massDOT
Massachusetts Department of Transportation

MUNICIPAL RESOURCE GUIDE

FOR WALKABILITY

MAY 2019

MASSACHUSETTS
PEDESTRIAN
TRANSPORTATION PLAN

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Letter from the Secretary

I am pleased to present the Massachusetts Department of Transportation's **Municipal Resource Guide for Walkability**. MassDOT created this Guide to help municipalities address some of the most common questions and challenges regarding walkability. This Guide is an element of MassDOT's 2019 **Pedestrian Transportation Plan**. Walking is the most basic and fundamental form of transportation for people of all abilities, including those using assistive devices. Everyone is a pedestrian at some point, whether walking to a local store, traveling to school, accessing a transit stop, or crossing the street to get to their car. MassDOT is committed to ensuring that Massachusetts residents and visitors have safe, accessible, and connected walking routes to encourage walking as an everyday form of travel.

MassDOT regularly works with critical stakeholders—and no stakeholder is more critical than the Commonwealth's municipalities. For pedestrians, this relationship is particularly important, as the vast majority of sidewalks in Massachusetts—92 percent—are under local ownership and control. Together, MassDOT and municipalities can promote walking for transportation and recreation for people across the Commonwealth. By using resources such as the Complete Streets Funding Program and Safe Routes to School, MassDOT is partnering with municipalities to make investments in programs and projects that support accessibility, connectivity, and mobility. The Guide also discusses the important relationship between walking and transit and how best practices in transit access and transit stop design can be applied across a variety of contexts.

I would like to thank all of those inside and outside of MassDOT who contributed to this Guide, including municipal staff who provided valuable feedback on the challenges and opportunities to developing walking infrastructure at the local level. Not only does this Guide address the physical elements essential to walkability—walkways, direct and convenient routes, and safe crossings—but it also provides best practices and case studies on how municipalities can maintain walkways both during the winter and on a year-round basis. Ensuring that pedestrians of all abilities have access to our public right-of-way is an essential component of the Americans with Disabilities Act of 1990 (ADA). MassDOT is committed to ensuring accessibility on our own facilities and supporting its municipal partners in doing the same. The Guide clarifies the responsibilities municipalities have under ADA and offers solutions to the most common issues encountered when developing ADA Transition Plans and upgrading streets, sidewalks and crosswalks to ADA compliance.

MassDOT has been working for years to make our transportation system more sustainable, to encourage the use of walking, biking, and transit, and to ensure that roadway designs are safe and convenient for all users. This Guide—and the **Pedestrian Transportation Plan** of which it is part—builds upon the work of the award-winning **Project Development & Design Guide** (2006), the **GreenDOT Policy Initiative** (2010), the **Healthy Transportation Directive** (2013), and the internationally recognized **Separated Bike Lane Planning & Design Guide** (2015). The Municipal Resources Guide for Walkability represents MassDOT's continued commitment to partnering with municipalities to build Complete Streets that are accessible, safe, and convenient for users of all ages and abilities.

Stephanie Pollack
Secretary of Transportation and Chief Executive Officer
Massachusetts Department of Transportation

Introduction

As part of the MassDOT Pedestrian Transportation Plan, the Commonwealth has developed the following vision for walking:

Short trips can be walkable if people feel safe and comfortable.

The Municipal Resource Guide provides an introduction to the core concepts of walkability and outlines additional resources that are available on each topic. The Guide is intended to provide communities with the tools and information needed to hold discussions on why and how to improve walkability. The audience for this Guide is community practitioners: municipal staff, elected officials, volunteers, residents, and advocates.

The topics addressed in this guide were selected based on input received during stakeholder interviews with representatives of the following:

- Municipal Planning, Engineering, Economic Development and Department of Public Works staff
- Disability Commissions and Advocates
- Regional Planning Agencies
- Regional Transit Agencies
- Massachusetts Department of Public Health
- Mass in Motion Coordinators
- Massachusetts Municipal Association
- MassDOT
  - Office of the Secretary
  - Districts
  - Traffic Engineering
  - Safety Section
  - Project Management
  - Highway Design
  - Right-of-Way
  - Snow & Ice Operations
  - Massachusetts Bay Transportation Authority
  - Complete Streets Funding Program
  - Office of Civil Rights
  - Safe Routes to School
  - Walking and Biking Working Group

PEDESTRIAN

Throughout this Guide, and the 2019 Massachusetts Pedestrian Transportation Plan, the terms "walking" and "pedestrian" are used inclusively of people of all abilities including those using assistive devices.

The Massachusetts Bicycle and Pedestrian Advisory Board (MABPAB) serves as the Steering Committee for the Pedestrian Transportation Plan. The MABPAB was established by law in 2004 and serves in an advisory role advancing bicycle and pedestrian transportation for MassDOT and other state agencies. Its members are appointed by the Governor of the Commonwealth.

Contents

This Guide is organized into seven chapters, each of which focuses on a specific topic related to development and maintenance of pedestrian infrastructure. Each chapter features key information about the topic as well as links to additional resources.

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Why is Walkability Important?

Every trip involves walking at some point, whether it is getting to a bus stop, crossing a street, or getting from a parked car to a building entrance. The term "walkable" can apply to both communities and roadways that are accessible, safe, comfortable, convenient, and well-connected. When greater numbers of people walk, communities can experience social, economic, health, and environmental benefits. Municipalities that invest in programs and infrastructure projects to encourage walking can realize these benefits at the community level.

Walkability can help rural, suburban, and urban municipalities advance their goals related to mobility, safety, economic development, public health, sustainability, and equity. Pictured above: Main Street in Northfield.

Benefits of Walkable Communities

Mobility and Connectivity

- Accessible communities **increase mobility options for everyone** and are essential for the mobility of people with physical disabilities, limited mobility, or without access to a vehicle.
- Investments in accessibility upgrades can also **benefit transit users** who need to travel to and from bus stops or rail stations. Transit can be more appealing to use when the access routes feature sidewalks, accessible curb ramps, and conveniently located road crossings. For more information, see Pedestrian Access to Transit on page 37.
- Walking infrastructure **increases opportunities for recreation** by connecting residents and employees to parks, trails, and open spaces.

Safety

- Designing communities to be walkable can help **improve safety for all modes.** Elements of walkable communities—greater intersection density and fewer lanes on major roads—are associated with fewer total, severe, and fatal crashes because they slow vehicle speeds and encourage more predictable behaviors.[13]
- A pedestrian hit by a vehicle travelling at **20 mph** has an **18 percent** likelihood of a severe injury or death. That likelihood increases to **77 percent** if the vehicle is travelling at **40 mph** (see Figure 1).[14] For more information, see Safety on page 23.
- Research on injury crash rates shows that **safety improves as more people walk**. For example, doubling the number of people walking corresponds to a **34 percent** decrease in an individual's risk of being struck by a vehicle.[15]

Health and Wellness

» Walking is an easy way for people to get physical activity, which **can improve an individual's physical health and fitness**. Research shows walkable communities correlate with improved health.[1 2 3]

» Greater intersection density, greater street connectivity, and fewer lanes on major roads—tenets of walkable communities—correlate with a **reduction in obesity, diabetes, high blood pressure, and heart disease rates**.[4]

» Studies suggest that physical activity, like walking, may **improve mental health, increase happiness, and promote well-being.**[5]

» Research shows that children who walk or bike to school arrive focused and ready to learn, because physical activity substantially **benefits brain function and cognition**.[6]

» **Walking can reduce health care costs.** Walking an additional **8 minutes** per day is estimated to reduce health care costs by **$5,500** over a lifetime.[1]

Economic Development

» Studies show communities with greater walkability have **increased economic activity** and help attract new businesses.[7 8 9]

» Homes in walkable neighborhoods have **higher values** than homes in less walkable neighborhoods. Studies have shown premiums of more than $30,000 for homes in walkable neighborhoods.[8 10 11]

Figure 1. Pedestrians involved in crashes with motor vehicles are more likely to be severely or fatally injured when vehicle speeds are higher.[14]

Environment

» When people replace driving trips with walking trips, it can **reduce carbon dioxide emissions**, the primary greenhouse gas contributing to climate change.

» Getting more people to walk rather than drive for short trips means **less air pollutants that are harmful to breathe,** such as carbon monoxide, nitrogen oxides, hydrocarbons, and particulate matter.

» Walkable roadway designs often incorporate more space for trees, landscaping, and pervious surfaces, which **reduces stormwater run-off and increases groundwater infiltration.**

Equity

» Improving walkability can **help achieve various equity objectives** by providing infrastructure that all can use, regardless of economic wealth or physical mobility.

» The cost to own, operate, and maintain a vehicle accounts for nearly $8,500 per year, or about **94 percent** of the average household's annual transportation costs.[12] **People who walk may be able to reduce the use of or eliminate household motor vehicles**, potentially reducing household transportation expenditure.

Explore More Resources

» Pedestrian and Bicycle Information Center Library, Federal Highway Administration. http://www.pedbikeinfo.org/data/factsheet.cfm

Roadways that do not have dedicated crossing areas can put pedestrians in dangerous situations when they cross the roadway.

Elements of Walkable Communities

Walkable communities feature a mix of uses and infrastructure to support walking.

Complete Streets

Complete Streets is an approach to transportation policy and infrastructure design that seeks to provide safe and comfortable facilities for all road users regardless of age or ability in a manner appropriate for the context of the roadway. In practice, this means considering the needs of and providing space for people walking, bicycling, taking transit and driving. MassDOT's Complete Streets Funding Program provides training, design guidance, and funding for municipalities to construct Complete Streets.

MassDOT is committed to creating safe, well-connected, and accessible walking environments throughout the Commonwealth. Municipalities are essential partners in this effort because the vast majority of sidewalks in the Commonwealth—92 percent†—are under local jurisdiction.

This chapter is intended as a guide for municipalities to improve the walking environment. An overview of the relationship between land use and walkability is provided, followed by details on walkway and crossing design elements. Given the variety of rural, suburban, and urban settings in Massachusetts, it is important that these design elements are context sensitive and can support the goals of each community.

Funding Tools for Municipalities

Municipalities have a variety of funding tools available to assist them with the design and construction of pedestrian projects including the following:

- Chapter 90
- MassDOT Complete Streets Program
- State or regional transportation improvement plans
- Safe Routes to School
- Capital Investment Plan
- MassWorks Infrastructure Program Grants
- USDOT BUILD Discretionary Grant Program

† Based on the MassDOT Road Centerline geographic information system (GIS) file, 10,876 of the total 11,804 total sidewalk miles in Massachusetts are under municipal jurisdiction.

Major destination

Figure 2. A connected street network (left) provides shorter, more direct routes between origins and destinations, while disconnected street networks (right) can increase travel distances.

Design Standards

Roadway projects should be designed following applicable guidelines and standards, including but not limited to:

- MassDOT **Project Development and Design Guide (PD&DG)**
- Federal Highway Administration (FHWA) **Manual on Uniform Traffic Control Devices (MUTCD)**
- National Association of City Transportation Officials (NACTO) **Urban Street Design Guide (USDG)**
- American Association of State Highway and Transportation Officials (AASHTO) **Guide for the Planning, Design, and Operation of Pedestrian Facilities**

Community Design

Land use and transportation are highly interdependent. The way a community is designed influences people's transportation choices.

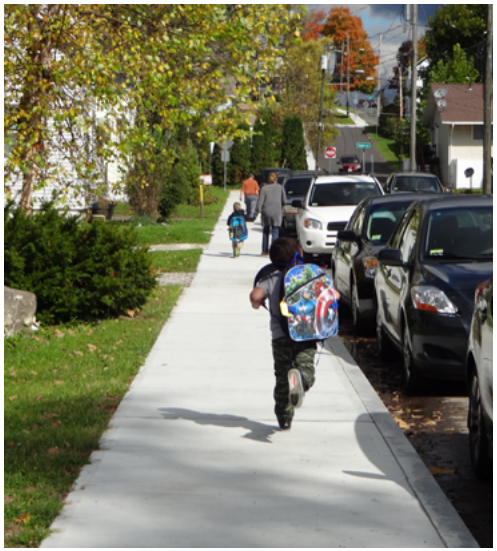
Two overarching elements of community design are important for walkability. First, compact, mixed-use communities encourage walking because distances are typically short enough to be covered on foot.[18] Mixed-use communities have been shown to have higher rates of walking trips.[19] Second, design elements such as the placement of buildings, the layout of the street and sidewalk network, streetscape elements, landscaping, and other features influence the likelihood that people will choose to walk.[18] [20] [21]

According to national surveys, **50 percent** of walking trips are less than one mile while only **7 percent** are longer than five miles.[22] This shows that proximity of origin and destination points is a factor in walkability. Even in rural communities, there is typically a village center or other district that would benefit from walking infrastructure.

Destinations

Density and land use mix are important elements of walkable communities. Research has found that communities with a higher concentration and diversity of uses—especially those that meet daily needs such as grocery stores, civic and community spaces, retail establishments, restaurants, pharmacies, and other goods and services—encourage walking by making it part of people's everyday routine.[21] Routine walking trips can include walking to school or work, errands, or recreational trips on paths or trails.

Fortunately, Massachusetts has an abundance of historic mixed-use town and city centers that provide the built-in density that supports walkability. Communities can leverage these assets by incentivizing redevelopment in areas with existing density and good multi-modal access. Municipalities planning for new growth can establish zoning regulations to encourage development that replicates features found in historic areas, such as compact mixed-use centers, smaller block sizes, shorter



Sidewalks are fundamental to walkable communities.

setbacks, and housing in close proximity to retail, schools, and other services.

Street and Sidewalk Layout

A well-connected street grid with small block sizes can encourage walking because it typically provides shorter routes between origins and destinations.[23] Neighborhoods that feature disconnected streets and cul-de-sacs can discourage walking by increasing the distance between origins and destinations, even when they are geographically close together (see Figure 2). Where the street grid is spread out or disconnected, a useful walking network can be established by introducing pedestrian shortcuts between parcels and via public easements.

Providing a sidewalk represents a significant safety benefit. Research conducted by FHWA has shown that the presence of sidewalks was associated with an **88 percent** reduction in "walking along roadway" crashes.[16]

Municipalities should consider including requirements for walking facilities, such as sidewalks, shared use paths, and connectivity easements, in their subdivision ordinances.

Building Placement

The way buildings are situated in relation to the street—particularly in commercial areas—indicates whether or not an area is walkable. Active frontages directly abutting the sidewalk—such as stores, restaurants, windows, and public parks—have been linked with increased pedestrian activity.[21]

Municipal zoning regulations can require that new development is sited close to or at the edge of the public right-of-way and that building entrances are located facing the sidewalk. Parking can be placed behind buildings to provide direct access to building entrances from the sidewalk. Communities can consider shared parking to manage parking supply while also reducing impervious surface. Reducing building setbacks is also a recognized strategy to support traffic calming because it conveys a village or town center environment where lower vehicle speeds and increased attentiveness are expected.

Access management is a related strategy to reduce the number of driveways on a corridor while providing access to adjacent land uses. Driveways are a potential conflict point between people walking and vehicles, therefore reducing driveway frequency is a strategy to enhance safety. Environments with frequently spaced driveways have been found to decrease the appeal of walking between retail destinations.[18]

For more information, see:

- Section 16.5.1 of the PD&DG
- Chapter 15 – Access Management of the PD&DG
- Urban Land Institute's Shared Parking

Walkways

Walkways are inclusive of sidewalks, paths, and other locations where pedestrians are permitted. In many locations, walkways are a separate linear space parallel to a roadway. Less frequently, walkways can include a space shared with other modes in a low speed environment. This section describes common walkway types, their applicability, and key design considerations.

Certain minimum requirements apply to all walkways in order to comply with the Americans with Disabilities Act (ADA). More information on walkway accessibility requirements can be found in ADA and Accessibility on page 30. As a best practice, walkways (continued on page 14)

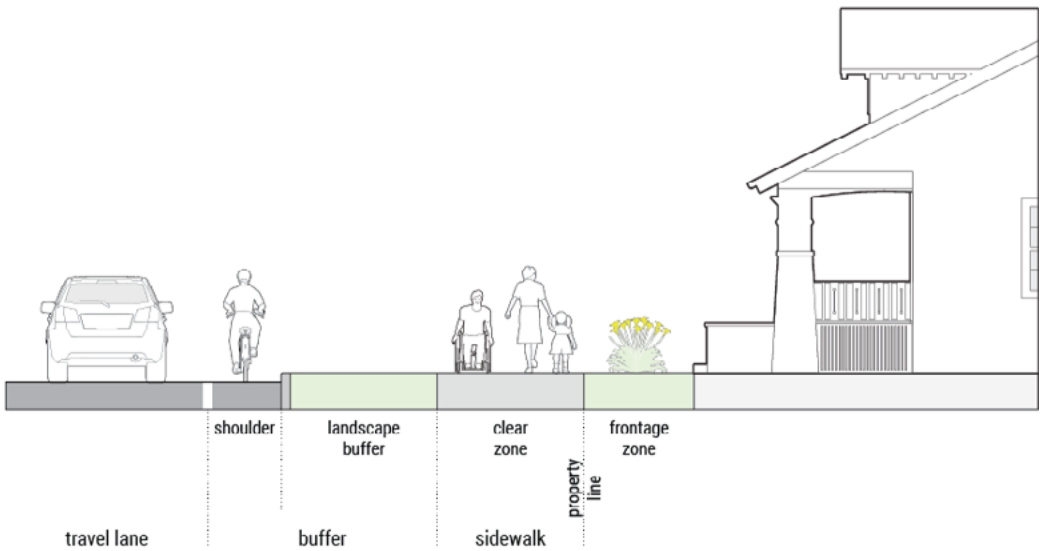


Figure 3. Functional Zones in a Medium- to Low-Density Residential Environment

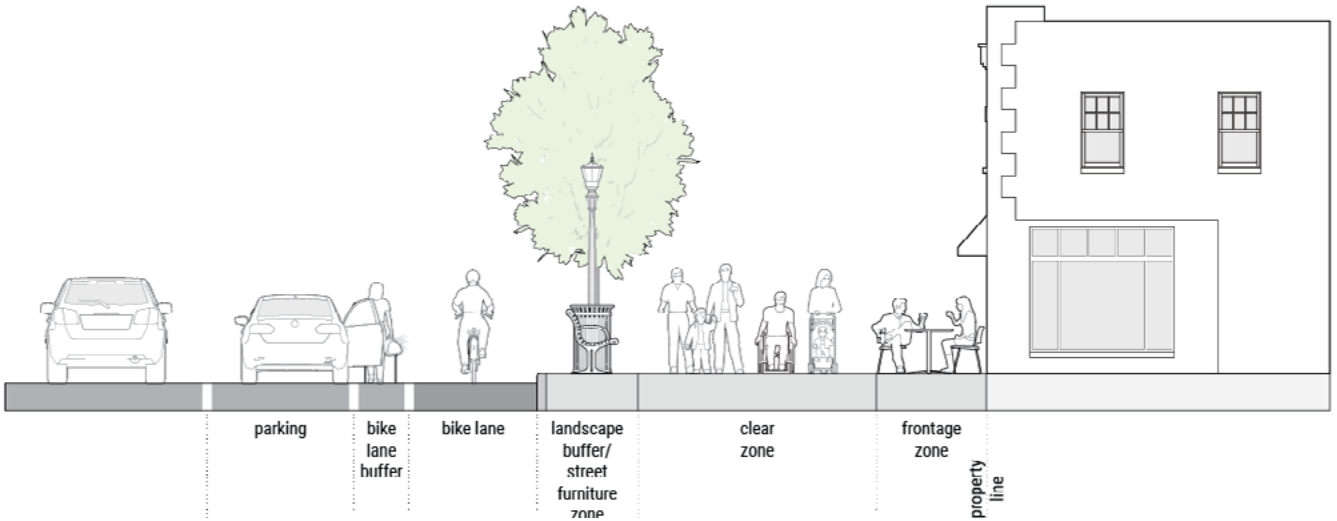


Figure 4. Functional Zones in a Town or Village Center Mixed-Use Environment

Case Study: Lincoln

Lincoln has developed an 80-mile network of trails and roadside paths for pedestrians, giving the town's 6,400 residents the opportunity to walk between neighborhoods, parks, schools, churches, town hall, the commuter rail station, and the library. The town's conservation department and the Lincoln Land Trust maintain and operate the trails. Licenses and easements have been granted by private property owners, and online maps guide people throughout town. Visit Lincoln Land Conservation for more information.

Figure 5. Shared use paths can provide more direct routes between origins and destinations in communities with a disconnected street network.

should be designed to standards described in the U.S. Access Board's Public Right of Way Accessibility Guidelines (PROWAG).

Sidewalks

Sidewalks provide pedestrians with an area to walk that is physically separated from motor vehicles. Typically separated from the roadway with a vertical **6-inch** curb, sidewalks are the safe and accepted standard for providing walking facilities along a roadway. Concrete is a preferred surface material because of its durability. Asphalt may also be used but may requires more frequent repair. Brick sidewalks create numerous challenges: they are slippery when wet, difficult to clear of snow and ice, and can be difficult to navigate for people with mobility impairments.

A buffer between the sidewalk and roadway should be provided to enhance the safety and comfort of people walking, particularly on roads with higher motor vehicle traffic speeds and volumes. Buffers may also help to reduce exposure to harmful vehicle emissions.[17] Buffers vary by context and can include, but are not limited to, a parking lane, landscaped strip, and/or a bicycle facility. In a constrained right-of-way, the value of providing a buffer should be weighed in conjunction with requirements for other cross section elements.

Streetscape Elements

Sidewalks can be enhanced through the placement of streetscape elements, which support walkability by providing amenities and creating an attractive environment for people who are walking. The placement and type of streetscape elements depends on the roadway context and adjacent land uses. The pedestrian realm can be divided into functional zones as shown in Figure 3 and Figure 4.

Along roadways in town centers and urban environments, streetscape elements can include benches, trees, refuse receptacles, informational signage, water fountains, and

An example of a transition from a sidewalk to a shoulder featuring a detectable warning surface.

Low volume, low speed local roads may be appropriate for a shared roadway treatment.

An example of a well-lit crosswalk and a sidewalk with pedestrian scale lighting.

other amenities. These elements should be in the street furniture zone between the curb and the sidewalk, providing a buffer between pedestrians and automobile traffic. Elements such as fire hydrants, light poles, sign posts, and bicycle racks should be located so that they do not impede access for pedestrians.

Rural areas are often characterized by tree-lined roads and fields. Many rural communities have an interest in retaining these features. Designers have the flexibility to route sidewalks or paths around mature trees, rock outcroppings, and other natural features to reduce the need for clearing, regrading, or both. Right-of-way and environmental constraints can affect the feasibility and placement of sidewalks or paths in the rural environment.

Paths

Many communities build paths and trails for pedestrians using a variety of impervious or pervious surface types. There is a wide variety of path types, ranging from narrow and informal to wider paved paths designated for shared use with people bicycling. Paths may or may not follow roadway alignments.

In communities where the street network is disconnected, paths can be an effective strategy to create more direct routes for people walking (see Figure 5). Pedestrians are particularly sensitive to out-of-direction travel and benefit from direct routes. For more information, see Chapter 11– Shared Use Paths and Greenways of the PD&DG.

When developing or reconstructing shared use paths, communities should design for anticipated use. For example, when user volume exceeds certain thresholds, all users may benefit from a wider path or separate parallel pathways designated for slower and faster users.

For more information on determining when a wider path or separation may be necessary, see:

» Shared Use Paths in FHWA's Achieving Multimodal Networks

» FHWA's Shared-Use Path Level of Service Calculator–A User's Guide

Shared Roadways

Planners and designers should always strive to provide the safest facility feasible. Separated pedestrian facilities—such as sidewalks or shared use paths—are always the preferred treatment because they provide space for pedestrians separate from motor vehicles and therefore avoid the

potential for conflicts. Shared use paths can maintain an area's rural character while still providing a level of safety that is not possible with a shared facility.

However, in some locations it may be appropriate to accommodate pedestrians in the roadway. This should be limited to local roads where traffic volumes and speeds are low (up to **2,000 vehicles per day** and up to **30 mph**).

Marked shoulders can provide pedestrian accommodations on roadways in sparsely developed areas. The shoulder should be a minimum of **4 feet**. Wider shoulders are desirable where there are higher traffic speeds or truck volumes. If a shoulder is the chosen pedestrian facility, it should meet the Massachusetts Architectural Access Board requirements for "walkways" under 521 CMR, to the extent feasible. For more information, see Section 5.3.1.2 of the PD&DG.

Advisory shoulders are an alternative treatment on lower volume (up to **6,000 vehicles per day**), lower speed (up to **35 mph**) roadways. Motorists are allowed to use advisory shoulders to pass other vehicles after yielding to or in the absence of pedestrians. In order to install advisory shoulders, an agency is required to obtain an approved Request to Experiment from FHWA as detailed in Section 1A.10 of the MUTCD. For more information, see "Advisory Shoulders" in Chapter 2 of FHWA's Small Town and Rural Multimodal Networks.

Lighting

Illuminating sidewalks and crossings makes it easier for people to see when walking at night and also increases their visibility to drivers. There are many considerations when selecting, designing, and implementing lighting to enhance the pedestrian environment. The presence of pedestrian-generating land uses and existing or anticipated pedestrian crossing activity should be considered when determining the appropriate level of illumination.

Lighting fixtures should be consistent with any historic district requirements and, to the greatest extent possible, minimize light pollution by directing the light source toward sidewalks and crosswalks. Consider selecting pedestrian-scale fixtures that are closer to the ground than highway-scale fixtures, and varying illumination levels by context (for example, greater illumination in commercial areas compared to residential areas).

Other considerations include spacing, relation to the tree canopy, bulb types and color of light, and routine bulb replacement.

For more information, see:

» Roadway Lighting by American National Standards Institute

» Lighting at FHWA's Pedestrian and Bicycle Information Center

Crossings

In Massachusetts and nationally, the ability to safely cross a roadway is important for

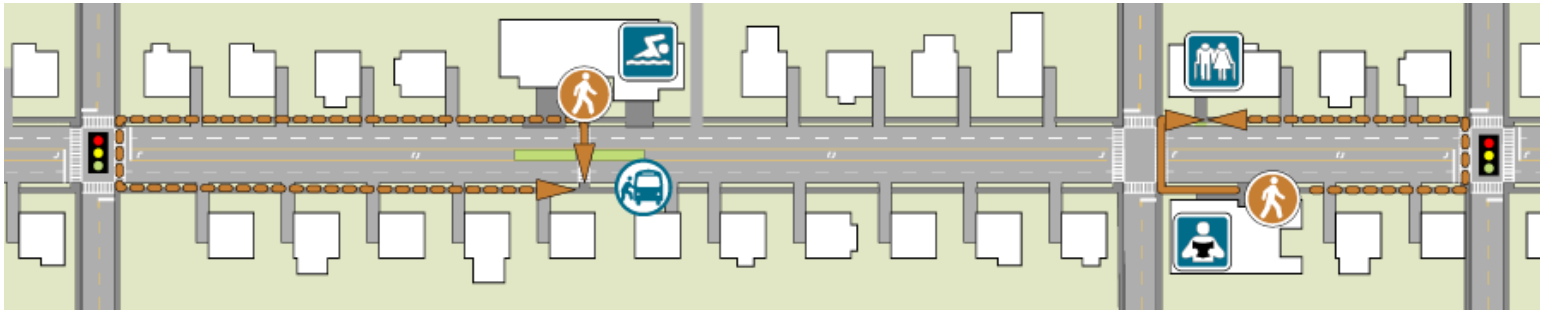


Figure 6. Crosswalk Placement and Walking Distance. Credit: FHWA Achieving Multimodal Networks

people walking, as more pedestrian crashes occur when people are crossing the roadway rather than walking along it.[24] Depending upon the context, design treatments may vary and can include features from the easy-to-install signs and pavement markings to more infrastructure-focused options such as traffic signals and curb extensions.

While applications will need to be selected based on site-specific characteristics, it is important that treatments be applied uniformly and as described in the MUTCD. A lack of uniformity can distract or confuse both drivers and people walking.

Placement

70 percent of pedestrian fatalities occur at mid-block locations.[25] This reflects the importance of providing safe places for people to cross the street. Enhancements such as signs, pavement markings, crossing islands, and lighting can be applied to improve safety at a location where people want to cross the street. It is also worthwhile to note that each approach to an intersection (signalized or unsignalized) is a legal pedestrian crossing even if no crosswalks or curb ramps are provided.

In developed areas, crossing demand can be anticipated where there are pedestrian generating land uses on either side of a street (see Figure 6). People walking are sensitive to out-of-direction travel and may choose the most direct path even if there is no marked crosswalk. Safety and connectivity both benefit from the presence of well-sited and appropriately designed crossings, both at intersections and midblock where there are desire lines.

Crosswalks should be spaced **200 to 300 feet** apart in developed areas, though up to **500 feet** is acceptable. It is a best practice to provide a crosswalk on all legs of a signalized intersection. For more information, see:

- Section 5.3.1.1 of the PD&DG
- Enhanced Crossing Treatments in FHWA's Achieving Multimodal Networks

Pavement Markings

Crosswalks pavement markings indicate to people walking the intended route through an intersection or mid-block crossing. Several different types of crosswalk patterns are in common usage, including parallel bars, diagonal, and ladder (or "continental"). Ladder crosswalks provide higher visibility and are the preferred treatment at unsignalized crossings. Stop or yield bars can also be placed in front of crosswalks. For more information, see:

- Section 6.7.7.1 of the PD&DG
- Section 3B-16 and 3B-18 of the MUTCD.

Signs

Various signs may be placed at marked crosswalks, indicating that motorists must yield for pedestrians crossing within them. In-roadway and overhead signs increase the visibility of crosswalks, compared with signs posted on the sides of roadways. For wide crossings, which expose pedestrians to vehicular traffic for a longer period of time, measures in addition to signs may be needed. For more Information, see Sections 2B.11, 2B.12, 2C.50, and Chapter 7B of the MUTCD.

Figure 7. Example of a hybrid beacon (top) and an RRFB (bottom)

Figure 8. Leading Pedestrian Interval sequencing

Flashing Beacons

Three primary types of flashing beacons may be used to warn motorists of pedestrian crossings:

» **Pedestrian hybrid beacons (PHB)** - pedestrian-activated warning device located on the roadside or on mast arms over mid-block pedestrian crossings. The beacon head consists of two red lenses above a single yellow lens (see Figure 7).

» **Warning beacons** - consists of one or more signal sections of a standard traffic signal face with a flashing circular yellow signal indication in each signal section. Warning beacons may only be used to supplement an appropriate warning or regulatory sign or marker.

» **Rectangular rapid flash beacons (RRFB)** - consists of a pedestrian warning sign, diagonal downward arrow plaque, and user-activated light-emitting diodes (LEDs) using an irregular flash pattern. See Chapter 4F and Section 4L.03 of the MUTCD, as well as FHWA's RRFB Informational Sheet. RRFBs are not yet incorporated into the MUTCD, but MassDOT and local agencies have interim approval from FHWA to use them (see Figure 7).

Traffic Signals

Signals should include pedestrian indicators with countdown timers and pedestrian phases timed at a minimum of **3.5 feet** per second which allows enough time for people who walk more slowly than average to cross. Approaches may include automatic methods for detecting pedestrians, programming signals so that walk cycles automatically appear, and concurrent phasing featuring leading pedestrian intervals as described below. Accessible pedestrian signals (APS) are required at all signalized crossings regardless of whether or not the walk phase is automatic. For more information, see:

» Accessible Pedestrian Signals on page 34

» Pages 37 – 40 of FHWA's Achieving Multimodal Networks

Leading Pedestrian Intervals

Leading pedestrian intervals (LPI) give pedestrians a head start at signals. The walk phase begins three to seven seconds before parallel traffic gets the green light, allowing pedestrians to enter the crosswalk before motorists begin to move (see Figure 8). This reduces conflicts by making people walking more visible to motorists and allows

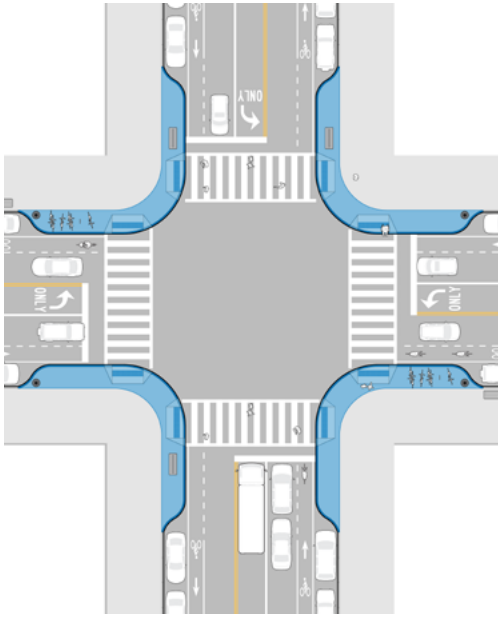


Figure 9. Curb extensions

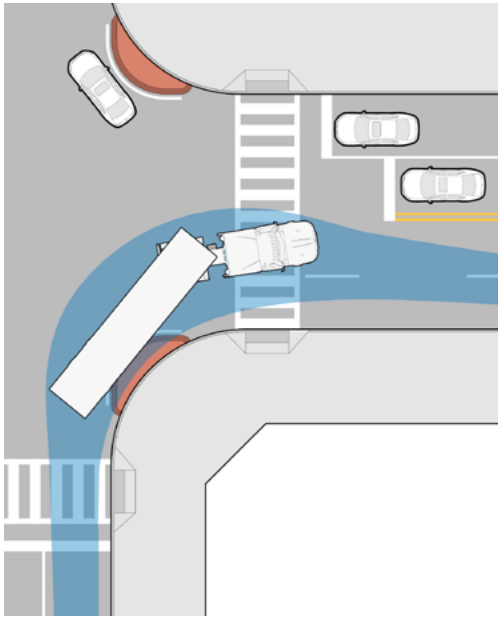


Figure 10. Mountable truck apron

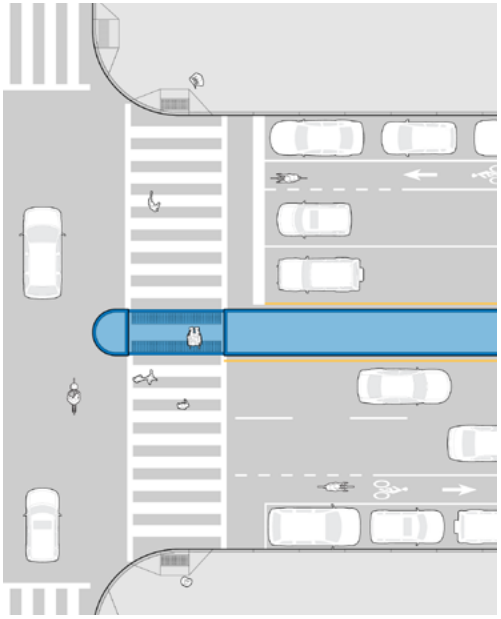


Figure 11. Median crossing island

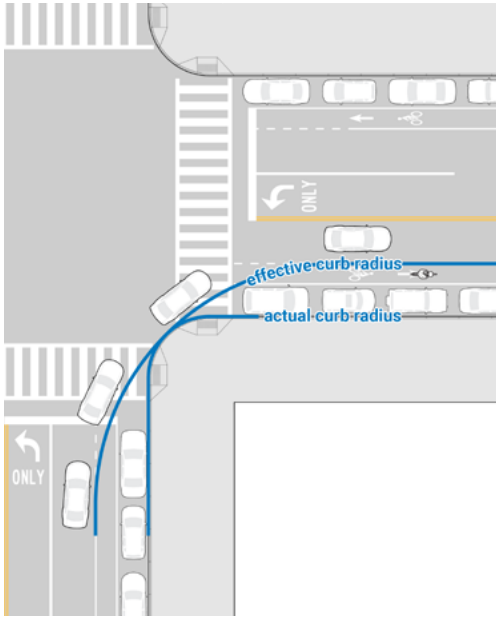


Figure 12. Actual vs. effective curb radius

them to finish crossing sooner. As a best practice, turning movements should be restricted during the red phase for crosswalks with an LPI. For more information, see Leading Pedestrian Interval in the USDG.

Intersection Geometry

Curb extensions, mountable truck aprons, crossing islands, and corner radii are examples of intersection design elements that determine the distance within which pedestrians are exposed to motor vehicle traffic, as well as their visibility to drivers (see Figure 9–Figure 12). Well designed intersections slow turning motor vehicle traffic to improve safety for pedestrians. For example, mountable truck aprons can be constructed to deter passenger vehicles from making higher speed turns, while still accommodating occasional trucks.

For more information, see:

- Chapter 6 – Intersection Design of the PD&DG
- Intersection Geometry in FHWA's Achieving Multimodal Networks
- Intersection Design Elements in the USDG
- Interim Design Strategies in the USDG

What Makes a Walkable Environment?

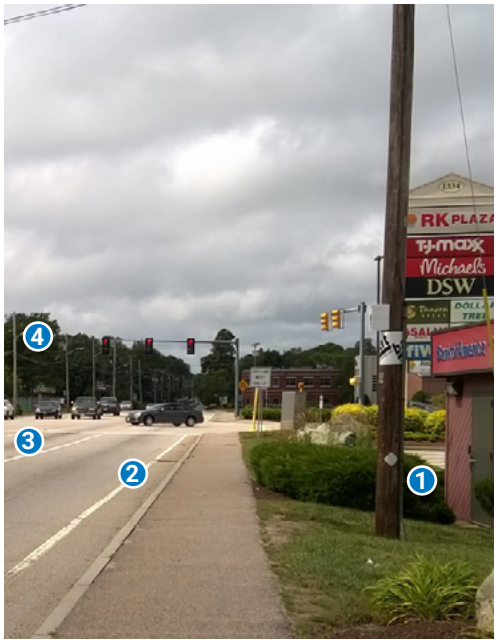
Walkable Mixed-Use Area

1. Mix of uses with entrances directly facing the sidewalk
2. Parked cars provide a buffer from traffic
3. Windows at eye level
4. Street trees
5. Street furniture zone for seating, utilities, and other objects

Walkable Rural Area

1. Landscape buffer provides separation from traffic
2. Narrow travel lanes and shoulder provide a traffic calming effect
3. Sidewalk meets preferred minimum width of **6 feet**

Less Walkable



1. Low-density land use and large building setback
2. No buffer between people walking and traffic
3. Multiple lanes of high-speed traffic
4. Highway-scale lighting

Explore More Resources

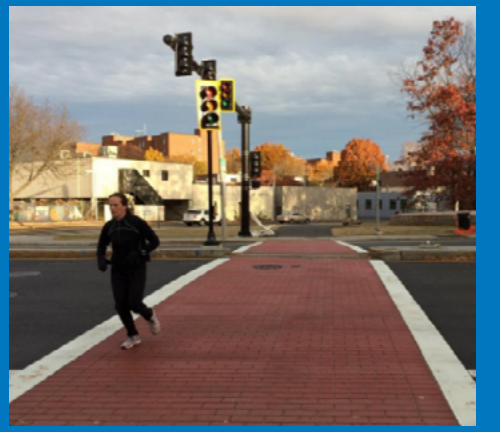
- Rural Walking in Massachusetts: A Tool Kit for Municipalities. WalkBoston, 2013. http://walkboston.org/sites/default/files/WalkBoston%20Rural%20Walking.%20Tool%20Kit%202013.pdf
- Small Town and Rural Multimodal Networks. Federal Highway Administration, 2016. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf. Pedestrian lanes: 5-7 and 5-8 of FHWA's. Advisory Shoulders: 2-17 through 2-24. Shared Roads: 2-3 through 2-8.
- Sample Public Pedestrian Access Agreement (Redmond, OR)
- The Massachusetts Amendments to the Manual on Uniform Traffic Control Devices and the Standard Municipal Traffic Code. Massachusetts Department of Transportation. http://www.massdot.state.ma.us/Portals/8/docs/traffic/MassMUTCD20120409.pdf
- Pedestrian and Bicycle Information Center. Federal Highway Administration. http://www.pedbikeinfo.org/index.cfm
- Federal Highway Administration. Crash Modification Factors Clearinghouse. http://www.cmfclearinghouse.org/index.cfm

Case Study: Brookline

For decades, people walking along the Emerald Necklace park system in Brookline struggled to cross Route 9, a busy six-lane roadway. Rather than walk **650 feet** out of the way in either direction to access designated crosswalks, most people would choose the most direct route across Route 9, utilizing a narrow median as a refuge.

Initiated in 2011, the planning process involved coordination between multiple jurisdictions including the Town of Brookline, City of Boston, MassDOT, MBTA and the Department of Conservation and Recreation. The project was advised by the Emerald Necklace Bicycle and Pedestrian Crossings Committee.

Completed in 2016, the project added a **12-foot**-wide shared use crossing, traffic signals, Accessible Pedestrian Signal (APS) buttons, a widened median, new connecting shared use paths, and modifications to Route 9 and intersecting streets designed to calm traffic and improve safety for all users.



New crossing of Route 9 in Brookline. Credit: Jenna Fisher, Wicked Local

For more information, visit the Town of Brookline's project website.

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Safety

This chapter provides best practices to improve safety for people walking, including the setting of safe speed limits, recommending designs to support safety, the selection of crash countermeasures in response to pedestrian crash types, and the promotion of work zone safety.

The role speed plays in safety considerations is a primary focus of this chapter. Research shows that speed reduction is the most effective strategy to reduce severe injury or death for pedestrians involved in a crash.[14] **Vehicle speed is a critical factor in reducing pedestrian injuries and fatalities, and in creating walkable environments** (see Figure 13).

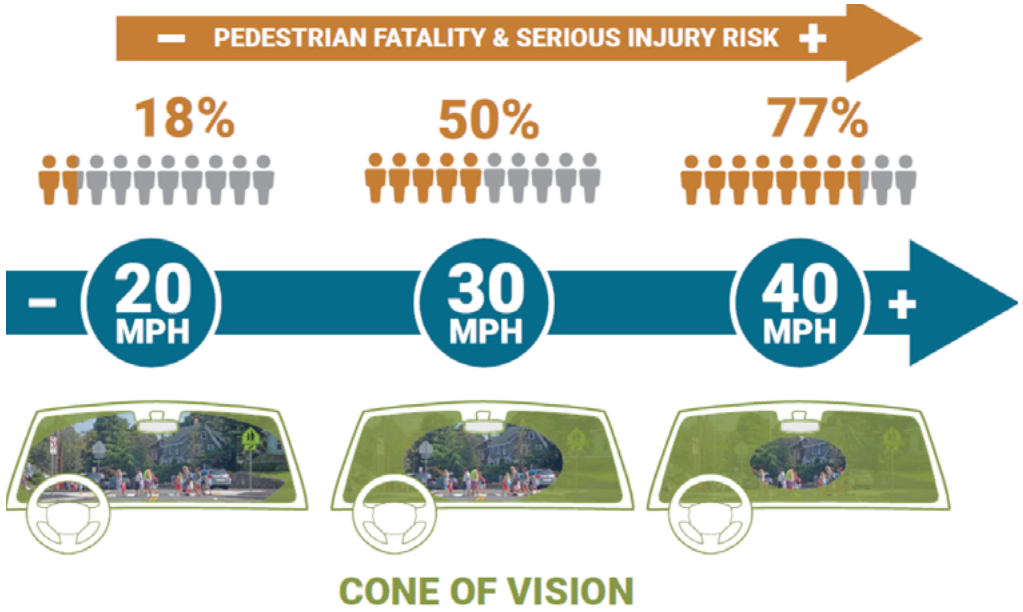


Figure 13. Motorists traveling at lower speeds are less likely to contribute to pedestrian fatalities and serious injuries.[14] Credit: FHWA's Achieving Multimodal Networks

Setting Safe Speed Limits

Speed limits indicate to motorists the expected and enforceable travel speed along a roadway. Massachusetts General Law establishes statutory speed limits which serve as a default. The laws governing speed limits, speed regulations, and enforcement are described in Massachusetts General Law Part I, Title XIV, Chapter 90, Sections 17 and 18.[28]

Setting speed limits is a component of an integrated speed management strategy, however, speed limit reductions alone are generally not enough to induce lower speeds. For new or reconstructed roadways, MassDOT sets speed limits in consideration of the design speed and other contextual factors. MassDOT evaluates requests for speed limit changes on existing roadways on a case-by-case basis in consideration of the existing or expected mix of roadway users, adjacent land uses, existing operating speeds, and other contextual elements. It is most effective to combine speed limit changes with changes to the roadway design that encourage drivers to travel at the intended speed. Procedures for Speed Zoning on State Highways and Municipal Roads provides more detail on the standards and practices MassDOT uses to set speed limits.

For more information, see:

- Design Controls in NACTO's Urban Street Design Guide
- USLIMITS2, a speed limit setting tool developed by FHWA that takes into account context, pedestrian and bicycle activity, crash data, and other unique characteristics of the road.

Special Speed Regulations

The **Municipal Modernization Act** of 2016 allows municipalities to establish regulatory speed limits on locally-owned roadways lower than the statutory/default speed limit in certain contexts. These include **20 mph Safety Zones**, **20 mph School Zones**, and **25 mph zones** in thickly settled areas on business districts as shown in Figure 16 and are summarized on page 25. Establishing special speed regulations on MassDOT-owned roadways requires MassDOT approval. MassDOT may also conduct speed studies on municipal roadways if the roadway carries a numbered route.

A municipality seeking to establish or change a special speed regulation on a municipal roadway may submit a request to their MassDOT District Office. An engineering study is required. The posted speed limit may increase if the results indicate that the 85th percentile speed is higher than the posted speed.

For more information, see:

- FHWA's Methods and Practices for Setting Speed Limits: An Informational Report
- NTSB's Reducing Speeding-Related Crashes Involving Passenger Vehicles

Default Speed Limits

Massachusetts General Law establishes statutory speed limits which serve as a default. The enforceable default speed limit is **20 mph** in school zones, and **30 mph** in business districts and thickly settled areas, and higher speeds in less populated areas. Agencies may also set a regulatory speed limit that is different from the statutory speed limit for that area, in which case speed limit signs are required (see **Figure 14**).

Thickly settled areas are defined by the Massachusetts General Law by the following definition: the territory contiguous to any way which is built up with structures devoted to business, or the territory contiguous to any way where the dwelling houses are situated at such distances as will average less than **200 feet** between them for a distance of a quarter of a mile or over. (MGL Part I, Title XIV, Chapter 90, Section 1)

Roadway Jurisdiction	Posted/Regulatory Speed Limit (also called a Special Speed Regulation)	Statutory/Default Speed Limit*
MassDOT roadway	» Requires engineering study (conducted by MassDOT District) » Requires MassDOT approval	» **20 mph** in school zone » **30 mph** in thickly settled or business district » **40 mph** on undivided way outside of thickly settled or business district » **50 mph** on divided way outside of a thickly settled or business district
Municipal roadway	» Requires engineering study (conducted by municipality) » MassDOT approval: › None for **20 mph** Safety Zones › None for **25 mph** roadways in thickly settled areas or business districts, but municipality must notify MassDOT › Approval required for other contexts	

* Statutory/default speed limits are not posted except for school zones. School zones must be properly established and speed limit signs must be posted. School zone speed limits may only be in effect during the hour(s) children are walking to school, the hour(s) children are leaving school, or during the school noon hour if children are allowed to leave the school property.

Figure 14. Regulations on Setting Regulatory Speed Limit and Default Speed Limits

Safety Zones have a regulatory speed limit of **20 mph**. Safety Zones should be adjacent to locations where vulnerable road users are likely to be present, such as playgrounds, senior citizen housing, hospitals, high schools, and daycare centers. They should be at least **¼ mile** long and contain areas of potential conflict with motor vehicles.

School Zones have a statutory **20 mph** speed limit that is to be marked with regulatory signage indicated in the Massachusetts Amendments to the MUTCD. Criteria defining a school zone include: having a school adjacent to the roadway with one or more grades between 1 and 8; direct pedestrian access to the roadway from school property; and the inclusion of at least one marked crosswalk. In addition, the **20 mph** speed limit will only be in effect when children are accessing school grounds.

Additionally, Massachusetts Safe Routes to School can help municipalities with both infrastructure and non-infrastructure programming.

For more information, see pages 66 to 73 of the Massachusetts Amendments to the Manual on Uniform Traffic Control Devices.

Case Study: Boston

The City of Boston's Neighborhood Slow Streets program built around the principle that traffic calming on residential streets will improve safety, comfort, and willingness to walk and bike. In the past, implementation of physical traffic calming measures relied solely on engineering analysis focused on 85th percentile speeds and statistical safety metrics such as vehicular volumes, crash rates, and fatalities. However, these metrics do not fully reflect how individuals feel and perceive safety, or their level of comfort when walking and biking.

With the implementation of traffic calming measures, the program will collect post installation data to understand the effectiveness of these measures in different neighborhoods.

Credit: City of Boston

The traffic calming toolbox primarily includes signage, pavement markings and speed humps. For more information, see Boston Neighborhood Slow Streets.

Roadways in **business districts or thickly settled areas** may have a regulatory speed limit of **25 mph**. Municipalities may implement this reduced speed unless a special speed regulation has already been established. Thickly settled areas and business districts are defined as corridors where buildings are less than **200 feet** apart on average over a 0.25 **mile** stretch.

Awareness and Training

The role of speed in pedestrian safety should be made clear to the public, State, local and municipal agencies, and consultants. Baystate Roads, as well as the resources noted at the end of this section, provides resources and training opportunities to support awareness-raising initiatives.

Designs to Support Safety

Designing roadways with built-in physical features that makes pedestrians more visible and require motorists to travel at lower speeds can improve safety.

For more information, see:

» Designs to Support Safety on page 26

» Chapter 16 – Traffic Calming and Traffic Management in the PD&DG

» MassDOT Complete Streets Funding Program

» FHWA - Traffic Calming Primer

Improving Visibility

In addition to speeds, lack of visibility is a major contributing factor to pedestrian crashes. Crash data (2010-2014) indicate that 51 percent of crashes involving a fatality or serious injury to a pedestrian occur outside of daylight hours. Therefore, improving visibility is a best practice at minimizing risk for pedestrians. Visibility at crossings can be improved through lighting, signs, and pavement markings as discussed in Elements of Walkable Communities on page 10. For more information on basic design improvements to enhance safety, see Facility Design at FHWA's Pedestrian and Bicycle Information Center.

Road Diets

A road diet involves reconfiguring travel lanes on a roadway to accomplish objectives including traffic calming, improved safety, and/or providing increased space for pedestrian and bicycle facilities. Typically, road diets involve converting a four-lane roadway to two lanes with a median or two-way left turn lane, though other types of conversions are possible (see Figure 15). Bicycle facilities are often introduced. Road diets have several benefits for people walking:

» Reduce traffic speeds which decreases the risk of serious and fatal crashes

» Eliminate risk of a "double threat" crash, in which a pedestrian is crossing multiple lanes of traffic but is blocked from the sight of drivers in adjacent lanes due to the vehicle which has stopped for them

» Increase the space in the right-of-way for pedestrian facilities

Corridors are typically selected for a road diet based on traffic volume and crash history. Additional factors may include vehicle speed, and number of left-turning vehicles. For a four lane roadway, the typically accepted upper threshold for conversion to two lanes is **20,000 vehicles per day** and/or **750 – 1,200 vehicles per hour** during peak hour. However, communities have had success with road diets on roadways that exceed this threshold. Each situation should be evaluated based on its specific site characteristics.

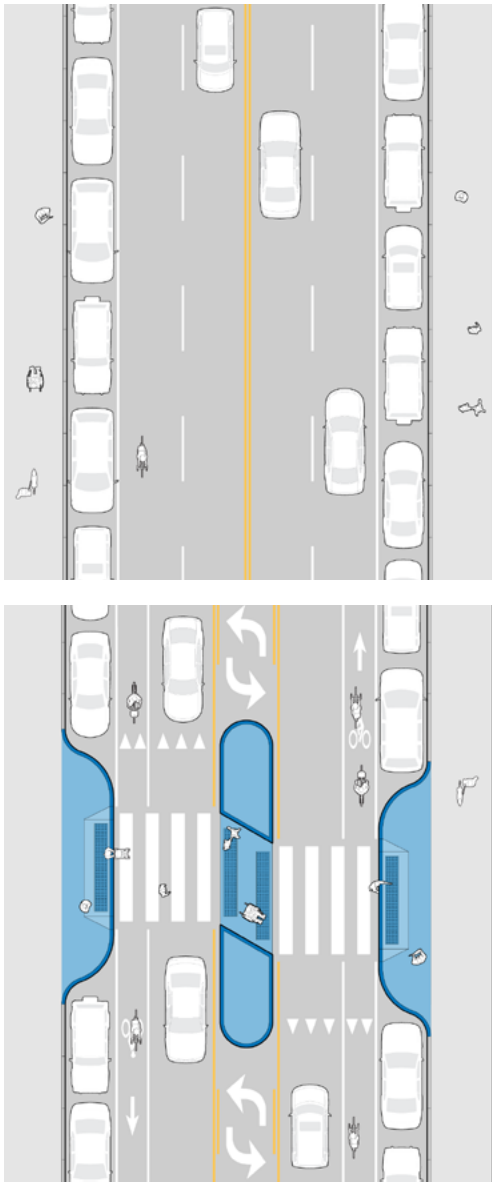


Figure 15. Converting a four-lane roadway (above) to two-lanes (below) is the most common type of road diet. Space can be reallocated to pedestrian crossing islands, bicycle facilities, and turning lanes.

Figure 16. Pedestrian crossing islands improve pedestrian visibility and encourage yielding.

Figure 17. Speed humps, shown here on a residential street, are a traffic calming strategy.

Figure 18. Raised crosswalks encourage yielding to pedestrians and reduce vehicle speeds.

Municipalities may also modify existing travel lanes to achieve lower vehicle speeds and make space for multi-modal accommodations. On roadways with a high pedestrian demand, travel lanes of **10 to 11 feet** can encourage motorists to travel slower and reduce the crossing distance for people walking. Research has shown that, in nearly every case, narrower travel lanes on urban and suburban arterials have no negative impact on vehicle safety and operations when implemented as part of an integrated and holistic design.[26]

For more information, see:

» FHWA's Road Diet Informational Guide.

» Road Diets and Traffic Analysis in FHWA's Achieving Multimodal Networks

Pedestrian Crossing Islands

Crossing islands provide physical separation between pedestrians and vehicles at the midpoint of a roadway crossing (see Figure 16). They also improve visibility of pedestrians and calm traffic. FHWA notes that they may reduce pedestrian crashes by **46 percent**.[25]

Vertical Deflection

Vertical deflections cause motorists to slow down and most commonly come in the form of speed humps and speed tables. Defined as strips of raised pavement which are approximately **12 feet** in length and perpendicular to the direction of travel, **speed humps** are usually placed in a series along municipal roadways (see Figure 17).

This results in slower speeds, reduced traffic volumes, and lower frequency and severity of collisions. Reduced traffic volumes can occur due to drivers modifying their routes. Using a zone-based approach can minimize traffic diversion to other local roads and encourage the use of roads with higher functional classes.

For more information, see:

» Case Study: Boston on page 25

» Institute of Traffic Engineers – Speed Humps.

Similar to speed humps, **speed tables** are built at a similar elevation to adjacent sidewalks, eliminating the need for curb ramps when used in combination with a

crosswalk. Speed tables are typically longer than speed bumps. Speed tables combined with crosswalks are **raised crosswalks**, which are an FWHA-promoted pedestrian safety countermeasure (see Figure 18).

When constructed correctly, vertical traffic calming devices should not cause significant interference with snowplows. Planning for traffic calming should consider emergency response routes. The functional roadway classification should also be considered when determining if speed tables or speed humps are appropriate.

For more information, see Institute of Traffic Engineers – Speed Humps and Tables.

Closures

Several types of roadway closures are used to reduce traffic volumes, including diagonal diverters, full-roadway closures, half closures, and median barriers. All closures can be designed to permit pedestrian, bicycle, transit, and emergency vehicle traffic.

For more information, see Institute of Traffic Engineers – Closures

Pedestrian Crash Countermeasures

Pedestrian crashes can be categorized into types and then addressed through specific countermeasures. FHWA's PEDSAFE Pedestrian Safety Guide and Countermeasure Selection System identifies 12 crash types and 67 corresponding countermeasures that can be applied to improve pedestrian safety. The tool includes matrices to help select countermeasures based on either crash type or performance measures.

Knowing the type of pedestrian crashes that are occurring at a site, municipalities can use the PEDSAFE selection tool to help identify applicable countermeasures specific to the site's circumstances. For example, if the crashes are specifically related to people crossing the street at a bus stop, then the appropriate countermeasures might be a pedestrian crossing island or a raised crossing.

Additional detail as to what comprises a crash type and the countermeasures, including planning-level cost estimates, are available on the PEDSAFE website.

Statewide Safety Trends

A review of available statewide crash data (2010-2014) suggests that there are a high number of "through vehicle at unsignalized location" crashes involving pedestrians, which may have occurred at an unsignalized intersection or mid-block location. "Walking along roadway" and "dart/dash" crash types are also prevalent. According to the PEDSAFE Countermeasure Selections System, municipalities may want to consider focusing on crossing locations, pedestrian access to transit, and roadway design, depending on the specific site characteristics.

It is essential that municipalities review the crash data for a specific site and determine the predominant crash type before selecting a countermeasure.

Work Zone Safety

Pedestrian ways, like roadways, are periodically impacted by construction. Per the Americans with Disabilities Act (ADA), it is legally incumbent upon agencies maintain and enforce safe and accessible pedestrian routes through or around work zones. The U.S. Access Board requires that an alternate pedestrian access route be provided to the maximum extent feasible during construction. For more information, see **R205 Alternative Pedestrian Access Route** on the U.S. Access Board's Scoping Requirements webpage. This section describes best practices in providing safe pedestrian access around construction.

Clear Path of Travel

Pedestrian detours should include a firm, stable, and slip resistant surface that is at least **4 feet** (preferably **6 feet**) wide and complies with the ADA requirements of **5 percent** maximum walkway running slope (or following natural topography) and **2 percent** maximum cross slope.

Figure 19. An example of a temporary accessible curb ramp in a construction pedestrian detour

Figure 20. A temporary walkway separated from traffic through a construction zone

Signage

Directional signage should be placed in advance of the detour to clearly indicate where pedestrians should go to avoid construction equipment and operations.

Accessible Ramps

Temporary curb ramps may also be necessary (depending on the site) to maintain access for anyone using a wheeled mobility device (see Figure 19). All curb ramps should comply with the ADA requirement of an **8.33 percent** maximum running slope.

Separation from Traffic

Pedestrians should not be directed to mix with motor vehicle traffic. If necessary, a parking or travel lane should be temporarily closed to provide a safe space for people walking (see Figure 20).

For more information, see Chapter 6D of the MUTCD and Construction Detours on page 41.

Explore More Resources

» Traffic Calming and Management. MassHighway, 2006. https://www.massdot.state.ma.us/Portals/8/docs/designGuide/CH_16.pdf

» High-Visibility Enforcement on Driver Compliance with Pedestrian Right-of-Way Laws. National Highway Traffic Safety Administration, 2013. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/811786.pdf

» Bertulis, Tomas, and Daniel M. Dulaski. 2014. "Driver Approach Speed and Its Impact on Driver Yielding to Pedestrian Behavior at Unsignalized Crosswalks." Transportation Research Record: Journal of the Transportation Research Board: Issue 2464. http://docs.trb.org/prp/14-2349.pdf

» FHWA Proven Safety Countermeasures. https://safety.fhwa.dot.gov/provencountermeasures/

» FHWA Every Day Counts (EDC): Safe Transportation for Every Pedestrian (STEP). https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

ADA and Accessibility

ADA Transition Plans

By federal law, every municipality must have an ADA Transition Plan or other planning method in place or be subject to legal recourse.

In 1990, the Americans with Disabilities Act (ADA) established the legal right for people with disabilities to have access to transportation within the public right-of-way. This federal civil rights law requires that new roadways, sidewalks, and shared use paths be accessible to people with disabilities. Existing facilities are also required to be upgraded in accordance with the applicable accessibility design standards, including when a planned project occurs.

In addition to the requirements for new and altered facilities to meet accessible design standards, municipalities must have ADA Transition Plans or program access plans. These plans are based on a self-evaluation and include a prioritized, multi-year plan for making all existing facilities accessible.

MassDOT recently updated its Statewide ADA Transition Plan, which details how state-owned transportation infrastructure in the Commonwealth will be updated to be ADA compliant. The MassDOT Office of Diversity and Civil Rights (ODCR) has conducted a curb ramp inventory to assess the compliance of curb ramps on MassDOT roadways and has developed a prioritization plan for addressing ramps that require updates.

All public agencies may face legal liabilities for not having a Transition Plan in place or for a lack of progress towards implementation. As of 1992, municipalities are required to have Transition Plans in place. Development of a Transition Plan is a Community Compact best practice and Baystate Roads can provide training to municipalities to help ensure that infrastructure projects are ADA compliant.

Best Practices

Universal design is the concept that the built environment should be accessible for people of all abilities. According to the US Census Bureau, one in five Americans has a disability, rising in prevalence as people age, from **8 percent** in youth under **15 to 70 percent** in adults 80 and over. Building and maintaining sidewalks for universal design means considering how people with physical, communicative, and cognitive disabilities can get from Point A to Point B.

Requirements for ADA have been created by the U.S. Access Board, the federal agency that promotes equality for people with disabilities. Over the past three decades, ADA guidelines have been developed through research and a federal advisory committee of people with disabilities. In 2011, the Board published Public Rights-of-Way Accessibility Guidelines (PROWAG), which have been adopted by many jurisdictions, including

Bottom photo: City of Somerville

MassDOT, as design standards. However, PROWAG has not been adopted by the U.S. Department of Justice. As a result, it is not an enforceable standard, but is considered to be today's model code. Although PROWAG is currently in draft form, the Massachusetts Architectural Access Board (MA AAB) regulations at 521 CMR and the ADA Accessibility Guidelines are currently law and must be complied with. Local standards may improve upon current proposed guidelines but should meet all minimum requirements.

ADA guidelines should be applied to the primary pedestrian route along a roadway, which may consist of sidewalks, shared use paths, shoulders or a shared roadway. The next section discusses best practices for meeting or exceeding PROWAG guidelines.

For more information on the definitions of new and altered routes, as well as exceptions for physical, scope, and cost constraints, see PROWAG.

General

Providing smooth, level surfaces and sufficient width to make routes accessible are a good starting point for your community.

For more information, see:

» U.S. Access Board's PROWAG

» MassDOT's Engineering Directive E-12-005: Walks and Wheelchair Ramps

Surfaces

Routes should be firm, smooth, and free of large gaps. For example, brick sidewalks must be properly installed and maintained to avoid painful vibrations for people using mobility devices. Over time, surfaces such as brick may fall out of compliance as a result of freeze and thaw cycles, resulting in uneven surfaces. Vertical trip hazards should not exceed **0.25 inches**, although they may be up to **0.5 inches** if they are beveled to a maximum **1:2** or **50 percent** slope.

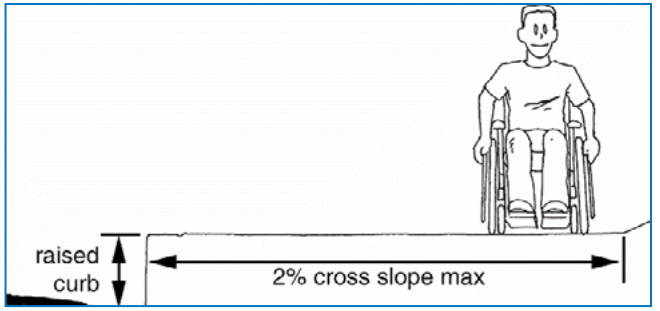


Figure 21. This sidewalk does not exceed **2 percent** cross slope, ensuring that people using mobility devices will not tip over on their left or right side. Credit: US Access Board

Widths

The minimum clear width requirement for pedestrian routes is **4 feet**, exclusive of the width of curb stones**.** With a pedestrian path of **less than 5 feet** passing spaces (a minimum of **5 feet by 5 feet**) are required every **200 feet.** Many communities have therefore standardized **5 feet** as the minimum clear width for pedestrian facilities. Medians and crossing islands should also be a minimum of **5 feet** in width. Street elements, such as fire hydrants, sign posts, light poles, and benches, may not be placed within this minimum clear width area. Wider sidewalks and clear widths should be provided in areas with greater pedestrian activity.

Running Slopes

The running slope refers to elevation changes in the direction of travel on a pedestrian facility. Running slopes may not exceed **5 percent** unless the grade of the adjacent roadway is more than **5 percent**, at which point it may equal the grade of the adjacent roadway. However, this exception does not apply to roadway crossings at intersections. Running slope requirements also apply to paths.

Pedestrian walkways that exceed **5 percent** running slopes, such as overpasses and underpasses, must comply with access requirements for ramps, including provision of handrails and level landings every **30 feet**. If a pedestrian facility is not adjacent to a roadway, the running slope should not exceed **5 percent**, unless physical constraints make compliance impractical.

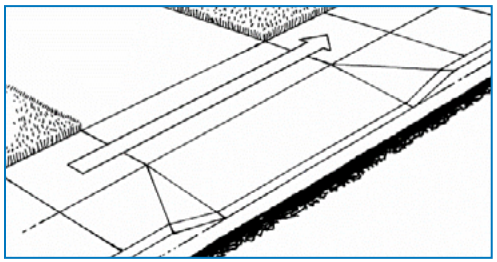


Figure 22. A sidewalk at the back of a driveway creates a level pedestrian route, meeting the proposed ADA cross slope requirement of **2 percent** or less. Credit: US Access Board

Running slopes that exceed these guidelines are subject to required reconstruction or closure by the MA AAB except in cases where an Application for Variance has been submitted. For more information on Variances, refer to the MA AAB Rules and Regulations.

Cross Slopes

The cross slope refers to lateral elevation changes on a pedestrian facility perpendicular to the direction of travel (see Figure 21). Cross slopes should not exceed **2 percent**. As an example, on a **5-foot** (**60 inches**) sidewalk the cross slope should not exceed **1.2 inches**.

Unless an Application for Variance has been submitted, the MA AAB may require reconstruction or closure at locations where cross slopes fail to meet these guidelines.

Driveways

Maintaining the proposed minimum cross slope across driveways may require additional considerations, especially in constrained locations. Provided below are several examples of how to resolve this issue. Solutions that provide a continuous, level path are far preferable to solutions that require a pedestrian to navigate multiple ramps.

- Add a landscape/grass strip between the sidewalk and roadway, which can also be used for the driveway apron.
- Construct a level pedestrian route at the back of the driveway so that the sidewalk is continuous (see Figure 22).
- It is not recommended to lower the sidewalk to the height of the driveway or to an intermediate level between the sidewalk and the driveway. However, in some constrained locations it may be considered.

The placement of utility poles and signs can become obstacles and create accessibility challenges for people with disabilities.

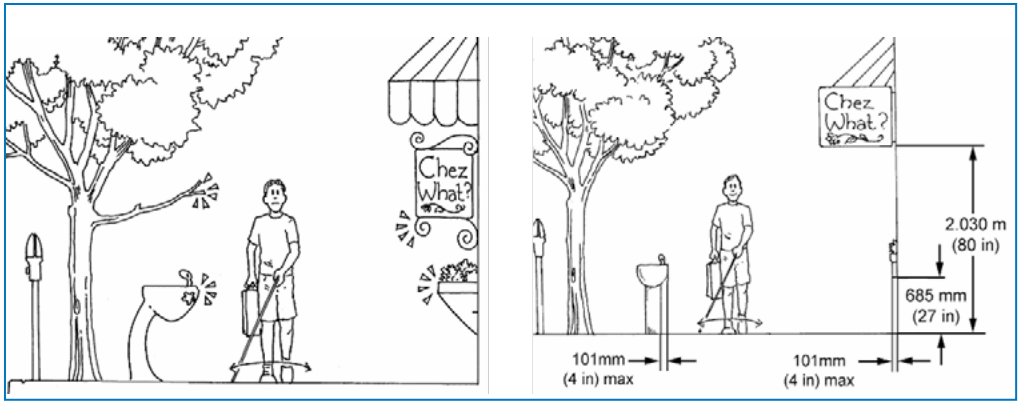


Figure 23. Obstructions on the left are altered on the right to provide access for people with visual impairments. Credit: US Access Board

Obstructions

Objects located on or near sidewalks may impede pedestrian travel. Obstructions can force pedestrians into the roadway, which significantly decreases safety in locations with higher traffic speeds and volumes.

Light poles, fire hydrants, sign posts, temporary construction related signage, and other objects should not be placed in a pedestrian's path of travel (see Figure 23). Trees, signs, and planters should be placed so that they do not protrude into the area of pedestrian travel. Objects between **27 inches** and **80 inches** tall cannot be detected by people with visual impairments using canes. Thus, protrusions may not extend more than **4 inches** into the pedestrian route, unless a curb is built around the object.

Curb Ramps

When a pedestrian facility meets a roadway crossing, curb ramps must be provided. Curb ramps are also required at railroad crossings, mid-block crosswalks, median islands, and ADA accessible on-street parking spots. The maximum running slope allowable for ramps is **8.33 percent**. Reconstruction projects are an alteration which require retrofitting the roadway with ADA accessible curb ramps.

For more information, see:

» MassDOT's Engineering Directive E-12-005: Walks and Wheelchair Ramps

Example of a level landing

» FHWA's Curb Ramps – Designing Sidewalks and Trails for Access

» FHWA's Resurfacing and Curb Ramps Technical Assistance

» FHWA's Supplementary Questions and Answers

Detectable Warning Surfaces

To alert people with vision impairments that they are approaching or departing a roadway or railroad crossing, curb ramps must include a detectable warning surface where the ramp meets the roadway. Detectable warning surfaces are identical in width to the curb ramp or sidewalk, but their length is always **2 feet**. They should not be placed in medians less than **6 feet** wide.

Detectable warning surfaces may be installed on a curb ramp as a composite, cast iron, or stainless steel plate, glued or otherwise fastened on to the surfaces, or formed in place as concrete is finished.

Example of an accessible pedestrian signal.

Landing Areas

The tops and bottoms of curb ramps should have a level landing area, which may be shared between two curb ramps at the same corner. These are locations where a person using a mobility device may change their direction of travel without risk of tipping over or hitting objects. Landing areas should be a minimum of **48 inches by 48 inches** and may not exceed **1:50** (**2 percent**) slope in any direction. In locations where standing water accumulates at the bottom of ramps, drainage inlets should be placed directly upstream from the flow of water to correct the issue.

Accessible Pedestrian Signals

Accessible pedestrian signals (APS) are required at all signalized crossings, and should be installed at new and significantly repaired signals, utilizing touch and sound for people with visual disabilities. Electronic speakers at a push button emit sounds to announce its location, and notify pedestrians when the walk signal is on. A tactile arrow that can be felt with a hand, points pedestrians in the proper direction.

Accessible pedestrian signal devices should be located close to the crossing. They must be less than **6 feet** from the edge of the curb, within **5 feet** of the crosswalk, and not higher than **42 inches** from the finished sidewalk. Buttons need to be parallel to the associated crosswalk, making it clear which button should be used to cross the roadway. In addition, reach to the accessible device must not exceed **10 inches** from the level landing if obstructions are present, such as a curb or signal foundation.

Baystate Roads provides a training course on Designing Pedestrian Facilities for Accessibility, which includes details on APS. For more information, see:

» National Cooperative Highway Research Program's Accessible Pedestrian Signals Guide

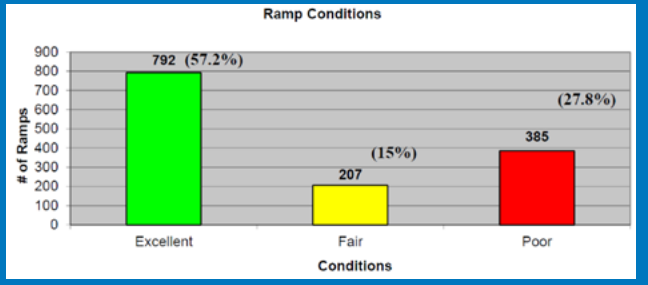
» Sections 4E.08 through 4E.13 on ADA Accessible Signals of the MUTCD

» Architectural Access Board section of the Code of Massachusetts Regulations

Case Study: Beverly

In 2012, the City of Beverly completed an ADA Transition Plan focused on curb ramps and signalized intersections. Through an implementation component of the plan, the community plans to repair non-compliant ramps over a 31-year period, and non-compliant signals over a 13-year period. Improvements were organized by order of priority, at schools, transit stops, and then parks. The City assigned an ADA coordinator, created ADA curb ramp and signal request forms, and has published a list of repaired curb ramps annually since 2012.

For more information, visit the City of Beverly's ADA Transition Plan.



Distribution of curb ramps by condition from the City of Beverly's ADA Transition Plan. Credit: City of Beverly

Other Topics

Transition Plans

All municipalities are required by ADA to perform self-evaluation to determine compliance. Municipalities with fewer than 50 employees must maintain a program access plan to ensure that programs, services, and activities are accessible. Municipalities with more than 50 employees were required to complete a formal ADA Transition Plan as of 1992. Such plans designate an employee as an ADA Coordinator, create a grievance procedure, document existing conditions, and establish a course of action such as methods to make facilities accessible, the schedule, and integration into existing transportation funding programs.

As of 2017, 112 out of 351 Massachusetts municipalities have ADA Transition Plans in place. Input received at stakeholder interviews indicated that some municipalities are not taking action on accessibility improvements because of staff limitations,

lack of resources, and a lack of understanding of ADA requirements and liabilities.

For more information, see:

» Baystate Roads: ADA Transition Plans Made Easy

» FHWA's ADA Transition Plans: A Guide to Best Management Practices

» FHWA's Q&A about Transition Plans

Construction Zones

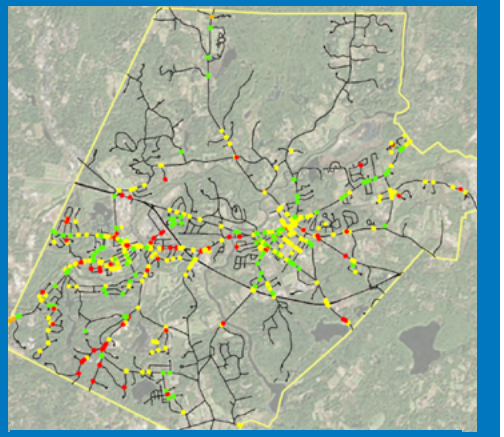
Alternate routes for pedestrians are required during construction and maintenance projects. Alternate routes may include pedestrian channelizers, barricades, temporary walkway surfaces, and detectable warning surfaces. Warnings for people with vision impairments should include actuated audible message devices. See Work Zone Safety on page 29 for additional information.

MassDOT has convened a Work Zone Safety Task Force to improve safety at construction zones. Chapter 17 of the Massachusetts Project Development & Design Guide also provides additional information.

For more information on requirements for pedestrian accommodations in work zones, see Chapter 6D on Temporary Traffic Control Pedestrian Safety of the MUTCD.

Case Study: Concord

In 2016, the Town of Concord completed a thorough self-evaluation of pedestrian facilities. This included an inventory of sidewalk cross slopes, pinch points, trip hazards, and overhead obstructions, using GPS-enabled tablet PC's to locate each issue. In addition, the condition of each sidewalk was assessed using a Sidewalk Condition Index and each curb ramp was assessed using a Ramp Condition Index. Finally, each of the Town's five signalized intersections were evaluated for accessibility. A $3.5 million cost estimate and 20- to 25-year implementation schedule was developed to bring the sidewalks into ADA compliance. The Town also publishes sidewalk plowing program procedures, which includes locations and snowfall thresholds for Town-led sidewalk clearing. For more information, see the Town of Concord ADA Transition Plan.



A curb ramp compliance map. Credit: Town of Concord

Snow and Ice Removal

Snow and ice often inhibit the movement of people with disabilities. FHWA has issued guidance that pedestrian routes must be open and usable throughout the year, with only isolated or temporary interruptions. Snow removal is also required on pedestrian facilities which have been constructed with federal funds. For more information, see:

» FHWA's Maintenance Q&A Regarding ADA

» FHWA's Memorandum on Snow Removal on Sidewalks Constructed with Federal Funding.

More information on this topic can be found in "Snow and Ice Clearance" on page 45.

Explore More Resources

- Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; Shared Use Paths. Federal Register, 2013. https://www.access-board.gov/attachments/article/1108/sup-snprm.pdf
- Planning and Design for Alterations. United States Access Board, 2007. https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/guidance-and-research/accessible-public-rights-of-way-planning-and-design-for-alterations
- MassDOT's ADA/Section 504 Transition Plan. MassDOT, 2017. https://www.massdot.state.ma.us/OfficeofCivilRights/ADA.aspx
- Engineering Directive E-12-007: Accessible Pedestrian Signal Installation Policy. Massachusetts Department of Transportation. http://www.massdot.state.ma.us/Portals/8/docs/EngineeringDirectives/2012/e-12-007.pdf
- MassDOT's Accessible Pedestrian Signal Installation Policy, 2012. http://www.massdot.state.ma.us/Portals/8/docs/traffic/APSPolicy20120601.pdf

Pedestrian Access to Transit

The vast majority of transit riders—**80 percent**—walk to transit, whether on foot or using a mobility device.[27] Therefore, creating an accessible pedestrian realm greatly benefits transit users. The design of roadways can improve access to transit by providing a comfortable, connected network of sidewalks with safe and conveniently located roadway crossings. The principles identified in the Elements of Walkable Communities and ADA and Accessibility chapters are also critical to pedestrian access to transit.

This section outlines some of the best practices for pedestrian access to transit. Applications should be selected based on specific contexts. Responsibility for transit stop siting requires coordination between the transit operator and the local jurisdiction.

Well-marked crossings create locations for pedestrians to cross the roadway safely near transit stops.

Best Practices

Connectivity Between Transit Stops and Sidewalks

- Ensure that transit stops and stations are directly connected to local destinations by sidewalks or shared-use paths.
- Review bus stops for ADA compliance and accessible paths of travel.

Safe and Convenient Pedestrian Crossings

- Pedestrian crossings should provide a dedicated, safe, and convenient location for pedestrians to cross the roadway.
- Pedestrian crossings should be near all transit stops and stations to provide pedestrians access to transit stops on either side of a roadway.
- Consider the following features to draw additional attention to pedestrian crossing locations: high-visibility crosswalk markings, crossing islands, signs to warn motorists of an approaching crossing or crossing location, and/or rectangular rapid flash beacons (RRFB).

Flag Systems

Most regional transit authorities in Massachusetts operate bus routes that include flag stops. Rather than featuring designated stops, riders may "flag down" an oncoming bus at any point along the route. Pedestrian access to transit along these routes can be improved by providing walkways along the road and crossings near major destinations. Improvements can be prioritized based on passenger volume along the route and locations along the route with vehicle-pedestrian crashes. Flag routes raise accessibility challenges, particularly for riders with sight impairments. Additional work is needed to identify solutions.

Bus Stop Design

- Municipalities should coordinate with local transit providers to properly design bus stops. See Chapter 5 and Chapter 6 of the MassDOT PD&DG.
- Bus stops should be well-connected to roadways, sidewalks, or paths to ensure accessibility.
- Boarding and alighting areas should be a minimum of **5 feet** wide by **8 feet** deep and be free of obstructions.
- When possible, include bus stop amenities such as benches, lighting, newspaper vending machines, route/schedule information, and trash receptacles, but be mindful not to block the pedestrian way.
- On lower-speed corridors through urban areas and town centers, consider curb extensions at bus stops. Curb extensions improve accessibility by relocating bus stop amenities away from the sidewalk and allowing bus operators to more easily align with the curb. Curb extensions allow buses to stay in lane, which can reduce time waiting at stops and improve service reliability.
- In locations where it is anticipated that transit users would bicycle to the bus stop, bicycle parking should be considered. Longer-distance bus routes are one example.

Minimize Modal Conflict Points

- Transit station and roadway design should aim to reduce conflicts between modes, including conflicts between pedestrians, bicyclists, motorists, and transit vehicles.
- Conflicts can be reduced by improving sight lines, providing dedicated space for each mode, marking potential conflict points, and clearly communicating space through wayfinding and signage.

Snow banks block a bus stop, creating accessibility challenges for transit users, particularly those with limited mobility.

- On higher speed corridors, consider bus pullouts, a space where buses can pull out of traffic to pick up and drop off passengers, to minimize conflicts with motor vehicles and increase comfort for waiting passengers.
- On corridors with bicycle facilities, consider floating bus stops, which route bicycle travel behind the bus stop and away from buses. See pages 98–104 of the MassDOT Separated Bike Lane Planning & Design Guide.
- For more information on reducing transit conflicts, see Transit Conflicts in FHWA's Achieving Multimodal Networks.

Snow and Ice Clearance

» Winter maintenance around bus stops and rail stations is critical to ensuring pedestrian access to transit.

» Snow and ice should be cleared from bus stops to provide a minimum **5-foot** by **8-foot** boarding and alighting area. Ensure a **4-foot** minimum path is cleared to connect this area to the sidewalk or other access route.

» For more information, see "Snow and Ice Clearance" on page 45.

Explore More Resources

» Transit Street Design Guide. National Association of City Transportation Officials, 2016. https://nacto.org/publication/transit-street-design-guide/

» FHWA Achieving Multimodal Networks, Applying Design Flexibility and Reducing Conflicts. See "Bus Stops" on page 49-52. Federal Highway Administration, 2016. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/multimodal_networks/fhwahep16055.pdf

» Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices. Federal Highway Administration, 2015. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/global_benchmarking/global_benchmarking.pdf

» Pedestrian Safety Guide for Transit Agencies. Federal Highway Administration, 2008. https://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/transit_guide.pdf

» TCRP Report 153: Guidelines for Providing Access to Public Transportation Stations. Transportation Research Board, 2012. http://www.reconnectingamerica.org/assets/Uploads/20120327tcrprpt153.pdf

» TCRP Web-Only Document 44: Literature Review for Providing Access to Public Transportation Stations. Transportation Research Board, 2009. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_44.pdf

» Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way. United States Access Board, 2011. https://www.access-board.gov/attachments/article/743/nprm.pdf

» MBTA Bus Stop Design Guide.

Maintenance and Repair

Walking facilities require ongoing maintenance to provide pedestrian accessibility and ensure safety. For example, issues often arise because of deferred maintenance: a heaved sidewalk forces people using a mobility device into a roadway, or a faded crosswalk makes pedestrians at a roadway crossing less visible. Non-winter maintenance is broadly placed into two categories: walkway infrastructure repair and year-round maintenance. Both types of maintenance should be supported by a robust inspection and compliance program. This chapter describes management approaches to maintenance and specifies types of maintenance. For information on winter maintenance, see "Snow and Ice Clearance" on page 45.

Regular maintenance of pedestrian facilities is essential to protect capital investments and to ensure a safe and accessible environment for all pedestrians.

Management Approaches

Inspection and Compliance Programs

Inspection and compliance programs provide the framework around which walkway maintenance takes place. These programs aid in managing municipal assets, improving accessibility and level of service, reducing liability, and programming repairs. Inspection and compliance programs often form the basis for the transportation portion of a community's ADA Transition Plan. For information on ADA, see "ADA and Accessibility" on page 30.

An inspection and compliance program should have:

- A clear set of criteria that establishes minimum requirements for walkway surface discontinuities, cross slopes, running slopes, obstructions, minimum walkway widths, curb ramps, crosswalk conditions, temporary closures, and signalized intersections.
- A written policy or ordinance that establishes the responsibilities of property owners and the community, including time frames for compliance, procedures for repairs, as well as education and enforcement.
- A database which organizes and summarizes deficiencies, so that community leaders have the information needed to make decisions about maintenance funding.

- A department and contact person at an agency who is responsible for the program.
- Short- and long-term schedules for completing different types of repairs.

Inspection programs may be carried out in the following ways:

- Community-wide inspection - Often undertaken in smaller communities, or when sidewalks have not been repaired on a regular basis in larger communities. Every sidewalk is inspected within a defined period, such as a six-month window. The community-wide inspection method can also serve as the foundation for a zone inspection system.
- Zone inspection - The recommended long-term practice for moderate to large-sized communities with extensive walkway networks is to divide a municipality into a minimum of three and maximum of ten zones and inspect one zone annually. However, areas with higher pedestrian traffic, such as downtowns, universities, and hospitals, should be inspected on a more frequent basis.
- In addition to a proactive inspection program, agencies should have multiple means for members of the public to report sidewalk, crosswalk, and other pedestrian issues. Examples include See-Click-Fix and BOS:311.
- Agencies should establish a protocol that results in a response within 48 hours after the report is received (in high pedestrian and traffic volume areas perhaps even sooner).

Maintenance Funding

In Massachusetts, Chapter 90 funds are widely used by municipalities for pedestrian facility maintenance. Other potential funding sources for sidewalks and shared use paths include:

- General municipal funds
- Improvement districts
- Homeowners associations
- Special assessments (typically community-wide)
- Utility fees
- Taxes (sales tax, etc.)
- Assessments to adjacent property owners

Construction Detours

Roadway construction projects often negatively impact pedestrian travel, so it is important to develop a temporary traffic control plan for pedestrians, including those with disabilities. According to PROWAG, when a pedestrian path is temporarily closed for construction or maintenance activities, an alternate pedestrian access route complying with sections 6D.01, 6D.02, and 6G.05 of the MUTCD should be provided (R205).

An example of a detectable warning panel in need of replacement.

Material	Relative Cost $=Low $$$$=High	Lifespan (months)	Retroreflectivity *=Low ***=High
Paint	$	3-24	*
Epoxy Paint	$$	24-48	**
Thermoplastic (sprayed)	$$$	48-72†	**
Pre-formed Tape	$$$$	36-96†	***

Figure 24. Pavement Marking Materials Costs and Benefits

† Estimates based on minimum standard crosswalk treatment and updated to reflect 2013 comparative costs. Thermoplastic and tape have shortened lifespans in snowy areas where they are often damaged by snowplows. Inlaid thermoplastic or pre-formed tape may last significantly longer than standard surface applications. Table adapted from FHWA A Guide for Maintaining Pedestrian Facilities for Enhanced Safety.

To address construction impacts to sidewalks or pedestrian paths, including transit stops, consider the following:

- Develop a temporary traffic control plan to guide the pedestrians through the construction zone.
- Close the pedestrian circulation path through the construction zone; develop a detour route consistent with the accessibility features present in the pedestrian circulation path being closed.
- Close or narrow an adjacent travel lane to provide a temporary accessible pedestrian route through the construction zone.

Types of Maintenance

Crosswalks and Pavement Markings

Crosswalks can be marked with different types of pavement markings including latex paint, epoxy paint, thermoplastic, and pre-formed tape. The life cycle cost of each type is affected by the amount of motor vehicle traffic exposure, plowing operations, available equipment and labor, and the pavement types and previous crosswalk markings, if any (see Figure 24).

The table above supports decision making by offering a comparison of the relative costs, lifespans, and retroreflectivity of different materials.

For more information, see National Cooperative Highway Research Program Synthesis 306: Long-Term Pavement Marking Practices.

Case Study: Brookline

The Town of Brookline, Massachusetts has a policy which states "because it is highly reflective, durable, slip-resistant, and does not require a high level of maintenance, it shall be the policy of the Town to install marked crosswalks using inlay tape whenever possible. To the maximum extent practicable, inlay tape shall be used as the preferred marking material whenever crosswalks are installed on new or resurfaced pavements."

Case Study: Hinsdale

In 2016, the Town of Hinsdale completed a sidewalk condition inventory as part of its "Complete Streets Needs Assessment and Prioritization Plan." The Town's 2.6 miles of sidewalks were rated on a four-tier scale of excellent, good, fair, and poor. Because of this assessment, the Town received a $400,000 grant in 2017 from MassDOT's Complete Streets Funding program to replace deteriorating sidewalks on Church Street and Goodrich Street.

Curb Ramps and Detectable Warning Surfaces

» Detectable warning surfaces should be inspected to ensure that they do not become damaged or displaced.

» When designing curb ramps, it is important to maintain a gutter slope that allows water entering the curb ramp to drain and carry away debris that may otherwise pool up after rain events.

Sign Repair

» Pedestrian regulatory and wayfinding signs may be damaged, vandalized, or worn through natural aging and require repair or replacement.

» Regulatory signage requirements should be reviewed to ensure that necessary signs, particularly in school zones and at crosswalks, are in place and up-to-date.

» To mitigate vandalism, signs can be treated with an anti-graffiti coating that makes it easier to remove common forms of graffiti such as spray paint and marker pens.

» Signs should be replaced on an as-needed basis, which varies based on sign type, age, poor retroreflectivity, and/or deterioration, or instances of accidental damage.

Poor drainage can lead to water pooling at curb ramps

An asphalt sidewalk with root damage.

Sweeping

» Sweeping sidewalks and shared use paths clears sand, leaves, or other debris from pedestrian facilities and reduces hazardous conditions. Many agencies sweep shared used paths and trails in their jurisdiction once or twice per year.

» In many municipalities, property owners are required by ordinance to perform sidewalk sweeping.

» Special service districts (or business improvement districts) will sometimes include sweeping services, which can have a marked benefit for downtowns.

» Large-scale sweeping efforts are most effective with special sweeping equipment, such as broom attachments for utility vehicles. Broom attachments can also be used for snow during winter maintenance.

Vegetation Management

Vegetation management includes the maintenance of grass, trees, tree roots, bushes, and other organic material. Municipalities may wish to utilize the services of an arborist to assess the condition of trees and carry out root and limb pruning. Common vegetation management includes:

» Trimming vegetation overhanging into the pedestrian path.

- Trimming or removing vegetation growing at sidewalk level that narrows the effective width of the sidewalk, forcing pedestrians into the roadway or causing a tripping hazard.
- Removing discarded vegetation building up on sidewalks, including leaves and branches.

Upheaved sidewalk panels from tree roots can be addressed by:

- Cutting and trimming or complete removal of tree roots, if necessary, before replacing sidewalk panel.
- Beveling the surface may be considered for locations where the vertical discontinuity is between 0.25 inch and 0.5 inch (see "Surfaces" on page 31).

Explore More Resources

- A Guide for Maintaining Pedestrian Facilities for Enhanced Safety. Federal Highway Administration, 2013. https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037/
- Pedestrian Facilities During Construction. Iowa Department of Transportation, 2013. https://www.iowadot.gov/design/dmanual/12a-04.pdf
- Long-Term Pavement Marking Practices. National Cooperative Highway Research Program Synthesis 306, 2002. http://www.trb.org/Main/Public/Blurbs/152126.aspx
- Designing Sidewalks and Trails for Access – Part II. Chapter 11: Sidewalk Assessment. Federal Highway Administration. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/contents.cfm
- Manual on Uniform Traffic Control Devices https://mutcd.fhwa.dot.gov/

Snow and Ice Clearance

For walking to be practical, safe, and comfortable in the wintertime, it is critical to clear or remove snow and ice from all pedestrian facilities. Clearing or removing snow and ice from pedestrian facilities—not just along sidewalks, but also at crosswalks and curb ramps and bus stops—promotes year-round use and reduces the risk of injury. Snow and ice clearance is essential to maintaining ADA-compliant access throughout the winter.

For sidewalks and walkways under municipal jurisdiction, there are two general models of sidewalk snow and ice clearing practices that most municipalities follow. In many municipalities, property owners are required to clear all snow and ice from sidewalks adjacent to their property, and to spread sand or salt to mitigate slippery surfaces. The municipality is responsible for maintaining sidewalks adjacent to municipal properties, such as government buildings, parks, or schools. Other municipalities take the lead on sidewalk snow and ice clearance, utilizing either municipal staff or hired contractors to clear snow and ice from all sidewalks in the jurisdiction. These policies usually go into effect only after a snowfall depth reaches a certain threshold.

As part of the forthcoming Statewide Pedestrian Plan, MassDOT will be providing clarification and further direction regarding snow and ice clearance on sidewalks and walkways under its jurisdiction.

The Town of Brookline clears snow from select priority sidewalks. Boylston Street is shown above.

Responsibility of Property Owner

The most common practice is to require adjacent property owners to clear all snow and ice from sidewalks abutting their property within a certain time frame, which generally varies from 4 to 24 hours after a snowfall has stopped.

Municipalities that require adjacent property owners to clear sidewalks normally enforce these ordinances by issuing warnings for non-compliance. Warnings are followed by citations given to property owners who do not clear sidewalks after a defined time frame following the warning. If sidewalks are still not clear of snow and ice after the warning period, municipalities will either clear the snow themselves or order a contractor to clear the snow, and the resident will be charged a bill for the service. If bills are left unpaid, they are added to the property owner's tax bill at the end of the year.

There are a variety of methods which a community can use to enforce sidewalk snow removal, and a combination of these approaches is usually most effective.

Some municipalities issue citations for non-compliance the day after a snow event while others have inspectors who regularly examine sidewalks to ensure snow and ice is cleared in a timely fashion. Others rely strictly on residents to report sidewalk snow or ice violations. The effectiveness of complaint-based systems is contingent upon how regularly, and if, the public reports violations.

Municipality-Led Programs

Forty-six Massachusetts municipalities—**13 percent**—have a policy to remove snow from sidewalks under their jurisdiction.[28] Municipality-led snow removal programs have the following benefits:

» Municipality-led programs can be effective in clearing snow from sidewalks in a timely and consistent manner.

» Programs are beneficial to residents who cannot physically clear sidewalks abutting their properties, and covers winter sidewalk maintenance adjacent to abandoned properties which is sometimes the responsibility of the municipality.

» Some municipalities contract with private businesses to clear snow from municipal streets and sidewalks. In cases like this, it is especially important that contract language be explicit and clear. For example, the contract should be clear that snow should not be piled up at curb ramps and intersection corners.

» Snow removal programs are generally funded by property taxes and/or additional fees.

Best Practices

The following section describes some of the best practices for maintaining pedestrian facilities in the wintertime. It is important to sequence operations so that snow doesn't cover an area that was just cleared: first all roadways, then sidewalks, curb ramps, intersection corners, then apply salt and de-icer.

As a best practice, road designs should consider snow clearance operations and storage. In locations where sidewalk snow removal operations are planned or already occur, pedestrian facilities should be designed to accommodate the width of snow removal equipment. Buffer zones between the roadway and pedestrian facility should leave space for snow storage.

Municipalities may want to consider prioritizing routes for snow clearance based on whether they are used to access a school, transit route, commercial district, senior center, or other site that serves vulnerable populations or has high volumes of people walking

Snow piles near roadway corners create barriers for pedestrians.

Intersection Corners

Intersection corners are a particularly challenging issue for pedestrians in the winter because snow plows often create snow banks which block crosswalks and curb ramps. Having clear intersection corners and curb ramps is very important for all pedestrians, but especially those with mobility limitations because traveling through a snow bank is often impossible for a person using a mobility device. Clearing snow and ice from intersection corners and crosswalks is generally the responsibility of

municipalities, although due to the number of corners across most jurisdictions, this effort can take several days and cause accessibility challenges. Some municipalities direct snow plows to deposit snow either prior to or after an intersection (behind the crosswalk) rather than at the intersection corner, which can be an effective solution to this issue. Other municipalities have developed specific programs that dedicate staff and equipment to clearing snow from intersection corners, which is usually performed using specialized equipment or tractors that are narrow enough to drive on the sidewalks. These programs often prioritize certain pedestrian routes based on a variety of factors such as heavily traveled bus routes, school zones, and commercial areas.

Pre- and Post-Winter Storm Treatments

Treating pedestrian facilities with salt, salt brine, or sand can help reduce icy and slippery conditions and make these facilities safer and more accessible.

Icy sidewalks can form in multiple ways. If a sidewalk is not cleared down to bare pavement after a snowfall, pedestrians will walk over the snow and create a trampled patch of hardpacked snow which can eventually get icy and hazardous. Ice is also commonly formed from cycles in weather. Warm weather melts snow which often runs onto the sidewalks and later freezes with cold temperatures. The problems from these freeze-thaw cycles are difficult to mitigate, but staying proactive in reducing icy sidewalks will help avoid thick build-ups of ice patches on sidewalks. There are many different treatments that can be used for de-icing sidewalks. Salt is widely regarded as the most effective and low-cost solution for de-icing, however, there are serious environmental concerns. Salt melts away with snow and ice and can make its way into water bodies, which pollutes the water and has many negative impacts. For that reason, many municipalities try to limit their salt use as much as they can, as well as encourage residents to limit their salt use on residential sidewalks. Moreover, salt is not effective if it's 15 degrees or colder, so using sand to treat icy sidewalks is advisable in those conditions. Salt may also corrode pavement surfaces over time, decreasing the lifespan of a sidewalk surface.

Some municipalities have developed educational campaigns that aim to increase residents' awareness of the environmental implications of heavy salt use on sidewalks or roadways. These campaigns may include door hangers, informational web pages, and social media announcements. Salt brine is occasionally used on shared use path or trail facilities to mitigate icy surfaces. Salt brine is a mixture of salt and water, which is generally sprayed onto a surface 48 hours prior to an anticipated winter storm.

Walkways can become icy as a result of the freeze-thaw cycle.

Sidewalk Winter Maintenance Programs

Programs relating to sidewalk winter maintenance can include public education, communication, reporting, and volunteers. Programs can complement winter maintenance practices and policies by providing services or helpful information to residents about winter maintenance.

Case Study: Lexington

The Town of Lexington takes responsibility for clearing snow from 65 miles of sidewalks during the winter to encourage year-round walking and biking to school. Crews usually begin clearing snow right after a winter storm has ended. Bus stops also get cleared if they are located on the same sidewalk segment. The Town often encounters challenges when private contractors hired to clear driveways plow snow back onto previously cleared roads and sidewalks. New sidewalks in Lexington are designed with a **5-foot** minimum clear zone and **52 inches** clear at pinch points to accommodate snow removal. Fitting plows through **52-inch** openings, however, can still be a challenge.

Case Study: Chelsea

The City of Chelsea will take on the responsibility of clearing their local busway and greenway when the Silver Line Gateway extension opens. The City has an ordinance that property owners must clear sidewalks, though often times this goes unenforced. The resulting action of the City is to clear the sidewalks themselves with inspection crews issuing fines to the property owners. Most school children in Chelsea walk to school, so maintaining clear sidewalks in the winter is critical. Most snow removal downtown is performed by hand, but the City recently purchased their first mini plow for their local greenway.

Resident Reporting

Municipalities often have mechanisms for reporting snow and ice issues, as well as tools for tracking the progress of maintenance crews. Examples of reporting programs include 311 programs (such as the See-Click-Fix software), that provide residents a tool to report sidewalk snow and ice issues to the municipality. The municipality can then address the complaint through warnings or citations to property owners responsible for clearing the sidewalk.

Material Assistance

Some municipalities have free sand programs that supply property owners with an inexpensive solution to mitigating slippery, hazardous conditions by spreading sand on sidewalks. These programs provide free sand at multiple pick-up locations spread

People often choose to walk in the roadway when sidewalks are obstructed by snow and ice.

throughout the municipality, making it easy and convenient for residents that have access to a motor vehicle to pick up sand.

Need-Based Assistance

Snow and ice clearing can be challenging for older adults and people with disabilities. Some communities develop volunteer programs that assist those in need with shoveling their sidewalks. Sometimes called "snow angels" or "snow buddies", these programs mobilize volunteers to shovel and scrape ice for those in need of assistance.

Some municipalities operate "snow exemption" programs, which are another way of accommodating older adults and people with disabilities with a snow removal service. These programs usually define requirements for age, ability, and income to qualify. If eligible, municipal staff will remove snow and ice from sidewalks adjacent to properties, but not on personal property.

Explore More Resources

Supporting resources on snow and ice maintenance on pedestrian facilities are below:

» FHWA Guide for Maintaining Pedestrian Facilities for Enhanced Safety, October 2013 https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037/

Snow plows should not pile snow on crosswalk curb ramps.

» Scott, Marcia and Brandon Rudd. "Winter Maintenance of Pedestrian Facilities in Delaware: A Guide for Local Governments" University of Delaware, February 2012 http://www.ipa.udel.edu/publications/SnowRemoval.pdf

» Street, Sidewalk and Path Snow Removal, City of Boulder, Colorado, May 2013. http://www.bouldercolorado.gov/index.php?option=com_content&id=173&Itemid=1206

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