State of Georgia

Department of Transportation

Pedestrian and Streetscape Guide

Pedestrian and Streetscape Guide

4/25/19

Rev 3.0

Atlanta, Georgia 30308

GDOT Georgia Department of Transportation

This document was developed as part of the continuing effort to provide guidance within the Georgia Department of Transportation in fulfilling its mission to provide a safe, efficient, and sustainable transportation system through dedicated teamwork and responsible leadership supporting economic development, environmental sensitivity and improved quality of life. This document is not intended to establish policy within the Department, but to provide guidance in adhering to the policies of the Department. This is update #1.0 to GDOT's Pedestrian and Streetscape Guide.

Your comments, suggestions, and ideas for improvements are welcomed.

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DISCLAIMER

The Georgia Department of Transportation maintains this printable document and is solely responsible for ensuring that it is equivalent to the approved Department guidelines. All photographs by AECOM unless otherwise indicated.

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Interview Sources

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List of Effective Chapters

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Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
APBP	Association of Pedestrian and Bicycle Professionals
ARC	Atlanta Regional Commission
BMP	Best Management Practice
CRZ	Critical Root Zone
DBH	Diameter at Breast Height
DDI	Diverging Diamond Interchange
FHWA	Federal Highway Administration
GDOT	Georgia Department of Transportation
GEPA	Georgia Environmental Policy Act
HDOT	Hawaii Department of Transportation
ISA	International Society for Arboriculture
ITE	Institute of Transportation Engineers
LAP	Local Administered Project
LPI	Leading Pedestrian Interval
mph	miles per hour
MS4	Municipal Separate Storm Sewer System
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
PEDS	Pedestrians Educating Drivers on Safety
PHB	Pedestrian Hybrid Beacon
PROWAG	Proposed Right-of-Way Accessibility Guidelines
R.O.A.D.S	Repository for Online Access to Documentation and Standards
RRFB	Rectangular Rapid Flash Beacon
SPUI	Single-point Urban Interchange
TPZ	Tree Protection Zone

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Chapter 1. Introduction

The Georgia Department of Transportation (GDOT) Pedestrian and Streetscape Guide contains guidelines and best practices for the design of streets and roadways that support safe multimodal travel. As defined by the Federal Highway Administration (FHWA), a pedestrian is "Any person not in or on a motor vehicle or other vehicle. Excludes people in buildings or sitting at a sidewalk cafe." The National Highway Traffic Safety Administration also uses another pedestrian category to refer to pedestrians using conveyances and people in buildings. Examples of pedestrian conveyances include skateboards, non-motorized wheelchairs, roller skates, sleds, and transport devices used as equipment.

The Guide focuses on design of pedestrian and streetscape facilities, but good design is one component of a successful pedestrian facility. Conscientious planning, effective education programs, and consistent safety and law enforcement also contribute to improving our communities for everyone. Some guidance related to planning for people who walk is provided, but the overall intent is to encourage good design practices. Further guidance is provided in Appendix A for locating mid-block crossings.

1.1 Intended Users of this Guide

The anticipated users include planning and design practitioners, elected officials, developers, advocates, and public works departments, as well as others listed in Figure 1.1. The Guide provides information on how to design pedestrian infrastructure, build out a connected pedestrian network, and create a comfortable environment for people to walk.

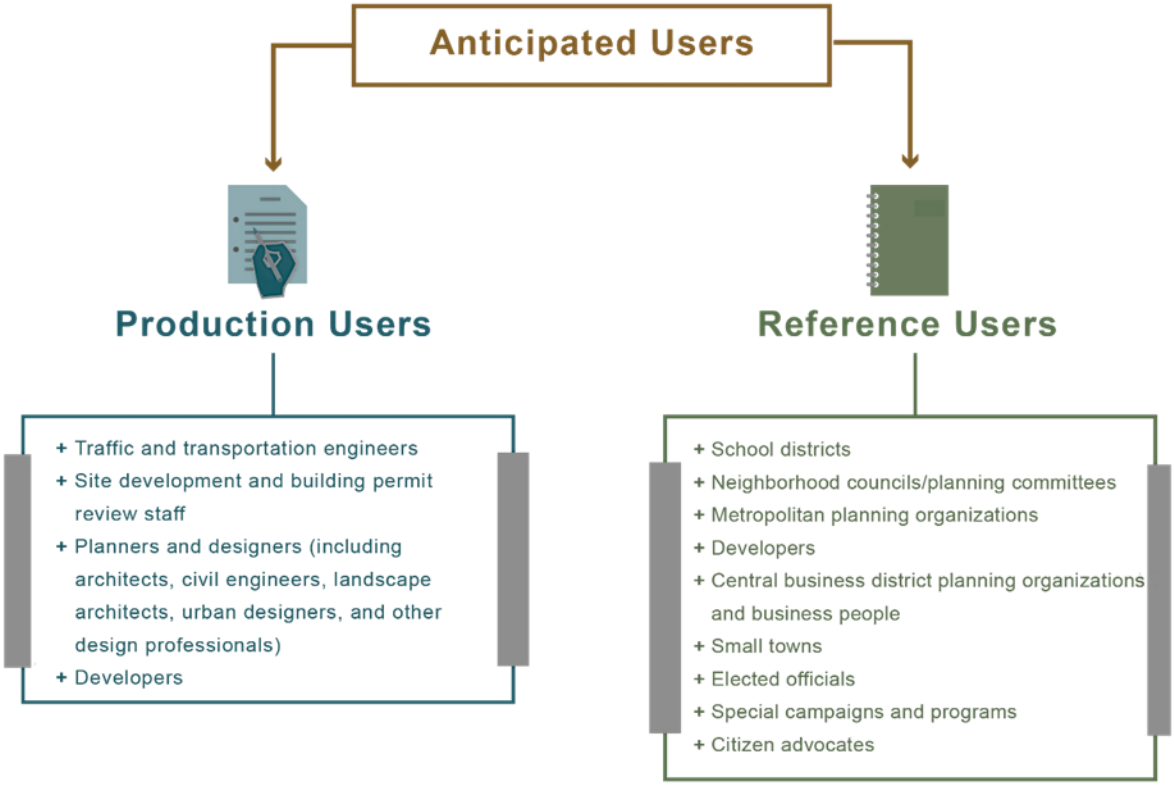


Figure 1.1. Anticipated Users of the Pedestrian and Streetscape Guide

1.2 Relationship to Other Policies and Design Guidelines

This Guide builds upon the design guidelines and standards set forth in the GDOT *Design Policy Manual* and the US Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG) by providing supplemental recommendations for enhancing pedestrian infrastructure beyond the minimum standards. The recommendations in this Guide do not supersede the policies established in the GDOT *Design Policy Manual* or PROWAG.

The recommendations in this Guide were compiled from numerous local, state, and national sources. The sources are referenced throughout the Guide and detailed in Chapter 8.

The following list provides the main sources that were consulted in the development of the Guide.

(From top left)

American Association of State Highway and Transportation Officials (AASHTO) *Roadside Design Guide* (latest edition)

AASHTO *A Policy on Geometric Design of Highways and Streets* ("Green Book") (latest edition)

FHWA *Manual on Uniform Traffic Control Devices for Streets and Highways* (latest edition)

GDOT *Context Sensitive Design Online Manual* (latest edition)

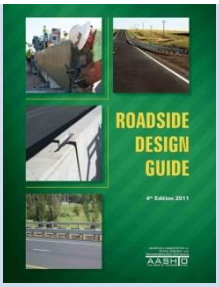
GDOT *Design Policy Manual* (latest edition)

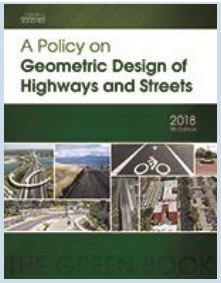
GDOT *Plan Development Process* (latest edition)

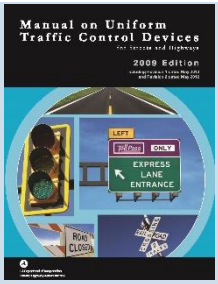
AASHTO *Guide for the Development of Bicycle Facilities* (latest edition)

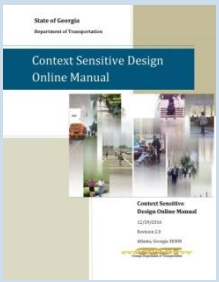
National Association of City Transportation Officials (NACTO) *Urban Street Design Guide* (latest edition)

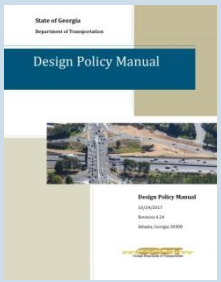
Institute of Transportation Practitioners (ITE) *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* (latest edition)

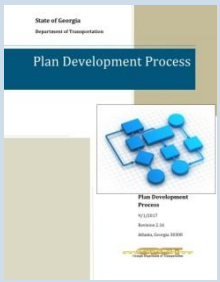


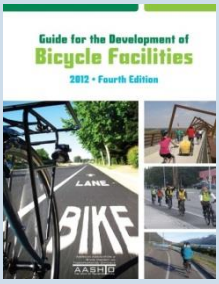


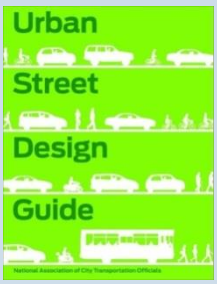


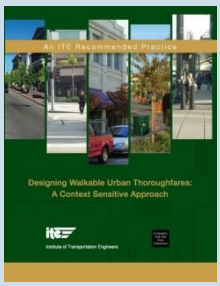












1.3 Navigating the Guide

Utilizing the table of contents at the beginning of the document, users can quickly find topical information that is pertinent to their immediate planning or design need. The following words are intended to be helpful to understand how to apply the guidance and requirements mentioned in the Guide:

- Shall: a mandatory condition or action
- Should: the standard under normal conditions

- May: a permissive condition where no requirement for design, application, or standards is intended

1.3.1 Application of Design Features

Given the complexities of streetscape design, an evaluation process and engineering judgment are recommended to confirm the implementation of safety treatments or countermeasures is appropriately placed within its context. More than one countermeasure is often needed to provide the most effective solution for pedestrian safety at a given location. In these cases, a more in-depth and site-specific evaluation is needed by an experienced practitioner to determine the combination of countermeasures that provide the maximum safety benefit for the pedestrian.

To assist practitioners, speed limit icons are used throughout the Guide to indicate the conditions under which countermeasures and design features are most appropriate. An icon is not provided if a countermeasure or design feature may be used on roads with any speed limit. In addition, a no-truck icon is included in certain sections to indicate design features that may not be appropriate on roads with high volumes of truck traffic. The icons are shown in Figure 1.2.

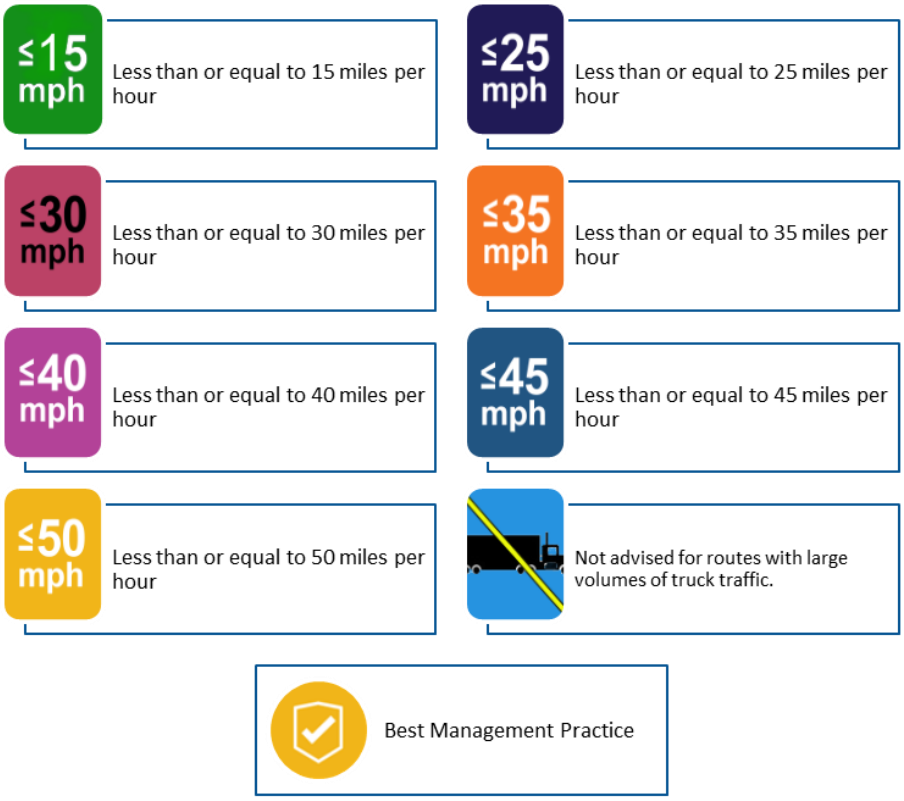


Figure 1.2. Applicability of Design Features

1.3.2 Benefits of a Streetscape

A well-designed streetscape satisfies a variety of mobility needs and interests, and is integral to the larger system of social, economic, environmental, and health considerations for Georgia communities. These considerations serve as the basis for the planning, design, engineering, and implementation processes, enhancing the quality of life of Georgia's pedestrians while positively

impacting environmental and economics within an area. A streetscape project is typically designed and implemented in an urban context whether it is a small town or large city. A streetscape project typically involves ADA pedestrian facility upgrades, sidewalk construction, and amenities such as street trees, pedestrian-scale lighting, and an amenity zone for benches, litter receptacles, bike racks, and additional buffered landscape areas. To this point FHWA states, “No single design feature can ensure that a streetscape will be attractive to pedestrians. Rather, the best places for walking combine many design elements to create streets that are comfortable to people on foot. Street trees, separation from traffic, seating areas, pavement design, lighting, and many other factors should be considered in locations where pedestrian travel is accommodated and encouraged.” Above all, the primary goal of a streetscape project is to improve pedestrian safety.

Some primary benefits of well-designed streetscapes are described below:

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Chapter 2. GDOT Project Delivery

To improve quality and consistency in the design review process, GDOT has adopted a process for developing construction plans and approving design variances. The standard GDOT process involves quality review checks throughout all stages of a transportation or streetscape project. These checks are intended to improve design-related coordination, develop the construction supplemental agreements, and reduce technical problems, utility delays, and liability claims during construction. This chapter provides an overview of GDOT's standard processes for developing and submitting construction plans and variances.

2.1 Plan Development Process and Plan Presentation Guide

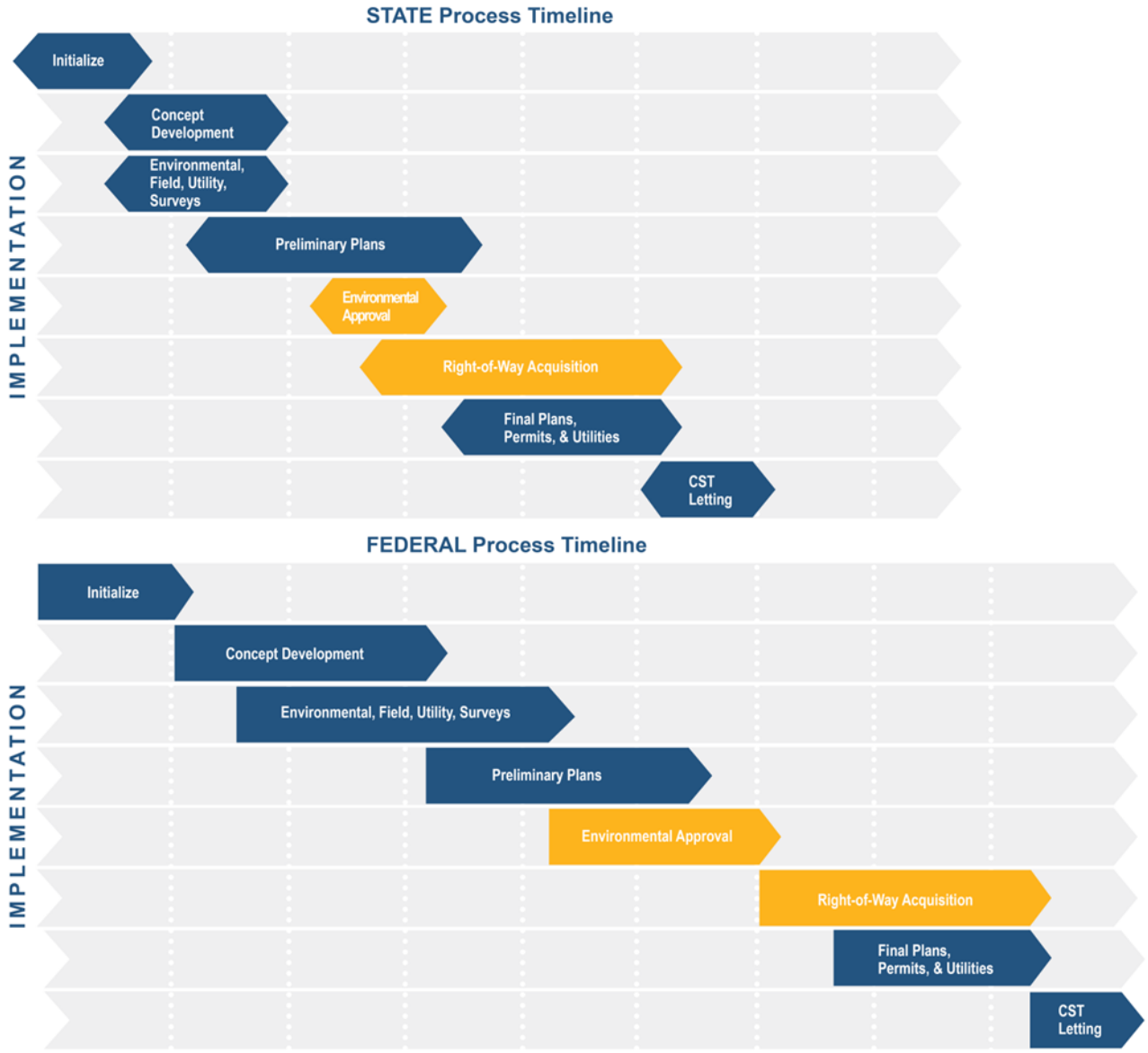
GDOT's *Plan Development Process* and the *Plan Presentation Guide* outline a standardized process for delivering federal-, state-, and locally-funded transportation and streetscape projects, and provide guidance on project plan production and computer aided drafting guidelines. The process and guide support efficient project delivery and create consistency across projects with varying funding sources, site characteristics, and requirements. The *Plan Development Process* should be applied to the following types of projects:

- Construction and right-of-way projects prepared by or for GDOT where GDOT is proposed to let the project to construction.
- Construction projects that require the purchase of right-of-way.
- Construction projects prepared by the Office of Maintenance requiring full-size plans.
- Intelligent transportation system projects.
- Major construction projects prepared by or for the Office of Local Grants as set forth in project management agreements.
- Projects required by project framework agreements (see GDOT *Plan Development Process*).
- Locally-sponsored projects on the state highway system, interstate system, or where GDOT will be responsible for maintenance.

The GDOT *Plan Development Process* applies primarily to projects on state-owned facilities. Projects on local streets are not required to follow the standard *Plan Development Process*.

GDOT has developed a process for state-funded projects that includes the same major steps as the federal process but provides significant flexibility in the timing of individual steps, with the objective of shortening project delivery. These timelines are illustrated in Figure 2.1.

In addition to the timelines, another difference between the federal and state processes is the environmental evaluation and approval as it relates to right-of-way acquisition. Federally-funded projects follow the National Environmental Policy Act (NEPA), whereas state-funded projects follow the Georgia Environmental Policy Act (GEPA). GEPA submittals should be in accordance with GDOT's *Environmental Procedures Manual*. Most streetscape and pedestrian upgrade projects fall within a Categorical Exclusion level of environmental approval. Categorical Exclusions are considered to have the least amount of impact on environmental resources.



Source: GDOT *Plan Development Process* (2017)

Figure 2.1. Federal and State Plan Development Process Timelines

For additional guidance on sub-tasks and certification requirements within each step of state- and federal-process timelines, refer to GDOT's *Plan Development Process, State Funded Projects*.

When following the *Plan Development Process* for both federal- and state-funded projects, public participation should be maintained throughout the project so that state and federal funds are not jeopardized. For more information on public involvement refer to Chapter 3 of this Guide and GDOT's *Context Sensitive Design Online Manual*.

2.2 Design Variances and Exceptions

When a transportation construction or reconstruction project is located within an "on system" facility, which are roadway facilities owned by the State or a transportation facility owned by the National Highway System, contains design features that do not meet GDOT policy, a design variance should be requested through a formal Design Variance request in writing to the attention of the Chief Engineer. Table 2-1 system conditions that require a design variance approval by GDOT. Additionally, whenever a road construction project on a state route contains design features that do not meet AASHTO guidelines, a design exception should be requested from the Chief Engineer and FHWA for Project Division Interest.

If a design variance is anticipated, designers should coordinate with GDOT at an early stage of the project, such as the concept phase. Requests should be listed and identified in the Concept Report for review by GDOT. Design variance and exception templates can be found in the current edition of the GDOT *Plan Development Process*.

Table 2-1. Facilities that Require a Design Variance

Project	Funding/Maintenance	On/Off System	Variance Required
Category I	GDOT	On System	Yes
Category II	GDOT + Local	On System	Yes
Category III	Local	Off System	No Variance Required

As stated in the Georgia Code § 50-21-24, Exceptions to state liability. "GDOT has decided to waive the requirement of a formal Design Exception or Design Variance for projects on off-system roadways regardless of whether state or federal funding is involved, with the two exceptions listed below:

1. Whenever employees of the Department are directly involved in the engineering and design, right-of-way acquisition, and/or construction letting of a project on an off-system roadway, then the normal approval of a Design Variance by the Department's Chief Engineer will be required before any deviation to minimum design standards can be incorporated into the project. This also applies to any of the above work activity being accomplished on behalf of the Department by consulting engineering firms or contractors hired by the Department.

Design Variances for "Off-System" Projects

1. Any deviation proposed to "Design Loading Structural Capacity" standards will require the normal approval of a Design Variance from the Department's State Bridge Engineer and/or the Department's Chief Engineer before any deviation can be incorporated into a project.

This change is intended to provide more flexibility to local governments and their Engineer-of-Record, to make practical design decisions for "off-system" roadways within their jurisdiction."

The following are two examples associated with pedestrian infrastructure or streetscape projects located "On System," which would require a Design Variance approval.

- Request to reduce the lateral offset for a fixed object such as a tree or a street light.
- Request to reduce the width of a sidewalk.

Please see 2.2.3 Design Variances for Off-System Roadways, GDOT *Design Policy Manual* (latest edition) for further guidance.

Further Guidance

GDOT, *Context Sensitive Design Online Manual* (latest edition)

GDOT, *Environmental Procedures Manual* (latest edition)

GDOT, *Local Administered Project (LAP) Manual* (latest edition)

GDOT, *Plan Development Process* (latest edition)

GDOT, *Plan Presentation Guide* (latest edition)

GDOT, *Public Involvement Plan for NEPA Projects* (latest edition)

GDOT, R.O.A.D.S (latest edition)

GDOT, *Regulations for Driveway & Encroachment Control* (latest edition)

GDOT, *Design Policy Manual* (latest edition)

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Chapter 3. Planning Streets for Pedestrians

To create safe, comfortable, and connected spaces for people, designers should consider the needs of pedestrians at the onset of a transportation project. This chapter provides guidance on how to plan for pedestrians in the concept development phase of a transportation project. The concept development phase considers how the project fits into surrounding multimodal networks and studies how the surrounding land uses influence pedestrian activity. This chapter is intended to be used for small-scale corridor level planning. It does not provide exhaustive guidance on creating pedestrian-focused transportation plans and policies and does not reflect GDOT's pedestrian infrastructure investment plans. For more information on creating local and regional pedestrian and bicycle master plans, refer to the Atlanta Regional Commission (ARC) bicycle and pedestrian plan, *Walk. Bike. Thrive!* For more information on pedestrian infrastructure investment needs, refer to the GDOT *Statewide Strategic Transportation Plan*.

Figure 3.1. Raised Crosswalk with RRFBs, Atlanta, Georgia

For a procedure for planning uncontrolled intersections (mid-block crosswalks), refer to Appendix A for more detailed information.

3.1 Prioritizing Presentation Safety

Pedestrian safety is a city or community's key metric in measuring livability. Providing safe pedestrian facilities and complete networks promotes social and physical health and wellness for all. In recent years, pedestrian injuries and deaths have increased in Georgia. In 2017, 258 pedestrian fatalities were recorded, representing an increase of 91 fatalities from those recorded in 2012. This trend, illustrated in Figure 3.2, can only be reversed by instituting policies, action plans, and roadway design practices that prioritize pedestrian safety. The four most prominent national and statewide pedestrian safety commitments include the GDOT Complete Streets Policy, PROWAG, GDOT's Georgia Pedestrian Safety Action Plan 2018-2022, and

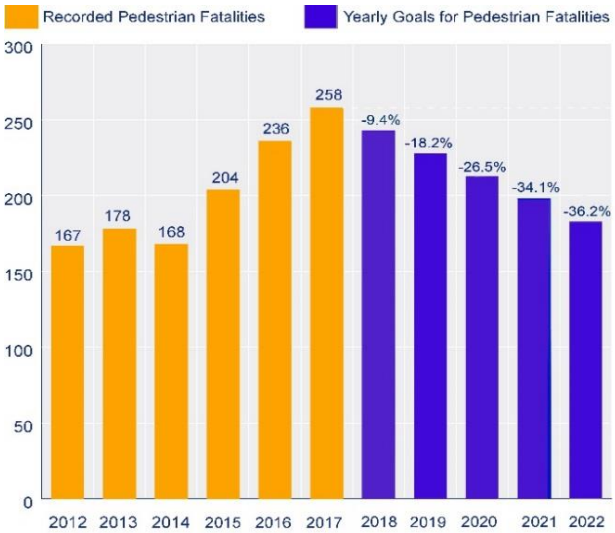


Figure 3.2. Crash History and Goal for Reduction in Statewide Pedestrian Fatalities, 2012–2022

the Governor's Office of Highway Safety's "What GA Codes Say About Pedestrians."

Together, these policies and plans guide the design of pedestrian infrastructure and the development of a connected pedestrian network.

3.1.1 Georgia Complete Streets Policy

In 2012, GDOT adopted a Complete Streets Policy that requires pedestrian, bicycle, and transit accommodations to be incorporated into transportation infrastructure projects on a regular basis. The policy establishes standards for where pedestrian infrastructure should be provided.

For more information on the Complete Streets Policy, refer to Section 3.2 of this Guide.

3.1.2 Public Right-of-Way Accessibility Guidelines (PROWAG)

Roads and streets that are required to accommodate pedestrians should be accessible by people of all ages and abilities. GDOT accepts the PROWAG as the basis for the design of pedestrian infrastructure, except for situations where the FHWA *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) or AASHTO Green Book does not specifically endorse PROWAG. The conditions under which an exception may be granted are when the PROWAG requirement is structurally impractical, technically infeasible, or unsafe. In those cases, a decision to select a value or retain an existing condition that does not meet the criteria defined in PROWAG should require a comprehensive engineering study and the prior approval of a design variance from the GDOT Chief Engineer.

Refer to the GDOT *Design Policy Manual* Section 9.5 for further information.

3.1.3 Georgia Pedestrian Safety Action Plan

The GDOT *Georgia Pedestrian Safety Action Plan 2018-2022* outlines strategies and actions that state and local agencies should take to improve pedestrian safety and reduce pedestrian fatalities. The *Pedestrian Safety Action Plan* identifies locations, corridors, and recurring road characteristics associated with pedestrian crashes throughout Georgia. The plan highlights focus counties, cities, and corridors where pedestrian infrastructure should be improved. When planning and prioritizing infrastructure improvements, local agencies should reference the list of focus destinations in the *Pedestrian Safety Action Plan* to ensure resources align with the greatest investment need.

3.1.4 Georgia's Policy of "Promoting Zero Pedestrian Deaths "

The Governor's Office of Highway Safety states that "Georgia will take decisive and sustained action Towards Zero Deaths – a state with zero pedestrian fatalities and zero serious injuries caused by vehicle-pedestrian crashes." This statewide commitment fundamentally changes the way state and local agencies in Georgia approach road design and traffic operations. Instead of designing with the assumption that drivers and pedestrians will conform and demonstrate ideal human behavior, the design of infrastructure should account for realistic human behavior.

For more information on Georgia's policy, refer to the Governor's Office of Highway Safety *Georgia Strategic Highway Safety Plan*.

3.2 GDOT Complete Streets Policy

The GDOT Complete Streets Policy establishes standards and guidelines for incorporating bicycle, pedestrian, and transit accommodations into transportation infrastructure projects. GDOT's Complete Streets Policy should be reviewed at the beginning of the concept development phase of a transportation project or planning study on GDOT-owned facilities to determine whether pedestrian infrastructure should be considered. Streets under the jurisdiction of a local agency should also be considered for pedestrian accommodations.

Table 3-1 presents questions that break down GDOT's Complete Streets Policy by warrant. This table can be used as a tool to check whether pedestrian accommodations are warranted on GDOT-owned facilities. The table is intended help practitioners interpret the warrants; however, the final determination should still be made in the context of the warrants.

Table 3 1. GDOT Complete Streets Policy: Pedestrian Warrants Policy Check

	Questions		Y/N
Standard	Is the project located in an urban area?	If located in an urban area, is the project a planning study, reconstruction, new construction, capacity-adding, or resurfacing project which include curb and gutter as part of an urban border area? (Refer to Section 6.7 of the GDOT *Design Policy Manual* for more information on urban border areas).	
	Is the project located in a rural area?	If located in a rural area, are there existing or planned pedestrian travel generators and destinations along the segment of roadway under evaluation? (Generators and destinations can include but are not limited to residential neighborhoods, commercial areas, schools, public park, transit stops and stations, and convenient stores).	
		If located in a rural area, is there evidence of pedestrian traffic (e.g., a worn path along roadside) at any point along the segments of roadway under evaluation?	
		If located in a rural area, have there been pedestrian crashes equal to or exceeding the rate of 10 crashes per ½ mile segment of roadway over the most recent five years for which crash data is available?	
		If located in a rural, has a local or regional adopted planning study identified the need for pedestrian accommodations for any point along the segment of roadway under evaluation?	
Guidelines	Is there a school, college, university, major institution, shopping center, convenience store, park, or another major pedestrian generator along or within close proximity to the segment of roadway under evaluation?		
	Is there a shared use path or transit stop along the segment of roadway under evaluation?		
	Is there an approved development that may generate pedestrian traffic in the future within close proximity to the segment of roadway under evaluation?		
	Is the project in an urbanized area or an area projected to be urbanized by an MPO, regional commission, or local government prior to the design year of the project?		

	Questions	Y/N
	Have one or more pedestrian fatalities occurred along the segment of roadway under evaluation?	
	Has a vehicle-pedestrian crash occurred in the past five years along the segment of roadway under evaluation?	
	Do any city, county, MPO, or regional commission plans (comprehensive transportation plans, livable community, community development plans, etc.) identify the need for pedestrian accommodations along the segment of roadway under evaluation?	
	Has reasonable community interest related to pedestrian infrastructure been received in the past two to four years?	

Steps after reviewing the policy:

- If one or more of the standard warrants are met for streets under GDOT's jurisdiction, pedestrian accommodations should be incorporated into the infrastructure project.
- If one or more of the standard warrants are met and the accommodations are impractical, technically infeasible, or unsafe, a design variance and coordination with the district traffic operations office are required. Refer to Section 9.4 of the GDOT *Design Policy Manual* for more information on obtaining a design variance.
- If the standard warrants are not met but one or more of the guideline warrants are met for streets under GDOT's jurisdiction, pedestrian accommodations should be incorporated into the infrastructure project.

3.3 Connected Pedestrian Networks

Maintaining and improving the connectivity and usefulness of the overall pedestrian network in the project area should be a key focus throughout the planning and design process.

A well-connected pedestrian infrastructure promotes walkability as destinations can be obtained through a safe and efficient pedestrian network. During the planning process, attention should be paid to how a project location fits into the surrounding pedestrian, transit, and bicycle networks (including planned facilities). Designers should assess where pedestrian travel demand exists or may exist in the future and how well that demand is already being served.

Figure 3.3. School Crossing, Decatur, Georgia

The GDOT Complete Streets Warrants provide a good starting point for identifying the presence of pedestrian trip generators in the area; however, it is necessary to go a step further and consider how they fit together and how a

project can be designed to promote pedestrian mobility and safety between the destinations in the area. Once walkable destinations have been identified, the next step is to connect these places through safe, efficient pedestrian infrastructure that is responsive to the needs of the users.

When planning and designing connections, it is important to pay close attention to the proximity of destinations, observe where people are walking today, and consider how new development might generate more pedestrian activity and introduce new travel paths. Knowing where people want to walk will help to prioritize investments and identify where pedestrian infrastructure should be implemented, such as crosswalks, midblock crossings, curb extensions, pinch points, traffic calming features, etc.

Practitioners should collect, and document data related to the pedestrian network in the early stages of a project. Section 3.4 provides recommendations for what type of data should be collected to support a thorough assessment of pedestrian needs in a project area.

3.4 Pedestrian-Oriented Data Collection

During the initial planning phase of a roadway project, it is common practice for practitioners to collect data on existing traffic conditions, roadway characteristics, and crash history in the project study area. These site assessments should also study and document existing and future pedestrian activity and adjacent developments. This section can be used to help guide the practitioner in capturing useful pedestrian-oriented data during the site assessment.

Figure 3.4. Road Safety Walk Audit

The data outlined in this section may be collected for the following types of roadway projects:

- Road construction and reconstruction
- 3R (resurfacing, restoration, rehabilitation) projects
- Corridor or intersection restriping
- Targeted safety improvements
- Road safety audits
- Traffic engineering studies
- Streetscape projects
- Corridor planning project

Figure 3.5. Streetscape, Midtown, Atlanta, Georgia

3.4.1 Compile Transportation and Site Development Plans

Background information from transportation or community development plans related to the site will help identify previous discussions, assumptions, and decisions made related to pedestrian infrastructure. Proposed and approved site development plans will provide insight into where future pedestrian activity is likely to occur. Together, these documents will help evaluators understand the history, provide direction for future modifications (if any), and support the final recommendation. At the onset of a project, designers should ask the following questions:

- Do previously adopted plans and/or concept design documents mention the need for or provide recommendations for pedestrian infrastructure in the study area?
- How much pedestrian activity will future developments generate?

3.4.2 Document Existing Infrastructure and Developments

Existing roadway configuration, pedestrian accommodations, and adjacent land uses, and developments should be used to determine the type and location of pedestrian infrastructure. Existing conditions and proposed developments should be evaluated so that the pedestrian facilities or countermeasures can be designed or phased to accommodate the future conditions. In addition, existing historic districts, features, landmarks, and environmentally sensitive areas should be identified early on to avoid or minimize any impacts to these features.

When assessing existing site conditions, consider the following questions:

- What are the adjacent existing and future land uses or developments (i.e., multi-family housing, grocery store, educational institution, etc.)?
- What are the existing and proposed densities of these adjacent land uses?
- What are the existing pedestrian accommodations (i.e., shared use path, sidewalk, and worn foot paths in the dirt)?
- Where are the existing pedestrian accommodations along street segments (both sides of the street, one-side)?
- What are the existing pedestrian accommodations at intersection and mid-block crosswalks (marked crosswalks or unmarked crosswalks, traffic circles, curb extensions, crossing islands, etc.)?

Figure 3.6. Example of Mixed-Use Development, Smyrna, Georgia

- What is the existing roadway configuration including the width of roadway (from curb to curb), number of lanes, turn lanes, presence and type of bicycle infrastructure, parking lanes, and the presence of painted or raised medians or traffic calming features?
- What is the type (painted, raised, planted, etc.) and dimensions of the median (if applicable)?
- Are physical barriers present either along the roadway or leading up to the roadway that are channelizing pedestrians to certain crossing points (fences, ditches, vegetation, etc.)?

- Are there traffic controls (stop signs, traffic signals, marked crosswalks, rectangular rapid flashing beacons [RRFB], pedestrian hybrid beacons [PHB], warning signs, etc.) along the corridor?
- If there is a traffic signal along the corridor, how long is the pedestrian signal phase? Are there special features such as a pedestrian scramble or leading pedestrian interval?
- If there is a marked crosswalk, what is the pedestrian crossing sight distance at the crosswalk?
- Are there lights along the corridor? If so, what is their primary function (i.e., Pedestrian or Roadway lighting)? Or do both complement each other providing safe conditions for all users.
- Where are the transit (bus or train) stops along the corridor?
- Are the transit services high-capacity/frequent transit or lower capacity transit service?
- Are there shared use path entrances along the corridor?
- Are special events (sports games, farmers markets, concerts, etc.) held on adjacent properties along the corridor?

3.4.3 Observe Pedestrian Activity

In order to design useful pedestrian infrastructure, a practitioner should have an understanding of the level and type of pedestrian activity along a corridor. This information can be used to identify the infrastructure, traffic operations, and places to install pedestrian crossings. When collecting traffic data, consider the following questions:

- Where are pedestrians walking and crossing the street?
- Are pedestrian crossings at intersections or mid-block?
- When are the peak hours of pedestrian activity (weekends, lunch time, at night, etc.)?
- What are the pedestrian volumes during the peak hours of pedestrian use along the segment of street or roadway?

Figure 3.7. Peachtree Road, Atlanta, Georgia

Peak hours of pedestrian use typically occur during fair weather conditions and could be different than peak hours of vehicular use. The developments and recurring community events in the study area may serve as indicators to determine the best time to collect data. For example, in some scenarios, pedestrian activity may be elevated on weekends or at night, if there are places of worship or restaurants in the study area. Multiple days of data collection may be necessary to observe peak pedestrian volumes. Three days of data collection is recommended but this may be shortened to one day if sufficient data are obtained based on engineering judgment. It is recommended to count pedestrians separately from bicyclists and to take note of the percentage of pedestrians who are under the age of 16, elderly, or disabled.

Other questions to consider include the following:

- What is the pedestrian compliance rate (i.e., are pedestrians crossing at a marked pedestrian crossing or during a designated pedestrian phase)?
- What is the driver compliance rate (i.e., are drivers yielding to pedestrians crossing or waiting the cross the street at a marked crosswalk)?
- Are drivers frequently exceeding the speed limit?

3.5 Context-Sensitive Design for Pedestrian Facilities

Context-sensitive design is a process of research and public engagement that identifies opportunities and concerns as well as existing context within a project area that is unique. Considerations should be made to preserve the existing identified context and use the context as inspiration for design elements within the streetscape or roadway project. Pedestrian needs are different for every project, as are the surrounding natural and built environments. Thus, a context-sensitive design approach should be employed when planning and designing pedestrian facilities. A context-sensitive approach balances technical analyses with public input and considers the needs of people who live near the corridor, as well as those who use the corridor to pass through an area. For example, residents who live near a corridor may need frequent crossing opportunities, whereas freight companies and drivers commuting to work may desire a high-speed road with few stopping points. Both needs should be considered and accounted for in the planning and design process.

To achieve a context-sensitive outcome, designers and planners should involve the people who live, own property, and/or operate a business along the street in the early stages of a project and keep them engaged throughout the concept development process. This section provides recommendations on how to involve the community in the planning and design process and describes the different contexts that a roadway may transect. Refer to the GDOT *Context Sensitive Design Online Manual* for a complete list of context-sensitive solution guiding principles.

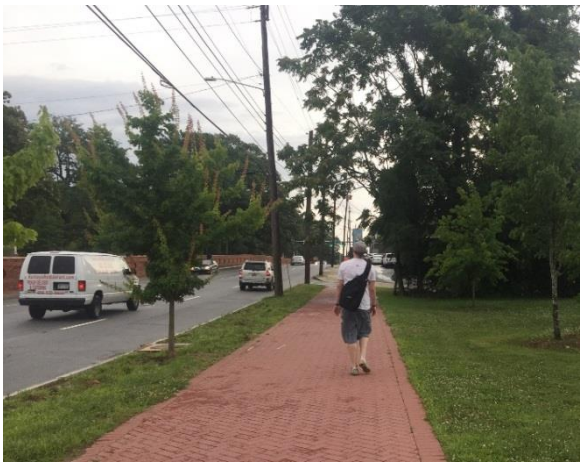


Figure 3.8. Context Sensitive Brick Pavers, Historic Oakland Cemetery, Atlanta, Georgia

3.5.1 Tactics for Involving the Community

A key component of the context-sensitive design approach is continual public involvement throughout the planning and concept development processes. Public involvement is critical to ensure that planning and design decisions reflect local needs and preferences. Each project and community are unique, so a variety of outreach techniques should be employed to connect with and hear from a diversity of stakeholders. The follow subsections describe community outreach strategies that can be used to engage the public and get feedback on the design of pedestrian infrastructure. To best reach all participants within a community or project area, the planning/design team should consult with their client and conduct research to determine the most convenient and efficient way to reach all stakeholders and citizens as each project context can be different with regards to demographics and access to meetings and online surveys. In many cases, it is best to use a multi-prong approach that provides several options to reach a diverse range of demographics.

Figure 3.9. Public Involvement, Atlanta, Georgia

3.5.1.1 Road Safety Walk Audit

Road safety walk audits are used to inventory the existing walking conditions along a road. Road safety walk audits are opportunities for practitioners, business owners, and community members to visit a site together and identify high-priority safety issues related to the existing pedestrian infrastructure. For more information on how to conduct a road safety walk audit, refer to the FHWA *Pedestrian Road Safety Audit Guidelines and Prompt Lists*.

3.5.1.2 Pop-Up Events

Pop-up events are casual opportunities for collecting public input and sharing information related to a project. There are two main purposes for a pop-up event:

- To bring community members together to realize the temporary transformation of a street into a more pedestrian- or bike-friendly public space and
- To test out solutions for bike, pedestrian facilities, and public spaces at popular and easily accessible destinations in a project area.

Both types of events can be fun and can generate enthusiasm or momentum for pedestrian-oriented improvements. Pop-up events can also be held in conjunction with larger community events such as Streets Alive, the Georgia Walks Summit, neighborhood festivals, and farmers markets. Hosting pop-up events in conjunction with larger popular community events enables a larger and more diverse group of people to be involved and provide feedback on a project. Participants should always coordinate with and get approval from the local municipalities prior to engaging in the event.

Figure 3.10. Pop-Up Events

Figure 3.11. Workshop

3.5.1.3 Workshops

Workshops are interactive events where community members and designers collaborate and brainstorm alternative designs. These events help develop concept design plans that reflect community desires by creating an open and transparent process involving decision-makers, stakeholders, and the public. Types of workshops include:

- **Educational and information sharing**: These workshops focus on informing the public or practitioners about best practices, technical analysis methodology, and the project delivery process.
- **Design charrettes**: Design charrettes are intensive, often multi-day workshops that focus on collecting information and processing it into early concept designs that can be vetted and refined as the project progresses.
- **Collaborative brainstorming events**: These workshops can involve small groups to entire communities. The focus is to solicit ideas from participants for assistance in solving key project issues.
- **Walkshops**: Similar to road safety audits, these workshops take place in the field and involve walking along the corridor under evaluation. However, they are less formal events that can be used to brainstorm ideas and build community support.

Figure 3.12. Pop-Up Events

3.5.1.4 Advisory Committees

Community advisory committees help formalize an inclusive planning and design process. Advisory committees provide input at milestones in the project and can help gain support and coordination among various groups. These committees are comprised of a diverse cross section of key individuals and organizations that have a vested interest in the project area and outcomes of the project itself. Representatives may include educational professionals, members with disabilities, advocates, residents, business owners, elected officials, and employees of local agencies such as planners, practitioners, law enforcement, public works, and first responders. Extra effort should be made to reach the disabled community or other underrepresented communities to obtain input and representation for their concerns and needs as they are particularly impacted by streets and roads with insufficient pedestrian accommodations. If the project area is within an area with a high concentration of a community whose primary language is not English, additional considerations should be made to have a project team member who can speak the community's primary language.

3.5.2 Street Types and Adjacent Land Uses

The existing and proposed contexts of an area are important when determining proposed transportation improvements. Careful attention should be made in evaluating the existing and future land uses and development trends so that the transportation infrastructure is sized correctly for the

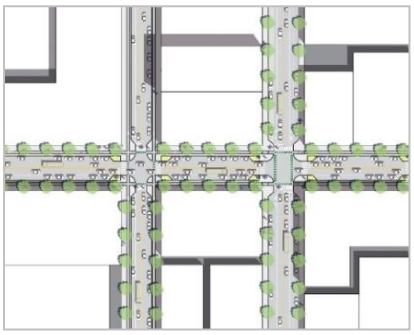
area. By conducting this evaluation, community leaders, planning/design teams, and citizens can determine the appropriate transportation improvement for the area. In general, a road/street should change in response to the surrounding context, whether it is rural farm land, small towns, suburbs, or urban areas. The design of pedestrian facilities and streetscapes should consider adjacent existing and proposed land uses and existing and projected pedestrian activity along the corridor. The context, or land use transect, generalizes development patterns into five land use contexts that transportation practitioners may commonly encounter in their projects, and their implications for pedestrian infrastructure (Figure 3.13).

While the five transects cannot comprehensively capture all land use scenarios, typically many kinds of developments may occur within a project area. For these site-specific developments, additional consideration should be given as to how the development traditionally has interfaced with pedestrian mobility and safety and how to mitigate the challenges often encountered. See Figure 3.16 for an industrial park with high truck volumes and large turning radii. Consideration should be given to increasing offsets from the edge of pavement or travel lane for fixed objects, including pedestrian facilities. Similarly, a low speed residential local street with street trees should be spaced to accommodate light spacing for the street light photo metrics.

Traditionally, the functional classifications of streets—using designations such as arterial, collector, and local—have been used to determine appropriate designs for both vehicle and pedestrian facilities. While these classifications are helpful for assessing traffic conditions and determining the appropriate facility design for vehicles, they do not specifically account for pedestrian needs, nor do they provide a framework for assessing the design of pedestrian infrastructure. Alternatively, the context sensitive design approach considers the character of the surrounding area and the corresponding pedestrian activity—in addition to traffic conditions—when designing street infrastructure.

Figure 3.13. Land Use Transects

3.5.2.1 Urban Core



The urban core is the densest context and includes a variety of land uses, such as retail, office, and multi-family residential. The urban core context has defined city blocks, minimal building setbacks or build-to requirements, and compact development patterns. These characteristics lend themselves to short travel distances, which can encourage people to walk instead of drive. In addition, traffic congestion and limited parking options naturally make walking,

biking, and transit the preferred transportation modes in an urban core.

To support walking and biking, roads and streets that transect an urban core should be designed to slow vehicular traffic and prioritize pedestrian access. Pedestrian infrastructure along the roads and streets should be designed to accommodate large volumes of pedestrians. In addition, traffic signals should be programed to automatically provide the WALK indication.

Typical Treatments		
• Corner Extensions • Crosswalks • Curb Ramps • Cycle Tracks • Green Infrastructure • Leading Pedestrian Interval • On-Street Parking	• Pedestrian Refuge Areas • Pedestrian-Scale Lighting • Pinch Points • Raised Crosswalks • Rectangular Rapid Flashing Beacons • Short Cycle Lengths	• Sidewalks • Site Amenities such as liter receptacles, benches, planters, wayfinding signage, etc. • Street Trees • Transit Stop Amenities

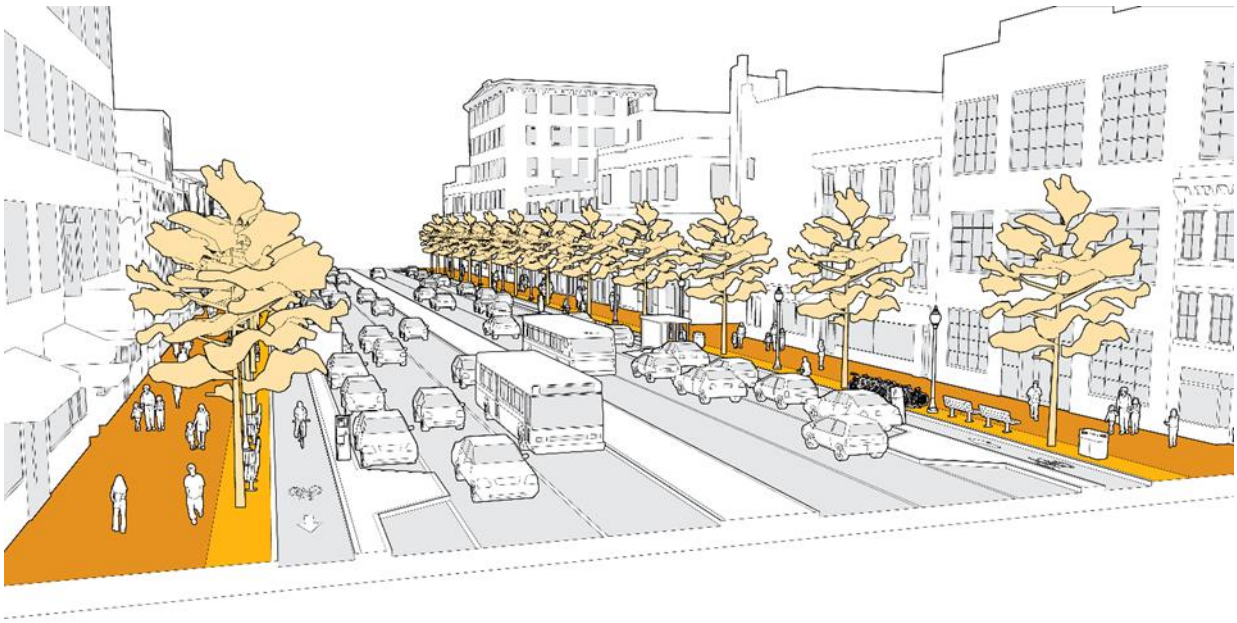
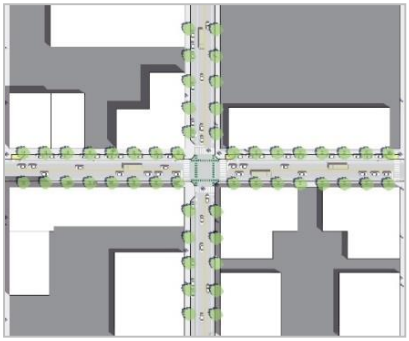


Figure 3.14. Urban Core Context Area

3.5.2.2 Urban



The urban context is densely developed and includes a variety of land uses, similar to the urban core context but with a reduced scale of development. Minimal building setbacks or build-to standards may be required in some areas. The urban context offers multiple amenities and destinations, and a variety of mobility choices (e.g., walking, biking, transit, and personal vehicles). Shorter travel distances between destinations and the proximity of signalized crossings may encourage walking and biking. While parking is available, it is limited to on-street parking and surface lots and structures that may not be near desired destinations; therefore, people may prefer walking and biking. The urban context may exist adjacent to the urban core or as a node of compact development surrounded by the suburban context.

The urban context should balance pedestrian and bicycle activity with vehicle-based travel. Traffic signal control and vehicle speeds should be managed to provide an environment where non-motorized activity is not threatened by vehicle speeds. Pedestrian street crossings may be dense, since the demand for pedestrian crossing is high. Traffic congestion and limited parking are necessary to prioritize the convenience and efficiency of the walkable environment. In addition, traffic signals should be programed to automatically provide the WALK indication.

Typical Treatments		
• Corner Extensions	• Pedestrian Refuge Areas	• Sidewalks
• Crosswalks	• Pedestrian-Scale Lighting	• Signal Progression
• Curb Ramps	• Raised Crosswalks	• Site Amenities such as liter receptacles, benches, planters, wayfinding signage, etc.
• Cycle Tracks	• Raised Intersections	• Speed Cushions
• Green Infrastructure	• Rectangular Rapid Flashing Beacons	• Street Trees
• Leading Pedestrian Interval	• Roundabouts	• Transit Stop Amenities
• On-Street Parking	• Short Cycle Lengths	
• Pedestrian Recall		

Figure 3.15. Urban Context Area

Figure 3.16. Urban Industrial Park Land Use Example

3.5.2.3 Suburban

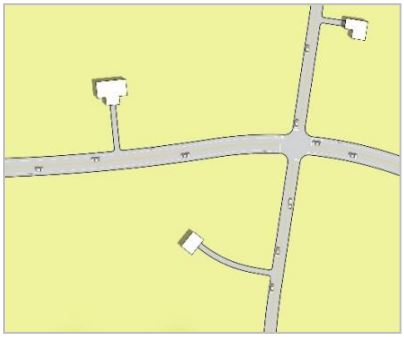
The suburban context includes a variety of land use types (e.g., residential, commercial, retail, and office) that are rarely mixed with one another on a single site but are connected by a network of arterial and collector streets. Commercial and industrial development is spread out on medium-to-large parcels with greater minimum setbacks and large surface parking lots. Suburban transportation corridors prioritize vehicular mobility from suburban areas to denser areas with employment, service, and entertainment destinations. Biking and walking opportunities may be available through limited on-street and adjacent-to-street facilities (e.g., sidewalks and bike lanes) and the development of off-street trails; however, non-motorized connectivity may be limited due to increased distances between signalized intersections along arterial and collector streets, and the curb cuts and driveways encountered in the suburban context.

The suburban context balances the vehicle-based mode and the non-motorized mode. As vehicle speeds become higher, non-motorized facilities must include greater buffer distances from vehicle lanes, and pedestrian street crossings must be designed to optimize pedestrian accessibility and visibility to the driver. Pedestrian street crossings may include enhanced features and should be selected for locations that improve pedestrian mobility and safety while considering driver expectations with respect to crossing locations and traffic control.

Typical Treatments		
• Crosswalks	• Pedestrian-Scale Lighting	• Signal Progression
• Curb Ramps	• Radar Speed Signs	• Site Amenities such as liter receptacles, benches, etc.
• Green Infrastructure	• Roundabouts	• Street Trees
• Leading Pedestrian Interval	• Shared Use Paths	• Transit Stop Amenities
• Pedestrian Hybrid Beacons	• Short Cycle Lengths	
• Pedestrian Refuge Areas	• Sidewalks	

Figure 3.17. Suburban Context Area

3.5.2.4 Rural



The rural context is characterized primarily by large parcels used for single-family residential or agricultural purposes that have significant setbacks from roadways. Service-oriented businesses are occasionally found in the rural context, including gas stations, small grocery stores, and agricultural equipment dealerships. Mobility options are limited primarily to vehicles due to long travel distances to amenities and destinations. Rural roadways may have earthen or paved shoulders where walking may occur, but are connected in low-density networks, often having few signalized intersections and low-volume but high-speed motorized vehicular use.

The rural context introduces high vehicle speeds. The high vehicle speeds require greater separation between vehicles and non-motorized activity. Where pedestrian volumes are higher, particularly near certain land uses such as residential neighborhoods and schools, more robust pedestrian facilities and street crossing with enhanced crossing features may be needed. Shared use paths with more significant offsets from the travel lane should be considered for accommodating both pedestrians and cyclists. As with all projects, context, speed, geometry, site distances, clear zones, etc., should be evaluated independently.

Typical Treatments		
• Crosswalks • Curb Ramps • Lane Shifts • Leading Pedestrian Interval	• Median/Pedestrian Refuge Areas • Pedestrian Hybrid Beacons • Radar Speed Signs	• Roundabouts • Shared Use Paths • Short Cycle Lengths • Sidewalks

Figure 3.18. Rural Context Area

3.5.2.5 Rural Town

The rural town context is a node of compact, relatively dense development surrounded by the rural context. This context has a variety of land uses that provide commercial services, government facilities, and public amenities to the surrounding area. Within the rural town context, compact development, low traffic volumes, slow speeds, on-street parking, and sidewalks may allow for enhanced walkability. Due to the surrounding low-density rural context, the rural town may be connected to a less dense road network with fewer signalized intersections and limited sidewalk connectivity outside the immediate rural town context. On-street and surface-lot parking accommodate both local patrons and visitors traveling longer distances to access the services and amenities in the rural town. The rural town context is suitable for pedestrian activity and promotes a “park once and walk” approach for commercial patrons and citizens seeking civic services and facilities. The rural town, urban, and urban core contexts are similar in that traffic speeds should prioritize pedestrian activity over vehicle throughput efficiency.

Typical Treatments

- Chicanes
- Corner Extensions
- Crosswalks
- Curb Ramps
- Green Infrastructure
- Leading Pedestrian Interval
- On-Street Bike Lanes
- On-Street Parking
- Pedestrian Refuge Areas
- Pedestrian-Scale Lighting
- Pinch Points
- Radar Speed Signs
- Raised Crosswalks
- Rectangular Rapid Flashing Beacons
- Roundabouts
- Short Cycle Lengths
- Sidewalks
- Site Amenities such as liter receptacles, benches, planters, wayfinding signage, etc.
- Speed Tables
- Street Trees

Figure 3.19. Rural Town Context Area

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Chapter 4. Road and Street Design for Pedestrians

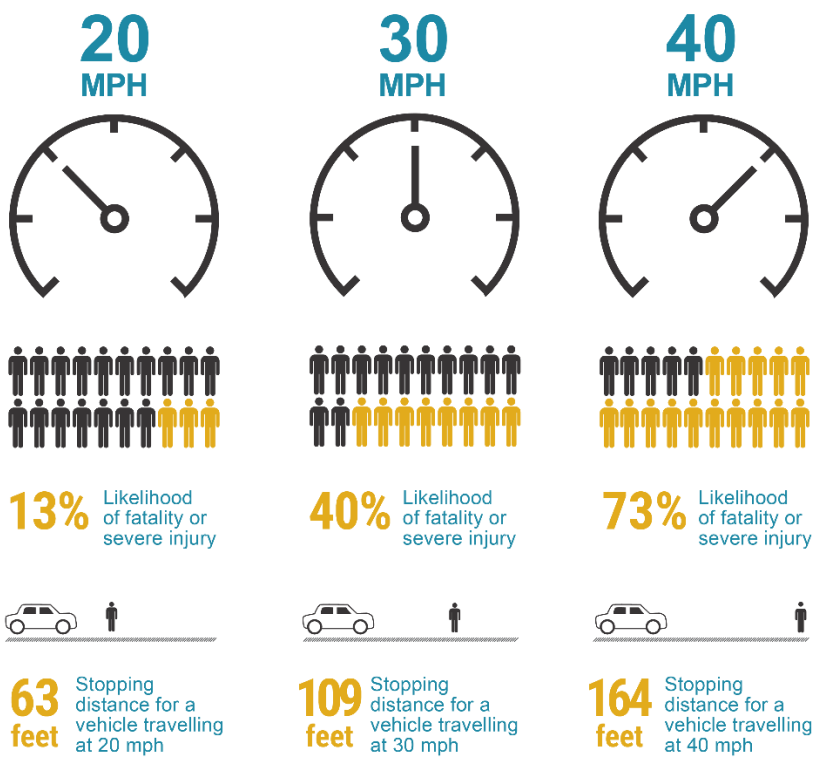
Designing roads and streets that are accessible and comfortable places for people requires a holistic approach that goes beyond providing the minimum pedestrian accommodation requirement and considers how vehicle speeds, traffic operations, and multimodal safety relate to the pedestrian experience. This chapter provides guidance on the design of pedestrian facilities, as well as several other roadway elements that are not exclusive to pedestrians but whose design has a direct influence on pedestrian mobility and quality of service. The information in this chapter supplements the GDOT *Design Policy Manual* and other national design policies by providing additional guidance on designing roads and streets for pedestrians.

4.1 Vehicle Speeds

4.1.1 Relationship among Vehicle Speed, Pedestrian Comfort, and Injuries

The faster vehicles are traveling, the more stressful walking is for pedestrians and the more likely a pedestrian-vehicle collision will result in a pedestrian fatality. The ability of a driver to stop in time for a pedestrian crossing the street significantly decreases as the vehicle speed increases.

The relationships among vehicle speeds, braking distances, and the likelihood of pedestrian fatalities are shown in Figure 4.1.



Sources: Tefft, Brian C. Impact speed and a pedestrian's risk of severe injury or death. Accident Analysis & Prevention. 50. 2013

University of Pennsylvania School of Engineering. "Vehicle Stopping Distance and Time."

Note: Stopping distances include breaking deceleration distance and perception reaction distance.

Figure 4.1. Relationship between Vehicle Speed and Pedestrian Injury

Further Guidance

- FHWA, *Pedestrian Safety Program Strategic Plan, Background Report* (latest edition)
- GDOT, *Georgia Pedestrian Safety Action Plan 2018–2022* (latest edition)
- Tefft, Impact Speed and a Pedestrian's Risk of Severe Injury or Death (latest edition)

4.1.2 Posted, Design, and Target Speed

The posted speed limit and roadway geometry (which is influenced by design speed) are two major factors that influence the speed at which motorists choose to drive, which in turn plays an important role in the safety of all road users. A third factor discussed in Section 3.5.2 of this Guide is land use, which sometimes has a direct relationship to posted speed. (e.g., a school speed zone is typically provided in the vicinity of a school facility).

The **posted speed limit** is the maximum speed motorists are legally allowed to travel on a given stretch of road, typically communicated using the familiar black and white "Speed Limit" signs posted along roads and streets across the United States. Posted speed limits are set by state statute or by the governing municipality. Regulations and guidelines for changing posted speed limits are set by MUTCD Section 2B.13; however, the policies and practices of applying these regulations and guidelines can vary from agency to agency. For example, some agencies and municipalities use vehicle operating speeds under free-flow conditions (typically the 85th percentile speed) as the sole input in the speed limit setting process. Reasons for using prevailing speeds as an input in the speed limit setting process include:

- To avoid setting speed limits that feel artificially low or arbitrary to drivers due to a perceived mismatch between the posted speed limit and the speed at which it "feels" like someone should be able to drive based on the roadway geometry and other factors
- An assumed trust that the average motorist (or 85 percent of motorists) has an accurate perception of the risks associated with their speed selection and makes a rational decision when selecting their travel speed given the roadway geometry and other factors

However, using vehicle speeds as the sole input for setting speed limits can neglect the safety needs of other road users and lead to situations in which it is difficult or impossible to lower posted speed limits to address safety issues and community needs. In an effort to prevent this pattern, some agencies and municipalities use methods that take multiple factors into account such as local context, adjacent land uses, crash history, and the presence of other road users besides motorists.

To help practitioners include multiple inputs in the speed limit setting process, the FHWA provides access to a planning tool called USLIMITS2, which is a web-based tool designed to help practitioners set reasonable, safe, and consistent speed limits for specific segments of roads. USLIMITS2 is applicable to all types of roads ranging from rural local roads and residential streets to urban freeways. However, the tool is not applicable to school zones or construction zones and does not include site-specific data such as roadway geometry and site distances. USLIMITS2 is a helpful planning tool but should not be relied upon solely in determining the final speed for a segment of road or street.

Because roadway geometry has a major influence on drivers' speed selection, it is important to consider how **design speed** and roadway geometry are related. A roadway's geometry, which includes things like width, curve radii, corner radii, and clear zone requirements, are the result of engineering decisions based on design standards that are related to the roadway's design speed. When a roadway is being designed or redesigned, engineers first select a design speed to govern the application of various geometric design standards. For existing roadways, the design speed is often selected from the existing posted speed limit or by measuring vehicle operating speeds, such as the 85th percentile speed. However, using existing posted speed limits or vehicle operating speeds to determine design speed and therefore roadway geometry can result in a cyclical situation slanted toward maintaining or increasing vehicle speeds rather than designing for the needs of all users of the right-of-way.

To address speed issues in the design process, national transportation professional organizations such as NACTO and ITE encourage designers to select and use a **target speed** in their design decisions rather than using the existing posted speed limit or observed speeds. The target speed should be selected based on multiple factors, including adjacent land uses, the active transportation activity levels along the street, and the community's planning objectives for the corridor or neighborhood. Establishing target speeds as part of design projects enables practitioners to design streets that encourage vehicle operators to drive at slower speeds while avoiding issues associated with changing the speed limit alone. The result is a design better suited for balancing the safety, livability, and mobility needs of all users.

At the outset of a project, practitioners should evaluate the current design speed from a pedestrian's perspective and check with project sponsors about the possibility of lowering the posted speed limit if necessary. Current and future pedestrian activity should be considered when setting speed limits. Refer to MUTCD Section 2B.13 for further guidance on establishing or reevaluating speed limits.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts* (latest edition)
- ITE, *Implementing Context Sensitive Design on Multimodal Corridors: A Practitioner's Handbook* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

4.2 Traffic Calming

Traffic calming infrastructure reduces vehicle speeds, and in some cases volumes, by introducing horizontal and vertical features that interrupt a straight travel path. Careful consideration should be made in determining the appropriate measure for the appropriate roadway functional classification. Traffic calming measures are specific to the roadway functional classification.

Another traffic calming method that can be effective is reducing the travel lane's width. Some types of traffic calming infrastructure are relatively inexpensive and can be quickly implemented as part of a maintenance or quick-response project. Other types of traffic calming infrastructure can include

impacts to stormwater management and underground or overhead utilities. While most traffic calming infrastructure is not used by pedestrians, the reduction in vehicle speeds improves the conditions for pedestrians and the overall walkability of a city or community. This section provides information on the applicability and design of traffic calming features. Table 4-1, from the FHWA *Traffic Calming ePrimer*, shows the applicability and acceptability of individual traffic calming measures within a given roadway functional classification.

Table 4-1. Traffic Calming Measures and Their Appropriate Applications

Traffic Calming Measure	Segment or Intersection	Street Functional Classification			Street Function	
		Thoroughfare or Major	Collector or Residential Collector	Local or Local Residential	Emergency Access	Transit Route
Horizontal Deflection						
Lateral Shift	Segment	3	5	5	5	5
Chicane	Segment	1	5	5	3	3
Realigned Intersection	Intersection	1	5	5	5	5
Traffic Circle	Intersection	1	3	5	3	3
Small Modern & Mini-Roundabout	Intersection	3	3	5	5	5
Roundabout	Intersection	5	3	1	5	5
Vertical Deflection						
Speed Hump	Segment	1	5	5	1	3
Speed Cushion	Segment	1	5	5	5	5
Speed Table	Segment	3	5	5	1	3
Offset Speed Table	Segment	3	5	5	5	3
Raised Crosswalk	Both	3	5	5	1	3
Raised Intersection	Intersection	3	5	5	3	3
Street Width Reduction						
Corner Extension	Intersection	5	5	5	5	5
Choker	Segment	5	5	5	5	5
Median Island	Both	5	5	5	5	5
On-Street Parking	Segment	5	5	5	5	5
Road Diet	Both	5	5	3	5	5
Routing Restriction						
Diagonal Diverter	Intersection	1	3	3	1	3
Full Closure	Both	1	3	3	1	1
Half Closure	Intersection	1	5	5	3	3

Traffic Calming Measure	Segment or Intersection	Street Functional Classification			Street Function	
		Thoroughfare or Major	Collector or Residential Collector	Local or Local Residential	Emergency Access	Transit Route
Median Barrier	Intersection	3	5	5	1	3
Forced Turn Island	Intersection	3	5	5	3	3

Legend:

5 – traffic calming measure may be appropriate
3 – caution; traffic calming measure could be inappropriate
1 – traffic calming measure is likely inappropriate

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- AASHTO, *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

4.2.1 Chicanes

Chicanes are a series of curb extensions or other features, such as edge islands or on-street parking, that alternate from one side of the street to the other. Edge islands are raised spaces that extend into the street and are offset from the curb. These traffic calming features encourage motorists to drive at slower speeds by restricting vehicle acceleration. Chicanes also provide additional space for landscape planting and stormwater management features. Chicanes are appropriate for low speed streets or roads, 35 mph or less, and are often effective traffic calming measures for a residential context.

Application

- Chicanes are appropriate for streets with a speed limit of 35 mph or less (ITE *Traffic Calming Fact Sheets*).
- Chicanes are appropriate on low-volume streets (maximum 3,500 vehicles per day).
- Chicanes may be installed at mid-block locations along a street.
- Chicanes may be used on one-lane, one-way streets and two-lane, two-way streets.
- Chicanes may be installed on primary emergency vehicle and bus transit routes, provided traffic volumes are low enough to allow an emergency vehicle to straddle the street centerline. Chicanes can utilize mountable curbs for easier access for emergency vehicles, buses, and delivery and garbage trucks.
- Chicanes are not appropriate at pedestrian crossings.

Critical Design Requirements

- The target speed should be used to determine the degree of horizontal deflection for chicanes.
- Chicanes should be made visible with signs, painted curbs, reflectors, markings, or street lights to guide motorists. If chicanes interrupt bike lanes, bicyclists should be diverted around the chicane by either (1) transitioning the bike lane into a sharrow or (2) providing a minimum 4-foot-wide space between the sidewalk curb and the extension. Signage should be provided to alert the bicyclist of the change in infrastructure.
- Plantings in chicanes should be low-maintenance and low-growing plants, less than 30 inches in height at maturity.

Additional Considerations

- Chicanes may be designed using curb extensions, on-street parking, or edge islands.
- Edge islands may be used to maintain existing drainage channels.
- Chicanes may be designed as bioretention or biofiltration planters.
- A best practice is to provide mountable curbs to assist with accessibility for emergency vehicles, buses, and delivery and garbage trucks.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- AASHTO, *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

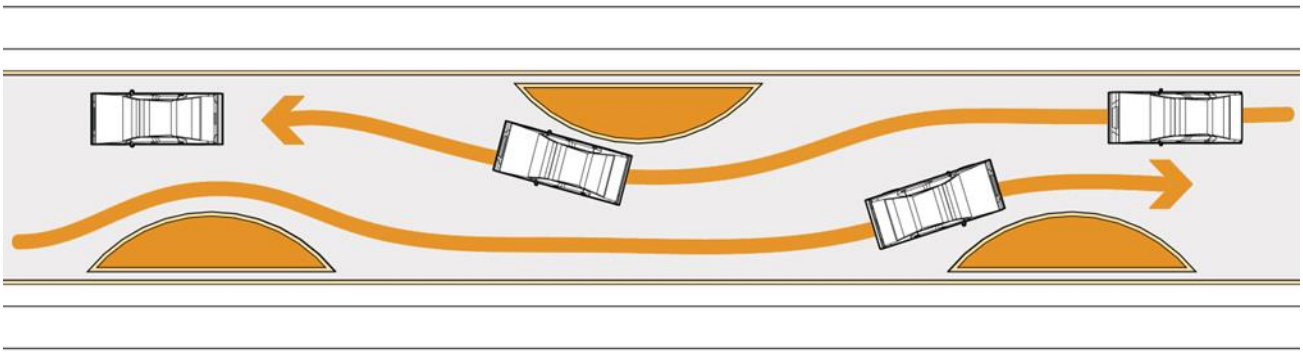


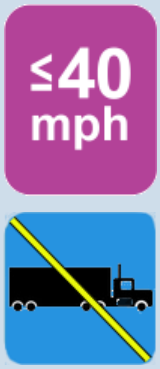
Figure 4.2. Plan of Chicanes

4.2.2 Curb Extensions

The primary purpose of curb extensions related to pedestrian safety is reducing pedestrian crossing distances at intersections and street crossings. Curb extensions have many benefits, such as providing additional room for streetscape amenities that do not obstruct views and are set back according to the lateral horizontal setback requirements, and protecting vehicles parked on street. They also increase the visibility between pedestrians and motorists at pedestrian crossing locations. Additionally, curb extensions slow vehicles down by narrowing the street and reducing turning radii at intersections. The types of curb extensions vary based on where they are installed and how they are designed.

Curb extensions installed at intersections are referred to as corner extensions and can be applied to all four corners of an intersection to reduce pedestrian crossing distances. When installed at mid-block locations, they are commonly referred to as pinch points. When there is a gap between the extension and the curb of the sidewalk, they are referred to as edge islands. A series of curb extensions or edge islands installed in an alternating pattern along both sides of a street is known as a chicane. When a curb extension is installed at a transit stop, it is referred to as a bus bulb-out. This section provides information on the design of curb extensions. Pinch points, chicanes, bulb-outs, and corner extensions are discussed in more detail in Sections 4.2.4, 4.2.1, 4.3.12, and 4.4.2, respectively.

Application



- Curb extensions can be installed at intersections or mid-block locations. The application of a curb extension varies based on the type of curb extension (e.g., corner extension, pinch point, bus bulb-out).
- Curb extensions are better suited on streets with speed limits of 40 mph or less.
- Curb extensions can provide added protection to on-street parking.
- Curb extensions are aesthetically helpful to visually break up long stretches of on-street parking.
- Not appropriate for high volume truck routes.

Critical Design Requirements

- If the curb extension includes a pedestrian crossing, streetscape amenities (e.g., lighting, signs, benches, bike racks), or landscaping on the curb extension should not obstruct visibility between the pedestrian and vehicles in the travel lanes.
- If used for a pedestrian crossing, applicable ADA measures should be implemented.

Additional Considerations

- Curb extensions may be opportunities to incorporate green stormwater infrastructure (e.g., bioretention planters) into the street. Section 6.4 contains additional guidance related to green infrastructure, which are only allowed on local off system streets.
- Curb extensions can provide additional space for streetscape amenities without protruding into the space dedicated for pedestrian access. Section 6.2.3 contains information on the placement of furniture in curb extensions.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- ITE, *Implementing Context Sensitive Design on Multimodal Corridors* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

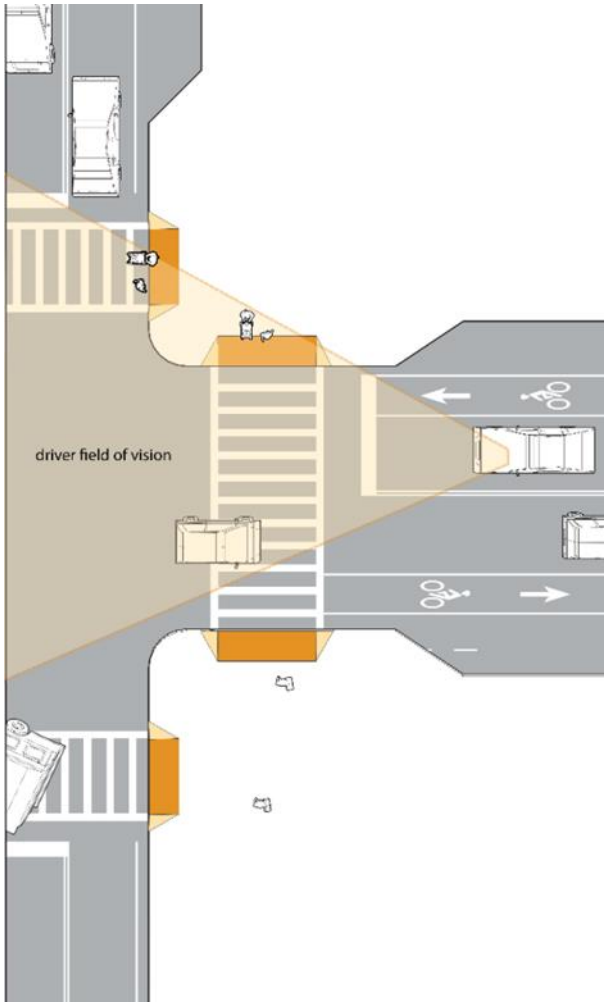


Figure 4.3. Plan View of Curb Extensions

4.2.3 Lane Shifts

Lane shifts are horizontal changes in the travel lane alignment. Like chicanes, lane shifts reduce vehicle speeds by forcing vehicles to move laterally back and forth while driving along a street. Whereas chicanes are more appropriate on streets with a speed limit of 35 mph or less, a lane shift can be incorporated into a higher speed roadway as long as specific criteria are met related to MUTCD, Lane Reduction Transition Markings.

Application

- Lane shifts may be used on streets with any speed limit as long as the guidance is met for the particular condition (MUTCD, Lane Reduction Transition Markings).

Critical Design Requirements

- Lane shifts should only be implemented at mid-block locations.
- Lane shifts should be designed using the MUTCD taper formula (MUTCD, Lane Reduction Transition Markings).

Additional Considerations

- While lane shifts can be facilitated by implementing curb extensions or on-street parking, they can also be designed with painted markings.
- A STAY IN LANE (R4-9) sign may be used where a multi-lane shift has been implemented.
- Highly visible edge lines or reflectors around landscape plantings may be used to guide motorists.
- A center island may be used to reduce conflicts between opposing traffic.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD, Lane-Reduction Transition Markings
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)

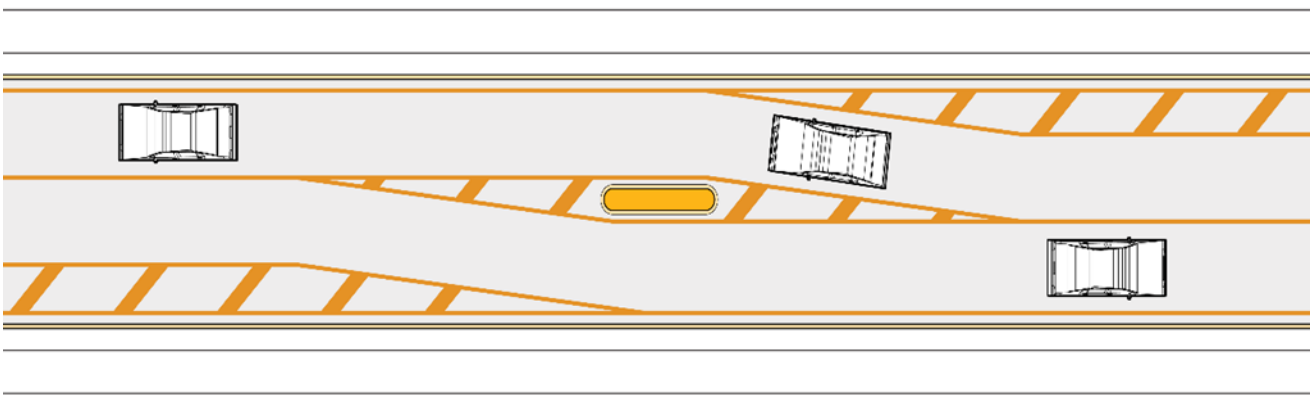


Figure 4.4. Plan View of a Lane Shift

4.2.4 Pinch Points

Pinch points, also known as chokers, are curb extensions applied on both sides of a street, its primary purpose is for traffic calming whereas a curb extension's primary purpose is to reduce the length of the pedestrian crossing. This traffic calming feature can reduce vehicle speed and provide additional space for landscaping. Pinch points may be installed as continuous extensions of the curb or as edge

islands. Edge islands are raised spaces that extend into the street and are offset from the curb. When used at marked or unmarked mid-block crossings, pinch points help delineate direct crosswalk paths, shorten the crossing distance, and increase visibility between pedestrians and vehicles in the travel lanes.

Application

- Pinch points may be used streets with a speed limit of 40 mph or less.
- Pinch points may be used on one-lane, one-way and two-lane, two-way streets.
- Pinch points are not appropriate on high-volume truck routes.
- Pinch points are appropriate along primary emergency vehicle and bus transit routes.
- In addition, curb extensions reduce pedestrian crossing distances and increase the visibility between pedestrians and motorists at pedestrian crossing locations.

Critical Design Requirements

- If the pinch point is installed at a marked or unmarked pedestrian crossing, street furniture or landscape planting on the curb extension should not obstruct the visibility between pedestrians and vehicles in the travel lanes.
- If the pinch point is installed at a marked or unmarked pedestrian crossing, curb ramps should be installed on both sides of the street.
- Pinch points should be 6 to 8 feet wide and offset from the through traffic lane by 1.5 feet (ITE *Traffic Calming Fact Sheets*).
- The length of a pinch point, curb extension, or edge island should be at least 20 feet (ITE *Traffic Calming Fact Sheets*).
- If pinch points interrupt bike lanes, bicyclists should be diverted around the pinch point by either (1) transitioning the bike lane into a sharrow (a shared bike and automobile lane) or (2) providing a minimum 4-foot-wide space between the sidewalk curb and the extension. Signage should be provided to alert the bicyclist of the change in infrastructure.

Additional Considerations

- On a two-way, two-lane roadway, a pinch point can be installed in combination with a median refuge island as a means to increase pedestrian safety when crossing more than one travel lane and may help reduce the possibility of opposing vehicle conflicts.
- Pinch points can also be installed using low-cost interim treatments such as bollards, striping, or planters.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

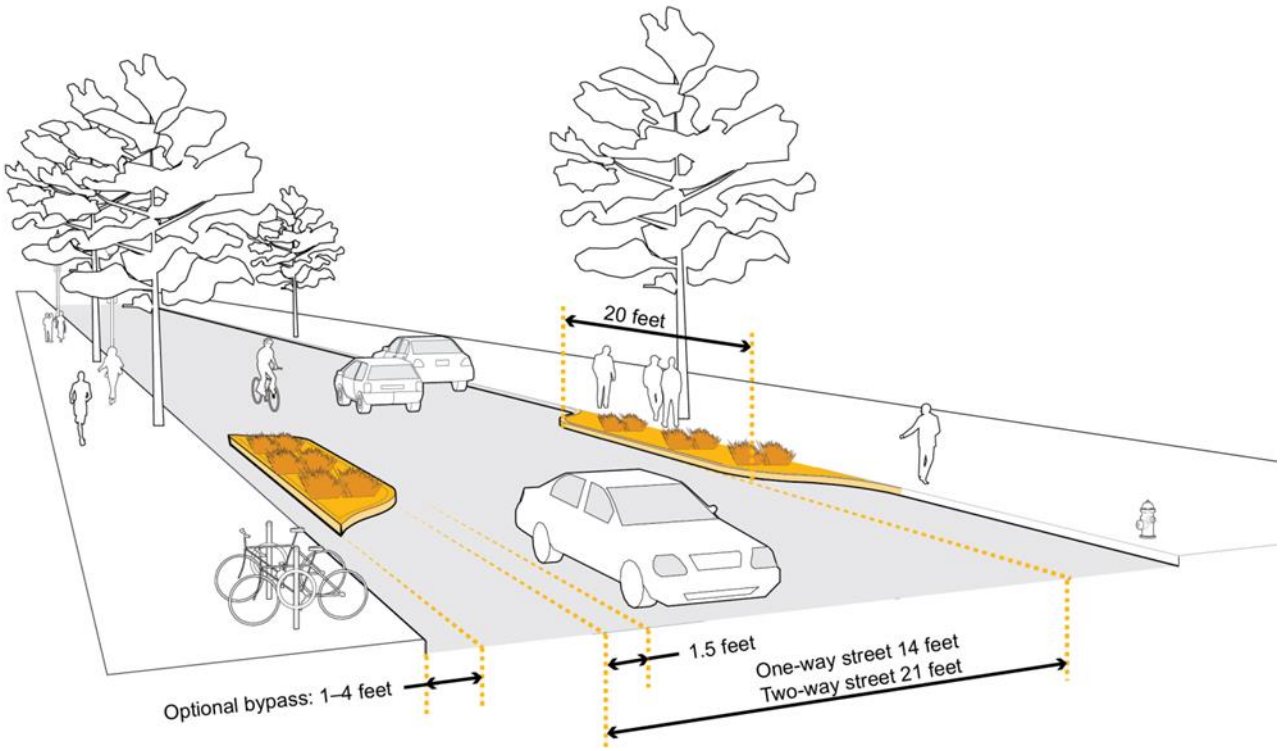


Figure 4.5. Standard Dimensions of a Pinch Point

4.2.5 Radar Speed Signs

Radar speed signs are electronic message signs that display to approaching drivers the speed at which they are traveling, and in turn, when they are exceeding the speed limit.

Application

- Radar speed signs may be used on streets with any speed limit.
- Radar speed signs may be permanently installed or temporarily deployed at locations where drivers frequently exceed the speed limit.

Critical Design Requirements

- Radar speed signs should be designed in accordance with FHWA MUTCD (latest edition).

Further Guidance

- FHWA, MUTCD (latest edition)

4.2.6 Signal Progression

Coordinated traffic signals with short cycle lengths regulate vehicle speeds between signals and decrease pedestrian delay. The speed of vehicle travel on a corridor may also be influenced by the offsets programmed for the green light. Refer to Section 5.1 for further guidance on signal timing strategies that can benefit pedestrian circulation.

Application

- Traffic signals in urban core, urban, suburban, and rural town context areas may be coordinated and programed with short cycle lengths.

Further Guidance

- ITE, *Guidance on Signal Control Strategies for Pedestrians to Improve Walkability* (latest edition)
- NACTO, *Global Street Design Guide* (latest edition)

4.2.7 Speed Cushions

Speed cushions are speed humps that include wheel cutouts to enable a vehicle with wide tracks (e.g., emergency vehicles and buses) or a bicycle to pass through the feature without vertical deflection. A speed cushion is often preferred to a speed hump or speed table (see Sections 4.2.8 and 4.2.9) for streets that serve as a primary emergency response or bus route.

Application

- Speed cushions may be used on streets with a speed limit of 40 mph or less
- Speed cushions may only be used at mid-block locations.
- Speed cushions are appropriate on primary emergency vehicle access and bus routes, but not on routes with high truck volumes.
- Speed cushions are preferred over speed humps and speed tables on bicycle routes.
- May not be appropriate on steep grades.

Critical Design Requirements

- Speed cushions should be 3 to 4 inches in height and span 12 to 14 feet wide along the vehicle travel path.
- The wheel cut-out should be 3 feet wide (perpendicular to the travel path).
- The slope length should be from 3 to 6 feet, depending on target speed.
- Speed cushions should be placed in a series with a distance ranging from 200 to 500 feet apart to keep the vehicle operating speed between 25 and 30 mph.
- If used in a series, the first speed cushion should be installed 200 feet or less from a street corner or stop-controlled intersection, to discourage vehicles from approaching the first speed cushion at a high speed.

Additional Considerations

- In urban areas with curb and gutter, speed cushions may be placed 1 to 2.5 feet from the curb to maintain stormwater drainage paths.
- In rural areas, or areas without curb and gutter, speed cushions may be placed 6 inches from the edge of the roadway to maintain stormwater drainage paths.
- Pavement markings and signage for a speed cushion should replicate those for a speed hump (see Section 4.2.8).

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

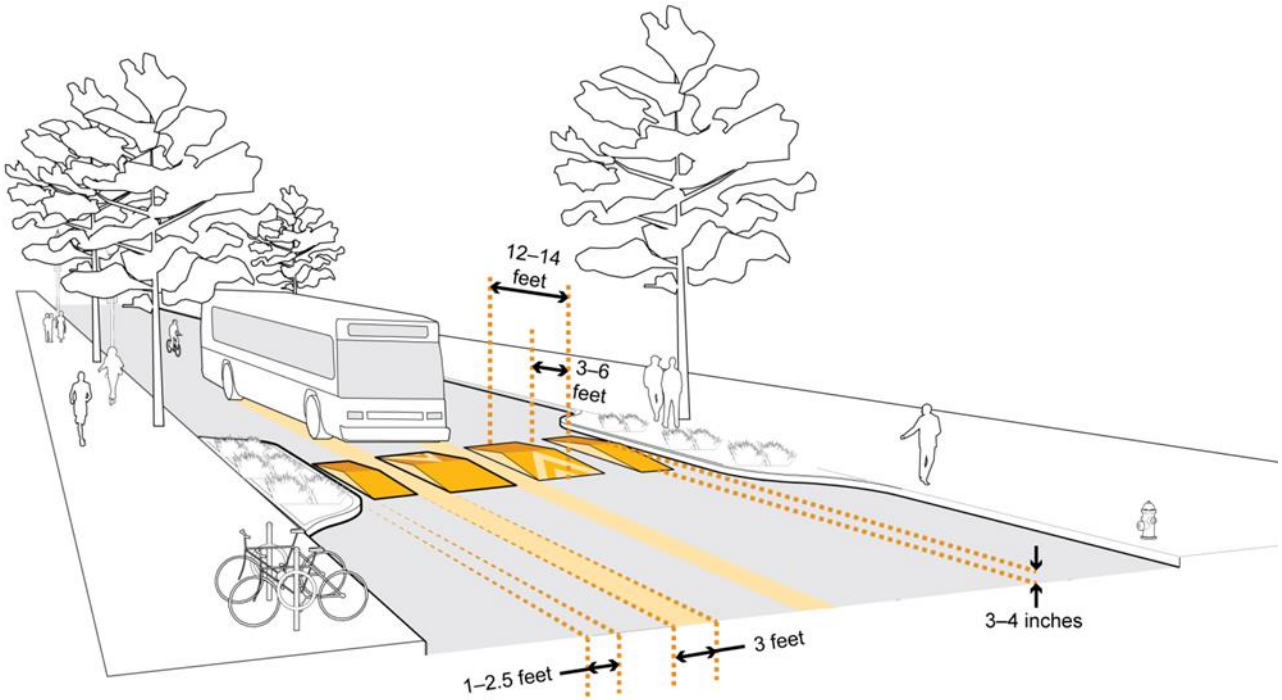


Figure 4.6. Typical Dimensions of Speed Cushions

4.2.8 Speed Bumps

Speed humps have an elongated parabolic profile that extends across the travel lanes at a right angle to the roadway. A speed hump may effectively slow vehicles down to a speed potentially less than the posted speed.

Application

- Speed humps are not appropriate on primary emergency vehicle access and may not be appropriate on bus routes.
- Speed humps may be used on streets with speed limits of 25 mph or less.
- Speed humps are best utilized at mid-block locations and in residential areas or school zones where speed reduction is desired.
- May not be appropriate on steep grades.

Critical Design Requirements

- Speed humps should be 3 to 4 inches in height and span 12 to 14 feet along the vehicle travel path.
- The slope length should be 3 to 6 feet, depending on target speed.
- If used in a series, the first speed hump should be installed 200 feet or less from a street corner or stop controlled intersection, to discourage vehicles from approaching the first speed hump at a high speed.
- In urban areas with curb and gutter, speed humps should be placed 1 to 2.5 feet from the curb to maintain stormwater drainage paths.
- In rural areas, or areas without curb and gutter, speed humps should be placed 6 inches from the edge of the roadway to maintain stormwater drainage paths.

Additional Considerations

- A best practice is to space speed humps 200 to 500 feet apart to keep vehicle operating speed between 25 and 30 mph.
- If speed humps are installed along bicycle routes, the curb-side edge of the speed hump can be tapered to allow bicyclists to more safely circumvent the speed hump.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

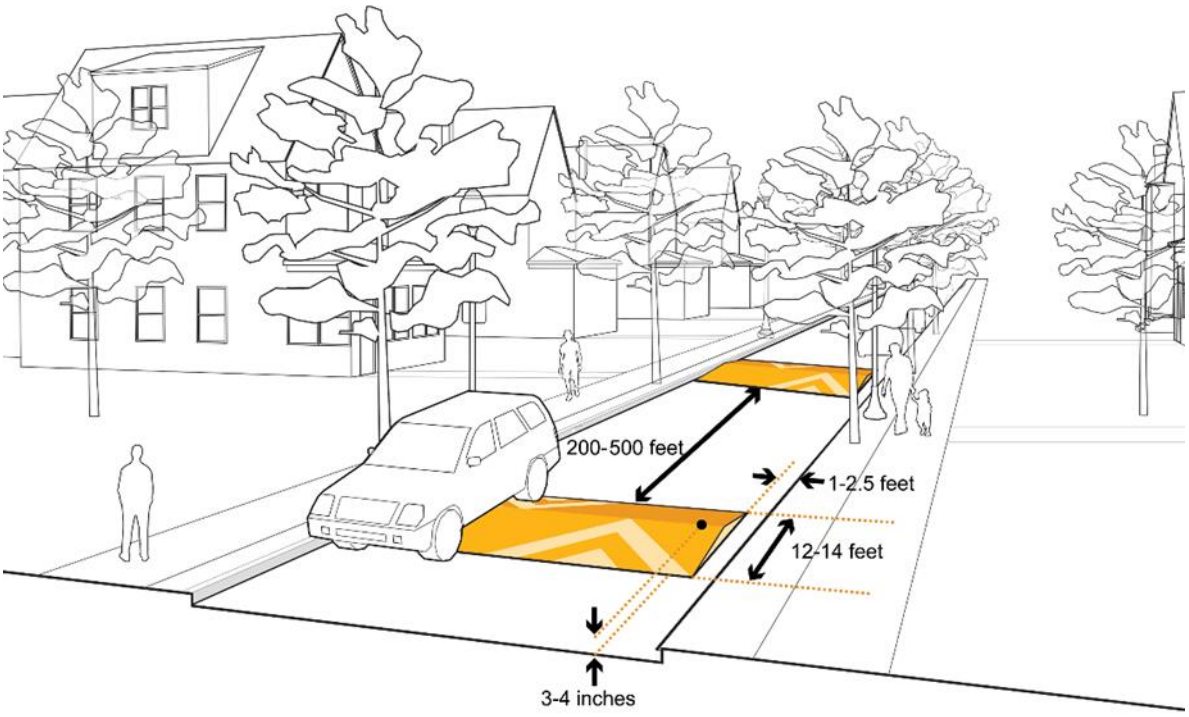


Figure 4.7. Typical Dimensions of Speed Humps

4.2.9 Speed Tables

A speed table has an elongated and extended profile with a flat top. Speed tables are longer than speed humps, allowing both the front and rear wheels of a passenger vehicle to be on top of the table at the same time. Speed tables may be used on streets with higher speeds than a speed hump. In urban areas with curb and gutter, speed tables can be placed 1 to 2.5 feet from the curb to maintain stormwater drainage paths. When used to elevate a pedestrian crossing, special accommodations should be made for stormwater drainage and to allow smooth transitions from the sidewalk curb height to the speed table.

Application

- Speed tables may be used on streets with a posted speed limit of 45 mph or less.
- Where applied, speed tables may be designed as raised midblock crossings, often in conjunction with curb extensions.
- Speed tables are generally not appropriate for a primary emergency vehicle route or street that provides access to a hospital or emergency medical services. Another form of vertical deflection – a speed cushion – may be more appropriate.
- Speed tables should not be applied on streets wider than 50 feet.
- On two-way streets, speed tables may be applied in both directions.
- Speed tables are generally not appropriate when the pre-implementation 85th percentile speed is 45 mph or more.
- ITE *Guidelines for the Design and Application of Speed Humps* recommends consideration if no more than 5 percent of the overall traffic flow consists of long-wheelbase vehicles.
- Generally, not appropriate for a bus transit route with BRT, Express, or Limited Stop service (unless the posted speed limit is 30 mph or less); a speed cushion could be more appropriate.
- ITE *Guidelines for the Design and Application of Speed Humps* recommends consideration only with a grade of 8 percent or less.
- Not appropriate along the primary access to an industrial site with require large volumes of truck traffic or designated truck routes.

Critical Design Requirements

- Speed tables should be 3 to 4 inches in height.
- Slopes should not exceed 1:10 or be less steep than 1:25.
- Side slopes on tapers should be no greater than 1:6.
- Speed tables should range from 20 to 22 feet along the vehicle travel path (10 feet flat top and two (2) 6-foot ramps on either side).
- Speed tables should be placed from 200 to 500 feet apart to keep vehicle operating speed between 25 and 30 mph.
- If used in a series, the first speed table should be installed 200 feet or less from a street corner, or stop controlled intersection, to discourage vehicles from approaching the first speed table at a high speed.
- Vertical speed control elements should be located where there is sufficient visibility and available lighting.

Additional Considerations

- A best management practice is to utilize speed tables to elevate pedestrian crossings. This treatment is referred to as a raised pedestrian crosswalk. The elevated crossing draws attention to the crosswalk and slows vehicles down as they approach the pedestrian crosswalk.
- In rural areas or areas without curb and gutter, speed tables may be placed 6 inches from the edge of the roadway to maintain stormwater drainage paths.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- American with Disabilities Act
- FHWA, *Traffic Calming ePrimer* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- ITE, *Traffic Calming Fact Sheets* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

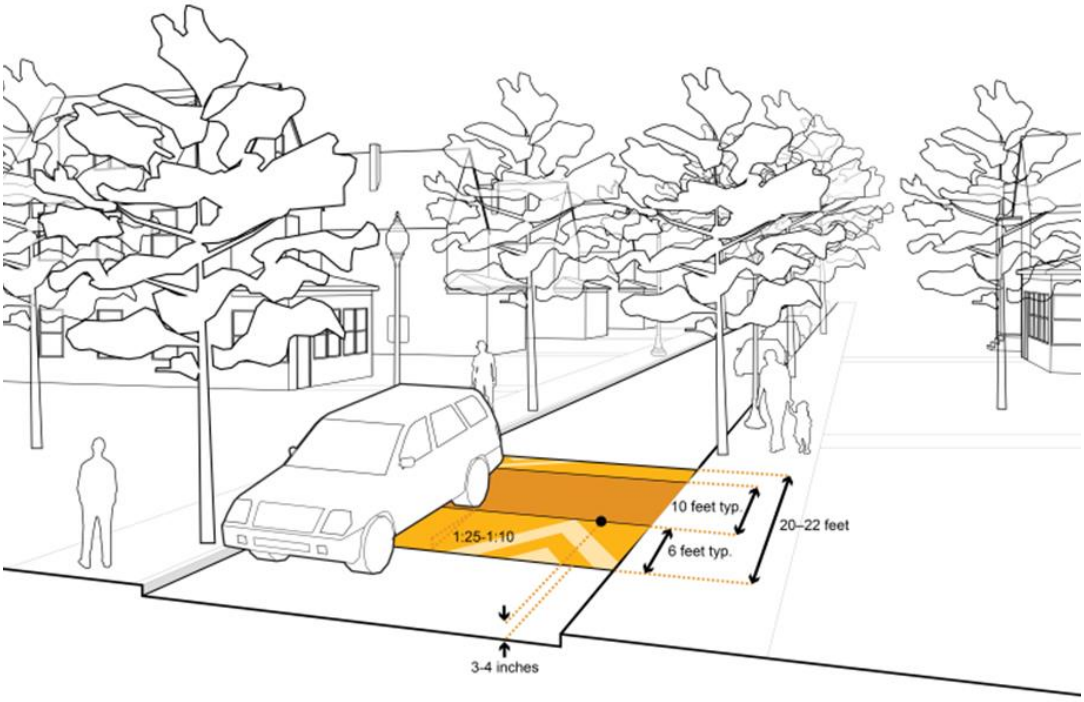


Figure 4.8. Typical Dimensions of Speed Tables

4.2.10 Two-Way Streets

Two-way streets, as opposed to one-way streets, require motorists to be more cautious of oncoming traffic thus influencing them to drive at slower speeds. However, the vehicle speed reduction improves the pedestrian environment, crossing a two-way street is also more difficult and creates greater delay for a pedestrian, since the pedestrian must judge simultaneous gaps in traffic for both directions of travel.

When converting a one-way street to a two-way street, curb extensions can be used to reduce the crossing distance for pedestrians. Medians are also important considerations. Medians and pedestrian refuge areas effectively turn two-way streets into two consecutive one-way street crossings for pedestrians. Together, these treatments can be effective in reducing vehicle speeds and simplifying the crossing process for pedestrians. Section 4.3.7 provides further guidance on the design of medians and refuge areas.

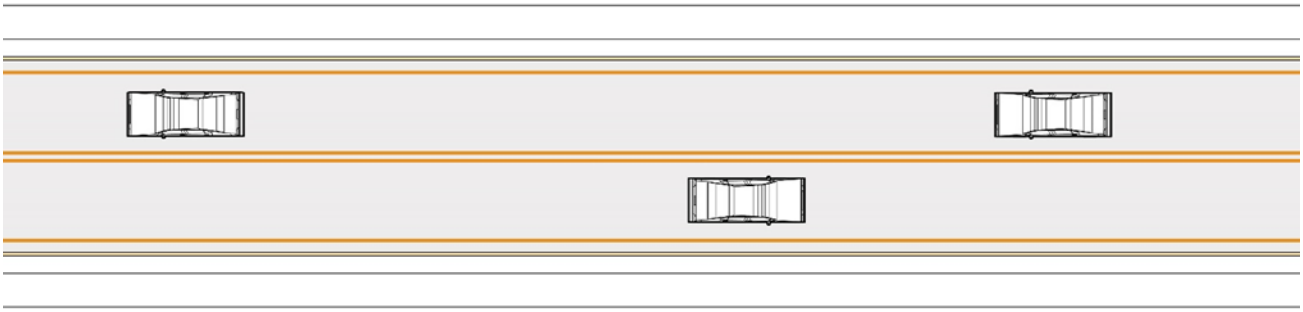


Figure 4.9. Plan View of Two-way Street

4.3 Optimizing the Cross Section for Pedestrians

As a street traverses places where people are likely to be walking, such as urban, urban core, suburban, rural town, and rural context areas, the design of cross-sectional elements should balance pedestrian mobility, access, and comfort with vehicle operational performance. This section provides information on the design of cross-sectional elements on sections of a street that traverse places where people walk.

4.3.1 ADA Ramps and Detectable Edges

To allow people with disabilities to cross streets safely, state and local governments must provide curb ramps at pedestrian crossings and at public transportation stops where walkways intersect a curb. To comply with ADA requirements, the curb ramps provided must meet specific standards for width, slope, cross slope, placement, and other features which shall follow all specifications associated with American Disabilities Act as well as the United States Access Board/PROWAG.

GDOT has a regulatory responsibility under Title II of ADA and Section 504 of the Rehabilitation Act of 1973 to ensure that recipients of federal-aid and state and local entities that are responsible for roadways and pedestrian facilities do not discriminate on the basis of disability in any highway transportation program, activity, service, or benefit they provide to the general public. Any GDOT work or project classified as an “alteration” must install, repair, or upgrade curb ramps within the scope of the work or the project. The need to install, repair, or update curb ramps should be discussed

during the early scoping phase of the work or the project so that budgets and schedules reflect the requirement. Refer to GDOT Construction Detail A-3 and Construction Detail A-4 for design of ADA compliant curb ramps and detectable warning surface/truncated domes.

ADA detectable edges are used to communicate to visually impaired pedestrians where a sidewalk crosses a street or commercial driveway.

Application

- Where curbs or a vertical elevation change between the street and sidewalk exists, ADA ramps should be used to allow people with disabilities to cross streets and access sidewalks safely.
- ADA ramps should be installed in conjunction with improvements, new alignments, or alterations within the limits of the specific transportation project.
- ADA detectable edges are used where the sidewalk or shared use path crosses roads, streets, and railroads.
- ADA detectable edges are used where the sidewalk or shared use path crosses commercial driveways with large volumes of entering and exiting vehicles.
- ADA detectable edges are not used at crossings of residential driveways.
- ADA detectable edges are used in medians - or pedestrian refuge areas with cut-throughs or ADA ramps for pedestrians.
- ADA detectable edges are used on boarding platforms at transit stops for buses and rail vehicles where the edge of the boarding platform is not protected by screens or guards.

Critical Design Requirements

- Refer to GDOT Construction Detail A-3 and Construction Detail A-4 for the design of ADA-compliant curb ramps and detectable warning surface/truncated domes.
- There should be a high visual contrast between the detectable warning and an adjoining surface or the detectable warning should be “safety yellow” (Figure 4.10).

Figure 4.10. Detectable Pavers – "Safety Yellow"

4.3.2 Bicycle Facility Infrastructure

Providing safe spaces for people of all ages to ride bicycles is equally important as providing places for people to walk. Bicycle facilities can be complementary to pedestrians to provide high performance streetscapes. Similar to interconnected pedestrian facilities, bicycle facility planning requires analysis, evaluation, and design to implement facilities that are safe and efficient for people who bike. For each proposed bicycle facility, a specific site evaluation must be conducted to determine the most appropriate facility for the project.

Bike lanes are a portion of the roadway designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists. Bike lanes enable bicyclists to ride at their preferred speed without interference from prevailing traffic conditions and facilitate predictable behavior and movements between bicyclists and motorists. A bike lane is distinguished from a cycle track in that it has no physical barrier (bollards, medians, raised curbs, etc.) that restricts the encroachment of motorized traffic. Conventional bike lanes run curbside when no parking is present, adjacent to parked cars on the right-hand side of the street or on the left-hand side of the street in specific situations. Bike lanes typically run in the same direction of traffic, though they may be configured in the contra-flow direction on low-traffic corridors necessary for the connectivity of a particular bicycle route.

Sharrows are road markings used to indicate a shared lane environment for bicycles and automobiles. Among other benefits, shared lane markings reinforce the legitimacy of bicycle traffic on the street, recommend proper bicyclist positioning, and may be configured to offer directional and wayfinding guidance. The shared lane marking is a pavement marking with a variety of uses to support a complete bikeway network; it is not a facility type and should not be considered a substitute for bike lanes, cycle tracks, or other separation treatments where these types of facilities are otherwise warranted or space permits. MUTCD Section 9C.07 outlines guidance for shared lane markings.

Two-way cycle tracks (also known as protected bike lanes, separated bikeways, and on-street bike paths) are physically separated cycle tracks that allow bicycle movement in both directions on one side of the road. Two-way cycle tracks share some of the same design characteristics as one-way tracks but may require additional considerations at driveway and side street crossings to provide safe site visibility. A two-way cycle track may be configured as a protected or raised facility. A protected cycle track is located at the same level as the street and includes a parking lane or other barrier between the cycle track and the motor vehicle travel lane. A raised cycle track has vertical separation from the adjacent motor vehicle lane.

One-way protected cycle tracks are bikeways that are at street level and use a variety of methods for physical protection from passing traffic. A one-way protected cycle track may be combined with a parking lane or other barrier between the cycle track and the motor vehicle travel lane. When a cycle track is elevated above street level it is called a raised cycle track, and different design considerations may apply.

Application

≤40 mph

- **On-street bike lanes** may be appropriate on streets with speed limits between 25 mph and less than 40 mph.

≤25 mph

- **Sharrows** or shared lane markings may be appropriate on streets with speed limits of 25 mph or less.

≤45 mph

- **Buffered cycle tracks** are dedicated bicycling facilities that may be appropriate on streets with a speed limit of between 25 mph and 45 mph.

- **Cycle tracks** should be incorporated in areas with existing or proposed high volumes of cyclists.
- **Cycle tracks** should be maintained in order to be free of potholes, broken glass, and other debris.
- Street sweeping maintenance may be required for cycle tracks more frequently than on streets, especially during the fall. The lack of the sweeping effect of motor traffic, together with the canyon profile of a cycle track, tends to hold leaves and other debris.
- Bikeable shoulders are appropriate in rural context areas or streets with no curb and gutter. Further evaluation should be conducted related to the posted design speed to determine the most appropriate measures to project the cyclists from motorized vehicles. In many cases, barriers are put up as needed adjacent to the bike facility.

Further Guidance

- AASHTO, *Guide for the Development of Bicycle Facilities* (latest edition)
- FHWA, *MUTCD* (latest edition)
- FHWA, Rumble Strips and Stripes (latest edition)
- FHWA, *Separated Bike Lane Planning and Design Guide* (latest edition)
- NACTO, *Urban Bikeway Design Guide* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

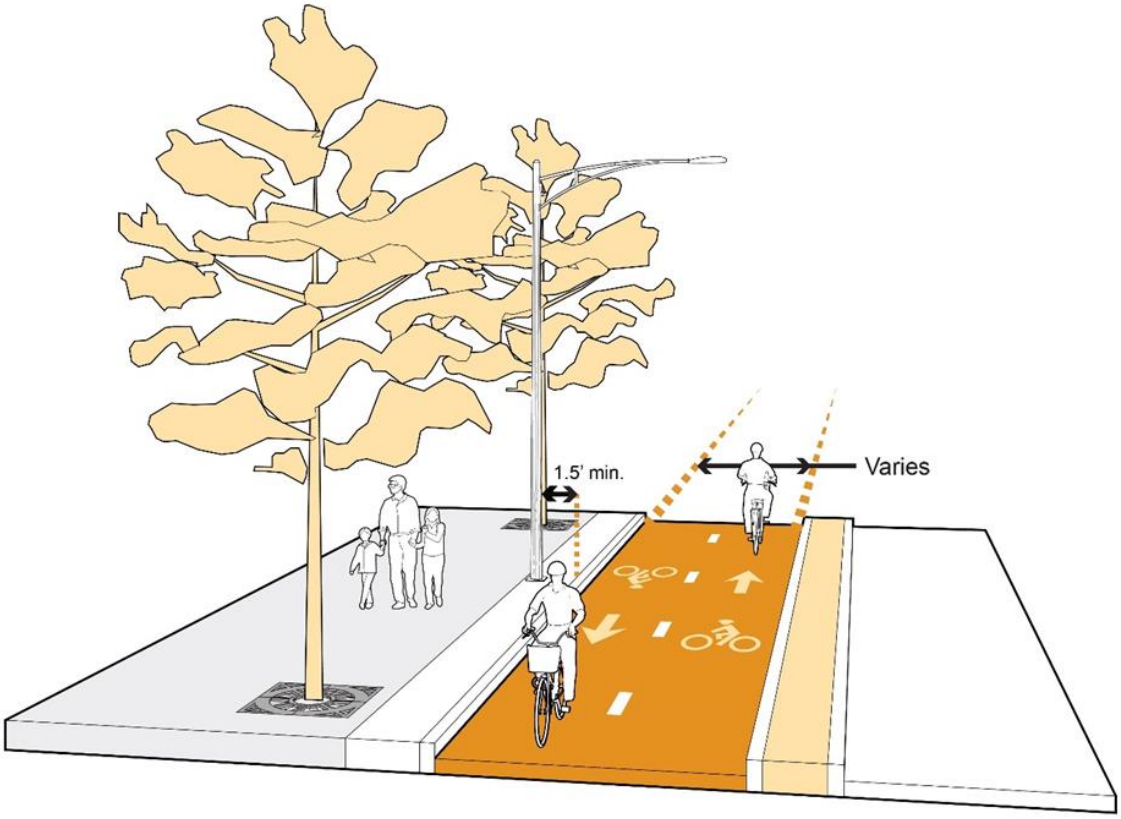


Figure 4.11. Typical Cycle Track Perspective with Tree Grates

Figure 4.12. Two-Way Buffered Cycle Track with Green Infrastructure, Decatur, Georgia

4.3.3 Handrails and Safety Railings

Handrails that are used to assist pedestrians up and down slopes and steps are an essential component of a streetscape where the sidewalk deviates from the roadway slope and requires an ADA accommodation. Safety railings are used to prevent pedestrians from a fall when the sidewalk or landing is adjacent to a vertical drop or slope that requires a barrier.

Application

- Vertical features such as handrails and safety railings are used to assist pedestrians in navigating up and down stairs and ramps, and to prevent pedestrian falls from elevated walkways, platforms, or landings.

Critical Design Requirements

- Handrails should extend at least 12 inches beyond the top and bottom of a slope or bottom tread of steps that require a handrail.
- Handrails should be 34 inches to 38 inches in height along slopes or steps.
- Handrail gripping surfaces with a circular cross section should have an outside diameter of 1¼ inches minimum and 2 inches maximum.
- Handrail gripping surfaces and any surfaces adjacent to them should be free of sharp or abrasive elements and should have rounded edges.
- Handrail gripping surfaces should be continuous, and not be uninterrupted by newel posts, other construction elements, or obstructions.
- Sidewalks and shared use paths with running slopes steeper than 5 percent should have handrails on both sides, unless the sidewalk or path follows the grade of the adjacent roadway.
- Safety railings should be installed when a vertical drop is 30 inches or greater, a downward slope is 2:1 or greater, or a body of water is less than 2 feet from the edge of the sidewalk or shared use path.
- Safety railings should be a minimum of 42 inches in height and should have a vertical post so that the space between the vertical posts does not exceed 4 inches width.
- Safety railings shall be 42 inches high and should have vertical post spaced no more than 4 inches apart.
- Safety railings should have a lateral offset of 1 foot minimum from the edge of the sidewalk.
- The ends of the safety railings, barriers, or guardrails should be flared away from the path edge or turned down. Barrier or rail ends that remain within the 2-foot clear area should be marked with object markers.

Further Guidance

- American with Disabilities Act
- FHWA, MUTCD Section 9C.07 (latest edition)
- FHWA, Rumble Strips and Stripes (latest edition)
- FHWA, *Separated Bike Lane Planning and Design Guide* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Bikeway Design Guide* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)
- US Access Board, *Detectable Warning Update* (latest edition)
- www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way

Figure 4.13. Pedestrian Safety Railing, Midtown, Atlanta, Georgia

4.3.4 Fencing for Pedestrian Access Control

Fencing may be installed in urban core, urban, suburban, rural, and rural town contexts to delineate the control of access. Fencing could be provided within the right-of-way to define a boundary or a physical barrier to discourage encroachment by pedestrians, bicyclists or animals, or vehicles.

Fencing may be placed to delineate outdoor seating adjacent to restaurants or may be required for pedestrian access control in locations where the crossing behavior exhibits poor choices by pedestrians and where a separation is not provided. Fencing may also be provided to restrict access to features such as retaining walls, bridges, and drainage structures. For more information on fencing, refer to the GDOT *Design Policy Manual* and AASHTO *A Policy on Geometric Design of Highways and Streets*.

Application

- To delineate the limit-of-access, fencing should be installed within the right-of-way and should be placed a minimum of 1 foot inside the right-of-way to accommodate space required for installation and maintenance.
- Fencing should be installed between the roadway and the frontage road.
- A 6-foot-high chain link wire fence may be considered around the perimeter of proposed permanent drainage features that hold water over 24 inches deep for greater than 48 hours such as natural ponds, detention ponds, and water quality ponds. This should be evaluated on a case-by-case basis.
- Fencing is not required in areas where there are steep slopes or natural barriers or where they are not required to preserve access control.
- Fencing installed on private property should be placed a minimum of 1 foot outside the right-of-way.
- If fencing is installed on private property by a GDOT contractor, a 5-foot-wide temporary "easement for the construction of fence" is required.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- GDOT, *Bridge and Structures Design Manual* (latest edition)
- GDOT, *Construction Standard Specification, Section 643 – Fence*
- GDOT, *Design Policy Manual* (latest edition)
- GDOT, *Right-of-Way Manual* (latest edition)

4.3.5 On-Street Parking

On-street parking provides a buffer zone between the travel lanes in a roadway and the sidewalk. However, on-street parking near pedestrian crossing locations can interfere with visibility between

pedestrians and vehicles in the travel lanes. When vehicles are parked too close to marked pedestrian crossings, they may block the line of sight between the driver and the pedestrian stepping off the curb to cross the street. Types of on-street parking include parallel parking, angled parking, and back-in-angled parking.

Application

≤35 mph

- On-street parking may be installed on streets in urban core, urban, or rural town contexts on streets with speed limits of 35 mph or less. Proposed on-street parking on a state route would require permission by GDOT.

Critical Design Requirements

- On-street parking should be set back a minimum of 20 feet from pedestrian crossings (FHWA 2002).
- Minimum parking space dimensions are defined by local agencies. Typical parking space dimensions of 9 feet wide by 24 feet long are desirable for on-street parallel parking stalls. However, in some cases the dimensions are reduced to 7 feet wide and 22 feet long, if allowed by local parking standards.
- When perpendicular or angled parking stalls are located adjacent to sidewalks, wheel stops should be installed to prevent the front of the vehicle from protruding into the sidewalk areas. The wheel stops, or curbing, should be located a minimum of 24 inches from the back of the wheel stop to the pedestrian travel zone.
- Wherever on-street parking is provided, accessible on-street parking must be included. Refer to PROWAG.

Additional Considerations

- Curb extensions may be used in combination with on-street parking to increase the visibility of pedestrians waiting to cross the street.
- On streets with bike lanes and parallel parking, a 3 to 4-foot buffer between the parking and the bike lane may reduce the risk of bicyclists colliding with car doors.
- Front-in-angled parking may be converted into back-in-angled parking to improve the driver's field of view when pulling out of the space. Back-in-angled parking is particularly useful when angled parking is combined with on-street bike facilities.
- On-street parking spaces may be converted into parklets for café seating or pop-up events.
- On-street parking spaces may be converted into bike corrals. Refer to Section 6.3.2 for more information on bike parking.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- ITE, *Implementing Context Sensitive Designs on Multimodal Corridors Chapter 4* (latest edition)
- NACTO, *Protected Bike Lane vs. On-street Parking* (latest edition)
- US Access Board, *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (latest edition)

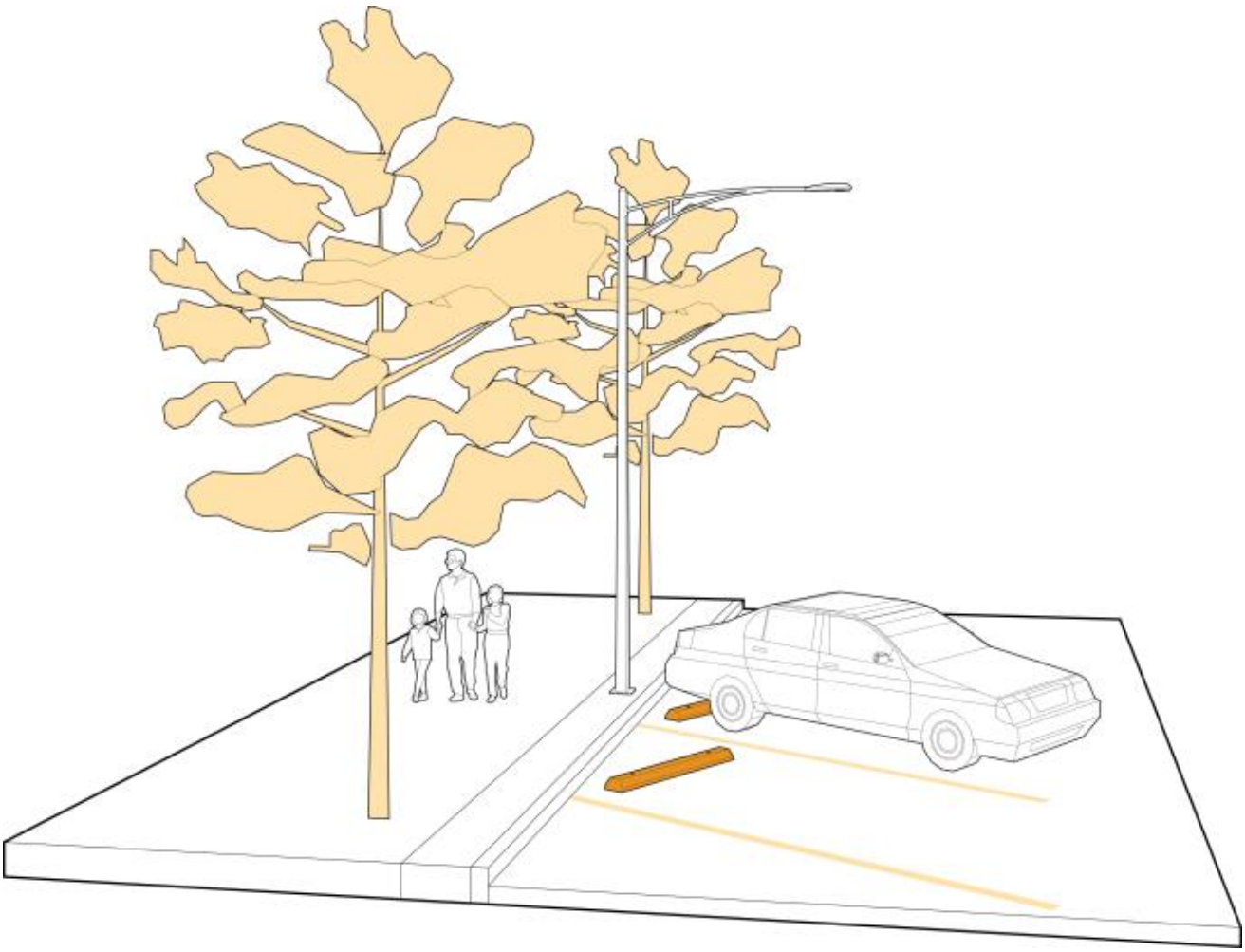


Figure 4.14. Back-In-Angled Parking with Wheel Stops

Figure 4.15. Example of Temporary On-Street Parking Used for Pop-Up Parklet at the Georgia Walks Summit, Rome, Georgia

4.3.6 Pedestrian Accommodations along Bridges and Constrained Rights-of-Way

Bridges provide road users with connections across barriers, such as highways, railroads, and bodies of water. Bridges should be designed with pedestrians in mind.

Application

- Bridges that connect to pedestrian networks should include space for pedestrians and bicycles and should include the appropriate countermeasures to protect both pedestrians and cyclists.

Critical Design Requirements

- Pedestrian railings and barriers on bridges should comply with GDOT *Bridge and Structures Policy Manual* Section 3.3.
- Sidewalks on bridges should be a minimum of 5.5 feet wide (GDOT *Design Policy Manual*).
- Shared use paths require a 5-foot buffer from face of curb when they cross bridges. (GDOT *Design Policy Manual*).

Additional Considerations

- When retrofitting existing bridges, excess shoulder space may be used to provide more space for sidewalks and shared use paths.
- A best management practice is to consider the use of planters, flexible bollards, or barriers for additional protection.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- ITE, *Implementing Context Sensitive Designs on Multimodal Corridors Chapter 4* (latest edition)
- NACTO, *Protected Bike Lane vs. On-street Parking* (latest edition)
- US Access Board, *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (latest edition)

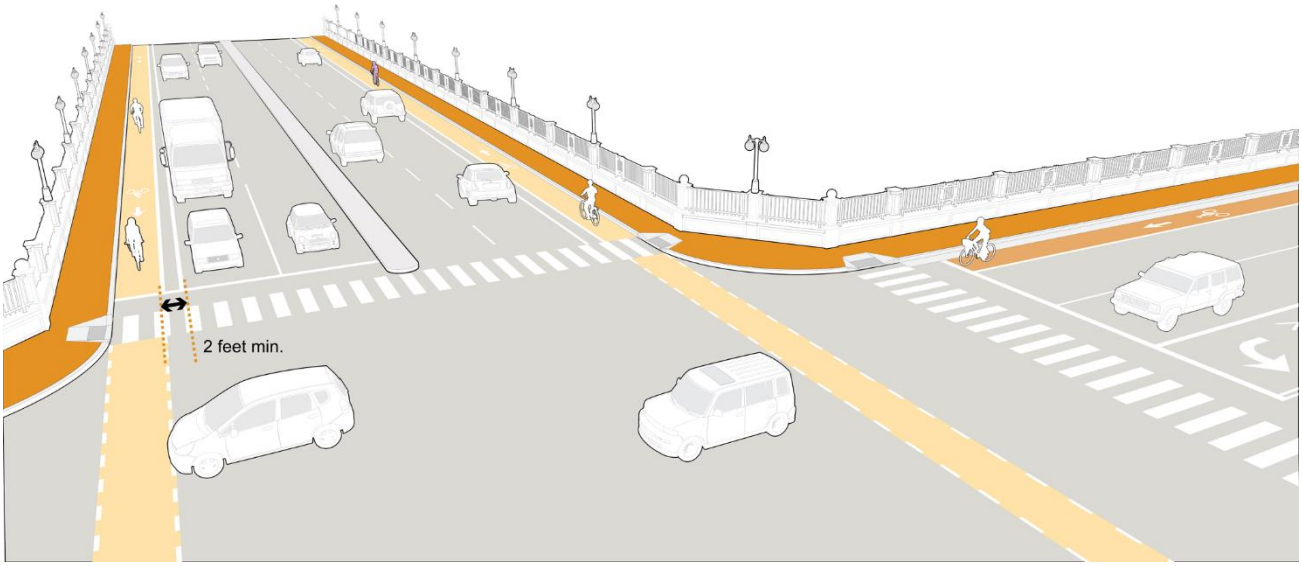


Figure 4.16. Bicycle and Pedestrian Accommodations on Bridges

4.3.7 Raised Medians and Pedestrian Refuge Areas

Raised medians and pedestrian refuge areas are spaces intended for pedestrian refuge that are located between active vehicle travel lanes. They are used to break up the total pedestrian crossing distance and provide more protection for pedestrians crossing the street. Raised medians and pedestrian refuge areas are considered traffic calming infrastructure because they effectively narrow the roadway and the field of vision of the approaching motorist, which results in reduced vehicle speeds. According to FHWA *Medians and Pedestrian Crossing Islands in Urban and Suburban Areas*,

studies have shown that raised medians and pedestrian refuge areas reduce pedestrian crashes by 46 percent and 56 percent, respectively.

Application

≤45 mph

- Raised medians can help to notify a driver of an upcoming transition from one-character area such as a rural area to a rural town area, or from an "on system" roadway to an "off system" roadway.
- Raised medians and pedestrian refuge areas can be installed at intersections or mid-block locations.
- Raised medians and refuge areas may be used on two-way streets but are particularly beneficial on streets wider than 60 feet.

Critical Design Requirements

- Pedestrian refuge areas should be a minimum of 6 feet wide in the direction of pedestrian travel.
- Pedestrian refuge areas should be accessible with either curb ramps or at-grade cut-throughs. At-grade cut-throughs are easier to construct and easier for pedestrians to negotiate than curb ramps, particularly for smaller areas. Additional consideration should be made to accommodate stormwater runoff, so water does not collect or pond on the street or the pedestrian crossing.
- At signalized intersections or locations with button-actuated beacons, pedestrian pushbuttons should be mounted in the pedestrian refuge areas to provide pedestrians with the ability to receive the pedestrian signal phase from their refuge position.
- Pushbutton posts and other poles should be located outside of the pedestrian travel way and meet MUTCD requirements.

Additional Considerations

- A median refuge area may be planted with low-growing, low-maintenance plants, which should be selected so that they do not exceed 30 inches in height at maturity.
- A best practice is to position reflective, flexible bollards at the leading edge of the raised median or at the pedestrian crossing to improve the driver's recognition of the pedestrian environment.
- A best practice at a mid-block pedestrian crossing is to install a median refuge area alone, without a device such as an RRFB or PHB. The devices may create a false sense of security for pedestrians. In some cases, a median refuge area may provide the most significant safety benefit for the pedestrian.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- FHWA, *Safety Benefits of Raised Medians and Pedestrian Refuge Areas* (latest edition)
- FHWA, State Best Practice Policy for Medians (n.d.)
- GDOT, *Design Policy Manual* (latest edition)
- ITE, *Implementing Context Sensitive Designs on Multimodal Corridors Chapter 4* (latest edition)
- NACTO, *Urban Bikeway Design Guide* (latest edition)

Figure 4.17. Mid-Block Crossing with Pedestrian Refuge Area, Atlanta, Georgia

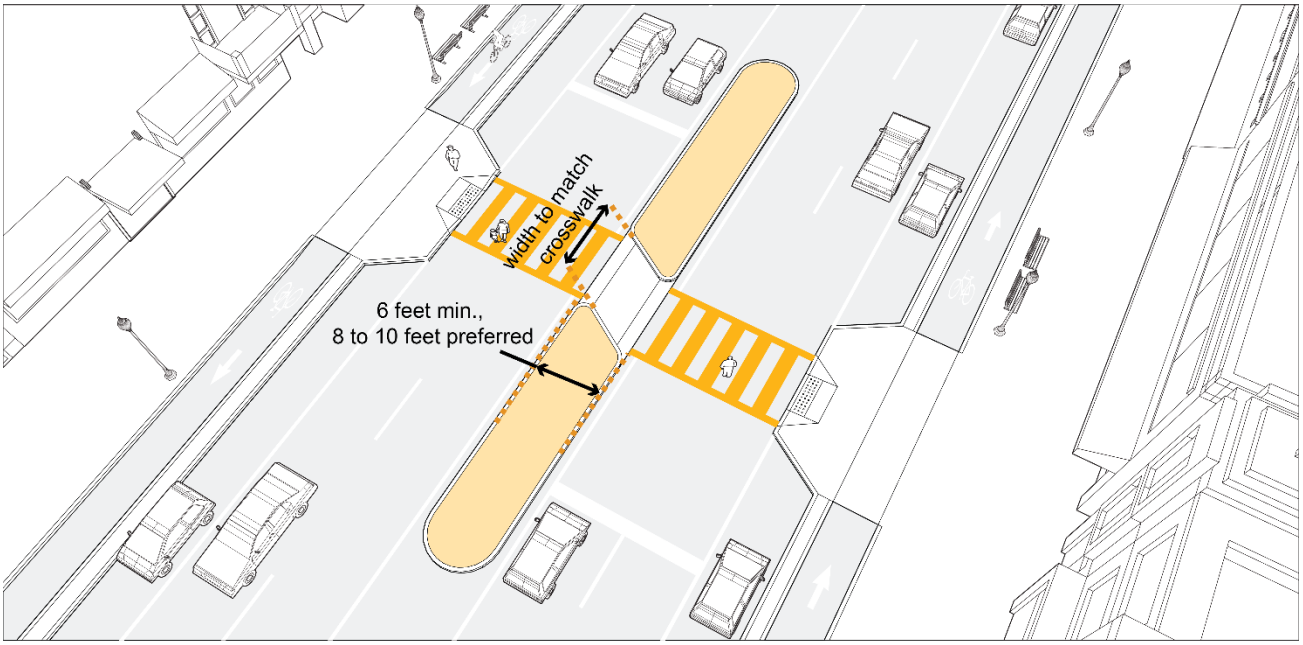


Figure 4.18. Minimum Dimensions of a Pedestrian Refuge Area

4.3.8 Roadway and Lane Diets

Wide street crossings can be major impediments to pedestrian access, connectivity, and safety; therefore, a very effective countermeasure for pedestrian safety is a “road diet.” A roadway reconfiguration known as a road diet offers several high-value improvements at a low cost when applied to traditional four-lane undivided highways. The primary benefits of a road diet include enhanced safety, mobility, and access for road users and a "complete streets" environment to accommodate a variety of transportation modes.

A classic road diet typically involves converting an existing four-lane, undivided roadway segment to a three-lane segment consisting of two through lanes and a center, two-way left-turn lane.

The resulting benefits include a crash reduction of 19 to 47 percent according to FHWA Road Diets/Roadway Reconfiguration, reduced vehicle speed differential, improved mobility and access by all road users, and integration of the roadway into surrounding uses that results in an enhanced quality of life. A key feature of a road diet is that it allows reclaimed space to be allocated for other uses, such as turn lanes, bus lanes, pedestrian refuge islands, bike lanes, sidewalks, bus shelters, parking, or landscaping.

Other road diet benefits include:

- Reduced rear-end and left-turn crashes due to the dedicated left-turn lane
- Reduced right-angle crashes as side street motorists cross three versus four travel lanes
- Fewer lanes for pedestrians to cross
- Opportunity to install pedestrian refuge islands, bicycle lanes, on-street parking, or transit stops
- Traffic calming and more consistent speeds

- A more community-focused, "Complete Streets" environment that better accommodates the needs of all road users

A road diet can be a low-cost safety solution when planned in conjunction with a simple pavement overlay, and the reconfiguration can be accomplished at no additional cost.

Road diets or lane diets are not appropriate for all roadways. Careful analysis on determining the feasibility need to be determined up front utilizing traffic count data, existing and proposed ADT, type of road, “off system” or “on system” and the need and purpose of the project to determine whether the street or road you are analysis is suitable for a road or lane diet.

FHWA Road Diets/Roadway Reconfiguration states that four-lane, undivided highways experience a number of crash types as traffic volumes increase, including pedestrian crashes due to the high number of lanes for pedestrians to cross with no refuge area. A number of strategies may be considered to reconfigure the street to improve vehicle and pedestrian safety, while simultaneously improving vehicle flow and reducing vehicle speeds.

Lane diets and road diets may be used to reduce the width of street crossings and/or the number of lanes that pedestrians must cross. Lane diets involve reducing the width of the travel lanes and road diets involve removing one or more lanes of traffic and, in some cases, reducing the width of the travel lanes. The excess space is converted into space for pedestrians or cyclists, such as wider sidewalks, curb extensions, pedestrian refuge areas, or bicycle facilities. Before proposing a road diet, a comprehensive traffic study should be conducted as well as a land use and walk shed analysis, which identifies existing and future walking and biking destinations. Together, both can help to justify the need and purpose of the project.

Application

≤35 mph

- The most typical road diet is the conversion of a four-lane undivided roadway to a three-lane undivided roadway made up of two through lanes and a center two-way left-turn lane utilizing the addition roadway gained for new bike and pedestrian facilities or widening the ones that may have existed. Road Diets provide an opportunity to balance the needs of all transportation users. For examples of types of road diets and when a road diet may be applicable, refer to FHWA *Road Diets/Roadway Reconfiguration*.

Critical Design Requirements

- The minimum lane widths should comply with the specifications outlined in the AASHTO Green Book (latest edition).
- Roadway and street geometry should be evaluated along with further engineering judgement to determine the appropriateness of a road diet.

Additional Considerations

- When converting a four-lane road into a two-lane road with a two-way left-turn lane, medians or pedestrian refuge areas may be placed at intersections or mid-block pedestrian crossing locations.
- The practitioner should determine the types of vehicles that primarily use the street before reducing the lane widths.
- A best management practice may be considered for utilizing mountable curbs on narrower lanes to accommodate larger vehicles.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, Road Diets/Roadway Reconfiguration (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

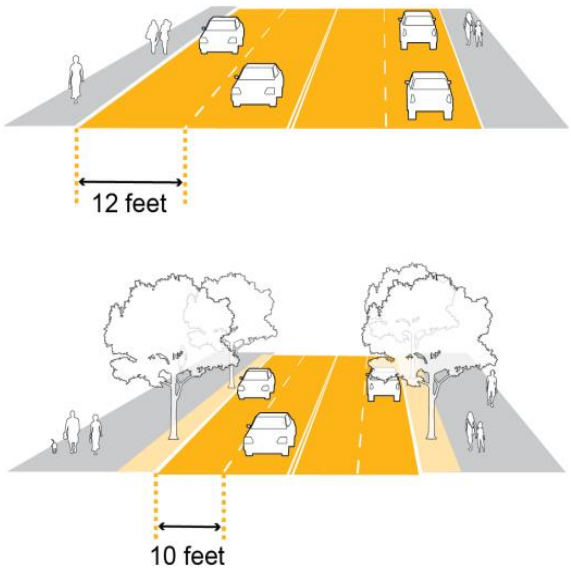


Figure 4.19. Lane Diet

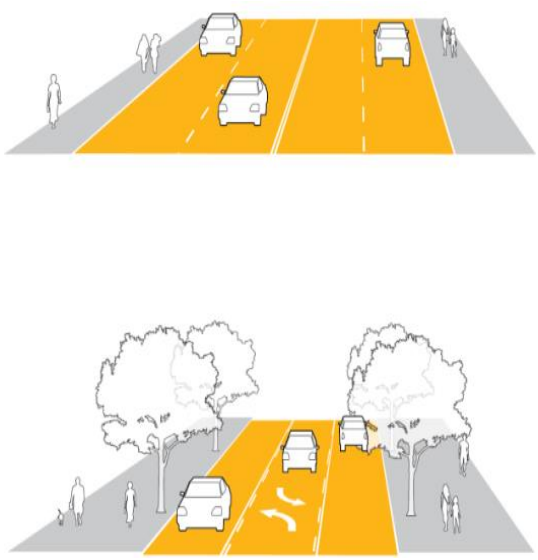


Figure 4.20. Road Diet

4.3.9 Shared Streets

Shared streets are streets where pedestrians, cyclists, transit, and vehicles function without conflicts and are primarily characterized by no expressly designated areas for the movement of any one mode of transportation. On shared streets, all modes of traffic are generally expected to travel at the pace of a pedestrian, the slowest user.

Application

- Shared streets are suitable in areas where pedestrian activity is high and vehicle volumes are low or discouraged.
- Shared streets are not appropriate on high vehicle volume streets (greater than 3,500 vehicles per day).
- Shared streets should only be considered on “off system” roads/streets.
- Shared streets should have a speed limit of 15 mph or less.

Critical Design Requirements

- Signs should be installed to alert motorists to yield to pedestrians.
- ADA detectable edges should be used to identify potential hazards for pedestrians with visual impairments.
- Materials and street furnishings should be strategically placed to delineate edges and direct the flow of traffic for all users.

Additional Considerations

- Shared streets may be any width that sufficiently accommodates the modes of transportation that are expected to use the space.
- Shared streets may be accommodated with or without a curb.
- Special paving features may be used to distinguish unique circulation patterns. Refer to Section 5.2.1 of this Guide for hardscape ideas.
- Where sidewalk areas extend into the street, bollards can be used to identify the path of travel as necessary if conflicts between users arise.
- Signage to reinforce the posted speed limit may be provided.

Further Guidance

- NACTO, *Urban Street Design Guide* (latest edition)

Figure 4.21. Shared Street Perspective

4.3.10 Shared Use Paths

Shared use paths located in a public right-of-way are physically separated from motor vehicle traffic by an open space, barrier, or grade separation. Like sidewalks, shared use paths can be critical roadway features that support pedestrian mobility and access. Unlike sidewalks, shared use paths can be used by other non-motorized modes of transportation, including, but not limited to, bicycles, rollerblades, and skateboards. Even though shared use paths can be used for recreation, they should be designed for transportation purposes and comply with PROWAG and other national standards for transportation infrastructure.

Application

- Shared use paths can be installed in urban, suburban, or rural contexts to accommodate pedestrians and bicyclists.
- Shared use paths can be located in the public right-of-way adjacent to roadways, along a body of water, or through parks or open space within an independent right-of-way.
- Shared use paths are best located on a street or roadway with minimal curb cuts.
- Additional considerations must be made to ensure the site visibility is not obstructed at intersections to and from users of the shared use path as well as to and from vehicles approaching, exiting, or entering the intersection.

Critical Design Requirements

- Shared use paths should be a minimum of 10 feet wide, except constrained shared use paths may be as narrow as 8 feet wide (AASHTO *Guide for the Development of Bicycle Facilities*). A preferred width of a shared use path is 14 feet and sometimes larger in areas with high volumes of pedestrians such as the Beltline in Atlanta, Georgia.
- A vertical clearance of 10 feet from fixed objects should be maintained. In some cases, vertical clearance should be taller than 10 feet to accommodate emergency and maintenance vehicles (AASHTO *Guide for the Development of Bicycle Facilities*).
- Horizontal clearance of 2 feet from fixed objects (trees, signs, etc.) should be maintained on each side of the path. Where smooth features such as bicycle railings or fences are introduced with flaring end treatments, a minimum clearance of 1 foot is acceptable. If adequate clearance cannot be provided between the path and lateral obstructions, reflective warning signs and markings should be used to capture the attention of pedestrians (AASHTO *Guide for the Development of Bicycle Facilities*).
- On streets with a speed limit of 35 mph or greater, shared used paths should maintain a 5-foot separation from through travel lanes. If the minimum separation cannot be accommodated, a vertical barrier with a minimum height of 3.5 feet may be needed to separate the path from vehicular traffic in through travel lanes.
- On streets with a speed limit greater than 40 mph, the vertical barrier and end treatments should be crash worthy.
- Side slopes or ditches should have a minimum of 4 feet of clear, level area (including shoulder) before the up slope or down slope (or ditch) begins.
- Where the shared use path is parallel to a street, the grade should not exceed the grade established for the adjacent street.
- Drainage grates and inlets should be located at the outside edge or adjacent to shared use paths. Grid style grates are recommended over grates with parallel bars. Grates should be set flush, less than 0.5 inch below the surface of the surrounding pavements, with no raised edges.
- Refer to AASHTO *Guide for the Development of Bicycle Facilities* (2012) for formulas and guidance for calculating the minimum radius for horizontal curves on shared use paths.
- Refer to Section 5.2.1 of this Guide for further guidance on material selection (e.g., asphalt or concrete).

Additional Considerations

- A best practice is to provide a 2 percent surface cross slope in one direction, rather than a crowning the trail, to simplify the drainage and surface construction.
- In areas with heavy non-motorized volumes, separation of pedestrians from bicyclists may be appropriate.
- A 4-inch-wide centerline stripe may be used for shared use paths with heavy volumes of pedestrians and bicyclists, on curves with restricted sight distance, and on paths were night-time use is expected. Shared used paths should be signed and marked.
- Reflective edge lines may be beneficial on paths that are intended to accommodate users in dark conditions.
- The pathway should not be placed in a narrow corridor or between two opaque fences for long distances. Such conditions create personal security issues, prevent visibility to users who need help, prevent path users from leaving the path in an emergency, and impede the response times for emergency personnel.
- When next to a retaining wall, pavement may be extended to the wall face. Narrow (2 feet or less) grass or vegetative buffers should be avoided to simplify maintenance.
- Conflicts at intersections and driveways are a major concern for paths adjacent to roadways (see AASHTO *Guide for the Development of Bicycle Facilities* Section 5.2.2 for more on this topic). Drivers may be less likely to notice non-motorized traffic that is traveling on separated shared use paths adjacent to the roadway.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- AASHTO, *Guide for the Development of Bicycle Facilities* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- ITE, *Implementing Context Sensitive Designs on Multimodal Corridors Chapter 4* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

Figure 4.22. Azalea Trail Shared Use Path on Street with speeds less than 35 mph, Valdosta, Georgia

Figure 4.23. Shared Use Path on Street with speeds greater than 35 mph, Brunswick, Georgia

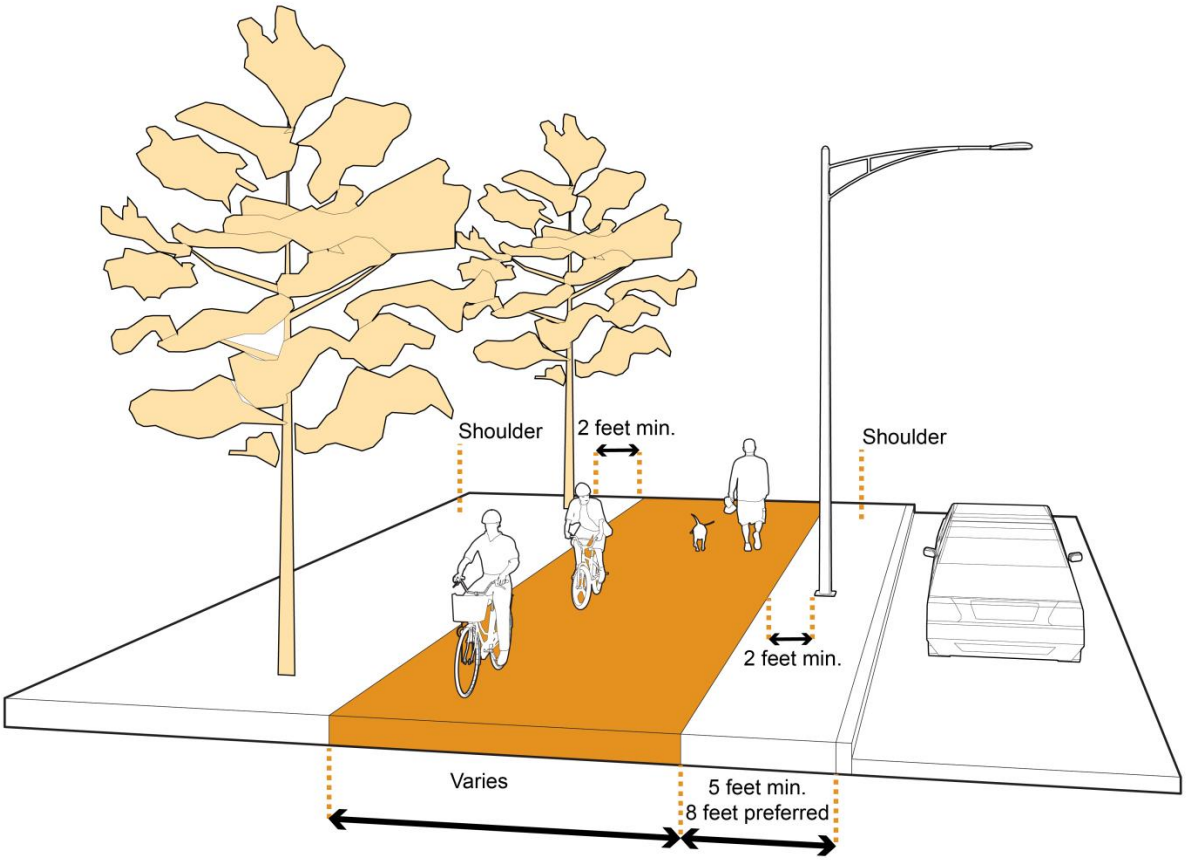


Figure 4.24. Minimum Width of Shared Use Paths adjacent to low speed street, 35 mph or less

4.3.11 Sidewalks

Sidewalks are spaces in the public right-of-way that are dedicated for pedestrian use. They should be designed and built for people of all ages and abilities to use and enjoy. This section provides guidance on the design of sidewalks in different contexts. For further information on sidewalk materials, lighting, and other streetscape amenities, refer to Chapter 6. Chapter 3 describes the importance of a connected and expansive pedestrian network and should be referenced during the scoping and planning phases of a project.

Application

- Sidewalks should be considered during the initial concept phase of a transportation project. The GDOT Complete Streets Policy and Chapter 3 of this Guide provide guidance on when pedestrian accommodations should be implemented.
- In urban core, urban, suburban, and rural town areas, where the typical roadway section includes curb and gutter, the sidewalk may be located immediately behind the curb, or preferably offset from the roadway to improve pedestrian comfort.

Critical Design Requirements

- Sidewalks should be a minimum of 5 feet wide, which is the minimum width that accommodates 2 wheelchairs side-by-side. This is also the minimum clear pedestrian zone width as shown in Figure 6.2 of the GDOT *Design Policy Manual*.
- GDOT adopts PROWAG as the standard design policy for ADA-compliant sidewalks.
- The grade of sidewalks should not exceed the grade established for the adjacent street or roadway. The running slope of a sidewalk should not exceed 5 percent if not adjacent to a street or roadway.
- A maximum of 2 percent cross slope will facilitate adequate drainage on trails and paths. Cross sloping to one side or the other instead of crowning the trail is preferred and may simplify the drainage and surface construction.

Additional Considerations

- The sidewalk width may vary in response to pedestrian activity, adjacent land uses, and context. Wider sidewalks contribute to placemaking by offering opportunities for landscape, pedestrian scale lighting, sidewalk furnishings, and wayfinding signage, creating an attractive streetscape. A minimum of a 5-foot pedestrian clear zone and a minimum of 5 feet should be maintained for the greenscape/furniture zone.
- In areas with high pedestrian activity, the width of the sidewalk (area from curb to edge of right-of-way) may range from 10 to 20 feet.
- In areas with relatively low pedestrian activity, the width of a sidewalk (area from curb to edge of right-of-way) ranges from 7 to 12 feet.
- Drainage grates and inlets may be located at the outside edge of or adjacent to sidewalks.
- Grid-style drainage grates are preferred to drainage grates with parallel bars. Grates should be set flush, less than 0.5 inch below the surface of the surrounding pavements, with no raised edges.
- Although 5 feet is the minimum required width of a sidewalk per GDOT's *Design Policy Manual*, a best management practice is to provide additional consideration to the existing and anticipated pedestrian volumes so that the appropriate width of the sidewalk is provided.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

Figure 4.25. Sidewalk in Urban Context Area

Figure 4.26. Sidewalk in Urban Core Context Area

Figure 4.27. Sidewalk in Suburban Context Area

Figure 4.28. Sidewalk in Rural Context Area

Figure 4.29. Sidewalk in Rural Town Context Area

4.3.12 Transit Stops

Transit riders also represent pedestrian trips. Whether catching a bus or getting off a bus, people riding transit expect to cross the street at bus stops. This makes the location of the transit stop in relation to a pedestrian crosswalk especially important. This section provides guidance on transit stop locations and design. For information on the placement and design of amenities, such as benches, maps, and signs, refer to Section 6.3.

In areas with a high ridership and sufficient street width, a dedicated bus lane that incorporates bus stops may be utilized. The ability to accommodate a bus lane should be determined based on the available street space and the needs of other modes, including bicyclists, pedestrians, and motorists. The minimum width of a curbside bus lane is 11 feet. The minimum width of an offset bus lane is 10 feet. An offset bus lane is a dedicated bus lane that is typically located between a parallel parking lane and a general through-traffic lane and may be applied to a wide variety of streets. Offset bus lanes are a core part of the transit toolbox for urban streets and are often implemented through simple lane conversions. Offset bus/transit lanes provide priority space for frequent or high-volume transit service, a variety of curbside uses and turning movements, and a comfortable sidewalk environment.

Application

≤35 mph

- Transit stops may be located on the near side of an intersection, the far side of an intersection, or at mid-block locations along a roadway. Figure 4.30 through Figure 4.32 to illustrate these options for transit stop locations.
- Placing the transit stop at the far side of an intersection or crosswalk is preferred because it minimizes site distance obstructions that may be created by the bus or transit stop related to a transit stop located on the near side of the intersection or crosswalk.
- Transit stops are generally best suited for lower speed roadways of 35 mph or less when shared with an active through lane.
- Transit stop locations should be evaluated on ridership or demand, locations that are safe for pedestrians to access and are visible for approaching vehicles.

Critical Design Requirements

- On streets that serve as a bus route, a minimum 5-foot-wide sidewalk should be provided.
- An 8-foot (perpendicular to the curb) by 5-foot (parallel to the curb) passenger loading zone should be provided at the transit stop to accommodate wheelchair lift operation.
- The passenger loading zone should be kept clear of obstructions to allow for wheelchair access to transit.
- Far-side and near-side bus loading zones should be located a minimum of 20 feet from the crosswalk.
- When there is a planting strip adjacent to the curb, a hardscape area that extends from the existing sidewalk to the curb should be provided.

Additional Considerations

- Bus bulb-outs may be used on streets with parallel parking to provide passengers adequate area to board or exit the bus without having to step into the street or the stream of pedestrian travel on the adjacent sidewalk.
- To accommodate a 40-foot bus, bulb-outs should be 25 feet long (parallel to the curb) by 8 feet wide (perpendicular to the curb).
- To accommodate a 60-foot bus, bus bulb-outs should be 45 feet long (parallel to the curb) by 8 feet wide (perpendicular to the curb).
- A best practice is for a mid-block transit stop is to locate the transit stop no farther than 200 feet from a marked pedestrian crossing.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

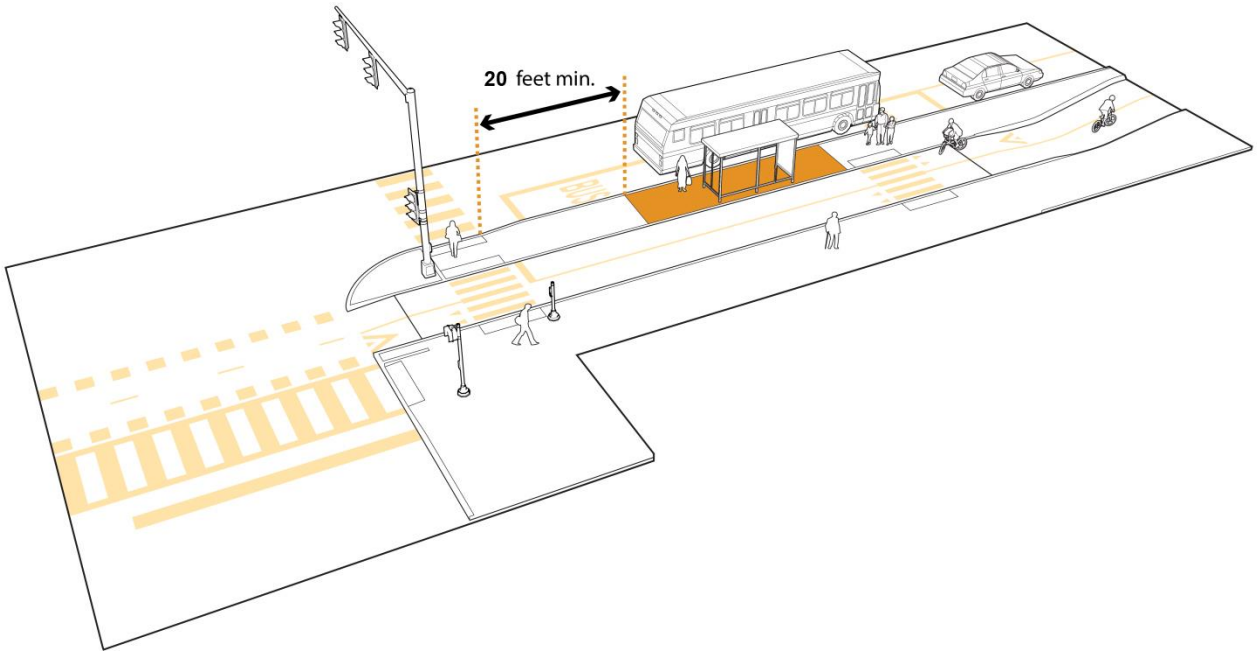


Figure 4.30. Example of a Far-Side Transit Stop in Proximity to Marked Crosswalk at Intersection (Preferred Option)

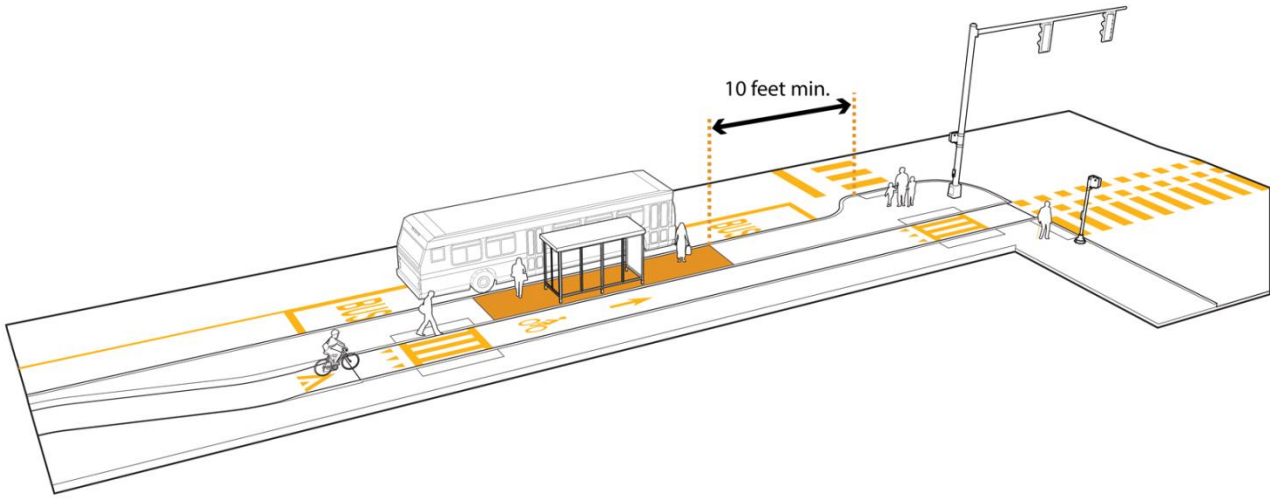


Figure 4.31. Example of a Near-Side Transit Stop in Proximity to Marked Crosswalks at Intersection

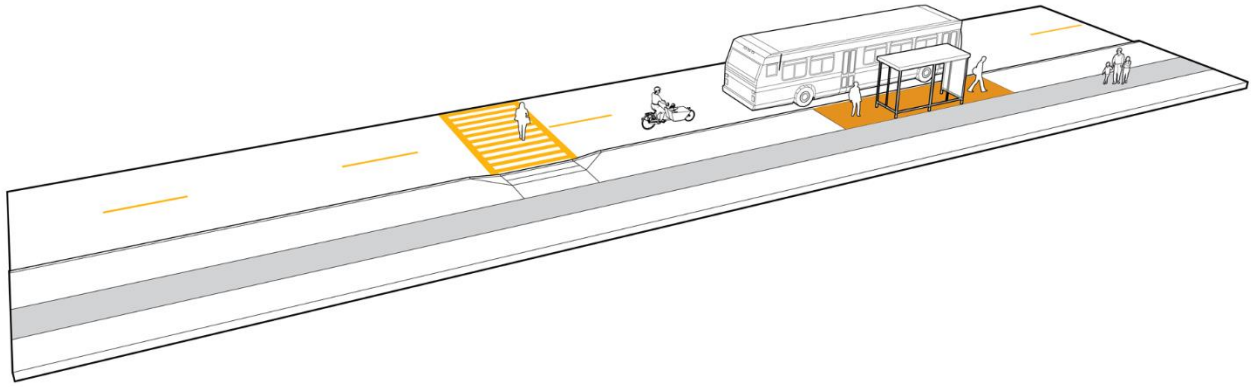


Figure 4.32. Example of a Mid-Block Transit Stop with Mid-Block Crosswalk

4.4 Intersection Design

Intersections are where two or more streets meet or cross each other at the same grade. With vehicles, freight, transit, pedestrians, and bicycles using intersections for both crossing and turning onto other streets, intersection activity may become complicated and result in the potential for conflicts. Intersection design should take a balanced approach to meet the needs of all modes of transportation.

Because of the multi-mode nature of intersection activity and the need to efficiently accommodate multiple modes and movements, intersections may be challenging parts of a street to design. Traditionally, vehicle movements and delay have been given the highest priority and has influenced intersection geometry. However, the optimal intersection design for vehicles may overlook the needs of pedestrians. This section offers guidance on how to balance the needs of both motorists and pedestrians in the design of controlled and uncontrolled intersections, supporting convenient pedestrian access while enabling drivers, pedestrians, and bicyclists to be aware of one another.

4.4.1 Channelized Right-Turn Lanes

Channelized right-turn lanes are right-turn-only lanes with no stop control and therefore introduce a potential conflict between an automobile and a pedestrian. Careful design and pedestrian safety countermeasures should be considered when proposing a channelized right-turn lane. The large turning radii enable drivers to maintain a high speed, which creates a challenging environment for pedestrians crossing the intersection. Channelized right-turn lanes create a wider intersection, increasing the crossing distance for pedestrians. Intersections with channelized right-turn lanes may be retrofitted by adding a pedestrian refuge area, which effectively reduces the corner radii and pedestrian crossing distance. Traffic calming measures that may be considered include smaller corner radii and raised crosswalks to encourage vehicles to slow down as they approach the turning movement.

Application

- Channelized right-turn islands may be appropriate where large curb return radii, such as those greater than 30 feet, are required to serve large vehicles.
- Channelized right-turn islands are typically not appropriate for an urban core, urban, or rural town context or areas with high pedestrian volumes or areas with a significant population of disabled people.
- If the project's primary need and purpose is to reduce traffic delay and support the need for a channelized right-turn lane. Pedestrian safety countermeasures should be carefully evaluated to offset potential conflicts between automobiles and vehicles.
- Channelized right-turns are typically more appropriate in automobile dependent land use or suburban context. They typically are not well suited for an urban core or urban context.

Critical Design Requirements

- The refuge island should be raised to provide a vertical barrier so that the pedestrian refuge area has greater protection from vehicle intrusion.
- Raised refuge areas should provide curb ramps from the sidewalk to the raised island or provide pedestrian cut throughs with detectable pavers.
- If space is limited in the island, a minimum 6-foot-wide cut through should be provided in the island for accessible pedestrian passage.
- The pedestrian refuge island should be clear of visual obstructions, including utility facilities and landscaping taller than 2 feet.
- The crosswalk should be placed perpendicular to the travel lane so that it crosses the channelized right-turn lane at 90 degrees or diagonal where the pedestrian is always facing traffic.

Additional Considerations

- The crossing point may be marked with a high-visibility crosswalk design and a stop bar.
- A best practice is to apply the elongated tail design for refuge areas, which provides a more direct line-of-sight between the driver and the pedestrian crossing and reduces the effective speed of the turning vehicle. In addition, the elongated tail design improves the angle between the turning vehicle and the oncoming traffic to which the turning vehicle should stop or yield, which otherwise requires a driver to turn their head to an angle that is either uncomfortable or difficult for some drivers. The elongated tail design improves the pedestrian environment and the driver environment as compared to a simple radius curve.

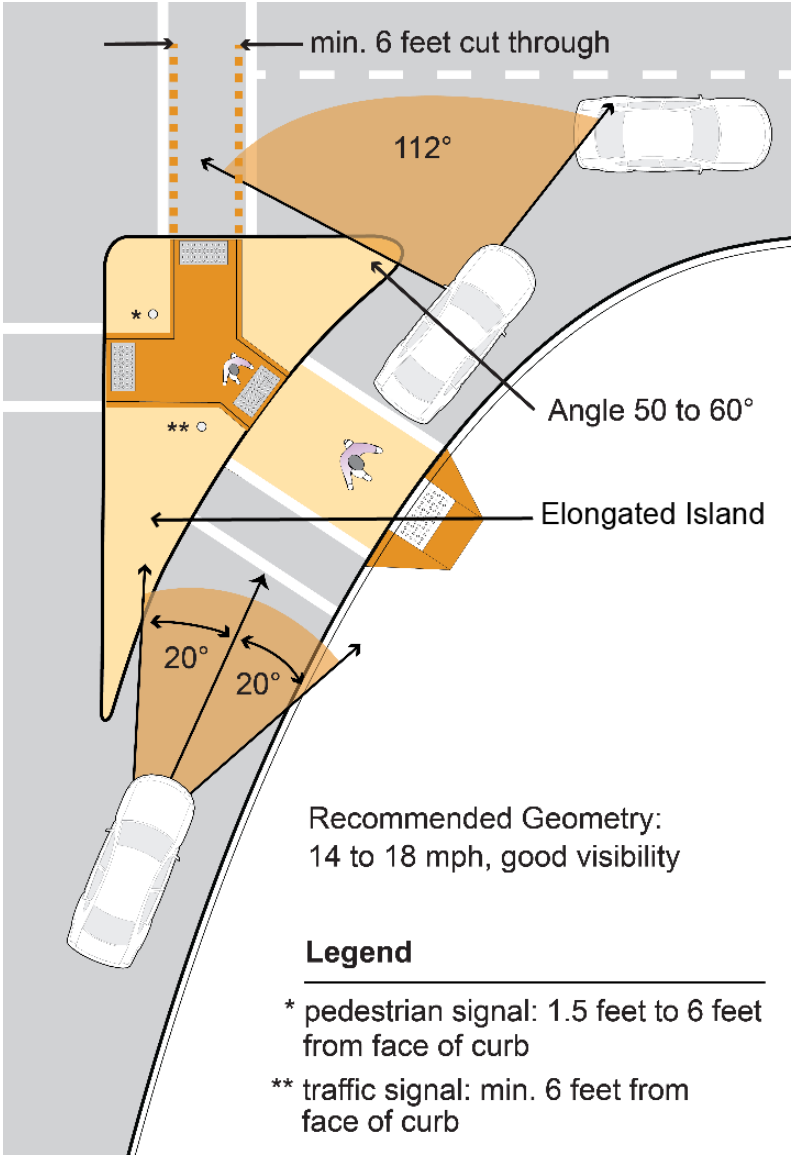


Figure 4.33. Example of a Channelized Right-Turn with an Elongated Island

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

4.4.2 Corner Extensions

Corner extensions reduce crossing distances and make pedestrians more visible to motorists at intersections. In addition, corner extensions provide traffic calming benefits, including a speed reduction for turning traffic and through traffic.

Application

≤40 mph

- Corner extensions should be considered where on-street parking exists, to provide pedestrians waiting at an intersection crosswalk with a place to stand with improved visibility to oncoming vehicles and from drivers.
- Corner extensions should be considered in cases where a turn lane is discontinued across an intersection or where a lane terminates on one side of the intersection.
- Corner extensions should only be used on a street with a curb.
- Corner extensions are appropriate for speed limits up to 40 mph.
- Corner extensions may not be appropriate where larger vehicles, emergency vehicles, and buses make frequent turning movements.
- Corner extensions may be used for one or both sides of an intersection crossing, and for one or both sides of a corner that serves two crosswalks.

Critical Design Requirements

- Corner extensions should be offset from the traffic lane by 1.5 feet.
- Corner extensions should be a minimum of 6 feet wide.

Additional Considerations

- On streets with on-street parking, corner extensions improve visibility for pedestrians at an intersection and drivers approaching the intersection.
- Corner extensions may provide additional space for streetscape amenities (e.g., trash cans, bicycle racks, benches).

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

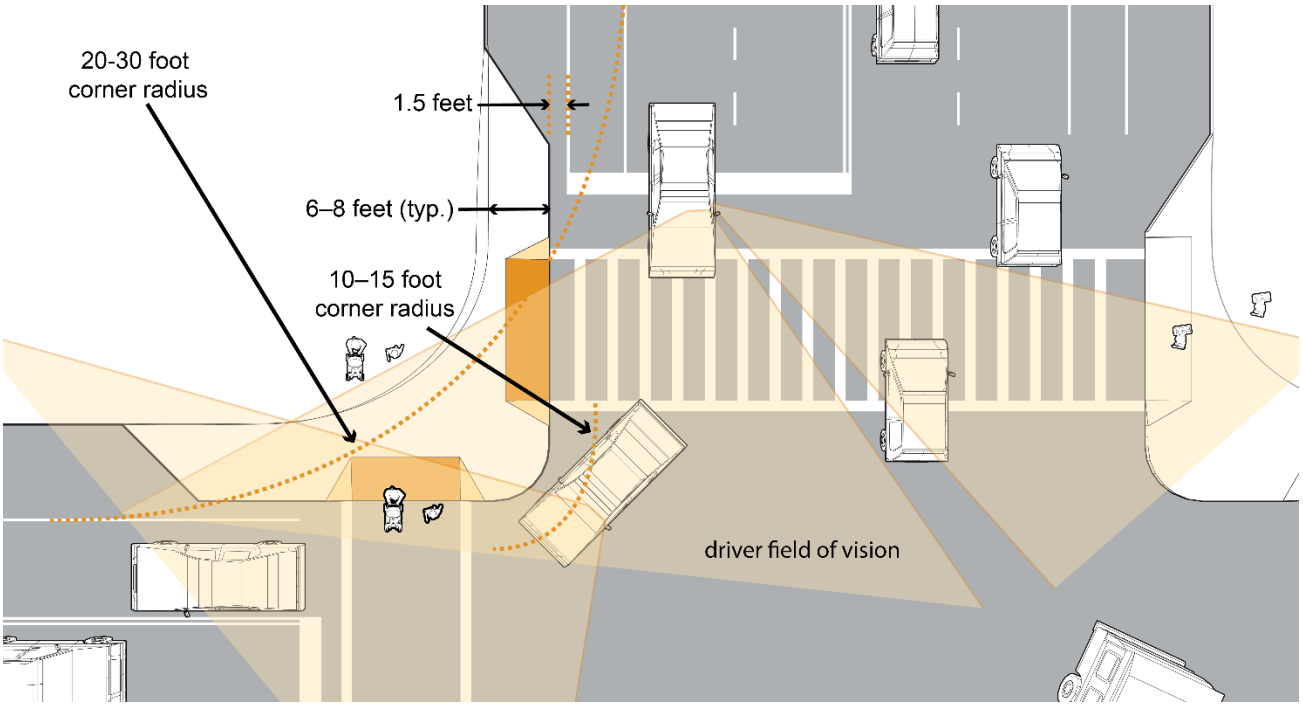


Figure 4.34. Typical Dimensions of a Curb Extension

4.4.3 Corner Radii

At intersections with pedestrian crossing activity and only limited truck and bus turning movements, the curb radii should be designed to improve the pedestrian environment. The selection of curb radii applies to a typical corner design, and the design of curb extensions and/or bulb outs. A smaller curb radius at an intersection shortens the pedestrian crossing distance and reduces vehicle turning speeds.

Application

≤35 mph

- A range of corner radii of 15 to 25 feet may be appropriate at minor cross street intersections where truck turning movements seldom occur or at major intersections where there in on-street parking located close to the intersection.

Critical Design Requirements

- Several basic parameters should be considered in determining corner radii such as context of the area, such as urban core, urban, suburban, rural town, or rural. Additionally, existing and future developments that may or may not need larger turning radii to accommodate truck movements should be evaluated. Other factors to consider include, but are not limited to, pedestrian volumes, vehicle speeds, intersection angle, number and width of lanes, design vehicle, turning path, clearances, encroachment into oncoming or opposing lanes, parking lanes, and shoulder widths.
- Vehicle operations should be balanced with the needs of pedestrians and the difficulty of acquiring additional right-of-way to accommodate corner setbacks on private property.
- A range of corner radii of 15 to 25 feet are adequate to support the turning movement for passenger vehicles for streets with speed limits of 35 mph or less.
- Where larger radii are used, a pedestrian refuge area or median island should be installed.
- Corner radii may be designed with turning design speeds of 15 mph or less. See Section 4.4.2 for further information.

Additional Considerations

- Locate fixed objects clear from the curb radius to avoid obstructing the sight lines between pedestrians and drivers, and to provide an allowance for the occasional large vehicles that cannot maneuver the turning movement without driving over the curb.
- Considerations for mountable curbs should be made for vehicles with larger turning movements.
- The GDOT *Design Policy Manual* explains that corner radii at intersections are design elements that affect the operation, safety, and construction costs of the intersection.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

4.4.4 Curb Ramps

Curb ramps provide access onto and off the sidewalk for pedestrians of all abilities. GDOT provides details for multiple ADA ramp configurations. Refer to GDOT Construction Detail T-11A for specific design criteria and additional guidance.

Application

- ADA-compliant curb ramps should be installed at marked crosswalk locations.
- Curb ramps should be installed on medians or channelized islands that serve as pedestrian refuge areas, unless an at-grade cut-through opening is provided.

Figure 4.35. Example of Curb Ramp

Critical Design Requirements

- Curb ramps should comply with GDOT Construction Detail A-3 and Construction Detail A-4.
- The low end of the curb cut should meet the grade of the street with a smooth transition.
- At locations where there is sufficient space, perpendicular curb ramps are preferred.
- Perpendicular curb ramps should have flat flared sides with a maximum slope of 10 percent measured parallel to the curb line.
- At locations where there is not sufficient space to provide an appropriately sized landing area at the top of the curb ramp, a parallel curb ramp should be used. See GDOT Construction Detail T-11A.
- ADA parallel curb ramps should have a longitudinal running slope that is in line with the direction of sidewalk travel and have the appropriate sized landings per GDOT Construction Detail T-11A.
- Curb ramps or pads should include an ADA detectable edge that extends the full width of curb ramp (exclusive of the flared sides) and is a minimum of 24 inches wide, measured from the edge of the curb closest to the street. Refer to PROWAG and Section 4.3.1 for more information on the design of ADA detectable edges.
- Curb ramps should align with and be fully incorporated within the corresponding crosswalk.
- Storm drainage inlets should be placed on the uphill side of crosswalks and curb ramps to avoid excessive drainage flows across the crossing area. Adequate drainage should be provided at intersection corners so that standing water does not accumulate within the crossing area or at the bottom of the ADA ramp.
- The maximum cross slope for an ADA accessible facility shall not exceed 2 percent.

Additional Considerations

- A best practice is to retain a project designer to conduct construction observation services with respect to ADA facility construction.
- A best practice is for the designer to approve ADA facilities for compliance prior to closing out the construction project.

Further Guidance

- American with Disabilities Act
- GDOT, Construction Detail T-11A
- GDOT, *Design Policy Manual* (latest edition)
- US Access Board, *Detectable Warning Update* (latest edition)

4.4.5 Diverging Diamond Interchanges

The diverging diamond interchange (DDI), also known as a double crossover diamond, is a diamond interchange that directs traffic to the opposite side of the road so that vehicles may make unimpeded movements onto freeway ramps. DDIs may be challenging places for pedestrians because of the unsignalized, channelized turn lanes and longer crossing distances and vehicles traveling on the left side of the road and approaching crosswalks from the opposite direction. Countermeasures may be applied to create a more comfortable walking environment for pedestrians.

Application

- If pedestrian accommodations are warranted by the GDOT Complete Streets Policy, sidewalks or center walkways and crosswalks should be provided at DDIs.
- Shorter crossing distances may be achieved by placing sidewalks along the perimeter of the DDI. However, the primary challenges with this design are that pedestrians must cross unsignalized, channelized right-turn and left-turn lanes, and they cannot cross the arterial at this interchange.
- Center walkways may be used to reduce the number of times a pedestrian has to cross an unsignalized, channelized turn lane. The crossings from the channelized island to the center walkway are signalized, while the crossings from the island across the right-turn lanes are often unsignalized. The primary challenge with this design is the long crossing distance between the channelizing island and the center walkway.

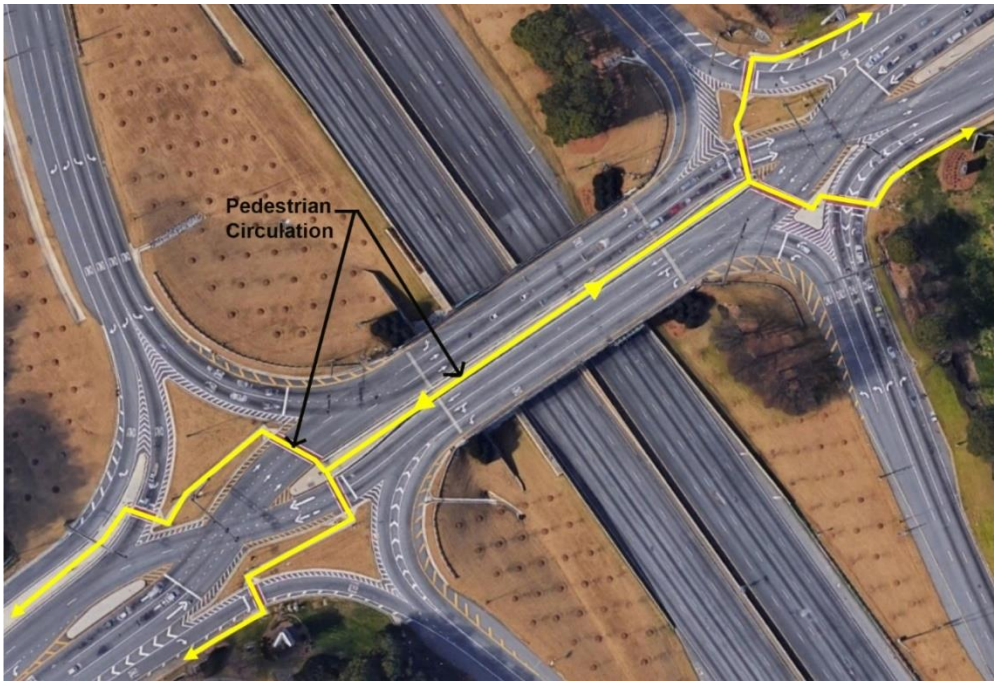


Image provided by Google Earth.

Figure 4.36. Example of a Diverging Diamond Interchange, Ashford Dunwoody Road, Dunwoody, Georgia

Critical Design Requirements

- High-visibility crosswalks and ADA curb ramps should be placed at pedestrian crossing points. Refer to Sections 4.4.8 and 4.4.4 for more information on crosswalks and curb ramps, respectively.
- The line of sight between motorists and pedestrians waiting at a crossing point should not be obstructed.
- Sidewalks along the perimeter should be designed in accordance with recommendations in Section 4.3.11.
- Center walkways should be a minimum of 8 feet wide (12 feet preferred) (two 1.5-foot-wide barriers and one 5- to-8-foot-wide pedestrian access route).
- Cut throughs or curb ramps with detectable edges should be provided at both ends of the center walkway and aligned with the crosswalks. The cut through should be a minimum of 6 feet wide (the distance between the end of the vertical barrier and the raised splitter island at the point of the center walkway).
- The center walkway should have a positive slope so that water does not collect or pond within the pedestrian facility.
- All ADA accessible codes must be met with the center walkway.
- Center walkways shall be separated from vehicular traffic by a vertical barrier. The vertical barrier should be a minimum 3.5 feet tall. The vertical barrier should not be so tall that it creates a tunnel or obstructs the view between pedestrians and motorists.
- The outside edge of the center walkway vertical barrier should be offset a minimum of 2 feet from the vehicle travel path.
- Right-turn and left-turn channelizing islands should be designed as pedestrian refuge areas with a minimum width of 6 feet in the direction of pedestrian travel. Refer to Section 4.3.7 for more information on the design of pedestrian refuge areas.
- Pedestrian signals and pushbuttons should be placed on either side of a signalized crossing.
- The lighting design for sidewalks, center walkways, and crossing points at a DDI should follow the same considerations as at other interchanges.

Additional Considerations

- Pedestrians may not expect traffic to be approaching from the opposite direction. Design elements, such as sidewalk markings, may encourage pedestrians to look in the direction of oncoming traffic.
- The radius for unsignalized, channelized turns may be reduced to slow down turning vehicles.
- Recessed lights may be used in the center walkway to provide adequate lighting when space is limited.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *Alternative Intersections/Interchanges: Informational Report* (latest edition)
- FHWA, *Diverging Diamond Interchange Informational Guide* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- Schroeder, *Observations of Pedestrian Behavior and Facilities at Diverging Diamond Interchanges* (latest edition)

4.4.6 Diverters

Diverters are physical barriers that redirect vehicular traffic while maintaining through access for pedestrians and bicyclists. These traffic calming features reduce vehicle volumes, cut-through traffic, and speeds by restricting through movements or certain turn movements. Diverters may either completely or partially close off access to an adjacent street.

Application

≤25 mph

- Diverters may be used on low-volume, low-speed streets (25 mph or less).
- The potential street network implications of limiting traffic movement with an interconnected pattern of streets should be considered. To this extent, traffic diverters may be used as part of a larger traffic management strategy.

Critical Design Requirements

- Pedestrian and bicycle pass throughs should be incorporated into diverters to provide access through the closed area.
- The impact of diverters on stormwater drainage should be considered.

Additional Considerations

- If emergency vehicles require access through the diverter, the diverter design may include a minimum 12-foot-wide limited-access lane (14 feet is preferred) that is clearly signed and marked for emergency vehicles only. It may also include breakaway or lockable bollards or gates.
- Raised diverters may be designed to incorporate green stormwater infrastructure. Raised green infrastructure diverters are not allowed “on-system” or State Routes.
- A best management practice is to provide warning signage to alert motorists of changes in the roadway.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- FHWA, *Traffic Calming ePrimer* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

Image provided by Google Earth.

Figure 4.37. Example of a Diverter, Brookhaven, GA.

4.4.7 Driveway Crossings

Driveways are vehicle access facilities that connect a roadway to the adjacent property or to a street. Driveways represent a conflict point between vehicles and pedestrians on sidewalks, and with cyclists if the facility is a shared use path or cycle track. Driveways that cross sidewalks and shared use paths may be challenging because drivers that are entering or exiting a driveway are often focused on the flow of vehicular traffic, and do not notice pedestrians crossing the driveway.

The raised driveway crossing countermeasure improves visibility of the pedestrian or cyclists crossing the driveway. In addition, the elevated driveway reduces the speed of vehicles entering and exiting the driveway. GDOT complies with the guidelines set forth in AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition).

Application

- The guidelines provided in this section are more appropriate on driveways with gentle slopes and with good visibility for drivers and pedestrians.

Critical Design Requirements

- Sight-distance requirements from the driveway to the sidewalk or shared use path are critical; see the MUTCD for further guidance.
- Driveways should be designed to accommodate emergency vehicles.
- Driveways should meet sidewalks and shared use paths at right angles.
- Driveways should not interrupt the grade of the sidewalk.
- In general, commercial driveways should be no more than 30 feet wide; check local ordinances that may apply.

Figure 4.38. Example of Driveway Crossing Sidewalk, Atlanta, Georgia

Additional Considerations

- Driveways should be designed so that the sidewalk is a visible feature where they intersect.
- The driveway may meet the sidewalk at sidewalk grade to eliminate the need to provide ADA transition slopes across the driveway. This may also help reduce the speeds of approaching vehicles.
- Careful consideration should be made to address stormwater so that ponding or standing water is not present or trapped after a rain event at the raised crossing.
- For locations where sight distance is insufficient, signs, or mirrors may be located to the side of the pedestrian travel way, and auditory warnings may be provided when vehicles are entering and exiting (such as entrances or exits for parking garages) to notify pedestrians that they are entering a vehicle travel path. In addition, careful consideration should be made to prevent glare from the mirror to the roadway or the approaching pedestrian or bike facility.
- As a best practice, sidewalk materials may continue across the driveway to alert drivers of an intersection with a pedestrian crossing.
- As a best practice, additional consideration should be made in regard to applying raised driveway crossings, as they tend to work best on driveways with flat and straight approaches.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

4.4.8 Marked Crosswalks

Marked crosswalks are designated locations for pedestrians to cross the street. Marked crosswalks provide an indication to pedestrians as to where they should cross the street and to motorists as to where pedestrians are likely to be crossing the street.

For "on system" roadways, the design of crosswalks should be in accordance with the GDOT details and the MUTCD. Crosswalk patterns should be striped per GDOT Construction Detail T-11A.

For "off system" or local streets, and the local government prefers to stripe a crosswalk with a different pavement striping pattern, it should comply with the MUTCD.

Application

- Marked crosswalks should be installed on all approaches at signalized intersections connecting adjacent (or future) sidewalks. Exceptions normally granted by GDOT include pedestrian crossings adjacent to highway-rail crossings where a preemptive signal is used to clear the tracks.
- Marked crosswalks may also be installed at mid-block locations. Refer to Appendix A for further guidance on determining the location for and designing crossings at uncontrolled locations.
- A best practice is to provide pavement markings and signage at marked crosswalks.
- For "on system" locations, a crosswalk may remain unmarked if the GDOT requirements found in Appendix A, Table A-5 are not met.
- For "off system" locations, a best practice is to follow the procedure found in Appendix A for consistency of crosswalk application throughout Georgia.

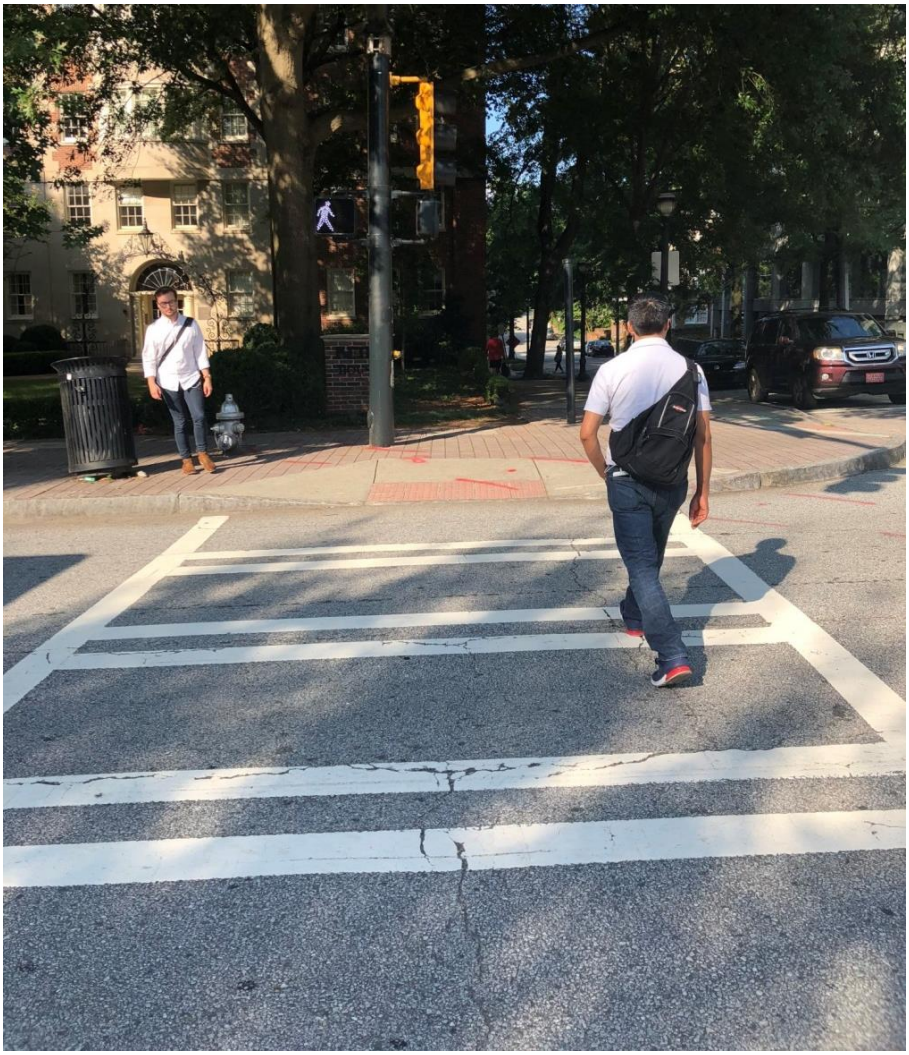


Figure 4.39. Example of Crosswalk Markings

Critical Design Requirements

- Crosswalk markings should be high visibility, non-slip, and should comply with GDOT Construction Detail T-11A.
- Crosswalks should provide the most direct connection between sidewalks or shared use paths.
- Crosswalks should align with the corresponding curb ramp.
- Crosswalks should always have a corresponding curb ramp when connecting to a sidewalk placed on a curb above the crosswalk elevation, regardless of whether the crosswalk is marked.
- Crosswalks should extend the full width of the roadway.
- Crosswalks should be a minimum of 8 feet wide.
- A stop bar should be located a minimum of 8 feet upstream from the crosswalk to reinforce yielding to pedestrians.
- If stop lines are used at a crosswalk that crosses an uncontrolled multi-lane approach, Stop Here for Pedestrians (R1-5 Series) signs should be used.
- In urban areas where crosswalks exist, signs should not be placed within 4 feet in advance of the crosswalk so that people who are wheelchair dependent may easily maneuver the access to the ADA ramp.
- Drainage inlets should be located on the uphill side of crosswalks and curb ramps to intercept stormwater runoff, so that standing water or ponding does not occur within the crosswalk.
- Crosswalk pavement markings should be white with reflective properties meeting MUTCD.
- Solid white lines should mark the crosswalk. The crosswalk should not be less than 6 inches or greater than 24 inches in width.
- GDOT prefers both transverse ("bar pairs") and parallel lines be used.
- FHWA Interpretation Letter 3(09)-24(I) – Application of Colored Pavement clearly describes acceptable and unacceptable color and pattern treatments for crosswalks. Local governments should refer to this ruling when considering designs that differ from GDOT Construction Detail T-11A.

Additional Considerations

- Raised crosswalks may be used at mid-block crossing locations and in channelized right-turn lanes. Refer to Section 4.4.11 for further guidance on the design of raised crosswalks.
- Further evaluation should be made to develop the right tool kit of countermeasures to provide optimal conditions for a pedestrian.
- Crosswalks may be painted with non-slip and high-visibility paint to enhance the roughness coefficient and visibility of a crosswalk. Refer to FHWA Interpretation Letter 3(09)-24(I) – Application of Colored Pavement, which clearly describes acceptable and unacceptable color and pattern treatments for crosswalks.
- In-street pedestrian crossing signs may be placed in the roadway center line within the crosswalk, on a lane line, or on a median island. The in-street pedestrian crossing sign should not be mounted on a fixed post located either on the left-hand or right-hand side of the roadway.
- Scored or stamped and colored concrete surfaces may be used as a placemaking tool. Special paving surfaces should be installed and maintained in a smooth, level, and clean condition.
- When using stamped, colored asphalt, concrete or brick materials for crosswalks, as a best management practice, it is recommended that GDOT Construction Detail T-11A be applied to the top surface for additional visibility of the crosswalk.
- Pavement marking contrast with the pavement is important to distinguish the roadway or street material from the crosswalk material or treatment.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, Interpretation Letter 3(09)-24(I) – Application of Colored Pavement
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

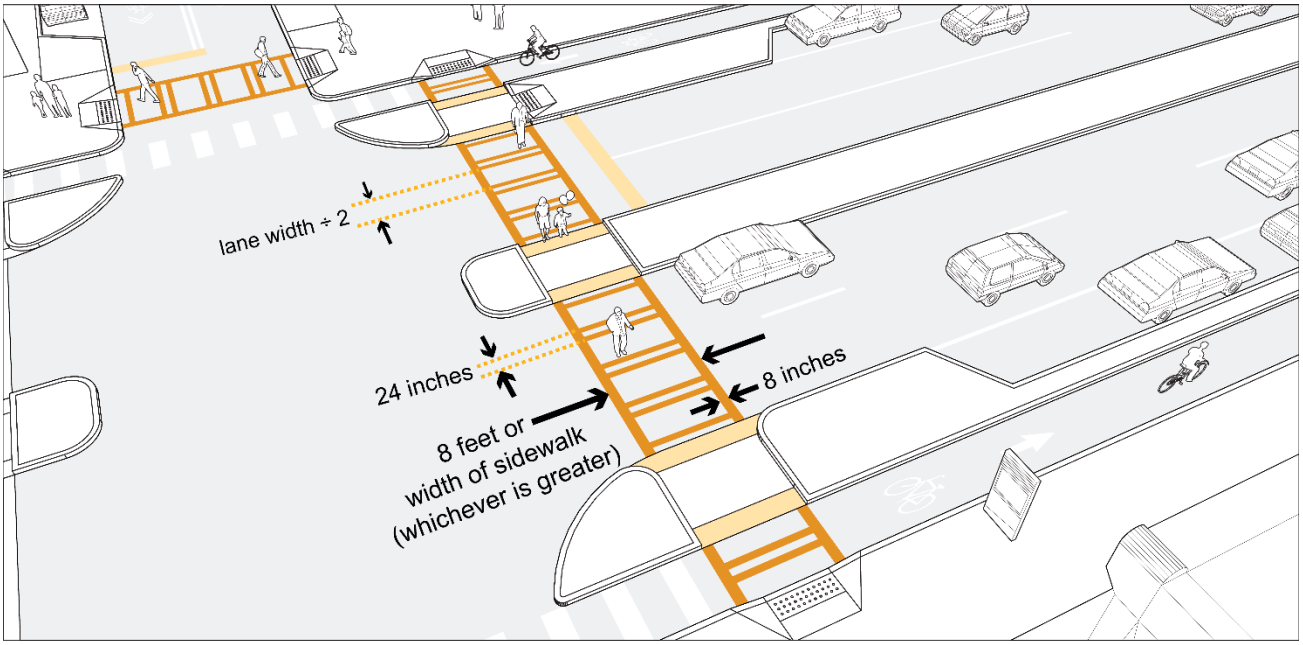


Figure 4.40. Crosswalk Markings and Dimensions

4.4.9 Pedestrian Bridges and Underpasses

Pedestrian bridges and underpasses are grade-separated crossings that allow pedestrians and bicyclists to cross barriers such as multi-lane, high-speed roads and rivers. Like shared use paths, bridges and underpasses separate pedestrians and bicyclists from vehicles and may make crossing the street safer and accessible for people of all ages and abilities but must be convenient and accessible for all users. Pedestrian bridges and underpasses may be very expensive, present challenges for convenient access, and may present users with perceptions related to the fear of heights, increased criminal activity, and convenience as compared to an at-grade crossing. In addition, grade-separated facilities may also increase delay for a pedestrian or cyclist depending on the access points. In most cases, stairs, ramps, or elevators are required to provide access for all users. Pedestrians may choose to cross the street at-grade whether the at-grade crossing is designed for pedestrian activity or not. On example where both pedestrians and bicycles are not allowed is on limited access facilities some examples of limited access facilities in Georgia are I-75, I-85 and I-20.

Application

- Grade-separated crossings may be appropriate when the pedestrian network is interrupted by multi-lane, high-speed roads, railroads, or natural barriers.
- Pedestrian bridges and underpasses may be considered at intersections where there is a high rate of pedestrian-vehicle conflicts or potential pedestrian-vehicle collisions. Pedestrian countermeasures for improving the at-grade crossing should also be evaluated as they may be more effective and more practical and should be explored first.
- Pedestrian bridges and underpasses may be considered at crossing locations where children are crossing (or anticipated to cross) major multi-lane, high-speed roads.

Critical Design Requirements

Bridges

- Bridges should be designed for pedestrian live loadings. Where maintenance and emergency vehicles may be expected to cross the bridge, the design should accommodate them.
- Pedestrian bridges should be ADA accessible.
- Pedestrian bridges should have a minimum width of 8 feet.
- If accommodating bicycles, pedestrian bridges should be a minimum of 14 feet wide.
- For pedestrian bridges, the receiving clear width on the end of a bridge (from inside of rail or barrier to inside of opposite rail or barrier) should allow 2 feet of clearance on each side of the pathway. Under constrained conditions the clear width may taper to the pathway width.
- Pedestrian bridges should have 42-inch railings on both sides.
- The minimum clearance of a bridge structure to a shared path or roadway is 17'-6", please see GDOT 2.3.3.1 for further guidance, GDOT Bridge and Structures Design Manual.
- Bridge spans over roads or railroads shall be long enough to span the travel way, drainage ditches, shoulders, sidewalks, clear zone for the travel way, and the offset distance from the toe of slope paving or face of abutment wall (See Sections 2.3.3 and 2.3.4) of GDOT Bridge and Structures Manual.
- The primary purpose of a bridge fencing project is to create a raised barrier that will deter persons from dropping or throwing objects from the bridge onto vehicles or pedestrians below the bridge. The raised barrier on bridge fencing projects is typically a fence that is added to an existing bridge. The project limits should be defined as the extent required to accommodate the bridge fencing. Standard fence details should be utilized whenever possible. See 11.2.1 Bridge Fencing Projects for additional guidance, GDOT, *Design Policy Manual*.

Underpasses

- Underpasses should have a minimum width of 14 feet.
- Underpasses over 60 feet long should be wider than 16 feet.
- Underpasses should have a minimum of 10 feet vertical clearance (AASHTO *Guide for the Development of Bicycle Facilities* Section 5.2.10).
- Lighting of at least 10 foot-candles should be provided in pedestrian tunnels to improve pedestrian safety/security. In addition, variable level lighting (to match outdoor lighting levels) should be used in pedestrian underpasses to accommodate persons whose eyes adapt slowly to lighting changes.
- White walls and roof openings may be used to increase lighting levels in tunnels.
- Warning signs indicating that the tunnel or underpass should not be used during high-water events should be provided at both entrances.
- Exit of the underpass should be visible from the entry.

Additional Considerations

- Bridges and underpasses with entrances that are wider than the pathway is more inviting for pedestrians and bicyclists.
- Pedestrians and bicyclists are unlikely to use a bridge or an underpass if a more direct route is available.
- Signs alerting pedestrians and bicyclists of the clearance height may be provided at bridge and underpass entrances.
- For underpasses that accommodate bicycles, reflective centerline striping may be used to avoid collisions during dark hours.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- AASHTO, *Guide for the Development of Bicycle Facilities* (latest edition)
- AASHTO, *Guide Specifications for Design of FRP Pedestrian Bridges* (latest edition)
- AASHTO, *LRFD Bridge Design Specifications* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Bridge Structures and Design Manual* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- Rails to Trails Conservancy, Tunnels and Underpasses (latest edition)

Figure 4.41. Retrofitted Train Trestle Pedestrian Bridge, Rome, Georgia

4.4.10 Protected Intersections

At a protected intersection, bicycles and pedestrians are separated from vehicle movements up to the vehicle lane crossing point. The separation is provided by placing raised islands at the corner between the vehicle lane and a separated bike lane. The corner refuge island allows the bike lane to be physically separated from motor vehicles up to the intersection crossing point, where potential conflicts with turning motorists may be controlled more easily. Corner refuge islands are used to maintain at-grade crosswalks across the entire roadway for crossing pedestrians.

Application

≤35 mph

- Protected intersections are used in conjunction with separated or on-street bike facilities.
- Protected intersections are appropriate on streets in areas such as an urban core, urban, or rural town with a high volume of pedestrians and cyclists.
- Protected intersections are appropriate on streets with a speed limit of 35 mph or less.

Critical Design Requirements

- If the raised islands that form the protected intersection are located within a pedestrian crossing path, they should be designed in accordance with PROWAG. Refer to Section 4.4.12 for information on the design of raised islands in protected intersections.

Additional Considerations

- A separated signal phase for turning traffic may be used to eliminate conflicts between vehicles, bicycles, and pedestrians.
- An apron located on the corner to accommodate large vehicles may be used in locations where large vehicles and buses are expected to make right turn movements.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

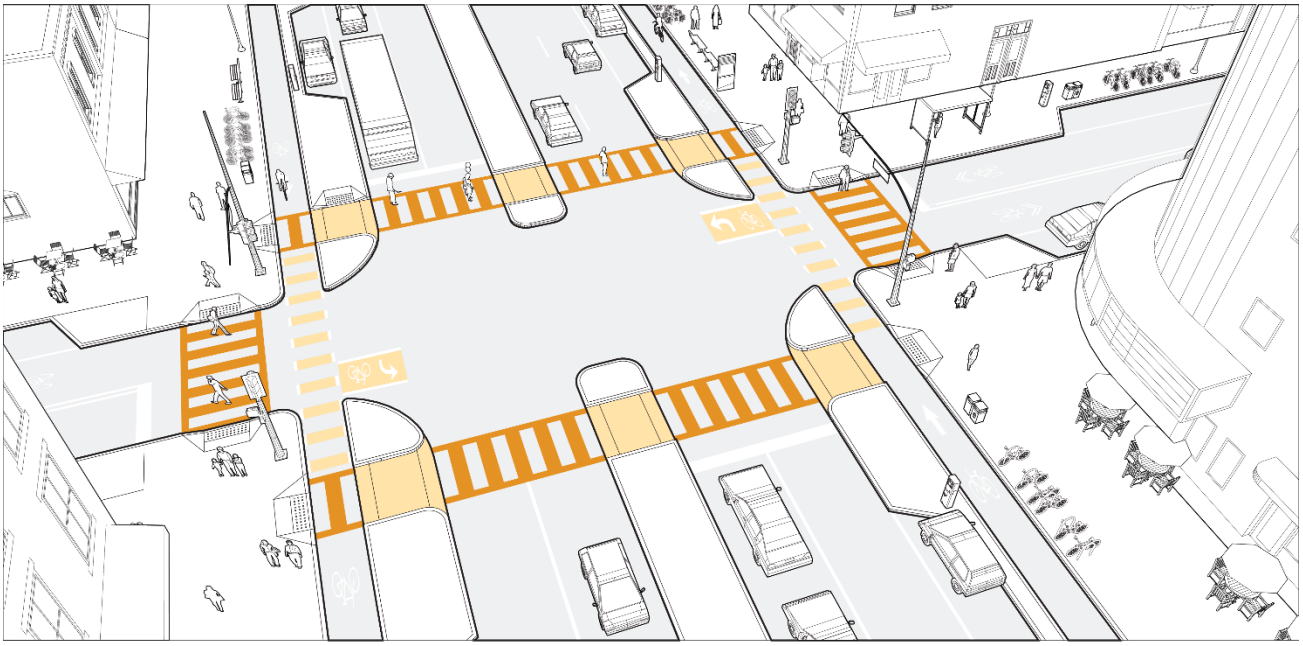


Figure 4.42. Protected Intersection – Urban Core

4.4.11 Raised Crosswalks

Speed tables used at pedestrian crossings are commonly referred to as raised crosswalks. Raised crosswalks have similar design standards to speed tables and speed humps and are marked and signed as designated crossings. Raised crosswalks are effective for reducing vehicle speeds and drawing attention to the pedestrian crossing. Raised crosswalks provide significant benefits to the pedestrian environment as they improve drivers' awareness of pedestrian crossings.

Application

≤30 mph

- Raised crosswalks should be marked with high-visibility crosswalk design features or alternatively they may be surfaced with different paving materials.
- Raised crosswalks are appropriate at mid-block locations on streets with a speed limit of 30 mph or less.
- Raised crosswalks may be used in areas with high pedestrian crossing activity, such as main streets, urban areas, airport drop-off and pickup zones, shopping centers, and academic or institutional campuses.
- Raised crosswalks may be used at uncontrolled pedestrian crossing locations to enhance the marked crossing.
- Raised crosswalks may be used at intersections as a gateway element to distinguish transitions to pedestrian-oriented areas that require slower vehicle speeds.
- May not be appropriate on steep grades.

Critical Design Requirements

- Raised crosswalks should extend curb-to-curb and be level with the adjacent sidewalks.
- Raised crosswalks should be highly visible, either striped as a marked crosswalk or constructed of a contrasting pavement design.
- A detectable edge should be used to distinguish the end of the sidewalk and the beginning of the roadway to assist visually impaired persons.

Additional Considerations

- A raised crossing may be 22 feet long in the direction of travel and include two 6-foot parabolic ramps on each end of a 10- to-12-foot flat section. The length may vary to align with the width of the adjacent sidewalk or shared use path.
- To maintain stormwater drainage channels, the raised crossing may be placed 1 to 2.5 feet from the curb. A flat cap that is flush with the adjacent sidewalks should bridge the gap between the sidewalk and the speed hump to comply with ADA.
- If the raised crosswalk extends to the edge of the curb, additional catch basins may be needed to handle interrupted gutter flow.
- Additional considerations should be made to accommodate large vehicles.
- Additional consideration should be made to ensure standing water or ponding does not occur at the base of the raised crosswalk.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

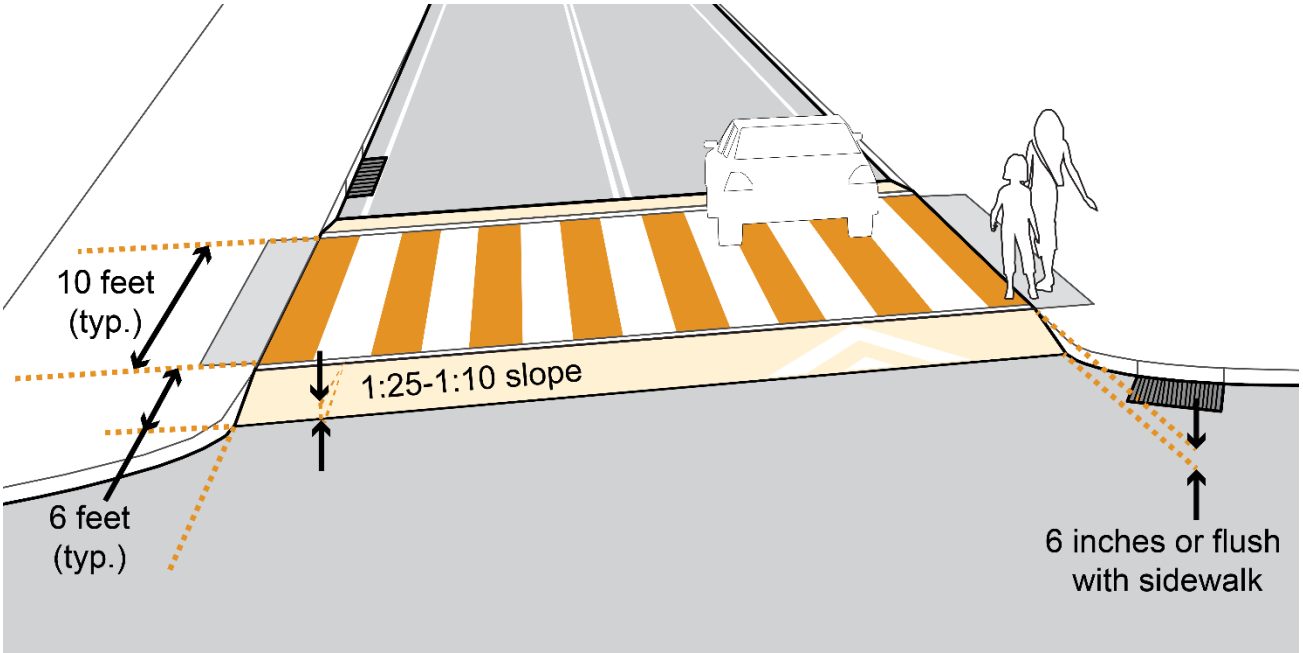


Figure 4.43. Raised Crosswalk for Shared Use Path Crossing

4.4.12 Raised Intersections

A raised intersection is a flat, raised area covering an intersection with ramps on all vehicle approaches. Similar to speed tables, raised intersections are effective in reducing vehicle speed to a range of 25 to 35 mph when crossing the intersection.

Application

≤35 mph

- Raised intersections are applicable on one-way or two-way local streets with a speed limit of 35 mph or less, and a maximum daily vehicle volume of 10,000 vehicles.
- Raised intersections are appropriate at controlled intersections with a large volume of pedestrians crossing.

Critical Design Requirements

- The vehicle ramp onto the raised intersection should be sloped at a 5 percent minimum to 8 percent maximum grade from the roadway approach to the top of the raised intersection surface.
- While raised intersections make it easier to meet ADA requirements as the crosswalk is a natural extension of the sidewalk with no change in grade, the diminished curb line makes it more difficult for sight-impaired pedestrians to detect the edge of the roadway. To this extent, special treatment such as detectable warning truncated domes should be used where the sidewalk transitions to a crosswalk.
- The pedestrian travel path and the vehicle path should be differenced with pavement marking or special paving materials.

Additional Considerations

- Bollards may be used to delineate the corner radii in flush pavement conditions.
- Raised intersections may serve as a gateway treatment on main streets and urban areas.
- Additional drainage inlets may be required where the raised intersection grade returns to street level.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, *MUTCD* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

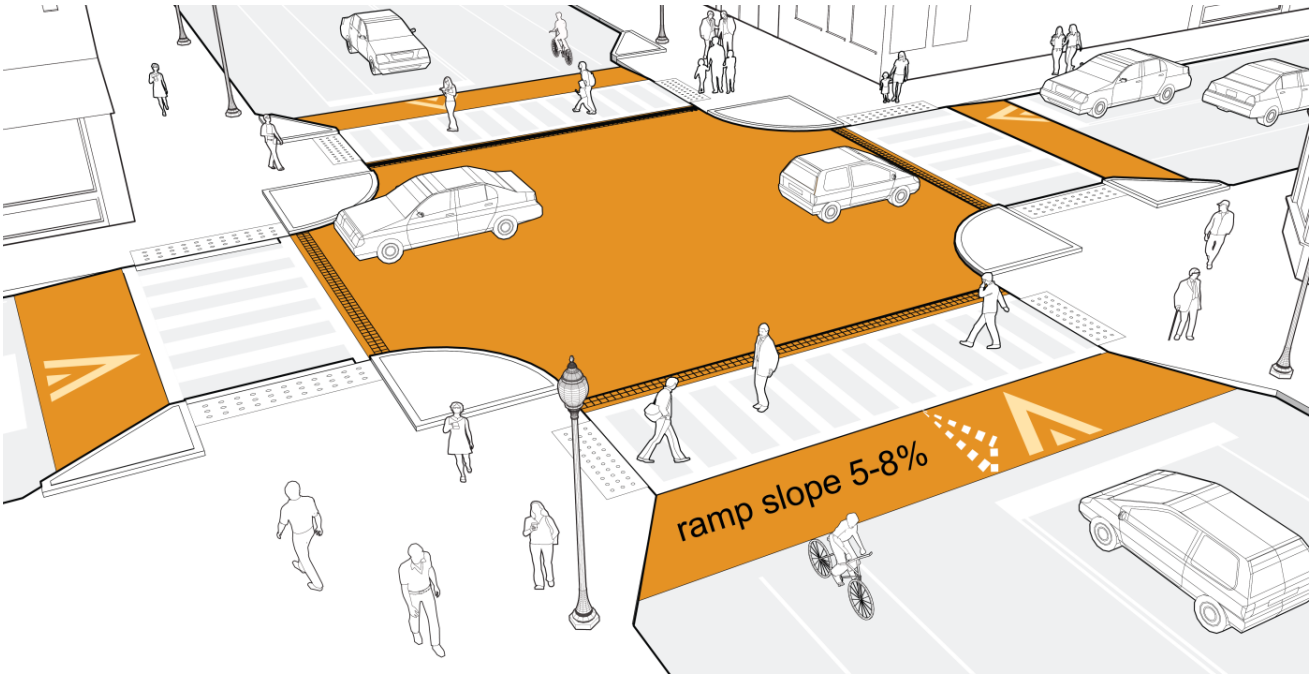


Figure 4.44. Raised Intersection

4.4.13 Roundabouts

A roundabout is a circular unsignalized intersection with a raised circular island in the center. There are many types of roundabouts, such as mini roundabouts, single lane roundabouts, and multi-lane roundabouts, all of which are effective in reducing vehicle speeds. Roundabouts differ from traffic circles in that they include truck aprons and splitter islands and approaching drivers must yield to traffic in the roundabout. In addition, approaching vehicles must stop for pedestrians who are at the crosswalk. Similar to medians and pedestrian refuge areas, splitter islands are important for accommodating pedestrians at roundabouts because they simplify the street crossing task to one direction of vehicle travel at a time, provide a more protected pedestrian crossing, and reduce the time that pedestrians are exposed to vehicles across the travel lane. In addition, roundabouts are effective in reducing vehicle speeds and in minimizing high-speed crashes that result in severe injuries.

Application

≤45 mph

- Roundabouts are appropriate treatments at intersections on local, collector, and arterial streets with posted speed limits of up to 45 mph.

Critical Design Requirements

- Crosswalks (or cut throughs for bike crossings) at roundabouts should be located 20 to 70 feet upstream from the yield line to accommodate one to two vehicles stopped between the crosswalk and the entrance line (FHWA *Roundabouts: Technical Summary* 2010).
- The crosswalk should be perpendicular to the centerline of the approach roadway.
- Splitter islands should be at least 6 feet wide at the crosswalk in the direction of pedestrian travel.
- Walkways through the splitter island should be cut through instead of ramped.
- The cut-through width should be the same width as the crosswalk.
- Curb ramps should be provided from the sidewalks at each end of the crosswalk.
- A detectable warning surface on splitter islands should begin at the curb line and extend 2 feet into the cut-through area, leaving a clearance of at least 2 feet between detectable warning surfaces.
- Where sidewalks are flush against the edge of the curb at roundabouts, and pedestrian street crossing is not intended, a continuous and detectable edge treatment should be provided along the street side of the sidewalk. Detectable warning surfaces should not be used for edge treatments. Where chains, fencing, or railings are used for edge protection, the bottom edge of the treatment should be 15 inches maximum above the sidewalk to be detectable by a cane.
- "Stop Here for Pedestrians" signs (R1-5 series) should not be used in advance of a crosswalk at a roundabout because these signs may potentially add to the sign clutter and confuse drivers.
- "Pedestrian Crossing" signs (W11-2) supplemented with a diagonal downward-pointing arrow plaque (W16-7P) should be used at the pedestrian crossing but should not be used in advance of the crossing.
- Adequate illumination should be provided for pedestrian crossings. Lighting should be placed upstream (at the approach) of a crosswalk on both sides of the crosswalk.

Additional Considerations

- Pedestrian signals, PHBs, or pedestrian warning beacons may be installed at roundabouts where there are (1) high vehicular volumes and insufficient gaps in vehicular traffic for pedestrians to cross, (2) high pedestrian volumes with continuous or frequent pedestrian crossing activity, or (3) complex crossing situations, such as two traffic lanes in each direction. Refer to Chapter 5 for further guidance on the application of each treatment.
- A best practice is to use mountable curbs for truck aprons.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)
- TRB, NCHRP 672 (latest edition)

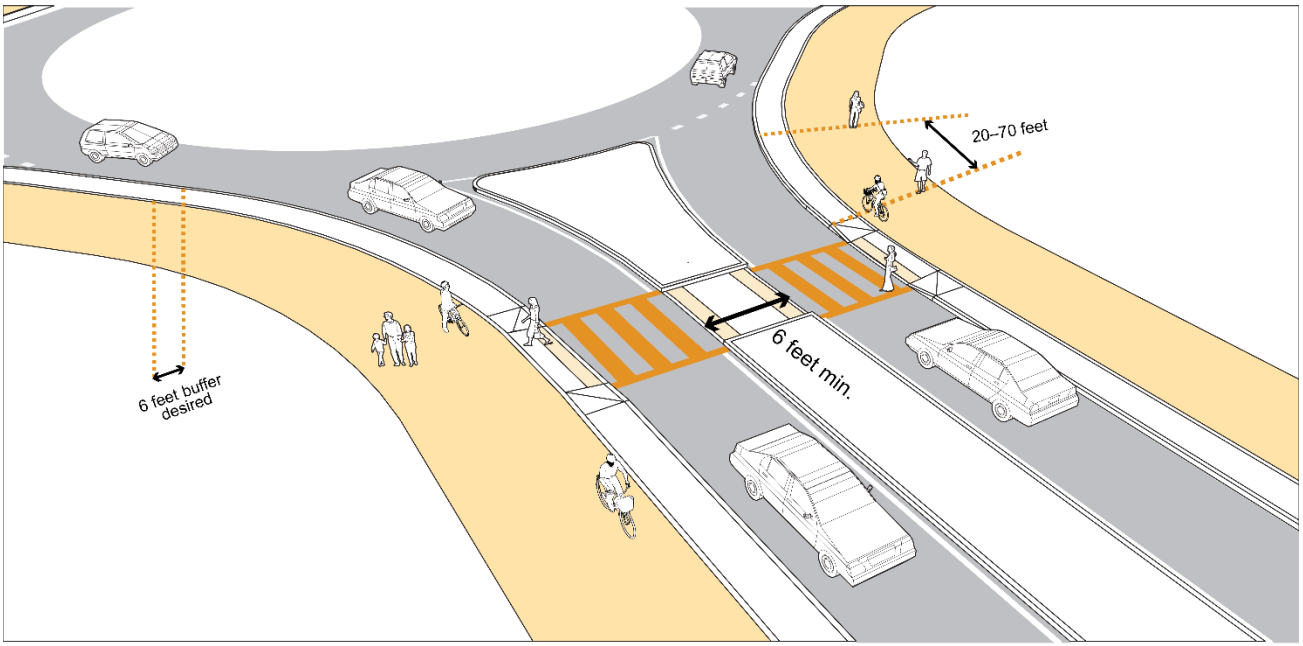


Figure 4.45. Dimensions of Crosswalks at a Roundabout

4.4.14 Single-Point Urban Interchanges

A single-point urban interchange (SPUI) uses split-phase signals and channelizing islands to consolidate opposing left-turn movements to one signal phase and direct traffic flow, respectively. While the primary purpose of an SPUI is to increase vehicle capacity and flow, these interchanges may be designed to accommodate pedestrians.

Application

- If warranted by GDOT Complete Streets Policy, sidewalks, curb ramps, and crosswalks should be provided at SPUIs.

Critical Design Requirements

- Pedestrians should not cross the road in one signal phase at SPUIs. Instead, the crossing should be broken up into several stages. To accommodate, medians and channelizing right- and left-turn islands should be designed as pedestrian refuge areas. Pedestrian refuge areas should be designed in accordance with the recommendations in Section 4.3.7.
- High-visibility crosswalks and ADA curb ramps should be placed at all crossing points. Refer to Sections 4.4.8 and 4.4.4 for more information on crosswalks and curb ramps, respectively.
- Pedestrian signals and pushbuttons should be placed on both sides of pedestrian refuge areas if pedestrians are expected to wait and cross the road in two separate signal phases.

Additional Considerations

- The radius for unsignalized, channelized turns may be made smaller to reduce the speed of turning vehicles.
- A two-stage pedestrian signal phase may be used as an alternative to a separate pedestrian phase. This signal design allows pedestrians to cross half of the road during the first left-turn phase and complete the crossing during the second left-turn phase.

Further Guidance

- California Department of Transportation, *Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians* (latest edition)
- FHWA, *Alternative Intersections/Interchanges: Informational Report* (latest edition)
- FHWA, *Median U-Turn Intersection, Informational Guide* (latest edition)
- FHWA, *Restricted Crossing U-Turn Intersection, Informational Guide* (latest edition)
- ITE, *Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges* (latest edition)
- Missouri Department of Transportation, *Design of Single-point Urban Interchanges* (latest edition)

4.4.15 Skewed Intersections

Skewed intersections occur when two streets meet at angles other than 90 degrees. Skewed intersections are discouraged for new construction, since the intersection geometry does not promote pedestrian safety. Existing skewed intersections that may not be realigned should be considered for countermeasures that may improve pedestrian safety.

Skewed intersections may be uncomfortable places for pedestrians to cross because of longer crossing distances, decreased visibility between pedestrians and drivers, and potentially high turning speeds.

Application

- If warranted by the GDOT Complete Streets Policy, sidewalks, curb ramps, and crosswalks should be provided on either side of the street and across each leg of the intersection.

Critical Design Requirements

- High-visibility crosswalks and ADA curb ramps should be placed at all crossing points. Refer to Sections 4.4.8 and 4.4.4 for more information on crosswalks and curb ramps, respectively.

Additional Considerations

- If there is adequate right-of-way, skewed intersections should be realigned as close to 90 degrees as possible, AASHTO recommends a minimum of 75 degrees.
- Curb extensions may be installed to shorten crossing distances, slow down turning vehicles, and in some cases adjust the skew.
- Medians with pedestrian refuge areas may be installed on wide roads where pedestrian crossings may need to be accommodated in two stages.
- The stop bar may be set back from the intersection to increase visibility between pedestrians and vehicles.
- If there is adequate right-of-way, skewed intersections may be reconstructed as a roundabout. Refer to Section 4.4.13 for more information on pedestrian accommodations at roundabouts.

Further Guidance

- California Department of Transportation, *Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians* (latest edition)
- FHWA, *Alternative Intersections/Interchanges: Informational Report* (latest edition)
- FHWA, MUTCD (latest edition)

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Chapter 5. Traffic Signal Operations for Pedestrian Mobility - Contents

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Chapter 5. Traffic Signal Operations for Pedestrian Mobility

Traffic operations practitioners should consider the needs and vulnerabilities of pedestrians when developing traffic signal timing plans. This chapter provides guidance on traffic signal timing strategies that improve accessibility, reduce pedestrian delay, and give more priority to pedestrians crossing the street. Historically, traffic signal timing has been primarily focused on automobile efficiencies, with less regard for the delay to pedestrians. Mitigation measures for pedestrian delay should be considered for urban core or urban areas, where there are high volumes of pedestrians.

"The traffic signal timing and optimization models we use continue to focus only on automobile traffic. These legacy signal timing policies at intersections have prioritized vehicle movements, leading to large and sometime unnecessary delays for pedestrians. Because pedestrian trips are short, delays at signalized intersections can affect pedestrians disproportionately and are a key factor in pedestrian non-compliance." – ITE Journal May 2018

5.1 Signal Timing Strategies for Pedestrians

5.1.1 Pedestrian Recall

Signals programmed with pedestrian recall automatically provide the pedestrian phase for every cycle. The pedestrian recall parameter causes the controller to place a continuous call for pedestrian service without active or passive pedestrian detection. Signals programed with pedestrian recall are more accessible and accommodating to pedestrians with disabilities than signals that require pedestrians to physically push a button to receive the pedestrian phase. In addition, the consistent service reduces pedestrian delay and increases the convenience for pedestrians.

Application

- Pedestrian recall should be programed into traffic signals in downtown urban core, urban, and rural town areas and around developments that generate large volumes of pedestrian activity, such as schools, educational institutions, transit stations, event stadiums, and medical centers.

Critical Design Requirements

- Pedestrian intervals and signal phases should comply with requirements in MUTCD Section 4E.06.
- The clearance interval should be calculated using a walking speed of 3.5 feet per second or less (MUTCD Section 4E.06).

Additional Considerations

- In areas with large volumes of pedestrian activity, such as schools, educational institutions, transit stations, event stadiums, and medical centers, the pedestrian clearance interval may be extended to accommodate large groups and pedestrians with disabilities, who may walk slower than 3.5 feet per second.
- Signals with pedestrian recall do not require pedestrian pushbuttons to be installed.

Further Guidance

- California Department of Transportation, *Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians* (latest edition)
- FHWA, *Alternative Intersections/Interchanges* (latest edition)
- FHWA, MUTCD (latest edition)

5.1.2 Leading Pedestrian Interval

Leading pedestrian interval (LPI) is a portion of a phase within the traffic signal cycle that provides the walk indication to pedestrians prior to the onset of the concurrent vehicular green indication. This allows the pedestrian to begin moving into the crosswalk before a right-turning vehicle enters the crosswalk space. This strategy may be used to increase the visibility of a pedestrian to drivers and has been shown to reduce conflicts between pedestrians and turning vehicles.

If an LPI is provided without accessible signal features, pedestrians who are visually impaired may begin crossing at the onset of the vehicular movement when drivers are not expecting them to begin crossing.

"Leading Pedestrian Interval has been shown to reduce pedestrian-vehicle collisions as much as 60% at treated intersections." - NACTO

Application

- LPIs should be incorporated into traffic phasing sequences at intersections with a high volume of pedestrians and right- and left-turning vehicles.
- LPIs are useful at T-intersections, where drivers on the side-street approach do not yield to oncoming traffic.

Critical Design Requirements

- LPIs should provide pedestrians with a minimum lead of 3 seconds and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the right-turning vehicle, before the right-turning vehicle is released (MUTCD Section 4E.06).
- An advanced WALK signal should be displayed while red indications continue to be displayed to parallel through or turning traffic.
- LPIs should be made accessible to visually impaired pedestrians. Refer to Section 5.2 for more information on accessible pedestrian signals.

Additional Considerations

- At intersections with a shared use path or bike infrastructure, a leading bicycle interval may be provided along with the LPI to reduce bicycle-vehicle conflicts.
- Curb extensions may be used in combination with leading pedestrian intervals to improve the visibility between pedestrians and turning vehicles and to shorten the crossing distance. Refer to Section 4.4.2 for more information.
- "No Turn on Red" (R10-11) prohibitions may be considered during the LPI.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

5.1.3 Pedestrian Scramble

The pedestrian scramble, also known as an all-WALK phase, is an exclusive pedestrian phase in which pedestrians may use lateral and diagonal crossings in an intersection while vehicle traffic is stopped. This strategy has been shown to reduce conflicts between pedestrians and turning vehicles.

Application

- Pedestrian scrambles may be implemented at intersections with large volumes of pedestrian crossings.
- Pedestrian scrambles may be implemented at intersections with a large number of conflicts or near misses between pedestrians and right- and left-turning vehicles.

Critical Design Requirements

- During the pedestrian scramble phase, all vehicle approaches should be stopped.
- Right turn on red should be prohibited during the exclusive pedestrian phase.
- If a pedestrian scramble is incorporated into the signal cycle, it must be provided consistently while the traffic signal is in normal operating mode. The signal cannot switch between an all-WALK phase, where pedestrians may cross diagonally, and a typical pedestrian signal, where pedestrians may only cross in the direction parallel to moving traffic. This is to maintain pedestrian and vehicle expectancy. While the pedestrian scramble must be provided consistently, there is flexibility as to the number of times it may be provided during a cycle, and the length of the phase.

Additional Considerations

- A best practice is to monitor pedestrian compliance and delay after the installation of the pedestrian scramble.
- The frequency and length of the pedestrian scramble phase may change in response to varying pedestrian and vehicle demand. For example, the pedestrian scramble may service the pedestrian phase once per cycle during peak vehicle hours and twice per cycle during peak pedestrian hours.
- Pedestrian scrambles may service the pedestrian phase twice per signal cycle to reduce pedestrian delay compared to one scramble phase per cycle and may improve pedestrian compliance at the intersection.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

5.1.4 Shorter Vehicular Cycle Lengths

Pedestrians may experience a disproportionate amount of delay at intersections due to long traffic signal cycles that are designed to optimize vehicle movements. Traffic signals with excessively long signal cycles may provoke pedestrians to cross the street during a conflicting signal phase, increasing the potential for pedestrian-motor vehicle conflicts. Research indicates that pedestrians stop watching for the signal to change, and instead start looking for gaps to cross streets, when the average pedestrian delay exceeds 30 seconds. The length of time that a pedestrian is willing to wait for the WALK indication is a function of the type of roadway and traffic conditions.

Shorter signal cycles may help reduce pedestrian delay at intersections and may be applied during non-peak and peak periods of traffic. In a coordinated traffic signal system, an example of a short

signal cycle is for an intersection to operate two cycles in the time that the traffic signal system operates a long cycle, which is commonly referred to as half cycles.

"Research has shown that in general, shorter cycle lengths benefit pedestrians leading to lower delay. The provision of shorter cycle lengths has also been recommended to encourage signal compliance and increase efficiency." – ITE Journal May 2018

5.2 Pedestrian Infrastructure at Traffic Signals

5.2.1 Pedestrian Detection Devices

Pedestrian detection devices inform the traffic signal of the presence of a pedestrian and cue the signal to provide the WALK signal in the next possible phase. The most common form of pedestrian detection is the pedestrian pushbutton, which is an active detection device. A pushbutton requires the pedestrian to physically push a button to receive the WALK signal. Alternatively, a passive pedestrian detection device identifies the presence of a pedestrian through infrared or video-processing technology without requiring action from the pedestrian.

Application

- Pedestrian pushbutton assemblies should be installed at signalized intersections where pedestrian recall is not used (in which the pedestrian phase is programmed to be provided automatically). Pedestrian recall is preferred in locations with moderate to large pedestrian volumes, including urban, urban core, and rural town contexts and near land uses that generate high pedestrian volumes.
- When used, pedestrian pushbutton assemblies should be installed on both ends of a crosswalk at signalized intersections and mid-block crossing locations with pedestrian signals, PHBs, or RRFBs.
- When used, pedestrian pushbutton assemblies should be provided in pedestrian refuge areas at locations with a two-stage pedestrian crossing and where pedestrians might not be able to cross the street in one traffic signal phase.
- Passive detection devices may be used in conjunction with a pedestrian pushbutton to identify the presence of pedestrians waiting on the sidewalk or in the crosswalk, and activate the traffic signal to provide, extend, and/or hold the pedestrian WALK phase.

Critical Design Requirements

- A pedestrian pushbutton assembly should be mounted on a traffic signal pole or on a free-standing pole.
- The pole on which the pedestrian pushbutton is mounted should not block the pedestrian access route or curb ramp.
- Pedestrian pushbuttons should be located no more than 5 feet from the edge of the curb ramp (MUTCD Section 4E.08).
- Pedestrian pushbuttons should be offset 1.5 to 6 feet from the edge of the curb, shoulder, or pavement (MUTCD Section 4E.08).
- Pedestrian pushbuttons should be mounted 3.5 to 4 feet above the pavement (MUTCD Section 4E.08).
- Pedestrian pushbuttons should be mounted such that it is clear which crosswalk is associated with the pushbutton operation.
- Pedestrian pushbuttons should be mounted such that a person in a wheelchair at the top of a curb ramp may access the button.

Additional Considerations

- The traffic signal operation may be programmed to provide automatic pedestrian phase service, even if pedestrian detection is present.
- If the traffic signal controller is enabled for detector diagnostics, the MaxView Detector Diagnostics reports, and Automated Traffic Signal Performance Measures may help identify pedestrian pushbutton failures and are useful maintenance tools.
- Passive pedestrian detection may be used to detect pedestrians in the crosswalk and extend the pedestrian phase.
- Passive pedestrian detection may be useful in areas where it has been observed that pedestrians do not use the pushbutton.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

5.2.2 Accessible Pedestrian Signals and Detectors

An accessible pedestrian signal and detector is an integrated device that uses visual or audible methods to communicate information about WALK and DON'T WALK intervals to pedestrians. Such

methods include audible tones, speech messages, and vibrational surfaces. These types of signals may help visually impaired pedestrians navigate an intersection.

Application

- Accessible pedestrian signals and detectors may be installed at signalized intersections and mid-block locations with a traffic signal, RRFB, or PHB traffic control device.
- While PROWAG states that accessible pedestrian signals and detectors should be installed at pedestrian crossings where pedestrian signals are provided (PROWAG R209.1), MUTCD does not require that they be provided. Instead, MUTCD recommends that an engineering study be conducted to determine the need for an accessible pedestrian signal and detector.
- Accessible pedestrian signals and detectors may be installed at intersections with large volumes of pedestrian activity, such as intersections within one-half mile of transit stations and medical centers or upon request from community members.

Critical Design Requirements

- The information provided by an accessible pedestrian signal should clearly indicate which pedestrian crossing is served by each device.
- The information provided by an accessible pedestrian signal should not be limited in operation by time of day or day of week.
- The design should comply with standards outlined in MUTCD Sections 4E.09 to 4E.13.

Additional Considerations

- Detectors may be active (pushbutton) or passive detection devices.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

5.3 Traffic Control Devices for Uncontrolled Pedestrian Crossing Locations

5.3.1 Rectangular Rapid Flashing Beacon

RRFBs are actuated flashing lights installed at a crosswalk with pedestrian crossing signs. RRFBs draw the driver's attention to the crosswalk and communicate the presence of a pedestrian and the

need to yield. An engineering study should be performed prior to installation that includes site-specific conditions. The guidance provided in this section may be used to guide the engineering study.

Application

≤35 mph

- RRFBs may be installed at uncontrolled pedestrian crossing locations (intersections or mid-block).
- RRFBs may be installed on streets with a speed limit of 35 mph or less.
- RRFBs may be installed on two-way streets with three or fewer lanes in each direction.
- RRFBs may be installed on one-way streets with three or fewer lanes.

Critical Design Requirements

- RRFB assemblies should be installed on the left and right sides of the roadway at the crosswalk.
- If an RRFB is installed on a two-way street with a pedestrian refuge area, an additional RRFB assembly should be mounted in the median.
- If an RRFB is installed on a multi-lane crossing without a pedestrian refuge area, an additional RRFB assembly should be mounted over the travel lane for each approach.
- If an RRFB is installed on a three-lane crossing with or without a pedestrian refuge area, an additional RRFB assembly should be mounted over the travel center lane for each approach.
- The beacon should be mounted below the standard crosswalk or school crosswalk warning signs, including W11-2 (Pedestrian), S1-1 (School), and W11-15 (Shared use trail crossing), and above the diagonal downward arrow (W16-7p) plaque (MUTCD Interim Approval 21).
- Pushbuttons should be located in accordance with the guidance in Section 5.2.

Additional Considerations

- Pedestrian refuge areas may be installed along with the RRFBs to break up the crossing distance.
- RRFBs may be installed at pedestrian crossings at roundabouts to increase the driver's awareness of a pedestrian crossing.
- RRFBs may be a lower cost alternative to traffic signals or PHBs.
- Depending on the environment, RRFBs may create a false sense of security for pedestrians. In some cases, a median refuge area may provide the most significant safety benefit for the pedestrian.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

Figure 5.1. Rectangular Rapid Flashing Beacon

5.3.2 Pedestrian Hybrid Beacons

A PHB, also known as a high-intensity activated crosswalk, is a traffic-control device used to stop vehicles at uncontrolled mid-block pedestrian crossing locations. An engineering study should be

performed prior to installation that includes site-specific conditions; the guidance provided in this section may be used to guide the engineering study.

Application

≤45 mph

- PHBs may be installed at uncontrolled mid-block pedestrian crossing locations (MUTCD Chapter 4F).
- PHBs may be installed on streets with a speed limit of 45 mph or less.
- PHBs may be installed on two-way streets with four or fewer lanes in each direction.
- PHBs may be installed on one-way streets with four or fewer lanes.
- Refer to MUTCD Chapter 4F for pedestrian and vehicular volume thresholds that warrant the installation of a PHB.

Critical Design Requirements

- The PHB should be designed in accordance with MUTCD Chapter 4F.02.
- If PHBs are installed on two-way streets with more than one lane in each direction, a pedestrian refuge area should be installed between opposing travel lanes.
- A PHB indication should be installed over each active through lane.
- Pushbuttons should be located in accordance with the guidance in Section 5.2.

Additional Considerations

- Pedestrian refuge areas designed with a zigzag cut through may be installed in conjunction with PHBs to break up the crossing distance and to encourage pedestrians to face oncoming traffic before crossing the street. Refer to Section 4.3.7 of this Guide for more information on design of pedestrian refuge areas.
- Consideration should be made to ensure standing water does not collect within the pedestrian refuge median or in front of the ADA ramps.
- On two-way streets with a pedestrian refuge area, PHB faces may be installed in the median in addition to either side of the crosswalk.
- PHBs may be installed at pedestrian crossings at two-lane roundabouts to increase the driver's awareness of a pedestrian crossing.
- PHB signals may be coordinated with adjacent traffic signals or in free operation. Pedestrians are more likely to be compliant with the signal if PHB is in free operation.
- For applications that cross a two-way roadway, PHBs may provide the WALK phase in one or two stages.
- Depending on the environment, PHBs may create a false sense of security for pedestrians. In some cases, a median refuge area may provide the most significant safety benefit for the pedestrian.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- FHWA, MUTCD (latest edition)
- GDOT, *Design Policy Manual* (latest edition)

Figure 5.2. Examples of Pedestrian Hybrid Beacons

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Chapter 6. Streetscape Design for Pedestrian

Beyond transportation, streets are public spaces where people gather, play, dine, exercise, and conduct business. To create a space where people are comfortable and enjoy walking, designers should go beyond the minimum standards for pedestrian accommodations. Thoughtful selection and placement of hardscape materials, wayfinding signage, lighting, seating, and trees may create a pedestrian-friendly street within the public right-of-way.

Figure 6.1. Streetscape, Atlanta, Georgia

Since pedestrians are vulnerable to severe crashes, providing a network that supports pedestrian safety is paramount for all people, regardless of disabilities or age.

This chapter provides guidance on the placement and design of streetscape components to improve accessibility and enhance the safety, comfort, and character of a sidewalk. While most of content in this chapter applies to streets with curb and gutter, guidance on plantings and trees may be applied to all roadways.

Prior to embarking on any streetscape project, the practitioner should carefully evaluate the context of the project, the speed of the street, and the primary intent of the project. Additionally, an essential component of all streetscape projects is the lateral offset to a fixed object, such as to lighting, benches, trees, bollards, trash receptacles, etc. The GDOT standard minimum lateral offsets to obstructions are listed later in this chapter. However, the reader is cautioned that the offsets alone do not present a complete solution to allow features or objects on the shoulder or roadside. Sound engineering judgment and reasonable environmental flexibility should be exercised in selecting and specifying roadside safety features at each location.

"Streets themselves are critical public spaces that can lend richness to the social, civic, and economic fabric of our communities." – Project for Public Spaces

"From town parades and trick-or-treating, to markets and public gatherings, [streets are] where we celebrate and come together with our neighbors." – Project for Public Spaces

6.1 Utilities

Utilities are often the most difficult element within a streetscape design project to coordinate and work with and around. It is essential that coordination with utility providers happens early and often and must be conducted throughout the project process. In some cases, sub-surface utility engineering (SUE) is required to determine the vertical and horizontal location of existing utilities. In other cases, a call to 811 to field locate the utilities may be sufficient, in conjunction with utilizing a registered surveyor, to develop accurate design plans that accommodate utilities. In all cases, utilities should be addressed at the onset of a streetscape, pedestrian improvement, or roadway project.

Utility installations are governed by the GDOT *Utility Accommodation Policy and Standards* Manual. Designers should read and understand the referenced policy, in conjunction with the policies and guidelines set forth in the GDOT *Design Policy Manual*.

Critical Design Requirements

- No utility obstacle shall encroach on sidewalk clearances required by PROWAG.
- Interruptions to pedestrian travel should be minimized, and construction should avoid damage to pedestrian facilities.
- Lateral offsets to utility obstacles are measured from the face of curb to the face of pole or obstacle.
- The utility provider should be contacted to relocate the existing utilities within the guidelines provided by GDOT's *Utility Accommodation Policy and Standards*.

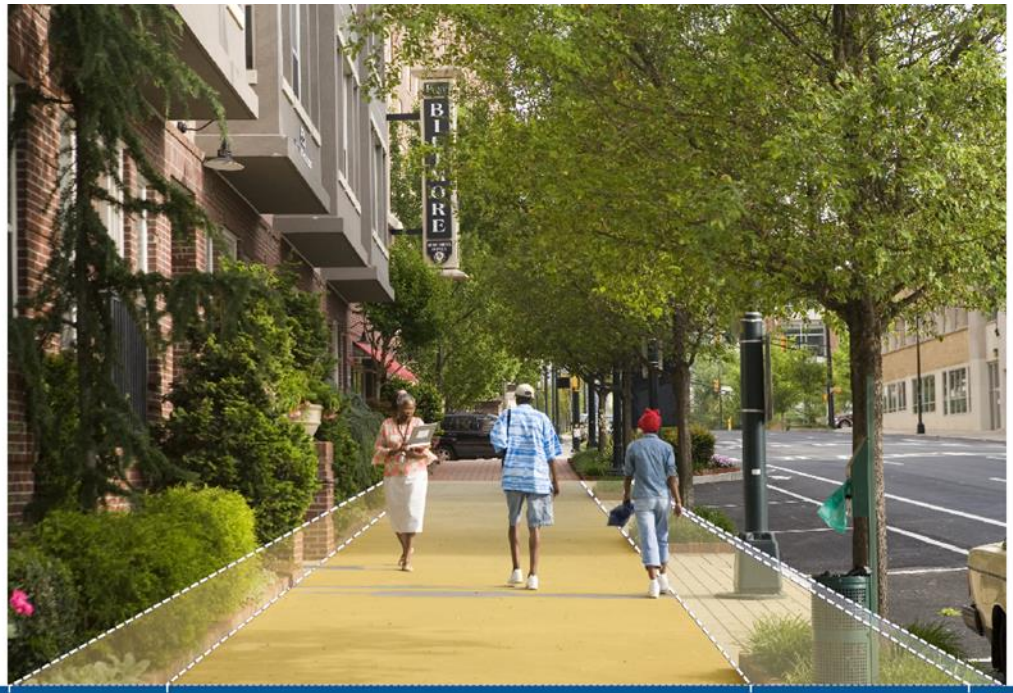
Additional Considerations

- For existing and proposed overhead utilities, the ideal option is to locate or relocate the utility underground; however, this option is often not financially feasible.
- The poles and utility wires should be consolidated to minimize redundant lines and poles.

6.2 Sidewalk Zones

Creating a street that provides a comfortable environment for pedestrians requires going beyond minimum sidewalk infrastructure requirements, such as a 5-foot-wide sidewalk. While the addition of streetscape components may enhance the pedestrian-friendly character of a street, they may also obstruct access and create tripping hazards if not planned for carefully. To provide a functional and inviting pedestrian route, designers should conceptualize the sidewalk as a composition of three zones. Dividing the sidewalk into zones will help practitioners and designers organize streetscape components and result in adequate space for the intended activities.

The three sidewalk zones discussed in this section are the frontage zone, pedestrian circulation zone, and greenscape/furniture zone. Although there is no physical boundary between these zones, each area has an optimal range of widths, as depicted on Figure 6.2, to accommodate a mix of streetscape components. The width of each zone varies based on the pedestrian activity, adjacent building uses, roadway and traffic characteristics, and desired character.



	Frontage Zone	Pedestrian Circulation Zone	Greenscape / Furniture Zone	Curb Zone
Urban Core	0 - 10'	10 - 12' or greater	4 - 6'	6"
Urban	0 - 10'	8 - 10' or greater	4 - 8'	6"
Suburban	0 - 10'	6 - 8'	4 - 10'	6"
Rural Town	0' - 10'	5 - 8'	4 - 6'	6"

Table applies to streets with curb and gutter, or urban shoulders.

This table is intended to provide general guidance only. Specific site conditions must be evaluated on an individual basis related to projects.

Figure 6.2. Sidewalk Zones

6.2.1 Frontage Zone

The frontage zone is the space connecting the adjacent property line to the pedestrian access route. Adjacent property use influences the type of activities that occur in the frontage zone and, in turn, the width and organization of streetscape components in this zone. For example, if the adjacent buildings are restaurants and shops, the frontage zone should be wide enough to accommodate outdoor café seating or storefront displays. Not all streetscapes have frontage zones but is a best practice to provide them especially if buildings and doors or adjacent to the sidewalk. Frontage zones are also great spaces for outdoor dining opportunities along a streetscape when ample space is provided.

Critical Design Requirements

- The frontage zone should be sufficiently wide to accommodate building door movements, and adequate space so that objects do not obstruct pedestrian circulation, including signs and seating.
- Objects mounted to buildings that are lower than 80 inches above the surface of the sidewalk should not protrude more than 4 inches into the pedestrian circulation path (PROWAG R402).
- Signs mounted in the frontage zone should be installed a minimum of 7 feet above the surface of the sidewalk (MUTCD Section 2A.18).
- If the frontage zone connects to a building entrance, the hardscape surface material should be smooth, firm, stable, and slip resistant, and comply with PROWAG R302.7. Refer to Section 6.3.1 of this Guide for more information on ADA-compliant hardscape materials.

Additional Considerations

- When a sidewalk abuts a building that generates a large volume of pedestrian activity, such as restaurants, shops, and transit stations, the frontage zone may be extended to provide adequate space for benches, outdoor restaurant seating, plantings, merchandise displays, portable signs, and awnings.
- The recommended width of the frontage zone to accommodate restaurant seating is 6 feet.
- When a sidewalk is adjacent to a parking lot, trees and plants may be planted in the frontage zone to provide shade and a buffer between the expanse of asphalt and the sidewalk.
- The minimum width of the frontage zone to accommodate trees is 4 feet.

Figure 6.3. Example of a Frontage Zone (using planter boxes to protect door movements), Norcross, Georgia

6.2.2 Pedestrian Circulation Zone

The pedestrian circulation zone is the portion of the sidewalk reserved for pedestrian travel. Like the frontage zone, the width of the pedestrian circulation zone should respond to the existing or anticipated volume of pedestrian activity. Areas with high volumes of pedestrian activity should be sized to accommodate the amount of anticipated pedestrian activity, rather than minimum requirements.

Figure 6.4. Examples of Pedestrian Circulation Zone

Critical Design Requirements

- The minimum width of the pedestrian circulation zone is 5 feet (GDOT *Design Policy Manual*). Larger widths may accommodate higher volumes of pedestrians.
- The longitudinal slope (or grade) of the pedestrian circulation zone should not exceed the grade established for the adjacent street or roadway. In cases where the sidewalk alignment deviates from the adjacent roadway, the longitudinal slope of the sidewalk should not exceed 5 percent (GDOT *Design Policy Manual*).
- The maximum cross-slope for the pedestrian circulation zone is 2 percent (GDOT *Design Policy Manual*).
- The hardscape materials in the pedestrian circulation zone should be smooth, firm, stable, and slip resistant, and comply with PROWAG R302.7. Refer to Section 6.3.1 of this Guide for more information related to hardscape materials and surfaces.
- The pedestrian circulation zone should be clear of obstructions.

Additional Considerations

- When a sidewalk is adjacent to developments that generate a large volume of pedestrian activity, such as restaurants, shops, and transit stations, the recommended width is 8 to 12 feet. (NACTO *Urban Street Design Guide: Sidewalks*).
- Relocation of fixed objects, such as utility poles, light fixtures, and other street furniture, should not impinge on or restrict the adjacent walkway. Walkways must be clear of fixed objects in coordination with ADA accessibility guidelines (NACTO *Urban Street Design Guide: Sidewalks*).
- When a sidewalk crosses a commercial driveway, the driveway may be raised to the level of the sidewalk and the sidewalk hardscape material continued across the driveway. This driveway crossing design is similar to a raised crosswalk. For more information on raised crosswalks and driveway crossings, refer to Sections 4.4.11 and 0 of this Guide, respectively.
- Sidewalk design should go beyond the bare minimum in both width and amenities. Pedestrians and businesses thrive where sidewalks have been designed at an appropriate scale, with sufficient lighting, shade, and street-level activity. These considerations are especially important for streets with higher traffic speeds and volumes, where pedestrians may otherwise feel unsafe and avoid walking.

6.2.3 Greenscape/Furniture Zone

The greenscape/furniture zone is the space between the pedestrian circulation path and the curb. This zone serves as a buffer between pedestrians on the sidewalk and vehicles on the street, and is reserved for signs, light and utility poles, seating, bicycle parking, transit stops, trash receptacles, trees, plants, and green stormwater infrastructure. The streetscape components in this zone should maximize safety, comfort, and function for all users. The width of the greenscape/furniture zone should respond to traffic speeds on the adjacent road, as well as the desired street furniture, amenities, and street trees and landscaping proposed for the zone.

Critical Design Requirements

- The greenscape/furniture zone should increase in width as the speed limit of the adjacent street increases.
- On streets with speed limits 35 mph or greater, the greenscape/furniture zone should be a minimum of 5 feet wide.
- The minimum width of the greenscape/furniture zone varies depending upon the streetscape components placed in this zone:
- If the greenscape/furniture zone is reserved for only light poles and utilities, the zone should be a minimum of 2 feet wide (FHWA *Designing Sidewalks and Trails for Access*).
- If planting trees or placing bike parking in the greenscape/furniture zone, the zone should be a minimum of 4 feet wide (FHWA *Designing Sidewalks and Trails for Access*). For more information on trees, plantings, and stormwater infrastructure in this zone, refer to Sections 6.4 and 6.5 of this Guide.
- If providing seating in the greenscape/furniture zone, the zone should be a minimum of 6 feet wide, with fixed objects set back a minimum of 4 feet from the face of curb for low speed streets of 35 mph or less.
- If the sidewalk is adjacent to a transit stop, refer to Sections 4.3.12 and 6.3.6 of this Guide for more information on the design of transit stops.
- Objects placed in the greenscape/furniture zone should not extend into and obstruct the pedestrian circulation zone.

Figure 6.5. Example of Pedestrian Circulation Zone with a Frontage and Furniture Zone, Norcross, Georgia

Figure 6.6. Example of Greenscape Zone

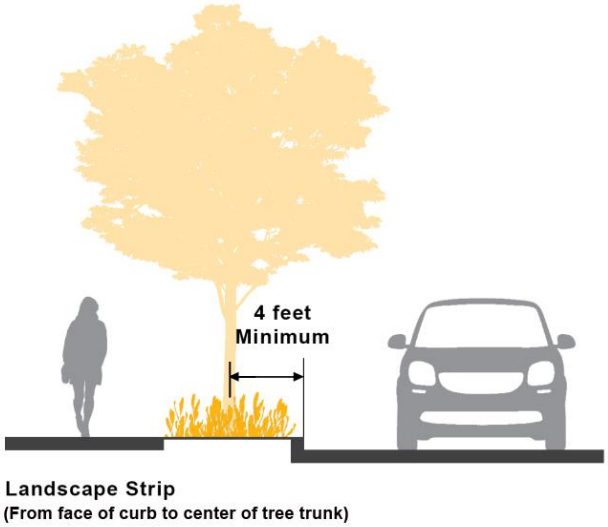


Figure 6.7. Dimensions of Greenscape/Furniture Zone with Tree on a low speed street of 35 mph or less located within a Central Business District

Figure 6.8. Examples of Greenscape/Furniture Zones

6.3 Components of a Streetscape/Urban Design Elements

Streetscapes are complex and are made up of many components that may change based on context and pedestrian activity. Components of a streetscape, often referred to as urban design elements, are typically confined to the urban shoulder of a street on lower speed streets, 35 mph or less and include but are not limited to elements such as hardscape materials, planters, tree grates, benches, trash receptacles, bike racks, kiosk, wayfinding signage, pedestrian scale lighting, bollards, and green infrastructure systems to treat the first 1 inch of stormwater runoff.

6.3.1 Hardscape

A variety of hardscape materials may be used to introduce color and texture to the sidewalk and enhance the character of a place. While using a variety of hardscape materials is encouraged, the surfaces used for pedestrian circulation areas should be smooth, firm, stable, and slip resistant, and comply with PROWAG Section R302.7. Quality control issues may be avoided by requesting the contractor prepare a mock-up of materials such as walls, specialty hardscape features, and stone work during the preconstruction phase, potentially saving time and money.

The primary hardscape materials used in sidewalks are concrete, asphalt, brick, concrete, and stone pavers. Concrete and asphalt are the primary materials for shared use paths. This section provides information on where materials may be applied, and considerations for installing and maintaining the hardscape surface.

Figure 6.9. Example of Sidewalk with Multiple Materials

6.3.1.1 Concrete

Concrete is the preferred hardscape material for sidewalks because it provides a smooth, durable finish and is easy to grade. Colored and textured concrete, such as a sand-blasted finish, may be used as accents in the frontage and greenscape/furniture zone.

A primary challenge with concrete surfaces is avoiding the development of cracks that will maintain ADA compliance. To comply with ADA, cracks that are 1/2-inch-wide or greater should be patched, and vertical displacements 1/4 inch or greater should be grinded or cut down. While cracks are a normal part of concrete aging, well-designed saw cuts or joints may minimize crack sizes over time and control where cracks occur.

6.3.1.2 Asphalt

Asphalt provides a smooth surface and may be used for shared use paths and for sidewalks in rural areas. While asphalt is less expensive than concrete, it is typically not as long lasting. Asphalt sidewalks and paths should be maintained to ADA standards.

6.3.1.3 Bricks and Pavers

Bricks and pavers may be used to introduce texture, color, and patterns into the sidewalk. These hardscape materials may be used in historic districts and plazas, and as accents in the frontage and greenscape/furniture zones. Brick and paver hardscapes may be designed with aggregate and sand joints to allow water to permeate the surface. While bricks and pavers may provide environmental and aesthetic benefits, maintaining a level surface and controlling the spacing between units are challenges. Transitions between unit pavers, tree grates, concrete panels, and pedestrian circulation zones should be given special attention to minimize gaps and bumps that may be caused by settlement. A contractor with experience in unit paver installation should be selected to install bricks and pavers.

Bricks and pavers that are proposed within a local road or street, should be placed on a bituminous setting bed in a herringbone pattern. When using bricks or pavers within a street, the designer should consult further with the brick or paver manufacturer for the exact specifications as each project has specific criteria that should be evaluated on a project by project basis. Bricks and pavers are not permitted to be used within the street or roadway on a State Route or “On System” facility.

Further Guidance

- FHWA, *A Guide for Maintaining Pedestrian Facilities for Enhanced Safety* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)

6.3.2 Bike Parking

Providing adequate and appropriate bike parking is essential to supporting and encouraging bicycling as a viable transportation option. The two primary factors that determine the usefulness of bike parking are location and type. This section provides guidance on the placement and installation of bike parking, as well as recommendations for selecting the type of bike parking.

Application

- Bike parking may be provided at common destinations, such as transit stops, grocery and convenience stores, schools, parks, main streets, and town centers.
- Bike parking may be placed in the frontage and greenscape/furniture zones.
- In situations where sidewalk space is limited or where a high demand for bike parking exists, bicycle parking may be located on-street parking spaces. Eight to ten bike parking spaces may typically be provided in one on-street vehicle parking space.

Critical Design Requirements

- Bike parking should be placed in convenient and well-lit locations, close to entrances, and visible from the bike route or destination entrance.
- A minimum clearance of 36 inches should be maintained on all sides of the bike rack, corral, station, or locker to prevent a parked bike from obstructing a travel path. Figure 6.10 illustrates the recommended offset dimensions for a typical U-rack.

Additional Considerations

- When deciding which type of bike parking is appropriate for a given location, the following may be considered: the anticipated number of users, the space available, the types of bikes being parked, and the length of use (short-term versus long-term). Common types of bike parking include bike racks, bike corrals, bike lockers, and bike shelters. There are variations within each type. For more information on the types of bike parking, refer to further guidance in this section.
- If there is not enough space to accommodate bike parking in one area, dispersed U-racks or repurposing an on-street vehicle parking space for bike parking may be considered.
- A variety of bike parking types may be needed to accommodate all bicycle shapes and sizes. The footprint of a standard bicycle is approximately 6 feet by 2 feet, but cargo bicycles and bicycles with trailers have a larger footprint and may require additional space.
- To accommodate long-term bike storage, bike shelters or bike lockers may be installed.
- If designing custom bike racks, verify that a bicycle may be locked to it with a standard U-lock.

Further Guidance

- AASHTO, *Guide for the Development of Bicycle Facilities* (latest edition)
- APBP, *Essentials of Bicycle Parking* (latest edition)
- City of Boston, *Boston Complete Streets Design Guidelines* (latest edition)
- Dero, Commercial Bike Racks (latest edition)
- FHWA, *Bicycle and Pedestrian Program* (latest edition)
- Mayor's Office of Transportation and Utilities, *Philadelphia Complete Streets Design Handbook* (latest edition)
- NACTO, *Bike Share Station Siting Guide* (latest edition)
- NACTO, *Transit Street Design Guide: Bike Parking* (latest edition)
- NACTO, *Urban Bikeway Design Guide* (latest edition)
- Reliance Foundry, *The Essential Guide to Bike Parking* (latest edition)
- San Francisco Municipal Transportation Agency, *Bicycle Parking: Standards, Guidelines, Recommendations* (latest edition)

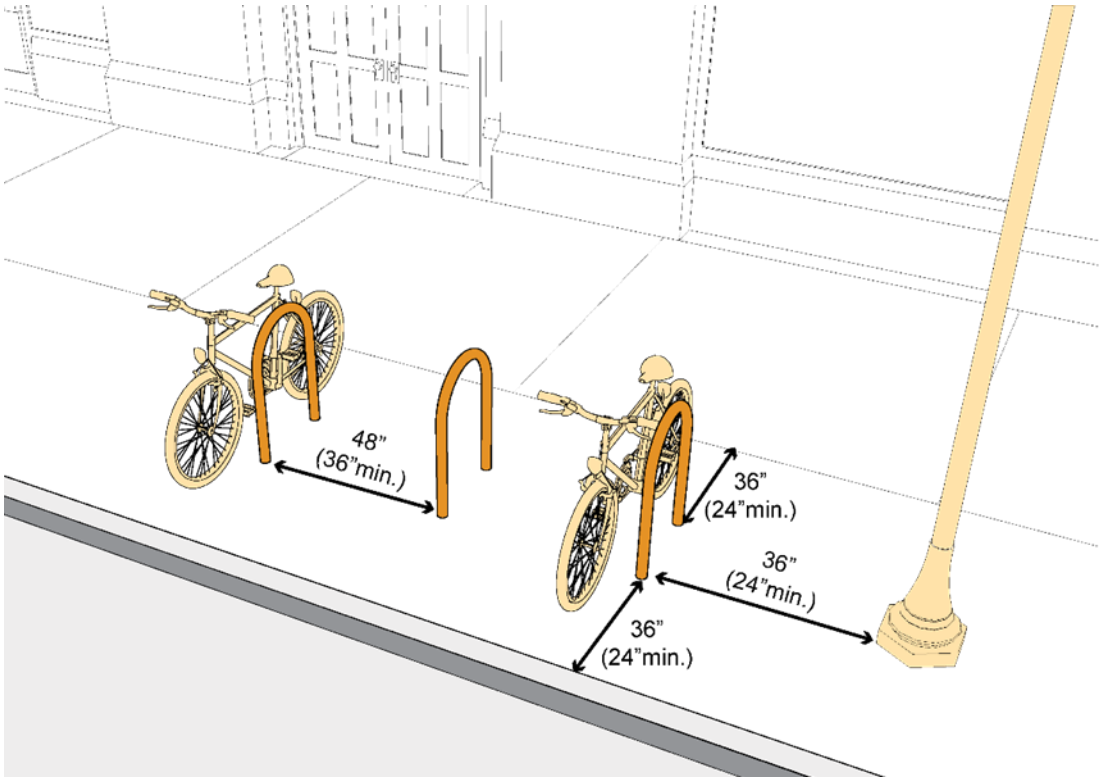


Figure 6.10. Offset Dimensions for U-Rack Bike Parking Placed Perpendicular to the Curb

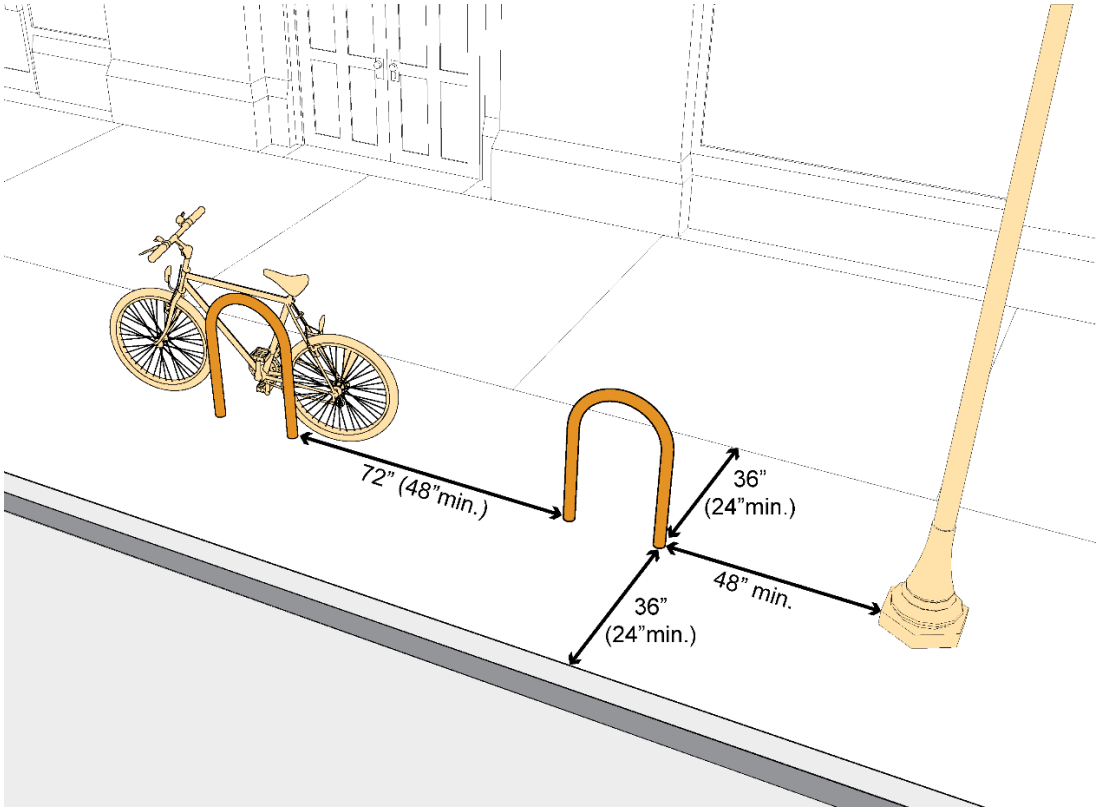


Figure 6.11. Offset Dimensions for U-Rack Bike Parking Placed Parallel to the Curb

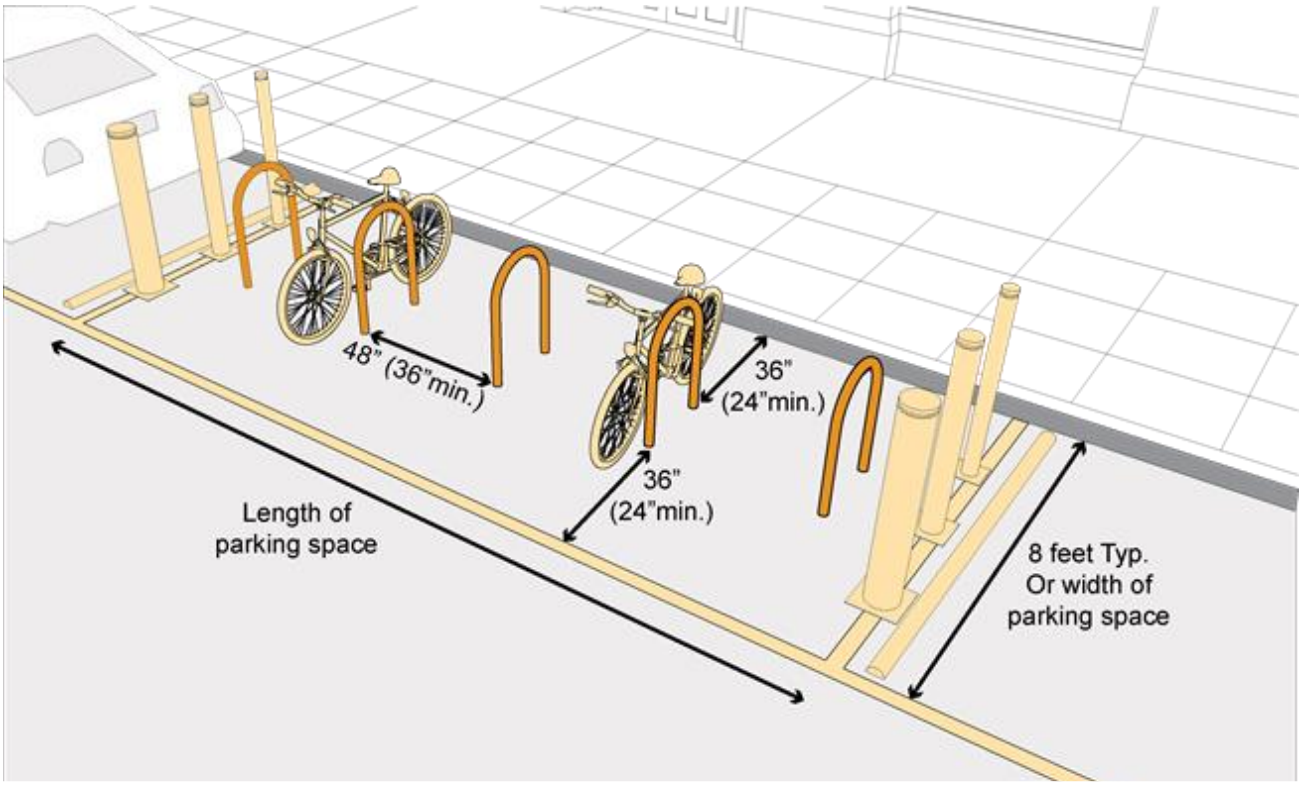


Figure 6.12. Offset Dimensions of Bike Corral

Figure 6.13. Example of Bike Parking in the Amenity Zone

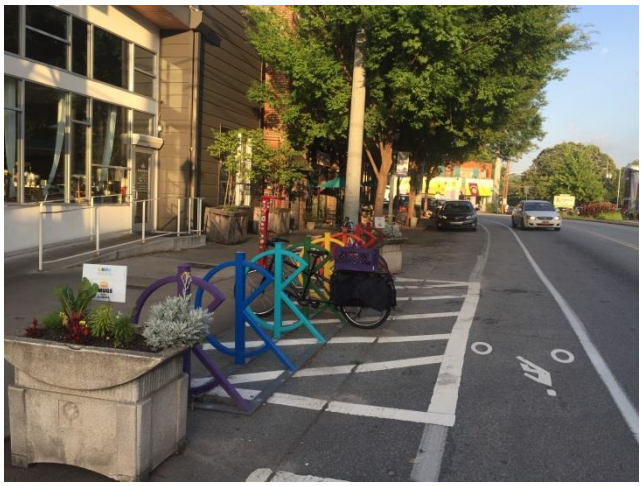


Figure 6.14. Example of Bike Parking in On-Street Parking Space

6.3.3 Bollards

Bollards are vertical objects that come in rigid, semi-rigid, or flexible varieties. They are used create temporary or permanent separation between components of the streetscape or modes of transportation. Using a context sensitive design approach or utilizing a municipality's streetscape design guideline if available, bollards may be a component of the street that adds character to the place while providing a separation without creating an impermeable barrier.

Application

- Bollards highlight traffic calming measures and, depending on how frequently they are placed, protect pedestrians, bicyclists, landscape plantings, and buildings by discouraging unauthorized vehicles from encroaching into the pedestrian circulation zone.

Critical Design Requirements

- The minimum height for bollards is 30 inches.
- Bollards should be visible in all lighting conditions for all users and marked with brightly colored reflective paint or emblems to contrast from the surrounding environment.
- Bollards may be lighted to provide supplemental illumination for a pedestrian facility.
- Bollard lighting may be solar powered.
- Bollards may be movable, flexible, semi-flexible, or fixed.
- Bollards may be spaced with a minimum distance of 5 feet apart, which provides sufficient space for pedestrians and bicyclists to move through but does not allow for the passage of vehicles.
- Proper spacing should consider the balance of restricting vehicles with the requirement of providing an unobstructed pedestrian circulation zone.
- Bollards should not be an obstruction for people with disabilities.
- Sight distance should allow users to adjust their speed, especially on paths that have traffic calming features installed.
- Bollards may be used to keep pedestrians from stepping off the curb in areas other than the crosswalk.
- Bollards require maintenance due to deterioration or crashes.

Further Guidance

- City of Boston, *Boston Complete Streets Design Guidelines* (latest edition)
- FHWA, Pedestrian & Bicycle Safety (latest edition)
- FHWA, MUTCD (latest edition)

Figure 6.15. Example of Bollards

Figure 6.16. Example of Flexible Bollards

6.3.4 Pedestrian-Scale Lighting

Pedestrian-scale lighting serves the essential function of illuminating sidewalks, crosswalks, and bike lanes, and has been shown to reduce crashes in urban and suburban areas where there is a concentration of pedestrians (AASHTO Green Book Section 3.6.3). The increased sense of safety and security allows pedestrians to feel more comfortable walking at night.

Application

- Pedestrian-scale lighting may be provided at intersections and street corridors with pedestrian infrastructure.
- Pedestrian-scale lighting may be provided at controlled or uncontrolled mid-block crossing locations.
- Pedestrian-scale lighting may be provided along bridges, tunnels, and pedestrian over- and underpasses.
- Pedestrian-scale lighting may be provided at transit stop locations.
- Pedestrian-scale lighting should be provided in places with high volumes of pedestrian activity, such as transit stations, medical centers, educational institutions, and downtown urban areas.

Critical Design Requirements

- Lighting at mid-block pedestrian crossings should be placed 10 feet in front of the crosswalk, from the driver's perspective (FHWA *Informational Report on Lighting Design for Midblock Crosswalks*).
- Lighting should provide 20 vertical lux at the crosswalk (FHWA *Informational Report on Lighting Design for Midblock Crosswalks*).
- When a pedestrian crossing is placed on roads with two-way traffic or roads wider than 44 feet, lighting should be provided on both sides of the crosswalk (FHWA *Informational Report on Lighting Design for Midblock Crosswalks*).
- Pedestrian light standards should be located at the back of the sidewalk. If sidewalk is not present, the light standards should be placed a minimum of 6 feet from the face of curb.
- Pedestrian-scale lighting should be less than or equal to 20 feet above the surface of the sidewalk.

Additional Considerations

- Lighting may be placed in the frontage or greenscape/furniture zone.
- The placement of trees should be coordinated with the proposed and existing pedestrian lighting so as not to create areas of shadow, reducing visibility on sidewalks.
- When selecting the type of lighting, energy-efficient options, fixture spacing, the shade of white color, and alternative power sources may be considered.
- A best management practice of utilizing LED lights should be considered to reduce maintenance and provide energy savings.

Further Guidance

- AASHTO, *Roadside Design Guide* (latest edition)
- AASHTO, *Roadway Lighting Design Guide* (latest edition)
- European Committee for Standardization
- FHWA, *Lighting Handbook* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- GDOT, *Lighting Design Process* (n.d.)
- Illuminating Engineering Society of North America (latest edition)
- International Commission on Illumination (latest edition)
- International Dark-Sky Association (latest edition)

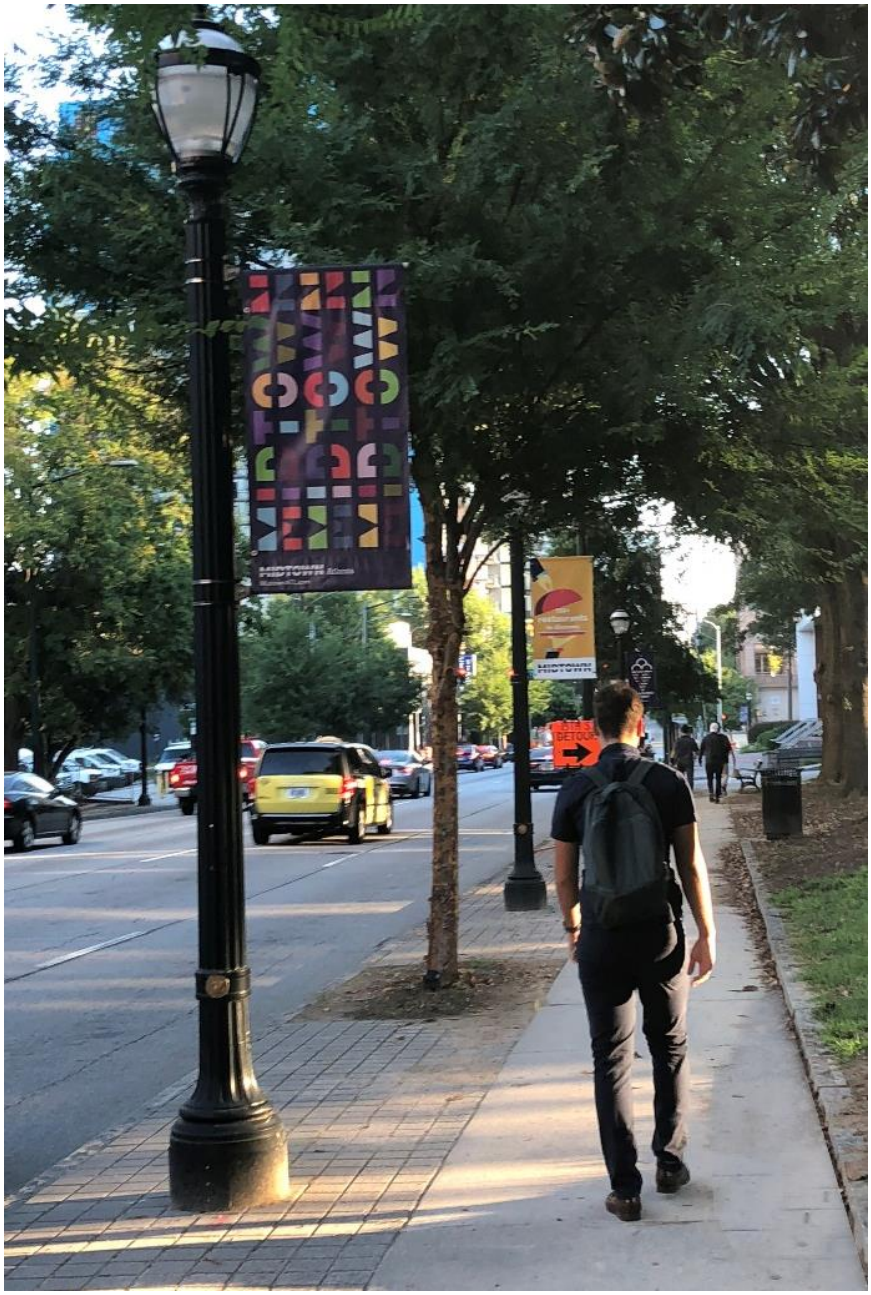


Figure 6.17. Pedestrian-Scale Lighting, Atlanta, Georgia

6.3.5 Seating

Opportunities to sit down and rest are necessary for pedestrians with mobility impairments and older adults. Seating also invites people to spend time in a place and socialize, bringing life to the street. Many forms of seating, such as benches, movable chairs, and seat walls, may be incorporated into a streetscape design. This section provides guidance on the placement of seating as it relates to the pedestrian circulation zone. This section does not provide recommendations for selecting the type of seating.

Critical Design Requirements

- Seating should not block fire hydrants, pushbutton assemblies, access to transit, or loading zones.
- Benches and other forms of seating should be placed a minimum of 5 feet from the back of the curb to accommodate wheelchair access.
- Benches and other forms of seating should be offset a minimum of 1.5 feet from the edge of the pedestrian circulation zone to ensure they do not obstruct pedestrian access.
- To accommodate wheelchair access, a 30 inch by 48-inch clear space should be provided adjacent to seating.

Additional Considerations

- Seating may be fixed or mobile.
- Seating may be integrated with other streetscape components, such as raised planting beds and low concrete walls.
- When placing seating, the view from the seat should be considered. It is often desirable to place seating to face the property adjacent to the street, and in others it might be necessary for the seating to face the street, such as at transit stops.
- It is often desirable to provide seating adjacent to trees or in a shaded area.
- When placing seating near other fixed objects, maintenance and trash removal needs to be considered. Seating may be offset a minimum of 1 foot from fixed objects for maintenance needs.

Further Guidance

- City of Boston, *Boston Complete Streets Design Guidelines* (latest edition)
- Mayor's Office of Transportation and Utilities, *Philadelphia Complete Streets Design Handbook* (latest edition)
- NACTO, *Transit Street Design Guide: Seating* (latest edition)
- US Access Board, PROWAG (latest edition)

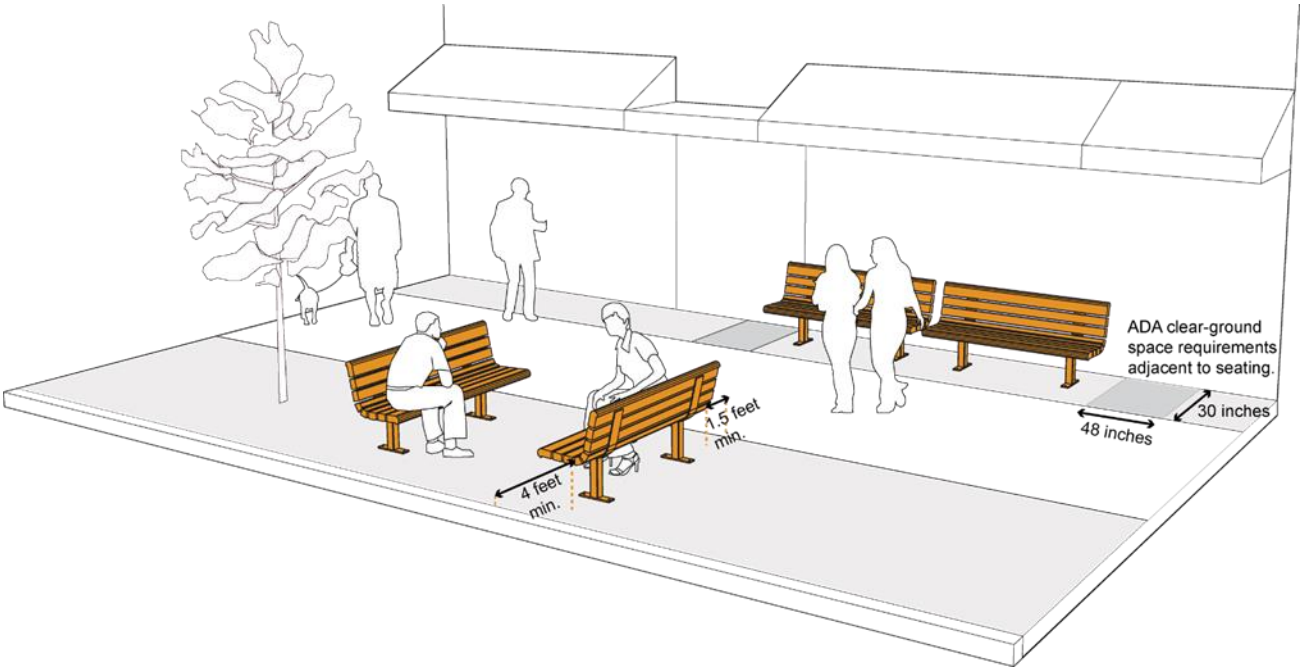


Figure 6.18. Seating Placement

Figure 6.19. Example of Seating, Atlanta, Georgia

6.3.6 Transit Stop Amenities

Amenities at transit stops such as signs, maps, benches, lighting, trash receptacles, bike racks, and shelters may improve accessibility, visibility, comfort, and convenience for pedestrians taking transit. When installing amenities at transit stops, it is important to consider how pedestrians will access transit vehicles and how non-transit riders will navigate around the transit stop. This section provides guidance on how to place amenities at transit stops while maintaining accessibility for all users. This section also provides recommendations for when to consider providing certain amenities. For more information on the placement of transit stops along a corridor and design specifications for bus bulb-outs and pullouts, refer to Section 4.3.12.

Application

- Transit accommodations may be provided in both urban and rural areas where pedestrians often rely on transit as their primary mode of transportation.
- Transit shelters may be provided in neighborhoods where buses run infrequently, in urban areas with high level of ridership, and in areas where there are many older adults or persons with disabilities.

Critical Design Requirements

- Transit stops should be ADA-compliant and accessible for all users.
- Amenities at transit stops should be installed considering the relationship to the adjacent sidewalk and transit boarding. Amenities at transit stops should not be placed in or protrude into the pedestrian circulation zone or the transit loading zone. Transit amenities include, but are not limited to, signs, maps, benches, light posts, kiosks, trash receptacles, and shelters.
- A 5-foot-long (parallel to the curb) by 8-foot-deep (perpendicular to the curb) loading zone should be provided at all transit stops.
- The loading zone should be kept clear to provide ample space for bus door operations, wheelchair lifts, and pedestrians waiting and queuing for transit. Sufficient space should be provided such that pedestrians waiting at the stop do not obstruct the pedestrian access route. The amount of space varies based on the type and ridership levels of the transit, and the available width of the sidewalk.
- Benches, light posts, kiosks, trash receptacles, and shelters should be set back a minimum of 4 feet (3 feet minimum) from the curb.
- Transit stop signs may be placed within 1 foot of the curb.
- The bottom of transit stop signs should be at least 7 feet and no more than 10 feet from the surface of the pavement.
- Bus shelters should be offset 3 feet from the loading zone, 10 feet from fire hydrants, and 1 foot from fixed objects.
- Local transit agencies should be consulted to verify local requirements for loading zones, bus stop locations, and other design criteria that may be unique to individual transit authorities.
- Amenities in or around transit shelters should be stable, durable, and vandal resistant.

Additional Considerations

- The placement of a transit shelter is decided on a case-by-case basis. Pedestrian facilities adjacent to and near transit stops should be planned and designed collaboratively among the transit agencies, public works, and traffic engineering departments of the local jurisdiction.
- Benches, trash cans, and lighting may be incorporated at transit stops.
- Accessibility should be provided with ramps, detectable warning features, and clearly defined and delineated pedestrian spaces.
- If the sidewalk is not wide enough to support a 5-foot-by-8-foot loading zone, a bus bulb-out may be installed. Refer to Section 4.3.12 for guidance on the design of bus bulb-outs.
- Well-lit and active accessways leading to transit facilities may be provided to increase security.
- Travel information keeps riders updated with schedules, routes, and real-time arrival and departure times. Local maps and wayfinding information should be provided to keep riders informed. Refer to Section 6.3.8 for more information.
- When determining appropriate transit stop or shelter placement, the location of utilities should be considered.
- A regularly scheduled maintenance plan should be used for bus stops and shelters.
- Shade awnings, trees, seating, and bicycle racks may be placed in the vicinity of transit stops to accommodate intermodal transfers and improve pedestrian comfort.
- Shelters should be located to facilitate maintenance.
- Additional passenger amenities such as seating, local area information, wayfinding, and real-time traveler information should be considered concurrent with shelters.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (latest edition)
- City of Boston, *Boston Complete Streets Design Guidelines* (latest edition)
- ITE, *Designing Walkable Urban Thoroughfares* (latest edition)
- Mayor's Office of Transportation and Utilities, *City of Philadelphia Green Streets Design Manual* (latest edition)
- NACTO, *Transit Street Design Guide: System Wayfinding & Brand* (latest edition)

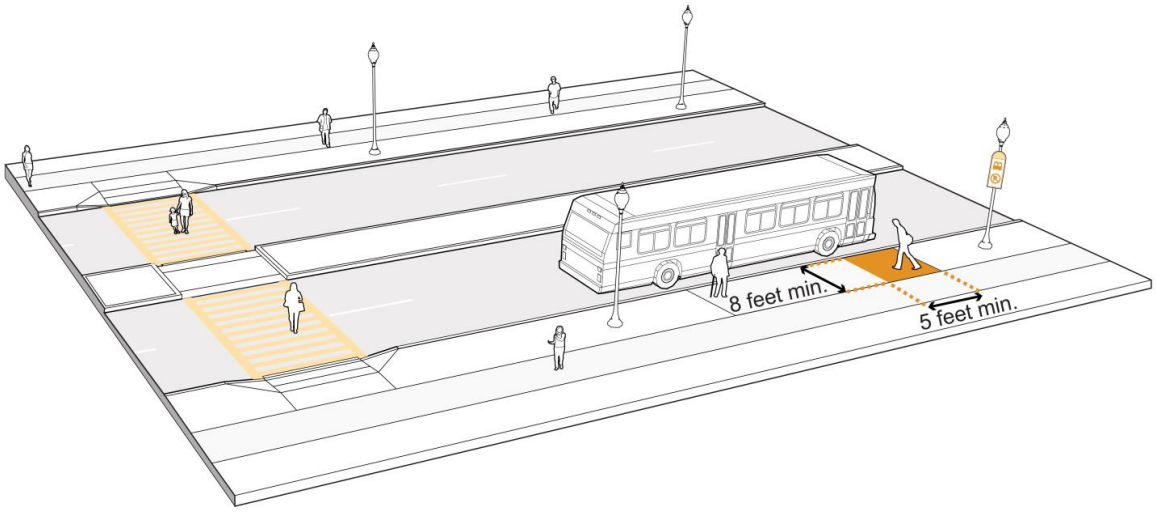


Figure 6.20. Standard Transit Stop

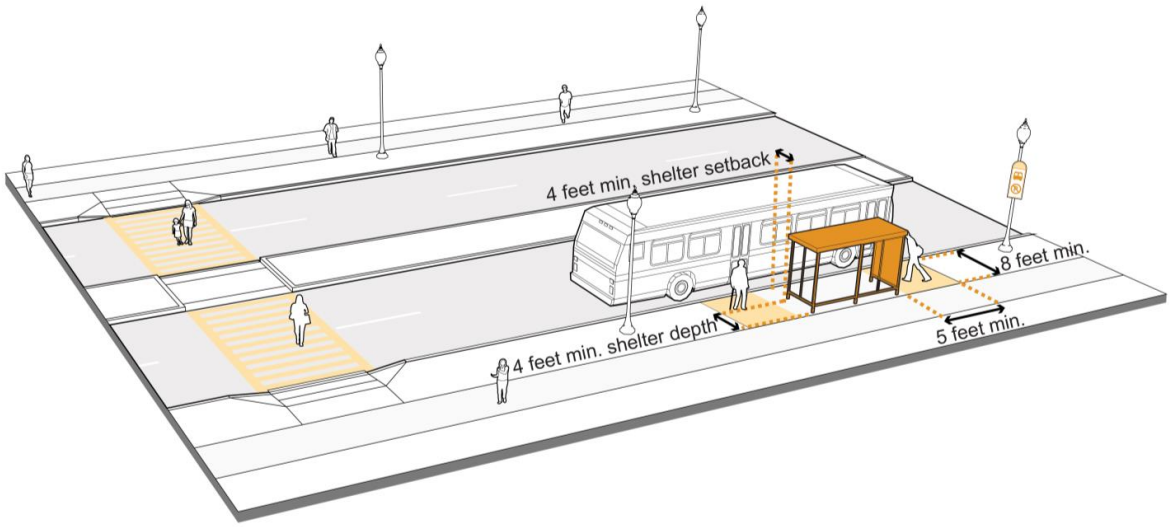


Figure 6.21. Transit Shelter Dimensions

Figure 6.22. Example Transit Shelter

Figure 6.23. Transit Shelter Wayfinding

6.3.7 Trash Receptacles

Strategically located trash receptacles are convenient to use and help keep streetscapes clean.

Application

- Trash receptacles may be located near high-pedestrian activity areas, such as near transit amenities or commercial areas.
- Trash receptacles may be placed in the frontage or greenscape/furniture zone.

Critical Design Requirements

- Trash receptacles should be located for pedestrian convenience and accessibility.
- Trash receptacles should not block or protrude into the pedestrian circulation zone.
- Trash receptacles (including animal waste bag dispensers and containers) should be easy to maintain and empty.
- The quantity of trash receptacles required on a site is based on the volume of people who use the area, the frequency of maintenance, sanitation schedules, and the amount of litter generated.

- **Additional Considerations**

- When selecting materials for trash receptacles, the durability of materials should be considered.
- The local municipality should be contacted to determine whether streetscape standards for urban design elements have already been established.

Figure 6.24. Site Elements – Bench, Trash Receptacle

6.3.8 Wayfinding Signage

Wayfinding signage is an essential component of pedestrian-friendly streetscapes that assist pedestrians with navigating an area. Wayfinding signage may be used to orient and provide directions to pedestrians, especially when they are in unfamiliar areas. Wayfinding signage is more flexible than regulatory signage in terms of design and placement. (Regulatory signage is used to inform users of traffic laws and to draw attention to pedestrian or bike facilities, and is governed by the FHWA

MUTCD.) While there are many types of signs that contribute to the complex character of streets, this section focuses on wayfinding signage.

Application

- Wayfinding signage may be used to direct pedestrians to destinations such as transit stops and stations, schools, parks, recreational facilities, libraries, cultural points, museums, entertainment centers, shops, business districts, neighborhoods, and bike route connections.
- Wayfinding signage may be used as part of a gateway treatment to identify the entrance to a place.
- Wayfinding signage may be used as a part of placemaking.
- Wayfinding signage may be placed in the frontage or greenscape/furniture zone, on furniture, on building facades, or in/on the pavement.

Critical Design Requirements

- Wayfinding signage should be placed at key decision points along pedestrian and bike routes and at origins and destinations. Decision points are where the pedestrian or cyclists must decide whether to continue along the route or change direction.
- Wayfinding signs should be offset a minimum of 1 foot from the curb (4 feet preferred).
- Wayfinding signs should not be placed in or protrude into the pedestrian circulation zone, except for pavement decals.
- Pavement decals should not be thicker than ¼ inch to comply with ADA and so as not to create a tripping hazard and shall not have a joint or opening exceeding ½ inch.
- Signage should be mounted 7 feet above the surface of the sidewalk.
- Wayfinding signage should be durable and designed to withstand harsh weather conditions.

Additional Considerations

- Wayfinding signage may take many forms; some examples include kiosks, maps, sidewalk or pavement decals, plaques embedded in the ground, or engravings.
- Wayfinding signage may be designed with simple phrases and graphics that are easy to interpret.
- A best practice is providing wayfinding signage that includes a reference point on a map—such as a symbol or the phrase 'You Are Here'—to help pedestrians orient themselves, as does signage that includes distances in the form of average walking or biking time.

Further Guidance

- City of Boston, *Boston Complete Streets Design Guidelines* (latest edition)
- Designworkplan, "Introduction to Wayfinding and Signage design" (n.d.)
- FHWA, MUTCD (latest edition)
- Foltz, *Designing Navigable Information Spaces* (latest edition)
- GDOT, *Signing and Marking Design Guidelines* (latest edition)
- Illuminating Engineering Society of North America (latest edition)
- NACTO, *Transit Street Design Guide: System Wayfinding & Brand* (latest edition)
- NACTO, *Urban Bikeway Design Guide* (latest edition)

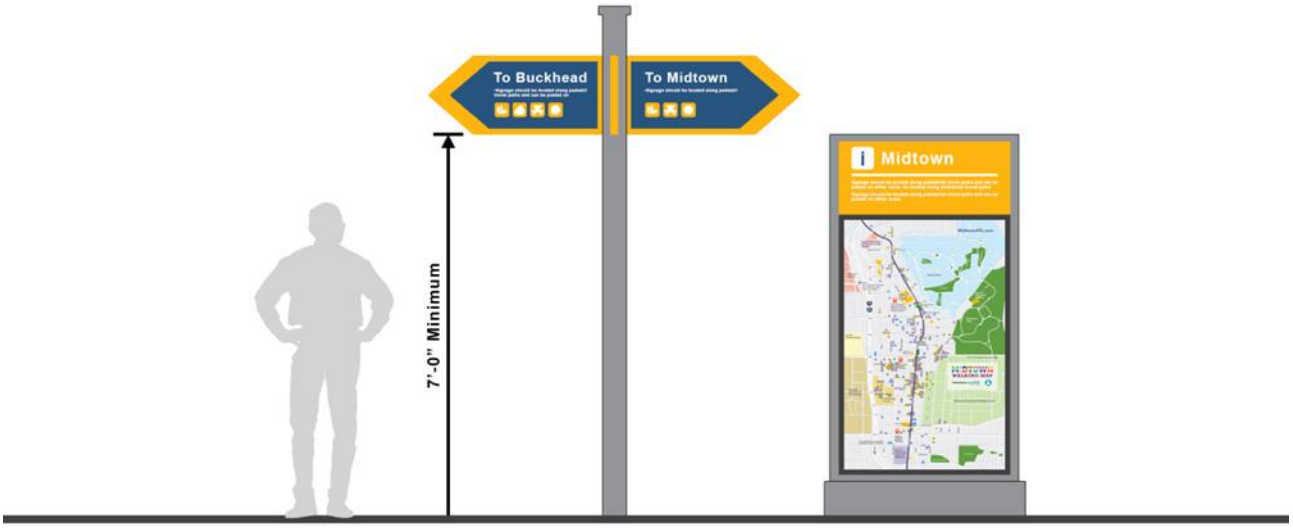


Figure 6.25. Example of Wayfinding Signage

Figure 6.26. Example of Wayfinding Signage, Midtown, Atlanta

Figure 6.27. Example of Placemaking with Banners and Sculpture

6.4 Green Stormwater Infrastructure

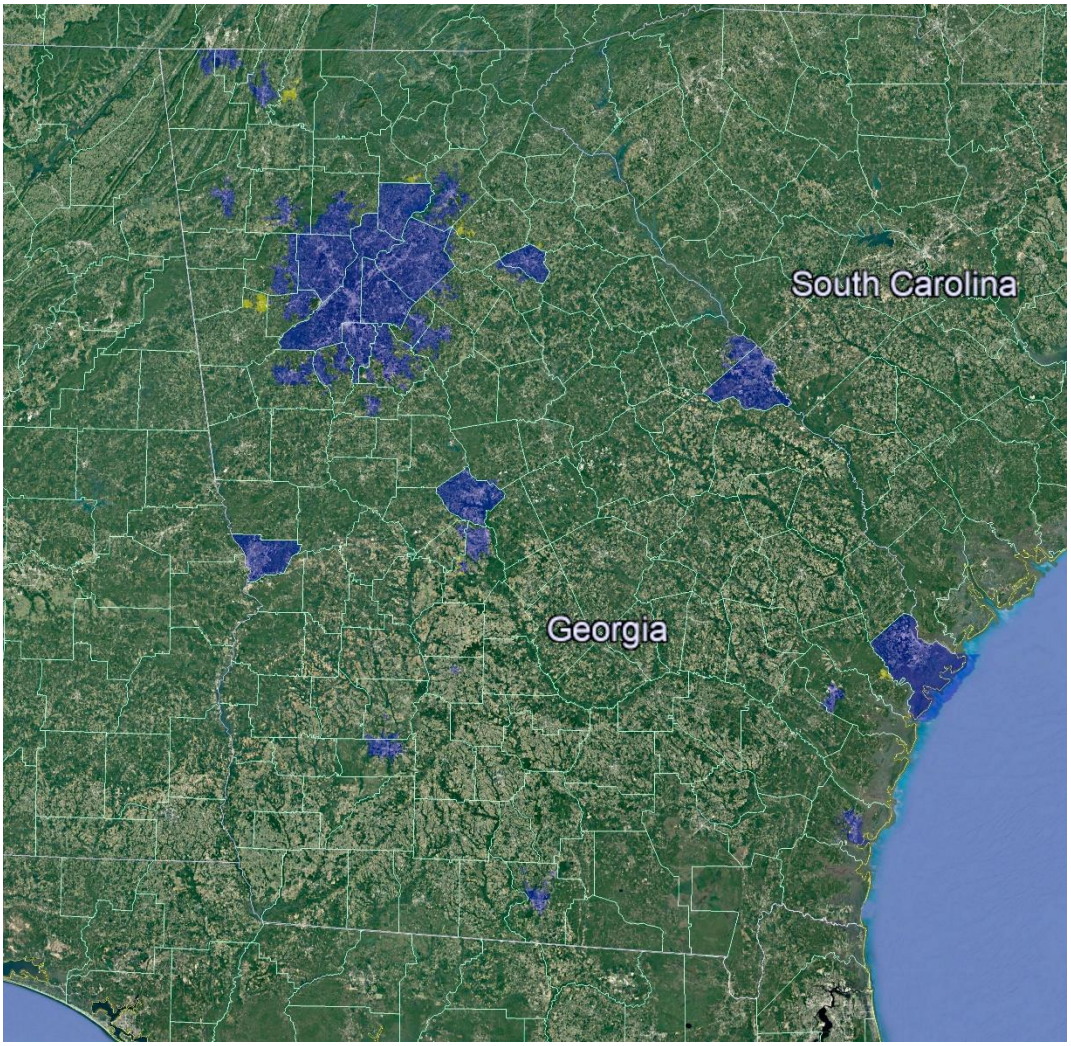
Green stormwater infrastructure refers to natural systems of plant, soil, and rock used to treat and reduce stormwater runoff from impervious surfaces at the source or where the rainfall lands. Since streets and sidewalks make up a large percentage of the impervious surfaces in the public right-of-way, green infrastructure should be considered as a first line of defense in treating stormwater quality. In addition, integrating green infrastructure best management practices into streetscape designs may reduce the volume of stormwater flowing into regional detention systems. Green infrastructure techniques are often the most effective when used in combination with conventional storm drainage systems such as inlets and pipes as they are typically only effective in treating the first 1 to 1.2-inch rainfall event.

GDOT-owned roads or streets that transect a municipal separate storm sewer system (MS4) area must incorporate green infrastructure into the project. Refer to Figure 6.30 at the beginning of a project to check whether the project is in an MS4 area. For more information on the requirements of MS4, refer to GDOT *Drainage Design for Highways* Chapter 10.

GDOT's *Drainage Design for Highways* and ARC's *Georgia Stormwater Management Manual* are the two statewide resources for additional detailed information on green stormwater management best practices. *Drainage Design for Highways* provides a list of GDOT green infrastructure applications pre-approved for use on GDOT-owned and operated facilities. This section provides high-level guidance for a few post-construction stormwater best management practices and green infrastructure types that may be adapted for urban areas and incorporated into streetscape designs.

Figure 6.28. Example of Green Infrastructure, Decatur, Georgia

Figure 6.29. Example of Green Stormwater Infrastructure, Decatur, Georgia



Source: GDOT, Stormwater MS4 Management Program Blue represent the MS4 Permitted areas

Figure 6.30. Map of MS4 Permitted Areas in Georgia

Below is a list of some best management practices, or BMPs, for “green infrastructure”. Please note not all BMPs are applicable for State Routes or “On System” facilities. Further engineering evaluation along with a detailed hydrology study should be conducted prior to the implementation of any stormwater BMP.

6.4.1 Bioretention Planters

A bioretention planter is a plant, soil, and rock infiltration and filtration system suitable for small drainage areas with a high percentage of impervious surfaces. Bioretention planters are bioretention basins with a vertical wall around the edges. Bioretention planters may be incorporated into the frontage or greenscape/furniture zone, curb extensions, and medians of pedestrian refuge areas. The planter depth, width, and vegetation type should be determined based on the results of a detailed hydrology study determining stormwater loads and site constraints. Bioretention planters should be sized to handle the runoff load of the tributary areas and drain within a minimum of 72 hours. Bioretention planters should be a minimum of 4 feet wide to maximize performance. Bioretention

Planters are best used in urbanized areas with limited Right-Of-Way are not permitted on State Routes or “On System Facilities”.

6.4.2 Biofiltration Planters

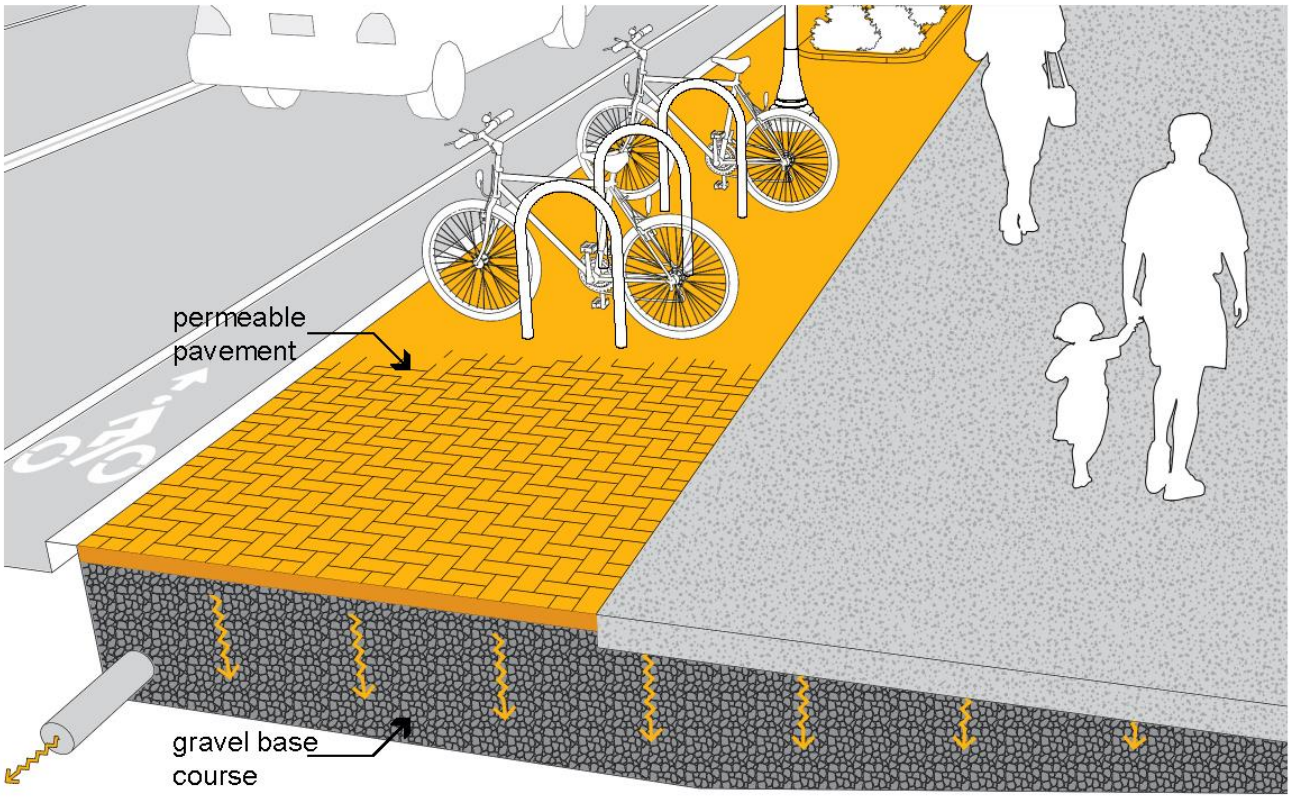
A biofiltration planter is a plant, soil, and rock filtration system suitable for areas where infiltration cannot be achieved. The design of biofiltration planters follows the same requirements as bioretention planters, except that stormwater is stored and slowly released into a subsurface perforated pipe and carried to the grey stormwater infrastructure instead of infiltrating into the subgrade soil. The size and width of a biofiltration planter should be determined based on the results of a detailed hydrology study determining stormwater loads and site constraints. Biofiltration Planters are best used in urbanized areas with limited Right-Of-Way are *not permitted* on State Routes or “On System Facilities”.

6.4.3 Grassed Swales

A grassed swale is similar to a bioretention planter, but without the walls around the edges. Grassed swales are shallow depressions with sloped slides. Bioretention swales require more space than planters to accommodate the optimal slope. Grassed swales are more appropriate when Right-Of-Way is more available as it requires more space implement. Grassed swale Best Manager Practices *are permitted* on State Routes or “On System” facilities.

6.4.4 Permeable Pavement

Permeable pavements are alternative pavement surfaces that allow stormwater to seep through the hardscape material or joints to the subsurface, rather than using traditional stormwater drain systems. Common types of permeable pavements include porous asphalt, pervious concrete, and permeable pavers or bricks. Permeable pavements are laid on top of an infiltration bed and subgrade soil to trap and filter pollutants. Permeable pavement may be used as hardscape accents in the frontage or greenscape/furniture zones. When incorporating permeable pavement into streetscapes, regular maintenance requirements should be considered to vacuum out the sediment which collects in the hardscape voids and blocks infiltration. Permeable pavements are not suitable for roads or streets with high volumes of truck traffic or on facilities with grades that exceed a 5” slope. An application that may be more suitable for permeable paving for consideration would be parking spaces, again further engineering evaluation should be conducted prior to utilizing permeable pavers as a stormwater BMP.



The voids within the permeable pavement are filled with pervious materials that allow stormwater runoff to pass through. The gravel base course provides structural support, temporary storage of stormwater runoff, and infiltrates runoff through underlying soils.
Permeable pavement can be used in conjunction with structural soils, suspended pavement, and tree trenches to increase the volume of water infiltrating into underlying soils.

Figure 6.31. Illustration of Permeable Pavement

Further Guidance

- ARC, *Georgia Stormwater Management Manual* (latest edition)
- GDOT, *Drainage Design for Highways* (latest edition)
- GDOT, *Stormwater System Inspection and Maintenance Manual* (latest edition)
- Liptan and Santen, *Sustainable Stormwater Management: A Landscape Driven Approach to Planning and Design* (latest edition)
- NACTO, *Urban Street Design Guide* (latest edition)
- NACTO, *Urban Street Stormwater Guide* (latest edition)
- Slaney, *Stormwater Management for Sustainable Environments* (latest edition)

6.5 Tree and Plant Considerations

Trees and plants should be incorporated into streetscape designs as much as possible to achieve the following benefits: improve air and water quality, reduce stormwater runoff and soil erosion, increase biodiversity in metropolitan areas, and provide shade and cooling for pedestrians. Tree and plants may be incorporated into the frontage and greenscape/furniture zones and within curb extensions and should comply with the specifications outlined in GDOT Policy 6755-9, *Policy for Landscaping and Enhancements on GDOT Right of Way*.

While trees and plants have numerous benefits for pedestrians, they may also create maintenance challenges. This section provides guidance on factors to consider helping mitigate maintenance issues related to street trees and plantings.

Application

≤35 mph

- Street trees are best planted between the sidewalk and edge of pavement on streets with speeds of 35 mph and less.

6.5.1 Tree and Plant Selection

It is important to select the right tree and plants for a site to ensure longevity and to minimize conflicts with adjacent infrastructure. Trees and plants should be selected based on the specific hardiness zone and the micro climate conditions for a site, including sun/shade conditions, soil compaction, water availability, size of a proposed planting area, and soil volume. In addition, the designer should evaluate specific existing and proposed site conditions associated with the site, which include, but are not limited to, posted speed limits, existing and proposed underground and overheard utilities, site distances at intersections, approaching traffic signal locations, existing and proposed underground and overhead utilities, site aspect (north, south, east, west facing), slopes, tree availability, and existing building and tree locations within the project area. These criteria will help determine the most appropriate tree and tree size for the project site location. The full mature size of the proposed tree should be factored into selection, as the placement of the tree could compromise lateral offset requirements and site distances to traffic signals, signs and from intersections. Trees should be limbed up 80 inches above the adjacent grade to provide clear visibility.

When selecting trees, designers should refer to the list of suggested trees below and the current edition of *American Standard for Nursery Stock* (AmericanHort latest edition) and GDOT Policy 6755-9, *Policy for Landscaping and Enhancements on GDOT Right of Way* for invasive plants that are not permitted on the state's rights-of-way.

Partial Tree Selection List	
Small Canopy: 15 to 20 feet tall with a spread of 15 to 30 feet wide	
Amelanchier arborea | Downey Serviceberry *Cercis canadensis* | Eastern Redbud *Chionanthus virginicus* | White Fringe Tree *Cornus florida* | Flowering Dogwood	*Crataegus phaenopyrum* | Washington Hawthorn *Koelreuteria paniculata* | Golden Rain Tree *Lagerstroemia indica* | Crepe-Myrtle *Prunus x yedoensis* | Yoshino Cherry
Medium Canopy: 35 to 40 feet tall with a spread of 25 to 35 feet wide	
Acer buergerianum | Trident Maple *Acer ginnala* | Amur Maple *Acer rubrum* | Red Maple *Carpinus betulus* | European Hornbeam *Carpinus caroliniana* | American Hornbeam *Cercidiphyllum japonicum* | Katsura Tree *Cladrastis kentukea* | American Yellowwood *Cupressus arizonica* | Arizona (Carolina Saphire) Cypress *Juniperus virginiana* | Eastern Redcedar *Magnolia virginiana* | Sweetbay Magnolia	*Metasequoia glyptostroboides* | Dawn Redwood *Nyssa ogeche* | Ogeechee Lime, Ogeechee Tupelo *Nyssa sylvatica* | Black tupelo *Oxydendrum arboretum* | Sourwood *Pistacia chinensis* | Chinese Pistache *Platanus x acerifolia* | London Plane tree *Prunus caroliniana* | Carolina Cherry laurel *Taxodium distichum* | Bald cypress *Ulmus parvifolia* | Chinese (Athena, Bosque, etc.) Elm *Ulmus americana* 'Jefferson' | Jefferson Elm
Large Canopy: 40 to 80 feet tall with a spread of 30 to 40 feet wide	
Acer rubrum 'Autumn Blaze' | Autumn Blaze Maple *Fraxinus americana* | White Ash *Ginkgo biloba* | Ginkgo (male variety only) *Liquidambar styraciflua* 'Rotundiloba' | Sweet Gum *Platanus × acerifolia* | London Planetree *Quercus alba* | White Oak *Quercus coccinea* | Scarlet Oak *Quercus falcate* | Southern Red Oak *Quercus hemisphaerica* | Laurel Oak *Quercus lyrata* | Overcup Oak	*Quercus phellos* | Willow Oak *Quercus prinus* | Chestnut Oak *Quercus rubra* | Northern Red Oak *Quercus shumardii* | Shumard Oak *Quercus stellate* | Post Oak *Quercus texana* | Nuttal Oak *Quercus virginiana* | Live Oak *Sabal palmetto* | Palmetto Palm *Ulmus americana* 'Princeton' | American Elm

Table 6-1. Partial Tree Selection List

Further Guidance

- AmericanHort, *American Standard for Nursery Stock* (latest edition)
- GDOT Policy 6755-9, *Policy for Landscaping and Enhancements on GDOT Right of Way*
- GDOT, *Design Policy Manual* (latest edition)
- University of Georgia Extension Service, *Shade and Street Tree Care* (latest edition)

Figure 6.32. Shade Trees along a Street, Dunwoody, Georgia

6.5.2 Hardiness Zones of Georgia

Hardiness zones should be used to determine what type of plants may be installed at the location where a streetscape project is being constructed. According to the United States Department of Agriculture, hardiness zones are geographic regions used to determine which plants are most likely to thrive at a specific location. The identification of trees and plants is based on average annual-minimum winter-temperature and climatic conditions. Using plants that are appropriate for the hardiness zone will ensure that they survive through different seasons.

Figure 6.33. Map of USDA Hardiness Zones in Georgia

6.5.3 Infrastructure for Healthy Root Systems

The health and longevity of a tree is related to soil volume available for root growth as the tree matures. Table 6-2 provides the minimum and optimal width of planting strips, tree spacing, and soil volumes for small, medium, and large trees. These dimensions should be met to accommodate root flare and minimize future damage to the sidewalk.

Table 6-2. Street Tree Planting and Soil Area Dimensions

	Small Canopy Trees	Medium Canopy Trees	Large Canopy Trees
Mature Height of Tree	15 ft to 20 ft	35 ft to 40 ft	40 ft to 80 ft
Planting Strip Width	4 ft	6 ft	8 ft
Spacing Between Trees	20 ft recommended 15 ft minimum	30-40 ft recommended 25 ft minimum	40-50 ft recommended 30 ft' minimum
Minimum Soil Volume	120 ft^3 per tree	500 ft^3 per tree	1,000 ft^3 per tree preferred

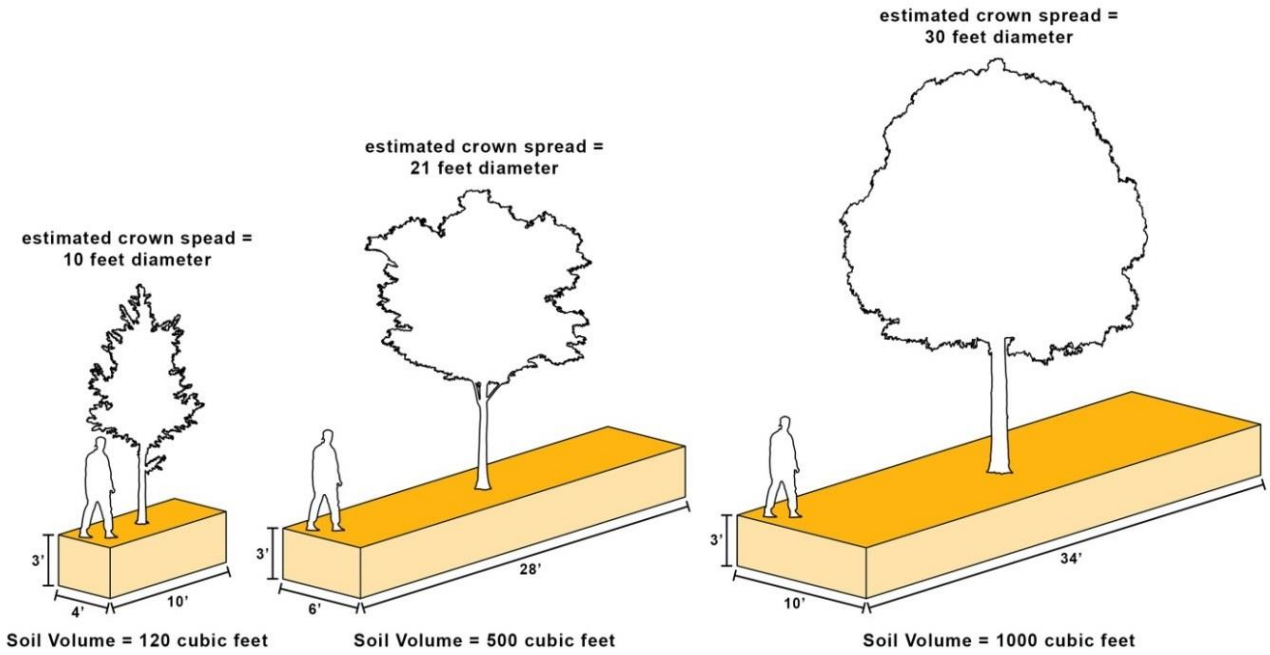


Figure 6.34. Recommended Soil Volumes

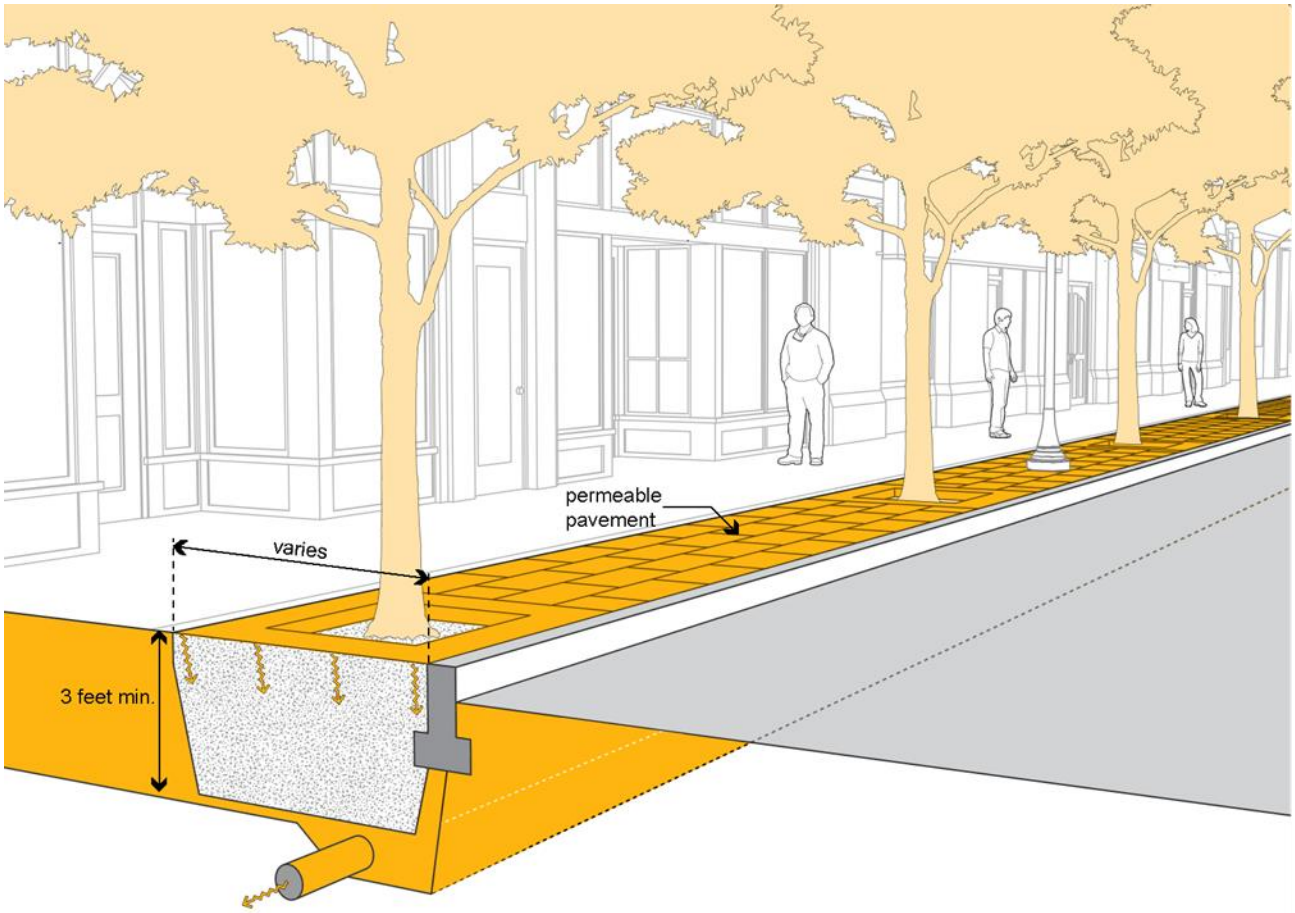
Trees should not be planted in spaces less than 4 feet wide as this will hinder the development of a tree's crown and roots. Tree trenches may be used to provide the appropriate soil volumes in limited urban environments. Tree trenches are continuous basins filled with soil that run parallel to the street.

6.5.3.1 Open Tree Trenches

In an open tree trench the soil around the base of the tree is exposed. These may be used in areas where pedestrians are not likely to walk on and damage the tree. For example, open tree trenches may be appropriate for a center median, but may not be appropriate for a street with curbside parking and retail, due to the volume of pedestrian traffic that is likely to walk across the tree trench.

6.5.3.2 Covered Tree Trenches

Covered tree trenches use a support system to suspend pavement over the soil in the trench. The pavement covering should protect the soil from compaction caused by excessive foot traffic and, in some cases, vehicles use for periodic maintenance. Examples of structural supports include structural cells, rock-based structural soil, sand-based structural soil, and soil boxes.



Structural soils provide sufficient soil volume to increase infiltration. Water distributed through the tree trench is then slowly released into the existing storm sewer. Other examples of best management practices to support healthy trees include structural cells and suspended sidewalks.

Figure 6.35. Example of Covered Tree Trench

6.5.4 Horizontal Clearances for Trees and Shrubs

The clearance zone is located adjacent to active lanes of vehicle traffic, and the width of the clearance zone is a function of the design speed of the roadway. The clearance zone requirements impact the placement and size of trees and shrubs located near the street.

Figure 6.36 is from GDOT's *Design Policy Manual* and provides the minimum horizontal clearance for trees and shrubs related to roadway posted design speeds and context. The minimum horizontal clearance, also referred to the lateral horizontal offset, is between the location of a proposed tree or landscape element measured from the adjacent edge of pavement or face of curb to the center of the tree trunk or plant.

For "on system" and state route roadways, trees and shrubs within the horizontal clear zone should be limited to a maximum height of 30 inches. For "off system" streets under the jurisdiction of local agencies refer to local ordinances that may apply. If local ordinances do not exist, refer to GDOT's *Design Policy Manual* for horizontal clearances for trees and shrubs.

Horizontal Clearances for Trees and Shrubs	
Posted / Design Speed	**Minimum Horizontal Clearance[1]**
≤ 35 mph (Commercial Area[2])	4-ft. 8-ft. median
≤ 35mph	8-ft. 8-ft. in median
40 mph	10-ft. 16-ft. in median[3]
45 mph	14-ft. 22-ft. in median[3]
>45 mph	Outside the clear zone
Interstates	120% of the clear zone requirement

[1] From center of tree to face of curb.

[2]In a Central Business District and/or where commercial businesses are typically directly adjacent to the rights of way.

[3]Small trees and shrubs that mature at ≤ 4" in diameter may be planted a minimum of 8 feet from the face of the curb in medians adjacent to 40 to 45 mph speeds. Tree size is diameter of the tree at maturity, measured at dbh (4.5 feet above the ground).

Certain situations may require an increased horizontal clearance setback for additional safety considerations.

For rural shoulders, trees should be placed outside the clear zone.

Figure 6.36. GDOT Chart - Horizontal Clearance for Trees and Shrubs

Deviation from the requirements for "on system" streets shall be approved by GDOT in writing through the design variance process (see Chapter 2). Refer to GDOT Policy 6755-9, *Policy for Landscaping and Enhancements on GDOT Right of Way* for further guidance on landscape enhancements on state rights-of-way. For "off system" streets under the jurisdiction of a local agency, refer to local design standards if available.

Street trees within medians and in pedestrian traffic areas should be pruned so that the limbs are a minimum of 7 feet above grade. Utilities and intersection sight distance requirements may affect the location of proposed trees in the horizontal clear zone. Additional requirements for clearance setbacks are provided by GDOT's *Design Policy Manual*. Within a streetscape setting, large mature trees should be pruned to provide a minimum of 80 inches of clear visibility and should be maintained to not obstruct traffic signals or traffic signs.

Prior to proposing a tree or plant material for a project, the practitioner must become familiar with the existing and proposed site conditions. Careful consideration should be made to determine the appropriate tree for the given context. The practitioner should evaluate the mature size of the proposed tree or plant so that essential elements such as traffic signals and signs are not blocked by the proposed tree or plant. A conservative approach is best for determining the right tree or plant for a location so that safety measures are not impacted by the installed landscape element.

For example, a Live Oak could be planted 4 feet from the face of curb to the center of the tree trunk within the horizontal clear zone on a low speed street of 35 mph or less within a Central Business District. However, the Live Oak's growth habit and size at maturity may result in an encroachment on the travel lane during its life, and therefore should be either set back further or replaced with a more suitable tree with a smaller size at maturity. In this case, the tree may suffer due to the limited soil volume, the sidewalk could be undermined and lifted, and roadway elements such as the curb and roadway base could be impacted. Countermeasures such as "root panels" may help mitigate the root system, however over time, the Live Oak roots will overcome the panels due to the root growth habit.

6.5.5 Tree and Plant Approval Prior to Installation

The project landscape architect should be retained by the client to tag trees and approve plant material at the nursery, prior to shipping or transporting items to the project site. The landscape architect should verify the specified design intent and quality is achieved. In some instances, it may not be practical to send the landscape architect to the nursery; in those cases, at a minimum, the landscape contractor should provide the landscape architect with pictures of the landscape material with a measuring tape or measuring rod to verify the height and form of the tree for review, comment, and final approval.

Figure 6.37. Tree Selection at a Nursery

6.5.6 Tree Protection during Construction

Soil compaction is the number one reason trees die as part of streetscape projects. Trees should be protected from soil compaction to mitigate damage that occurs to soil structure due to construction activities. Soil compaction from heavy construction equipment reduces the soil's capability to hold and absorb water, impedes and stunts root growth, increases runoff, and severely impacts the health of the tree. When a tree is within the project limits and there is a risk of construction activity occurring around the root zone of a tree that is to be saved, it should be included in the tree protection zone or (TPZ). The TPZ zone extends to the far ends of the tree canopy. The critical root zone (CRZ) is measured from the center of the tree, for every 1 inch of diameter of tree or caliper, extend the radius 1 foot out to the entire diameter of the existing tree. For example, a 36 inch diameter or caliper tree trunk will have a 36 foot radius CRZ. Whichever is further, the TPZ or the CRZ, is where to start the tree protection or orange barrier fencing and encircle the existing tree.

Another option for protecting the tree roots of an existing tree is to place 6 inches of gravel underneath the sidewalk or pavers to minimize soil compaction over the root system. This is an effective and low

cost method to provide additional benefits to the environment during and after a streetscape project is completed.

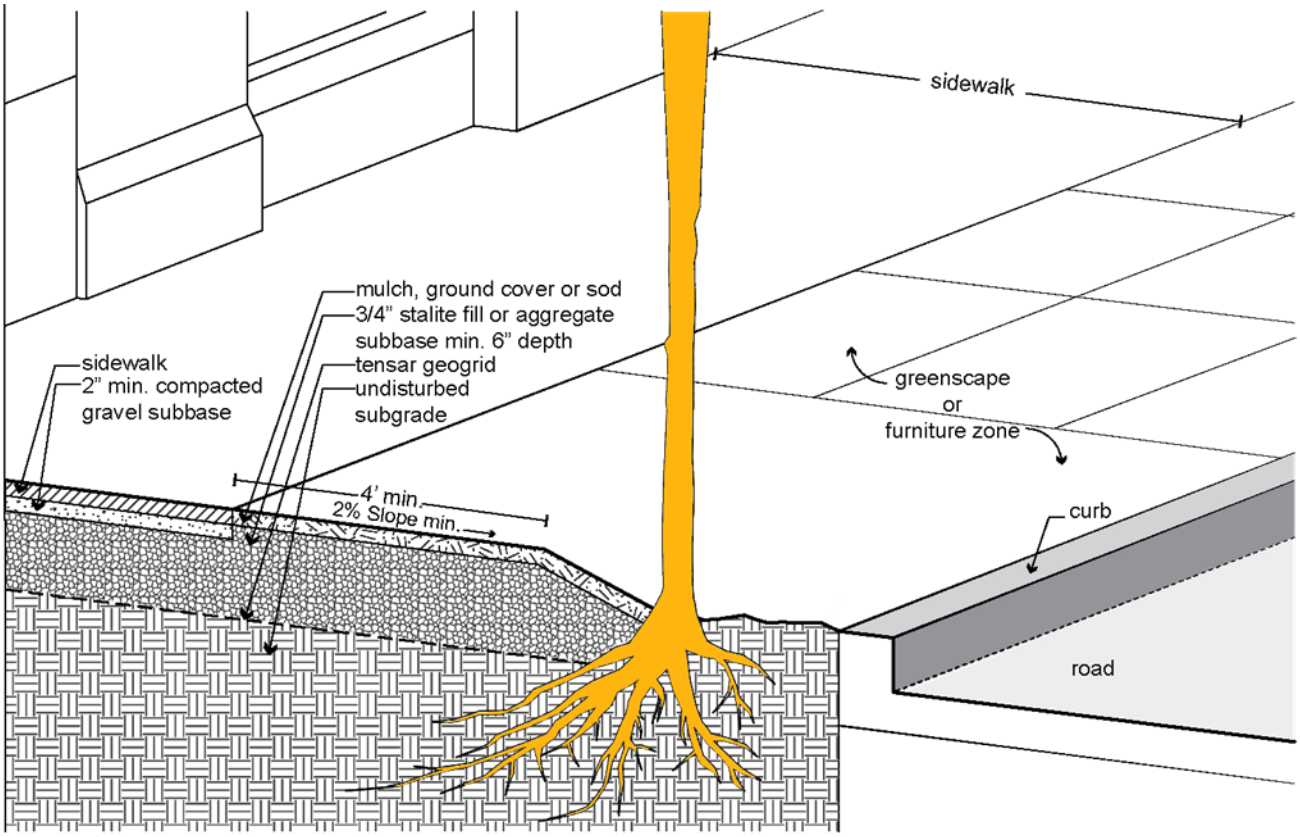


Figure 6.38. Tree Root Protection to Minimize Compaction

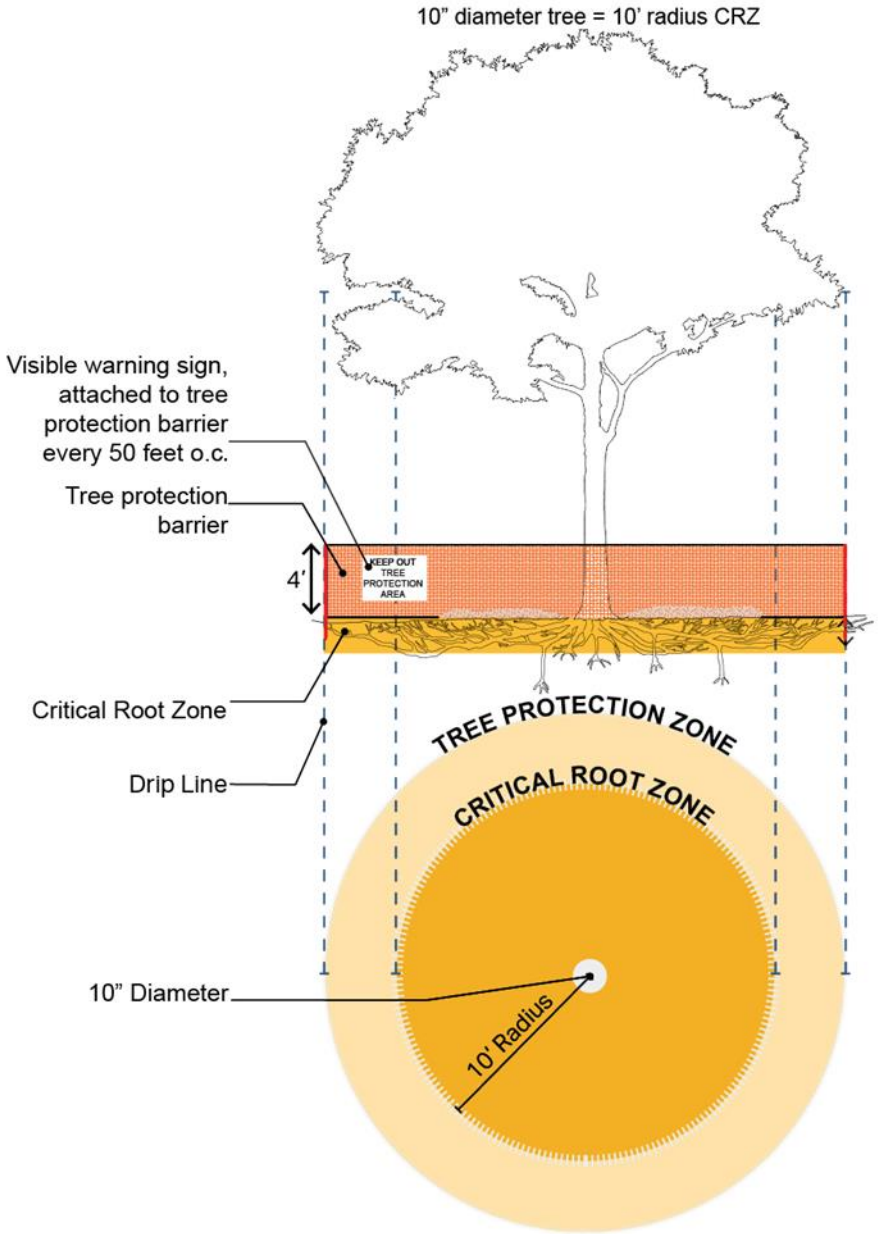


Figure 6.39. Tree Protection During Construction

Table 6-3 provides guidance on how to monitor trees during different phases of construction to ensure that the Critical Root Zone, or CRZ, is not damaged by soil compaction.

Table 6-3. Monitoring Trees During Construction

Survey Phase
• The surveyor should locate specimen trees, typically determined by the local municipality within their tree protection ordinance, within the project limits, noting at minimum the location, species, and caliper inches. • Surveyor should review the local tree ordinances to ensure that the survey picks of existing trees that meet the local tree ordinance as related to replacement and recompense requirements. • Site boundaries, required zoning, easements, and environmental setbacks should be marked on survey plans. • A tree inventory should include the location, size, and relative health of each tree.
Planning Phase
• Location and integration of long-term tree protection and site design should be discussed with the client and project team. • Assessment of existing utilities should be made to identify any conflicts between future street trees and existing utilities.
Design Phase
• Coordination between utility providers and street tree locations should be coordinated and approved by project team and utility providers. • Trees to be preserved onsite should be determined and trees should be conserved in groups where possible.
Pre-construction Phase
• Contractor ingress and egress of the project site should be discussed. The contractor's equipment and parking should be outside the fenced TPZ. • Potential laydown areas of soil/construction material and proximity to tree protection fencing should be discussed prior to construction. • Durable tree protection fencing (orange barrier or chain link fence as specified) should be placed to restrict entry into the TPZ in the construction zone. • Weatherproof signage should be placed along the tree protection barrier, at 6- to-8-foot intervals, stating "KEEP OUT TREE PROTECTION AREA." • Prior to construction activities, branches or trees that may pose an immediate risk to people or structures should be removed. • Soil health and past site damage should be surveyed, sampled, and assessed. • Each stage of construction should be photo documented.

Construction Phase

- Maintenance staff should be engaged in early decision making, and educated about the care of retained and proposed trees and their requirements for protection during construction.
- TPZs should not be disturbed during construction activities.
- If roots 2 inches or greater in diameter are exposed outside of the CRZ, contractors should use root wrap to further aerate and hydrate roots as feasible.

Site Monitoring

- Tree protection barriers should be kept until the project is completed.
- Contractor should inspect the TPZ a minimum of once per week to ensure fencing is compliant and intact. Contractor should correct fencing if damaged or unlocked.

Post-Construction Phase

- TPZ fencing may be removed.
- A final inspection should be performed. Mulch thickness and soil moisture should be monitored. Tree damage should be assessed and inspected for insects and pests, and fertilization if needed.

Further Guidance

- Dines and Brown, *Time-Saver Standards for Landscape Architects* (latest edition)
- FHWA, *A Guide for Maintaining Pedestrian Facilities for Enhanced Safety* (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- ISA, *Managing Trees During Construction* (latest edition)
- University of Florida, Landscape Plants (latest edition)
- Urban, *Up by Roots: Healthy Soils and Trees in the Built Environment* (latest edition)

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Chapter 7. Pedestrian Safety in Work Zones - Contents

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Chapter 7. Pedestrian Safety in Work Zones

The most common interruptions impacting the sidewalk are work zones from development-related construction projects, roadway and streetscape construction projects, and utility work in the public right-of-way, which may last for months or even years. Work zones may be particularly challenging for pedestrians, introducing unfamiliar conditions, confusion, noise, delay, and the potential for conflicts with vehicles. When a work zone disrupts pedestrian travel through the partial or full closure of the sidewalk, a convenient and accessible alternative route must be provided, guiding the pedestrian around the work site and back to the original sidewalk or walkway. This chapter provides guidance on alternative routes for pedestrians in construction work zones.

7.1 Temporary Traffic Control and Detour Plans

When roadway or development projects are in the planning phase, a plan should be developed to minimize pedestrian disruptions during construction. Temporary traffic control and detour plans should consider accessibility for pedestrians, bicyclists, and public transit. For further guidance, please refer, GDOT, Special Provision Section 150 – Traffic Control (latest edition)

Critical Design Requirements

- Existing pedestrian facilities, including access to transit stops, should be maintained. Where pedestrian routes are closed, alternate routes should be provided.
- Closures of existing, interim, and final pedestrian facilities should have the prior written approval of the Engineer, as specified in GDOT Special Provision Section 150.
- Whenever a sidewalk is to be closed, the Engineer should notify the maintaining agency two weeks prior to the closure, as specified in GDOT Special Provision Section 150.
- Prior to closure, barriers that are detectable by a person with a visual disability traveling with the aid of a long cane, as described by the MUTCD, should be placed across the full width of the closed sidewalk.
- When existing pedestrian facilities are disrupted, closed, or relocated in a temporary traffic control zone, the temporary facilities should be detectable and should include accessibility features.
- The alternative route should be located adjacent to the existing sidewalk where possible. Separation devices should be placed between the alternative route and the construction site, and between the alternative route and moving traffic.
- The sidewalk should be fully closed on only one side of the street at a time.
- Alternative pedestrian routes should be prioritized over parking and vehicle lanes.
- Efforts should be made to keep transit stops operational, and pedestrian pathways to transit stops and boarding locations must remain clear.
- Pedestrian detours and accommodations should not affect access to businesses during operating hours, and scaffolding and equipment must not block accessible electronic door opening panels. The agency or developer overseeing the project should consider the access needs of affected businesses and notify affected businesses and property owners.

Preferred prioritization for alternative pedestrian accommodations:

1. Separate the pedestrian walkway (or a portion thereof) from the work site with a separation device.
2. Create a temporary pedestrian walkway or shared use path in an adjacent parking lane and separate it from vehicle or bike traffic.
3. Create a temporary pedestrian walkway or shared use path in an existing bike lane adjacent to the sidewalk, separate it from vehicle traffic, and either merge bicycles with traffic or with pedestrians on a shared use path.
4. Create a temporary pedestrian walkway in an adjacent vehicle lane and separate it from vehicle traffic
5. Close the full sidewalk and detour the pedestrian across the street to the opposite sidewalk.
6. Close the full sidewalk and detour the pedestrian on a different route.

Sidewalk closure should only be considered when no other solution is possible. When closure is required, work crews and utility construction should be coordinated to minimize pedestrian impacts and avoid peak times.

7.2 Components of an Accessible Work Zone

Traffic control devices used during the construction of "on system" projects should meet the standards utilized in the MUTCD, and should comply with the requirements outlined in GDOT Special Provision Section 150, Georgia Construction Standards and Details, Project Plans, Design Manuals, and Special Provisions.

All traffic control devices used during the construction of "off system" projects by local agencies should meet the standards utilized in the MUTCD and the project construction documents. The GDOT requirements should be considered to provide an accessible work zone consistent with the standard practice used on construction projects in Georgia, or better.

7.2.1 Separation Devices

Temporary pedestrian walkways and shared use paths should have continuous physical separation from vehicular traffic (except at crosswalks) and active work zones.

Critical Design Requirements

- Barriers used along a temporary pedestrian route should comply with the MUTCD Section 6D.01-.02.
- Barriers must be ADA detectable and highly visible with retroreflective markings.
- Barriers with a hand rail should be between 34 inches and 42 inches high, allowing pedestrians to use the hand rail as a guide for their hands.
- Separation devices may be barriers, fencing, or other stable, continuous, non-flexible channelization devices; caution tape and flexible fencing do not provide sufficient separation.

7.2.2 Sidewalk Closure and Detour Signs

In the case of a sidewalk closure that requires a detour, advanced signage should be provided directing pedestrians to the detour. Clear signage should be provided at the nearest intersection and on both sides of a sidewalk or detour to alert pedestrians and guide them back to the original sidewalk.

Critical Design Requirements

- Sidewalk closure and detour signs should comply with GDOT Construction Detail T-21.
- Sidewalk closure signs should be cane-detectable and extend across the width of the sidewalk.
- Signage should not block the minimum pedestrian travel-way requirements.

7.2.3 Temporary Pedestrian Crossings

During construction near pedestrian crossings, advance signage should be placed at intersections to alert pedestrians of construction work sites that may be located at intersections or mid-block locations and direct them to safe alternate routes.

Critical Design Requirements

- Avoid closing crosswalks if possible. If a street crossing is closed, the crosswalk should be blocked with continuous Type II or Type III barriers. Pedestrian signal heads should be removed, covered, or turned, on both sides of the closed crosswalk, and sidewalk closure signage should be provided.
- Where temporary signals need to be included in the traffic control plan, pedestrian phases should be included in the temporary signals.
- Temporary marked crosswalks require an engineering study, and should meet crosswalk requirements in Section 4.4.8 of this Guide.
- Parking should be restricted within 50 feet of a temporary mid-block crosswalk, and within 20 feet of a temporary marked crosswalk at a permanent crossing for increased visibility.
- Where a temporary pedestrian walkway begins or ends at a crosswalk, temporary markings must be provided to align pedestrians with the legal crossing.
- Where a temporary pedestrian walkway includes a crosswalk that remains open, a barrier should be provided to align pedestrians with the legal crossing.
- The visibility of the pedestrian signal heads should be maintained from all points in the crosswalk.
- Access to pedestrian pushbuttons should be maintained if possible. Otherwise, the signal must temporarily be changed to include an automatic pedestrian crossing phase.

7.2.4 Temporary Pedestrian Walkways

During the construction of structures that are adjacent to sidewalks, a temporary covered walkway may be installed to protect pedestrians from falling debris. Temporary covered walkways should provide sufficient lighting for nighttime use, be designed to be robust and provide clear sight distances at intersections and crosswalks.

Critical Design Requirements

- Pedestrian walkways should comply with GDOT Sidewalk Diversion Detail T-20.
- Pedestrian walkways should be 5 feet wide (minimum 4 feet) for constrained areas.
- Pedestrian walkways should meet PROWAG requirements, including width, slope, and cross slope requirements.
- Grade changes greater than ½ inch must provide temporary ADA-compliant ramps.
- Temporary multiuse paths should be a minimum of 8 feet wide in confined areas for a limited distance, if not the temporary shared use paths should be a minimum of 10 feet.
- A 96-inch vertical clearance should be maintained along the length of a temporary shared use path.
- Covered pedestrian walkaways should maintain an 80-inch vertical clearance to overhead obstructions.
- Surface materials should be firm, stable, and slip resistant.

Figure 7.1. Example of Pedestrian Circulation Adjacent to a Construction Site

7.3 Maintenance of Pedestrian and Bicycle Infrastructure in Work Zones

Pedestrian and bicycle facilities in and adjacent to work zones should be maintained to provide safety and functionality. Proper maintenance will maximize the safety, effectiveness, and life of work zone alternative routes or detour facilities. Inadequate maintenance activity may result in increased work zone accidents. The contractor should maintain existing and temporary traffic control devices as specified in the traffic control plan, and should have them routinely inspected by a knowledgeable person for adequate compliance, visibility, and condition of the traffic control devices. Local jurisdictions should train construction inspection staff to recognize improper and unsafe pedestrian facilities.

Critical Design Requirements

- Walkways and bike route surfaces should be inspected regularly and be free of construction debris, including gravel, dirt, or mud.
- The contractor should inspect after storms for blown over construction signage, construction fencing, and barricades.
- Pathways should remain clear and passable and free of obstacles such as parked equipment and vehicles, temporary storage of construction materials, traffic control signs, overhead or encroaching obstructions, and misaligned construction fencing.
- Surfaces with holes, cracks, or vertical separation should be replaced.
- Damaged or misaligned traffic barriers should be replaced or repositioned to be consistent with the traffic control plan.
- If the pedestrian or bicycle route changes during construction, the detour signing should be inspected to ensure a clearly understood pathway.

Further Guidance

- AASHTO, *Guide for the Development of Bicycle Facilities* (latest edition)
- City of Chicago, *Rules and Regulations for Construction in the Public Way* (latest edition)
- City of Portland, *Traffic Design Manual Volume 2: Temporary Traffic Control* (latest edition)
- FHWA, MUTCD Section 6G.05 (latest edition)
- GDOT, Special Provision Section 150 – Traffic Control (latest edition)
- HDOT, *Hawaii Pedestrian Toolbox Section 11: Safety in Work Zones and Maintenance* (2013)
- NACTO, *Urban Street Design Guide: Curb Extensions* (latest edition)
- US Access Board, PROWAG (latest edition)

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Appendix A. Mid-Block Pedestrian Crossing Evaluation

A.1 Introduction

A.1.1 Goals of this Guide

The goal of this guide is to assist engineers, planners, and other professionals in evaluating the placement of pedestrian crossings, and selecting traffic control and other design elements at uncontrolled locations. Uncontrolled pedestrian locations occur where a sidewalk or pedestrian path intersects a roadway at a location where no traffic control (i.e., stop sign or traffic signal) that requires a stop condition in advance of the pedestrian crossing.

Pedestrians often desire to reach the opposite side of the roadway at more frequent intervals than crossing at existing signalized or stop controlled intersections permit. When deciding where to cross the street, pedestrians constantly judge whether their personal safety will be improved by walking to the nearest crosswalk versus crossing at a point outside of the marked crossing. In urban areas with large volumes of pedestrians and high crossing demand, a lack of pedestrian crossing opportunities can result in unsafe crossing behavior (PEDS, *Identifying, Assessing, and Improving Uncontrolled Intersections for Pedestrian Access: Draft Recommendations*). On the other hand, simply marking a crosswalk without including other pedestrian crossing treatments such as lighting, pedestrian hybrid beacons, curb extensions, etc., does not necessarily improve pedestrian safety. In some situations, the marked crosswalk alone may increase the potential for pedestrian-vehicle crashes.

Before installing a marked crosswalk at an uncontrolled location, agencies should complete a pedestrian crossing evaluation. This guide outlines a step-by-step process and provides data collection worksheets to assist with the evaluation.

This guide provides recommendations for situations where marked crosswalks:

- May be installed
- If placed alone are not sufficient
- May be supplemented with additional traffic control and pedestrian safety infrastructure, such as lighting, curb extensions, a median refuge island, etc.

A.1.2 Agency Application

There are many factors to consider when deciding whether a marked pedestrian crossing is recommended at a specific location and what type of treatment is appropriate. Because every situation is unique, it is difficult to prescribe a “one size fits all” evaluation process. The evaluation process and criteria presented in this guide are GDOT’s guidance and recommendations. The final decision to install pedestrian crossing infrastructure is based on engineering judgment.

A.1.2.1 Agency Feedback

Developing a methodology that supports consistent evaluation and installation of pedestrian infrastructure is a collaborative effort that requires continuous feedback. The process described in this guide is continually evolving and becoming more refined as more emphasis is placed on pedestrian safety and more pedestrian infrastructure is installed.

A.2 Pedestrian Crossing Evaluation Process Overview

The evaluation process may be applied to the concept-level design phase for the following situations:

- Road construction and reconstruction
- 3R (resurfacing, restoration, rehabilitation) projects
- Corridor or intersection restriping
- Targeted safety improvements
- Road safety audit
- Traffic engineering studies
- Corridor planning projects
- Response to public requests

A.2.1 Evaluation Process Overview

The process presented in this guide is intended to assist agencies with evaluating the appropriate location and design elements of pedestrian crossings and increase consistency in the decision-making process. Evaluation of an individual location or multiple locations along a corridor for potential crossing treatments should include the following basic steps, which are further defined below:

- Step 1: Review GDOT Complete Streets Policy
- Step 2: Collect Data and Make Field Observations
- Step 3: Evaluate the Location
- Step 4: Select the Pedestrian Crossing Treatment

A.2.2 Documenting the Pedestrian Crossing Evaluation

Every pedestrian crossing evaluation should be documented, and relevant material should be prepared in the form of an engineering study for GDOT. The engineering study should include:

- GDOT Complete Streets Policy checklist (step 1)
- Data collection sheets (step 2)
- Crosswalk location evaluation (step 3)
- Pedestrian crossing treatment selection (step 4)

A.2.2.1 Step 1: Review GDOT Complete Streets Policy

The first step in the evaluation process is to review GDOT's Complete Streets Policy and determine whether pedestrian infrastructure should be provided at a specified location. The GDOT Complete Streets Policy establishes standards and guidelines for when to incorporate bicycle, pedestrian, and transit accommodations into transportation infrastructure projects. GDOT's Complete Streets Policy should be reviewed at the beginning of the concept development phase of a transportation project or planning study, on GDOT-owned facilities, to determine whether pedestrian infrastructure should be considered as part of the project. Streets under the jurisdiction of a local agency should also be considered for pedestrian accommodations. Refer to Chapter 9 of the GODT *Design Policy Manual* to review the Complete Streets Policy.

Table A-1 presents a series of questions that break down GDOT's Complete Streets Policy: Pedestrian Warrants. This table can be used as a tool to check whether pedestrian infrastructure is

warranted on GDOT-owned roadways. This checklist is intended to help engineers and planners interpret the warrants, the final determination, but should still be made in the context of the warrants.

Table A-1. Pre-Evaluation Screening Questions

	Questions		Y/N
Standard	Is the project located in an urban area?	If located in an urban area, is the project a planning study, reconstruction, new construction, capacity-adding, or resurfacing project which include curb and gutter as part of an urban border area? (Refer to Section 6.7 of the GDOT *Design Policy Manual* for more information on urban border areas).	
	Is the project located in a rural area?	If located in a rural, are there existing or planned pedestrian travel generators and destinations along the segment of roadway under evaluation? (Generators and destinations can include but are not limited to residential neighborhoods, commercial areas, schools, public park, transit stops and stations, and convenient stores).	
		If located in a rural, is there evidence of pedestrian traffic (e.g., a worn path along roadside) at any point along the segments of roadway under evaluation?	
		If located in a rural, have there been pedestrian crashes equal to or exceeding the rate of 10 crashes per ½ mile segment of roadway over the most recent five years for which crash data is available?	
		If located in a rural, has a local or regional adopted planning study identified the need for pedestrian accommodations for any point along the segment of roadway under evaluation?	
Guidelines	Is there a school, college, university, major institution, shopping center, convenience store, park, or another major pedestrian generator along or within close proximity to the segment of roadway under evaluation?		
	Is there a shared use path or transit stop along the segment of roadway under evaluation?		
	Is there an approved development that may generate pedestrian traffic in the future within close proximity to the segment of roadway under evaluation?		
	Is the project in an urbanized area or an area projected to be urbanized by an MPO, regional commission, or local government prior to the design year of the project?		
	Have one or more pedestrian fatalities ever occurred along the segment of roadway under evaluation?		
	Has a vehicle-pedestrian crash occurred in the past five years along the segment of roadway under evaluation?		
	Do any city, county, MPO, or regional commission plans (comprehensive transportation plans, livable community, community development plans, etc.) identify the need for pedestrian accommodations along the segment of roadway under evaluation?		
	Has reasonable community interest related to pedestrian infrastructure been received in the past two to four years?		

A.2.2.2 Step 2: Collect Data and Make Field Observations

This section describes the data that may be collected to evaluate crossing locations and select a crossing treatment (steps 3 and 4). Review the following subsections, collect the data described in these subsections, and record the observations/data on the data collection sheets, which are included at the end of this document. These sheets can be printed or used as fillable forms.

A.2.2.2.1 Compile Previously Adopted Plans

Background information from transportation or community development plans related to the site will help identify previous discussions, assumptions, and decisions made related to pedestrian infrastructure. Proposed and approved site development plans will provide insight into where future pedestrian activity is likely to occur. Together, these documents will help evaluators understand the history, provide direction for future modifications (if any), and support the final recommendation. At the onset of a project, designers should ask the following questions:

- Do previously adopted plans and/or concept design documents mention the need for or provide recommendations for pedestrian infrastructure in the study area?
- How much pedestrian activity will future developments generate?

A.2.2.2.2 Document Existing Infrastructure and Developments

Knowledge of the existing roadway configuration, pedestrian accommodations, and adjacent land uses and developments is necessary to determine the type and location of pedestrian infrastructure. When assessing the existing site conditions, consider the following questions found in **Table A-2:**

Table A-2. Existing Site Conditions Assessment

Questions	
Pedestrian Path	What are the existing pedestrian accommodations (i.e., shared use path, sidewalk, worn foot)?
	Where are the existing pedestrian accommodations (i.e., both sides of the street, one-side)?
	What is the existing roadway configuration including the width of roadway (from curb to curb), number of lanes, turn lanes, and the presence of painted or raised medians?
	What is the type (painted, raised, planted, etc.) and dimensions of the median (if applicable)?
	Are physical barriers present either along the roadway or leading up to the roadway that are channelizing pedestrians to certain crossing points (fences, ditches, vegetation, etc.)?
Traffic Control	Are there traffic controls (stop signs, traffic signals, marked crosswalks, rectangular rapid flashing beacons [RRFB], pedestrian hybrid beacons [PHB], warning signs, etc.) along the corridor?
	If there is a traffic signal along the corridor, how long is the pedestrian signal phase?
Lighting	Are there street lights along the corridor? If so, what is their primary function (i.e., roadway or sidewalk illumination)?
Land Uses	What are the adjacent land uses or developments (i.e., multi-family housing, grocery store, educational institution, etc.)?
Transit	Where are the transit (bus or train) stops along the corridor?

Questions	
Non-motorized users	Are there shared use path entrances along the corridor?
Special events	Are special events (sports games, farmers markets, concerts, etc.) held on adjacent properties along the corridor?

A.2.2.2.3 Observe Pedestrian Activity

In order to design useful pedestrian infrastructure, an engineer should have an understanding of the level and type of pedestrian activity along a corridor. This information can be used to identify the infrastructure, traffic operations, and places to install pedestrian crossings. When collecting traffic data, it is important to consider the following questions in **Table A-3.**

Table A-3. Pedestrian Activity Assessment

Questions	
Pedestrian path	Where are pedestrians walking and crossing the street?
	Are pedestrian crossings at intersections or mid-block?
Pedestrian volumes	What are the pedestrian volumes during the peak hours of pedestrian use along the segment of roadway, crossing, or corridor under evaluation?
	When are the peak hours of pedestrian activity (weekends, lunch time, at night, etc.)?
Pedestrian Behavior	What is the pedestrian compliance rate (i.e., are pedestrians crossing at a marked pedestrian crossing or during a designated pedestrian phase)?
Driver Behavior	What is the driver compliance rate (i.e., are drivers yielding to pedestrians crossing or waiting the cross the street at a marked crosswalk)?
	Are drivers frequently exceeding the speed limit?

Peak hours of pedestrian use typically occur during fair weather conditions and could be different than peak hours of vehicular use. The developments and recurring community events in the study area may serve as indicators to determine the best time to collect data. For example, in some scenarios, pedestrian activity may be elevated on weekends or at night, if there are places of worship or restaurants in the study area. Multiple days of data collection may be necessary to observe peak pedestrian volumes. Three days of data collection is recommended but this may be shortened to one day if sufficient data are obtained based on engineering judgment. It is recommended to count pedestrians separately from bicyclists and to take note of the percentage of pedestrians who are under the age of 16, elderly, or disabled.

Other questions to consider include the following:

- When are the peak hours of pedestrian activity (weekends, lunch time, at night, etc.)?
- What is the pedestrian compliance rate (i.e., are pedestrians crossing at a marked pedestrian crossing or during a designated pedestrian phase)?
- What is the driver compliance rate (i.e., are drivers yielding to pedestrians crossing or waiting the cross the street at a marked crosswalk)?
- Are drivers frequently exceeding the speed limit?

A.2.2.3 Step 3: Evaluate the Crossing Location

This section presents the criteria to consider when recommending a pedestrian crossing be installed along the segment of roadway or corridor and when determining where along the segment of roadway or corridor a pedestrian crossing may be installed. The placement of marked pedestrian crossings at uncontrolled locations depends on several factors, including but not limited to adjacent land uses, pedestrian behavior, current and projected pedestrian volumes, proximity to other marked crossings, presence of a transit stop or shared path, and stopping sight distance.

Since every situation is unique, it is not possible to provide a completely standardized process for determining whether a crosswalk may be placed at a given location. Thus, this section is not prescriptive. Instead it describes the criteria to account for when determining where to install a crosswalk. For all scenarios, engineering judgement should be used to evaluate the criteria, situation, and potential for crashes.

Review the criteria presented in the subsections and document the evaluation on the location evaluation sheets.

A.2.2.3.1 Adjacent Land Uses and Multimodal Transportation Connections Criteria

The adjacent land uses are significant factors to consider when determining the need for a pedestrian crossing. Land uses such as commercial shopping centers, convenience stores, schools and parks tend to generate more pedestrian activity than others. The adjacent land uses and the presence of active transit stops (bus or rail), multiuse (shared) paths, or trails can be a used as supplemental data to justify the need for a marked pedestrian crosswalk.

If the answer to any of the following criteria in **Table A-4** is “yes”, the need for a pedestrian crossing at an uncontrolled location could be justified and the engineer should review the guidance (see Chapter 3) for where to install pedestrian crossing treatments.

- Is there a transit stop or multiuse (shared) path/trail along the segment of roadway under consideration?
- Are there more than two adjacent land uses (existing or planned) that generate significant pedestrian activity?
- Are there special events on a regular basis that generate pedestrian activity?

Table A-4. Adjacent Land Use Criteria

Criteria Questions	
Y/N	Is there a transit stop or multiuse (shared) path/trail along the segment of roadway under consideration?
Y/N	Are there more than two adjacent land uses (existing or planned) that generate significant pedestrian activity, such as commercial shopping centers, convenience stores, schools, and/or parks?
Y/N	Are there special events on a regular basis that generate pedestrian activity?

A.2.2.3.2 Pedestrian Volume Criteria

The number of pedestrians crossing the segment of roadway or corridor under evaluation may be used to support the recommendation for a pedestrian crossing at an uncontrolled location. If new

developments are planned along the roadway or corridor under evaluation, projected pedestrian volumes may be used as a surrogate for observed pedestrian volumes. The pedestrian volume thresholds are generally as follows:

- 20 pedestrians per hour in any one hour, or
- 18 pedestrians per hour in any two hours, or
- 15 pedestrians per hour in any three hours

Youth, elderly, and disabled pedestrians may count as 1.33 times their numerical value towards the pedestrian volume thresholds. The factor accounts for weighting users that potentially have needs that are materially greater than the typical, able-bodied person.

- Youth are generally those younger than 16 years old.
- Elderly pedestrians are generally those over 65 years old that cannot maintain a minimum 3.5 feet per second walking speed.
- Disabled pedestrians are generally those that cannot maintain a minimum 3.5 feet per second walking speed, or who use a wheelchair, walker, cane, or other mobility assistance device.
- If a family with an elderly, disabled, or a child under 16 crosses in a group, multiply the whole family by a factor of 1.33.

Pedestrian Volume Summary

Apply the pedestrian data collected in the field to the thresholds. If the observed pedestrian volumes meet or exceed the thresholds, the need for a marked pedestrian crosswalk may be justified. In this case, the engineer should review the guidance for where to locate the crosswalk and what specific pedestrian crossing treatments to install. Meeting or exceeding the pedestrian volume thresholds does not require the installation of a marked crosswalk nor does it immediately justify the need for specific crossing treatments such as pedestrian hybrid beacons or pedestrian signals; additional data should be applied to guidance in chapter 2 to determine the appropriate treatment.

If the observed pedestrian volumes do not meet the thresholds, the need for a marked pedestrian crosswalk cannot automatically be justified. In this case, the engineer may use adjacent land use data to supplement the pedestrian volume data and justify the need for a marked pedestrian crossing.

If projected pedestrian volumes are used as a surrogate for observed volumes, follow the recommended actions depending upon whether the projected volume meets or falls short of the thresholds. If projected pedestrian volumes are used to justify the installation of a marked pedestrian crossing, the crossing should be observed one year after the installation of the crossing treatments to verify the pedestrian crossing volumes. Depending on the circumstances, it may take more than a one year for the predicted pedestrian volumes to be realized. Engineering judgement should be applied for the one-year evaluation of the pedestrian crossing facility.

A.2.2.3.3 Vehicle and Pedestrian Sight Distance Considerations

Pedestrian crossings should shall only be installed at locations with adequate stopping sight distances. AASHTO defines stopping sight distance (SSD) as the distance needed for a driver to see an object in the roadway and bring their vehicle to a safe stop before colliding with the object. The stopping sight distances (SSDs) should be measured and checked against AASHTO minimum SSDs (provided in Tables A-2 and A-3) for locations under consideration. AASHTO defines SSD as the

distance needed for a driver to see an object in the roadway and bring their vehicle to a safe stop before colliding with the object.

In places where drivers must make complex or instantaneous decisions, where information is difficult to perceive, or when unexpected or unusual maneuvers are needed, the minimum SSD may not provide sufficient visibility distances for drivers to respond and perform appropriate maneuvers. In these instances, AASHTO recommends using decision sight distances, as shown in Table A-4. Decision sight distance is the distance needed for a driver to detect an unexpected or otherwise difficult-to-perceive information source or condition in a roadway environment that may be visually cluttered, recognize the condition or its potential threat, select an appropriate speed and path, and initiate and complete complex maneuvers (AASHTO Green Book).

Use the design speed, posted speed, or 85th percentile speed of the roadway to look up the minimum SSD and/or the decision sight distance recommended by AASHTO, provided in Tables A-52, A-63, and A-74. It is recommended that the highest value of the design speed, posted speed, or 85th percentile speed is used to determine the minimum SSD.

A.2.2.3.4 Vehicle Sight Distance Requirements

Pedestrian crossings should be installed at locations with adequate stopping sight distances. The stopping sight distances (SSD) should be measured and checked against AASHTO minimum SSDs (provided in Tables A-2 and A-3) for locations under consideration. AASHTO defines SSD as the distance needed for a driver to see an object in the roadway and bring their vehicle to a safe stop before colliding with the object.

In places where drivers must make complex or instantaneous decisions, where information is difficult to perceive, or when unexpected or unusual maneuvers are needed, the minimum SSD may not provide sufficient visibility distances for drivers to respond and perform appropriate maneuvers. In these instances, AASHTO recommends using decision sight distances, as shown in Table A-4. Decision sight distance is the distance needed for a driver to detect an unexpected or otherwise difficult-to-perceive information source or condition in a roadway environment that may be visually cluttered, recognize the condition or its potential threat, select an appropriate speed and path, and initiate and complete complex maneuvers (AASHTO Green Book).

Use the design speed, posted speed, or 85th percentile speed of the roadway to look up the minimum SSD or the decision sight distance recommended by AASHTO provided in Tables A-2, A-3, and A-4. It is recommended that the highest value of the design speed, posted speed, or 85th percentile speed is used to determine the minimum SSD.

Table A-5. Minimum Stopping Sight Distance on Level Roadways

Design Speed (mph)	Stopping Sight Distance on Level Roadways (feet)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645

AASHTO, *A Policy on Geometric Design of Highways and Streets*, 2011

Table A-6. Minimum Stopping Sight Distance on Grades

Design Speed (mph)	Stopping Sight Distance on Grades (feet)					
	Downgrades			Upgrades		
	3%	6%	9%	3%	6%	9%
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561

AASHTO, *A Policy on Geometric Design of Highways and Streets*, 2011

Table A-7. Decision Sight Distances

Design Speed (mph)	Decision Sight Distance (feet)				
	Avoidance Maneuver				
	A	B	C	D	E
30	220	490	450	535	620
35	275	590	525	625	720
40	330	690	600	715	825
45	395	800	675	800	930
50	465	910	750	890	1,030
55	535	1,030	865	980	1,135
60	610	1,150	990	1,125	1,280
65	695	1,275	1,050	1,220	1,365
70	780	1,410	1,105	1,275	1,445
75	875	1,545	1,180	1,365	1,545
80	970	1,685	1,260	1,455	1,650

AASHTO, *A Policy on Geometric Design of Highways and Streets*, 2011

Avoidance Maneuver A: Stop on rural road – t=3.0s
Avoidance Maneuver B: Stop on urban road – t=9.1s
Avoidance Maneuver C: Speed/path/direction change on rural road – t varies between 10.2 and 11.2 s
Avoidance Maneuver D: Speed/path/direction change on suburban road – t varies between 12.1 and 12.9 s
Avoidance Maneuver E: Speed/path/direction change on urban road – t varies between 14.0 and 14.5 s

Locate the point on the edge of the lane where the pedestrian would step into the vehicle travel lane. Draw a straight line representing the length of the minimum SSD and/or the decision sight distance and measure to a point in the center of the approaching travel lane(s). Lanes should be checked to ensure the "worst case" scenario is accounted for. Check that the area in the SSD and/or decision sight distance triangle is clear of objects that could obstruct the sight distance. Check that the measured stopping sight distance and/or decision sight distance is not obstructed by horizontal or vertical curves in the roadway. If there is on-street parking but currently no vehicles occupying the space, consider if the presence of a parked vehicle would obstruct the sight distance. If there is more than one lane, consider that a vehicle in a through travel lane that has stopped for a pedestrian in the crossing can obstruct the visibility for drivers in other travel lanes.

When evaluating the SSD, consider the night-time lighting conditions at the proposed location(s). If illumination at the location is inadequate, then a value of twice the minimum sight distance could be considered to see a pedestrian in the roadway and safely bring the vehicle to a stop in advance of the marked crosswalk. The value of twice the minimum sight distance is most appropriate for a speed of 30 mph or less, based on the typical distance limitation for vehicle headlight illumination.

While vehicle sight distance represents sight distance from the driver's perspective, pedestrian crossing sight distance represents sight distance from pedestrian's perspective. **The pedestrian crossing sight distance** is the distance required for a pedestrian to see a vehicle that could potentially conflict with the pedestrian crossing the street (PEDS 2014).

Typically, pedestrian crossing sight distance is greater than minimum SSD and decision sight distance. The pedestrian crossing sight distance takes into consideration the pedestrian start up and clearance time, the average pedestrian walking speed, the crossing distance, and the travel speed of vehicles (Minnesota Local Road Research Board 2014).

Pedestrian crossing sight distance is defined in Equation 1 where:

PedSD = Pedestrian Crossing Sight Distance

S = Design Speed (mph)

L = Crossing distance (ft)

S_p= Average pedestrian walking speed (ft/s), default = 3.5 ft/s* (refer to Section A.2.2.3.2 for more information on appropriate walking speeds for older adults and pedestrians with disabilities)

t_s= pedestrian start-up and end clearance time (s), default = 3.0 s

Equation 1: Pedestrian Crossing Sight Distance

$$\boldsymbol{PedSD = 1.47S\left(\frac{L}{S_p} + t_s\right)}$$

Accommodating pedestrian crossing sight distance may be considered for marked crosswalks. Since the crossing distance is a variable in the calculation for pedestrian crossing sight distance, a long pedestrian crossing distance may prove challenging to achieve pedestrian crossing sight distance. On the other hand, treatments that shorten the functional crossing distance (e.g. refuge islands, curb extensions, etc.) can result in lower calculated values of pedestrian crossing sight distance and thereby ease some of the challenges in achieving pedestrian crossing sight distance at a given location.

Sight Distance Considerations Summary

To install a marked crosswalk, the minimum SSD shall be met from both directions of travel at the location. Decision sight distance is appropriate where drivers must make complex or instantaneous decisions, where information is difficult to perceive, or when unexpected or unusual maneuvers are needed. Achieving pedestrian crossing sight distance allows pedestrians entering a crosswalk to see approaching vehicles that are likely to conflict with the pedestrian's crossing path moving at or below the selected speed. Based on a review of the proposed crossing, determine which criteria is most appropriate for developing the recommended sight distance in the given context.

If the actual (measured) sight distance is less than the recommended sight distance, consider removing obstructions to accommodate the recommended sight distance. In addition to removing obstructions, other treatments such as curb extensions, bulb-outs, median refuge areas, traffic control enhancements, or other treatments may help mitigate certain aspects of the vehicle or pedestrian sight distance limitations. If the treatments prove to be impractical, consider relocating the crossing to another location that meets the sight distance requirements that is located as close as possible to the ideal location, and preferably within 300 feet of the location that provides the desired walking route. Other factors being equal, a marked crosswalk location that provides both decision sight distance and pedestrian crossing sight distance is preferred.

A.2.2.3.5 Pedestrian Travel Paths and Transit Stop Locations

Use the pedestrian behavior data collected to identify a specific location(s) for pedestrian crossing treatments. Consider current pedestrian travel paths and anticipated travel paths; where are people coming from and going to? Is there a logical location for a crossing that would connect the origins and destinations? Consider the appropriate placement of a crossing in relation to transit stops and meet with the transit provider to review pedestrian crossing location options.

A.2.2.3.6 Pedestrian Sight Distance Requirements

In addition to considering the distance required for a vehicle to stop when the driver notices a pedestrian in the road, it is important to account for the distance required for a pedestrian to see vehicles that could potentially conflict with them crossing the street (PEDS 2014). The latter distance is referred to as the pedestrian crossing sight distance. Typically, the pedestrian crossing sight distance is longer than the vehicle stopping sight distances, and in turn is not satisfied by the minimum stopping sight distance. The pedestrian crossing sight distance takes into consideration the pedestrian start up and clearance time, the average pedestrian walking speed, the crossing distance, and the travel speed of vehicles (Minnesota Local Road Research Board 2014). Pedestrian crossing sight distance is defined in Equation 1 where:

PedSD = Pedestrian Crossing Sight Distance

S = Design Speed (mph)

L = Crossing distance (ft)

Sp= Average pedestrian walking speed (ft/s), default = 3.5 ft/s* (refer to Section A.2.2.3.2 for more information on appropriate walking speeds for older adults and pedestrians with disabilities)

ts= pedestrian start-up and end clearance time (s), default = 3.0 s

Equation 1: Pedestrian Crossing Sight Distance

$$PedSD = 1.47S\left(\frac{L}{S_p} + t_s\right)$$

A.2.2.3.7 Pedestrian Travel Paths and Transit Stop Locations

Use the pedestrian behavior data collected to identify a specific location(s) for pedestrian crossing treatments. Consider current pedestrian travel paths and anticipated travel paths; where are people coming from and going to? Is there a logical location for a crossing that would connect the origins and destinations? Consider the appropriate placement of a crossing in relation to transit stops and meet with the transit agency provider to review pedestrian crossing location options.

A.2.2.3.8 Presence of a Median or Two-Way Center Turn Lane

Use the physical site data collected to assess whether there is a median located in the vicinity of the logical crossing location. An existing raised median, painted median, two-way left-turn lane, or landscaped area can be retrofitted to provide a pedestrian refuge area by creating a cut-through or providing an ADA-compliant curb ramp. For design guidance on how to convert raised medians, painted medians, and two-way center turn lanes into pedestrian refuge areas, refer to the *Pedestrian and Streetscape Guide* Chapter 3. When installing or converting to a raised median, consider the impact of vehicular access to driveways and streets, as well as impacts to drainage, parking, etc.

A.2.2.3.9 Location of Parcel Access (Driveways)

Use the physical site data collected to assess whether there are heavily used vehicular access points (driveways) adjacent to the logical crossing location. Consider whether there is a potential for pedestrian conflicts with right turning or left turning vehicles. Assess the appropriate spacing between the access points and the pedestrian crossing to avoid these conflicts.

A.2.2.3.10 Proximity to Other Marked Pedestrian Crossings

The appropriate spacing between an uncontrolled pedestrian crossing to the nearest marked crossing is dependent on the site context (i.e., rural, suburban, and urban), the presence of a raised median, pedestrian volume, and traffic flow conditions.

Use the physical site data collected to determine the location of the nearest marked pedestrian crossing. Given the site context classification for the segment of roadway under investigation, use the minimum crosswalk spacing guidelines below to determine whether a marked crosswalk can be placed at the desired location. Engineering judgment that includes consideration for site-specific factors should supplement the guidance provided by the table.

The guidelines for minimum crosswalk spacing from an existing marked crosswalk or traffic signal installation are provided in **Table A-8.**

Table A-8. Minimum Crosswalk Spacing Guidelines

Site Context	Street Type	Minimum Crosswalk Spacing (feet)
Urban Core, Urban, or Rural Town	Local and collector (30 mph or less) with median that could be used as a pedestrian refuge island	200
	Local and collector (30 mph or less) without median that can be used as a pedestrian refuge island	300
	Arterial (intended to serve traffic with posted speed of 35-45 mph)	300
Suburban	Local and collector (35 mph or less) with median that could be used as a pedestrian refuge island	300
	Local and collector (35 mph or less) without median	400
	Arterial (intended to serve traffic with posted speed of 40-50 mph)	400
Rural	Local and collector (40 mph or less) with median that could be used as a pedestrian refuge island	400
	Local and collector (40 mph or less) without median	400
	Arterial (intended to serve traffic with posted speed of 45-55 mph)	500

Recommended Actions

If there is an existing marked pedestrian crossing within the minimum spacing, the installation of another crosswalk is typically not recommended. Instead, it is recommended to take action to direct pedestrians towards the existing marked crossing(s), which will require a field review of actual pedestrian crossing behavior. If the nearest marked pedestrian crossing is farther away than the minimum distance, a marked crossing may be considered for the identified location.

If the section of roadway under investigation has the potential for future pedestrian crossing demand, the data collection may be conducted in a manner to provide an opinion as to whether a single crossing would serve a minimum of 75 percent of the total pedestrian activity. If not, then consideration may be given to providing multiple pedestrian crossings.

When evaluating the need for multiple crossing locations along a corridor, use the minimum spacing between crossings listed above as a guide, but not a rule. The spacing guidelines (listed above) are minimums, not maximums. Consider the impacts of multiple marked pedestrian crossings on motorist compliance and traffic flow.

As noted in **Table A-3**, the presence of pedestrian refuge island provides the opportunity for closer spacing of marked crosswalks, since the pedestrian refuge island simplifies the crossing task for pedestrians.

A.2.2.4 Step 4: Select the Pedestrian Crossing Treatment

Once the need for a pedestrian crossing treatment is established and the location is identified, the next step is to select the appropriate crossing treatment. The appropriate crossing treatment is determined based on roadway configuration, vehicle volumes and speeds, and presence of a median. This section presents the FHWA baseline recommendations and additional treatments for consideration.

To determine the appropriate crossing treatment, use the data collected to identify the basic treatments recommended by FHWA and review the additional design considerations. Design recommendations for the treatments listed in the table can be found in Chapter 3 of the GDOT *Pedestrian and Streetscape Guide*.

A.2.2.4.1 FHWA Pedestrian Crossing Treatment Recommendations

Table A-9 is the baseline guide for evaluating treatment types given the vehicle volumes, vehicle speeds, and roadway configuration at the specified location. Use the traffic and roadway data collected to determine FHWA's baseline recommendations for a crossing treatment (countermeasure).

Table A-9: Potential Pedestrian Crossing Treatments and Safety Countermeasures

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

❶ Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.

\# Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restriction on crosswalk approach, adequate nighttime lighting levels
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Pedestrian Hybrid Beacon
8 Road Diet

This table was developed using information from: Zegeer, C. V., Stewart, J. R., Huang, H. H., Lagerwey, P. A., Feaganes, J., & Campbell, B. J. (2005), Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines (No. FHWA-HRT-04-100); Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 4F. Pedestrian Hybrid Beacons; the Crash Modification Factors (CMF) Clearinghouse website (http://www.cmfclearinghouse.org/); and the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) website (http://www.pedbikesafe.org/PEDSAFE/).

FHWA, Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, 2017.

A.2.2.4.2 ADA Compliance

ADA design standards must be met for pedestrian crossings. See the GDOT *Design Policy Manual* and PROWAG for further guidance.

A.2.2.4.3 Lighting for Pedestrian Crossings

Lighting at pedestrian crossing locations significantly increases the visibility of pedestrians during night-time/dark conditions. When installing lighting at a pedestrian crossing location it is important to consider the placement of the lights. Research suggests that the traditional placement of luminance at the crosswalk does not adequately illuminate the pedestrian. FHWA recommends that luminaries be offset from the crosswalk at about 10 feet and provides 20 vertical lux at the crosswalk, as illustrated in Figure A-1. It is recommended that luminance be placed in advance of the crosswalk from the drivers' perspective. For roadways with traffic traveling in both directions or roadways wider than 44 feet, luminance may be used on both sides of the street (FHWA 2008).

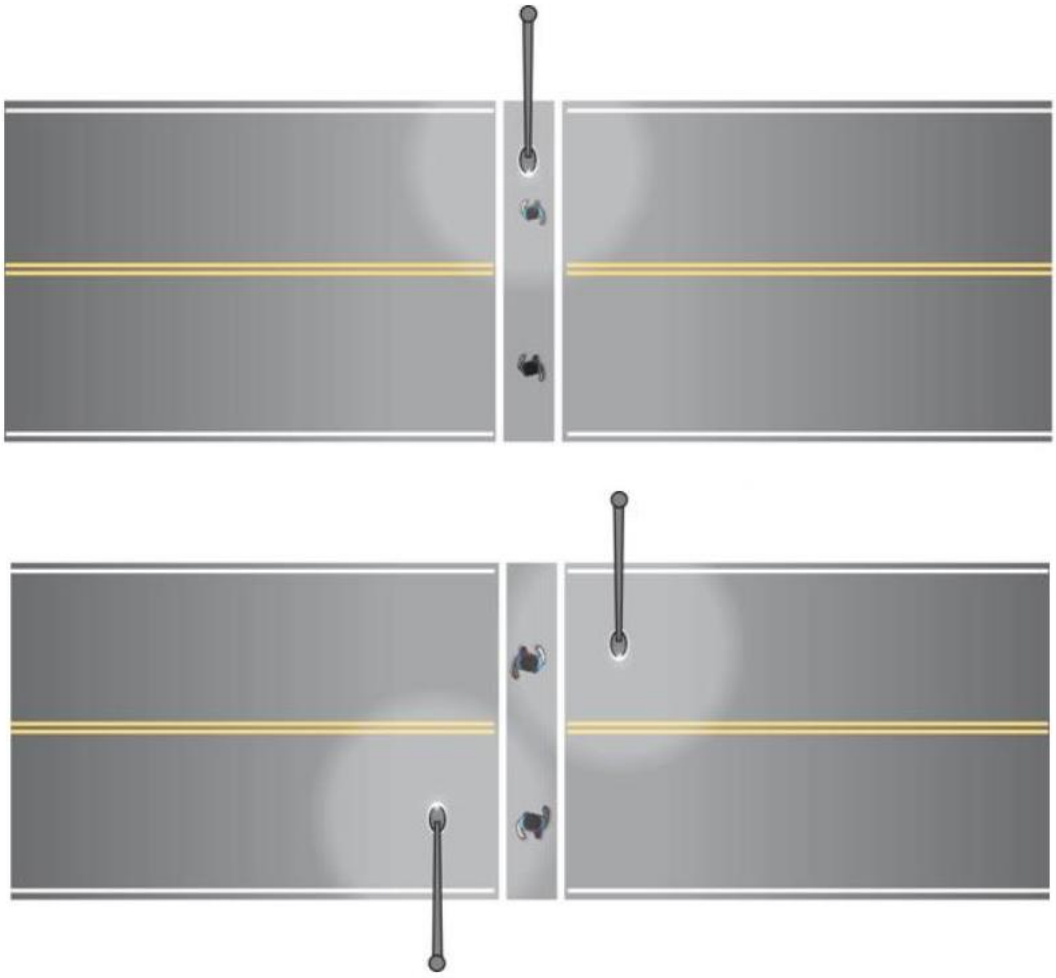


Figure A-1. Crosswalk Lighting Location Recommendation

A.2.2.4.4 Pedestrian Refuge Islands

Providing pedestrian refuge islands at pedestrian crossings reduces the risk of pedestrian-vehicle crashes (Lindley 2008). In addition to the FHWA recommendations provided in Table A-3, pedestrian refuge islands are encouraged on two-way streets with:

- A crossing distance of 44 feet or greater,
- Vehicle speeds greater than or equal to 35 mph, or
- AADT greater than or equal to 9,000 vehicles per day

Table A-6 does not provide recommendations for a pedestrian refuge island on roadways with an existing raised median. However, an existing raised or painted median or a two way center turn lane may be retrofitted to accommodate a pedestrian refuge island. For further guidance on installing pedestrian refuge islands, refer to Chapter 3 of the Guide.

For locations where a median refuge island cannot be accommodated with the existing roadway configuration, the following guidelines apply:

- Consider evaluating a “road diet” or “lane diet’ to create space for a pedestrian refuge islands
- Review opportunity for widening the road to provide a pedestrian refuge island, including the possibility of acquiring rights-of-way
- Evaluate the potential use of additional pedestrian crossing treatments as listed in Table 3 and described in Chapter 3 of the *Pedestrian and Streetscape Guide*.

A.2.2.4.5 Rectangular Rapid Flash Beacons

Rectangular Rapid Flash Beacons (RRFBs), also known as Light Emitting Diode (LED) Rapid-Flash System, Stutter Flash, or LED Beacons, can be installed at mid-block pedestrian crossing locations to increase the driver yielding rate and awareness of potential pedestrian conflicts. In addition, RRFBs can be a lower cost alternative to traffic signals or PHBs.

FHWA provides the following guidance on the application of RRFBs:

- RRFBs shall be used to supplement a post-mounted W11-2 (Pedestrian), S1-1 (School), or W11-15 (Trial) crossing warning sign with a diagonal downward arrow (W16-7P) plaque, or an overhead mounted W11-2, S1-1, or W11-15 crossing warning sign located at or immediately adjacent to an uncontrolled crosswalk.
- For any approach on which RRFBs are used to supplement post-mounted signs, at least two W11-2, S1-1, or W11-15 crossing warning signs (each with an RRFB unit and a W16-7P plaque) shall be installed at the crosswalk, one on the right-hand side of the roadway and one on the left-hand side of the roadway. On a divided highway, the left hand side assembly should be installed on the median, if practical, rather than on the far left-hand side of the highway.
- Except for crosswalks across the approach to or egress from a roundabout, an RRFB shall not be used for crosswalks across approaches controlled by STOP signs, traffic control signals, or PHBs.

A.2.2.4.6 Right-of-Way Availability

If there is not enough right-of-way available to provide ADA accommodations or support poles for traffic control devices (if applicable), consider relocating the crosswalk to a location with adequate right-of-way availability. The relocated crosswalk should be as close to the desired crossing location as practical, and preferably no more than 300 feet away. If crosswalk is relocated, sight distance requirements need to be rechecked. If crosswalk relocation is not a feasible option, right-of-way acquisition may be considered to accommodate the pedestrian crosswalk.

A.2.3 Evaluating the Safety of Existing Pedestrian Crossings

The application of the criteria and recommendations is largely based on the need to improve pedestrian safety. Pedestrian crash data are the mostly commonly used statistic for evaluating pedestrian safety. However, the frequency of pedestrian crashes is generally low enough that using pedestrian crash data as the sole method by which pedestrian crossings are evaluated may not be practical in some cases. Pedestrian compliance and pedestrian-vehicle near-miss data may be used to supplement pedestrian crash data.

The following sections provide the Engineer with tools to evaluate surrogate safety data based on pedestrian behavior, which can be used to complement traditional safety data such as pedestrian crash history. These tools are suggested for application in cases where there is an existing pedestrian marked or unmarked crossing that is being formally reviewed for enhanced treatments.

A.2.3.1 Measuring Pedestrian Compliance

Pedestrian and vehicle compliance, which is a safety-based performance measure, has proven to be a reliable metric that helps highlight the issues and measures the effectiveness of a solution. Pedestrian compliance measurements may be used to evaluate the safety of pedestrian crossing treatments.

The following compliance rates at existing pedestrian crossing locations can be determined based on field-collected data:

- Percentage (%) of pedestrians that crossed within the marked crosswalk
- Percentage (%) of pedestrians that crossed during the pedestrian phase (WALK signal or active PHB)
- Percentage (%) of motorists that stop for pedestrians at the marked crosswalk, as compared to the motorists that did not stop and should have stopped

Pedestrian compliance is currently measured via field observations, or field conditions captured on video for manual data processing convenience. Video capture of the field conditions provides a better environment for the person that is performing the manual data processing and provides the opportunity to “review the tape” if there is a question about the data accuracy or reliability. At some time in the future, video processing of pedestrian and vehicle compliance may be available to reduce the level of effort currently required for manual processing.

The compliance rates can be evaluated using **Table A-10** as a guide. Note that pedestrian compliance will depend on many factors, including traffic volume, street width, traffic signal timing operations, and various pedestrian-specific factors.

Table A-10: Pedestrian Compliance Rate Evaluation

Category	Pedestrian Compliance Rate Range	Suggested Approach
Excellent	95 - 100%	No action necessary
Good	90 – 94%	Further action may not be necessary
Acceptable	80 – 89%	Consider low-cost safety countermeasures
Marginal	60 - 79%	Consider safety countermeasures
Poor	Less than 60%	Strongly consider safety countermeasures

A.2.3.2 Pedestrian Conflict Detection

Potential pedestrian-vehicle conflict, also referred to as "near-miss," may also be used to supplement pedestrian crash data and evaluate the safety of a pedestrian crossing. The National Safety Council refers to a near miss as an event that did not result in injury, but had the potential to do so. Potential pedestrian-vehicle conflict data can be collected and analyzed with video processing software. Video processing software has the ability to trace the pedestrian and vehicle travel paths and detect potential conflict scenarios. This technology expands the ability to quantify pedestrian behavior and, in turn, provides more data for evaluating the safety of pedestrian crossings.

Further Guidance

- AASHTO, *A Policy on Geometric Design of Highways and Streets* (2011)
- City and County of Denver, *Uncontrolled Pedestrian Crossing Guidelines* (2016)
- City of Boulder, *Pedestrian Crossing Treatment Installation Guidelines* (2011)
- FDOT, *Pedestrian Safety at Mid-block Locations* (2006)
- FHWA, *Informational Report on Lighting Design for Midblock Crosswalks* (2008)
- FHWA, MUTCD (2009)
- FHWA, *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations* (2005)
- FWHA, *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (2017)
- GDOT, *Design Policy Manual*, Complete Streets Design Policy, Pedestrian Warrants section 9.4.1 (2017)
- GDOT, Intersection Control Evaluation (ICE) Policy (2017)
- GDOT, Policy 6780-4: Establishment of Speed Zones
- GDOT, *Signing and Marking Design Guidelines* (2018)
- Governor's Office of Highway Safety, *Georgia Strategic Highway Safety Plan, Non-motorized Users* (2015)
- Lindley, Guidance Memorandum on Consideration and Implementation of Proven Safety Countermeasures (2008)
- Minnesota Local Road Research Board, *Pedestrian Crossings: Uncontrolled Locations* (2014)
- MnDOT, *Minnesota's Best Practices for Pedestrian/Bicycle Safety* (2013)

- National Safety Council, *Near Miss Reporting Systems* (2013)
- NCDOT, *North Carolina Pedestrian Crossing Guidance* (2015)
- PEDS, *Identifying, Assessing, and Improving Uncontrolled Intersections for Pedestrian Access* (2016)
- PEDS, Safe Routes to Transit (2014)
- TRB, *Improving Pedestrian Safety at Unsignalized Crossings* (2006)

The outcome of a pedestrian-vehicle conflict evaluation typically includes the number of incidents and/or a heat map showing the density and severity of the near misses, and sometimes short video clips are also provided. These reporting tools may be used to obtain a greater understanding of the conflict points and their relative impact on pedestrian operations, as well as perform before/after studies when targeted safety improvements are implemented.

A.3 Pedestrian Crossings at Uncontrolled Locations Template Engineering Study

Contact Information:

Project: _____

Prepared by: _____

Study Requested by: _____

Date: _____

Project Location:

GDOT District: _____

Congressional District: _____

County: _____

City: _____

Street Name: _____

Nearest Intersections:

Cross Street Name: _____

Signalized: Yes No Stop Signs: Yes No

Cross Street Name: _____

Signalized: Yes No Stop Signs: Yes No

Reason for Pedestrian Crossing Evaluation:

_____

_____

_____

_____

_____

A.3.1 GDOT Complete Streets Policy Pre-screening Form

Table 1. Pre-Evaluation Screening Questions

Question	**Y/N**
History	
Have one or more pedestrian fatalities ever occurred along the segment of roadway under consideration?	
Has a vehicle/pedestrian crash occurred in the past five years along the segment of roadway under consideration?	
Has a reasonable community interest been received in the past two to four years?	
Land-Use	
Is the site in an urbanized area or projected to be urbanized by an MPO, regional commission, or local government prior to the design year?	
Is there a school, major institution, shopping center, convenient store, park, or major pedestrian generator/destination along the segment of roadway or corridor under evaluation?	
Is there a multi-use path or transit stop on either side of the street along the segment of roadway or corridor under evaluation?	
Is there an approved development that may generate pedestrian traffic in the future?	
Physical Attributes	
Is there a sidewalk or evidence of pedestrian traffic (worn path) present?	
Is there an existing or has there ever been a marked pedestrian crossing?	
Projects/Funding	
Do any local government, MPO, or Regional Commission plans (i.e. transportation, livable community, community development plans, etc.) identify the need for pedestrian accommodations along the segment of roadway or corridor under evaluation?	
Are there construction or 3R projects planned?	

A.3.2 Data Collection Sheets

Map / Site Plan:

Some data may be better conveyed visually on a map. In this case, attach a copy of an aerial image, map, or site plan of the segment of roadway or corridor under evaluation and identify/call-out specific data point. Data points should include but are not limited to:

- Transit stops
- Trials or Share Use Paths
- Major Pedestrian Generators and Attractors
- New/Planned Developments
- Roadway Configuration
- Special Events
- Pedestrian Travel Paths
- Parcel Access or Driveways
- Street Lighting
- Sight Distance Details
- Proposed Location for Marked Crosswalk

Site Context:

(Record data below and on a map)

Site Context: Urban Core (Downtown) Urban Industrial/Office Park
Suburban (Residential) Suburban (Commercial i.e. Shopping Center)
Rural Town Rural

Transit Stops: Yes No Number of Transit Stops: _____

Trail or Shared-use Path: Yes No Number of Entrances (trail heads): _____

Adjacent Land Uses: _____

_____

Major Pedestrian Generators and Attractors: _____

_____

Special Events: Yes No

Frequency of Occurrence: _____

Traffic Data:

Time of Peak Pedestrian Use: Day _____ Time _____

Peak Hour Pedestrian Volume: _____

Peak Hour Bicycle Volume: _____

Vehicle Volumes - Annual Average Daily Traffic (AADT) Count: _____

Vehicle Speeds (Posted or 85th Percentile): _____

Pedestrian Compliance Rate (if applicable): _____

Driver Behavior: _____

(Sheets for collecting pedestrian and bicycle volumes and pedestrian compliance are on page 5 and 6)

Notes:

Roadway Configuration:

Total Number of Lanes: _____

Number of Through Lanes: _____ Number of Turn Lanes: _____

Two-Way Center Turn Lane: Yes No

Width of Roadway (Curb to Curb): _____

Median: Yes No If Yes, Median Type: Painted Raised Median Median Width

ADA Compliance Median Available (4'x4' landing): Yes No

Physical Barrier (preventing pedestrians from crossings at a certain location): Yes No

If yes, what is the physical barrier? _____

Existing Marked Crossings: _____

Existing Traffic Calming Devices: _____

Notes:

Pedestrian and Bicycle Volumes:

In-field Data Collection Sheet

Name of Street: _____

Date: _____ Day of Week: _____

Time Interval: _____

User	Count	Total
Youth, Elderly, and Disabled (YED) Pedestrians		
Pedestrians (Non-YED)		
Bicycles		
Total Count		

What are the major travel paths? _____

_____

Where are people crossing the street? _____

How are people crossing the street? _____

Notes:

Pedestrian Compliance at Existing Mid-Block Locations (if Applicable):

In-field Data Collection Sheet

Name of Street: _____

Date: _____ Day of Week: _____

Time Interval: _____

Pedestrians	Count	Percent of Total
Non-compliant with crosswalk location		
Non-compliant with crosswalk signal (if PHB or signal)		
Compliant		
Total Count		

Notes:

Specific Crossing Locations:

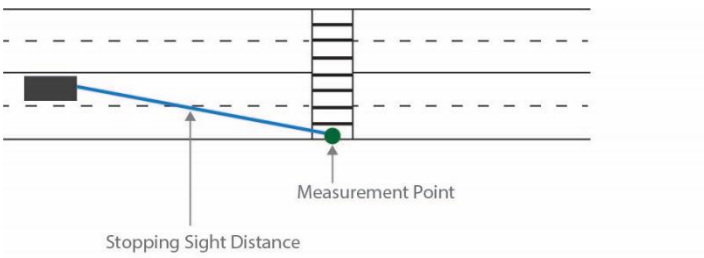
(Once a specific crossing location has been identified, complete the follow questions)

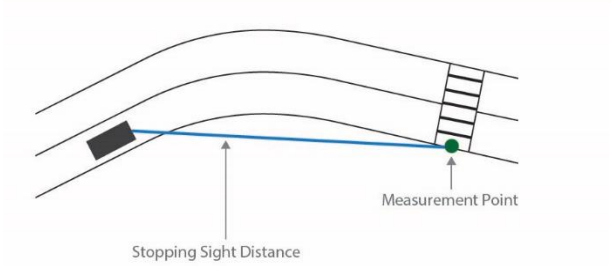
Street Lights at Crossing Location: Yes No Do they work? Yes No

Vertical and Horizontal Luminance at Crossing Location: _____

_____

Sight Distance Measurement Points:





Is the crossing location within horizontal or vertical curve? Yes No

Minimum Stopping Sight Distance from AASHTO: _____ SSD Met? Yes No

If pedestrian crossings occur at night at this location, can twice the recommend SSD be met? Yes No

If no, what objects are obstructing the sight distance? _____

_____

Can they be removed? Yes No

Nearest Marked Crosswalk: _____ Feet Away To the: N S E W

Is the Marked Crosswalk: Signalized Stop Sign Controlled Uncontrolled

Do the vehicle access points or driveways create possible right/left turn conflicts? Yes No

Previously Adopted Plans

Are there previously adopted transportation planning and/or design documents related to the segment of roadway or corridor under evaluation? Yes No

Names of the plans and agency:

_____

_____

_____

Are there any new commercial or residential developments under construction or planned? Yes No

Summarize recommendations (summary can be in bullet notes):

_____

_____

_____

*Attach a copy of the recommendations to the evaluation packet.

A.3.2.1.1 Right-of-Way Availability

If there is not enough right-of-way available to provide ADA accommodations or support poles for traffic control devices (if applicable), consider relocating the crosswalk to a location with adequate right-of-way availability. The relocated crosswalk should be as close to the desired crossing location as practical, and preferably no more than 300 feet away. If crosswalk is relocated, SSD requirements need to be rechecked. If crosswalk relocation is not a feasible option, right-of-way acquisition may be considered to accommodate the pedestrian crosswalk.

A.3.3 Evaluating the Safety of Existing Pedestrian Crossings

The application of the criteria and recommendations is largely based on the need to improve pedestrian safety. Pedestrian crash data are the mostly commonly used statistic for evaluating pedestrian safety. However, the frequency of pedestrian crashes is generally low enough that using pedestrian crash data as the sole method by which pedestrian crossings are evaluated may not be practical in some cases. Pedestrian compliance and pedestrian-vehicle near-miss data may be used to supplement pedestrian crash data.

The following sections provide the Engineer with tools to evaluate surrogate safety data based on pedestrian behavior, which can be used to complement traditional safety data such as pedestrian crash history. These tools are suggested for application in cases where there is an existing pedestrian marked or unmarked crossing that is being formally reviewed for enhanced treatments.

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Appendix B. Landscape Maintenance Program

B.1 Example of a Landscape Maintenance Program

- Edging: Maintain shapes and configurations of plant beds as installed.
- Foreign Matter: Remove extraneous leaves, weeds, trash, limbs and debris from plant beds as necessary to constantly maintain a completely clean appearance. This shall occur at each maintenance visit.
- Obtain soil samples from the site for analysis. Follow fertilizing and liming recommendations from testing laboratory.
- Weed Control: Use chemical and mechanical means to prevent weeds and/or undesirable grasses from encroaching in mulched areas. Maintain a valid, Georgia pesticide applicator and operator's license and use chemicals in strict accordance with federal, state and county directives on environmental control. Chemicals must have an EPA approval number.
- Watering: The contractor is advised that manual irrigation is to be used as a supplement to rainfall. The contractor is responsible for carefully observing the water requirements for landscaped areas and maintaining healthy, vigorous plant material by manually watering. Water newly planted lawns as necessary to keep the top 2 inches of soil moist. After grass is established, apply water approximately 3 to 4 times weekly during summer (1/4 inch to ½ inch per application). Cut back during the fall, spring, and winter.

B.2 Safety and Chemical Use

- All materials and performance of work must meet federal health and safety laws in effect. Chemicals to be used in performance of this contract must carry an EPA approval number. Chemicals must be approved by the City before purchase and implementation.
- Contractor must provide and require the wearing of protective clothing, mask, eye protection, etc., during any operation as required or directed by applicable laws, regulations or ordinances, and/or directions of manufacturers of material or equipment.
- All equipment must be properly maintained and is subject to inspection by the owner. Remove from premises equipment deemed inoperable or unsafe. Equipment must meet American Standard Safety Specification and OSHA requirements.
- The Contractor shall adequately protect workers, adjacent property, and the public, and take necessary precautions for the safety of his employees on the job and of the persons employed at the visited facility.

B.3 Specifics Related to Pruning

- **Street Trees**: Allow the tree to form a canopy type head (for shade), maintain a clear trunk of approximately 7 feet height to allow good visibility. The tree needs no pruning (except for deadwood or growth on the main tree trunk) unless the tree is disorganized and needs pruning in certain areas to achieve balance.

- **Flowering Trees**: Allow this plant to form its natural shape. Remove foliage and sucker growth from the stems to approximately 1/3 height of the plant. Allow the tree to achieve a maximum height of approximately 12 feet. Prune stems of the tree each year before spring.
- **Tree-Form Evergreens**: Always remove sucker growth from the stems of these plants to 1/3 the overall height of the plant. Prune the plants approximately two times each summer by removing the new shoots from the top of the plants and causing them to thicken up and spread out. (Do not make globe shapes out of these plants.)
- **Cherry, Fringe, and Chaste Trees**: Remove suckers periodically to promote clear trunk. Prune as necessary to promote healthy growth habits.
- **Evergreen Shrubs**: (Used as a hedge type plant): Allow to form a dense mass of plants. Height to be determined by Landscape Architect.
- **Low Shrubs**: (Used as massed type plants). Do not prune into individual shrubs. Allow to form a dense mass of plants at height no larger than 24 inches.
- **Medium Shrubs**: Prune twice a year minimum. Keep tight in character. Allow to grow such that plants will fill in as background. In medians allow plants to grow no larger than 30 inches, per GDOT/county regulations.
- **Daylilies and Daffodils**: Remove dead blooms/growth once a year to create clean appearance.
- **Groundcovers**: As specified on plant list, allow to fill in and create mass groundcover planting.

B.4 Typical Monthly Landscape Maintenance Guidelines

January

- Prune trees and shrubs that have become too large or out-of-shape.
- Inspect plants, shrubs, and trees and remove any damaged or dead wood.
- Inspect planting areas and remove any debris or litter.
- Check staking and weather protection of first year plants.
- Mulch bed areas as needed to replenish mulch levels.
- Transplant any trees and shrubs.
- Replace any damaged or dead trees and shrubs.
- Check moisture level in planted areas and water if necessary.
- Check drainage of planted areas, correct if excessive water persists.
- Protect plants susceptible to winter damage where possible during extreme cold periods.
- Clean up any litter in bed.
- Hand weed beds.

February

- Prune trees and shrubs that have become too large or out-of-shape.
- Inspect plants, trees, and shrubs and remove any damaged or dead wood.
- Inspect planted areas and remove any debris or litter.
- Check staking and weather protection for first year plants.
- Mulch bed areas as needed to replenish mulch levels.
- Apply pre-emerge herbicides to beds to prevent weeds (Treflan).
- Replace any damaged or dead trees or shrubs.
- Check moisture level in planted areas and water if necessary (weekly).
- Protect plants susceptible to cold damage during excessive cold periods if possible.
- Remove any staking on one-year old plantings.
- Spot spray any existing weeds with Round-Up.
- Reestablish a good edge on bed areas.
- Clean up any litter in bed.
- Hand weed beds.

March

- Inspect plants, trees, and shrubs and remove any damaged or dead wood.
- Check moisture level in planted areas and water if necessary (weekly).
- Start pruning where necessary to maintain shape and form (do not shear).
- All Liriope should be cut back to allow new growth to come out and remove winter damage to old growth.
- Hand weed bed areas as needed.
- Deep-root feed trees (Peter's 20-20-20).
- Clean up any litter in bed.

April

- Fertilize shrubs, trees, and groundcover area with Nursery Special by Sta-Green or equal.
- Cultivate and weed planted areas.
- Inspect planted areas and remove any dead plants and replace.
- Inspect plant material (shrubs and trees) and prune any dead limbs.
- Spot spray any weed problem areas.
- Inspect areas for insect and disease damage and treat as necessary.
- Prune shrubs after they have bloomed.
- Inspect plants and trees for insects and/or diseases and treat as necessary.

- Clean up any litter in bed.
- Hand weed beds.
- Aeration, reseeding and fertilization of lawn areas.

May

- Water/Irrigate planted areas as needed.
- Spot spray for weeds in planted areas with Round-Up.
- Weed groundcover areas as necessary.
- Plant annual color beds for the summer.
- Prune shrubs and hedges as necessary to keep shape and form.
- Prune any damaged plants.
- Clean up any litter in bed.
- Hand weed beds.
- Reestablish a good edge on bed areas.
- Lawn fertilization and weed control.

June

- Water/Irrigate planted areas as needed.
- Spot spray for weeds in planted areas with Round-Up.
- Weed groundcover and bed areas as necessary.
- Fertilize bed areas.
- Hand weed bed areas as needed.
- Clean up any litter in bed.
- Lawn fertilization and weed control.

July

- Water/Irrigate planted areas as needed.
- Hand weed bed areas as needed.
- Spot spray with Round-Up on weeds in planted areas where applicable.
- Inspect plant areas for insect and/or disease and treat as necessary.
- Prune shrubs and hedges as necessary to keep shape and form.
- Prune any damaged plants.
- Check bed areas for mulch replacement as needed.
- Clean up any litter in bed.

August

- Water/Irrigate planted areas as needed.

- Hand weed bed areas as needed.
- Spot spray with Round-Up on weeds in planted areas where applicable.
- Inspect plant areas for insect and/or disease and treat as necessary.
- Prune shrubs and hedges as necessary to keep shape and form.
- Fertilize groundcovers and bed areas.
- Check bed areas for mulch replacement as needed.
- Clean up any litter in bed.
- Reestablish a good edge on bed areas.
- Lawn fertilization and weed control.

September

- Water/Irrigate planted areas as necessary.
- Hand weed bed areas as needed.
- Inspect planted areas for insects and/or disease and treat as necessary.
- Prune shrubs and hedges as necessary to keep shape and form.
- Prune any damaged plants.
- Apply pre-emergent to bed areas (Treflan).
- Take soil test if necessary for lime and fertilizer requirements.
- Clean up any litter in bed.
- Lawn fertilization and weed control.

October

- Water/Irrigate planted areas as needed.
- Inspect planted areas for insects and/or disease and treat as necessary.
- Prune any damaged plants.
- Remove leaves from planted and lawn areas.
- Replace and/or plant any new trees or shrubs.
- Clean up any litter in bed
- Hand weed beds.
- Reestablish a good edge on bed areas.
- Aeration, reseeding, and fertilization of lawn areas.

November

- Check mulch in beds and replace where necessary.
- Check planted areas for water requirements.
- Hand weed beds.

- Apply approved anti-desiccant to evergreen trees during the first two weeks
- Clean up any leaf letter and trash litter in bed.
- Lawn fertilization and weed control.

December

- Clean up litter and leaves on paved and bed areas.
- Check planted areas for water requirements.
- Hand weed beds.
- Lawn fertilization and weed control.

Further Guidance

- FHWA, A Guide for Maintaining Pedestrian Facilities for Enhanced Safety (latest edition)
- GDOT, *Design Policy Manual* (latest edition)
- GDOT, Maintenance Office
- GDOT, Office of Traffic Operations
- GDOT, Policy 6755-9: *Policy for Landscaping and Enhancements on GDOT Right of Way* (latest edition)
- GDOT, Request for Qualified Contractors for Routine Maintenance Services