian facilities within 0.5-mile of the project location, and bicycle facilities within 1 mile of the project area. The checklist considers existing and proposed pedestrian and bicyclist generators in the area, such as schools, libraries, shopping areas, bus stops, and transit stations and terminals. It also provides a threshold over which designers should consider a road diet for the corridor.

During the Scoping and Design phases, pedestrian and bicyclist crash history are considered, along with potential traffic calming measures and lighting. At this stage NYSDOT considers accessibility issues with existing pedestrian infrastructure, as well as gaps in both the pedestrian and bicycle networks between generators in the area. NYSDOT also considers access to transit facilities, local delivery needs, improvements to parking, and opportunities to consolidate


Sand Creek Road in Colonie, NY

driveways. In many instances, completion of the checklist may require communicating internally within NYSDOT, and externally with the local host community and transit operator. Municipal documentation of issues and opportunities prior to project initiation can greatly improve coordination with the NYSDOT with NYSDOT's capital projects.

In addition, the New York State Smart Growth Public Infrastructure Policy Act was signed into law in August 2010 as an amendment to the Environmental Conservation Law. The Act is intended to minimize the unnecessary cost of sprawl development and requires State infrastructure agencies, including NYSDOT, to ensure public infrastructure projects undergo a consistency evaluation and attestation using the eleven Smart Growth criteria specified in the Act. This review encourages growth in developed areas with existing infrastructure to sustain it, particularly municipal centers, downtowns ("Main Streets"), urban cores, historic districts and older first-tier suburbs. Some criteria of Smart Growth complement the goals of Complete Streets, such as furnishing transportation options other than automobiles, and reducing regional air pollution. NYSDOT's Smart Growth Screening Tool assesses a project's consistency and alignment with relevant Smart Growth criteria.

NYSDOT Practices

As implemented in the CDTC planning area, notable NYSDOT practices include pedestrian crossing infrastructure at signalized intersections, use of 11-foot wide lanes as a standard practice, and communication practices. The NYS Highway Design Manual and NYSDOT policies and practices described in this section date to 2021 and are subject to change.

Pedestrian Infrastructure at Signalized Intersections

NYSDOT considers the need for pedestrian infrastructure as part of roadway improvement projects. Chapter 18 of the NYS Highway Design Manual notes, "Intersections should be designed with the premise that pedestrians will be present, and will be able to cross the street safely." The document specifically notes that curb ramps are required where sidewalks present the opportunity for pedestrians to cross the street. However, NYSDOT generally includes curb ramps and accessible pedestrian signals at all crossings regardless of sidewalk presence unless pedestrian access is prohibited, the cost to do so is excessive compared to the larger project, or there is an absence of need as in sparsely populated areas. NYSDOT undertakes this nuanced evaluation for all projects and documents the justification for unwarranted pedestrian infrastructure in the project's design report.

Shoulders for Non-Motorized Users

Where there are no sidewalks or trails, shoulders may serve as space for pedestrians and bicyclists. Shoulders that are at least 4 feet wide may be striped and signed as a bicycle lane. To improve space for non-motorized traffic, NYSDOT will often reduce lane widths of 12 feet or wider to 11 feet and redistribute the space that is gained to the shoulder. This is specifically the case on two-lane roadways with posted speeds of 40mph or less and shoulders currently less than 4' wide. An important exception is on important freight routes that are part of the Qualifying Highways, and for which lane widths must be at least 12 feet.

NYSDOT generally communicates directly with the chief elected official of the local municipality where any project is located.

Communication with Municipalities and Public Input

All NYSDOT projects include a Public Involvement Plan, created in the earliest stages of the project. NYSDOT generally communicates directly with the chief elected official of the local municipality where any project is located. For simple projects such as repaving, this enables the municipality to plan and alert nearby residents and businesses of any upcoming disruption during construction.

On more complex projects, those with multiple alternatives or with controversy, the Public Involvement Plan will outline any planned direct public engagement. NYSDOT projects reflect the principles of Context Sensitive Solutions, namely that the planning, design and construction of transportation facilities meet service and safety needs while at the same time meeting environmental, natural resource, cultural and community needs. Input that the public provides is incorporated into the project throughout its development. In certain instances, NYSDOT must hold a formal public hearing. Those include projects for which right of way will need to be taken,[31] or those that:

- Substantially change the layout or functions of connecting roadways or of the facility being improved,
- Have a substantial adverse impact on abutting property,
- Otherwise have a significant social, economic, environmental or other effect, and those
- For which FHWA determines that a public hearing is in the public interest.[32]

II. Implementing Complete Streets at the Capital District Transportation Committee

The Capital District Transportation Committee supports its partners in implementing Complete Streets in many ways.

Long-Range Transportation Plan

One of CDTC's primary responsibilities is to develop a Long Range Transportation Plan, also known as a regional transportation plan, with a long term (20+ year) planning horizon, updated every five years. The plan establishes regional planning and investment principles, strategies and actions that lead to an integrated multi-modal transportation system facilitating the safe and efficient movement of people and goods. The plan, known as "New Visions," includes investing in Complete Streets as a planning and investment principle, and further:

Street design will serve all users equitably, including pedestrians, bicyclists, transit riders, freight, and personal vehicle drivers and riders.

Transportation investments are made based on a Complete Streets framework which supports the convenient and safe travel of all people — of all ages and abilities as appropriate to a facility's community context.

Utilizing a Complete Streets framework ensures that transportation investments are consistently planned, programmed, designed, operated and maintained with all users in mind – including bicyclists, public transportation vehicles and riders, pedestrians of all ages and abilities, and local delivery needs.


Troy-Menands Bridge in Troy, NY

Successful implementation of a Complete Streets framework will be achieved by working with municipalities to improve communication and coordination, training and education, and design standards and other resources.

Transportation Improvement Program and Merit-Evaluation Process

The Transportation Improvement Program (TIP) is a multi-year program of transportation projects that implements the products of the planning process described in New Visions. Federal regulations require that transit, highway and other transportation improvement projects within the Capital District metropolitan area be included in this TIP if these projects are to be eligible for federal capital or operating funding. CDTC periodically solicits new projects from its members and local governments.

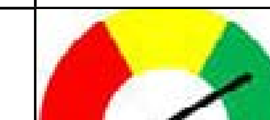
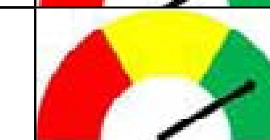
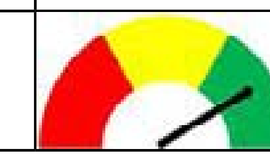
In 2015 CDTC developed a qualitative component to be considered with the quantitative Benefit/Cost ratio as part of the TIP project candidate merit evaluation process. In reviews of proposals submitted for the Transportation Improvement Program, CDTC includes the qualitative component. The Complete Streets category allows for a maximum of five points for projects that are transformative, replacing infrastructure which primarily serves high or moderate speed through traffic with a facility that fully or substantially implements complete street design, with 8 or more Complete Streets elements. The category deducts up to two points for projects that remove three or more Complete Streets features. In this manner, projects that include Complete Streets elements are prioritized for funding. In addition, the process encourages project sponsors to consider all potential roadway users when maintaining and improving roadways.

Performance Measures

Federal regulations require CDTC to use a transportation performance management approach in planning and programming activities. CDTC maintains a comprehensive list of objectives and corresponding performance measures for each New Visions program area. The identified measures are key metrics that represent the performance of each of the Planning and Investment principals that guide CDTC's planning process. Improving conditions of the performance measures indicate progress toward the New Visions goals.

The Complete Streets performance measures are listed below, along with the baseline value in December 2019 and the desired direction of change. An effective Complete Streets policy lays the foundation for the implementation process. Training on Complete Streets not only educates staff responsible for implementation, but also allows for discussion among responsible parties to ensure that the approach works for everyone. While all projects are important, CDTC tracks those funded with federal funds as a performance measure since CDTC influences the expenditure of federal funds. Maintenance, particularly snow removal, is a key issue and frequent source of public complaints. Finally, the use of a checklist for project development is critical to ensure consideration of Complete Streets opportunities.

Complete Streets Performance Measures

Performance Measures	Baseline Value	Performance Goal	Current Trend
Number of Communities in the Capital Region adopting Complete Streets policies via governing body action.	8 (2019)	Increase Baseline Value	
Number of CDTC Complete Streets training sessions held.	8 (2019)	Increase Baseline Value	
Number of funded TIP projects including Complete Streets features.	20 (2019-2024 TIP)	Increase Baseline Value	
Number of municipalities that maintain year-round usability.	N/A	N/A	New Measure
Number of municipalities utilizing a checklist for project development.	2	Increase Baseline Value	

Linkage Program

CDTC's Community and Transportation Linkage Planning Program (the Linkage Program) is an integrated land use and transportation planning program created to implement New Visions. The program provides financial and technical assistance to local communities for planning, with particular emphasis on projects that support implementation of innovative transportation and land use concepts. Integration of land use with transportation under this program often leads to consideration of Complete Streets measures to accommodate demands that local land uses place on the transportation system.

Advisory Committees

CDTC's advisory committees provide the CDTC Policy Board and Planning Committee with in-depth technical information on topics of particular interest or concern. The advisory committees are guided by CDTC's staff and serve as a forum for the exchange of ideas, practices and progress reports about various initiatives taking place at National, State, regional and local levels. Advisory committees are also tasked with providing input to CDTC's Planning Committee and Policy Board on projects being evaluated for inclusion in the Transportation Improvement Program (TIP).

The advisory committees focus on active transportation including bicyclists and pedestrians as well as newer mobility types, freight movement, human services transportation, and operations and safety. One of the priorities of the advisory committees was the creation of this Design Guide.

Complete Streets Education and Technical Assistance Workshops

Despite local and state regulations favoring Complete Streets, local governments often face challenges. In gathering everyone involved in the local street design process, workshops facilitate mutually held goals and objectives for the roadway system. CDTC sponsors workshops to assist local governments with developing and implementing Complete Streets policies and projects. Tailored to each municipality, these workshops help transportation planning practitioners and decision-makers identify and overcome Complete Streets policy and implementation barriers. These free workshops are highly interactive, with the goal of building local capacity to implement Complete Streets approaches and strengthen relationships between transportation practitioners, other departments, and the community. Key decision-makers, stakeholders, and agency professionals learn how to more effectively balance the needs of all users and routinely create and maintain Complete Streets.

CDTC sponsors workshops to assist local governments with developing and implementing Complete Streets policies and projects.

Aviation Road in Colonie, NY

III. Implementing Complete Streets in Your Community


Albany County Rail-Trail

Many communities interested in or actively trying to implement Complete Streets want to know: "What is the best or most effective action we can take to make our streets complete?" The answer is that there isn't any one action or policy that can fix every problem or even effectively change the status quo. Everything starts with context and the unique needs of the community. A multi-pronged strategy ensures effective and systematic implementation of Complete Streets. The strategies discussed in this section can be used to create a connected and coordinated effort to implement Complete Streets.

If it seems overwhelming to consider the many actions that need to be taken to do this, consider developing an anchor strategy or policy, and coordinating other strategies and policies around that anchor. For example, this anchor strategy can be the adoption of a Complete Streets Policy, an update to a Comprehensive Plan, or both.

Crafting an Effective Complete Streets Policy

An effective Complete Streets policy lays the foundation for the implementation process. Policy adoption formally acknowledges the benefits and importance of planning, designing, and maintaining a street network that balances the needs of all users and all modes. It marks an institutional shift in how the state, county, municipality, or other entity views its streets and integrates and codifies Complete Streets principles into daily operations. Careful documentation of exemptions can be invaluable well-designed changes to encourage Complete Streets implementation.

A strong and effective Complete Streets policy has several key elements:

- Statement of purpose and intent, describing the goals, visions, and desired outcome of the policy
- Definition of users and modes, stipulating whose needs are to be considered in the implementation of Complete Streets
- Stipulation of the types of improvements covered by the policy
- Reference to design standards that will be followed when implementing the policy
- Definition of the exemptions process, clearly identifying legitimate instances when the policy would not be applied
- Implementation plan to guide how the plan will be put into practice

Beyond the Policy: Integrating Complete Streets into the Planning and Design Process

The adoption of a Complete Streets policy is intended to ensure that future street projects consider the needs of all travelers, regardless of age, ability, or mode of transportation. But what happens after a policy is adopted? The transportation planning process can be complex, and existing procedures are reflective of an entrenched method of doing business. Because of this, implementation of a Complete Streets policy can often be very difficult in many communities. Three key actions should be considered in order to achieve more effective and consistent implementation of the Complete Streets policy:

1. **Change the way decisions are made**
2. **Involve stakeholders and members of the community**
3. **Redefine how you measure success**

1st Street in Troy, NY

Change the Way Decisions are Made

Complete Streets is a process, not a specific product. Complete Streets provides an approach to identifying, analyzing, and developing solutions to transportation issues. Changing the everyday processes that guide decision-making lies at the heart of successful Complete Streets initiatives. While changing these processes can be challenging, it is essential to successful implementation.

The following are strategies to help integrate Complete Streets into the decision-making process:

- Develop a Complete Streets Checklist
- Integrate it into the Comprehensive Plan and Zoning
- Align Plans, Programs, and Funding
- Create a Formal Implementation Plan
- Review and Update Roadway Design Guidance
- Working with Limited Project Scope

Develop a Complete Streets Checklist

A Complete Streets Checklist is intended to ensure that projects comply with the Complete Streets policy. Development and implementation of a checklist should be included as a requirement of the policy. The Complete Streets Checklist reinforces the policy by formalizing a multimodal approach to roadway planning, design, and construction. It assists planners and engineers in evaluating the current and future functions of a street, the needs of all users of the street, the street's context, and existing conditions and facilities for all modes. It also documents the evaluation process.

The Complete Streets Checklist should be used at the beginning of a project to ensure that the developed alternatives comply with the policy. The NYSDOT Complete Streets checklist divides responsibility between the planning staff in the initial scoping stages, and the engineering staff in the later design stages. Locally, the cities of Saratoga Springs[33] and Troy[34] each use their own Complete Streets checklists.

Any checklist should include a list of design elements to be addressed, a place to indicate whether the element was included, and a description of how it was included or, if there was an exemption, why this exemption was made.

Integrate it into the Comprehensive Plan and Zoning

A Comprehensive Plan represents and outlines the goals and priorities of a community. Integrating Complete Streets into the Comprehensive Plan is an essential step for implementation. Most traditional master plans include a Circulation Element, which often focuses almost exclusively on vehicular circulation. The Comprehensive Plan should be updated to reflect the goals of the Complete Streets policy. This includes taking a more comprehensive approach to the transportation element. The City of Albany did this when it updated its Comprehensive Plan in 2012, and subsequently updated its zoning code in 2017. This new zoning code includes a section on Circulation, Access, and Connectivity. The code also requires use of the City's Complete Streets Design Manual for the streetscape of the sidewalk area in new construction and significant expansion of existing buildings.

Align Plans, Programs, and Funding

Complete Streets integration does not stop with the Comprehensive Plan. All guiding documents of a community should be aligned and coordinated—including those focusing on bicycle and pedestrian mobility. Complete Streets priorities should also be integrated into other plans, including housing, recreation, and redevelopment plans, as well as any other guiding documents that influence how things are built or maintained.
Updates to zoning ordinances and building

codes may be necessary to reflect the needs of all roadway users. This ensures that new developments, parks, and other facilities are built, retrofitted, or maintained in such a way that integrates Complete Streets and the overarching goals of the community. For example, where site planning and design standards stipulate requirements for vehicle parking and vehicular access, provisions should also be required for bicycle parking and bicycle and pedestrian access. The local development review process ensures that these standards are adhered to, Complete Streets principles are followed, and accommodations for all users are included in new infrastructure.

Create a Formal Implementation Plan

An implementation plan is an effective tool that can maintain the momentum generated during policy development and formalize a process for implementation of Complete Streets. The creation of an implementation plan should involve staff and decision-makers who are involved in the planning, design, construction, and maintenance of the jurisdiction's streets. This may include planners, engineers, maintenance and public works staff, and other key stakeholders. An implementation plan provides an opportunity to assess current decision-making practices and relevant documents including decision trees, checklists, design guidance, and subdivision codes. In many cases, it will be necessary to update these documents and reassign responsibility and timelines for integrating Complete Streets into both municipal roadway projects and private development review.

An implementation plan should include:

- Assessment of the street design process, transportation infrastructure, and network gaps
- Guidance on street design, including standards, best practices to serve all street users
- Complete Streets Checklist

The Saratoga Springs 2012 Complete Streets Plan includes an implementation strategy. The strategy describes stand-alone projects funded to create Complete Streets, integration with other public and private projects such as the annual paving program and private development review, and education of professionals and the community. The City of Albany's Complete Streets Policy and Design Manual includes a section entitled Process and Implementation, which discusses the municipal process to evaluate both City-sponsored and privately sponsored projects. These guides are good local examples of implementation plans.

How to Prioritize Project Funding

The National Cooperative Highway Research Program (NCHRP) Report 803 presents the "ActiveTrans Priority Tool (APT)[35]," a step-by-step methodology for prioritizing improvements to pedestrian and bicycle facilities, either separately or together. Available for free download, the methodology is flexible, allowing the user to assign goals and values that reflect those of the agency and the community. It is also transparent, breaking down the process into a series of discrete steps that can be easily documented and communicated to the public.

The tool is a useful model for planners and other staff responsible for the most effective allocation of scarce resources to where they will provide the most benefit.




Photos (clockwise from top left)

It just takes tape and cones to demonstrate a protected bike lane in Schenectady, NY

Pop-up Food Cart in Albany, NY

Bike racks are essential for welcoming bicyclists in Schenectady

Planning for bump-outs made easy in Albany, NY

Review and Update Roadway Design Guidance

Outdated design practices are often the most significant barrier to implementing Complete Streets. In many jurisdictions, the go-to reference for all transportation projects is New York State's Highway Design Manual, which functions to assure uniformity of design practice for New York State's Department of Transportation to design attractive highways that provide adequate safety and convenience to all highway users. Some common strategies that are often used to overcome outdated or automobile-focused design guidance includes:

- Writing or rewriting street design guidelines unique to the jurisdiction
- Choosing existing guidance documents that reflect national best practices
- Updating subdivision and zoning codes

Developing a community-specific design manual might be appropriate for some communities. The process of writing design guidelines can become an educational process for all involved, helping local officials and staff better understand the needs of their community. Many innovative design manuals go beyond traditional roadway functional classifications to create new street typologies based on surrounding land-use context. This approach can help local planners and engineers better understand context and design needs. The City of Saratoga Springs' Complete Streets Plan outlines five different street classifications for corridors in urban areas. These classifications will each have different users, different needs, and different challenges, resulting in a set of different recommendations. In the City of Albany, the Design Manual sets typologies based on roadway function and the surrounding context (right-of-way width, building type, and land use) and primary transportation mode.

Writing a design manual is not necessary for many communities and may not be feasible. A variety of national and state design resources are already available that local municipalities can apply to achieve desired outcomes on a given street. This design guide outlines a variety of design elements and focus areas, as well as suggested resources for further guidance. This guide, along with those listed in Chapter 1, should be considered acceptable design guidance and applied where appropriate.

Working with Limited Project Scope

Limited scope projects extend the functional and structural life of assets such as pavement and provide a mechanism to address deficiencies. Unlike full-scope projects, limited scope projects do not have a preliminary engineering phase, creating a more streamlined project delivery process that supports quicker implementation. Limited scope projects include repaving, bridge deck/superstructure replacement, sign structure installation, and drainage improvements, among others. These projects are typically limited to the existing curb-to-curb width and do not involve right-of-way or utility impacts. In any given year, entities typically implement many more limited scope projects than full-scope projects.

Do We Need to Write a Design Manual?

Many communities assume that they must re-write their design manuals; however, such re-writes can be expensive and time-consuming. Ultimately, determining exact design specifications is less important than achieving clarity in how design decisions are made. Focus should be given to introducing more flexibility in design practices than might already be in place. No design manual can be completely applicable to each unique situation or challenge, and there are often multiple design options and design tools to achieve the same goal for a street.


Parklets and Dining on Broadway in Troy, NY

Limited scope projects do not require the same extent of analysis. New York State's Complete Streets checklist accommodates limited scope projects by directing the appropriate staff to complete a shortened version of the checklist for those projects. It focuses on pavement markings, signs, shoulders, and curb ramps. Municipalities may choose to follow a similar approach, or create a streamlined checklist for limited scope projects. While these projects provide limited opportunity to introduce Complete Streets elements, they do provide the opportunity for significant low-cost improvements.

Professional Education and Training

Professional education is an extremely important component of a successful Complete Streets program. Planners, engineers, consultants, decision-makers and agencies need a thorough understanding of new procedures and concepts. Officials should receive on-going education to understand the community benefits of Complete Streets and how the general Complete Streets goals will be translated into built projects. Educating the public about design options they can consider to improve or transform their streets, as well as how changes to their streets fit into the larger street network and impact and benefit the community as a whole, is essential for successful implementation. Common education strategies include:

Complete Streets workshops for staff, consultants, community leaders, and the public. CDTC offers free Educational and Technical Assistance Workshops. In addition, professional development training opportunities and webinars may be offered by NYSDOT, CDTC, NACTO, the Cornell Local Roads Program, professional organizations, and transportation non-profits. Such opportunities can provide on-the-job training for staff, and foster cross-department or interagency discussion, further strengthening Complete Streets procedures.

Involve Stakeholders and the Community

Decisions about transportation and other public works projects should be guided by public input and feedback from different community stakeholder groups. A lack of understanding and support can hinder or obstruct implementation of transportation projects. This can be exacerbated by silos within and between different agencies. The key to this challenge is to formalize an inclusive decision-making process. Often a project will even make it far along in the process before running up against opposition from a key decision-maker or stakeholder, and can result in costly delays. It is of utmost importance to create an inclusive process involving decision-makers and stakeholders at the outset of a project, conduct outreach to these groups on the overall and continuing goals and benefits of draft designs, and explain how a specific project fits into the larger network and needs of the community.

The following are a few methods that have proven successful in involving the community in the decision-making process and building support for Complete Streets:

- Complete Streets Committee
- Workshops
- Road Safety Audits
- Walking audits and bicycle rides
- Demonstration projects
- Advocates, Volunteers, and Community Action
- Engage the Creative Community

Complete Streets Committees

One common method for formalizing an inclusive implementation process is the establishment of a Complete Streets Committee. The Committee can involve relevant stakeholders throughout the entire transportation planning and decision-making process and achieve more buy-in, support, and coordination between various actors.

Colonie, NY

Henry Street in Saratoga Springs, NY

A Complete Streets Committee should be comprised of representatives and officials from various local agencies, including planning, engineering, police, fire, public works, elected officials, and other stakeholders and decision makers. While it may include several members who participate voluntarily, a Complete Streets Committee will be most effective if it includes those who are directly involved in the transportation planning process and have the authority to make decisions.

The Complete Streets Committee should be directly involved in the preparation of requests for proposals for the entity's roadway projects. It should also review completed Complete Streets checklists and significant private development proposals impacting the right-of-way. If an exemption is made to the Complete Streets policy, the Committee should document how and why this occurred.

In the Capital Region, the Cities of Saratoga Springs and Troy and the Town of Niskayuna provide examples of municipal Complete Streets committees. The Saratoga Springs Complete Streets Advisory Board was established in 2012 with the adoption of the City's Complete Streets Policy. The Committee focuses on advancing priority Complete Streets projects within the city. The Niskayuna Complete Streets Committee coordinates review of new street construction and reconstruction with the Highway Department and other Town departments to implement Complete Streets elements when possible. They review Planning and Zoning Board projects and share ideas between the Conservation Advisory Council and the Tree Council to implement Complete Streets solutions to private projects and approvals whenever possible. They also try to coordinate between the Niskayuna Central School District and the Town of Niskayuna to develop safe routes to schools and daycares for Niskayuna families.

Public Engagement

Depending on the scope of the project, it may be necessary to schedule time and budget to educate and collect input from the general public, decision-makers, and stakeholders not involved in the design process. Gathering input throughout the planning and design process is an effective tool for:

- Developing plans and projects that reflect community needs
- Demonstrating an open process and support for plan outcomes
- Involving decision-makers, stakeholders, and other contributors in an on-going process

Public engagement often involves workshops, which may serve several purposes and be structured in different formats. Some workshops are primarily an educational tool to share information on the project's design or the benefits and implementation of Complete Streets. Other workshops may seek input to create the design and might include a design charrette or field walk of the project area. These are two approaches that allow stakeholders to view and assess the project area firsthand; collaborate and share ideas with the project team, other stakeholders, and decision-makers; brainstorm potential design solutions; and provide input on design concepts developed by the project team.

Workshops might not be appropriate for every project or community. Methods such as demonstration projects, visual preference surveys, and outreach through community groups can also collect valuable opinions. An extensive public involvement process conducted in conjunction with the development of a redevelopment plan, bicycle and/or pedestrian plan, or other Complete Streets planning document can also provide useful community input and support for future initiatives. Regardless of the size or context of the project, public engagement efforts provide an opportunity to communicate directly with those who have an influence on or interest in a project.

Road Safety Audits

The Federal Highway Administration encourages Road Safety Audits on existing roads and intersections as well as those that are new. During an audit, a multidisciplinary team that is independent of the project conducts a formal safety performance examination of an existing or future road or intersection. An audit qualitatively estimates and reports on potential multimodal road safety issues and identifies opportunities for improvements in safety for all road users. It identifies elements of the road that may present a safety concern and seeks opportunities to eliminate or mitigate identified safety concerns. Field reviews conducted as part of an audit help participants and decision-makers see and experience the problem spot or corridor from the perspective of other participants, revealing issues they might not otherwise detect.

The end product of an audit is data and information that documents existing deficiencies and the participation of a wide cross-section of stakeholders. This information can help document project need and build consensus and support for action. The agency's response to the report documents actions taken to improve safety at the location.

Schenectady, NY

Lead Walking Audits and Bicycle Rides with Decision Makers, Staff, and the Public

Walking or bicycling along a corridor or study area enables people who normally drive or who don't live or frequently visit the study area to experience the roadway in a different light. As part of the Washington Avenue/Patroon Creek Corridor Study in the City of Albany, members of the Advisory Committee walked and bicycled along the 4-5 lane corridor to become familiar with the roadway's existing physical attributes and potential constraints that would need to be considered in developing feasible alternatives. As part of a lighting project, the City of Saratoga Springs hosted a guided, interactive night walk for attendees to better understand existing after-dark conditions. Key discussions touched upon the atmospheres and ambiances created by publicly supplied illumination and private light sources, such as shop windows and building-mounted fixtures like sconces and bracketed floods.

Demonstration Projects

There are often some stakeholders that are concerned about potential improvements, particularly if there may be a loss, such as reduced parking, increased signal phase times, or reduced lane width. Any change can lead to discomfort as existing patterns and habits accommodate the new system. It can be difficult to envision the functional impacts of changes to the transportation system. Sometimes proposed changes lead to an outcry as people who will be impacted try to imagine those impacts. Short-term pilot projects that will be removed before final installation of long-term infrastructure serve a useful role in such situations. They can save long-term infrastructure costs if the new design is not supported by the community and other stakeholders, or they can build support as people experience the proposed changes in their daily lives.

Advocates, Volunteers, and Community Action

Interested residents and stakeholders are effective allies in building community support for a project and advocating with decision-makers. Working with these stakeholders and involving

Liberty St and Jay St in Schenectady, NY

State Street in Schenectady, NY

them throughout the process can help advance a project more quickly and efficiently. On smaller-scale projects, such as minor park improvements or trail projects, advocates and volunteers can also assist with implementation. As part of the Craig-Main Complete Streets Study in the City of Schenectady, schoolchildren expressed discomfort walking to and from school over Interstate 890. Working with NYSDOT, which owns the bridge, the project team determined that artwork may be installed on the bridge to shield pedestrians from the highway below. In addition, a local firm expressed interest in incorporating youth art into materials they could produce to install along the bridge.

Engage the Creative Community

Good streets are the outdoor living room for many communities. Engaging the creativity and passion of a community can enliven streets and give residents a sense of ownership and pride. There are many examples throughout New York where residents have transformed their community through collective creativity and action. In Troy, several community groups joined forces with RPI students and a grant from the New York State Council for the Arts to hire local artists to design "Creative Crosswalks" at intersections. Designs included a honeycomb with bees and flowers, and a stained glass design representing nearby churches. In Schenectady, Capital Roots worked with the City to install flexible bollards to narrow an intersection with high conflict between pedestrians and drivers, and hired a local artist to paint the newly created bumpouts. The high visibility artwork enhanced the ability of the bollards to calm traffic.

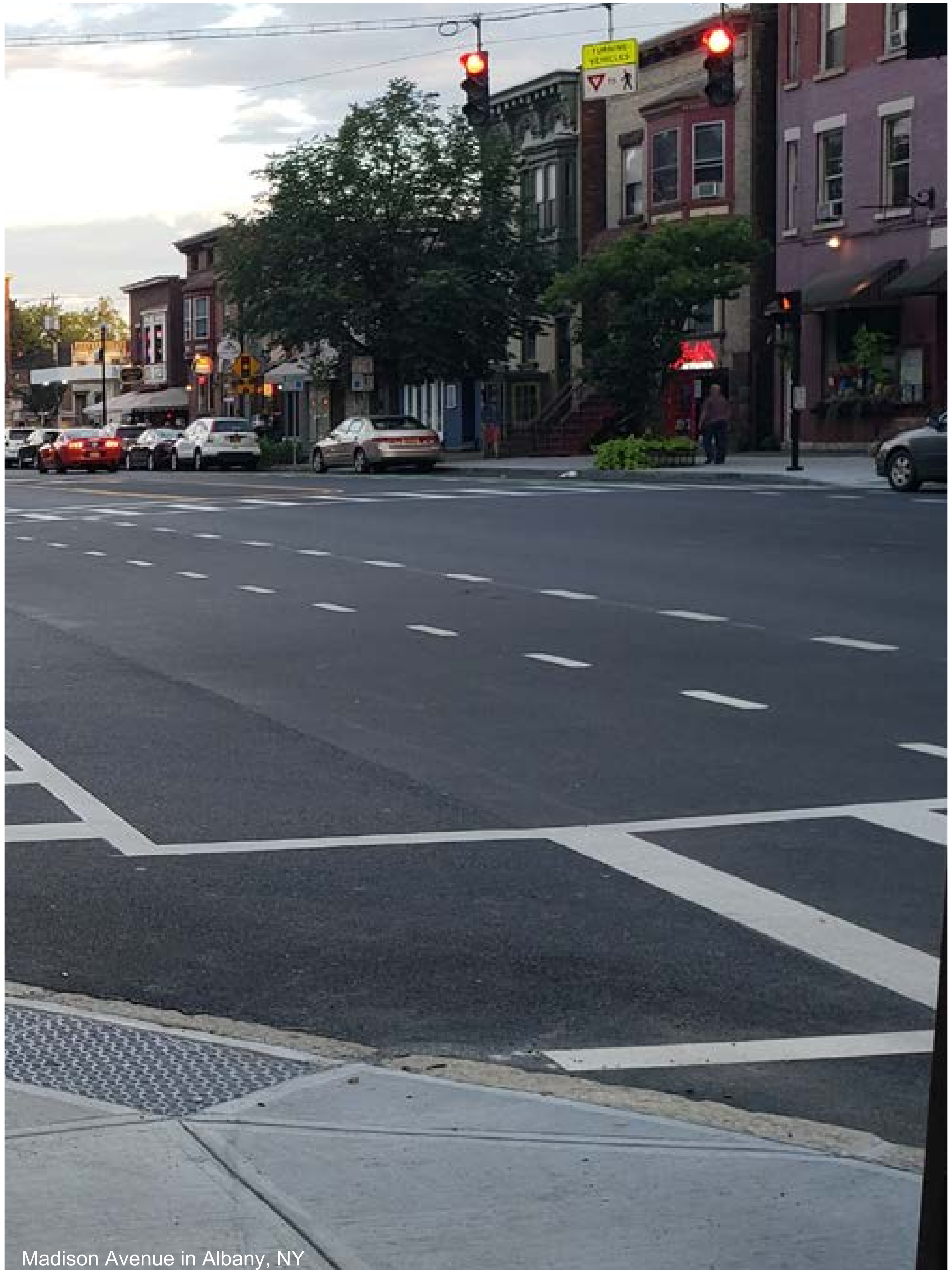

CDPHP Cycle! Station

Redefine How You Measure Success

Creating new ways to measure success for transportation projects, and of the transportation system as a whole, is essential to not only ensure that projects serve all intended roadway users but that future Complete Streets investments are made based on this success. While traditional performance measures tend to focus primarily on vehicle throughput (level of service), FHWA now tracks person miles traveled (instead of vehicle miles), in addition to the percent of non-single occupant vehicle travel. Other useful metrics include crash reduction, economic activity, public health, stormwater reduction, and shifts in mode share to walking, biking, and/or transit trips. Common activities to measure these metrics before and after improvement projects include:

- Number of crashes and injuries for all types of roadway users
- Sales tax revenue
- Property values
- Health indicators such as childhood obesity, asthma rates, diabetes
- Number of new or repaired facilities each year (e.g., miles of sidewalks)
- Number of combined sewer overflows
- Use of street facilities by different modes (e.g., number of people walking)

Each local agency may have different goals and therefore focus on different measures to track success. A Complete Streets approach means shifting the focus of transportation projects from being concerned primarily with vehicle flow to a broader view of all current and potential users of a street and how the street influences and is influenced by surrounding land uses, economic factors, and travel behavior. Performance measures should be established that reflect and therefore incentivize taking this broader view. For example, tracking person-miles instead of vehicle-miles traveled takes into account the total number of people traveling in buses, cars, and trucks over a given roadway segment.


Madison Avenue in Albany, NY

3
Street Typologies

The character and usage of the Capital District's streets have evolved over centuries, influenced by changing technology, shifting land use patterns, and population growth. Streets that were built as rural farm routes between and through downtowns are often now highways or arterials, carrying thousands of cars every day. Urban streets, which once carried carriages and streetcars, were transformed by the rise of the automobile, to the detriment of other modes of transportation and local residents.

The Complete Streets approach prioritizes context as a critical factor in street design. Because of this, it is important to recognize the unique history and function of the Capital District's streets, both in land use and transportation contexts, and to understand how decisions made today will influence the future function and economic viability of streets, communities, and ultimately the Capital Region.

The following street typologies represent a cross-section of typical road types in the Capital Region. They reflect not only the transportation needs of the street, which are often captured in a traditional functional classification hierarchy, but also the community context. The purpose of generating these typologies is to apply best practices in Complete Streets design to streets with different contexts and needs. The needs of any particular street change depending on density and other contextual factors. These differences are addressed in this chapter through different applications of design considerations and minimum standards.

The street typologies presented in this chapter are not exhaustive, but the Complete Streets application principles behind them can be applied to other street typologies. Street typologies are not necessarily continuous along the entire length of a street; a single street may change typology as the surrounding land uses or functions of the roadway changes.

How to Use Street Typologies
Context and Trade-Offs

SAMPLES AND EXAMPLES: WHICH TYPOLOGY IS MY STREET?

The Capital District is filled with a multitude of types of streets, from alleyways to highways. A street may not cleanly fit into the typologies shown here, but similar Complete Streets principles may still apply. These typologies can serve as a starting point for identifying ways to redesign a street to accommodate many types of users comfortably and safely. Below are some steps for identifying a street typology and potential ways to implement Complete Streets.

CONTEXT AND TRADE-OFFS

Every Complete Streets project will vary based on the setting and context. Balancing the trade-offs between different modes of transportation based on context is vital to including a diverse range of users. Complete Streets investments should be evaluated based on how they impact the transportation system, and the trade-offs made between alternative investments. For example, prioritizing pedestrians and bicycle facilities on a residential street could require removing parking. Similarly, prioritizing motor vehicles could negatively impact pedestrian and bicycle safety, which may discourage the use of alternative modes of transportation. During the planning and design phases of a Complete Streets project, safety and congestion impacts should be considered when analyzing trade-offs.

Conventional planning practice traditionally favored designs that preserved or enhanced roadway operations for motor vehicles, and pedestrian or bicycle improvements were only added when right-of-way and funding were available. This chapter provides a framework for incorporating Complete Streets, wherein all modes are accommodated appropriately based on the surrounding context, and all current and future needs of roadway users are considered early during the planning process.

WHAT PURPOSE DOES MY STREET SERVE?

Freight routes, bike routes, existing plans, land-uses, institutions, and contexts are all a part of defining the character and purpose of a street. Look at what exists along a street and what a street leads to. Example questions can include: Is the street connecting houses or hospitals? Do businesses receive deliveries in front or behind their buildings?

WHAT PURPOSE SHOULD MY STREET SERVE?

Many streets in the Capital District have been redesigned in the 20th century to accommodate motor vehicles, but it's always important to assess the current accommodations on any given street. Cities in the Capital District often have fairly comprehensive sidewalk coverage, but may lack comfortable crosswalks – a crosswalk near a senior center or hospital may need elongated crossing times. Narrower roads in the region may not be suitable for most bicyclists to ride comfortably. Identify who needs to use the street and who isn't accommodated on the street today.

Downtown Street
Urban Mixed-Use

Existing Conditions

Downtown streets are often challenging to reconfigure and retrofit. They typically have multi-modal needs and a constrained environment. Design solutions often have to balance motor vehicles, commercial deliveries, turning movements, and other high-intensity uses with the needs of other street users.

The first illustration depicts a wide four-lane urban thoroughfare that can lead to high speeds, weaving motor vehicles, double-parked cars, obstruction of buses, and challenging and uninviting places to bicycle or walk.

Recommendations

1 A road diet allows the reorganization of the street space to provide accommodations for non-motorized users and transit vehicles.

2 A dedicated bus lane can improve transit service and reliability along high frequency transit routes.

3 A separated bicycle lane significantly reduces conflicts between bicyclists and motorists. They need special attention at intersections.

4 The sidewalk space allows for the inclusion of amenities such as street furniture, pedestrian-scale lighting, and stormwater management.

Main Street Neighborhood Center

Main streets are the centers of neighborhood life, with high volumes of pedestrians, transit vehicles, bicyclists, and motorists vying for limited space. Most main streets need to accommodate local and through travel while maximizing livability and economic vitality.

The first image depicts a main street with four motor vehicle lanes. It may have been designed for projected peak-period commuter volumes, remaining below capacity at other times of day.

Recommendations

1 Road diets from four lanes to three lanes provide space for turning vehicles and non-motorized users.

2 Turn lanes help eliminate weaving conflicts that are common on a four-lane road.

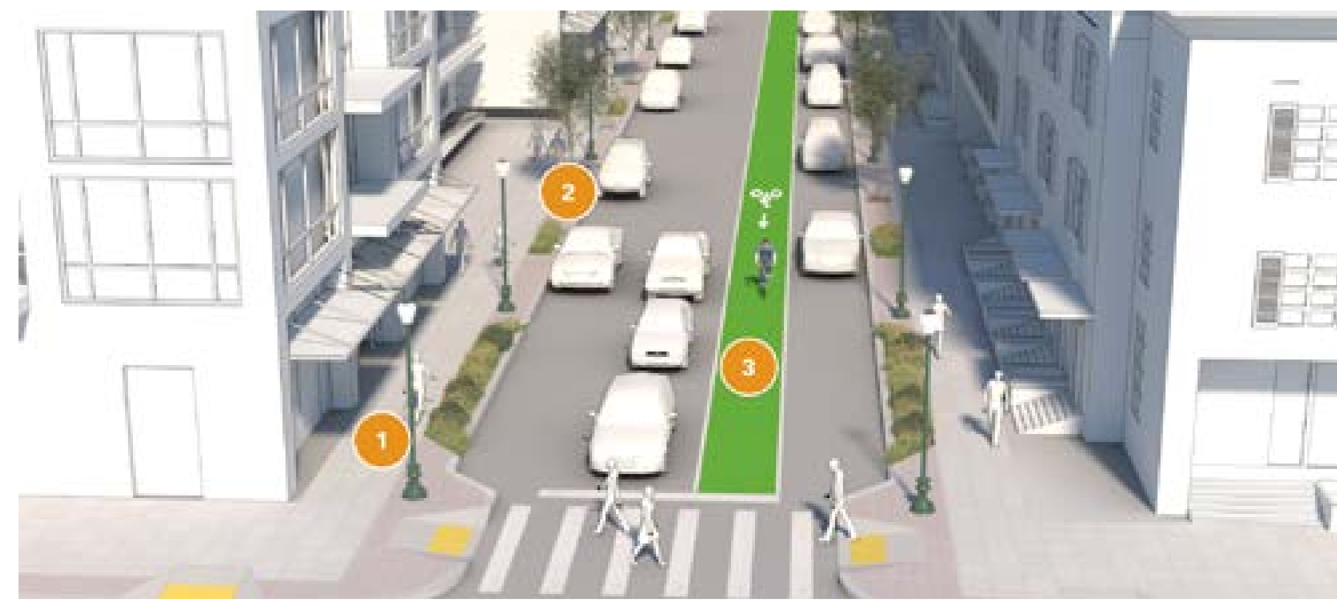
3 Buffered bicycle lanes provide dedicated space for cyclists with more distance from motor vehicles than a conventional bicycle lane.

4 Bike boxes help cyclists make left or right turns by placing them in front of traffic at a red light. On streets with higher volumes of traffic, cyclists may prefer to make a two-stage turn.

Urban Residential

Urban residential neighborhoods support high densitities. Streets should provide parking and safe, inviting places for people to walk and bike. They can include stormwater management techniques, curb extensions, vertical speed control elements, and bicycle facilities.

The first illustration depicts a one-way urban residential street with narrow sidewalks that may have been cracked by tree roots. A wide single travel lane leads to frequent double parking.



Recommendations

1 Wide sidewalks and a narrow furnishing zone provide room for pedestrians and accessibility for those with mobility limitations.

2 A tree pit with a metal grate covering provides more room for tree roots and a wider effective walking area, reducing tripping hazards.

3 A bicycle lane provides space for bicyclists on a lower-stress street while reducing speeding and double parking. Where space allows, the addition of a protected bicycle lane would prevent double parking and provide a more comfortable bicycle facility.

Commercial Corridor

Many arterial roadways in suburban or exurban locations were designed exclusively for automobile access. The lack of access for pedestrians, bicyclists, and transit has disproportionate negative impacts on low-income and minority populations who access properties along these corridors.

The initial illustration depicts two wide travel lanes, one two-way turning lane, and no sidewalks. Frequent driveways create conflicts between motorists and with non-motorized users.

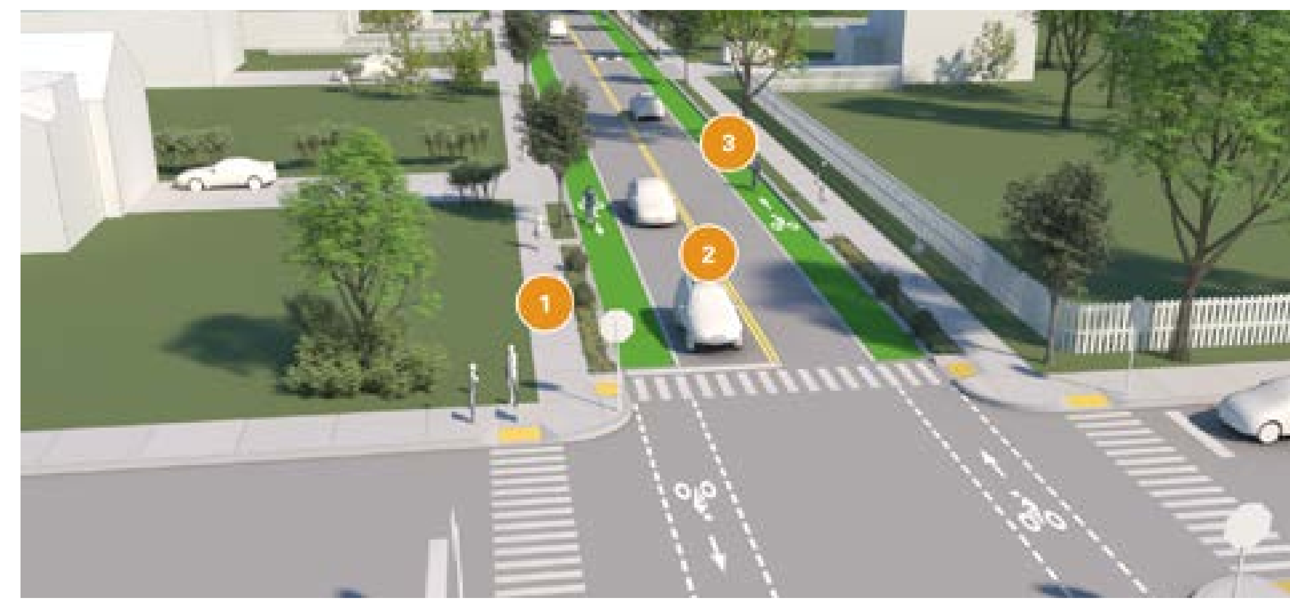
Recommendations

1. A well lit multi-use path accommodates bicyclists and pedestrians.
2. A bus pull-out may be appropriate on arterial corridors to reduce weaving from motorists.
3. Narrow travel lanes help reduce travel speeds while maintaining vehicle capacity.
4. One-way turning lanes provide definiion and a pedestrian refuge with a curbed median.
5. Continuous sidewalks in a strip commercial corridor can dramatically improve pedestrian safety and mobility.

Suburban and Rural Mixed-Use Collector

Many of these streets facilitate higher travel speeds. Design should generally favor separation of uses rather than shared spaces and focus on increasing safety and mobility through a mixture of traffic calming and pedestrian and bicycle accommodations.

The first image shows two 12-foot travel lanes with parking on one side and off-street at each residence. Sidewalks are narrow, forcing pedestrians passing each other into the planting strip.



Recommendations

1. Wide sidewalks and narrow planting zones provide room for pedestrians and accessibility for those with mobility limitations.
2. Narrower travel lanes are essential for improving safety and reducing vehicular speeds.
3. The addition of a bicycle lane provides space for bicyclists on a lower-stress street while reducing propensity for speeding. Where space allows, the addition of a separated or protected bicycle lane would provide a more comfortable bicycle facility.

Suburban and Rural Residential

Many low-volume suburban and rural residential streets feature constrained curb-to-curb widths that cannot accommodate dedicated space for all modes. Instead, design of the streets should focus on safe and comfortable shared spaces with design speeds of 25 mph or less.

The initial illustration depicts an unstriped 30-foot roadway with two directions of traffic, on-street parking, a narrow sidewalk, and a wide planting strip.

Recommendations

1 A wider sidewalk and planting zone provides more room for pedestrians, increases accessibility for those with mobility limitations, and increases pedestrian comfort and separation from vehicle traffic.

2 A bicycle boulevard with traffic-calming features such as curb extensions, speed humps or tables, cushions, chicanes, and lower speed limits create a more comfortable environment for bicyclists and pedestrians at all times of day.

Rural Highway

Land uses along rural highways are often disparate while the roadways themselves generally carry higher speed traffic.

The first illustration depicts a two-way highway with shoulders and vegetated areas on each side. While rural highways may have a constrained pavement width, there is often additional space within the public right-of-way that can be used when conditions warrant.

Recommendations

1 A well lit multi-use path accommodates bicyclists and pedestrians.

2 Paved shoulders provide space for bicyclists outside of the motor vehicle lanes.

3 Narrow travel lanes discourage speeding and provide space for shoulders or bicycle lanes.

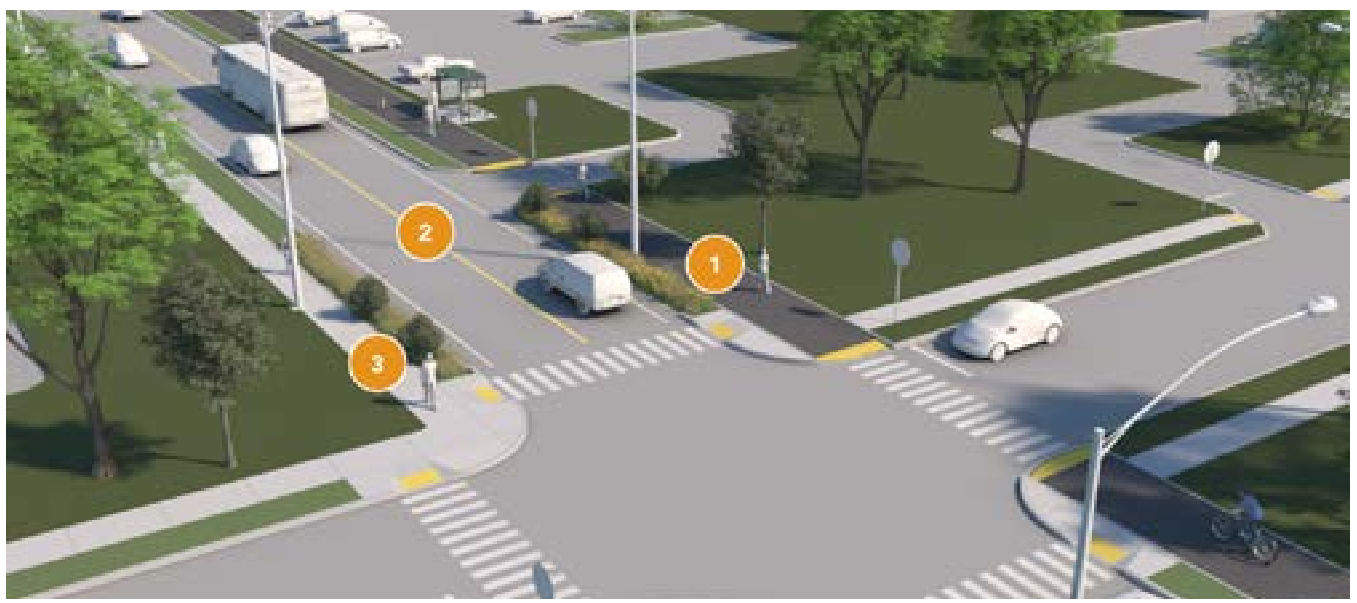
4 A continuous sidewalk provides a pedestrian facility at key locations along the corridor.

5 A bus shelter provides seating on a lower frequency transit route. The adjacent sidewalk creates an accessible and comfortable route to the bus stop.

Industrial and Office Park

Industrial and office centers are typically designed for automobile and truck access due to the surrounding land uses and need to accommodate deliveries or truck traffic. They should incorporate other modes to enable employment of people arriving by means oher than a personal vehicle, including nearby public transportation.

The initial illustration depicts a wide street with no striping. Grass areas on each side of the roadway may be used by pedestrian and transit riders.



Recommendations

1 A well lit multi-use path can be installed in the wide planted area to provide accommodations for bicyclists and pedestrians.

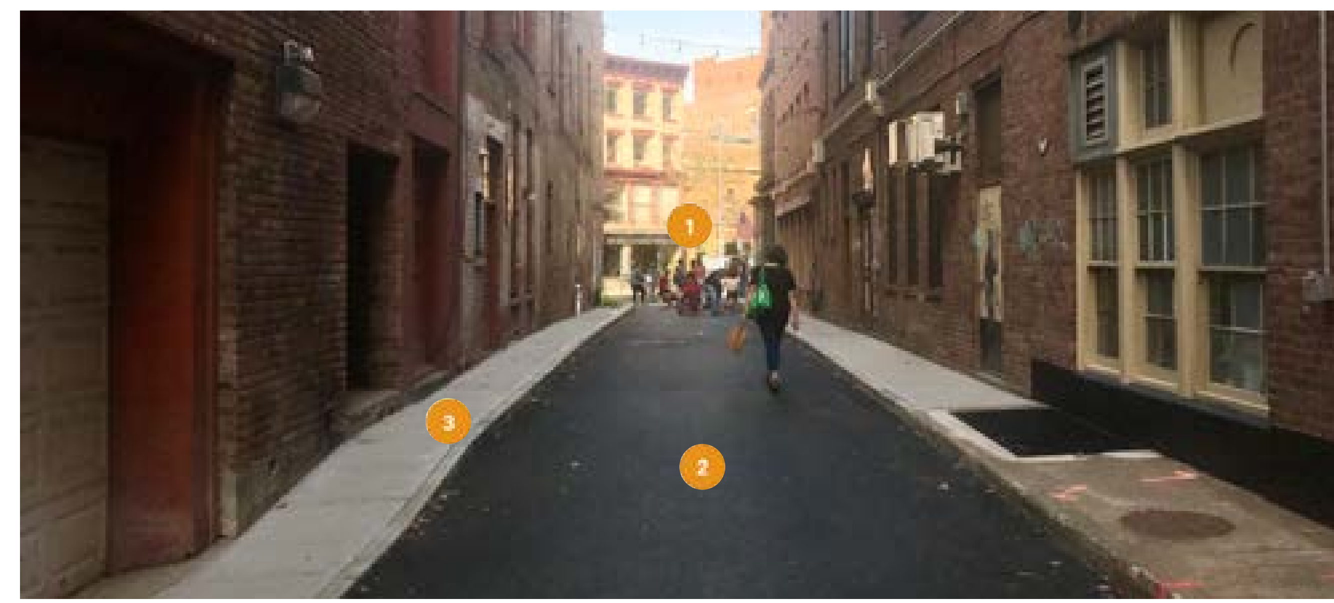
2 Narrow travel lanes are essential for improving safety and reducing vehicular speeds.

3 A continuous sidewalk provides an accessible pedestrian facility throughout the area.

Connecting Alleyway

Alleyways play an important role in access management and provide additional parking, space for deliveries, and waste management.

The initial image depicts an alleyway featuring a narrow pavement area with no striping that carries two directions of traffic.



Recommendations

1 Restaurants can benefit from lighting and additional temporary seating and retail locations can display merchandise on temporary tables.

2 A smooth pavement surface is ideal for accomodating bicyclists and all alleyway users.

3 A continuous sidewalk enables pedestrian access when the alleyway is used by motor vehicles.

4
Complete Streets Toolbox

Policy and Design Guidance for Implementing Complete Streets

This chapter describes the building blocks that make up a street and how they work together to transform our streets into vibrant places and activity centers. The operation, look, and feel of a street are the product of a series of design decisions for each street element, as well as considerations about how those elements relate to each other.

The toolbox is organized into four sections that reflect the primary physical spaces of a street network:

- SIDEWALKS
- ROADWAYS
- INTERSECTIONS
- CURBSIDES

Within each area of the street network, a myriad of treatments are available to planners, engineers, and designers. The toolbox provides a primer on common design treatments and their typical applications, design considerations, and how they impact different modes.

Sidewalks should be part of a continuous network and connected with crosswalks at roadway intersections. They should be safe, comfortable, and attractive facilities that provide accommodations for people of all ages and abilities.

State Street in Schenectady, NY

SIDEWALKS

Sidewalks are an extension of the street system. They are the primary conduit for pedestrian travel and fundamental to facilitating residential, commercial, and social activity in urban, suburban, and rural village communities. Sidewalks provide access between buildings and provide space for dynamic street life. Sidewalks, everywhere, form the foundation for a vibrant community. Lively sidewalks are venues for people to participate in face-to-face activities and support businesses. Sidewalks should be part of a continuous network and connected with crosswalks at all roadway intersections. They should be safe, comfortable, and attractive facilities that provide accommodations for people of all ages and abilities. While ubiquitous in urban environments, sidewalks in rural villages are equally important as they serve a specific function, such as linking neighborhoods to a school or village center.

The Federal Highway Administration has demonstrated that pedestrian crashes are more than twice as likely to occur in places without sidewalks, while locations with sidewalks on both sides of the road have the fewest crashes.[36] Surveys have also found that a lack of sidewalks and safe places to bike are a primary reason people give when asked why they don't walk or bicycle more.[37] The choice of sidewalk form, material, and width is determined by its context, surrounding density, mix of activities, and travel needs.

Sidewalk Zones

The primary objective in designing sidewalks is to provide continuous, safe, and accessible pathways for pedestrians. Sidewalks should be designed to follow as much as possible the natural path of travel. In some cases, it is more desirable for a sidewalk to divert from that path to provide a more adequate facility or a greater degree of separation between the sidewalk and the roadway.

Design Guidance

Many reference guides describe the sidewalk as having three distinct elements or functions: the Frontage Zone, the Pedestrian Zone, and the Planted Buffer/Furnishing Zone. Given the diversity of contexts throughout the Capital District, the needs and design standards may differ greatly.

Frontage Zone

In locations where buildings are adjacent to the sidewalk, the frontage zone provides a buffer between passing pedestrians and opening doors and other architectural elements. The frontage zone keeps the pedestrian zone safe and clear of obstacles and obstructions. In parts of the Capital Region, a frontage zone may not be necessary where a building is not adjacent to a sidewalk.

Pedestrian Zone

The pedestrian zone is the area of the sidewalk that is intended specifically for pedestrian travel. The pedestrian zone should be free of any physical obstructions, including street furniture, plantings, and surface utilities. The quality of the sidewalk surface in the pedestrian zone is extremely important and must meet accessibility standards. The material should be smooth, level, and have minimal gaps or rough surfaces.

Planted Buffer/ Furnishing Zone

Wherever there is sufficient space, a planted buffer/furnishing zone should be established to delineate space for objects that would otherwise obstruct pedestrian movement, as well as provide a buffer for pedestrians from the adjacent roadway. This zone is where street trees, stormwater elements, street lights, signage, hydrants, benches, trash and recycling receptacles, parking meters, signal and lighting control boxes, utility poles, and other potential obstructions should be located.

Sidewalk Context

Whenever possible, sidewalks should be built on both sides of the street. In urban, suburban, and village center areas, sidewalks are essential. While shoulders may be appropriate in rural areas, sidewalks should be considered around pedestrian generators such as schools and job centers that may be important destinations for people arriving by walking or public transit.

Introducing segments of sidewalks can be an essential first step to building out a larger sidewalk network, and efforts should be made to link new segments to nearby jobs, retail, or services. Regardless of whether the purpose of a sidewalk is recreational or for transportation, it is still essential for pedestrian safety.


Wolf Road in Colonie, NY

ADA Compliance

The sidewalk is the basic unit of mobility within our transportation system. Every sidewalk should be accessible and well maintained. The pedestrian zone must be free of all obstacles, protruding objects, or vertical obstructions.

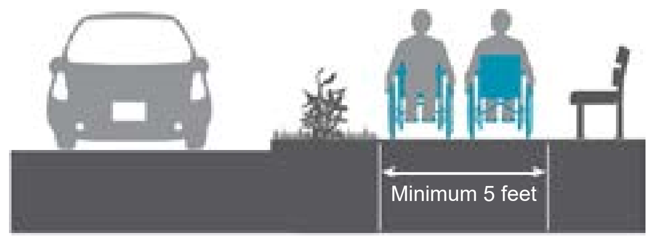
To maintain accessibility, a sidewalk must be:

1. Accessible by ALL users
2. Adequate width
3. Safe to use
4. Continuous and connected

Sidewalk Widths

Sidewalks should be at least 5 feet wide to accommodate two wheelchairs passing each other. In addition to providing a more accessible facility, this minimum width also creates a more comfortable environment for pedestrians to walk side-by-side and pass each other, and for families with strollers. The ADA specifies that sidewalks may be as narrow as 4 feet wide, but must then include 5 square feet of passing space at intervals no greater than 200 feet.

Sidewalks should be constructed as wide as possible to accommodate foot traffic and improve pedestrian comfort, given available street right-of-way. Sidewalk width should support the surrounding street context, land uses, and current and future pedestrian demand — the greater the density, demand, and mix of activities, the wider the sidewalks should be. Downtown and commercial areas, for example, generally require sidewalk widths of at least 6 to 10 feet, allowing pedestrians to walk side-by-side and to comfortably pass one another. Sidewalks immediately adjacent to the curb should provide additional



width to enable pedestrians to move away from passing traffic and opening car doors. No existing sidewalk should be reduced in width in the course of street widening projects. Opportunities for widening sidewalks and narrowing roadway width should always be considered whenever roads are reconstructed.

Sidewalk Maintenance

Sidewalks are prone to damage caused by environmental conditions as well as overgrowth from vegetation within and outside of the public right-of-way. Keeping sidewalks in a state of good repair is an essential part of maintaining accessibility. Sidewalks in poor repair can limit access for many users and can be a health and safety issue for pedestrians, especially those with limited mobility. When sidewalks are in poor condition, tripping hazards can develop and pedestrians can be compelled to travel in the street.

Surface Materials

The choice of surface materials for sidewalks, plazas, or other spaces where pedestrians walk can have a significant impact on accessibility. Sidewalk materials generally consist of concrete or asphalt; however, tile, stone, and brick are also frequently used. Although these materials provide an aesthetic benefit, they can lead to grooves or odd spacing that can catch wheelchair castors or create a tripping hazard for pedestrians, especially those with vision or mobility disabilities. Decorative surfaces may also create a vibrating, bumpy ride that can be uncomfortable or painful for those in wheelchairs.

- Brick or cobblestone can sometimes be improper for the pedestrian zone. Creative alternatives include using these materials as trim or decorative elements in the furnishing zone or using colored concrete.
- Surface materials must be firm, stable, and slip resistant. Concrete surfaces should be broom finished to help increase slip resistance.
- Vertical discontinuities must not be greater than ½ inch. Causes of vertical discontinuities include:
  - Tree roots pushing upward
  - Uneven transitions from street to gutter to ramp
  - Heaving or settling due to frost
  - Buckling due to improper sub-base preparation
- A ¼ to ½ -inch vertical discontinuity may be beveled with a maximum grade of 50 percent. Larger vertical discontinuities must be leveled following slope requirements discussed in Chapter 1.

Gaps, Grates, and Openings

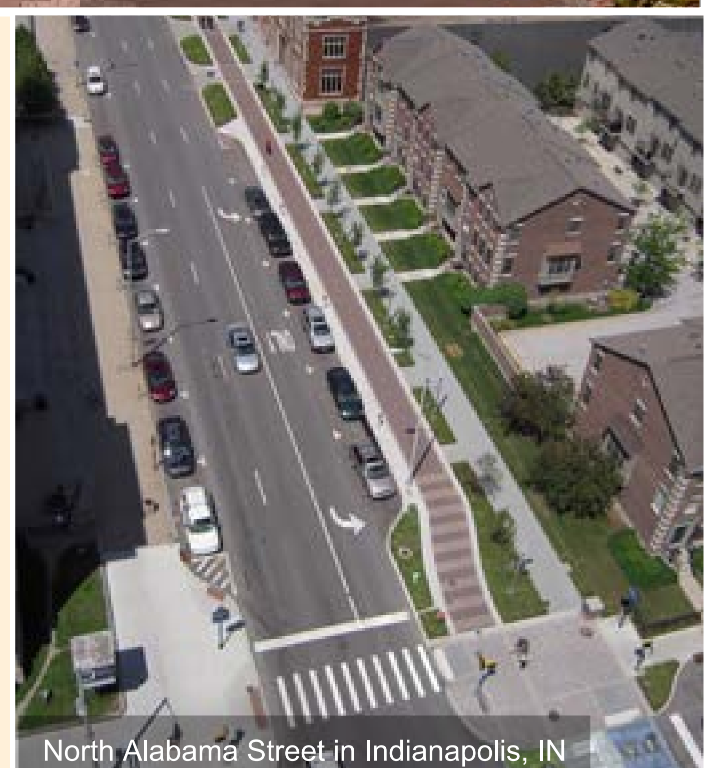
Wheelchair casters, bicycle wheels, and walking aids such as canes and crutches can get caught in grates and gaps. Whenever possible, grates should be located outside of the pedestrian access route, including away from the bottoms of curb ramps and crosswalks. Grates, gaps, and cracks must not be greater than ½ inch. The long dimensions of grate openings must be oriented perpendicular to the most frequent direction of travel. This helps people traveling in a wheelchair to maintain control.

New Scotland Avenue in Albany, NY

Indianapolis Cultural Trail in Indianapolis, IN

Community Identity

Surface Materials can play an important role in creating a sense of identity for a community. One example is the Indianapolis Cultural Trail: an urban trail composed of bricks and stamped cement that connects businesses, historic sites, parks, landmarks, housing, and community facilities. The bricks make the trail identifiable, and keep bicyclists traveling slowly enough to safely share the limited space with pedestrians. Branding and signage help complete the story of the trail, unifying Indianapolis' downtown. Plantings, seating, bike racks, and lighting are also present, making the Cultural Trail a destination and a key link for the community.


North Alabama Street in Indianapolis, IN

SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES

Driveways

Drivers must yield to pedestrians, and proper driveway design should reinforce, not hinder, this hierarchy. The design of driveways should provide a continuous and level pedestrian zone across the vehicular path, encouraging drivers to stop for pedestrians on the sidewalk. Driveways should not be designed as intersections, where the sidewalk is interrupted by the driveway. The public sidewalk has the right-of-way over private crossings. Pedestrians are the vulnerable user in their relationship with motor vehicles. As with other types of intersections and crossings where pedestrians must interact with motor vehicles, the design should make pedestrian right-of-way clear and obvious to motorists.

Bad Driveway Design

Good Driveway Design

Driveways should be designed for continuous and level pedestrian passage. Proper driveway design, such as in the above right, increases the visibility of pedestrians, encouraging drivers to stop. Driveways designed more like intersections, such as in the above left, feature an interrupted sidewalk, which can reduce pedestrian visibility and increase the likelihood that drivers will not stop for pedestrians. In addition, they often contain greater than allowable grades and cross slopes.

Slopes and ADA Compliance

Steep grades and cross slopes can often be hazardous. Both powered and manual wheelchairs can become unstable or difficult to control on sloped surfaces. Engineers should make every effort to provide surfaces that are as level as possible. All requirements apply to driveway crossings.

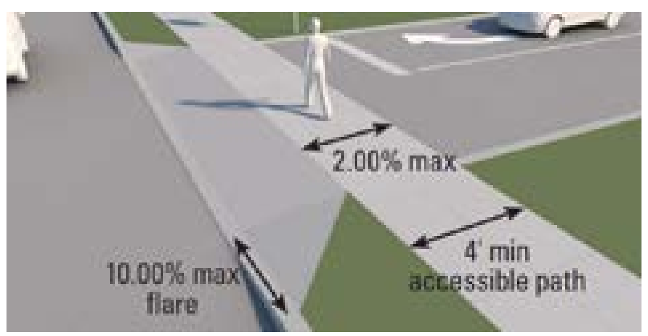
Grade

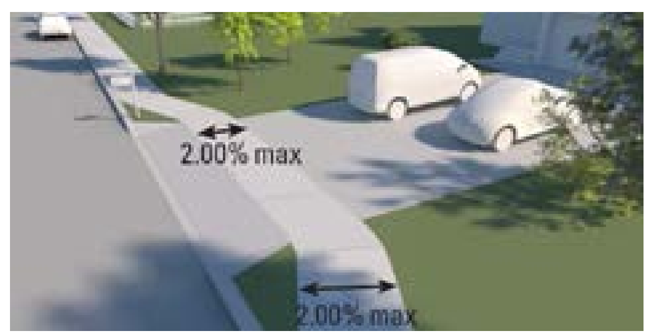
The grades of sidewalks within a street or highway right-of-way must not exceed the general grade of the adjacent street or highway. Grades of sidewalks or other pedestrian access routes that are not contained within a street or highway right-of-way must not exceed 5 percent. Crosswalk grade must not exceed 5 percent.

Cross Slope

Severe cross slopes require wheelchair users and other pedestrians to work against gravity to maintain their balance and can cause wheelchair users to veer toward the curb and onto the street. Cross slope is often an issue where driveways are built into the sidewalk.

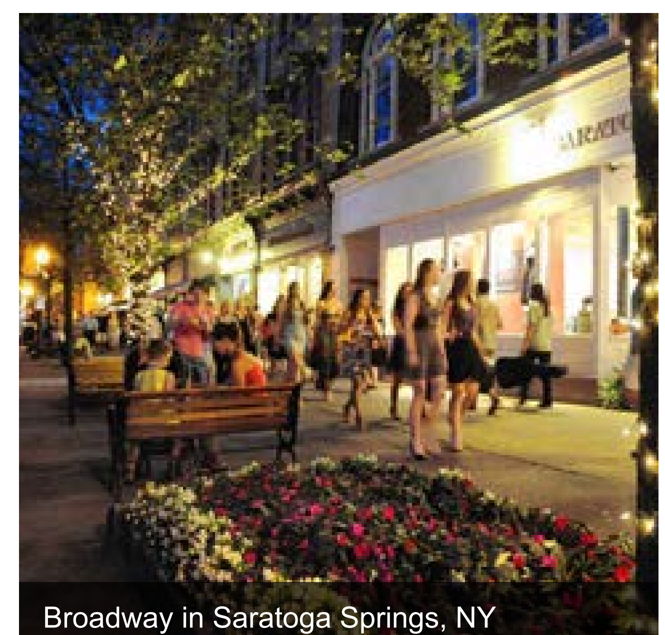
- The maximum cross slope permitted for sidewalks and crosswalks in controlled intersections is 2 percent.
- At uncontrolled intersections, the cross slope may be up to 5 percent. At midblock crosswalks, the cross slope may equal the street or highway grade.





Street Furniture

Street furniture encompasses a variety of amenities that can enhance the aesthetics and functionality of the sidewalk environment. Well designed and placed street furniture makes the sidewalk a more comfortable, convenient, and inviting place. Benches and other seating options can facilitate gathering, provide a place for rest, or create an attractive spot to have lunch or coffee from a nearby business. Well distributed and maintained trash bins help keep a street clean. Appropriately located bicycle parking encourages more people to bicycle by making parking more convenient. Conversely, improperly laid out street furniture can obstruct and clutter the sidewalk environment and impede pedestrian mobility and accessibility. Street furniture should generally be installed in the furnishing zone or in a curb extension, and should not protrude into or hinder circulation within the pedestrian zone.


Broadway in Saratoga Springs, NY

Seating

Seating comes in a variety of temporary and permanent forms, including chairs, benches, seating walls, or planters. Seating helps create a more inviting environment and encourages active public spaces.

Design Guidance

Seating should not interfere with clear pedestrian zones, building entrances, loading zones, parked vehicles, access to fire hydrants, or other potential conflicts.

ADA requires benches at each location to include:

- A minimum 2.5 by 4 foot clear space, located at one end of the bench or at least 1.5 feet away from the front of the bench.
- One side of the clear space must adjoin either the sidewalk or another clear space.
- Ideally, full back support and armrests.

Bicycle Parking

Providing adequate, secure bicycle parking is essential to accommodate and encourage bicycling as an alternative travel mode. Proper parking facilities increase the convenience of bicycling for commuting, utilitarian, or recreational purposes while also alleviating the threat of theft.

Design Guidance

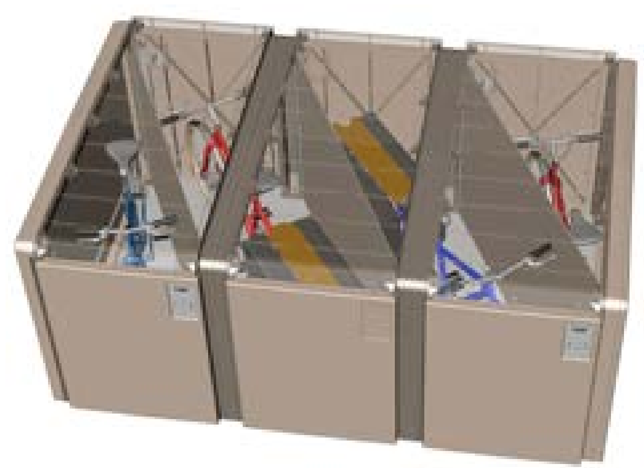
The typical parked bicycle is 6 feet long and 2 feet wide, making bicycle parking space-efficient and easy to locate. Parking should be conveniently located, well lit, and visible for bicyclists arriving at a destination. Based on guidelines from the Association of Pedestrian and Bicycle Professionals (APBP), a bicycle rack should meet the following requirements:

- Be intuitive to use
- Support the bicycle upright by its frame in two locations
- Enable the frame and one or both wheels to be secured
- Support bicycles without a diamond-shaped frame and horizontal top tube
- Allow both front-in and back-in parking with a U-lock through the frame and wheel
- Resist the cutting or detaching of any rack element with hand tools

Older style racks, such as the "schoolyard" and "wave" are not recommended because they do not properly support the bicycle frame, generally do not facilitate locking of the frame to the rack, and frequently cause interference between the handlebars of adjacent bicycles when the rack is near capacity. Recommended racks include the "inverted U" and "post and ring." Bicycle racks should also be properly spaced to allow easy, independent access to each bicycle.

Bicycle Lockers

Bike lockers are a great option for homes and businesses that may not have access to covered bicycle parking otherwise. These small enclosed shed-like lockers can help to encourage bicycling during the rainier or snowier months of the year.



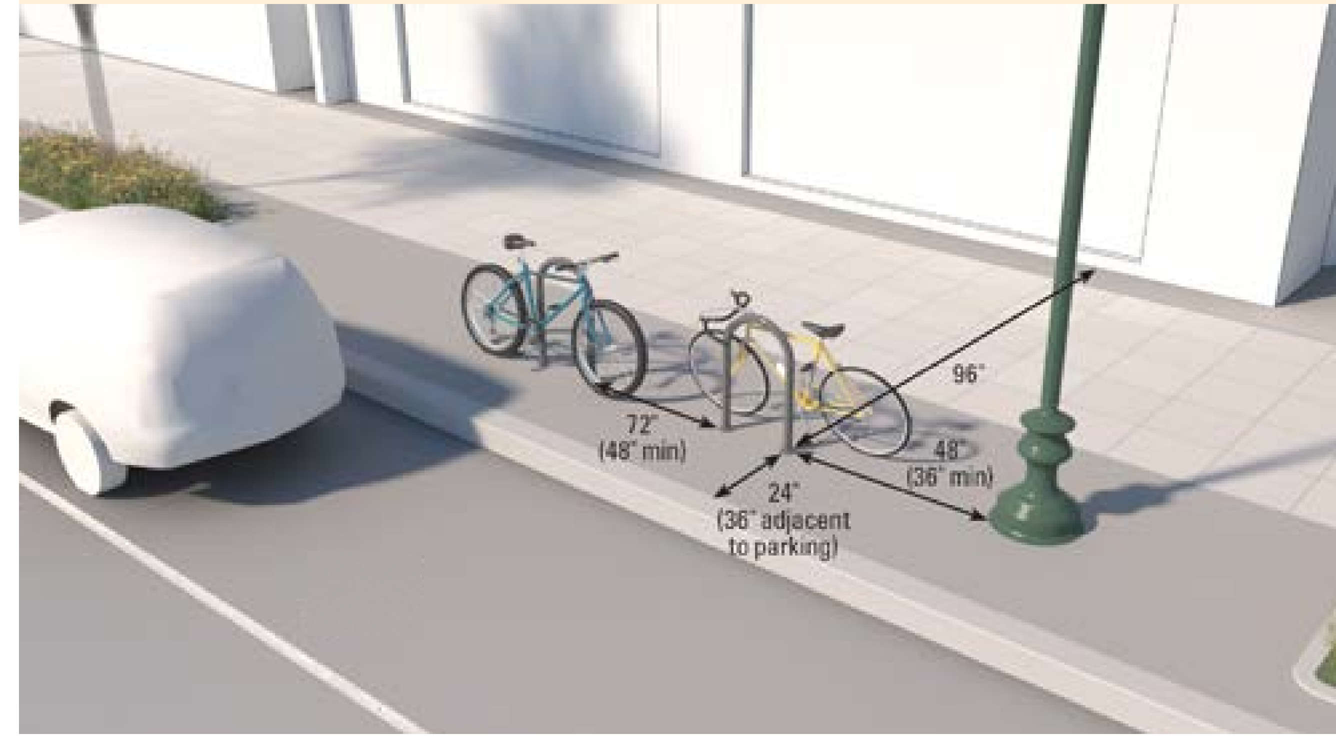
Bicycle Storage Rooms and Showers

When updating a zoning code or form-based code, remember that bike storage rooms are an excellent tool for encouraging bicycling in dense housing, office, or mixed-use developments. Bike storage rooms often feature wall-hooks and indoor racks which facilitate condensed storage. Bike storage rooms in office, commercial, or mixed-use buildings can also feature showers and changing areas, so that employees can bike wearing different clothes than they'll wear during the workday.

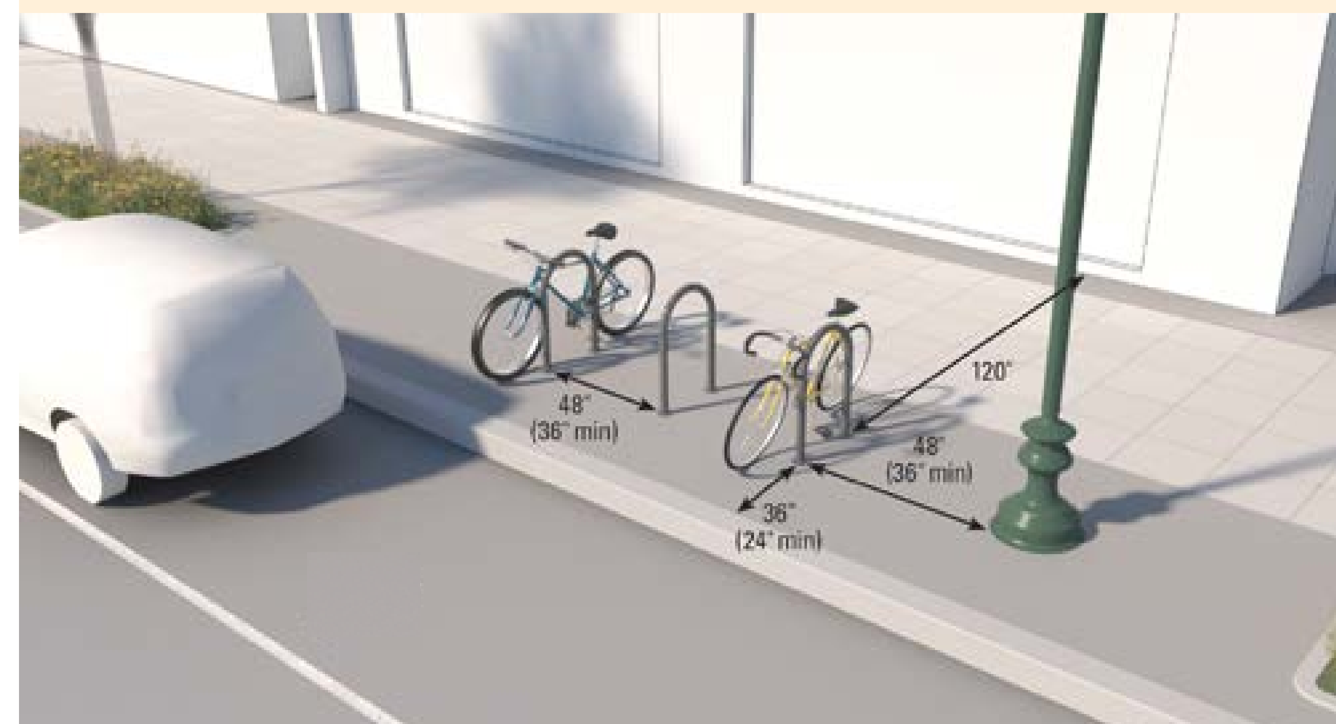
Further Guidance

- *Boston Complete Streets Design Guide*
- *Philadelphia Complete Streets Design Guide*
- *Newark Complete Streets Design Guidelines and Implementation Plan*
- *Essentials of Bicycle Parking,* APBP
- *Bicycle Parking: Standards, Guidelines, Recommendations,* San Francisco Municipal Transportation Agency

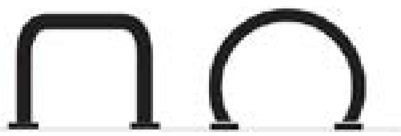
Recommended Dimensions for Racks Parallel to Curb



Recommended Dimensions for Racks Perpendicular to Curb

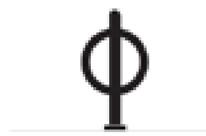


Recommended Bicycle Rack Designs



Inverted U

Common style appropriate for many uses; two points of ground contact. Can be installed in series on rails to create a free-standing parking area in variable quantities. Available in many variations.where pedestrians must interact with motor vehicles, design should make pedestrian right-of-way clear and obvious to motorists.



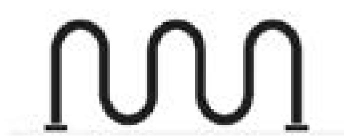
Post and Ring

Common style appropriate for many uses; one point of ground contact. Compared to inverted-U racks, these are less prone to unintended perpendicular parking. Products exist for converting unused parking meter posts.

Wheelwell Secure

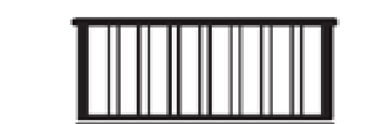
Includes an element that cradles one wheel. Design and performance vary by manufacturer; typically contains bikes well, which is desirable for long-term parking and in large-scale installations (e.g., campuses); accommodates fewer bicycle types and attachments than the other two styles.

Racks to Avoid



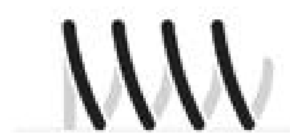
Wave

Not intuitive or user-friendly; real- world use of this style often falls short of expectations; supports bicycle frame at only one location when used as intended.



Schoolyard (Comb)

Does not allow locking of frame and can lead to wheel damage. Inappropriate for most public uses but useful for temporary attended bicycle storage at events and in locations with no theft concerns.



Spiral

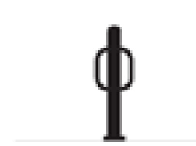
Despite possible aesthetic appeal, spiral racks have functional downsides related to access, real-world use, and the need to lift a wheel to park.

Wheelwell

Racks that cradle bicycles with only a wheelwell do not provide suitable security, pose a tripping hazard, and can lead to wheel damage.

Coathanger

This style has a top bar that limits the types of bicycles it can accommodate.



Bollard

This style typically does not appropriately support a bicycle's frame at two separate locations.

Images and descriptions courtesy of APBP *Essentials of Bicycle Parking*

Wayfinding

Pedestrian and bicycle wayfinding systems provide navigational aids that help pedestrians and bicyclists orient themselves within their surroundings and determine the best route to reach a destination. Wayfinding systems also help create a sense of place within a community or corridor, knitting it together through consistent treatments to help residents and visitors navigate between points of interest. Wayfinding signage should identify the locations of key destinations, such as businesses, recreational areas, historical or cultural landmarks, bicycling routes, transit, and connections to nearby areas of interest.

Wayfinding systems can be designed and implemented formally by municipalities or business improvement districts. In many cases, walking and biking advocates have organized informal wayfinding systems to promote active transportation.

Signage should be flexible and fit its context and need. Types of wayfinding signage are shown in the graphics on the following page, including sidewalk signs with area maps and decision point signs showing directions and distances to nearby destinations.

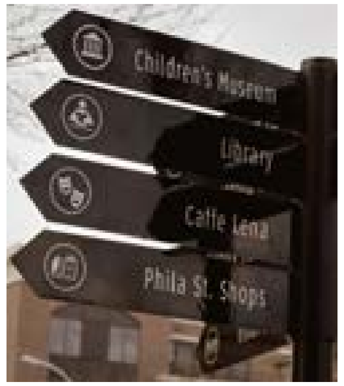
Wayfinding has many benefits for a community. By helping pedestrians and bicyclists overcome the hurdle of distance perception (where the time needed to walk or bike tends to be over-estimated), wayfinding can help encourage different transportation choices, including improving access to transit.

Many transit agencies have found that one of the simple, yet critical ways to increase transit ridership is to improve the communication of information to passengers. Real-time information (on a smartphone, computer, or at a transit stop) and improved route planning are among the ways that transit agencies have improved service and made transit a more attractive option. Similarly, a comprehensive wayfinding system for a bicycle network has many benefits that can help increase bicycle ridership, including the following:

- Familiarizes bicyclists with the bicycle network
- Improves awareness of the bicycle network and the presence of bicyclists among motorists
- Identifies the preferred routes to key destinations
- Makes bicycling and the bicycle network more accessible and convenient for visitors and casual users
- Minimizes the tendency to overestimate the amount of time it takes to travel via bicycle by including information on mileage and/or travel time to destinations

Further Guidance

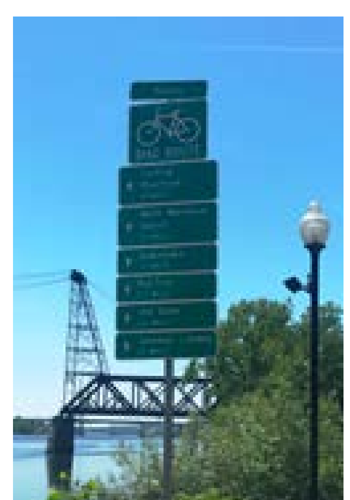
- *Urban Bikeways Design Guide,* NACTO
- *Urban Street Design Guide,* NACTO
- *Manual on Uniform Traffic Control Devices (MUTCD),* FHWA



Design Guidance

To be as effective as possible, a wayfinding system should be implemented consistently and deliberately. The following guidelines should be followed, when possible, when implementing or retrofitting a wayfinding system:

- Signage should maintain a clean, visible, and consistent design.
- Signs should be posted on both sides of the street or trail along major walking or bicycling routes.
- Maps should be oriented so that the direction the user is facing is at the top; indicate the orientation with the underlined phrase “You Are Here” where the pedestrian is within the map, and place an upward arrow under it. (A separate north arrow should still be present!)
- Distances should be defined by the miles and time needed to reach them (e.g., “It’s a 3/4-mile 15-minute walk away” or circles encompassing destinations within various intervals).
- A standard prioritization system should be used on maps to limit the number of landmarks identified.
- The facades of important landmarks should be illustrated on maps to help orient pedestrians.
- Indexes of major landmarks should be included.
- Public data should be made available to private organizations to develop smartphone applications (“apps”) at no cost to governmental agencies.



Gateways

Major intersections often serve as gateways within a community, delineating a change in community context or street typology, or serving as a de facto entrance to a downtown, historic district, or public square. For example, an intersection might mark a transition from a higher speed, auto-oriented context to a quiet residential street or a denser, lower-speed, downtown environment with greater pedestrian activity. By alerting users of the change in character and context of the roadway, gateway treatments are intended to trigger and enforce a change in user behavior, such as for drivers to reduce speed or be aware of a higher level of pedestrian and bicyclist activity.

Design Guidance

Gateway treatments incorporate visual cues to alert users of a change in street typology or context. Strategies may include a variety of traffic calming, placemaking, and wayfinding tools.

Vertical cues can make a roadway feel more confined, triggering a higher state of alertness among users and a greater awareness of their surroundings. Tools include:

- Massing and height of buildings near corners, such as for the gateway to a main street business district; building entrances facing the corners help frame the intersection
- Unique, decorative signage welcoming users to a neighborhood or district, either at the curbside or an overhead banner
- Specialty light fixtures
- Prominent street trees near the intersection
- Public art installations, such as sculptures or murals
- Radar speed signs to highlight a change in speed limit
- Raised crosswalk or raised intersection
- Wayfinding kiosks, signage, or map displays

Horizontal cues include a physical narrowing of the roadway or features of visual interest, such as a change in color or texture. Tools include:

- High-visibility crosswalk striping or a unique crosswalk striping design distinctive of the district or neighborhood
- Textured pavement or a painted intersection using a mural design representative of the district or neighborhood
- Curb extensions to narrow the intersection

The visual cues used at the gateway should be context-sensitive and reflect the surrounding neighborhood, street typology, and vernacular design. Features introduced at the gateway may also be incorporated into the streetscape design of the neighborhood and street typology, or appropriately scaled and used at subsequent, smaller intersections.

In addition to roadway intersections, trail crossings present the opportunity to create a gateway that achieves multiple purposes: a gateway entrance, an enhanced trail crossing, and traffic calming.


North Jay Street in Schenectady, NY

Bus Stops

Excellent bus stops are necessary for maintaining a quality level of transit service that is attractive and dignified for passengers.

Washington Street in Albany, NY

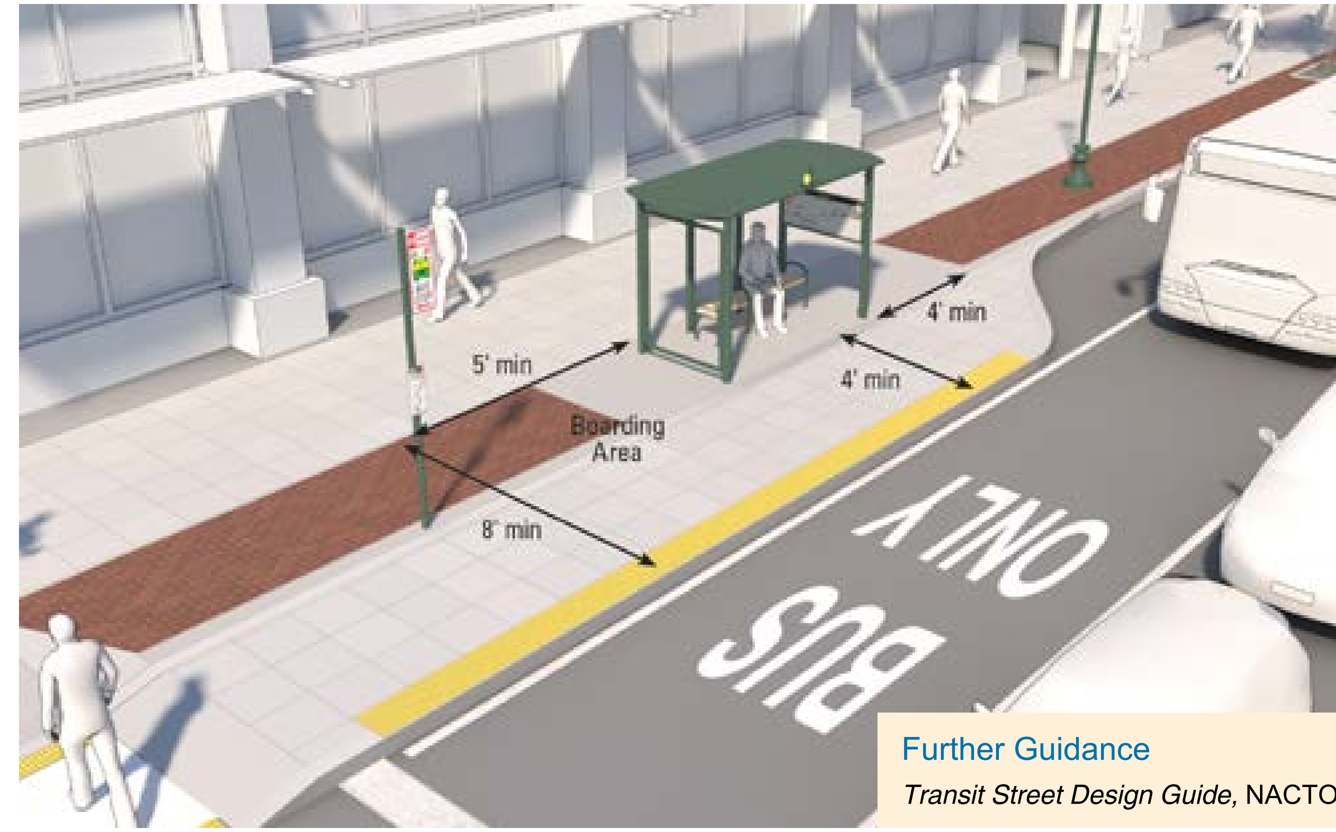
Off-Board Fare Collection

Off-board fare collection allows passengers to pay their fare at the station, or stop, instead of on the bus. This allows riders to board any door, reducing the delay caused by passengers funneling through the front door and paying on board. Off-board fare collection is particularly useful at busy stations or stops.

Design Guidance

- Bus stops should include travel information and a sidewalk connection. Seating, lighting, and shelters should be considered as well.
- Travel information is essential and should include, at a minimum, route and schedule information. Where possible, real-time arrival and departure information should be included, as well as local area maps and wayfinding.
- Bus stops should be maintained regularly.
- All bus stops must be ADA-compliant.
- Stops should provide ample room for riders to gather while providing a clear path for pedestrians. Bus bulbs can facilitate this space.
- Generally, bus stops should be located on the far-sides of intersections, after crosswalks, and on bus bulbs (see page 110).
- Bicycle parking should be provided near bus stops, particularly near busy stops.

The bus stop above lacks an ADA-compliant landing-pad and sidewalk connection.



Further Guidance

Transit Street Design Guide, NACTO

Bus Shelters

Bus shelters provide a place for passengers to wait in comfort and security, protected from the elements.

Design Guidance

- Bus shelters should be at least 4 feet from the curb.
- Bus shelters should be placed with a minimum of 5 feet of space behind and beside the shelter to facilitate wheelchair and pedestrian movement around the shelter.
- Travel information is essential and should include, at a minimum, route and schedule information. Where possible, real-time arrival and departure information should be included, as well as local area maps and wayfinding.
- Bus shelters should be maintained regularly.
- All bus shelters must be ADA-compliant.

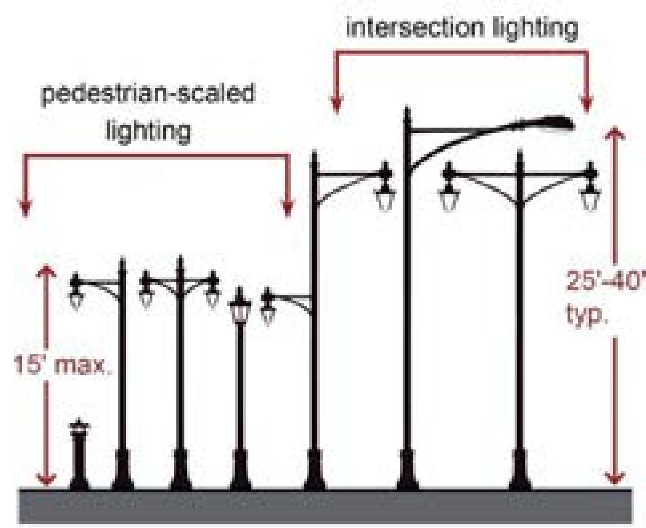
Platform-Level Boarding

Passenger platforms at stations or stops should be approximately level with the bus floor to provide for easy access and boarding. Making boarding fully accessible for wheelchairs, disabled passengers, and baby strollers reduces delay and provides a higher quality of service for all passengers. Level boarding can be accomplished through raised platforms (12 to 14 inches) combined with low-floor buses.

Street Lights

Lighting is an essential component of complete streets. Pedestrian-scale lighting should be provided near transit stops, crosswalks, commercial areas, parks and plazas, residences, and other locations where night-time pedestrian activity is possible. Lighting should be considered at focal points such as sculptures or fountains - places that are often useful for wayfinding. Pedestrian-scale street lights generally should not be more than 15 feet tall and 30 feet apart. Poles may be outfitted to enable hanging banners, flower baskets, or artwork to promote the public realm. Pedestrian-scale lighting helps to illuminate sidewalks and improve pedestrian safety, security, and comfort. Street lights should be energy efficient, evenly spaced, and focused downward to reduce light pollution. LEDs are now widely available for street lights, and can help improve visibility while reducing energy costs and light pollution.

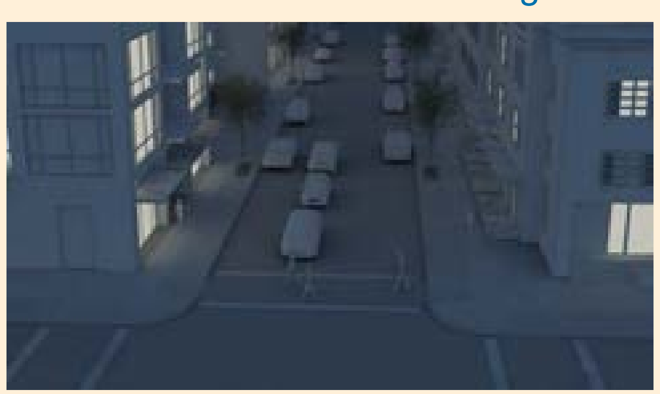
Lighting fixtures should reflect the character and urban design of the street type. While taller street lights can be appropriate for motor vehicle traffic, it is important to provide lighting for pedestrians in urban, suburban, and village areas. Properly designed and installed pedestrian-scale lighting can both help define a streetscape and create a sense-of-place in a community.



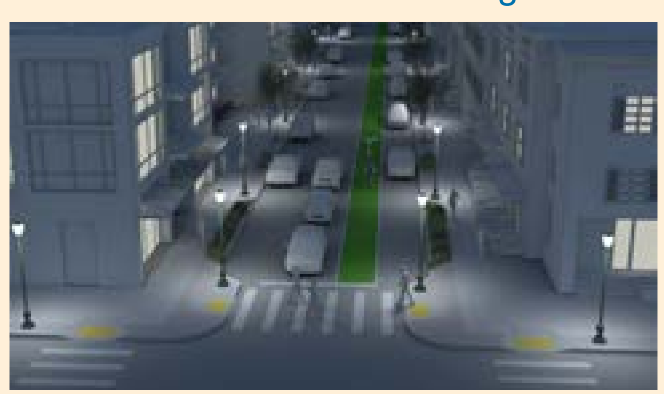
Further Guidance

- *Lighting Handbook,* FHWA

Crosswalk without Street Lights



Crosswalk with Street Lights



Street Trees

Trees, shrubs, and other landscape plantings play an important role in making a street complete. Tree canopies can help make a street comfortable and sustainable, help to define the character of the street and provide shade, act as a buffer from traffic, reduce the heat island effect and energy consumption, and help to absorb and cleanse stormwater. Trees and other landscape plantings also absorb greenhouse gases and help filter airborne pollutants, while enhancing not only the visual aesthetic character of a street, but also by dramatically improving the physical environment of the corridor.

Trees should only be planted in locations that include space for the tree's crown development and have adequate soil volume, including good soil structure for root development to support desired tree growth. Tree roots do not successfully establish in highly compacted soils due to poor soil structure, which limits access to air and water, thus resulting in the tree's diminished growth and eventual mortality. In some situations, existing soils may be readily modified by the incorporation of organic material. Other times, existing soils may need to be removed in their entirety and replaced with a planting soil.

An additional consideration during the design process is the inclusion of subsurface drainage to facilitate the removal of excess water from the tree planting soil. It is possible that water will move through the planting soil but not through the soil beneath the planting soil zone because of its denser and/or compacted nature, thus potentially causing root decay and mortality. One solution is to run a perforated pipe the length of the planting soil zone, connected to an existing storm sewer system.

Design Guidance

Where street trees are appropriate, they should be planted approximately every 35 feet along the street. Under power lines, shade trees may not be appropriate and ornamental trees with a lower mature height should be planted approximately every 20 feet.

Additional care should be taken when planting street trees in urban areas to avoid planting in compacted soil. Soil should be decompacted or replaced with a structural soil to allow root growth and tree survival. This can be done in lieu of or in addition to a perforated pipe.

Railroad Place in Saratoga Springs, NY

Open Soil Trench

An open soil trench is a continuous trench filled with planting soil. The width and depth of the trench will vary based upon the horizontal space available and the height of the tree root balls to be planted. Tree trenches can be located within a sidewalk's furnishings zone or within street medians, and provide an excellent urban environment for trees. Tree trenches can also be used for shrubs, ground covers, and/or mulch.

Open soil trenches are typically used in residential environments where foot traffic is low and crossing of the soil trench surface is minimal. An open soil trench is not recommended in areas with high-turnover curbside parking.

Sidewalks should be flush with the edges of soil trenches to avoid tripping hazards. The adjacent sidewalk can be pitched toward the open soil trench to provide a stormwater benefit. However, consider the quality of the potential stormwater runoff in light of deleterious materials, such as deicing salts, which - in high enough volumes - could negatively impact or prevent plant and tree growth.

Covered Soil Trench

A covered soil trench features structural support, which enables the soil trench to support pedestrian traffic on the paved surface. Support systems commonly used include concrete structures, structural soil, and plastic structural cells. Covered soil trenches often still allow passive irrigation to reach the soil. Permeable pavement and brick pavers are both examples of treatments that allow infiltration of water during rain and snowfall.

While sizing and projecting the annual performance of any green infrastructure, Capital Region designers should consider that the absorption rate of soils above the frost line is quite low.

Tree Pits

Tree pits should be generous in size with soil volumes at least the size of the tree pit opening. Tree pits have historically been constructed at 4 feet by 4 feet and 5 feet by 5 feet, which can result in trees outgrowing the soil volume and pavement opening, creating upheavals of adjacent sidewalks and pavement. Where space allows, tree pits that are 4 or 5 feet wide by 8 or 12 feet long may be considered.

Soil Panels and Break-Out Zones

When planting trees in urban areas, it is important to provide adequate rooting space for the tree's ultimate crown development. Soil panels and break-out zones can provide this necessary rooting space.

Soil panels are contiguous volumes of soil, connected to the tree pits, into which tree roots can penetrate, grow, and extend themselves. Soil panels can be placed beneath sidewalks and paving. As tree roots grow through these soil panels they may enter a break-out zone or a large volume of soil some distance from, but adjacent to, the sidewalk tree pit or soil trench. These break-out zones can be included in the site design or occur in an adjacent open lawn or planting bed. Break-out zones provide additional soil volumes for tree root growth and establishment.

Ground Cover Plantings

Hardy ground covers and mulch enhance the appearance and minimize volunteer growth within tree pits. They also provide a visual and physical queue that the tree pit is not part of the pedestrian walking surface.

To further protect the tree pit from pedestrians and dogs, an 18-24 inch high ornamental element may be installed around three of the tree pit's sides when immediately adjacent to the curb, and all four sides when the curb is at least 2 feet away from the closest edge of the tree pit. This will help protect the tree from soil compaction and harmful substances.

Street Trees and Accessibility

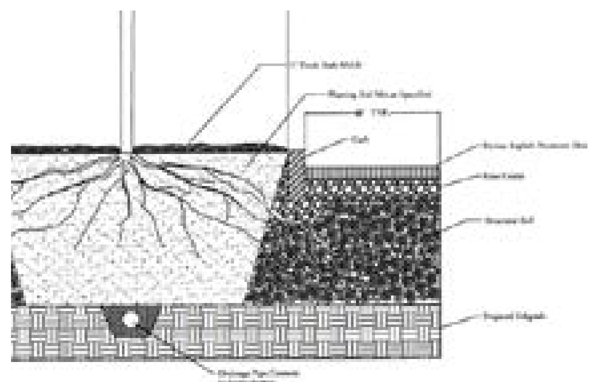
Low-hanging branches can be a hazard for pedestrians, particularly those with vision impairments. Tree branches must hang no lower than 6.7 feet over the sidewalk. Tree pits in narrow sidewalks should be covered with a tree grate or pervious pavement. This surface must be level with the sidewalk and meet ADA surface standards if it would otherwise reduce the sidewalk width to less than 4 feet.

Flexible Pavement

Flexible pavement is a cost-effective, pliable, porous surface material that bends but does not crack, making it an ideal treatment near tree roots. Albany, NY has used flexible pavement effectively in situations such as those shown in the photo. Flexible pavement is an appropriate treatment for many constrained areas to maintain a passable surface and prevent cracking.

Structural Soil

Structural Soil is a compacted soil that adheres to pavement design requirements. It consists of crushed stone and clay, which facilitates structural stability underneath pavement while enabling ornamental tree root growth. It can be used in individual tree pits or continuous planting strips beneath a sidewalk, and enable healthier urban ormnamental tree and plant growth while filtering stormwater.



Structural Cells

Structural Cells are a pavement support system intended to facilitate tree growth. Plastic, metal, or fiberglass structures can be placed adjacent to individual tree pits or continuous planting strips beneath a sidewalk. Structural cells provide a large amount of space for soil, enabling healthier urban tree and plant growth along with stormwater filtration.

SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES

Winter Maintenance

Sidewalks in the Capital Region are frequently buried in snow and ice during wintertime. Cities and peer regions across Upstate New York, the Northeast, and Midwest are beginning to focus more heavily on municipal sidewalk plowing, shoveling, and salting, as well as on increased enforcement. Curb ramps and sidewalks must be cleared of snow, ice, and any other condition that renders them unusable by people who have disabilities. Special attention should be paid to bus stops and public facilities. Permeable pavement can be used to help prevent the ponding of water, reducing the likelihood of ice formation and, accordingly, the amount of salt needed.

Jay Street in Schenectady, NY

Further Guidance

- *Green Infrastructure Toolkit*, CDRPC
- *Urban Street Stormwater Guide*, National Association of City Transportation Officials, Island Press, 2017.
- *Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses, Sixth Edition*, Michael A. Dirr, Stipes Publishing, 2009.
- *Up By Roots: Healthy Soils and Trees in the Built Environment*, James Urban, International Society of Arboriculture, 2008.
- *Trees in the Urban Landscape: Site Assessment, Design, and Installation*, Peter J. Trowbridge & Nina L. Bassuk, John Wiley & Sons, 2004.
- *Principles and Practice of Planting Trees and Shrubs*, Gary W. Watson & E.B. Himlick, International Society of Arboriculture, 1997.

Stormwater Management

A variety of sustainable stormwater management techniques help to collect, treat, and slow runoff from impervious roadways, sidewalks, and building surfaces. Development generally includes a generous amount of pollution-generating and non-pollution-generating impervious surfaces that change natural drainage patterns. This often results in flooding issues and the need for expensive drainage flow control storage and water quality treatment facilities. Impervious surfaces, such as concrete and asphalt, prevent rainwater from being absorbed at the source. As a result, stormwater flows and pollutants enter the pipe network and are discharged into receiving water bodies or become an additional burden to Capital Region wastewater systems. The Capital District Regional Planning Commission (CDRPC) works closely with municipalities to facilitate the Green Infrastructure Toolkit (which supplements the NYS Stormwater Management Design Manual), the 604(b) Clean Water Program, the MS4 Stormwater Program, and the Long Term Control Plan for the combined sewage overflow sites of the Hudson River Albany Pool communities - Albany, Troy, Rensselaer, Cohoes, Watervliet, and Green Island.

Stormwater management techniques can help reduce the impact of development by managing stormwater at the source and mimicking natural or pre-development conditions. These techniques are sustainable and can add aesthetic and ancillary social benefits to the built environment. They can help reduce pollution to rivers and other water bodies, decrease flooding, increase groundwater recharge, and reduce energy consumption. The following are examples of stormwater management techniques that can easily be implemented and should be considered as primary best management practices (BMPs) where technically feasible. They can be used within the public right-of-way or as part of a private development to offset the impacts of impervious development.


Watervliet, NY

Design Guidance

Bioretention Facilities

Bioretention facilities are vegetated retention areas designed to manage and treat stormwater by using a conditioned planting soil bed and organic materials that filter runoff stored within shallow depressions. Biofiltration facilities can be flow-through filtration systems with an underground perforated collection pipe that captures and conveys treated runoff to the final discharge point. They also may be designed as pure retention facilities, relying on natural soil infiltration as a primary discharge. Both systems rely on an amended or engineered soil filtration specifically designed to remove particulates and pollutants before proceeding to a self-contained discharge location.

Further Guidance

- *NYS Stormwater Management Design Manual*, NYS DEC
- *Green Infrastructure Toolkit*, CDRPC
- *Bioswale Care*, NYC Environmental Protection
- *Managing Wet Weather with Green Infrastructure*, EPA
- *Green Infrastructure Funding Sources*, NYS DEC
- *Greening DC Streets*, DDOT
- *Urban Street Stormwater Guide*, NACTO

Biofiltration Planters or Swales

Biofiltration or infiltration swales are vegetated, shallow landscape conveyance systems that are designed to capture and treat stormwater runoff as it is conveyed and discharged to the downstream storm system. Bioswales are typically sized to treat the initial infiltration of stormwater, which includes the most pollutants. They are a very effective type of infrastructure for slowing runoff velocity and cleansing water while recharging the underlying water table. Biofiltration swales are flexibly designed and may be installed in medians, cul-de-sacs, bulb-outs, or other spaces not within the pedestrian zone.

Composition and Drainage

- The engineered soil mixture should consist of 5 percent maximum clay content.
- Engineered soil must be designed to pass 5 inches of rainwater per hour.
- Underlying native soils should be analyzed to verify that they are not contaminated before implementation.

Slope

Biofiltration swales must be designed to allow water to move along the surface at a specific velocity and treatment surface area. Ideal slopes are 4:1 with a maximum 3:1 slope and a maximum velocity of less than 3 feet per second.

Flow-Through Planters

Flow-through planters are hard-edged stormwater management facilities with an impermeable base. Flow-through planters treat water by allowing runoff to soak through its soil and filter into an underdrain system that conveys filtered runoff to a downstream discharge point.

Composition and Drainage

- The engineered soil mixture should consist of 5 percent maximum clay content and 10 percent organic matter by weight.
- Planters should be designed to drain within 24 hours.

Location

Flow-through planters should not be located in constrained areas next to buildings, or areas with limited setbacks, poorly draining soils, steep slopes (>4 percent), or contaminated soils.

Curbs

Curb cuts should be at least 18 inches wide. Cuts may be spaced from 3 to 15 feet apart depending on tributary areas and the profile of the roadway gutter. Curb cut systems should allow for a drop in grade between the street and the finished grade of the biofiltration swale that prevents runoff surcharge and blockage and is sized for the expected sediment storage depth.

Pervious Strips

Pervious strips are long, linear landscaped areas of permeable pavement or gravel that capture and slow runoff. Pervious strips provide some infiltration but less than a biofiltration swale. Pervious strips are an inexpensive step in stormwater management but are less effective than other BMPs for treating a street's major water event. They are also subject to a higher maintenance cycle due to the lack of an upstream pre-settlement chamber that prevents the clogging of permeable voids.

Location

- Pervious strips can be integrated with sidewalks, medians, curbs, and other features.
- Pervious strips utilize long, continuous spaces to treat and filter pollutants.
- Pervious strips require a maintenance plan that is specific to the location of the strip, accounting for outside factors that will affect performance and frequency of maintenance.

Slope

A maximum 2 percent gentle side slope should be used to direct flow into the facility. Additionally, facilities greater than 5 percent typically are not suitable for pervious applications unless specific design criteria are used that are unique to the geography and topography.

Rain Gardens

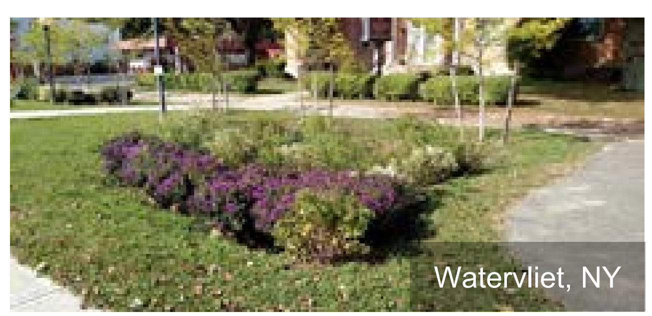
Rain gardens are planted depressions or holes that allow rainwater runoff from impervious surfaces to be absorbed. Native plants are recommended for rain gardens because of their tolerance for the local climate, soil, and water conditions. Native plants also have deep and variable root systems that enhance water filtration, but rain gardens are generally not designed to handle high volumes of pollutants. Rain gardens can sometimes be designed with an overflow structure to help prevent flooding.

Location

A rain garden requires an area where water can collect and infiltrate.

Composition

Planting soils should generally be 2.5 to 4ft deep and composed of sandy loam, and covered with a layer of mulch.[38]



Watervliet, NY

Porous Pavement

Porous or permeable paving materials allow stormwater runoff to infiltrate through the material into the ground instead of being diverted as runoff into the storm drain systems. In addition to reducing runoff, porous pavement traps pollutants, reducing the need for expensive filtration and water conveyance systems. Permeable paving can be used on roads, walking paths, and even parking lots. Permeable pavement is typically laid on top of an infiltration bed and subgrade soil. Examples of porous materials are described below.

Permeable Asphalt

Permeable asphalt is produced and placed using the same methods as conventional asphalt concrete; it differs in that fine aggregates are omitted from the asphalt mixture. The remaining large, single-sized aggregate particles leave open voids that give the material its porosity and permeability. Permeable asphalt is best suited in lower-traffic areas, such as parking lots or residential streets. Site placement can have an impact on operations and maintenance. When placed along a slope or an area with high debris movement, permeable asphalt can become clogged and require frequent maintenance.

Permeable Concrete

Permeable concrete is similar to permeable asphalt and is designed to have more void spaces that allow air and water to pass through the material. In the Capital Region, it's recommend that installers use cured-in-place concrete panels. Panels can be dropped in, easily replaced, and facilitate access to underground infrastructure. Some communities have even pulled up panels to power wash them, thus ensuring the panels are free from debris.

Interlocking Concrete Pavers

Interlocking concrete pavers are concrete (or stone) units with open, permeable spaces between the units. They can bear both light and heavy traffic.

Maintaining Porous Pavement

Porous pavement requires different levels of maintenance and may include:

- Annual inspection of materials
- Periodic replacement of sand, gravel, or vegetation
- Periodic vacuuming of pavement to unclog sand or debris

Maintenance is important to the life of the asset and should be considered before installation. Once porous surfaces become clogged, they lose their effectiveness and can become unrecoverable. This is particularly true with permeable asphalt. Planted treatments can have lower operations and maintenance costs than permeable paving; however, they require additional space for placement.

Construction Testing and Materials

The American Society for Testing and Materials provides guidance on the type of testing for material density, placement, and durability. However, standard industry testing of in-place materials continues to be developed.

"Emphasis has been placed on the joint use of transportation corridors by pedestrians, cyclists, and public transit vehicles. Designers should recognize the implications of this sharing of the transportation corridors and are encouraged to consider not only vehicular movement, but also movement of people, distribution of goods, and provision of essential services." - *AASHTO 2011 "Green Book" Foreword, pg xliv*

South Pearl Street in Albany, NY

ROADWAYS

Road design is governed by detailed and comprehensive guides and standards, such as the FHWA's *Manual of Uniform Traffic Control Devices* (MUTCD) and AASHTO's *A Policy on Geometric Design of Highways and Streets - Sixth Edition* (referred to in this document as the "Green Book"). The FHWA emphasizes that a flexible approach to bicycle and pedestrian facility design is needed to achieve increased implementation. FHWA encourages agencies to appropriately use these guides and other resources to help fulfill the aims of the 2010 US DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations, which states:

" ...DOT encourages transportation agencies to go beyond the minimum requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities, and utilize universal design characteristics when appropriate."

Planning and engineering guidance can and should enhance, not impede, multimodal safety and mobility. Complete Streets seeks to bring vehicular flow and throughput into balance with safety, mobility, and access considerations.

Allocating Use of Street Space

The configuration, width, and allocation of space to travel, parking, and bicycle lanes have a large impact on how the Capital District's streets meet the mobility needs of residents, visitors, and businesses. The primary goal of Complete Streets is to equitably accommodate users of all modes and abilities. Decisions regarding the allocation of roadway space impact how the street accommodates various modes. Prior to road reconstruction and resurfacing projects, designers should conduct an assessment to ensure that the design appropriately accommodates all users. This assessment should include examining the feasibility of reallocating space in the roadway to better accommodate pedestrians, bicycles, and transit vehicles.

Two basic methods should be reviewed during a road reconstruction or resurfacing project to optimize the allocation of street space:

- Road Diet
- Lane Diet

Further Guidance

- *Road Diet Informational Guide*, FHWA
- *Urban Street Design Guide*, NACTO

Madison Avenue in Albany, NY

Travel Lanes

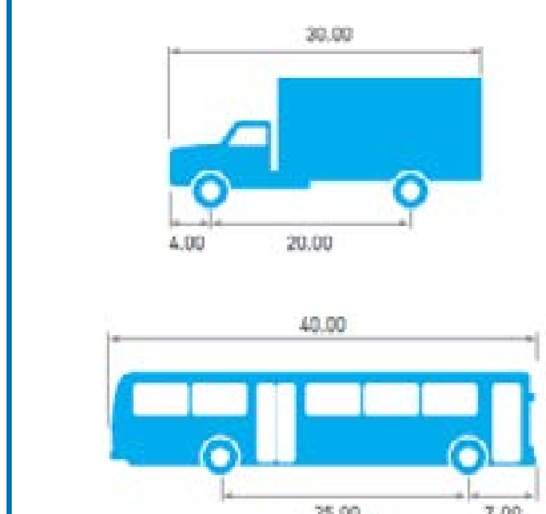
Travel lane width has a large impact on the design speed of a roadway. Traditionally, roads have been designed with wider travel lanes (11 to 13 feet) to create a forgiving buffer for drivers, particularly in high-speed environments. However, the unintended consequence of this is that wider lanes encourage higher travel speeds, which negatively impacts safety and the urban environment. A growing body of research has shown wider travel lanes correlate with higher vehicle speeds.[39] Many engineers and planners previously assumed that lanes narrower than 12 feet decrease traffic flow; however, research has demonstrated that there is no measurable difference in urban street capacity between a 10- and 12-foot lane.[40] Lane widths of 10 feet are appropriate in urban areas and have a positive impact on the safety of a street without impacting traffic operations. Along routes that have high truck and/or bus volumes, 11-foot travel lanes may be preferred.

Narrower lanes are cheaper to construct, decrease crossing distances for pedestrians at intersections and mid-block crossings, and require less impervious pavement, reducing the need for additional stormwater management. For multi-lane roadways with transit or freight, the wider lane should be the curbside lane while the inside lane is designed at the minimum possible width. Designers should consider the movement of freight when developing roadway projects, especially those located on designated NYSDOT Qualifying or Access Highways. The NYSDOT Qualifying and Access Highways designation is intended to provide a network of roadways that allow for the movement of freight. On these roadways, it is imperative to consider the through and turning movements of freight vehicles; however, freight can coexist in a Complete Streets environment. Designers are encouraged to consult the most recent version of NYSDOT's Official Description of Designated and Access Highways in New York State for more information.[41]

Design Vehicle

Engineers and planners should prioritize the mobility needs of a street's most vulnerable users (including pedestrians, bicyclists, or senior citizens) rather than the largest possible vehicle. While it is important to account for the challenges of moving larger vehicles (especially emergency vehicles), infrequent challenges should not supersede the safety and comfort of the majority of daily street users. By designing for the largest vehicle, overall street safety is reduced by creating streets that accommodate and encourage higher vehicle speeds and longer pedestrian crossing distances.

Typical Design Vehicles



Lane Diets

In cases where there are wide travel lanes (12 feet or greater), a lane diet should be considered to narrow the lanes to 11 or 10 feet. On a roadway with wide or undefined lanes, a lane diet can recapture space for bicycle lanes and pedestrian crossing elemens such as bumputs without reducing vehicle capacity. Reduced lane widths encourage slower vehicle speeds, further improving safety, reducing crash severity, and supporting pedestrian and bicycle travel.

Benefits

- Lower vehicle speeds
- Reduced pedestrian crossing distance
- Provide more space for other modes of travel, including bike lanes or wider sidewalks

Applications

Typical applications of a lane diet are on streets with lanes wider than 10 feet, streets with wide parking lanes, or streets with wide center turn lanes.

The City of Albany defined travel lanes on Ten Broeck Street, allowing for the addition of standard bicycle lanes alongside travel and parking lanes.

Road Diets

Road Diet - Before
Road Diet - After

A road diet is a reduction in the number of lanes on a roadway. In the above example, a four-lane roadway is converted to a three-lane roadway with a center turn lane and buffered bicycle lanes.

Often implemented where there is excess capacity or high crash rates, road diets reduce the number of travel lanes and reallocate space for other modes of travel, often bicycle lanes. While road diets may be feasible at up to 25,000 vehicles per day (vpd) or higher, FHWA advises that roadways with over 20,000 vpd should be evaluated for road diet feasibility.[42]

Benefits

- Lower and more consistent vehicle speeds
- Reduced crash rates
- Improved pedestrian safety
- Accommodation of other modes of travel

Applications

Typical applications of a road diet occur on four-lane undivided roadways, which can be converted to a three-lane cross-section (one lane in each direction with a center turn lane or center median), or multi-lane streets with extra capacity where one or more lanes could be removed.

Research shows that road diets can reduce overall crash frequency by up to 47 percent.[43] Road diets can help reduce crashes with dedicated turn lanes, which make driver behavior more predictable, reduce weaving, and improve sight-lines.

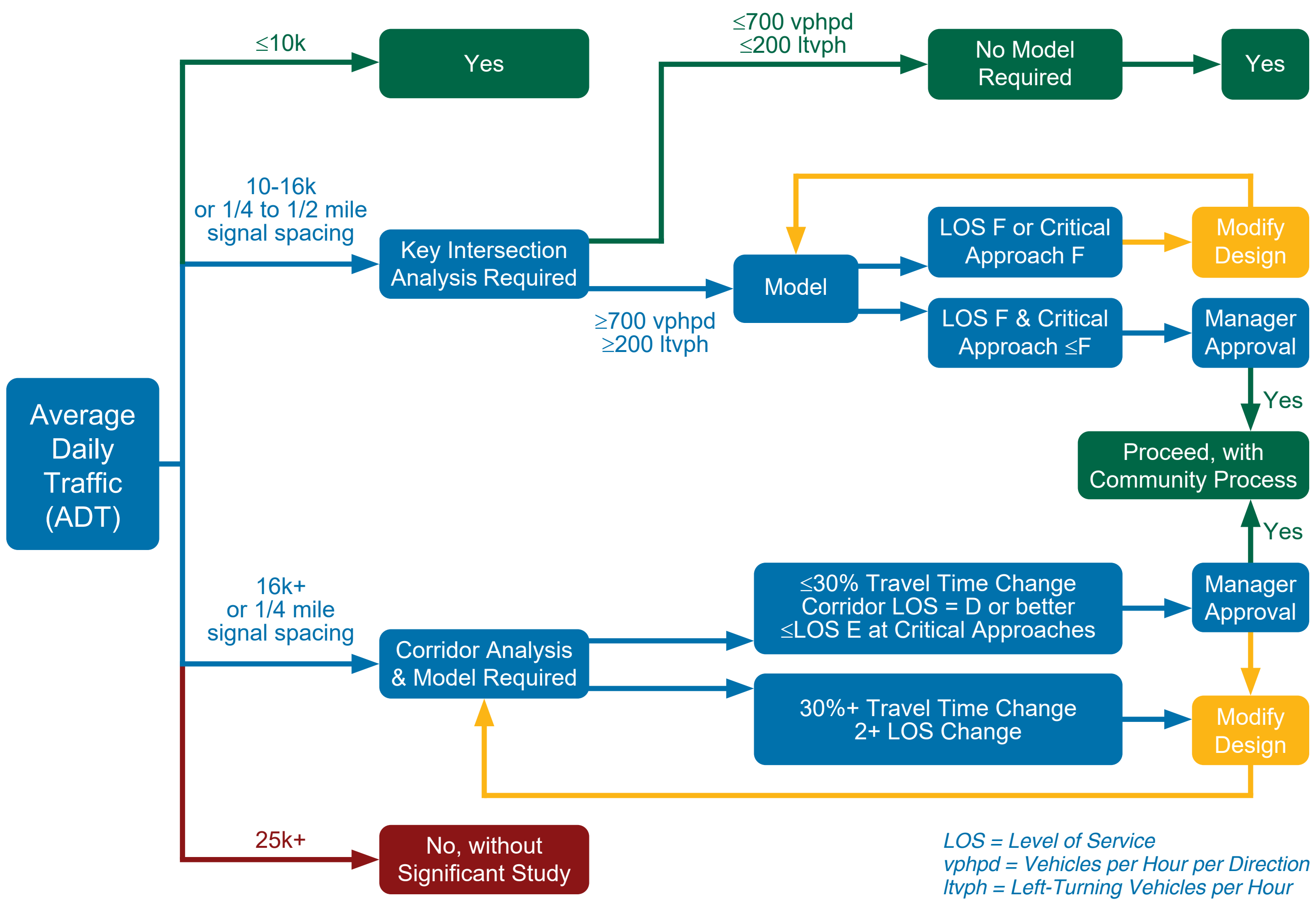
Reallocation of Space

Space that is reclaimed by the reduction in lanes can be repurposed for a variety of uses, including the implementation of bicycle lanes. For reconstruction projects, a road diet provides an opportunity to widen sidewalks, create curb extensions, plant street trees, implement stormwater management treatments, or install street furniture.

Road Diet Feasibility

The City of Seattle has created a formal process for determining whether a street is an appropriate candidate for a road diet. The flow chart below represents the process the City uses to determine candidates for a 4/5 lane to 3 lane conversion. The City's approach is innovative because rather than requiring evidence to show that a road diet would be feasible, the City's method requires evidence to show that a road diet is not feasible. This process is logical, quantitative, and based on sound engineering principles. It is part of an overall strategy to make building complete and safe streets the default way of doing business.

City of Seattle Modeling Flow Chart for Road Diets (from 4 or 5 to 3 lanes)



Traffic Calming Features

The following design techniques can help achieve lower travel speeds and safer motor vehicle traffic. Some of these techniques alter the configuration of the roadway, while others change how people psychologically perceive and respond to a street. These techniques should be considered in appropriate contexts.

Curb Extensions

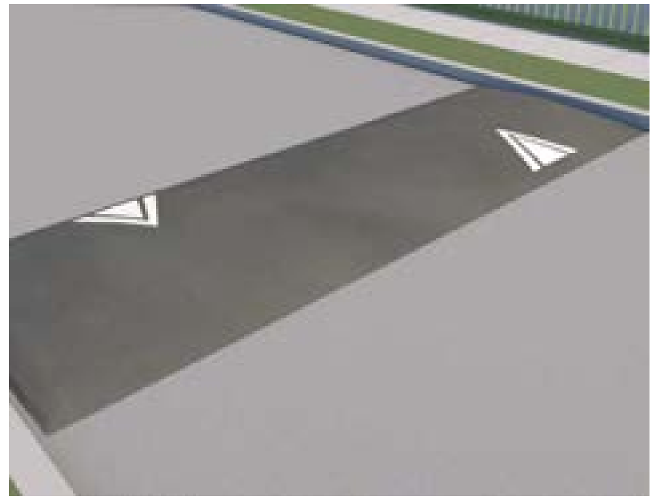
Curb extensions visually and physically narrow the roadway at intersections and mid-block locations. Curb extensions are generally used where there is on-street parking to shorten the pedestrian crossing distance. A curb extension is typically constructed to a width of 6 to 8 feet. It should be offset from the through traffic lane by 1.5 feet. The length should be at least the width of the crosswalk (but preferably extended to the advanced stop bar).[44]

Neckdowns

Neckdowns create pinch points by extending the curbline to narrow the roadway, which deters motorists from operating at high speeds on local streets.[45] Neck downs and curb extensions are ideal for bus stops (called "bus bulbs" in this context), as they eliminate the need for buses to pull back into traffic after riders board, are more ADA-compliant, and are easier to plow during the winter than pull-out bus stops.[46]

Chicanes

Chicanes are a series of curb extensions, edge islands, or parking bays that are placed on alternating sides of a street to form an S-shaped bend in the roadway. Chicanes reduce vehicle speeds by requiring drivers to shift laterally through narrow travel lanes.

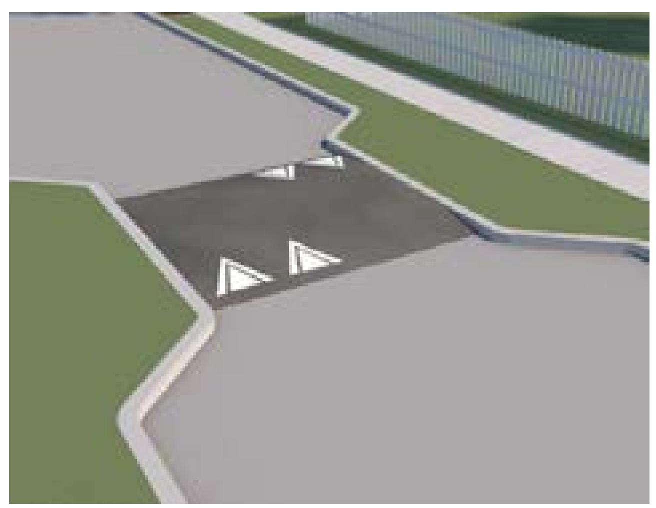


Speed Humps

Speed humps are typically 3 to 4 inches high and 12 feet long, and are designed for vehicles to cross at 15 to 20 mph.[47] Speed humps are often referred to as “speed bumps.”

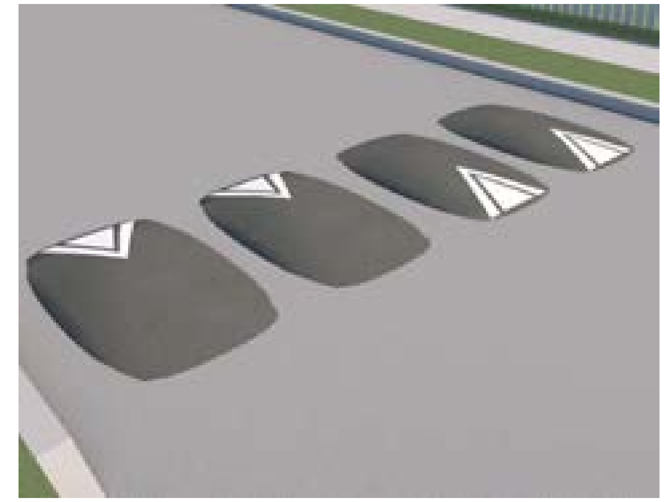
Center Islands

Center islands, median islands, or pedestrian refuge islands can help create pinch points for traffic and reduce pedestrian crossing distances. A center island causes a small amount of deflection without blocking driveway access. Center islands impede high-speed turns and keep drivers in the correct receiving lane.[48]



Speed Tables

Speed tables are longer than speed humps and have a flat top, generally with a height of 3 to 3.5 (and up to 6) inches, and a length of 22 feet. Speed tables are perfect for raised crosswalks. Speed tables are usually intended for vehicles to cross at 20 to 35 mph.[49] Longer speed tables have been used on collector streets, transit, and/or emergency responder routes.



Speed Cushions

Speed cushions are speed humps or speed tables that include wheel cutouts to enable larger vehicles to pass unaffected but reduce passenger vehicle speeds. Cutouts are located so that passenger vehicles must travel over a portion of the raised pavement. Speed cushions are often used on key emergency response routes to allow emergency vehicles to pass unimpeded while still slowing the typical automobile.[50]

Coordinated Signal Timing

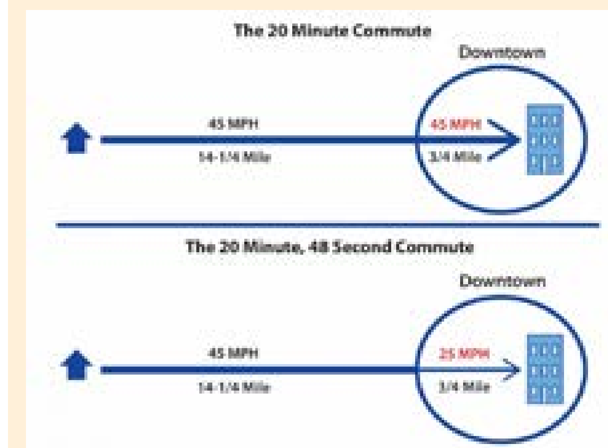
Traffic signals timed to a street’s target speed can create lower and more consistent speeds along a corridor with less frequent stops and starts, helping to improve safety.[51]

Speed Limit Reduction

Speed limit reduction can be an essential part of making a street safe for all users. An FHWA alternative to 85th-percentile speed studies is the use of target speed, crash rates, and surrounding contexts.[52] FHWA provides a speed limit calculator, USLIMITS2, to help practitioners set appropriate speed limits.[53] On most urban collector or local streets the maximum target speed that should be considered is 30mph. In neighborhoods and areas with high pedestrian volumes, a lower design speed should be considered.[54] Speed limit lowering should generally be paired with traffic calming and infrastructure treatments.

Will reducing speed limits lengthen my commute?

No! Travel time is primarily determined by factors such as traffic signals, congestion, double-parked vehicles, and turning vehicles. In other words, intersections and traffic conditions determine travel time in most situations, not speed limits. In many cases, reduced speed limits can lead to improved travel times and reduced congestion by reducing stacking and bottlenecks at intersections.[55] Signals should be timed appropriately to encourage lower and more continuous speeds in developed areas.



On-Street Parking

As discussed in the Curbsides section, on-street parking narrows the street and slows traffic by creating friction for moving vehicles.

Further Guidance

- *Highway Design Manual*, NYSDOT
- *Urban Street Design Guide*, NACTO

Transit

Efficient and cost-effective public transportation is essential for the continued growth and quality of life in the Capital District. The region has multiple communities with high population densities that are served by an extensive public transportation network, enabling many residents to rely on transit for daily trips. The Capital District Transportation Authority is one of the 50 highest ridership transit agencies in the country, with over 16 million annual riders.[56]

For Fiscal Year 2022, CDTA reported over ten million rides.[57] This means that in the Capital Region, the bus network plays an integral role in the daily transportation needs of residents. Quality accommodations for bus service is an important goal of Complete Streets and also critical to the future mobility of Capital District transit riders. Compared with single-occupancy vehicles, buses consume far less public space per passenger and can help relieve congestion, improve air quality, and reduce greenhouse gas emissions.

Improving the frequency, speed, comfort, and reliability of transit is critical to supporting growth and encouraging mode shift away from private automobiles. These guidelines outline two basic types of transit facilities that can help achieve this goal: bus lanes, which are demarcated with pavement markings, lines, and/or color but no physical separation, and Dedicated Transitways, which generally provide some level of physical separation along with other service enhancements to make bus transit more efficient, reliable, and attractive.

Every transit passenger is a pedestrian before and after their transit trip. Safe, comfortable, and convenient pedestrian connections are therefore critical to effective transit service and encouraging higher ridership. The toolbox elements discussed in the Sidewalk section provide strategies to integrate transit stops into the pedestrian network and enhance pedestrian access to transit.

Eagle Street in Albany, NY

Bus Lanes

Bus-only lanes improve transit system reliability by accommodating faster travel and ensuring that buses are not delayed by traffic congestion. Bus right-of-way can be demarcated using a variety of methods, including a change of grade, curbing, different pavement material (such as concrete), bollards, red colored pavement, signage, or lane markings. Curbside bus lanes, sometimes called Business Access and Transit (BAT) lanes, are occasionally open to private vehicles at intersections or driveways as turning lanes.

In constrained urban environments, a contra-flow bus lane can be used to provide bus service counter to the flow of general traffic on one-way streets. Contra-flow lanes are generally used on short segments of connector streets to provide a continuous transit network. Because other users might be unaccustomed to looking both ways on a one-way street, contra-flow lanes should be well marked and separated from opposing traffic lanes.

Design Guidance

- Bus lanes should be 11 feet wide. Bus lanes can be separated with buffers or physical barriers. Buffers can include striping, rumble strips, or other clear zones. Physical barriers can include curbs, medians, planters, bollards, or similar vertical elements.
- Center bus lanes can be effective on roadways with high transit frequency and traffic congestion.
- Curbside parking adjacent to a bus lane should be avoided where possible.
- For contra-flow lanes, separation can be achieved with double yellow lines as well as flexible bollards, if necessary.
- If utilizing red colored pavement, ensure that FHWA approval is sought when needed.

Central Avenue in Colonie, NY

Dedicated Transitways

Dedicated transitways are a high-capacity form of transit that can dramatically improve mobility and transform communities. While there is a wide range of Bus Rapid Transit (BRT) systems that have been implemented in this country, including some that operate primarily in mixed-traffic, a dedicated transitway includes dedicated lanes as well as other infrastructure designed to improve system quality, reduce travel time, and reduce delays.

A BRT system aims to provide higher capacity and quality service. The features, characteristics, and quality of BRT systems can make them more attractive to potential riders than conventional bus services, which can help encourage a mode shift towards transit. Because of its flexibility, BRT can support multi-nodal corridors.

The Capital District Transportation Authority (CDTA) operates BusPlus service, a BRT system that provides enhanced and higher quality bus service. Moving forward, BRT and dedicated transitways can be implemented to improve mobility in the Capital Region in both urban settings and suburban corridors. When undertaking BRT projects, efforts should be made to provide design features that improve the reliability of service to the highest degree (including dedicated lanes and bus priority at intersections). Dedicated lanes are ultimately a critical component of a complete BRT system, facilitating faster and more reliable service and making the bus a more attractive and usable travel option.

Red Line BRT in Indianapolis, IN

Bicycle Facilities

Bicycle infrastructure is critical for facilitating bicycling as an essential form of transportation and encouraging increased bicycling rates. Bicycle facilities must be properly designed and implemented to ensure that they are safe, comfortable, and useful for all potential users. The guiding principles to achieve effective implementation are the “Five Cs”:

Comfortable

A bicycle network should be comfortable and inviting for riders of all ages and abilities, providing the sense that bicycling is a safe and convenient activity.

Continuous

Bicycle lanes should be continuous through intersections and other stressful locations, emphasizing protected intersections.

Connected

Bicycle routes should be interconnected and signed to create a full network that connects where people live and where they want to go.

Convenient

Bicycle networks that conveniently and directly connect people to key destinations help encourage higher rates of bicycling. Destinations must have adjacent bicycle parking to facilitate a convenient end to a trip.

Complete

A successful network takes into account what happens when a bicycle ride ends. This means considering how complete a street is, including the presence of sidewalks, bicycle parking, and access to transit.

Further Guidance

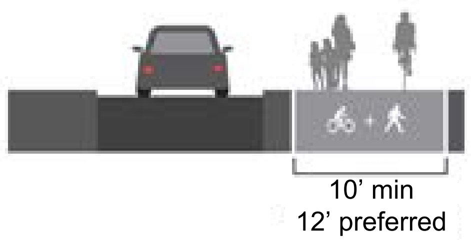
- *Urban Bikeways Design Guide*, NACTO
- *Guide to the Development of Bicycle Facilities*, AASHTO
- *Separated Bicycle Lane Design Guide*, FHWA
- *Small Town and Rural Multimodal Networks*, FHWA

North Broadway in Saratoga Springs, NY

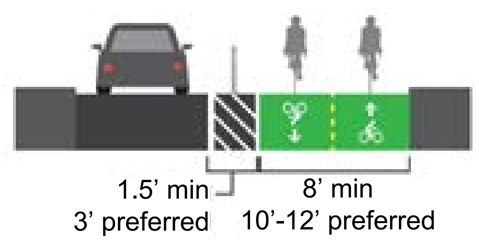

Bicycle Facility Selection Guidance

Selecting an appropriate bicycle facility is a process that requires understanding land-use context, roadway characteristics, and how a facility fits within the overall roadway and bicycling network. Design options with lower speeds or greater separation are more attractive for bicyclists. The facilities and designs in this chapter are summarized on this page and reflect Capital Region contexts with references provided to the New York State Highway Design Manual, Empire State Trail Design Guide, NACTO, FHWA, and other guidance. As with most design guidance, flexibility through professional judgment is essential in applying the guidelines. Information on continuing bicycle facilities through intersections is included in the next chapter.

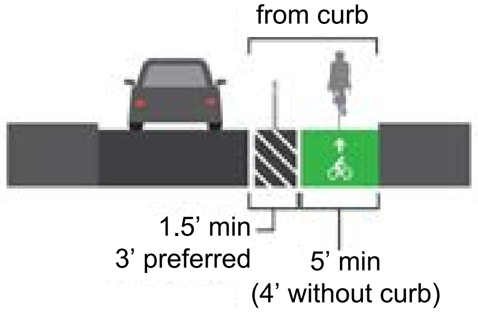
Shared-Use Path



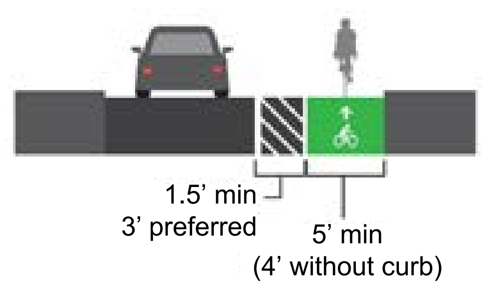
Two-Way Protected Bike Lane



Protected Bike Lane



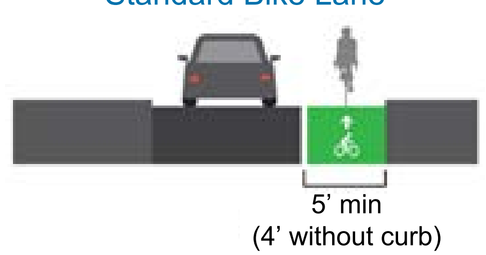
Buffered Bike Lane



Shared Street or Bicycle Boulevard

≤ 25 mph and ≤ 3,000 ADT
Truck percentages should be under 5% of ADT
“Sharrows” are inappropriate on multi-lane roads

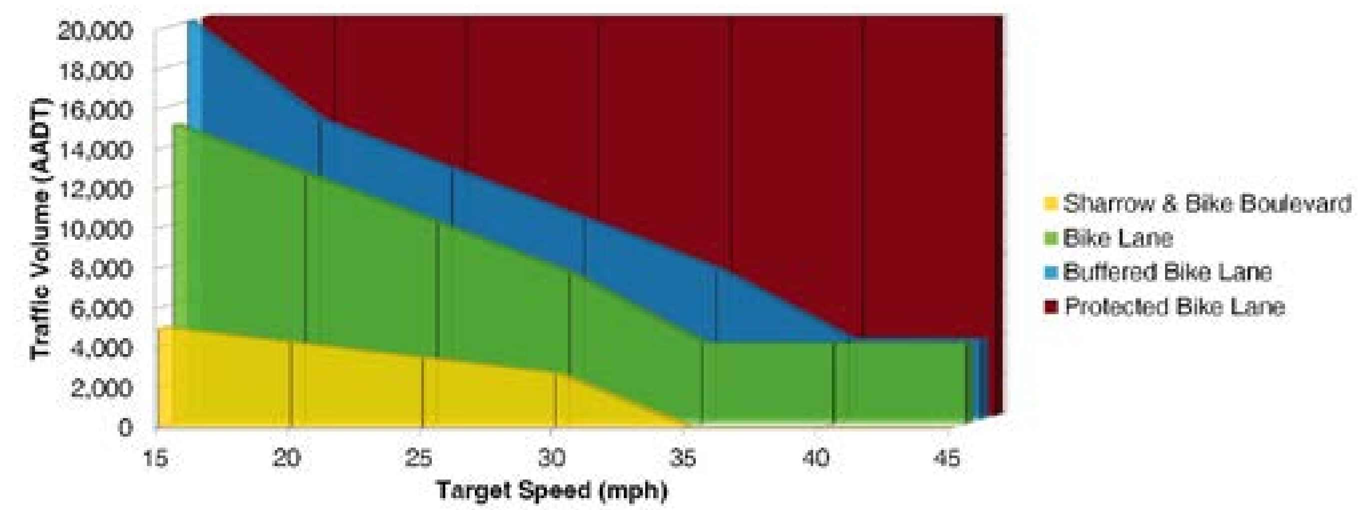
Standard Bike Lane



SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES

Speed and Volume

The graph below uses 85th percentile motor vehicle speeds (if not available, use posted speed) and average daily traffic (ADT/AADT) to determine which bicycle facility is appropriate and comfortable for all potential bicyclists - particularly children and the elderly. Additional factors, such as truck volumes and roadway classification/function, should also be considered. Design options with lower speeds or greater separation are more attractive for bicyclists. Protected bicycle lanes (or shared-use paths) should be considered and are preferred wherever space allows in almost all design scenarios, regardless of speed or volume. Similarly, buffered bike lanes are always preferable to standard bike lanes. Shared use paths, and one-way and two-way protected facilities are not distinguished in the graph below, nor are other specialized bicycle facilities, but guidance for these facilities is detailed throughout this chapter. As with most design guidance, flexibility through professional judgment is essential in applying the guidelines.



Comfortable for Everyone

Of the 77% of the total population who are interested in bicycling, only 7-10% are highly confident and will ride with motor vehicle traffic. Another 8-13% are somewhat confident and will ride in standard bicycle lanes or in wide shoulders.

The remaining 77-85% of potential bicyclists are only interested in safe and comfortable protected and separated bicycle facilities. This group may ride on sidewalks if paths or protected bicycle lanes are not available, but are unlikely to ride in standard bike lanes.[58]

Shared-Use Paths

Shared-use paths are routes that are distinctly separate from the roadway and are sometimes referred to as "trails" or "side-paths". Located outside of the roadway, they are separated physically from motorized traffic by either open space or a barrier. Shared-use paths are designed to facilitate both utilitarian and recreational trips. Intended users may include bicyclists, pedestrians, roller skaters, skateboarders, and other non-motorized users.

Shared-use paths are typically designed for two-way travel. They can help provide low-stress bicycle and pedestrian accommodations in a variety of circumstances: a shortcut through residential neighborhoods and parks, a commuting route from residential to commercial centers, or as a side path along a roadway in lieu of (or in addition to) an on-road bicycle facility. Shared-use paths should be built as a system of off-road transportation routes that complements and enhances the on-road bicycle network.

Design Standards[59]

Shared-use paths should generally be constructed with asphalt. The minimum width for a shared-use path is generally 10 feet. Depending on the context, volume, and mix of users of a path, widths may range from 10-14 feet or more.

A path may be reduced to an 8-foot width in certain circumstances:

- For a short distance due to physical constraint
- Where bicycle traffic is expected to be low
- Where pedestrian use is expected to be low
- Where there are frequent passing opportunities

Wider paths (11-14 feet or more) are advised where there are steep grades to provide additional passing space.

Applications and Use

- Shared-use paths should receive priority at driveways and minor cross streets. Signage for path users in advance of a crosswalk or intersection should be utilized.
- At intersections and driveways, motorists might not expect path users. Signage and pavement markings should be used to indicate their presence and remind drivers to approach the intersection preparing to yield.
- Using a sidewalk as a shared-use path is undesirable. Sidewalks are usually not intended for use by bicycles. If there is an intention for bicyclists to ride along the same corridor as pedestrians, the facility should follow the design guidelines for a shared-use path.

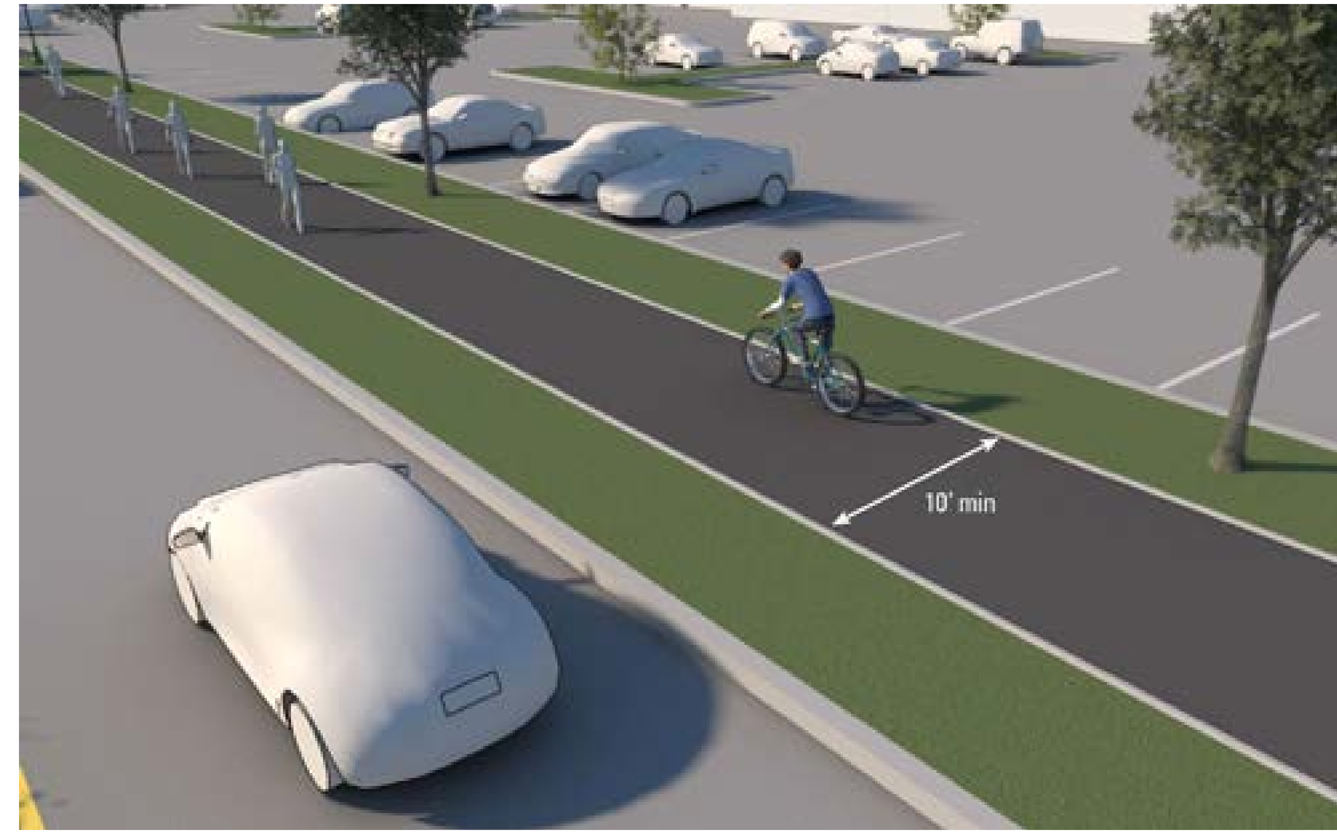
Benefits

Shared-use paths:

- Provide a low-stress facility that accommodates multiple types of users.
- Provide connections between important origins and destinations and increase bicycle network connectivity where roadway space or context might make implementation of an on-road bicycle facility infeasible.
- Help improve bicycle mode share for commuting and recreational trips.

Accessibility

Shared-use paths provide some of the best routes for people with disabilities. Because shared-use paths are designed for both bicyclist and pedestrian use, they fall under the accessibility requirements of the ADA and should be designed as fully accessible facilities. The United States Access Board provides guidelines for the design of accessible shared-use paths.[60]



Mohawk-Hudson Bike-Hike Trail

Two-way Protected Bike Lanes

Two-way protected bicycle lanes – sometimes called cycle tracks – are bikeways that are at street level and use a variety of methods for physical separation from passing traffic allowing bicycle movement in both directions on one side of the road. Two-way protected bicycle lanes share many of the same design characteristics as one-way separated bicycle lanes, but might require additional considerations at driveway and side-street crossings. Two-way protected bicycle lanes reduce the detour length for bicyclists by providing contra-flow movement and permitting more convenient and direct routes. Research indicates that two-way separated bicycle lanes are very attractive to bicyclists of all ages and abilities.[61]

Design Standards[62]

- The preferred width of two-way protected bicycle lanes is 10-12 feet. The minimum width permitted is 8 feet. The preferred width of a buffer is 3 feet or more[63] (minimum 2 feet adjacent to parking,[64] 1.5 feet without parking[65]).
- Vertical protection should be at least 1 foot away from the bike lane and parked cars.
- The minimum height of flexible delineators, planters, or other vertical protection is 2 feet, with a maximum height of 3 feet.
- Cycle tracks that encounter traffic signals may need bicycle signal heads for bi-directional travel[66] (preferred option), elongated yellow lights (up to 5 seconds), or signage to indicate to bicyclists that they should obey pedestrian signals.

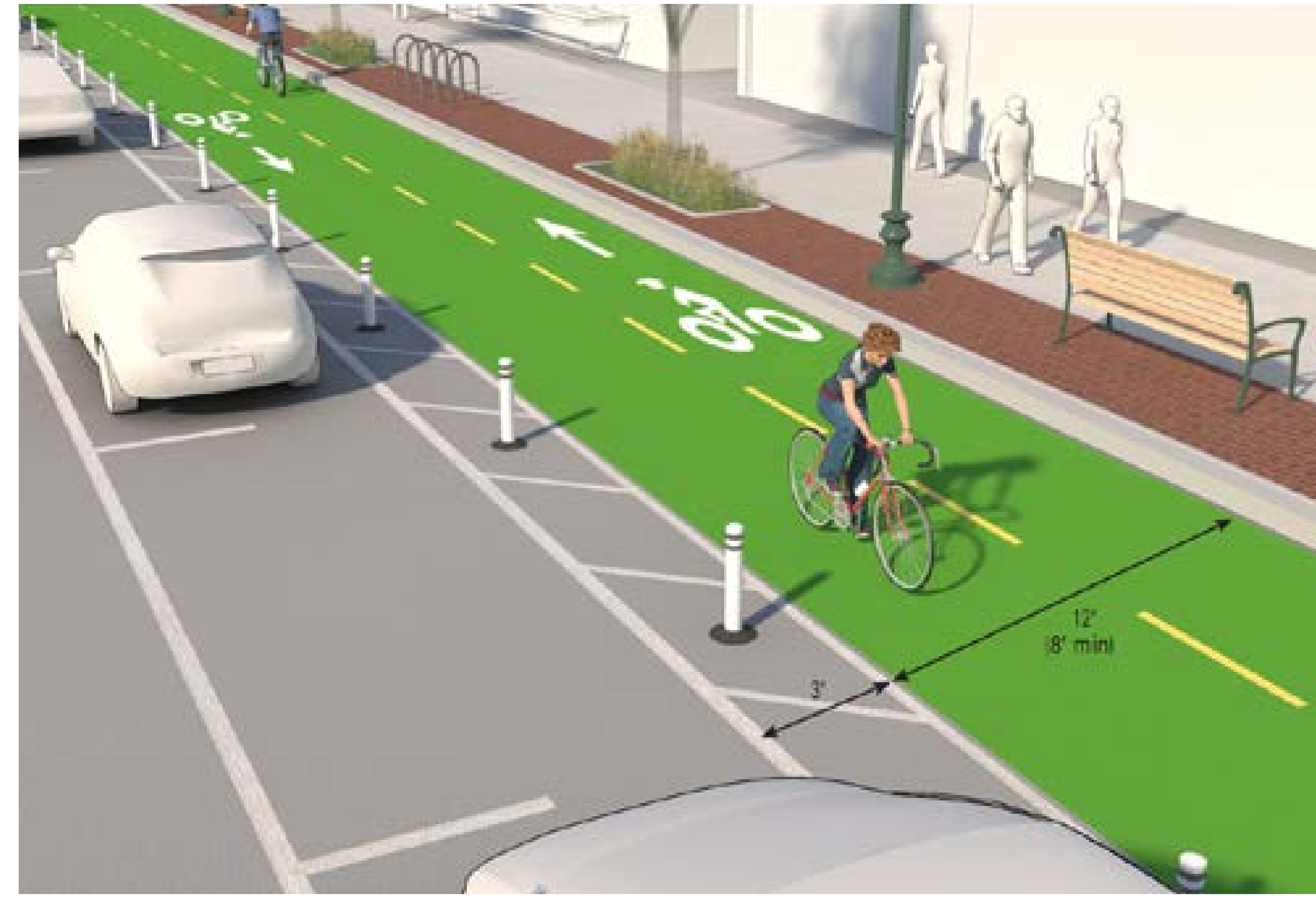
Applications and Use

- Because of the high level of protection they provide, two-way protected bicycle lanes are recommended on any streets with traffic speeds of 25 mph or higher, and AADT over 6,000 vehicles per day. However, two-way protected bicycle lanes are appropriate for roadways in almost any context.[67]
- Two-way protected bicycle lanes are preferred on streets with on-street parking, frequent parking turnover, infrequent driveways, higher traffic volumes or speeds, and/or along streets with high bicycle volumes.[68]

Benefits

- Two-way protected bicycle lanes increase safety on the roadway and encourage increased bicycle use among people who are not comfortable riding with motor vehicles.
- Two-way bicycle lanes are easy to maintain in winter months with existing plow trucks and equipment because of the wider space available. Street sweeping is also easier for existing vehicles and equipment on cycle tracks. Care must be taken to ensure unauthorized vehicles do not use the wide space for driving, parking, loading, or other unauthorized use.
- Two-way protected bicycle lanes can be used in more constrained conditions than standard protected bicycle lanes by eliminating the need for two buffer zones.
- Two-way protected bicycle lanes help to decrease wrong-way bicycling, which may occur on one-way streets with one-way separated bicycle lanes.

SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES



Protected Bike Lanes

Protected bicycle lanes – sometimes called separated bicycle lanes – are bikeways at street level that use a variety of methods for physical separation from passing traffic. Unlike a conventional or buffered bicycle lane, a protected bicycle lane provides vertical separation to prevent vehicle encroachment, improve safety, and deter double-parking. The separation of the bicycle lane from motor vehicle traffic makes the facility more attractive for bicyclists of all ages and abilities. Protected bicycle lanes also have a reduced risk of "dooring" compared to conventional bicycle lanes.

Design Standards[69]

- The minimum width of a protected bicycle lane is 5 feet. The minimum width of a buffer adjacent to parking is 3 feet.[70] (minimum 2 feet adjacent to parking,[71] 1.5 feet without parking[72]).
- The minimum width between any vertical separation and the curb is 5 feet. Vertical protection should be at least 1 foot away from the bike lane and parked cars.
- The minimum height of flexible delineators, planters, or other vertical protection is 2 feet, with a maximum height of 3 feet.

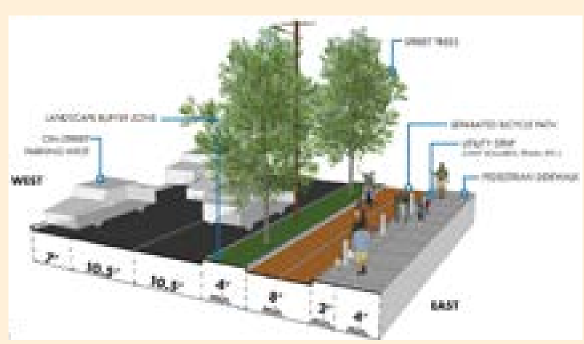
Applications and Use

- As with two-way protected bike lanes, protected bicycle lanes are recommended on streets with traffic speeds of 25 mph or higher, and AADT over 6,000 vehicles per day.[73]
- Typical forms of separation include removable or permanent bollards, raised curbs or medians, or planters.
- Where on-street parking is present, the parking lanes should be located adjacent to the travel lane, creating a physical separation for the bicycle lane.
- Parking must be prohibited a minimum of 20 feet from an intersection to increase the visibility of bicyclists.[74]
- Similar to guidance for conventional bicycle lanes and buffered bicycle lanes on one-way streets, protected bicycle lanes on one-way streets should typically be placed on the left side of the road because of the increased visibility of cyclists to drivers.
- Protected bicycle lanes are preferred on streets with on-street parking, frequent parking turnover, higher traffic volumes or speeds, and along streets with high bicycle volumes. Where bicycle accommodation is desired, protected bicycle lanes are almost always the preferred design option.

Benefits

- Protected bicycle lanes increase safety on the roadway and encourage increased bicycle use among riders who are not comfortable riding with motor vehicles.

In a recent study, CDTC found that a large majority of surveyed residents preferred a two-way protected bike lane on Craig Street in the City of Schenectady over sharrows or a shared sidewalk, even if it would reduce parking.[75]



Buffered Bike Lanes

Buffered bicycle lanes are conventional bicycle lanes that are paired with a marked buffer space to horizontally separate the bicycle lane from the adjacent motor vehicle travel lane. Buffered bicycle lanes should only be built when there is not sufficient width for a protected bicycle lane. While buffers are typically used between bicycle lanes and travel lanes to increase bicyclist comfort, they can also be used between curbside bicycle lanes and parking lanes (creating a de-facto protected bicycle lane) where there is high parking turnover to help prevent double-parking and decrease the risk of conflicts with drivers opening their doors.

Buffered bicycle lanes on a one-way street should typically be placed on the left side of the roadway when possible and follow the same guidelines for right-side buffered bicycle lanes.

Design Standards[76]

- The preferred width of a buffered bicycle lane is 5 feet (minimum 4 feet, maximum 6 feet). The preferred width of a buffer is 3 feet (minimum 2 feet adjacent to parking, 1.5 feet without parking).

Applications and Use

- Buffered bicycle lanes are appropriate on streets with traffic speeds of 35 mph or less, and AADT under 10,000 vehicles per day. Where additional space is available, a protected bicycle lane should be utilized.
- Where only one buffer can be installed on a constrained corridor with on-street parking, the buffer should typically be placed between the bicycle lane and the travel lane. Ensure the bicycle lane and parking lane can be identified by drivers, typically with green paint in the bike lane[77] and frequent bike lane pavement markings.
- Buffered bicycle lane striping should use the following standards: a 6- to 8-inch solid white line next to the travel lane and a 6-inch solid white line next to the parking lane.[78]
- Buffer striping should have interior diagonal cross-hatching if the buffer is 1.5 feet in width or wider.[79]
- Where existing pavement width allows, buffered bicycle lanes should be considered anywhere a conventional bicycle lane is recommended, particularly on streets with higher travel speeds and volumes or on-street parking. On streets with sufficient width and on-street parking, a second buffer should be considered between the bicycle lane and the parking lane, though a protected bicycle lane is always the preferred option.

Benefits

- Buffered bicycle lanes provide additional separation between bicyclists and motor vehicles.
- The buffer encourages bicyclists to ride outside of the door zone when the buffer is placed between the bicycle lane and the parking lane.
- Buffered bicycle lanes increase the perception of safety on the roadway and encourage increased bicycle use.[80]

According to a 2011 Portland State University study, bicyclists indicated that they feel a lower risk of being "doored" in a buffered bicycle lane, nine in ten bicyclists preferred a buffered lane over a conventional lane, and seven in ten indicated that they would go out of their way to ride in a buffered lane rather than a conventional lane.[81]


Cambridge, MA

Bike Lanes

Bicycle lanes provide dedicated space for bicyclists through the use of pavement markings and signage. Standard bicycle lanes should be utilized only when there is insufficient space for protected or buffered bicycle lanes. Bicycle lanes are generally intended for one-way travel and are typically located on both sides of a two-way street and on one side of a one-way street. Bicycle lanes enable bicyclists to ride at their preferred speed, free from interference from motorists. Bicycle lanes help facilitate predictable behavior between bicyclists and motorists. Bicyclists may leave the bicycle lane to pass other bicyclists, make left turns, or avoid obstacles and conflicts. Motorists may pass through the bicycle lane to access parking or make other turning movements, but they may not stand or park in the lane.

Design Standards

- The minimum bicycle lane width adjacent to on-street parking or a curb is 5 feet. The minimum width is 4 feet with no curb.[82] The maximum desirable width is 6 feet. Wider lanes should be buffered to prevent driver confusion regarding motor vehicle travel or parking lanes.

Applications and Use

- Standard bicycle lanes are recommended on streets with traffic speeds of 30 mph or less, and ADT under 7,000 vehicles per day.[83] Where additional space is available, a buffered or protected bicycle lane should always be utilized.
- Bicycle lane striping should use the following standards: a 6- to 8-inch solid white line next to the travel lane, and a 6-inch solid white line next to the parking lane.[84, 85]
- Bicycle lane placement should be intuitive and visible for drivers and bicyclists.

Left-Side Bicycle Lanes

Left-side bicycle lanes have the same design requirements as right-side bicycle lanes. Left-side bicycle lanes are recommended on many one-way streets, and can result in fewer conflicts between bicyclists and motor vehicles, particularly on streets with heavy right-turn volumes or frequent bus stops. Left-side bicycle lanes can also increase the visibility of bicyclists to motorists at intersections. On one-way streets with delivery zones or frequent parking turnover on the right side, a left-side bicycle lane will result in fewer conflicts with parked cars. Additionally, due to higher frequency of single-occupant vehicles, on one-way streets with parking on both sides, bicyclists riding on the left will have fewer conflicts with car doors opening on the passenger side.[86]

On one-way streets where there is a dramatically higher frequency of left turns to right turns, a right-side bicycle lane may be the appropriate treatment. Left-side placement may not be appropriate on streets that transition from one-way to two-way.

SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES


Albany, NY

Contra-Flow Bike Lanes

Contra-flow bicycle lanes are bicycle lanes that are designed to allow bicyclists to ride in the opposite direction of motor vehicle traffic. In many locations throughout the Capital Region, particularly dense urban settings, the configuration of the roadway network (including the layout of one- or two-way streets) can make bicycling to specific destinations and points within the network difficult. A contra-flow bicycle lane can help solve this problem by converting a one-way street into a two-way street for cyclists: one direction for motor vehicles and bicycles and the other for bicycles only. Contra-flow lanes should be separated with yellow center lane striping.

Design Standards

- Dimensions of a contra-flow lane should follow the guidance of bicycle lanes (or buffered/ protected bicycle lanes where possible) with a minimum lane width of 4 feet.
- A solid double-yellow lane line marking must be used to demarcate the lane from opposing traffic, unless the bike lane is protected.
- Bicycle lane word, symbol, and arrow markings (MUTCD Figure 9C-3) should be used to define the bicycle lane direction and designate space for cyclists.
- "One-Way" sign (MUTCD R6-1, R6-2) with "Except Bikes" plaque should be posted along the facility and at intersecting streets and driveways.
- "Do Not Enter" sign (MUTCD R5-1) with "Except Bikes" plaque should be posted along the facility to only permit use by bicycles.[87]

Applications and Use

- Contra-flow lanes are for use on one-way streets that provide more convenient connections for bicyclists where other routes are less desirable.
- Contra-flow lanes are less desirable on streets with frequent and/or high-volume driveways on the side with the proposed lane.
- Contra-flow lanes provide a network connection that reduces the trip length and improves the convenience of cycling.
- Contra-flow lanes are ideal when a parallel route is too fast or busy with motor vehicle traffic, or when an alternative route would increase the length of a bicycle trip by more than 30%.

Benefits

- Provide connectivity and access to bicyclists traveling in both directions.
- Reduce dangerous wrong-way riding or the frequency of bicyclists riding on the sidewalk.
- Reduce bicyclist trip distance while accommodating bicyclists on safer and less heavily traveled streets.

Climbing Bike Lanes

Climbing bicycle lanes are designed to allow bicyclists to ride safely uphill in constrained corridors. Hills can make bicycling difficult in parts of the Capital Region. Without a dedicated bicycle lane, bicyclists may go considerably slower than motorists, possibly impeding traffic. If there is not room for full dedicated bicycle infrastructure on both sides of the road, a single climbing bicycle lane can provide a space for bicyclists to ride uphill. Downhill bicycle traffic can be facilitated with sharrows or bicycle boulevard markings.

Design Standards

- Climbing bike lanes are similar to Advisory bike lanes, discussed on the next page.
- Dimensions of a climbing lane should follow the guidance of bicycle lanes (or buffered/ protected bicycle lanes where possible) with a minimum lane width of 5 feet.
- Wider climbing lanes may be appropriate to facilitate side-to-side bicycle movement.
- Corridors with climbing bike lanes should feature sharrows or bicycle boulevard markings for downhill bicycle traffic, following the guidance found later in this chapter.

Applications and Use

- Climbing lanes are for use on constrained corridors where there is not room for full dedicated bicycle infrastructure on both sides of a road, particularly on corridors with a hill that slows bicyclists.[88]
- Climbing lanes help continue a network that reduces the trip length and improves the safety and comfort of bicycling.
- Climbing lanes are ideal for improving safety by providing a dedicated space on roads where motorists might overtake slow moving bicyclists.

Benefits

- Climbing lanes provide a safe, dedicated space for bicyclists traveling uphill at reduced speeds.
- Reduce slow bicycling in mixed traffic, and reduce the frequency of bicyclists riding on the sidewalk


17th Street SE in Washington, D.C.

Advisory Bike Lanes

Advisory bicycle lanes are designed to provide bicyclists with a semi-dedicated space to ride alongside motor vehicle traffic on low-volume roadways. Throughout the Capital Region, narrow roadways often prevent the inclusion of fully dedicated bicycle facilities. Advisory bicycle lanes can help complete a bicycle network and indicate to drivers that bicyclists are welcome on a constrained corridor. Advisory bike lanes are not appropriate on roadways with traffic volumes over 6,000 vehicles per day,[89] truck or bus routes,[90] one-way vehicle traffic,[91] multiple lanes,[92] or centerline striping.[93]

Design Standards

- Ensure that FHWA approval is sought for advisory bike lanes and shoulders. Approval is required for every corridor and installation.[94]
- Dimensions of an advisory bike lane should follow the guidance of bicycle lanes, with widths of 4 to 6 feet.
- Bicycle lane word, symbol, and arrow markings (MUTCD Figure 9C-3) should be used to define the bicycle lane direction and indicate space for cyclists.[95]
- Use an unmodified Two-Way Traffic warning sign (W6-3) to clarify two-way operation of the road.
- The two-way center vehicle travel lane width should be a minimum of 10 feet, with a preferred minimum width of 13.5 feet. The maximum width permitted is 18 feet.
- Do not stripe a center line, unless the pavement widens, allowing for full conventional motor vehicle lanes and full bicycle lanes.
- At minor street crossings, use a dashed line extension on both sides of the advisory lane to maintain delineation of the advisory bike lane through the intersection.
- If green coloration is used in the advisory bike lane, maintain the coloration through driveway crossings and minor intersections.
- At controlled intersections, provide standard width shoulders or design as a shared roadway.[96]

Applications and Use

- Advisory bike lanes are only for use on two-way streets to provide semi-dedicated connections for bicyclists where fully dedicated facilities will not otherwise fit.
- Advisory lanes are only for use on low volume roads, with a preferred ADT under 3,000 and a maximum ADT of 6,000 vehicles.[97] Over 6,000 ADT, a center line (double-yellow) would be required, preventing the use of advisory lanes.[98, 99]
- Advisory lanes are most appropriate on streets with operating speeds under 25 mph.[100]

Benefits

- Provide connectivity and access for bicyclists traveling in both directions.
- Encourage bicycling through the use of semi-dedicated space on the roadway.
- Accommodate bicyclists on safer and less heavily traveled streets.


Potomac Greens Dr in Alexandria, VA

Shared Lanes

On roadways with motor vehicle speeds of 25 mph or less, where it is not feasible to provide dedicated bicycle facilities, shared-lane markings (also known as "sharrows") may be used to indicate a shared environment for bicycles and automobiles. Shared-lane markings should be used to connect and provide a designated route to dedicated bicycle facilities. A shared-lane marking is not a bicycle facility type but can be used to visually legitimize bicyclists on the roadway. Shared-lane markings help provide motorists with visual cues to anticipate the presence of bicyclists.

Design Standards

- When adjacent to a 7 foot parking lane, shared-lane markings should be placed a minimum of 11 feet from the curb. The center of the markings should be at least 4 feet from the edge of the parking lane. The center of shared-lane markings should be at least 4 feet from the curb or pavement edge where there is no parking.[101]
- The preferred placement for a shared-lane marking is at the center of the travel lane.[102]

Applications and Use

- Shared-lane markings are intended for use on one- to two-lane streets with speeds of 25 mph or less, and where traffic volumes are low enough that it is desirable for bicyclists to ride in traffic – generally under 3,000 vehicles per day.[103]
- Shared-lane markings should be paired with traffic-calming measures to encourage and reinforce appropriate vehicular speeds for shared-lane conditions. See the next section on Bicycle Boulevards for traffic calming measures.

Bicycle Boulevards

Bicycle boulevards are corridors of interconnected, traffic-calmed streets where bicyclists are afforded an enhanced level of safety and comfort. Many local streets that have existing low motorist travel speeds and volumes create the basic components of a safe and comfortable bicycling environment. These streets should be enhanced with treatments that discourage high vehicle speeds and volumes to create a bicycle boulevard. These treatments benefit not only bicyclists, but all users of the street by creating a safe and quiet environment. A street that is not calm cannot be a bicycle boulevard.

Bicycle boulevard treatments include signs, pavement markings, and other traffic-calming measures to discourage through trips by motor vehicles while accommodating local access. Many bicycle boulevards also include links for bicyclists that are not open to vehicular through traffic.

Applications and Use

According to NACTO's Urban Bikeway Design Guide, streets developed as bicycle boulevards should have 85th percentile speeds at 25 mph or less (20 mph preferred). A variety of tools are available to help manage vehicle travel speeds and create a comfortable environment for bicyclists and pedestrians.

Toolkit

The following treatment types can be used (where applicable) to create a bicycle boulevard:

- Signage and markings
- Speed management
- Volume management

Signage and Markings

Signs and pavement markings are important elements of a bicycle boulevard. While signs and markings alone do not create a safe and effective environment, they indicate and reinforce the concept that a roadway is intended as a shared, slow street. The NACTO Urban Bikeway Design Guide provides additional guidance on sign and marking types and applications.

Speed Management

Bicycle boulevards should have a maximum operating speed of 25 mph[104] and a maximum posted speed limit of 25 mph wherever possible.[105] Speeds below 25 mph are preferred.[106] Speed limit adjustments and signage alone may do little to reduce vehicle travel speeds and should be considered in conjunction with physical infrastructure improvements as a method for reducing vehicle travel speeds.

Speed management treatments aim to reduce motor vehicle speeds closer to those of bicyclists. Lower vehicle speeds improve the bicycling environment by reducing instances of vehicles overtaking bicyclists, improving drivers' ability to see and react to bicyclists, and reducing the severity of crashes if they occur. There are two common types of speed management treatments: horizontal and vertical deflection. These treatments can be implemented individually or in combination to increase their effectiveness. These traffic-calming measures are also discussed in more detail on page 103 and in Intersections.

- *Horizontal Deflection* — Horizontal speed control devices are used to slow motorists by either visually narrowing the roadway or deflecting motorists through an artificial curve. Where possible, sufficient space should be provided for bicyclists to pass around the treatments. Examples of horizontal deflection include curb extensions, chicanes, center islands, and neighborhood traffic circles.
- *Vertical Deflection* — Vertical speed control measures are composed of wide, slight pavement elevations that self-enforce a slower speed for motorists. Narrow and abrupt speed bumps that are often used in private driveways and parking lots are not recommended for public streets and are hazardous to bicyclists.

The following are examples of vertical deflection:

- Speed humps
- Speed tables
- Speed cushions
- Raised crosswalks

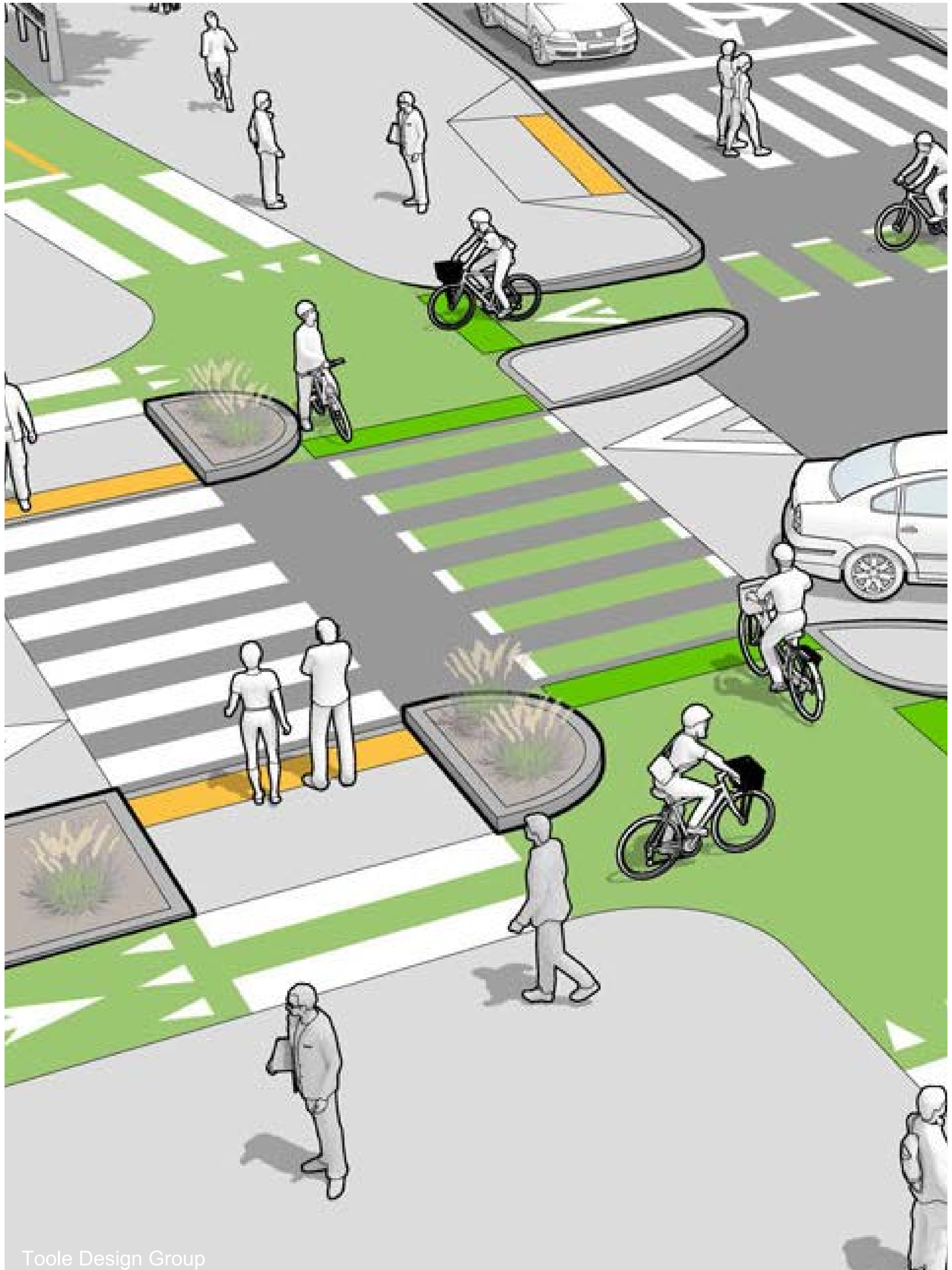
Volume Management

Volume management techniques reduce or discourage through traffic on designated bicycle boulevards by physically reconfiguring select intersections. Bicycle boulevards should be designed for motor vehicle volumes under 3,000 vehicles per day.[107]

Volume management techniques are discussed further in the Intersections section and include:

- **Forced Turn at Intersection** — Restriction on through movements for motor vehicles using signage. This can allow passage by buses and emergency vehicles but can lead to reduced compliance.
- **Channelized Right-In/Right-Out Island** — Forces motor vehicles to turn right using a physical barrier (like curbing) while bicyclists can continue straight through.
- **Median Islands/Diverters** — Used to close one direction of traffic with a physical barrier at an intersection while allowing full bicycle passage.

Olentangy River Trail in Columbus, OH



INTERSECTIONS

Intersections are critical parts of the transportation network and streetscape. They are key decision points for all users as they navigate the street network and important activity nodes for community life as well as transportation. Intersections often account for the most serious and frequent conflicts between pedestrians, bicyclists, and drivers. Poorly designed intersections can dramatically reduce mobility and safety for all of these modes. However, a well-designed intersection can reduce crashes, improve mobility, enhance public spaces, and tap civic and economic potential.

A well-designed intersection facilitates visibility and predictability for all users, reduces motor vehicle travel speeds, and makes complex movements feel safe and intuitive. An intersection should promote eye contact between all street users, allowing the street space to be effectively shared by pedestrians, bicyclists, and drivers.

The strategies described in this section enable practitioners to build intersections that safely and effectively accommodate all users.

Corners and Curb Radii

Corner treatments and curb radii have a significant impact on the safety, operation, and comfort of an intersection for all modes of travel. Selection of an appropriate curb radius should reflect the context and needs of the typical users of the street and be based on an appropriate design speed and design vehicle (see p. 28 and p. 29). A large curb radius allows vehicles to make a turn more quickly and makes it easier for truck movements, but this comes at the expense of a longer crossing and a less comfortable environment for pedestrians. Conversely, a small curb radius shortens the pedestrian crossing, improves pedestrian visibility, and slows vehicular turning traffic but could impinge access for large vehicles. Smaller curb radii also enable designers to incorporate more public space into the pedestrian realm. This provides more room for pedestrians to wait at crossings; street furniture and plantings; positioning of lighting, traffic signal equipment, or signage; and flexibility in design and location of ADA- compliant curb ramps.

The two key elements of curb radius design are the actual curb radius and the effective curb radius. Actual curb radius refers to the physical curve of the curb, while effective curb radius refers to the path that vehicles follow when making a turn. The effective curb radius is affected by the presence of other street elements, such as on-street parking, bicycle lanes, adjacent travel lanes, medians, and other features, which may increase the curvature of the path that a vehicle takes around a corner.

Engineers and planners should design curb radii for short pedestrian crossings, and low and safe turning speeds for vehicles. If frequent large vehicles must be accommodated, designs should be modified off of this default.

Further Guidance

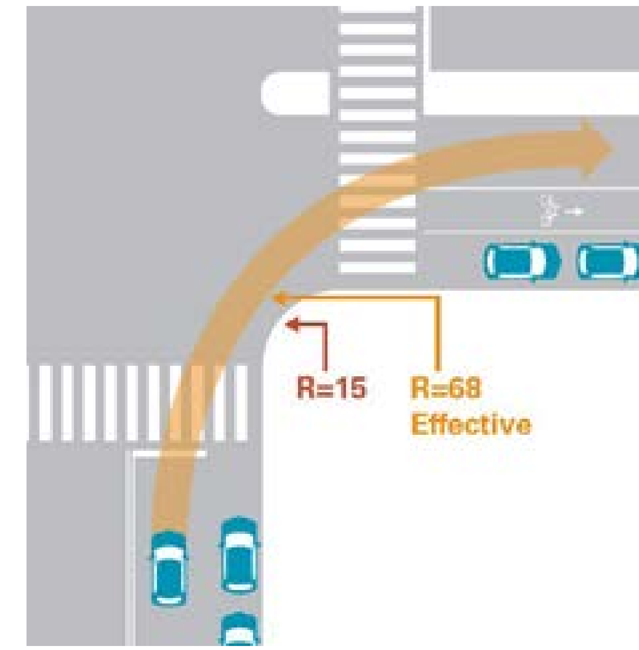
- *Optimizing Large Vehicles for Urban Environments*, NACTO

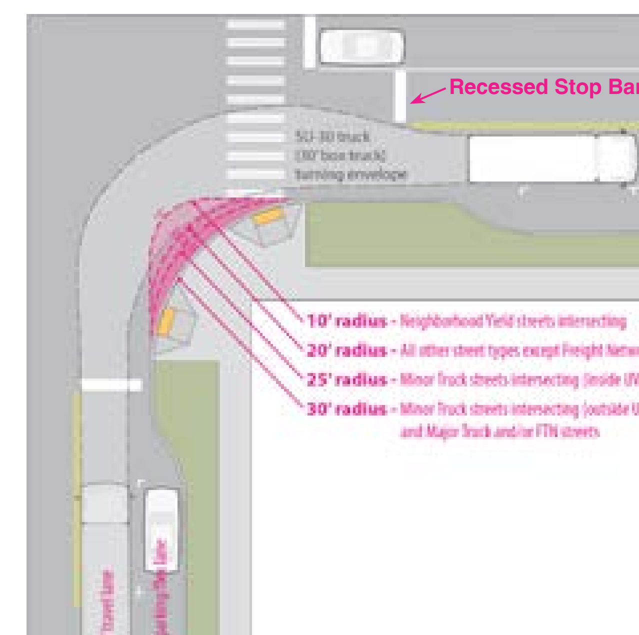
South Pearl Street in Albany, NY

Design Guidance

Designers should seek to optimize the curb radii to best fit the context, allowing safe and practical operation by typical vehicles while also minimizing vehicular turning speed and maximizing pedestrian safety and comfort. Key concepts include the following:

- Minimize the actual curb radii in locations with higher densities, where there is more pedestrian activity, or where traffic calming is desired, such as downtown and residential environments.
- Maintain an adequate effective curb radius to accommodate larger vehicles, as necessary, such as along bus routes or designated truck routes. An advanced or recessed stop bar can also be utilized to reduce the required curb radius for larger vehicles (as shown at right).
- Select the smallest possible desired design vehicle, taking into account traffic volumes and how often larger vehicles are expected to turn at an intersection.
- Include all roadway elements and geometry in the evaluation of the effective curb, such as the angle of the intersection, curb extensions, the number of receiving lanes, on-street parking, bicycle lanes, medians, the number of travel lanes, and lane width.
- Implement a variety of mitigation measures to increase the effective curb radius, helping to balance the needs of pedestrians (desiring a small actual curb radius) with those of larger vehicles (desiring a larger effective curb radius), such as:
  - » Integrate other features such as bicycle lanes or on-street parking into street design.
  - » Utilize an advanced stop bar adjacent to the receiving lanes (as shown at right).
  - » Prohibit parking at least 20 feet from an intersection to increase the effective turn radius for vehicles and to “daylight” the intersection to improve visibility for pedestrians, bicyclists, and drivers.
  - » Provide an apron on medians to better accommodate large vehicles.
  - » Allow the use of adjacent travel lanes on multi-lane streets and the full street width on low volume, local roadways.





Curb Extensions

Curb extensions, also referred to as bulb-outs or bump-outs, can improve the quality and safety of the pedestrian environment at intersections. As denoted by its name, curb extensions extend the curb line and sidewalk into the roadway, expanding the pedestrian realm. Use of curb extensions is often referred to as "daylighting" an intersection due to the significant improvement in visibility at the intersection. Curb extensions have a variety of benefits, including improving visibility for pedestrians and drivers, reducing the pedestrian crossing distance, calming traffic, and shielding on-street parking at the intersection approaches. They also expand the pedestrian realm, providing more opportunities for public space, such as street furniture, as well as more flexibility in the placement of curb ramps, lighting, traffic signal control equipment, and signage. Curb extensions are also an opportunity to incorporate green stormwater treatments, such as rain gardens, as well as bicycle parking.

Design Guidance

Curb extensions are typically used at intersections or mid-block locations on streets with on-street parking.

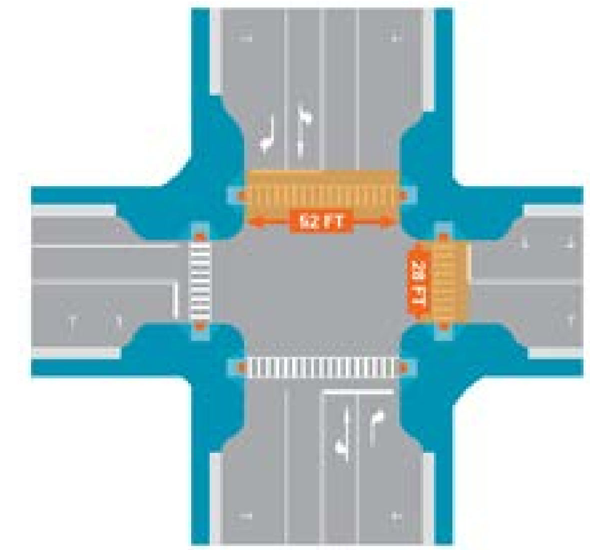
- Curb extensions are well-suited for wide intersections, areas with significant pedestrian activity, intersections with high traffic volumes and/or speeds, or near schools or pedestrian routes to other major destinations.
- Curb extensions should not extend into the travel lane or bicycle lane.
- Curb extensions should be built 1 to 2 feet wider than the travel lane. On a street without parking, this may mean a bump-out that only extends 2 to 4 feet out from the curb. On a street with parking, a curb extension should extend the width of a parked vehicle, no less than 6 feet. The selected width is intended to achieve an effective curb radius that is compatible with the context and the street's desired design speed and design vehicle.
- The minimum length of a curb extension is the width of the crosswalk (minimum of 6 feet). The designer should consider extending the length to 20 feet—the minimum setback for on-street parking near an intersection or crosswalk per NYS V&T Law and referenced in the MUTCD.[108, 109, 110]
- The designer should consider the impact of curb extensions on the effective curb radius and, particularly, potential impacts on larger turning vehicles. A narrower curb extension width may be used, as needed, to reduce the impact.

Bus Bulbs

Curb extensions can be used as "bus bulbs," or bulb-outs that are for bus stops. These are ideal for most urban bus stops, and can facilitate a level boarding platform curb, add space for a shelter, and provide extra room for riders to congregate. Bus bulbs also allow buses to remain in their travel lane, reducing delays to buses, particularly in congested areas.

Curb Extension - Before

Curb Extension - After



In the above example, the addition of curb extensions shortens pedestrian crossing distances from 75 feet to 52 feet in one direction and 51 feet to 28 feet in the other direction without reducing the number of travel lanes.

Place-making at Intersections

Intersections are nodes of activity. Not only do they serve an important transportation function, but they often play an important role in community life as crossroads of social activity, commerce, and public space. Particularly in downtowns and along main streets, they are places for people to gather, interact, and enjoy. Intersections are also important for wayfinding. They are typically key waypoints in the transportation network as travelers navigate to their destinations, often featuring notable landmarks or public buildings. These functions should be reflected in intersection design to create an environment reflective of the context.

Intersection design should reflect the multiple functions that an intersection can serve as well as the context of the location. The following placemaking and wayfinding strategies can be integrated into the design to create a more pedestrian-friendly environment:

- Reclaim space at intersections into the pedestrian realm by creating additional public space
- Create a welcoming environment with street furniture, public art, planters, kiosks, pedestrian-scale lighting, parklets, or small plazas
- Define the space using street trees, buildings, art, or other features that help enclose the area
- Enhance access to public buildings or local amenities, such as libraries, post offices, schools, and businesses
- Integrate access to curbside amenities, including transit stops, bike parking, and bike share stations

Curb Ramps

ADA guidelines require accessible pedestrian crossings. Accessible crossings are essential to provide easy access to sidewalks for pedestrians of all ages and abilities, benefiting not only those with mobility or visibility disabilities, but also children, seniors, or those with strollers, carts, bicycles, or delivery dollies. Curb ramps and blended transitions enable a smooth transition from the sidewalk level to street level at intersections and mid-block crossing locations.

Design Guidance

- Curb ramp placement should reflect the desired pedestrian path through an intersection.
- Two curb ramps are preferred over one ramp located at the apex of the corner. This enables the curb ramps to provide direct access to their associated ramp across the street.
- Drainage design should prevent water and debris from accumulating at the bottom of a curb ramp.
- Drainage grates, utility access covers, and other appurtenances should not be placed on curb ramps, landings, or along the pedestrian crossing.
- Curb ramp width should generally be the same as that of the pedestrian zone on the sidewalk approach.

ADA Compliance

Street crossings are critical to providing access between the sidewalk and the street for people who use wheelchairs or have limited mobility, and for those with vision impairments who rely on the curb to identify the transition between the sidewalk and the street.

An accessible connection between the sidewalk and the street includes a:

- Stable, firm, and slip-resistant surface.
- Detectable warning surface to alert people with visual impairments of the transition from the sidewalk to the roadway.
- Maximum cross slope of 2.0 percent at locations with yield or stop control.
- Maximum ramp slope of 8.3 percent.
- Generally minimum 4’x4’ turning space at the top of the curb ramp.
- Minimum 4’x4’ turning space at the bottom of the curb ramp, within the crosswalk and outside the vehicle lane.

Curb Ramps

Curb ramps must be flush and have a level transition from the ramp to the street.

Detectable Warning Surfaces

Detectable warning surfaces indicate the boundary between pedestrian and vehicular routes where there is a flush rather than a curbed connection. Detectable warnings contrast visually with the sidewalk and consist of truncated domes with a:

- Bottom diameter of 0.9 inches to 1.4 inches.
- Top diameter of 0.45 inches to 0.9 inches.
- Height of 0.2 inches.
- Center-to-center spacing of 1.6 inches to 2.4 inches.
- Visual contrast, either light-on-dark or dark-on-light. Burgundy, red, yellow, and other contrasting colors are common for detectable warning surfaces. Cast iron surfaces are recommended where plow blades might scrape the truncated domes.

Curb Ramp Drainage

Poor drainage at the bottom of a curb ramp can be a nuisance for all pedestrians but is particularly problematic for those who cannot avoid the curb ramp. When the water dries up, debris often remains at the base of the ramp, further impeding access. In cold weather, water can turn to ice or slush creating a more hazardous situation.

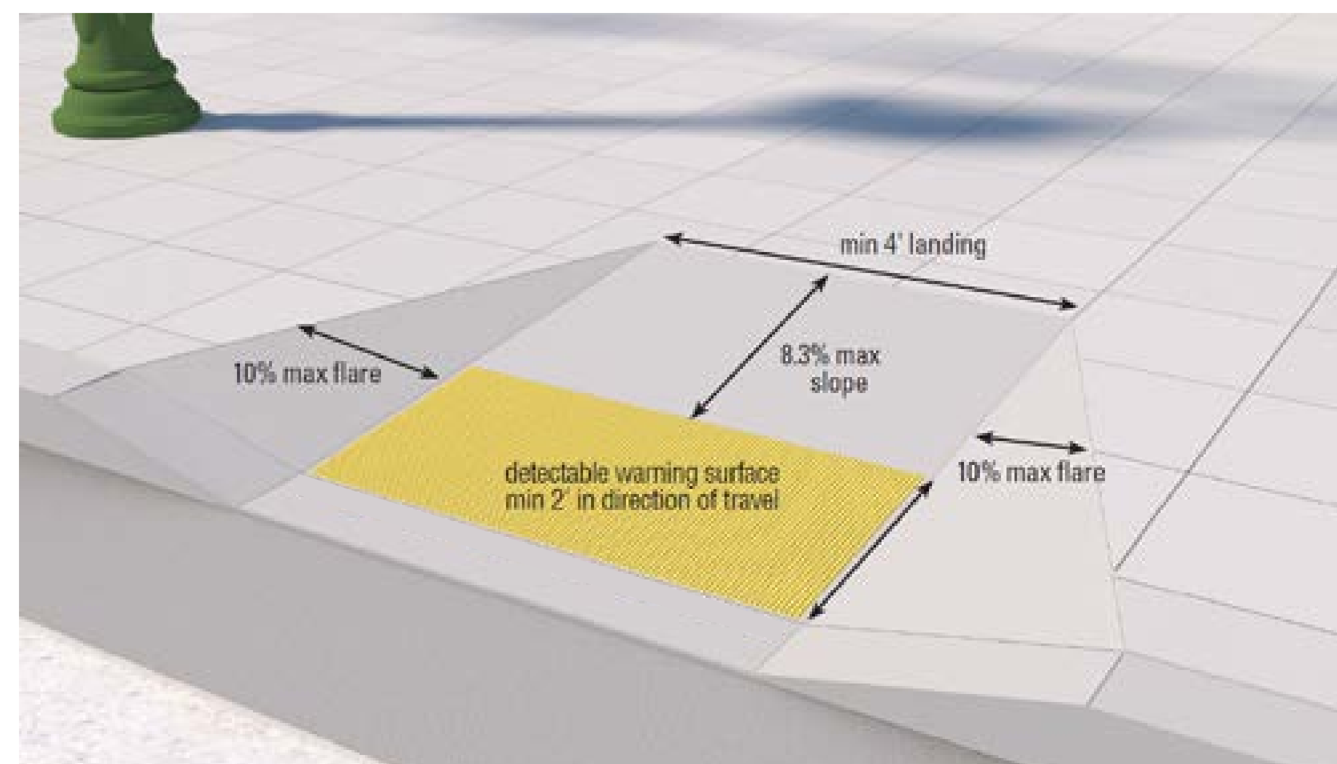
Because many drainage systems focus on channeling water to the corner of the street, care should be taken when developing the grading plan to ensure that drainage of the sidewalk is directed across and down toward the bottom of a curb ramp and then away from the curb ramp. A grading plan should specify:

- Dimensioned distances, elevations, and inlet/catch basin locations
- Curb/gutter elevation (the ends, center, and quarter points are normally needed in each curve)
- Sidewalk, pavement, ramp, and gutter slopes

Drainage grates should be located adjacent to the uphill side of the curb ramp and not the bottom of the ramp. Gutter slopes should be designed specifically to guide water away from the bottom of the ramp. Maintenance programs should be established to periodically remove gutter debris.

Further Guidance

- *Public Rights-of-Way Accessibility Guidelines (PROWAG)*, United States Access Board



Crosswalk Design

Marked crossings are a critical component of a complete pedestrian network and a more walkable environment. Crosswalks connect sidewalk segments across a roadway. Effective crosswalk striping improves pedestrian safety, enhances visibility for motorists, improves motorist awareness, creates an expectation of potential pedestrian activity, and indicates to pedestrians a preferred crossing location.

Striping design can significantly impact the visibility of a crosswalk. Traditional transverse striping, typically a pair of parallel lines oriented perpendicular to the driver, has a very limited visual profile to motorists. Conversely, longitudinal striping (often referred to as "continental," ladder, or high-visibility striping) is oriented parallel to motor vehicle travel, which significantly improves the visibility of the crossing to motorists.

Design Guidance

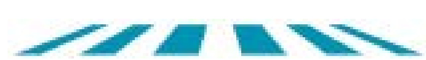
- Crosswalks should be marked on all crossings of a signalized intersection. Crosswalk placement should also consider other aspects of the intersection design, such as signal phasing and sight lines.
- According to NYS V&T Law and referenced in the MUTCD, parking should not be allowed within 20 feet of an unsignalized or unmarked crosswalk and 30 feet of a signalized crosswalk.[111, 112, 113] This distance should be extended for mid-block crosswalks, up to 100 feet.[114] Bumpouts, striping, and bollards are all effective ways to prevent illegal parking in these areas. These areas may not be used for loading zones.
- At uncontrolled crossings and mid-block locations, a crosswalk alone should not be used on streets with:[115]
  - Vehicle speeds greater than 40 mph
  - Four or more lanes without a raised median or pedestrian refuge island and an average daily traffic (ADT) of 12,000 or greater
  - Four or more lanes with a raised median or pedestrian refugee island and an ADT of 15,000 or greater
- On these roadways, additional supplemental design tools should be used to enhance the visibility of the crossing, improve pedestrian safety, and/or slow vehicular traffic.
- Yield lines are encouraged for mid-block crosswalks. Yield lines should be placed 20 to 50 feet from the edge of a crosswalk.
- On streets with low volumes (ADT less than 3,000), low speeds (less than 20 mph), and few lanes (1 or 2 lanes), striping crosswalks may not always be necessary at uncontrolled intersections. They should, however, be provided at major pedestrian destinations, such as schools, parks, transit stops, and major public buildings.
- Crosswalks should be marked to create the shortest pedestrian crossing distance, but also consider pedestrians' desire lines. This is particularly an issue at skewed intersections.
- Crosswalk design should reflect the street context. High-visibility striping should be used to enhance pedestrian crossings and is preferable at all crossings, particularly those that have significant pedestrian activity or provide access to major destinations (e.g., walking routes to schools and transit stops).
- Crosswalks must be a minimum of 6 feet wide. Crosswalks should be at least as wide as the paths they are connecting. This enables pedestrians moving in opposite directions to comfortably pass each other.
- Stop bars should be placed a minimum of 4 feet from the edge of a crosswalk. A larger buffer is preferred to create a more welcoming pedestrian environment.

Crosswalk Types

Transverse

Ladder

Continental



Traditional transverse crosswalk striping can be difficult for drivers to see, particularly on higher-speed roadways, inclines, or where striping has faded. Ladder or Continental "High-Visibility" striping is always preferable because of increased safety and striping lifespan.

No Turn on Red

Most municipalities in the U.S. allow right turns at red signals with the requirement that motorists come to a full stop, yield to cross street traffic, and yield to pedestrians. Permissible right turns on red are intended to reduce vehicle delay and save fuel. However, motorists that do not fully comply with the regulations may block crosswalks and create a hazard for crossing pedestrians. FHWA recommends considering the prohibition of right turns on red in locations with substantial pedestrian volume and places where children cross. FHWA also encourages the use of leading pedestrian intervals in conjunction with prohibiting right turns on red.[116]

Crosswalk Signage

In urban areas where crosswalks exist, signs should not be placed within 4 feet of the crosswalk. W11-2 is the standard pedestrian warning sign for uncontrolled crosswalks. At most mid-block crosswalks with speed limits of 35 mph or less, R1-6 "in-road" signage is appropriate. R1-6 signs can be placed on any lane lines in a roadway, but may not be placed in the gutter or on a curb. Additional crosswalk signage is discussed in sections 2B.11-12 of the MUTCD.

W11-2

R1-6 with S4-3P

Rectangular Rapid Flashing Beacons

Rectangular Rapid Flashing Beacons (RRFBs) can be used to enhance a pedestrian crossing. The combination of signage and irregular flash pattern of the amber LED lights increases the visibility of a crossing, and studies show that they improve driver compliance with stopping for pedestrians at a marked crosswalk. Driver yield and stop rates can improve from as low as 11% at a standard marked crosswalk to 80% and higher at crosswalks with RRFB installations.[117, 118]

Design Guidance

- RRFBs must be used in conjunction with a marked crosswalk and curb ramps. They may be combined with other pedestrian crossing enhancements, such as curb extensions. Parking should not be allowed within 20 feet of any crosswalk.[119, 120]
- RRFBs can be used on single-lane or multi-lane roadways. Overhead signage may be appropriate for multi-lane or higher speed roadways.
- They are often used at unsignalized locations with significant pedestrian activity, such as mid-block crossings near major destinations or trail crossings, or where high traffic volumes, speeds, and/or driver behavior make pedestrian crossings challenging.
- RRFBs can be installed with active or passive actuation.
- On divided roadways, RRFBs can be included in the median or center island to further increase visibility and driver yielding behavior.
- RRFBs are typically freestanding and powered by a solar panel unit. They are easily implementable at trail crossings or other locations without easy access to a traditional power source.

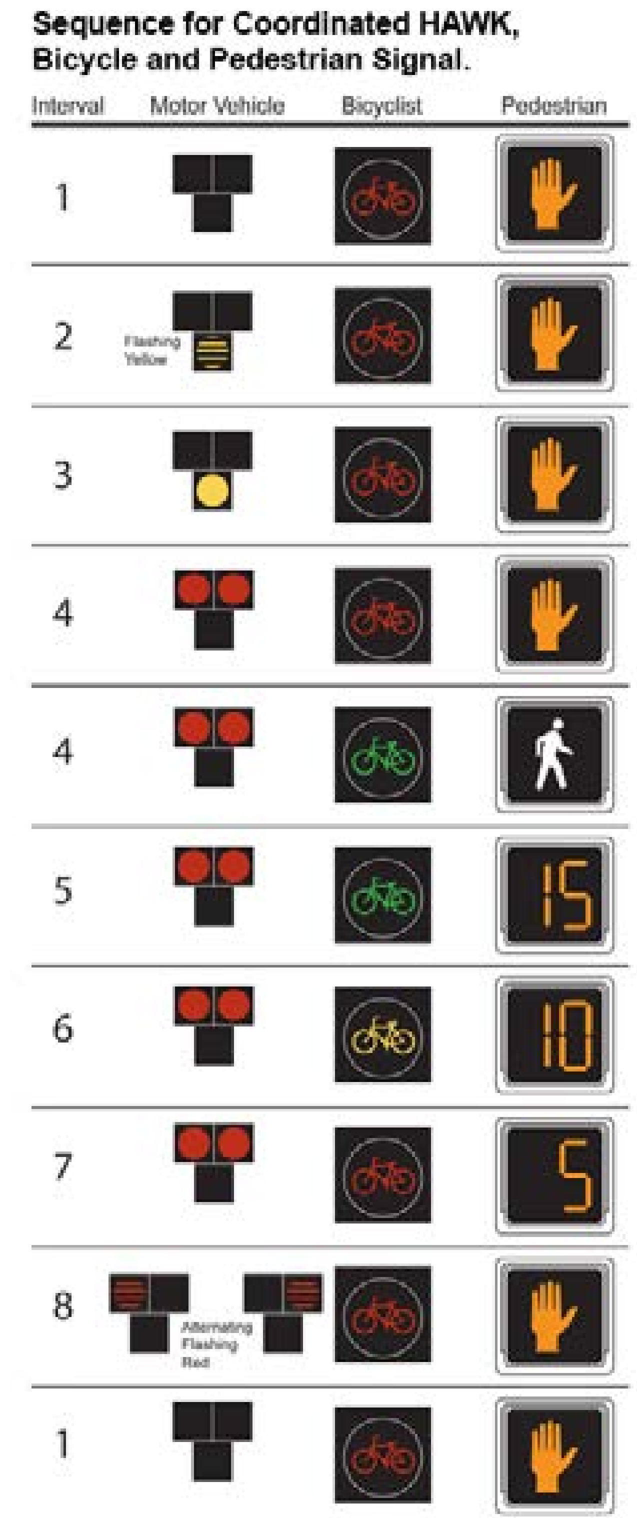
Pedestrian Hybrid Beacons

A pedestrian hybrid beacon (PHB), also known as a high intensity actuated crosswalk (HAWK), is a pedestrian-actuated traffic control device for mid-block pedestrian crossing locations. PHBs enable pedestrians to cross higher-speed and higher-volume roadways while traffic is stopped. They provide planners and engineers with an intermediary option for locations that do not meet requirements for a traffic signal warrant, but where traffic conditions exceed the limitations of an RRFB. If a full traffic signal is warranted by pedestrian or vehicle volumes, it is always the preferred option in the Capital Region.

A PHB consists of an overhead mast arm with two red lights and one yellow light, as well as pedestrian signal heads. When actuated by a pedestrian, the beacon goes through a sequence of flashing and steady yellow light intervals, followed by a steady red light, at which point a “walk” signal is indicated to pedestrians. After the “walk” phase, the pedestrian signal switches to a flashing orange hand, and the hybrid beacon switches to alternating flashing red lights. The beacon goes dark after the cycle.

Design Guidance

- PHBs must be used in conjunction with a marked crosswalk and curb ramps, and parking is not allowed within at least 100 feet in advance of and at least 20 feet beyond the crosswalk.[121] PHBs may be combined with other pedestrian crossing enhancements, such as curb extensions.
- Pedestrian hybrid beacons are typically installed at mid-block locations (at least 100 feet from a stop or yield controlled intersection or driveway)[122] with higher traffic volumes, wide cross-sections, or at difficult pedestrian crossings. They are a useful tool where gaps in traffic are insufficient to allow pedestrian crossings or where there is excessive pedestrian delay.



Bicycle Intersection Markings

Intersections can be confusing and stressful for bicyclists. In the Capital District, 47 percent of bicycle crashes occurred in intersections.[123] An inherent mixing of traffic occurs at intersections, creating conflicts between vehicular and bicycle traffic.

Intersection design that reduces conflicts between motorists and pedestrians can:

- Reduce conflict points between bicyclists, motorists, and pedestrians
- Improve the visibility of bicyclists to motorists
- Denote a clear right-of-way and path through the intersection for bicyclists

Intersection Markings

Bicycle markings should be extended through intersections and major driveways to enhance the continuity of the bicycle facility, guide bicyclists through the intersection, and mitigate bicyclist stress.

Bicycle intersection markings provide several benefits:

- Increases the visibility of bicyclists
- Reduces bicyclist stress by clearly delineating roadway space for bicyclists and guiding them through the intersection in a direct path
- Reinforces that through bicyclists have priority over turning vehicles or vehicles entering the roadway
- Helps bicyclists position themselves within the intersection
- Improves driver awareness of bicycle activity and movement through a high conflict area
- Makes bicyclist movement at intersections more predictable to motorists

Design Guidance

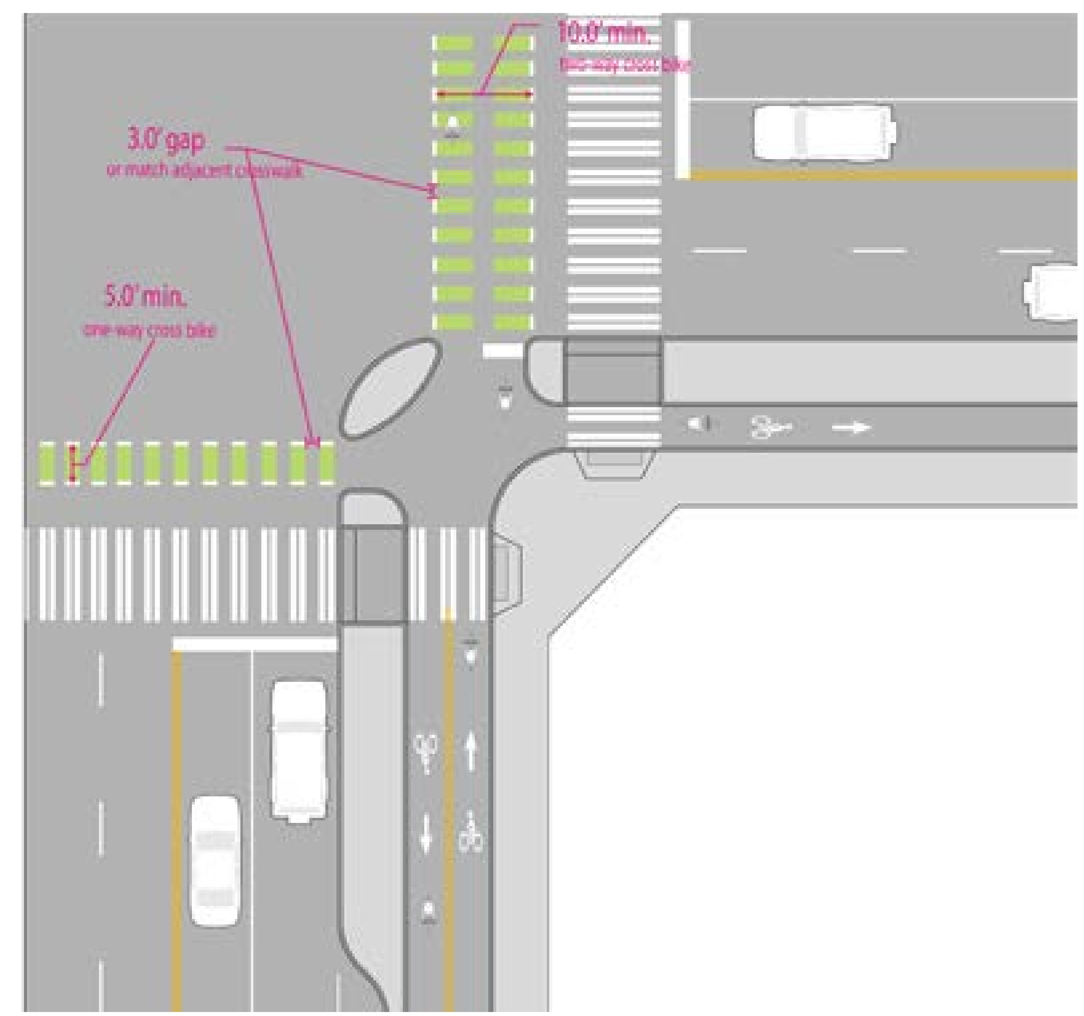
There are several common treatment types for intersection markings. The standard treatment is a white dotted line extension of the bicycle lane, which maintains the continuity of the bicycle lane through the intersection. The MUTCD contains guidance on this treatment in Section 3B.08, Pavement and Curb Markings.

This treatment may be enhanced to improve the visibility of the bicycle facility through various combinations of pavement markings, colored pavement, or higher visibility striping. The use of colored pavement helps improve the visibility of the bicycle facility and increases awareness of potential conflict areas between bicyclists and motorists.

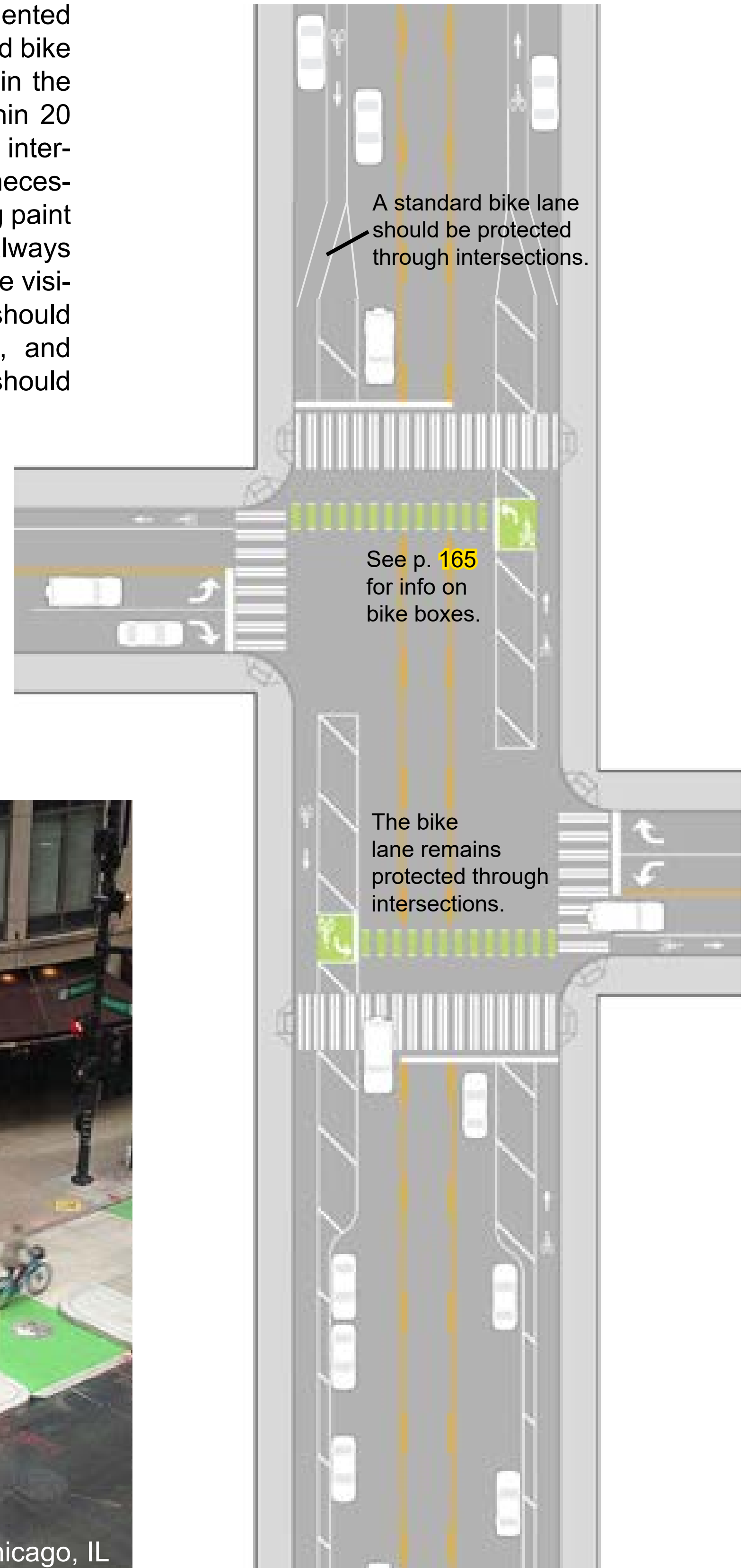
Bicycle lanes should not end at intersections or intersection approaches, which can occur when turning lanes for vehicles are included.

Protected Intersections

"Protected intersections" are the current best practice for safely accommodating pedestrians, bicyclists, and motor vehicles. The design has been implemented in the United States in Syracuse, NY, Bethesda, MD, Ann Arbor, MI, Columbus, OH, Cambridge, MA, Chicago, IL, Salt Lake City, UT, and dozens of other locations. Protected intersections help maintain separation between motor vehicles, bicyclists, and pedestrians, creating a lower stress environment for all modes. They are used when an intersection has a standard bicycle lane or separated bicycle lane. Built around similar principles as a curb extension, the design incorporates curbed (or bollard) islands at each corner. These islands facilitate motorists making slower turns, and maintain separation between motorists, pedestrians, and bicyclists. They also offset bicycle traffic from the intersection and move the conflict point between bicyclists and turning motorists so that the two modes cross paths where motorists have better visibility of bicyclists and pedestrians. Protected intersections also facilitate two-stage left-turn movements for bicyclists. Protected intersection designs can be used at uncontrolled or signalized intersections.



Protected intersections should be implemented with standard bike lanes as well as protected bike lanes. Per NYS V&T Law and referenced in the MUTCD, parking should be prohibited within 20 feet of crosswalks and 30 feet of signalized intersections.[124, 125, 126] This provides the space necessary to create a protected intersection using paint and/or bollards. Bike lanes should almost always be curbside through intersections to improve visibility for turning motor vehicles. Bike lanes should not end when approaching intersections, and "mixing-" or "blender-zones" in turn lanes should be avoided whenever possible.



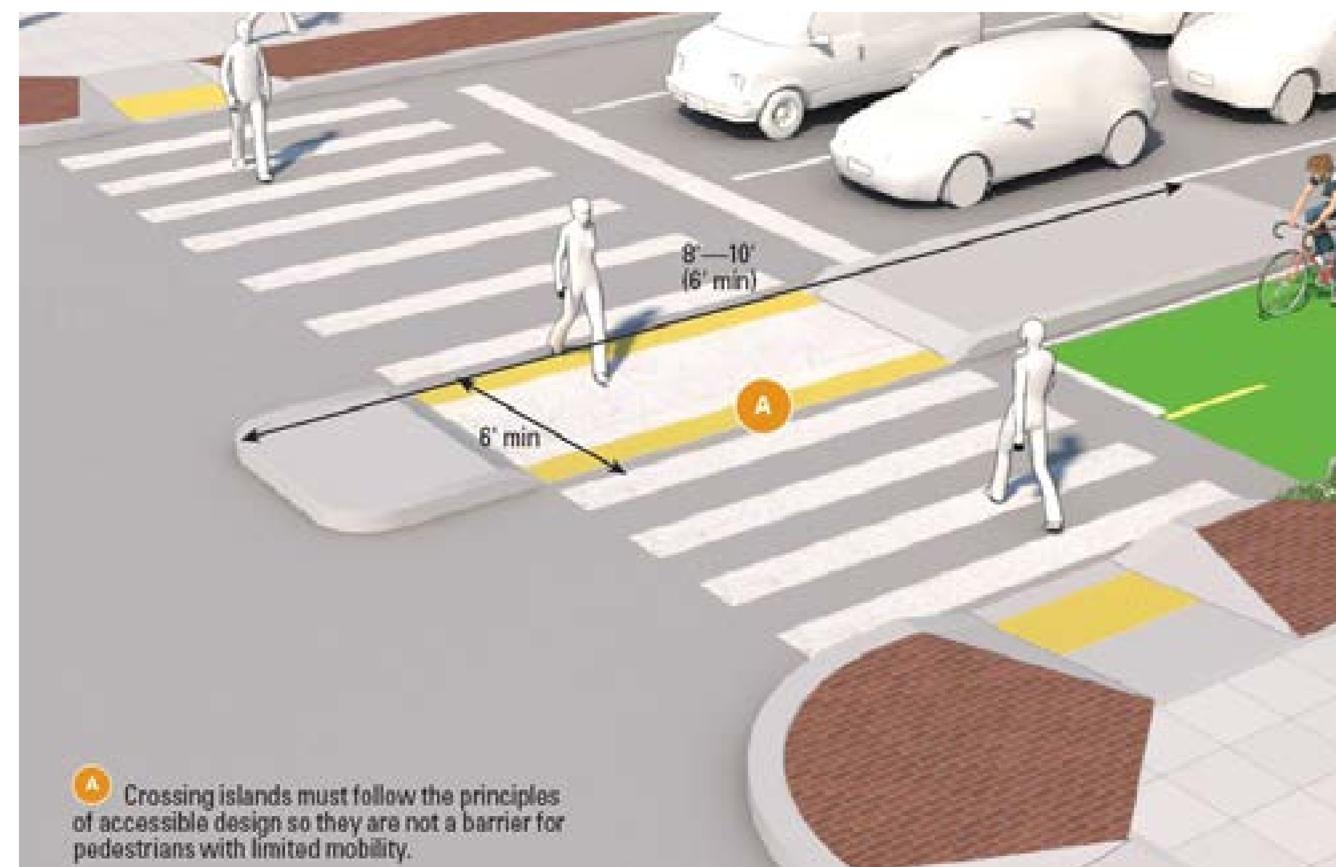
Crossing Islands

Crossing islands, or pedestrian refuge islands, are a means to calm traffic and improve pedestrian safety. They enable pedestrians to make a crossing in two stages. This reduces the exposure time of pedestrians to vehicular traffic.

Design Guidance

Crossing islands are typically built in locations where pedestrian crossings are exposed to heavy vehicular traffic. This often occurs on multi-lane roadways, where pedestrians must cross more than two lanes of traffic, or on roadways with high traffic volumes or speeds. Crossing islands should be considered on all roads with more than four lanes or traffic speeds over 40 mph.[127]

- Crossing islands may be used at intersections or mid-block pedestrian crossings.
- Where intersections have slip lanes, the resulting islands should be designed as pedestrian crossing islands.
- Roadways with an existing median space can be retrofitted as a crossing island. Crossing islands should be a minimum of 6 feet wide, with a preferred width of 8 to 10 feet, and a minimum of 6 feet long. Islands narrower than 6 feet may be used, in which case the signal must be timed for a complete crossing.
- Crossing islands must meet ADA requirements, including slope and detectable warning strip requirements, and a 5' minimum clear width.



Splitter Islands

Similar to crossing islands, splitter islands provide a means to calm traffic and more formally separate vehicle movements. They provide a raised median or barrier that reduces the effective curb radius and prevents turning vehicles from "cutting the corner" and encroaching into an oncoming travel lane as they complete a turn. Unlike crossing islands, splitter islands may not be wide enough to accommodate a pedestrian refuge area.

Design Guidance

- Splitter islands are used only where the available roadway width is insufficient to provide a full crossing island with a pedestrian refuge.
- Splitter islands are used to separate vehicle lanes at roundabouts or where the intersection design requires a slip lane to accommodate turning vehicles.
- Impacts on the effective curb radius for turning vehicles and the street design vehicle should be considered.

Clinton Avenue in Albany, NY

Raised Crosswalks and Intersections

Raised crossings prioritize pedestrian movement through an intersection or mid-block crossing. They improve the visibility of pedestrians and force vehicular traffic to slow down as they pass through the crossing. They also increase the rate at which motorists comply with the "stop for pedestrians" law. Raised crossings may be implemented for an individual crossing or expanded to cover an entire intersection to create a wide public space level with the sidewalk.

Design Guidance[128]

- Raised crossings and intersections should be flush with the sidewalk.
- ADA-requirements must be followed for pedestrian access.
- Vertical deflection should be gradual (max. 8% grade), rising to 6 inches above the existing roadway.

Bellevue, WA

Signalized Intersections

The allocation of time at a signalized intersection is equally important as the allocation of space. In combination, time and space determine the quality of a street and transportation network, how it operates, and how it meets the mobility, safety, and public space needs of its users and the community. Signal timing should reflect the context and needs of the street. Just as the distribution of space within an intersection geometry and cross-section can make a street feel more or less welcoming to a given mode, the way in which time is distributed by a traffic signal has a similar impact: an inadequate pedestrian crossing time or lack of pedestrian signals can create a barrier to walking and discourage walking; transit priority signaling can improve the performance of a transit service and encourage higher ridership; and excessive delay at an intersection for any mode can create a bottleneck and cause users to violate the signal or take unsafe risks.

Signal Timing

In areas with closely spaced signals, the timing of adjacent traffic signals should be designed to balance the needs of all users of the road. This may mean not designing signal progression for typical vehicle-based metrics, such as maximum vehicle throughput or minimum vehicle delay.

Signal progression for vehicles can be used to help maintain vehicle speeds, which can in turn decrease both the risk and severity of collisions with pedestrians and other vehicles.[129] "Green waves" can be established so that any vehicle traveling down the signalized roadway will see a progressive cascade of green lights, provided they travel at a certain speed (for example, the speed limit). Slower green waves of approximately 10-15 mph may be used to encourage bicycle travel. Green waves have been shown to reduce emissions and vehicle delay.[130, 131] Green waves are typically established in the direction of greatest vehicle flow, but two-way green waves are possible depending on constraints from signal spacing.[132]

NACTO recommends cycle lengths that are 60 to 90 seconds. Shorter cycles allow for more frequent pedestrian crossing opportunities, increasing pedestrian compliance with signals and safety.

Where there is a high density of signals, such as with a downtown grid, effort should be made to ensure that the coordination does not cause pedestrians to experience delays at consecutive crossings along the same street. Both block length and typical walking speed should be considered.

Coordinated Signals

Traffic signal coordination (or "synchronization") may be used on signalized roadways to improve vehicle flow with the intent to reduce travel time, stops, and vehicle emissions. According to FHWA, adjacent signals within three-quarters of a mile should be coordinated.[133] Signals greater than three-quarters of a mile apart may still be recommended for coordination if strong "platooning" – clustering of arriving vehicles – is observed.[134] Signals can also be coordinated to prioritize transit service on a corridor, leading to more reliable and faster transit service.[135]

Delaware Avenue in Albany, NY

Signal coordination may be achieved in a variety of ways:

Time-Based Coordination

Each signal maintains the same cycle length, and are synchronized based on their internal clocks. Modern systems can set their clocks by radio or internet to ensure timings do not drift, and are not affected by power interruptions. Time-based coordination does not require communication between intersections.[136, 137]

Centralized Control

Signals communicate with a centralized computer controller via hardwire (i.e., fiber optic connection) or wirelessly. With such a system, changes to signal timing may be made remotely.[138]

Adaptive Signal Control Technology (ASCT)

Unlike conventional signal equipment, ASCT processes real-time data and adjusts signal timing to accommodate changing traffic patterns and mitigate congestion. The technology responds to fluxes in daily traffic flow and events, such as crashes, construction, or special events, creating smoother traffic flow and improved travel time reliability. Compared to traditional signal equipment, average ASCT may improve travel time by more than 10 percent, and in areas with particularly outdated signal timing, improvements can exceed 50 percent.[139, 140]

Signalized Turns

This treatment is best applied for turning movements with high volumes where pedestrian volumes are high enough to severely limit turning capacity for vehicles. A short protected turning phase can be provided for right-turning vehicles from one-way or two-way streets, or for left-turning vehicles on a one-way street each cycle or when a long queue is detected. This protected turning phase should be just before the end of the green phase (not at the start) to prioritize pedestrian movement.

Vehicle Detection

Signalized intersections may be equipped with devices that detect vehicles, such as induction loops under the pavement or cameras mounted on mast arms. Such devices permit more efficient allocation of green time. Detectors may even allow certain phases to be skipped – for example, if a detector senses there are no vehicles in left-turn lanes, the protected left-turn interval may be skipped, and its green time may be allocated to an under-served phase. Other vehicle detection systems allow the signal to "rest on green" for the major road, and allocate time to side streets only when vehicles arrive.[141] Systems which utilize "rest on green" detection should time and coordinate the green phase for side streets with other signals within three-quarters of a mile.

Caution should be used when implementing vehicle detection systems to ensure that pedestrian crossing intervals are still accommodated, and are not skipped by the signal. Pedestrians should not be stranded waiting for a vehicle to approach a certain detector for the signal to allow for safe pedestrian crossing.[142, 143] In addition, certain detection systems may not reliably detect bicyclists.[144] Care should be taken to ensure that bicycle movements are not entirely dependent on vehicle detection, potentially by ensuring a shortened light cycle every few minutes, or by including a bicycle actuation button.

Pedestrian Signals

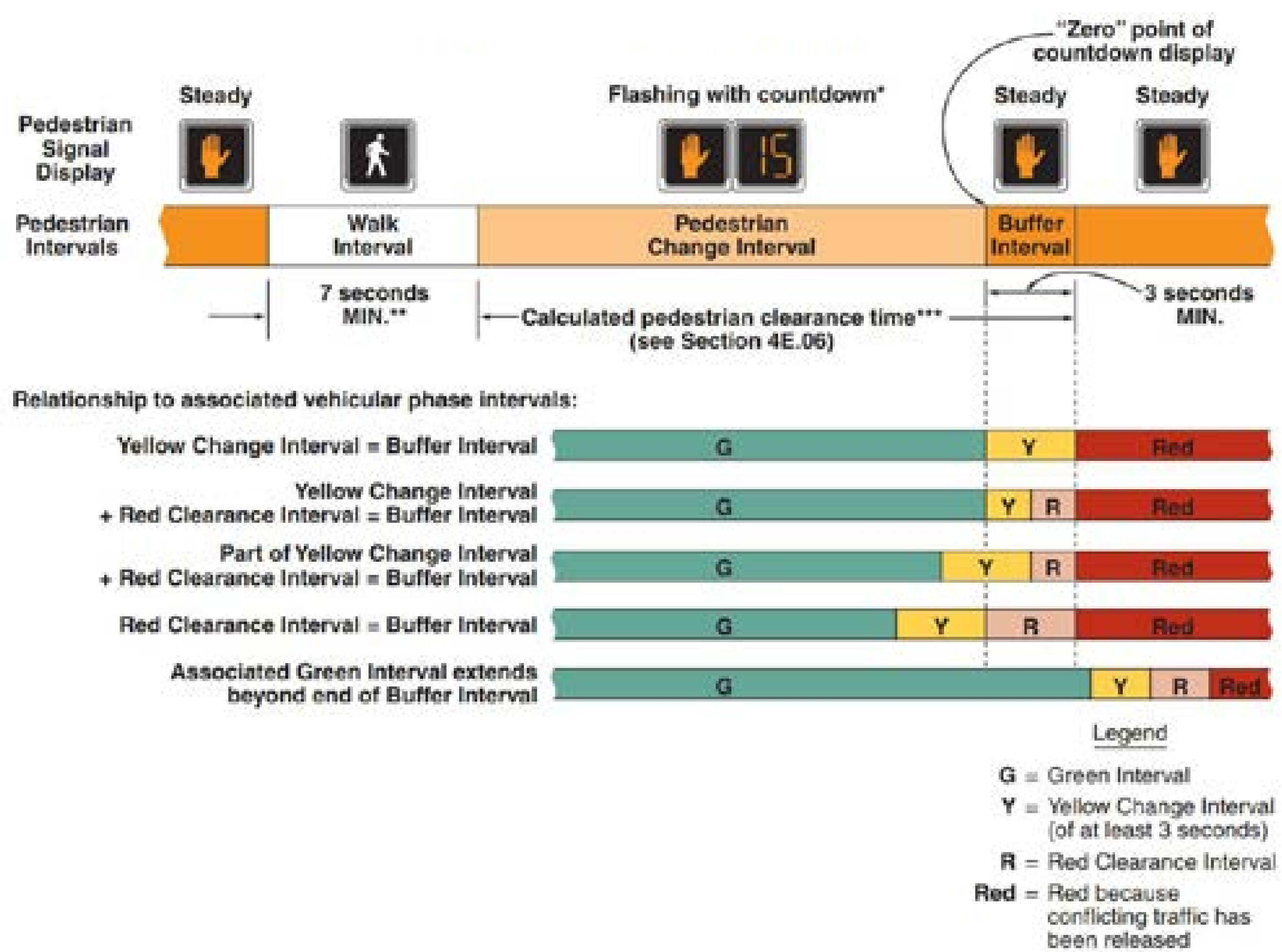
Pedestrian signals are used to control pedestrian traffic and indicate pedestrian right-of-way to turning vehicles. Signal indications consist of the illuminated symbols of a walking person (symbolizing walk) and an upraised hand (indicating don't walk). Many signals use a flashing upraised hand to indicate a clearance interval for pedestrians who are already crossing to complete their crossing and that no pedestrians should enter the intersection. A preferred treatment is to use a countdown timer simultaneously with the flashing upraised hand to indicate how much time is left on the pedestrian phase.

Pedestrian Signal Heads

Pedestrian signal heads with countdown timers provide clarity to pedestrians and increase safety by clearly indicating when it is appropriate to cross the intersection and how long a pedestrian has to do so.

Pedestrian Clearance Time

The pedestrian clearance time should provide adequate time for a pedestrian leaving the curb at the end of the "walk" interval to reach the opposite curb before the traffic signal changes to green for on-coming traffic. The minimum crossing time for the signal timing is a function of the width of the crossing and the pedestrian walk speed, and must be no faster than 3.5 feet per second. In locations commonly used by pedestrians who walk more slowly or use wheelchairs, a slower walk speed should be used.



SIDEWALKS | ROADWAYS | INTERSECTIONS | CURBSIDES

Pedestrian Actuated Signals - Push Button

The use of actuated pedestrian detection, typically through the use of pushbuttons, is discouraged in high pedestrian traffic areas like central business districts and downtowns. The pedestrian phase should be provided for all crossings during each and every cycle.

In the case that pedestrian actuation is deemed appropriate, typically where pedestrian volumes are low on suburban and rural streets, the following strategies can be considered to reduce pedestrian delay while limiting impacts to vehicle traffic:

- Provide the pedestrian phase during each cycle when pedestrian volumes are expected to be high, such as commuting times
- Eliminate the need for actuation by reducing the crossing length (and therefore time) through the use of curb extensions
- Reduce the cycle length

For semi-actuated signals, typically used where a high-volume street meets a lower-volume street, the pedestrian interval should always be provided with the higher-volume green phase. For the minor crossing, effort should be made to reduce wait times.

Leading Pedestrian Interval

This treatment is best for intersections with high vehicular turning volumes. This interval provides a few seconds of pedestrian crossing time before vehicle traffic is provided a green light. This lead time allows for increased visibility of pedestrians, reducing the risk of collisions. NACTO recommends 3 to 7 seconds for the leading interval before the corresponding vehicle interval begins.

Exclusive Pedestrian Interval

This is sometimes referred to as an exclusive pedestrian phase, all pedestrian phase, or a "pedestrian scramble." This treatment is best implemented at intersections with high pedestrian volumes that make turning prohibitive. During each signal cycle, a phase exclusive to pedestrians is provided, allowing pedestrians to cross between any corner in the intersection. The timing of this pedestrian phase should reflect the crossing distance from diagonal corners; this longer time required does not allow this treatment to be used on wide intersections. In a typical implementation, no pedestrian movements are permitted during the vehicular phases, therefore long cycle lengths are discouraged to increase pedestrian compliance.

Accessible Pedestrian Signals

If an intersection or other street crossing includes pedestrian signals, the signals need to include both accessible pedestrian signals and accessible pedestrian pushbuttons to communicate information about the WALK and DON'T WALK intervals in non-visual formats.[145] The use of actuated pedestrian detection to request a WALK signal, typically through the use of pushbuttons, is discouraged in high pedestrian traffic areas like central business districts and downtowns, but pushbuttons should be used for information about the intervals.

Crossing Times

The necessary times needed for a pedestrian to cross an intersection varies based on walking pace, visual impairments, disability, age, and mobility limitations. The MUTCD standard identifies a "normal" walking speed as 3.5 feet per second. However, according to FHWA, a majority of pedestrians walk at speeds slower than this. This group includes those with limited mobility and older adults. As the population of the Capital Region ages, this group will grow larger.

It is required that crossing times be based on a walking speed of no more than 3.5 feet per second at all crossings. A slower walking speed should be considered near senior centers, rehabilitation centers, or other locations where a higher proportion of potential users may have a slower walking speed. Pushbuttons may be programmed to increase the crossing time if proper signage and auditory cues are utilized.

If crossing times cannot be reduced, crossing distance should be decreased (through either a curb extension or a median refuge) to benefit pedestrians who need more time or at particularly long or complex crossings.

Crossing Times

Pedestrian signals must be accessible, with accessible pushbuttons.

- Locate pedestrian pushbuttons within easy reach of pedestrians using each crosswalk, within 10' of the curb or pavement edge, but at least 1.5 feet from the edge of the curb, or pavement if there is no curb. Ideally, locate the devices at least 10' from each other.
- Provide a minimum clear space of 2.5 ft by 4 ft, with a cross slope no greater than 2 percent and a running slope consistent with the sidewalk. A larger clear space may be necessary if the clear space is confined.[146] Mount the device at approximately 42 inches – but no higher than 48 inches – above the sidewalk so that children, people who use a wheelchair, or shorter individuals can easily operate it.
- Locate the control face of the button so that it is parallel to the direction of the marked crosswalk. Install signs to make it obvious which pushbutton is associated with which signal.[147]
- Design the activation button to require no grasping, pinching, or twisting, and no greater than 5 lbs of force. This enables people with limited hand function to operate it easily.
- Avoid button designs that activate through conductivity.
- Sidewalk access to accessible pushbuttons must remain clear of snow and ice during winter months, facilitating people with visual impairments or using a wheelchair.

The use of actuated pedestrian detection to request a WALK signal is discouraged in high pedestrian traffic areas.

Providing Information in Multiple Formats

People with vision impairments are at a disadvantage at an intersection if they are unaware of the presence of a pedestrian- actuated signal device. Signal information needs to be accessible and usable by all pedestrians, including those with vision impairments. Pedestrian signals need to provide both audible and vibrotactile walk indications.

Audible

The audible component of the pedestrian signal includes an audible indication for the walk interval. If pushbuttons are located less than 10 feet from each other, each needs to provide a speech information message when pushed. If they are at least 10 feet apart, the audible walk indication shall be a percussive tone. In addition, audible tones must automatically adjust volume in response to surrounding noises.[148]

Vibrotactile

The tactile component of the pedestrian signal can be provided by a raised arrow on the pedestrian actuated signal device. This indicates which street is controlled by the push button. The arrow vibrates during the walk interval.

Visual

The visual component of the pedestrian signal is provided on the device and through the illuminated visual signal, as well as the accessible pushbutton.

Delaware Avenue in Albany, NY

Transit Priority

Signal Priority at Intersections

Bus priority signals can improve service and reduce delays at intersections controlled by traffi signals by extending the green phase or reducing the red phase for transit vehicles' direction. Bus priority can be implemented by installing a detection system for the traffic signal and a transmitter on the transit vehicle. Bus priority strategies include green extension if the transit vehicle is approaching; early green when a bus arrives at an intersection; early red when a bus is on approach to cycle through the red phase earlier; phase rotation, where the order of phases can be shuffled so that transit vehicles arrive during the phase they need; and actuated transit phases, which are phases when a transit vehicle is present, allowing transit vehicles to make movements that are generally not allowed for mixed traffic.

Queue-Jump Lanes

In addition to bus priority signals, installing queue-jump lanes that allow a bus to avoid the queue and access an intersection can have major benefits. Queue-jump lanes are particularly useful at congested intersections, or as an interim inclusion before building dedicated bus lanes. are being added along new BRT routes in towns, villages, and cities that CDTA serves.

Further Guidance

- *Bus Rapid Transit Planning Guide*, Institute for Transportation and Development Policy
- *Transit Street Design Guide*, NACTO

Bicycle Signals

Bicycle signal heads and bicycle-specific timing strategies are methods of improving bicycle safety at intersections. Bicycle signals can simplify bicycle movements at complex intersections, clarify navigation of the intersection for bicyclists, separate motor vehicle and bicycle movements to reduce conflicts, and prioritize bicycle movements. Bicycle signals are often important on two-way separated bicycle lanes and on contra-flow bicycle lanes where the contra-flow movements benefit from an independent signal phase and signal head to resolve conflicts with other movements.

Applications and Use[149]

Bicycle signals are useful for:

- Addressing bicyclist non-compliance with the previous traffic control.
- Providing a leading or lagging bicycle interval.
- Continuing a bicycle lane on the right-hand side of an exclusive turn lane.
- Augmenting the design of a separated counter-flow bicycle facility, like a two-way protected bike lane or cycle track.
- Providing an increased level of safety by facilitating unusual or unexpected arrangements of the bicycle movement through complex intersections, conflict areas, or signal control.


Columbus, OH

Bike Boxes

A bike box provides a designated area for bicyclists at the front of a travel lane at signalized intersections. It allows bicyclists to move to the front of the queue during a red light, increasing their visibility to motorists. Bike boxes also reduce signal delay for bicyclists, help prioritize bicycle movement, mitigate the potential for "right-hook" crashes at the start of the green signal, facilitate left-turn positioning for bicyclists when the box extends across the entire intersection approach, and create an additional buffer from motor vehicles for pedestrians.

Bike boxes have several applications, including:

- At signalized intersections and where there are conflicts between turning movements
- To mitigate conflicts between through-bicycle movements and vehicle right turns
- To better accommodate left-turning bicycle traffic, particularly where there is a high volume of turning traffic, a designated bicycle route turns left, or a bicycle lane shifts from the right side of the street to the left side

Design Guidance

- Bike boxes should be 10 to 16 feet in length.
- The motor vehicle stop bar for the intersection is placed at the end of the bike box farthest from the intersection. It may be placed up to 7 feet in advance of the bike box to reduce motor vehicle encroachment. Optionally, a post-mounted "Stop Here on Red" sign (MUTCD R10-6A) and/or "Wait Here" pavement marking can be used to reinforce the stop bar and deter encroachment.
- "No Turn on Red" signage (MUTCD R10-11) should be installed to prevent conflicts in the bike box.
- A bike symbol pavement marking should be centered in the bike box. Aligning it outside of the wheel path increases the longevity of the marking.
- Green colored pavement may be used to increase the visibility of the facility and encourage compliance by motorists.

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Two-Stage Turn Bike Boxes

A two-stage bike turn box provides a safer and more comfortable way for bicyclists to cross streets with higher vehicle speeds or volumes. Similar to a crosswalk, bicyclists complete a left turn by dividing it into two movements. Bicyclists first proceed through the intersection with traffic to a bike box on the far side of the intersection, where they position themselves in front of the traffic queue on the cross street. When the traffic signal turns green for the cross street, they proceed across the intersection with traffic, completing the left turn.

Design Guidance

- A two-stage bike turn box is typically used with conventional or separated bicycle lanes to facilitate left-turn movements, particularly on multi-lane streets.
- The queue box should be placed in a protected area. Different configurations may be used based on the geometry of the intersection, design of the bicycle lane, the presence of on-street parking, etc.
- "No Turn on Red" signage (MUTCD R10-11) should be installed to prohibit vehicles from entering the turn box.
- The turn box should be marked with a bicycle symbol and turn arrow.
- Green colored pavement may be used to increase the visibility of the facility and encourage compliance by motorists.
- The box should be positioned laterally in the cross street to improve the visibility of bicyclists.

Roundabouts

Roundabouts are an alternative to traditional signalized or stop-controlled intersection designs. The modern roundabout generally has a small diameter and yield control on all entries, which can lead to reduced vehicle speeds, increased safety, and operational improvements.

Compared to a traditional four-way intersection, roundabouts reduce the total number of vehicle conflicts points. As a result, single-lane roundabouts generally have a lower number of fatal and injury crashes. However, consideration must be given to accommodations for bicyclists and pedestrians, as they are often involved in a relatively higher proportion of injury crashes in roundabouts compared to other intersection designs.

Roundabouts can improve the operation of the roadway. Since vehicles do not need to come to a complete stop at a roundabout, vehicles can experience reduced delays, particularly at off-peak times. All approaches have equal priority in roundabout design, as all vehicles must yield to traffic when entering the roundabout. Therefore, it is also important to consider the comparative volumes on each approach and the potential delay for the major movements. During peak times or on high-volume corridors, roundabouts can be less efficient than a signalized intersection.

In addition to potential safety and operational improvements, other benefits associated with roundabouts include:

Operation and maintenance costs: A roundabout may have lower maintenance costs than a signalized intersection, and a longer service life.

Traffic calming: By requiring all approaches to yield, a tight roundabout can have a traffic-calming effect on a street network.

Aesthetics: The central island of a roundabout can provide opportunities to create signature entries or centerpieces of a community.

Environment: The reduction in vehicle delay and the number and duration of vehicle stops can have a positive impact on fuel consumption, emissions, and noise and air quality impacts.

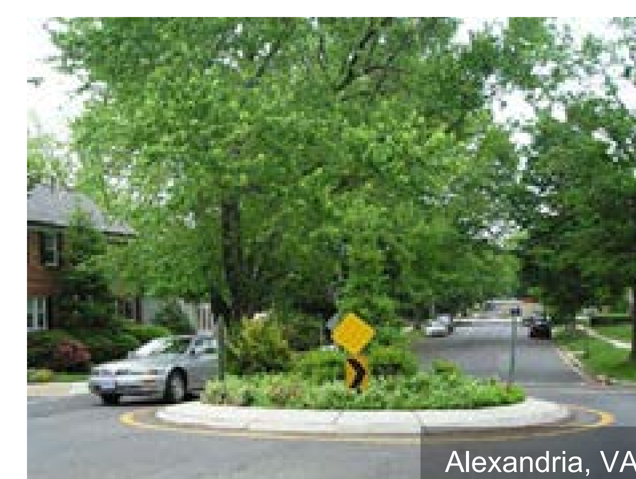
Spatial Requirements: The spatial advantages and disadvantages of a roundabout vary by intersection design. While roundabouts require more land area than a typical four-way stop-controlled intersection, they can be more space-efficient than intersections with jug-handles, highway interchanges with large infield areas, or signalized intersections with several turn lanes on multiple approaches.

Design Guidance

- Design entry points that require vehicles to deflect around the central island. Entry points that enable a path tangent to the central island support faster vehicle speeds.
- Provide pedestrian crossings on all approaches. Raised crossing islands with high-visibility striping on each approach create a more comfortable crossing for pedestrians, reduce vehicle speeds, and improve driver awareness of pedestrians. Pedestrian crossings should generally be located one car length from the roundabout entry/exit point, which improves pedestrian visibility. Rectangular Rapid Flashing Beacons or Pedestrian Hybrid Beacons should be considered for most crosswalks at roundabouts, and the current version of PROWAG requires pedestrian activation for multi-lane pedestrian crossings at roundabouts.
- Use multi-lane roundabouts judiciously. Multi-lane roundabouts can lead to increased total crash rates, and can be difficult for pedestrians and bicyclists to navigate safely.
- Roundabouts can increase the level of discomfort experienced by bicyclists and pedestrians, with multilane and higher speed roundabouts causing the highest level of stress (see page 26: LTS).[150, 151] Smaller roundabouts can minimize vehicle speeds and are more comfortable for bicyclists and pedestrians. On larger or multilane roundabouts, deflect bicyclists via merges onto a shared-use path around the perimeter of the roundabout. This provides separation from vehicular traffic and enables bicyclists to use the pedestrian crossings.[152]
- Truck aprons can be used to accommodate freight traffic and emergency vehicles on roundabouts with a smaller diameter or on designated truck routes.
- If the roundabout is on a transit route, ensure that the design comfortably accommodates operation of the transit vehicle without the need to use the truck apron.

Mini-Roundabouts

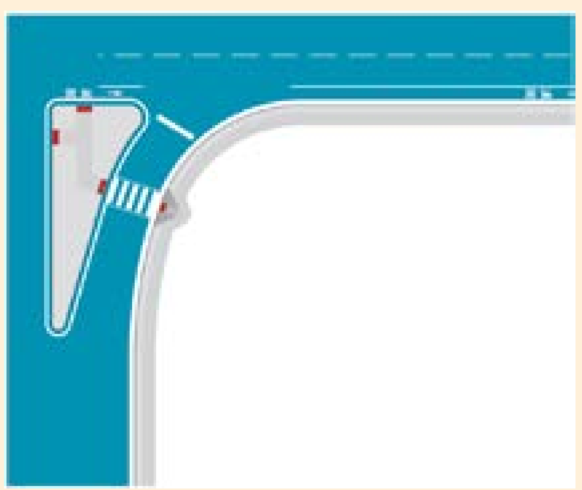
Roundabouts can be scaled to fit a wide range of contexts and street typologies. Mini-roundabouts and neighborhood traffic circles can be used on existing local residential streets to provide traffic calming and efficient vehicle flow; urban compact roundabouts can balance efficient vehicle flow with the needs of bicyclists and pedestrians.


Alexandria, VA

Channelized Right-Turn Lanes

Channelized right-turn lanes, also referred to as slip lanes, facilitate right-turn movements for motorists. They should primarily be used to enable right turns when the intersection geometry would otherwise make the turn infeasible, such as an acute angle.

By widening the intersection and enabling higher turning speeds, channelized right-turn lanes create a less inviting environment for bicyclist and pedestrians. They are therefore best suited for contexts that need to prioritize truck movements, and should be avoided in areas with bicycle and pedestrian activity. The drawbacks of channelized right-turn islands can be reduced through proper design, minimizing curb radii, and integrating pedestrian refuge islands into the turn island.



Where channelized right turns are necessary, they should be designed to slow driver turning speed and improve visibility of pedestrians, bicyclists, and on-coming motor vehicle traffic for the turning driver.

Design Guidance

Channelized right-turn lanes are most appropriate where:

- Geometric constraints make right turns difficult, such as an acute angle intersection.
- There is a high demand for right-turn movements by large vehicles.

Channelized right-turn lanes should be avoided in areas with high levels of bicycle and pedestrian activity, such as downtowns, mixed-use areas, and residential neighborhoods.

Design features:

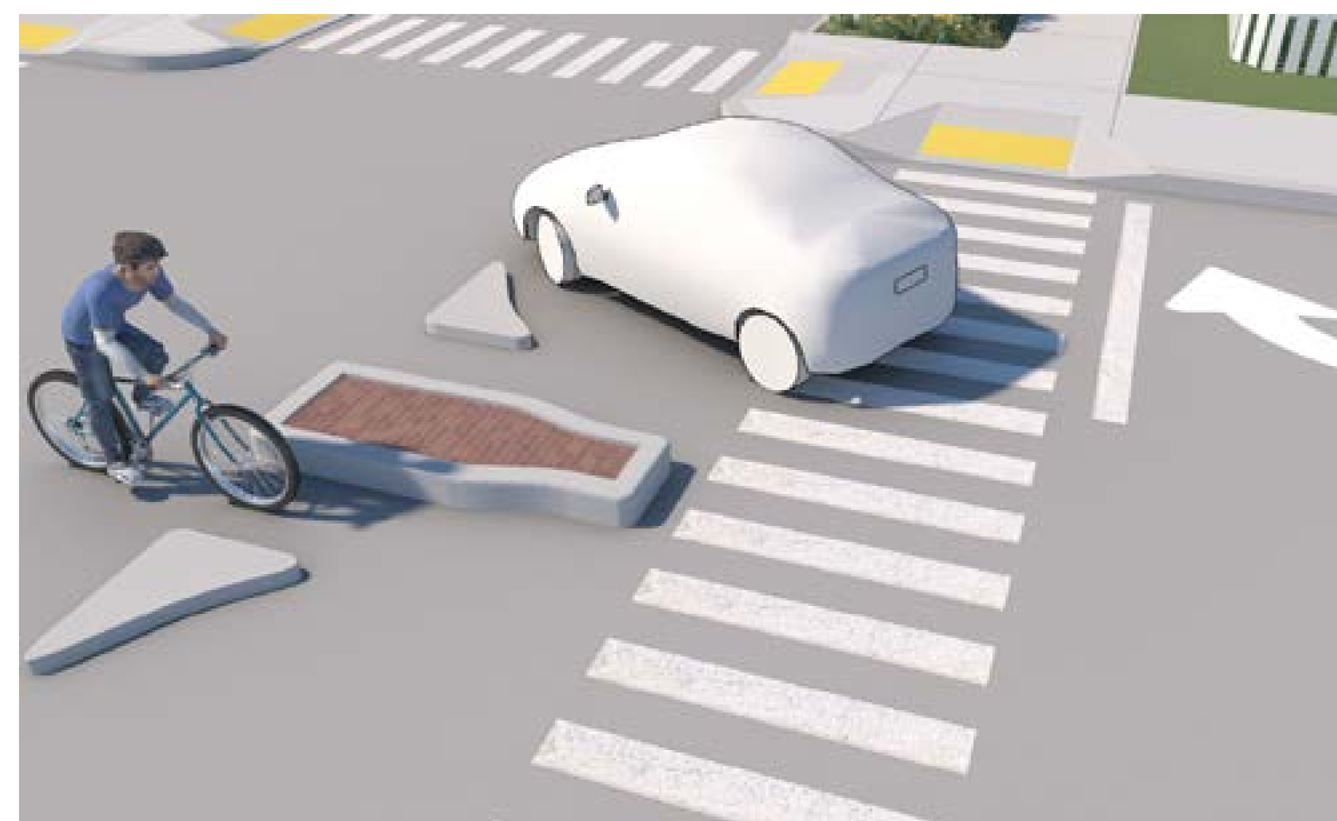
- Minimize the angle at which the right-turn lane intersects the cross street (e.g., 110 degrees)
- Minimize the curb radius (depending on the design vehicle) to slow vehicle speeds and improve visibility
- Minimize the width of the turn lane using edge and gore striping to narrow the perceived roadway width while still accommodating larger vehicles, if necessary
- Locate the crosswalk one car length back from the curb line
- Orient the crosswalk perpendicular to the flow of traffic
- Design the turn island as a pedestrian crossing island
- Do not provide an acceleration lane coming out of the turn, as it encourages motorists to take the turn quickly and not stop or yield at the intersection

Diverters

Diverters are a tool for traffic volume management. They are used to restrict the movement of vehicles onto a given street and deter its use as a through-traffic route. Diverters reduce traffic volumes and speeds, creating a friendlier environment for bicyclists and pedestrians. Diverters can take a variety of forms, such as curb extensions, medians, or islands.

Design Guidance

- Diverters may prohibit through traffic or a particular turning movement.
- Implementation of a diverter should be part of a larger strategy for traffic calming and traffic routing.
- Diverters should restrict vehicular movement while still accommodating pedestrian and bicycle access.
- Typical applications are along local roadways, either to discourage through traffic on a residential street or to support a bicycle boulevard.
- Consideration should be given to emergency vehicles; designs that allow access by emergency vehicles are preferred.



CURBSIDES

Curbsides are among the most important parts of a Complete Street. Properly utilizing and managing curb space is essential to connecting vehicles to the pedestrian realm and adjacent land-uses. While curbsides are often used for parallel parking, curb space is now recognized as a valuable link and barrier between moving traffic and pedestrians. Common uses of curbside space now include loading zones, transit stops, parklets, restaurant seating, bike lanes, bicycle parking, electric vehicle charging stations, bike share stations, scooter parking, and much more.

Proper utilization of curbsides can help improve safety, help businesses and residents, and make drivers and pedestrians feel more comfortable interacting with the space around them.

Curbside Management

Managing curbside space is an evolving part of Complete Streets. Traditionally, curbsides were used for on-street parking, but as the use of streets has evolved, alternative curbside uses have been identified that can help complete a street. This chapter discusses some of those, including loading zones and local deliveries, bus stops, and vehicle charging. On-street parking is still important for residences and businesses, and parking can enhance a street by providing a buffer between vehicles and the pedestrian realm. For streets with bike lanes or bike paths, on-street parking can act as a barrier between motorists and bicyclists, which increases the sense of safety for bicyclists and pedestrians.


Broadway in Troy, NY

On-Street Parking

On-street parking provides convenient access to adjacent land-uses and offers a desirable parking option for visitors arriving by car. It should be located based on the characteristics of the street, the needs of adjacent land-uses, and applicable local policies and plans for parking management. On-street parking supports many businesses, slows traffic, and provides a buffer for pedestrians. It can also enhance a street by providing a buffer between vehicles and the pedestrian realm. For streets with bicycle lanes or cycle tracks, on-street parking can separate motorists from cyclists, increasing the sense of safety for both cyclists and pedestrians.

The presence of on-street parking is not a requirement nor does it make a street more or less complete. Rather, on-street parking should be seen as a possible consideration for Complete Streets and should be properly designed to promote safety and provide accessibility benefits. In constrained environments, providing parking is a trade-off of to widening sidewalks or providing bicycle lanes or other design elements such as delivery zones, curb extensions, bus stops, or landscaping. In addition, the very presence of parking encourages driving. Parking needs to be carefully managed and incorporated into policies and programs to effectively maintain the principles of Complete Streets.

Design Guidance

The inclusion of on-street parking in the design of a Complete Street provides an opportunity to increase the number of available parking spaces across the municipality while simultaneously narrowing the roadway. It is important that the benefits of on-street parking are only implemented using appropriate design elements that avoid negative impacts, such as reduced sight lines and blocked crosswalks.

Parallel Parking

Parallel parking is the traditional arrangement for on-street parking that requires the least amount of roadway space and is the most compatible for streets with higher speeds. Road diets, which are often employed on roads that have excess travel lanes for the level of vehicle traffic volume or safety issues for bicyclists or pedestrians, can often incorporate parallel parking.

Parallel parking lanes should be between 7 and 9 feet wide.[153] Parking lane width reductions are a helpful part of implementing bus lanes or protected bicycle infrastructure.

Head-Out Angle Parking

Head-out angle parking is useful on low-speed streets as long as the extra curb-to-curb width is not achieved at the expense of sidewalk or bike lane width. Head-out angle parking improves the safety of the street by increasing drivers' line-of-sight of oncoming vehicles, bicyclists, and pedestrians when re-entering the travel lane. In addition, head-out angle parking eliminates the risk of dooring cyclists. This design approach can also be useful for narrowing the width of the roadway.

Driveways

On streets where driveways are frequent or ubiquitous, on-street parking should be considered non-essential. In these instances, roadway space can be utilized for expanded sidewalks, bicycle infrastructure, or other curbside uses.


Summit Street in Columbus, OH

Shared Parking

Shared parking is parking that is utilized jointly among different businesses and facilities in an area. Shared parking can be used to take advantage of peak parking characteristics that vary by time of day, day of the week, and season. Since the majority of parking spaces are only used part time, shared parking arrangements significantly reduce the amount of land devoted to parking needs.

Parking Pricing

The pricing of on-street parking is an important part of managing on-street parking and Complete Streets. Parking pricing is discussed further in this chapter.

Parking Minimums

While a number of downtowns in the Capital Region do not require parking, many municipalities do set minimum parking requirements for new buildings ("parking minimums"). This practice is intended to ensure that new development doesn't overwhelm the public parking supply (either on-street or a public parking lot). However, requiring all new buildings to provide off-street parking has many negative impacts on cities and towns. Minimum parking requirements:

- Spread development over a larger area, reduce density, increase municipal service costs, and encourage or even necessitate car ownership and use.
- Subsidize car ownership by transferring the cost of parking away from the user.
- Degrade design by encouraging people to build surface lots and garages rather than inviting storefront and residential facades.
- Reduce walkability by reducing density and placing active driveways and curb cuts.
- Increase flooding and overwhelm sewer systems with large impervious parking areas.

Further Guidance

- *The High Cost of Free Parking*, Donald Shoup

SIDEWALKS ROADWAYS INTERSECTIONS CURBSIDES

The provision of parking also increases the costs of development. These costs are passed on to residents and commercial establishments through higher rents and maintenance costs, and to consumers through higher prices for goods and services. As of 2012 the average cost of building an above-ground parking structure was $24,000 per space and for an underground structure, $34,000 per space.[154] In many communities, this high cost required to meet minimum parking requirements can prevent new development or renovations entirely.

Fundamentally, minimum parking requirements are based on the assumption that the demand for parking does not depend on its price and therefore the supply of parking should not depend on the cost. By decoupling the cost of parking from the user, the demand for parking is inflated and justifies further increases to the supply of parking.

As a result, many cities do not use minimum parking requirements and in some cases use maximum parking allowances. In Albany, building developers are able to provide amenities such as transit passes, on-site car sharing services, and bicycle parking in lieu of off-street parking spaces.

Accessible Parking

Where there are metered or marked parking spaces, accessible parking spaces must be included. Generally, 1 per 25 spaces - or 4% - should be signed as accessible. Accessible parking spaces should not have more than a 2% cross-slope, and should provide a level space for loading and unloading. In order to provide easy access to curb cuts and the entrances of buildings, site accessible parking spaces near the ends of blocks.[155]

In many communities, the high costs required to meet minimum parking requirements can prevent new development or renovations.


Alexandria, VA

Loading and Delivery Zones

Short-Term Loading Zones and Uses

Designated short-term loading zones are one approach to providing convenient access to storefronts and residences, reducing the likelihood of double parking, which causes obstructions to other users on the street. Short-term loading zones should generally be signed for between 5 and 10 minutes, and are ideal for quick pick-ups, high turnover businesses, and restaurants with delivery services. Short-term loading zones may need to remain active as long as adjacent businesses are open; for example, bars and restaurants may benefit from short-term loading zones late into the night.

Long-Term Loading Zones and Uses

Space that is specifically allocated for longer-term commercial loading and unloading activities allows the movement of deliveries and goods to operate smoothly, regardless of the street function. Designated long-term loading zones are one approach to providing convenient access to storefronts, reducing the likelihood of double parking, which causes obstructions to other users on the street. Long-term loading zones should generally be signed for less than 30 minutes, and may require a commercial license plate to be visible.

Delivery Coordination

If commercial loading zones are becoming overwhelmed, a community might pursue delivery coordination. Delivery coordination can encourage businesses to schedule deliveries at different times, helping to prevent double-parking or the blocking of other street uses, including emergency vehicles. Delivery coordination can be particularly important in places where double-parking or alleyways are not available to businesses, potentially frustrating delivery workers and businesses alike.

Washington Avenue in Albany, NY
Image courtesy of All Over Albany

Parking Pricing

An important curbside management tool is properly priced on-street parking by using meters, kiosks, and parking permits. Metered or time-restricted parking provides short-term parking for retail customers and visitors while discouraging long-term parking. Permits provide longer-term parking to residences or commuters.

Timed Parking

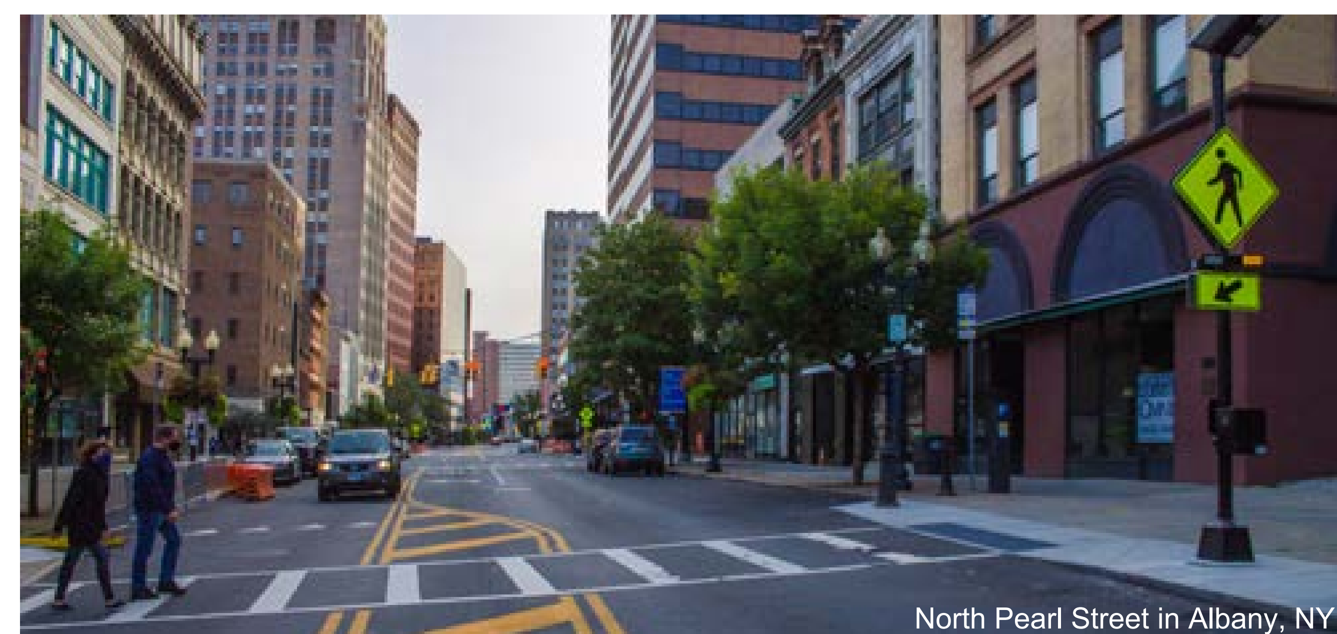
Placing time restrictions on short- and long-term parking and loading zones can help ensure that ample passenger and delivery vehicles can access businesses and residences throughout a day. Timed parking and loading zones may help address issues with double-parking and illegal parking without the addition of meters. Timed parking is usually achieved through the addition of relevant signage and enforcement.

Metered Parking

In communities with high demand for on-street parking, installing meters or parking kiosks may be a solution to double-parking and illegal parking. If timed parking alone is not enough to induce turnover in parking, proper pricing may help promote faster turnover times, improving access to businesses and residences. Meters may be individually placed alongside parking spaces, or may be consolidated into kiosks that may dispense a ticket or note a vehicle's license plate. Meters can be used to supplement short- or long-term parking and loading zones. Ensure that metered parking includes ADA accessible parking, as required.

Parking Permits

In areas with more residential land-uses or commuters, parking permits can help ensure that parking is available to access residences. Permits can also be used to allow longer-term guests, specific commuter or business parking, or commercial vehicle parking. However, parking permits generally do not facilitate short-term parking, which may be important for loading and unloading, and accessing businesses. Accordingly, it's important to designate short-term loading zones on blocks with permit parking.



North Pearl Street in Albany, NY

Bicycle, Scooter, and Motorcycle Parking

In areas with bicycle, scooter, or motorcycle traffic, allocate space along the curb for parking these smaller vehicles. A normal-sized parking spot can be used to park up to three or more motorcycles, and 10 or more bicycles or scooters. This helps keep bicycles, motorcycles, and scooters off of narrow sidewalks and visible to users. Space that is saved on the sidewalk can be used for furniture or planters, and placing this parking on-street can help encourage bicycles, scooters, and motorcycles to ride in the road instead of on sidewalks.

Bicycle Corrals

Bicycle corrals can include rows of bicycle racks installed in the curbside lane of the street instead of the sidewalk. Bicycle corrals provide ample bicycle parking without occupying sidewalk space and are a good treatment in locations where bicycle parking is desired but sidewalk space is limited. Bicycle corrals can also help “daylight” an intersection by preventing motor vehicles from parking close to intersections, beyond designated spaces. Bicycle corrals can be installed permanently or on a temporary basis for events or warmer months.

Recommended Dimensions for Bicycle Corrals

SIDEWALKS | ROADWAYS | INTERSECTIONS | CURBSIDES

Bus Stops

Bus stops are an essential part of transit in the Capital Region. When considering bus stop placement and use of the curb, remember that buses rarely stop for longer than it takes a car to parallel park. Buses also help alleviate congestion by reducing trips by personal vehicles. Adding curb extensions – bus bulbs – that allow buses to stop in the travel lane can help improve safety and travel times on busy or high-ridership corridors. This also helps prevent buses from getting stuck trying to pull in and out of traffic.

Buses should also not be impeded by taxis, ride-hailing vehicles, or trucks loading or unloading near bus stops. Proper “No Parking – Bus Stop” signage (MUTCD R-7 Series) or similar signage indicating no stopping or standing should be utilized. Enforcement is a key part of ensuring bus stops remain clear for transit vehicles, and providing adequate loading zones can be equally important.

Bus stops, like all parking and loading zones, should be avoided within 20 feet of crosswalks and 30 feet of controlled or signalized intersections.[156, 157, 158]

Design Guidance

- Standard bus stops should generally be placed on the far sides of intersections, allowing buses to proceed through a traffic signal before stopping for passengers.
- Bus stops at stop-sign controlled intersections or mid-block crosswalks should always be placed after the crosswalk or intersection. This ensures that pedestrians can safely cross behind the bus after disembarking and prevents multiple threat crashes.
- Bus stops should be designed to enable buses to stop in the travel lane, reducing the need for buses to pull in and out of vehicle traffic. Bus bulbs are considered the best option for roads with parallel parking.
- Bus stop pull-offs (out of the travel lane) should only be utilized where buses are idling for extended lengths of time.
- Bus stops should be designed to discourage personal vehicles from blocking the curb and landing platform. Loading and unloading from trucks, ride-hailing vehicles, and taxis can create a barrier for buses and people with disabilities. Bus bulbs are ideal for preventing bus stops from being misused by personal vehicles and trucks on roads with parallel parking.

South Pearl Street in Albany, NY

Electric Vehicle Charging

As Electric Vehicle (EV) ownership in the region increases, EV Charging will become an important part of curbside management. For visitors and Capital Region residents who don't have personal garages for parking, publicly available charging stations - or Electric Vehicle Supply Equipment (EVSE) - will be increasingly important. Communities may have opportunities to install electric vehicle chargers as a part of a Complete Street. EVSE should generally be included with parking pricing and meters.

As fast charging technology continues to improve, it may become possible to include charging stations along-side short-term loading zones. Care should be taken to implement networking options to ensure pricing schemes that limit long dwell times at the chargers, ensuring other users can access the charger. It is important to sign electric charging stations properly so that they arent blocked by vehicles that cannot use the chargers. Ensure that any curbside electric vehicle charging stations follow any revelant ADA-parking requirements.

Street users who may benefit from curbside power include:

- Public and Private Vehicle Fleets
- Electric Carshare Fleets
- E-Bikes
- Emergency Vehicles
- Transit Vehicles
- Delivery Vehicles
- Private Vehicles

Design Guidance

Charging station installations may be situated around institutional land-uses until a wider deployment of EVs and EVSE occurs in New York. Emphasis should be placed on installing:

- Level 2 Chargers
- Fast Chargers

EVSE may be suitable for installation in areas with:

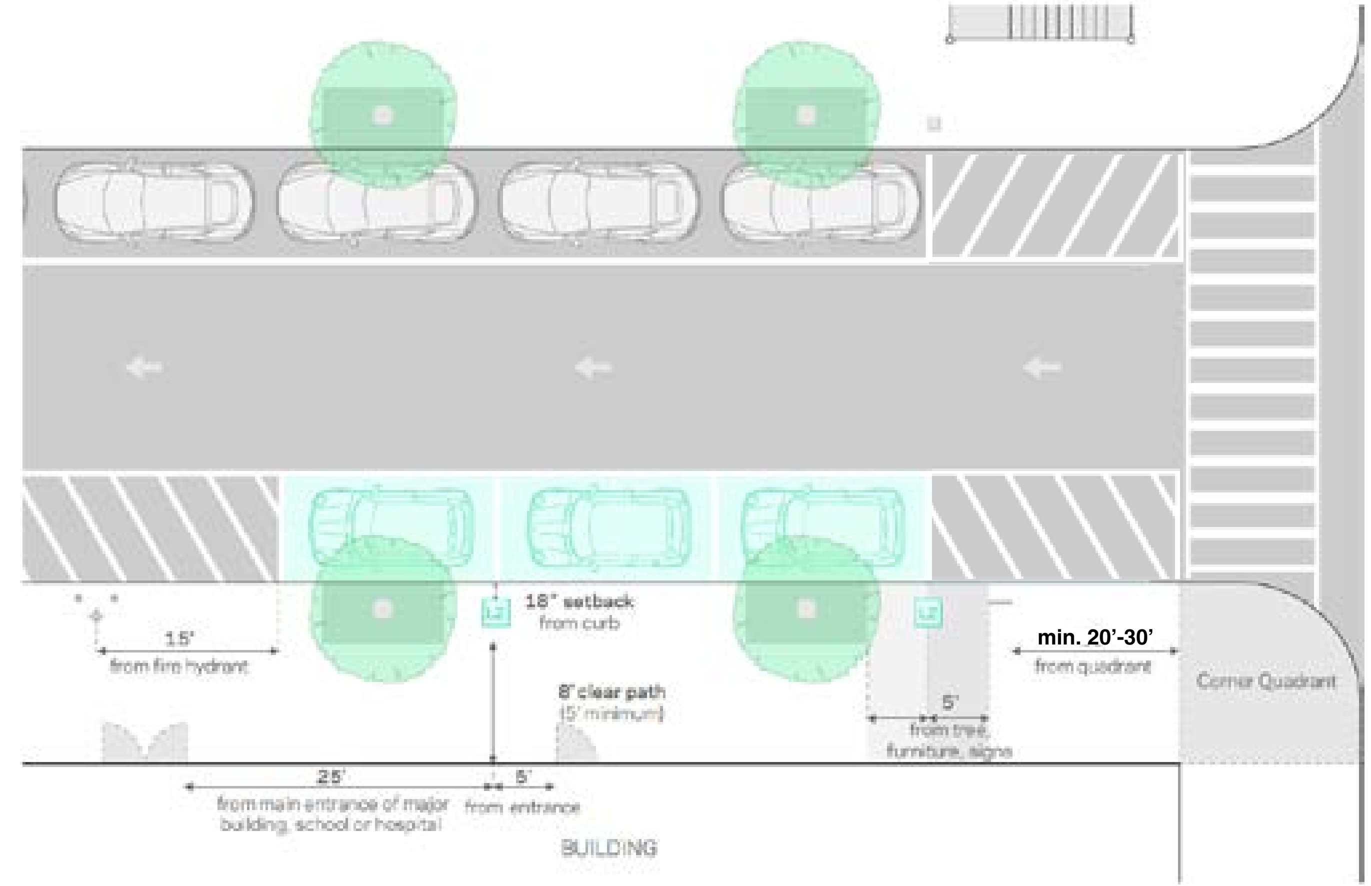
- High vehicle ownership levels
- High visibility, preferably near intersections
- Fewer disruptions to existing high parking demands
- Low access to existing parking lots or garages
- Low numbers of curb cuts
- Wide sidewalks, ideally wider than 15'

EVSE is best suited for driver's side (left-hand) parallel parking (usually found on one-way streets), head-out (back in) angled parking, or 90 degree parking. As of 2017, 68% of EVs in the US have their charging ports on the driver's side, and 54% have their charging ports on the driver's side rear. Because of this, installing EVSE with right-hand side parallel parking may be suboptimal or pose safety issues.

EVSE should never be be installed across bike lanes, or impede the path of travel for sidewalk users.

Charging units should be installed a minimum distance of:

- 18" minimum setback from curb and siting in
- the amenity strip
- 5' minimum clear path of travel (ADA)
- 8' preferred clear path of travel
- 10' from the trunk of a street tree or 5' from
- the edge of a tree pit
- 5' minimum from sign and legal furniture
- No parking within 15' of fire hydrant
- No parking within 20' of uncontrolled cross-walks and intersections, and 30' of controlled crosswalks and intersections
- 5' from a building entrance
- 25' clearance from the main entrance of a
- major building, school, or hospital
- 15' from bus stops[159]



Curb Enthusiasm, 2018. WYX Urban Design for NYSERDA and NYSDOT

Parklets

A parklet is a sidewalk extension that provides more space and amenities for people using the street. Parklets are typically installed in parking lanes and use one or more on-street parking spaces. A parklet re-purposes part of the street into a public space for people and is intended as an aesthetic enhancement to the streetscape. Parklets also provide public amenities such as seating, bicycle parking, art, and plantings. They are often funded and maintained by local businesses, residents, and/or community organizations because they can provide both a public amenity and a benefit to local businesses by offering outdoor seating for customers. Parklets can be temporary or permanently installed.

Recommended dimensions shown in the image below are six feet wide by 40 feet long. Vertical elements at least three feet tall provide separation from vehicles that are parking or traveling in the adjacent lane.

Further Guidance

- *San Francisco Parklet Manual*
- *Urban Street Design Guide*, NACTO

Recommended Dimensions for Parklets

Pop-Up Projects

Pop-up projects - often referred to as demonstration projects or temporary installations - are a tool for introducing new roadway features and designs before permanently making improvements. Pop-up projects are a way for communities of all sizes to install temporary and long-term Complete Streets features.

Design guidance for pop-up projects usually follows the designs of features listed throughout this design guide, but may utilize paint, tape, cones, and bollards instead of thermoplastic or concrete.

Pop-up projects in the Capital Region include:

- Tape-based Road Diets, Bike Lanes, and Contra-Flow Bike Lanes with cones in Watervliet and Schenectady (pictured top left)
- Tape-based Curb Extensions and temporary bollards in Albany (pictured top right)
- Tape-based On-Road Trails and Two-Way Bike Lanes with cones in Saratoga Springs (pictured bottom right)
- Paint-based Curb Extensions and temporary bollards in Watervliet and Schenectady (pictured bottom left)

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