

CHAPTER

7



Design Guide

7.1 Introduction

Quality design of active transportation facilities is key to creating a non-motorized transportation network for all users. To accommodate growing user demand and create future facilities that are appropriately designed for all types of users, this chapter presents pedestrian and bicycle design best practices to be used as guidelines in the selection, design, and maintenance of bicycle and pedestrian facilities. Maintenance of some bicycle and pedestrian facilities may require additional staffing and cost and should be considered when selecting facility types.

The following pages describe national, state, and local guidance consulted to develop the non-motorized design guidelines. Facilities should meet federal and state standards at a minimum, but if local guidance provides a safer facility or better practice then local guidance should be applied. This section reflects existing guidance at the time of publication. Designers should check to see if newer versions of these resources exist, which may provide revised or expanded guidance.

Design Guidance

NATIONAL GUIDANCE

Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) and Alaska

<https://mutcd.fhwa.dot.gov/>

The MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is the primary source for guidance on lane striping requirements, signal warrants, and recommended signage and pavement markings.

To further clarify the MUTCD standards, the FHWA created a table of contemporary bicycle facilities that lists various bicycle related signs, markings, signals, and other treatments and identifies their official status (e.g., can be implemented, currently experimental).

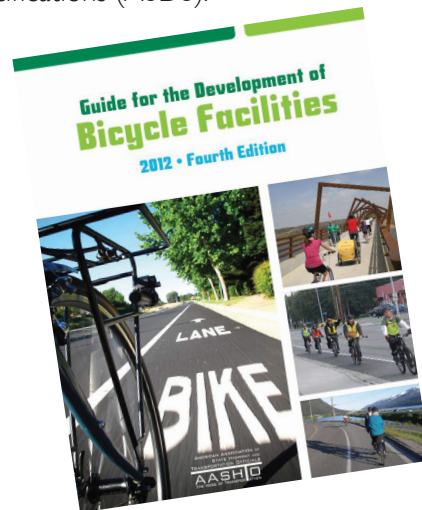
Bicycle way treatments not explicitly covered by the MUTCD are often subject to experiments, interpretations and official rulings by the FHWA. The MUTCD Official Rulings is a resource that allows website visitors to obtain information about these supplementary materials. Copies of various documents (such as incoming request letters, response letters from the FHWA, progress reports, and final reports) are available on this website.

Alaska Traffic Manual Supplement (ATMS)

<http://www.dot.state.ak.us/stwddes/dcstraffic/resources.shtml>

By statute, the 2016 Alaska Traffic Manual Supplement (ATMS) is a supplemental guide to be used in combination with the Federal MUTCD. The 2016 ATMS includes the latest standards on addressing nonmotorized traffic control devices and their use at crossings.

This document provides the standards for traffic control devices on public roads in Alaska. It includes THE Federal MUTCD, 2016 Alaska Traffic Manual Supplement, and the Alaska Sign Design Specifications (ASDS).



American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities

American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities

The AASHTO Guide for the Development of Bicycle Facilities, updated in June 2012, provides guidance on dimensions, use, and layout of specific

bicycle facilities. The standards and guidelines presented by AASHTO provide basic design information, such as minimum shared use pathway widths, bicycle lane dimensions, geometric design, detailed striping requirements and recommended signage and pavement markings.

AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities.

The 2004 AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities provides comprehensive guidance on planning and design for people on foot.

National Association of City Transportation Officials' (NACTO) 2012 Urban Bikeway Design Guide

<https://nacto.org/publication/urban-bikeway-design-guide/>

The NACTO Urban Bikeway Design Guide is a publication of nationally recognized bicycle way design, and offers guidance on current state-of-the-practice designs. The NACTO Urban Bikeway Design Guide is based on current practices in the best cycling cities in the world. The intent of the guide is to offer substantive guidance for cities seeking to improve bicycle transportation in places where competing demands for the use of the right of way present unique challenges. All of the

NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US.

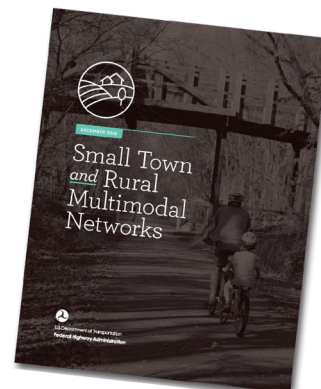
National Association of City Transportation Officials' (NACTO) 2013 Urban Street Design Guide

<https://nacto.org/publication/urban-street-design-guide/>

NACTO has also produced the 2013 Urban Street Design Guide which provides best practice for streets to serve as not only efficient travel corridors but public spaces. This guide includes a toolkit of street design elements with key dimensions and applications.

US Department of Transportation (USDOT) Small Town and Rural Multimodal Networks Guide

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/



US Department of Transportation (USDOT) Small Town and Rural Multimodal Networks Guide



Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, 2007

The Small Town and Rural Multimodal Networks Guide translates existing street design guidance and facility types for bicycle and pedestrian safety and comfort for the smaller scale places not addressed in guides such as the NACTO Street Design Guide and ITE Walkable Urban Thoroughfares report. The guide provides clear examples of how to interpret and apply design flexibility to improve bicycling and walking conditions. This guide pertains in particular to the Municipality of Anchorage as it is comprised of a small urbanized area and large rural area.

The stated goals of the guide include “to provide a bridge between existing guidance on bicycle and pedestrian design and rural practice, encouraging innovation in the development of safe and appealing networks for bicycling and walking in small towns and rural areas, and to provide examples of peer communities and project implementation that is appropriate for rural communities.”

The Recreational Trails Program of the Federal Highway Administration, U.S. Department of Transportation. (FHWA) Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, 2007.

https://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/07232816/

The Equestrian Design Guidebook provides guidance for construction of trails and associated facilities with specific treatments for use by equestrians.

2006 and 2010 Americans with Disabilities Act (ADA) Standards for Accessible Design

https://www.ada.gov/2010ADASTandards_index.htm

The 2006 and 2010 ADA Standards contain guidance for the construction of accessible facilities. This includes requirements for sidewalk curb ramps, slopes, and pedestrian railings along stairs.

Some of these treatments are not directly referenced in the current versions of the AASHTO Guide or the MUTCD, although many elements of the treatments are found within these documents. In all cases, engineering judgment is recommended to match the application to the context of each treatment. Meeting the requirements of the ADA is an important part of any bicycle and pedestrian facility project.

Public Rights-of-Way Accessibility Guidelines (PROWAG)

<https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/proposed-rights-of-way-guidelines>

The U.S. Access Board’s proposed Public Rights-of-Way Accessibility Guidelines (PROWAG) provides additional guidance on accessible design for public outdoor facilities (adoption pending).

Rails-with-Trails: Lessons Learned Literature Review, Current Practices, Conclusions, 2002.

<https://www.railstotrails.org/resourcehandler.ashx?name=rails-with-trails-lessons-learned&id=4495&fileName=ALTA%20RWT%20Study.pdf>

This document includes guidance on designing shared use pathways within or adjacent to active railroad right-of-ways. It was produced with guidance from U.S. Department of Transportation, FHWA, Federal Railroad Administration, National Highway Traffic Safety Administration, and Federal Transit Administration.

STATE GUIDANCE

Alaska Highway Preconstruction Manual

<http://www.dot.state.ak.us/stwddes/dcsprecon/preconmanual.shtml>

This document provides guidance for developing and designing highway and road projects across the state. A non-motorized transportation chapter was last modified in 2005.

LOCAL GUIDANCE

Municipality of Anchorage Design Criteria Manual, January 2007.

http://www.muni.org/departments/project_management/Pages/DesignCriteriaManual.aspx

The Municipality of Anchorage Design Criteria Manual (MOA DCM) includes roadway design elements, roadway requirements and characteristics based on classification, and street design criteria. The manual also includes guidance on drainage, landscaping, trails, lighting, public transportation, and traffic control.

Anchorage Municipal Code Title 21

<https://www.muni.org/Departments/OCPD/Planning/Projects/t21/Pages/Title21Rewrite.aspx>

Chapter seven of the Anchorage Municipal Code (AMC) Title 21 includes development and design standards for elements such as pedestrian facilities and bicycle parking.

AMATS NON-MOTORIZED PLAN

Anchorage Pedestrian Plan

https://www.muni.org/Departments/OCPD/Planning/AMATS/Documents/PedestrianPlan_Web.pdf

The Anchorage Pedestrian Plan was adopted in 2007 and includes sidewalk design principles.

Anchorage Bicycle Plan

<https://www.muni.org/Departments/OCPD/Planning/AMATS/Documents/AdoptedBicyclePlan.pdf>

The Anchorage Bicycle Plan is an element of the Municipality of Anchorage Nonmotorized Transportation Plan adopted in 2010 and includes guidance on bicycle facility design.

Areawide Trails Plan, 1997

<https://www.muni.org/Departments/OCPD/Planning/Publications/Documents/AreawideTrailsPlan-1997-noMaps.pdf>

The Anchorage Areawide Trails Plan recommends improvements for motorized and non-motorized shared use pathways in Anchorage.

Municipality of Anchorage Safe Routes to School Manual, 2019-2020

<https://www.muni.org/Departments/traffic/Pages/SafeRoutesToSchools.aspx>

The Anchorage Safe Routes to School Manual provides routing information to assist students who walk to and from school.

1988 Joint ARRC-DOTPF Policy for Rail-Highway Crossings and ARRC Technical Design Standards

http://www.dot.state.ak.us/stwddes/dcstraffic/assets/pdf/misc/rd_hwycrossings.pdf



7.2 User Needs

User Behavior

Active Transportation facilities attract a wide range of users with different needs and expectations. Important design characteristics are width, surface material, sight distances, clearances, and added features. The following section provides the framework for incorporating standards and guidelines for the following users:

- » **Pedestrians**
- » **Bicyclists**
- » **Wheelchair users**
- » **Other non-motorized users**

Design Needs of Users

PEDESTRIANS

Aside from space requirements related to pedestrian-specific activities such as pet walking or running, pedestrians have a variety of physical characteristics determining user needs and abilities. Age is one major factor that affects pedestrians' walking speed and environmental perception. Children have low eye height and walk at slower speeds than adults. They also perceive the environment differently at various stages of cognitive development, and may require supervision depending on age and ability to judge their surrounding traffic environment. Older adults walk more slowly and may require assisting devices for walking stability, sight, and hearing. The table below summarizes common pedestrian characteristics for various age groups.

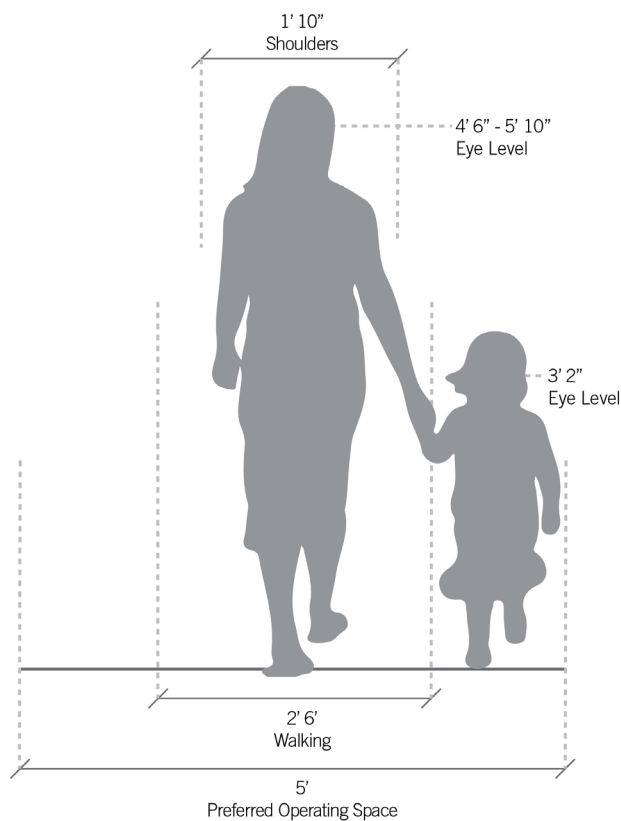
The Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) and the Alaska Traffic Manual (ATMS) compile standards for traffic control devices, including road markings, highway signs and traffic signals. As a rule of thumb, the MUTCD recommends a normal walking speed of three and a half feet per second for calculating the time needed for pedestrian crossings at traffic signals. Average walking speed is lowered to three feet per second in areas with older populations and persons with mobility impairments. While the type and degree of mobility impairment varies greatly across the population, the pedestrian network should accommodate these users to the greatest reasonable extent.

Table 7.1: Pedestrian Characteristics by Age.

AGE	CHARACTERISTICS
0-4	Learning to walk Require constant adult supervision Developing peripheral vision and depth perception
5-8	Increasing independence, but still require supervision Poor depth perception
9-13	Susceptible to "dart out" or intersection dash Poor judgment* Sense of invulnerability
14-18	Improved awareness of traffic environment Poor judgment
19-40	Active, fully aware of traffic environment
41-65	Slowing of reflexes

Source: AASHTO. Guide for the Planning, Design, and Operation of Pedestrian Facilities, Exhibit 2-1. 2004.

In addition to the sidewalks, crosswalks, and signals that facilitate the basic act of walking, additional amenities—such as benches, trash/recycling receptacles, dog walking stations, shade structures, restroom facilities, and water fountains—are necessary to support walking in its various forms and to encourage more active transportation. The provision of such amenities can help make walking an easy and comfortable choice for people of various ages and abilities.



Design dimensions of pedestrians and preferred operating space

BICYCLISTS

Bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle, or a tricycle) and behavioral characteristics (such as the comfort level of the bicyclist). Bicyclists require clear, open space with no visual obstructions to operate within a facility. The minimum operating width is greater than the physical dimensions of the bicyclist to allow the

bicyclists shy distance from vertical obstacles and to allow maneuvering space around uneven pavement or other obstructions. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable. Bicyclist speeds range from 12 to 30 mph on a paved level surface (grades less than 2 percent). Uphill speeds range from five to twelve mph, and downhill bicyclist speeds can reach 20 - 30 mph. As paths approach controlled intersections, path geometry should be such to promote lower design speeds.

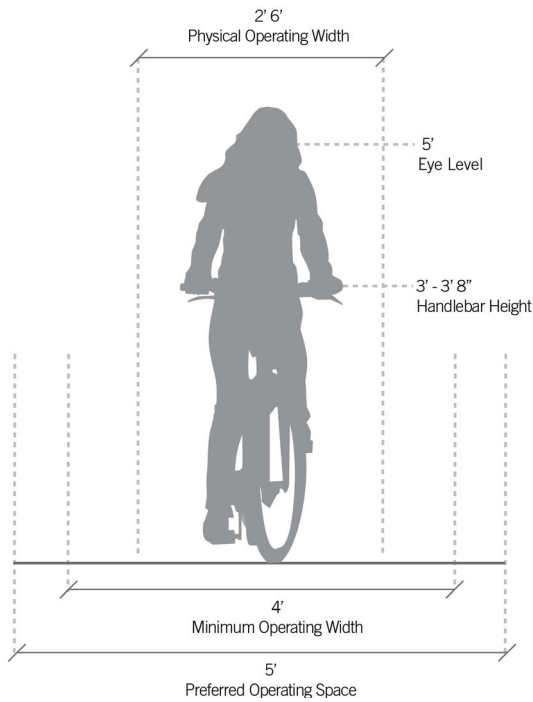
Table 7.2: Upright adult bicyclist - typical dimensions.

FEATURE	TYPICAL DIMENSIONS
Physical width	2 ft 6 in
Operating width (minimum)	4 ft
Operating width (preferred)	5 ft
Physical length	5 ft 10 in
Physical length of handlebars	3 ft 8 in
Operating height	8 ft 4 in
Eye height	5 ft
Vertical clearance to obstructions (tunnel height, lighting, etc.)	10 ft
Approximate center of gravity	2 ft 9 in = 3 ft 4 in

Table 7.3: Bicycle design speed expectations.

BICYCLE TYPE	FEATURE	TYPICAL SPEED
Upright Adult Bicycle	Paved level surfacing	8 - 15 mph
	Crossing intersection	10 mph
	Downhill	20 - 30 mph
	Uphill	5 - 12 mph
Recumbent Bicycle	Pavel level surfacing	11 - 18 mph

***Tandem bicycles and bicyclists with trailers have typical speeds equal to or less than upright adult bicyclists.**

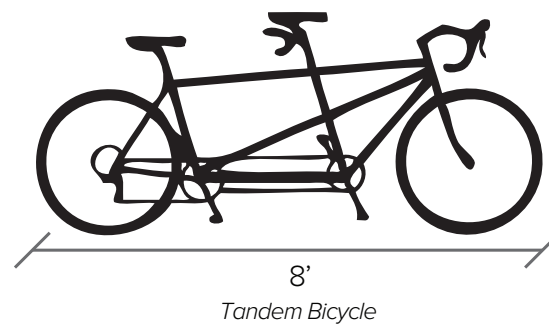
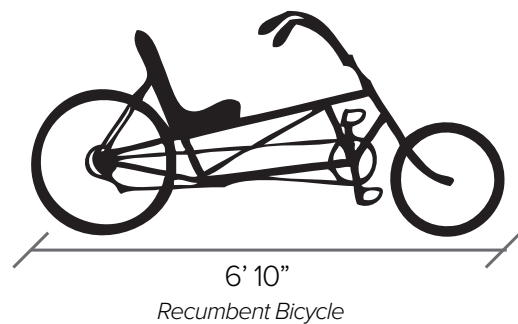
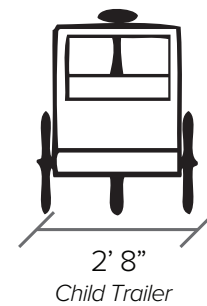
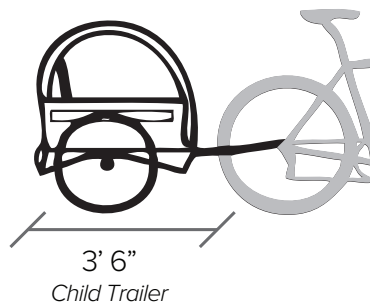
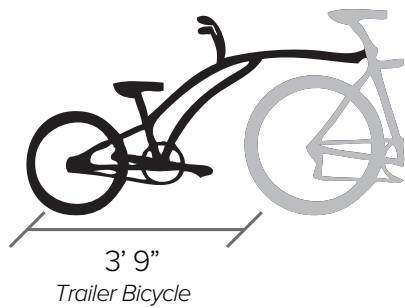
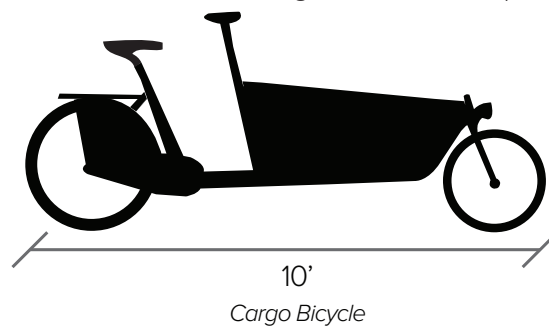
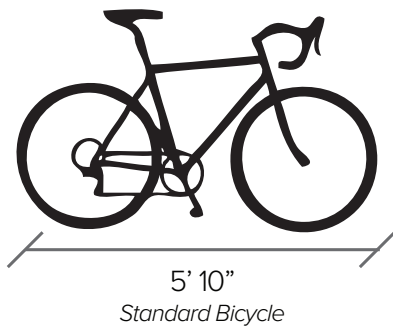


Typical bicycle operating widths

E-BIKES AND OTHER ELECTRIC MICROMOBILITY DEVICES

Electric bikes and other battery powered devices that may or may not resemble traditional bicycles, but share similar operating design speeds, such as e-scooters, have become fairly common places on our roads today. The variety of sizes and form factors ranges, but for the most part these can

be considered to have the same or similar typical operating envelope as traditional bikes. Along facilities where these devices are expected, more space (facility width) is needed to account for the speed differential of different devices, and provide for comfortable passing room. Physical separation can be used to manage different user speeds.



Typical dimensions for common bicycle types

WHEELCHAIR USERS

As the American population ages, the number of people using mobility assistive devices (such as manual wheelchairs, powered wheelchairs) increases.

Manual wheelchairs are self-propelled devices. Users propel themselves using push rims attached to the rear wheels. Braking is done through resisting wheel movement with the hands or arm. Alternatively, a second individual can control the wheelchair using handles attached to the back of the chair.

Power wheelchairs use battery power to move the wheelchair. The size and weight of power wheelchairs limit their ability to negotiate obstacles without a ramp. Various control units are available that enable users to control the wheelchair movement based on their ability (e.g., joystick control, breath controlled, etc.).

Maneuvering around a turn requires additional space for wheelchair devices. Providing adequate space for 180 degree turns at appropriate locations is an important element for accessible design.

OTHER NON-MOTORIZED USERS

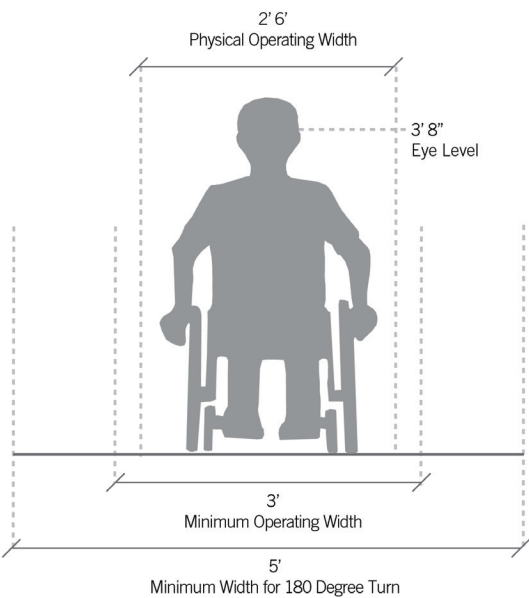
Please reference the forthcoming Recreation Trail Design Guidelines for guidance for other non-motorized users, such as those cross country skiing, skijoring, fat tire biking, horseback riding, and dog mushing.

Table 7.4: Wheelchair use typical speed.

USER	TYPICAL SPEED
Manual wheelchair	3.6 mph
Powered wheelchair	6.8 mph

Table 7.5: Wheelchair user design considerations.

EFFECT ON MOBILITY	DESIGN SOLUTION
Difficulty propelling over uneven or soft surfaces	Firm, stable surfaces and structures, including ramps or beveled edges
Cross-slopes cause wheelchairs to veer downhill	Cross-slopes of less than 2 percent



Typical wheelchair operating widths

Rules of the Road

PEDESTRIANS

Just as there are rules of the road that govern operating a motor vehicle, there are specific laws pertaining to pedestrians. Both the Municipality of Anchorage, and the State of Alaska provide rules and ordinances to pedestrian's rights and duties when walking in a public right of way. A brief summary of those rules are provided below. A full record of pedestrian-related ordinances is available through the Alaska State Legislature online administrative code, www.legis.state.ak.us/basis/aac.asp#13.02.150, and Anchorage's municipal ordinances, library.municode.com/ak/anchorage/codes/code_of_ordinances?nodeId=TIT9VETR_CH9.20PERIDU

- Pedestrians must comply with traffic and pedestrian-control signals.
- A pedestrian may not enter or remain on the rotary traffic island of a roundabout or the roadway circulating around it.
- When traffic-control signals are not in place or not in operation, the driver of a vehicle shall yield the right-of-way to a pedestrian who is on a sidewalk, vehicular way or area, or who is crossing a roadway within a crosswalk when the pedestrian is upon the half of the roadway upon which the vehicle is traveling, or when the pedestrian is approaching so closely from the opposite half of the roadway as to be in danger.
- No pedestrian may leave a curb or other place of safety and walk or run into the path of a vehicle which is so close as to constitute an immediate hazard.
- When a vehicle is stopped at a marked crosswalk or at an unmarked crosswalk at an intersection to permit a pedestrian to cross the roadway, no driver of another vehicle approaching from the rear may overtake and pass the stopped vehicle.
- A pedestrian crossing a roadway at a point other than within a marked crosswalk or within an unmarked crosswalk at an intersection shall yield the right-of-way to all vehicles upon the roadway (except as provided in AS 28.35.145).
- No pedestrian may cross a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided and which is accessible at road level at or near the point of crossing, unless a marked crosswalk is also provided at that point. If a pedestrian overpass or tunnel is not accessible and if no marked crosswalk is provided, a pedestrian crossing the roadway must yield the right-of-way to all vehicles on the roadway which are so close as to constitute a hazard.
- Between adjacent intersections in a business or residence district in which traffic-control signals are in operation, no pedestrian may cross except in a marked crosswalk.
- No pedestrian may cross a roadway intersection diagonally or otherwise than at a right angle unless authorized by an official traffic-control device. When authorized to cross diagonally, pedestrians must cross in accordance with the official traffic-control device.
- No pedestrian may cross a roadway where an official traffic-control device specifically prohibits the crossing.
- A pedestrian must cross a roadway at a right angle to the roadway or by the shortest route to the opposite side of the roadway.

BICYCLISTS

In order to bicycle safely, it is important to keep in mind the laws regarding bicycling in Alaska, and Anchorage in particular. A summary of Article 9 from Alaska's Administrative Code, pertaining to rules of the road for bicyclists, is provided below. For a full account of Alaska's laws and rules related to operating a bicycle, please visit the Alaska State Legislature online administrative code, available at www.legis.state.ak.us/basis/aac.asp#13.02.377 and library.municode.com/ak/anchorage/codes/code_of_ordinances?nodeId=TIT9VETR_CH9.38BI for Anchorage's municipal ordinances.

- Every person operating a bicycle upon a roadway has all the rights and is subpart to all of the duties applicable to the driver of any other vehicle as set out in this chapter, in addition to special regulations in secs. 385-420 of this chapter, except as to those provisions of this chapter which by their nature have no application.
- No person may violate the provisions of secs. 385-420 of this chapter. The parent or guardian of a child may not authorize or knowingly permit a child to violate a provision of this chapter.
- When signs are erected indicating that no right, left, or U-turn is permitted, no person operating a bicycle may disobey the direction of this sign unless first pulling to the extreme right or shoulder of the road, dismounting and making the turn as a pedestrian.
- No person operating a bicycle upon a highway may carry a person other than the operator, unless the bicycle is equipped with a seat for the passenger, except that an adult rider may carry a child securely attached to his person in a backpack or sling.
- No person operating a bicycle or other non-motorized conveyance may attach, hold on by hand or otherwise secure the bicycle or conveyance or himself to another vehicle so as to be towed or pulled.
- A person operating a bicycle upon a highway shall maintain control of the bicycle and shall at all times keep at least one hand upon the handlebars of the bicycle.
- No person may operate a unicycle, coaster, roller skates, or similar device on a highway.
- A person operating a bicycle upon a roadway shall ride as near to the right side of the roadway as practicable, and shall give way to the right as far as practicable to a motor vehicle proceeding in the same direction when the driver of the motor vehicle gives audible signal.
- Persons riding bicycles on a roadway may not ride more than two abreast except on paths or parts of roadways set aside for the exclusive use of bicycles. Persons riding bicycles two abreast may not impede traffic and, in a laned roadway, shall ride within the farthest right lane.
- When a shoulder of the highway is maintained in good condition, an operator of a bicycle shall use the shoulder of the roadway.
- A person operating a bicycle on a trail, path, sidewalk, or sidewalk area shall
 1. exercise care to avoid colliding with other persons or vehicles;
 2. give an audible signal before overtaking and passing a pedestrian, and
 3. yield the right-of-way to any pedestrian.
- A person riding a bicycle intending to turn left shall, unless he dismounts and crosses as a pedestrian, give a signal by hand and arm continuously during the last 100 feet traveled unless the hand is needed in the control or operation of the bicycle. When stopped to await an opportunity to turn, a hand and arm signal must be given continuously by the

- operator.
- No person may ride a bicycle upon a sidewalk in a business district or where prohibited by an official traffic-control device.
- No bicycle race may be conducted upon a roadway, except as provided under AS 05.35.
- No person may park a bicycle on a street or sidewalk in a manner which obstructs pedestrian traffic or the parking and driving of motor vehicles.
- No person may secure a bicycle to any of the following publicly owned facilities:
 1. fire hydrants;
 2. police and fire call boxes;
 3. electric traffic signal poles;
 4. stanchions or poles located within bus zones or stands;
 5. stanchions or poles located within 25 feet of an intersection; or
 6. trees under 10 inches in diameter.
- A bicycle parked on a highway must comply with the provisions of this chapter regulating the parking of vehicles.
- Every vehicle, including bicycles, traveling on a highway or other vehicular way or area within the state must illuminate lights
 1. between one half hour after sunset and one half hour before sunrise; or
 2. at any other time when, because of insufficient light or other atmospheric conditions, persons or vehicles on the highway are not clearly discernible at a distance of 1000 feet.
- A bicycle, when ridden at the times when lights are required by law (see above), must be equipped with at least one light on the front of the bicycle, emitting white light visible from a distance of at least 500 feet in front of the bicycle under normal atmosphere conditions.
- A bicycle must be equipped with a taillight which displays a red light visible 500 feet to the rear of a bicycle.
- Every bicycle, when ridden at a time when lights are required, must be equipped with a red reflector on the rear of the bicycle and reflective material visible from the sides of the bicycle meeting the visibility requirements described above.
- Every bicycle must be equipped with a brake system, maintained in good working condition, which will enable its driver to stop the bicycle within 25 feet from a speed of 10 miles per hour on dry, level, clean pavement.
- "Bicycle" means a vehicle propelled exclusively by human power upon which a person may ride, having two tandem wheels or three wheels in contact with the ground, except scooters and similar devices.



7.3 Facility Types

The following sections provides design guidance on the facilities types for AMATS's non-motorized transportation network:

- » **Pedestrian Facilities** – Sidewalk, pedestrian lane, festival street, (also see shared use pathway, sidepath)
- » **Bicycle facility selection**
- » **Enhanced shared roadway** – Yield roadway, bicycle boulevard
- » **Separated bikeway** – Buffered bicycle lane, protected bicycle lane
- » **Supplemental bicycle facilities** – Signed route, paved shoulder, advisory shoulder, bicycle lane
- » **Shared use pathway or sidepath** – Sidepath, shared use pathway
- » **Equestrian trails along roadways**
- » **Curb Types**
- » **Winter Design Considerations**

Pedestrian Facilities

SIDEWALKS

Sidewalks are the most fundamental element of the walking network as they provide an area for pedestrian travel that is separated from vehicle traffic. Sidewalks are typically constructed out of concrete and are separated from the roadway by a curb or gutter and sometimes a landscaped planting strip or furnishing zone. Added features for sidewalks include street trees, benches or places to sit, pedestrian scaled lighting, and bicycle racks.

Design Features:

- » In the central business district (zones B-2A, B-2B, and B-2C) the recommended sidewalk width is 12 feet with a minimum of 11.5 feet (AMC 21.40.150L, AMC 21.40.160L, AMC 21.40.170L). For the rest of the municipality the minimum width of sidewalks is five feet (MOA DCM, I-11). Maintenance equipment and resource needs should be considered when designing sidewalk widths.
- » The US Access Board has pending guidelines requiring a minimum of four-foot clear walking space with five-foot wide passing areas every 200 feet (PROWAG, R302.3-302.4).
- » To allow two people to comfortably walk side by side, six feet is the preferred minimum width (NACTO Urban Street Design Guide, 40). Additional width is recommended on major corridors wherever possible, (e.g., the redesign of Spenard Road).
- » Recommended landscape buffer between vertical curb and sidewalk of four to six feet is preferred for comfort and sufficient snow storage (Small Town and Rural Multimodal Networks, 4-21). Where bicycle facilities are present, special attention to snow storage space is necessary to ensure safe use of sidewalks and bikeways during and after snow events

- » Overhead utilities should be buried or otherwise removed from the sidewalk right-of-way to ensure accessibility and sufficient space for pedestrians and wheelchair users.

PEDESTRIAN LANE

Pedestrian lanes can serve as an interim or temporary pedestrian facility. Pedestrian lanes are not intended to be an alternative to sidewalks, but rather can serve as an interim solution to fill short gaps between other higher quality facilities. A pedestrian lane is a designated space on the roadway for exclusive use of pedestrians. Pedestrian lanes may be appropriate on roads with low to moderate speeds and volumes that are wide enough to support two-way vehicle travel outside of the pedestrian lane..

Design Features:

- » The preferred width of a pedestrian lane is eight feet (Small Town and Rural Multimodal Networks, 5-7).
- » Recommended minimum width is five feet to still allow for side-by-side walking and maneuverability for users of mobility devices (Small Town and Rural Multimodal Networks, 5-7).



Pedestrian lane in St. Charles, MN

FESTIVAL STREETS

Festival Streets are streets that have been repurposed for exclusively non-motorized use, prioritizing a travel way and gathering space for people walking, biking, rolling, resting, and gathering.

The official rededication and activation of this right of way space is typically done to refocus the space as a destination. Programming of the space can include live events, music, vendors, seating, eating/drinking spaces, and can introduce a variety of placemaking opportunities including public art, landscaping, education, and contribute to local identity/branding.

Festival streets are typically implemented along commercial corridors, and focused where there are a concentration of local destinations, landmarks, and public gathering spaces.

They can be activated for temporary use during special events, or permanent use based on a longer-term vision for the streetscape. In either case, a Festival Street can allow Anchorage to better utilize the public space, and respond to the changing needs and interests of adjacent properties and the larger community.

Design Features:

- » It is important to establish whether specific spaces within the Festival Street are public, private, or a combination of the two. Whether people have to spend money, consume goods/services in order to use the space is important. Typically, there is a mix of both types of areas, but creating some degree of non-transactional, non-consumptive spaces should be a priority for equity, and utility of space.
- » The introduction of physical barriers to restrict motor vehicles access is critical. Barriers can range from shorter-term traffic control devices, to more



Festival street

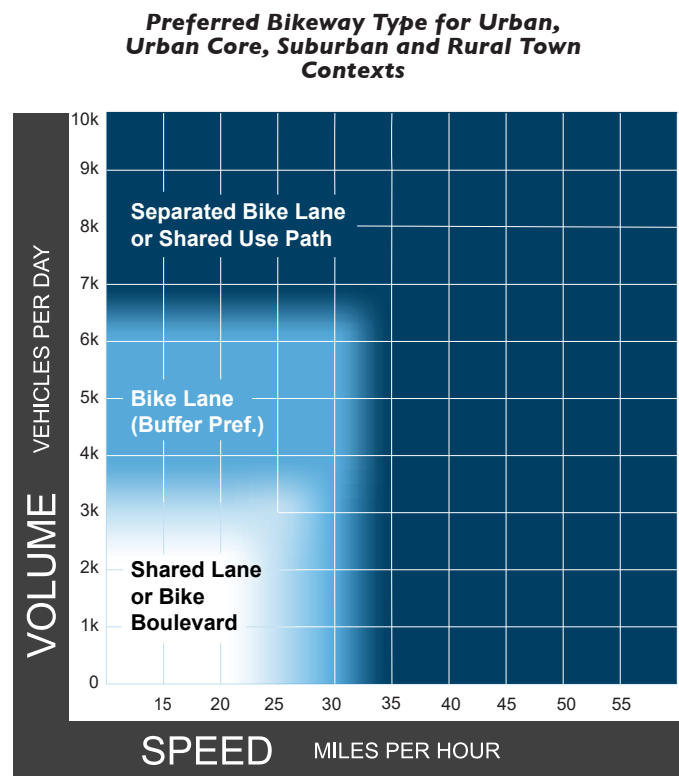
permanent concrete installations depending on budget and implementation timeframe.

- » Connectivity through the area needs to be preserved for people walking, rolling, and in some cases biking through the area. Programming and gathering spaces should not preclude accessways and travel, although it may be necessary to establish policies and clear guidance around dismounting and walking bikes or other personal mobility devices, in the absence of a dedicated travel space for specific users.
- » Programming will vary depending on time of day, week/weekend, and/or season.
- » Permanent Festival Streets can feature pedestrian scale lighting, trees and landscaping, water features, and public art as a permanent fixtures in the space.
- » Short of a full right of way vacation for private development, local jurisdictions will need to establish policy and a permitting structure for incentivizing and regulating private use of space in the public right of way.

Bicycle Facility Selection

Selecting the best bicycle way facility type for a given roadway can be challenging given the range of factors that influence a bicycle user’s comfort and safety. There is a significant impact on cycling comfort when the speed differential between bicycle and motor vehicle traffic is high and traffic volumes are high. The tool below will assist with appropriate selection of facility based on average daily traffic and posted speed. In addition to the factors of speed and traffic volumes outlined in the diagram below, winter maintenance and snow storage needs can influence the type of facility that is most appropriate in a given context.

Due to winter snow and darkness conditions, bicycle facility design should be more reliant on separated facilities. On existing facilities without a buffer space, the summer facility condition could operate as currently designed and a winter facility condition created through the use of hardpack with a buffer space being naturally created through roadway snow plowing operations and the resulting snow banks. Hardpacks can be created on the flat surfaces where physical width is available to accommodate varying user types including cross-country skiers, snow shoers, and the like.



- Notes**
- 1 Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.
 - 2 Advisory bike lanes may be an option where traffic volume is <3K ADT.
 - 3 See page 32 for a discussion of alternatives if the preferred bikeway type is not feasible.

Source: Facility selection tool from [FHWA Bikeway Selection Guide](#), where additional guidance is available on shoulder

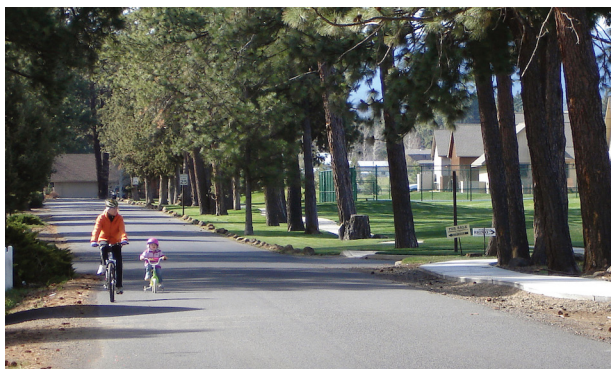
Enhanced Shared Roadway

YIELD ROADWAY

A yield roadway is designed to serve pedestrians, bicyclists, and motor vehicle traffic in the same slow-speed travel area.

Design Features:

- » Yield roadways serve bidirectional motor vehicle traffic without lane markings in the roadway travel area.
- » The travel way width can vary from 12 feet to 20 feet (Small Town and Rural Multimodal Networks, 2-3 - 2-4). The minimum width for a rural collector street in Anchorage is 20 feet (MOA DCM, 1-25). Yield roadways can be wider if they have physical definition to their on-street parking in the form of dirt areas, planters, or curb extensions creating this constriction.



Yield roadway in Sisters, OR

BICYCLE BOULEVARD

Bicycle boulevards, also called Neighborhood Greenways, are non-arterial streets with low motorized traffic volumes and speeds, designated and designed to give bicycles and pedestrians travel priority. Bicycle boulevards provide comfortable and attractive places to ride a bicycle or walk for people of all ages and abilities using minor street design modifications including wayfinding signage, pavement markings, traffic calming and/or traffic reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

Design Features:

- » Bicycle boulevards should have a maximum posted speed of 25 mph and target motor vehicle volumes of less than 1,500 vehicles per day, with an absolute maximum of no more than 3,000 vehicles per day (NACTO Urban Bikeway Design Guide, 154).
- » A critical component of a bicycle boulevard is to improve crossings at arterial streets for safer and more comfortable travel for both bicyclists and pedestrians (e.g. RRFB, signals, etc.). The selection and placement of RRFBs and other crossing treatments are based upon an engineering review of visibility, gaps, speed, crossing length, and traffic and pedestrian volumes.



Bicycle boulevard in Anchorage, AK

Separated Bikeway

BUFFERED BICYCLE LANES

Buffered bicycle lanes are conventional bicycle lanes with an additional designated painted buffer space, separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane.

Design Features:

- » Seven feet is the preferred minimum overall width of the bicycle lane and the painted buffer (NACTO Urban Bikeway Design Guide, 12-13).
- » The painted buffer should be at least 18 inches wide as it is impractical to stripe a narrower area (NACTO Urban Bikeway Design Guide, 13).
- » If located adjacent to a parking lane, a wider buffer should be provided to allow space for bicyclists to avoid the door zone.

PROTECTED BICYCLE LANES

Of all on-street bicycle facilities, protected bicycle lanes offer the most protection and separation from adjacent motor vehicle traffic. Protected bicycle lanes are bicycle facilities that are physically separated from motor vehicle traffic by a painted buffer and physical barriers such as flexible delineators, curbs, or planters. Parking lanes can also be used as a means of physical protection if there is a buffer space between the bicycle lane and the parking lane. Single or bi-directional protected bicycle lanes are ideally placed on streets with few driveways or mid-block access points for motor vehicles.

Design Features:

- » Eight feet is the minimum recommended total width for a protected bicycle lane, five feet of bicycle lane and three feet of physical buffer zone (NACTO Urban Bikeway Design Guide, 32-33).
- » The FHWA Separated Bike Lane Planning and Design Guide (2015) provides more guidance.



Buffered bicycle lane in Lyndonville, VT
Source: Western Transportation Institute



Protected bicycle lane in Jackson Hole, WY
Source: Wyoming Pathways

Supplemental bicycle facilities

SIGNED ROUTE

Signed bicycle routes are roadways shared with motor vehicles which have route signs for bicycle wayfinding. As per the Anchorage Municipal Law (AMC), signed routes, shoulders, and bicycle lanes fall under motor vehicle rules of the road. Where bike routes become side paths, they fall under pedestrian rules of the road and will follow use both a pedestrian and bicyclist symbol denoting multi-use and change in rules of the road. Signed bicycle routes provide connections with other bicycle facilities or designate preferred routes through high-demand corridors. Unlike bicycle boulevards, marked bicycle routes do not include traffic calming measures, pavement markings, or directional wayfinding signs to provide a higher level of comfort for bicycle users.

Design Features:

- » Typically, signed routes are placed on roadways with low speeds and traffic volumes, however there are also applications on higher volume roads with wide outside lanes or shoulders.



Bicycle route signage in Anchorage, AK

PAVED SHOULDERS

Paved shoulders on the edge of roadways can be enhanced to serve as a functional space for bicyclists and pedestrians to travel in the absence of other facilities with more separation. Paved shoulders can reduce “bicyclist struck from behind” crashes, which represent a significant portion of rural road crashes.

Except where expressly prohibited, pedestrians may legally walk on shoulders. Most roadway shoulders are not intended for regular use by pedestrians, but wide shoulders can accommodate occasional pedestrian use. Wider shoulders are preferable to allow a pedestrian to walk as far as possible away from the travel lane of a roadway.

Shoulders used as access routes should meet ADA requirements for pedestrian walkways (AASHTO Pedestrian Guide 2004, 55).

Design Features:

- » Provision of a four foot minimum continuous clear width (Small Town and Rural Multimodal Networks, 3-5).



Paved shoulder in Ridgecrest, CA

ADVISORY SHOULDER

Advisory shoulders create a usable area for bicyclists on a roadway that is otherwise too narrow to accommodate one. The shoulder is delineated by pavement markings and optional pavement color. Motorists may only enter the shoulder when no bicyclists are present and should overtake these users with caution due to potential oncoming traffic and cyclist safety.

Design Features:

- » The preferred width of the advisory shoulder space is six feet. Absolute minimum width is four feet when no curb and gutter is present (Small Town and Rural Networks Guide, 2-19).
- » Preferred two-way center travel lane width is 13.5 - 16 feet although may function with widths of 10 - 18 feet (Small Town and Rural Networks Guide, 2-19).

FHWA Experimentation:

» Advisory shoulders are an emerging treatment in the US. While all required traffic control device elements are included in the MUTCD in some capacity, the manual does not fully address the particular combination of traffic control devices which make up the treatment. It is recommended communities implement advisory shoulders within the experimentation process established by the FHWA. The experimentation process has monitoring and reporting requirements, but offers benefits to communities and agencies in the form of stronger liability protection, FHWA technical support, and makes a positive contribution to the body of knowledge regarding this facility type. The process involves writing a letter to the FHWA with the details of the existing circumstances, a proposed plan, and answering questions that may arise (Lessons Learned Advisory Bicycle Lanes in North America., 9).



Advisory shoulder in Edina, MN

BICYCLE LANE

Bicycle lanes designate an exclusive space for bicyclists with solid lane lines, bicycle symbol pavement markings, and signage. The bicycle lane is located adjacent to motor vehicle travel lanes and bicyclists ride in the same direction as motor vehicle traffic. Bicycle lanes are typically on the right side of the street (on a two-way street), between the adjacent travel lane and curb, road edge, or parking lane.

At signalized intersections bicycle detection can be used to detect bicyclists for crossing (see Bicycle Detection at Traffic Signals). As an interim solution bicycle exit and entrance ramps can be used to allow bicyclists to cross through the pedestrian crosswalk at intersections (AMATS Bicycle Plan). Bicyclists may choose to proceed through on the roadway under vehicular rules of

the road, or may be provided the option to exit to the nonmotorized facility and use pushbuttons and follow pedestrian rules of the road. Ramps may be retained to provide users of various skill levels a choice at larger, busier intersections, just as is standard for roundabouts. The need for ramps is determined during the design phase and are context dependent.

Design Features:

- » While four feet is the minimum width of a bicycle lane exclusive of the gutter pan, six feet is preferred. If illegal parking is a concern, five feet may be preferable (NACTO Urban Bikeway Design Guide, 6). When not designated, marked, and signed as a bicycle lane, six feet is a concern approaching major urban intersections. This is wide enough some motorists have been observed to intentionally use it as an auxiliary vehicle turn lane.
- » Gutter pans should not be included in bicycle lane widths



Bicycle lane in Anchorage, AK



Sidepath, Anchorage, CA

Shared use pathway or sidepath

SIDEPATH

As defined by AASHTO, a sidepath is a shared use pathway located immediately adjacent and parallel to a roadway. Sidepaths are for two-way movement by bicycles, pedestrians and other non-motorized users. Sidewalks are not considered sidepaths as they are not conducive to riding a bicycle and can lead to user conflicts (AASHTO Guide for the Development of Bicycle Facilities, 3.4.2). Sidepaths are appropriate adjacent to roadways with high speed or high volumes of motor vehicles that would discourage bicyclists from using the roadway, and there are no practical alternatives to improving the roadway or redirecting cyclists to alternate routes.

Design Features:

- » The preferred buffer width between a shared use pathway and roadway is seven feet or more to improve user experience and provide snow storage area without covering the facility (MOA DCM, I-II)
- » Sidepaths should have a minimum of five feet of distance between the path and the roadway. If this setback distance is not available, there should be a barrier or railing to protect the path from vehicles

and to discourage path users from crossing the roadway other than designated locations (AASHTO Guide for the Development of Bicycle Facilities, 5.2.2). The greater upfront costs associated with providing a setback or physical barrier/railing as a buffer between bicycle/pedestrian traffic and motor vehicles should be balanced by consideration of the long-term gains in safety, snow storage, and maintenance efficiency (see Section 7.8 for design guidance for facility width and buffer/separation distance as they relate to maintenance and snow storage considerations).

- » Sidepaths are eight to twelve feet wide with a recommended minimum of ten feet and eight feet in constrained conditions (Small Town and Rural Multimodal Networks, 4-13).
- » At intersections, physical separation of the sidepath through the crossing should be maintained in the form of sweeps. Sidepath separation distance may vary from 5 ft–24 ft. depending on the vehicle speed of the adjacent roadway (Small Town and Rural Multimodal Networks, 4-15). Balancing the competing needs and guidance on separation distances, sight triangles, and STOP bar compliance may result in separation distances of less than 5 ft and not as great as 24 ft. AMATS and DOTPF uses 0 to 10 feet setbacks (urban) per Regional Details, and 0-8 feet (rural).

SHARED USE PATHWAY

A shared use pathway is an off-street dedicated facility for two-way bicycle traffic and other non-motorized users such as pedestrians, skaters, wheelchair users, and joggers. Shared use pathways in Anchorage are Trail Class 5 or a fully developed trail that accommodates two-lane travel and is paved (MOA DCM, 4-9). These facilities are frequently found in parks, along rivers, beaches, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles. At low user volumes, shared use pathways are functional, pleasant, and adequate for use by users of all ages and abilities. In some rural contexts, an unpaved/natural surface trail may be an appropriate and more feasible facility; however, the recommendations for shared use pathways in this plan refer to paved paths.

Due to climate change and the natural transition from winter to spring, the potential for icing on facilities can be problematic. In areas where ice is an issue on pathways, proper drainage and cross-slope is important to reduce the potential for water

accumulation and freezing. Appropriate signage can also be added, warning trail users of areas where ice occurs, similar to how this is done on-road. Additionally, increasing maintenance operations to include the use of salt or friction aggregate such as sand will help during the transition periods of breakup and chinook.

Design Features:

- » Shared use pathways are 10 to 14 feet wide, single paved surface capable of accommodating low to moderate volumes of users (Small Town and Rural Multimodal Networks, 4-3).
- » 12 to 14 feet is preferred to accommodate two-way travel and enable passing (Small Town and Rural Multimodal Networks, 4-6).
- » AASHTO defines 10 feet as the minimum paved dimension for two way travel (AASHTO Guide for the Development of Bicycle Facilities, 5.2.1).
- » Eight feet is allowed in constrained conditions and is only recommended for low traffic situations or for short lengths (Small Town and Rural Multimodal Networks, 4-6).



Shared use pathway in Anchorage, AK

Equestrians trails along roadway

Equestrian trails adjacent to roadways pose risks as horses may run into the roadway. Either a physical barrier or buffer of a certain width can aid in the safety of all users.

Design Features:

- » AASHTO recommends separating equestrians and bicyclists on paved shared use pathway corridors.
- » Recommended separation between equestrians and other users is at least six feet wide and can be a vegetation buffer or barrier. In some areas, the treads are separated by an elevation change (FHWA Equestrian Design Guidebook for Trails, Trailheads, and Campground, 46).
- » The recommended height for most equestrian barriers is 60 inches to reduce the risk of a horse attempting to jump over a barrier. Barriers should be able to withstand the force of a trail animal attempting to run through them (FHWA Equestrian Design Guidebook for Trails, Trailheads, and Campground, 46).
- » Clearance to overhead obstructions should be 12 feet (FHWA Equestrian Design Guidebook for Trails, Trailheads, and Campground, 57).
- » A two-foot or greater shoulder on both sides of the trail should be provided. The installation of signage or other furnishings should be located at least two feet beyond the two-foot shoulder. (FHWA Equestrian Design Guidebook for Trails, Trailheads, and Campground, 56)



Equestrian trail adjacent to roadway in Anchorage, AK

Curb Types

The type and material of curbs varies from vertical-faced, mountable, traversable, and wing curb types. These options are commonly constructed from either concrete or stone, with the wing curb and rolled curbs being constructed out of asphalt. If concrete curbing is installed, it is encouraged to be between 7 inches and 9 inches of thickness for a vertical-faced curb to withstand plowing over time and be of enhanced visual presence. Rolled curb, while less expensive to install, does not withstand plowing pressure and does not provide enhanced visibility of the separated space between the non-motorized and motorized users. It should be noted that despite which curb type is installed, emphasis on a buffer space should be provided, as it offers snow storage, room for lighting and other street furnishings, and comfort to the nonmotorized user.

Winter Design Considerations

HEATED FACILITIES

Some winter cities around the world have created robust networks of heated sidewalks and paths to maintain active transportation networks. In Holland, Michigan, where lake-effect causes higher snowfall, the city has an approximate 5 mile network of heated facilities, which has resulted in a more active community throughout the winter. While these systems reduce maintenance costs, they require significant upfront investments to construct. Holland's system utilizes a large heat generation system where hot water is pumped through an intricate network of pipes and pex tubing below the city's streets and sidewalks. With systems like these, cities also have opportunities to heat structures and can pair heated pathway installation with new construction and development.

Anchorage is very spread out, so implementing this would be less cost effective. Alternative strategies to consider include pavement additives to lower the freezing point of water on the surface, which has been used on highways and bridges, or porous pavement could also be used.

For further details on examples of winter design treatments, visit:

<https://www.youtube.com/watch?v=XFWzDB7WvNI>

<https://www.worldhighways.com/wh6/feature/new-additive-self-de-icing-asphalt-mixture-roads-winter>

New Technology: Innovative technology treatments, such as street markings that are projected onto the snow (see featured video here: www.youtube.com/watch?v=8-INolxYsBQ), offer new opportunities for wayfinding and signage along pedestrian and bicycle routes. See Section 7.6 for more details.



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7.4 Intersections

Areas where different types of traffic intersect warrant special attention. Well-designed crossings can mitigate many operational issues and provide a higher degree of safety and comfort for all users. The context, or type of roadway will inform signage, pavement markings, and overall design. The following section provides design guidance to create safe and effective intersections. These guidelines consider the following components:

- » **At-grade intersection treatments** – Crosswalk, curb extension, median refuge island, curb ramp with detectable warning strip, crossbike, bicycle box, two-stage turn box, mountable truck apron
- » **Crossing types** – Rail crossings, Interchange crossing, Protected intersection, Driveway crossing, Trail entry control
- » **Signalization** – Pedestrian signal, bicycle detection at traffic signals, Rectangular Rapid Flash Beacon (RRFB)
- » **Grade-separated intersection treatments** – Grade-separated roadway crossing, grade-separated rail crossing



Raised crosswalk in Anchorage, AK



Curb extensions in Anchorage, AK

At-grade intersection treatments

CROSSWALK

A marked crossing, or crosswalk, typically consists of striped, high-visibility pavement markings which run alongside the direction of vehicle travel to indicate a dedicated pedestrian roadway crossing. Other markings, warning signs, active warning beacons, or traffic signals to slow or stop traffic may supplement crosswalk in order to increase safety and awareness for all users.

Design Features:

- » Transverse crosswalk lines should be used at controlled traffic signals or stops signs. Longitudinal crosswalk lines should be used at uncontrolled approaches or midblock crossings. (ATMS, Sec.3B.18).
- » Crosswalk lines shall be solid white lines 24 inches in width (ATMS, Sec.3B.18).

CURB EXTENSION

Extensions of the sidewalk at intersections functionally reduce the crossing distance, and thereby minimize pedestrian exposure while crossing. Most commonly, this sidewalk extension is located in the area of a parking lane, and extend into the roadway at the corners of intersections or at midblock crossings. These extensions also allow additional waiting space for pedestrians, and improve pedestrian visibility at intersections. Curb extensions also help position pedestrians closer to the cross street centerline to improve visibility and encourage motorists to yield at crossings (NACTO Urban Street Design Guide, 115).



Median refuge island in Anchorage, AK

MEDIAN REFUGE ISLAND

A median refuge island can improve user safety by providing pedestrians and bicyclists space to perform the safe crossing; one side of the street at a time. Refuge islands minimize user exposure by shortening crossing distance and increasing the number of available gaps for crossing. At-grade passage through the island, rather than ramps and landings, provides optimum accessibility. To promote yielding to non-vehicular users, the median safety island should require horizontal deflection of the motor vehicle travel lanes. Refuge islands may collect road debris and may require more frequent maintenance.

Design Features:

- » The waiting area is desired to be 10 feet or greater with a minimum of six feet (ATMS 4A.100).
- » Consider the use of landscaping with low-growing, minimally-spreading native shrubs and ground cover that require little maintenance and are no higher than 18 inches. This type of landscaping will not compromise the visibility of users crossing in the crosswalk.
- » For separated-use trail crossings, the crossing should maintain user separation. This can be accomplished with crosswalk markings in the pedestrian path, and green colored pavement in the bicycle lane.
- » Reflective delineators should be used to mark refuge islands for increased visibility during snow removal (ATMS 4A.100)

CURB RAMP W/ DETECTABLE WARNING STRIP

Curb ramps are the design elements that allow all users to make the transition from the street to the sidewalk. A sidewalk without a curb ramp can be useless to someone in a wheelchair, forcing them back to a driveway and out into the street for access. There are a number of factors to be considered in the design and placement of curb ramps.

Curb ramps must be installed at all intersections and midblock locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and ADA 1990). All newly constructed and altered roadway projects must include compliant curb ramps. In addition, existing facilities must be upgraded to current standards when appropriate.

The edge of an ADA compliant curb ramp should be marked with a detectable warning surface (also known as truncated domes) to alert people with visual impairments to changes in the pedestrian environment. Visual contrast between the raised tactile device and the surrounding infrastructure is important so that the change is readily evident to partially sighted pedestrians.

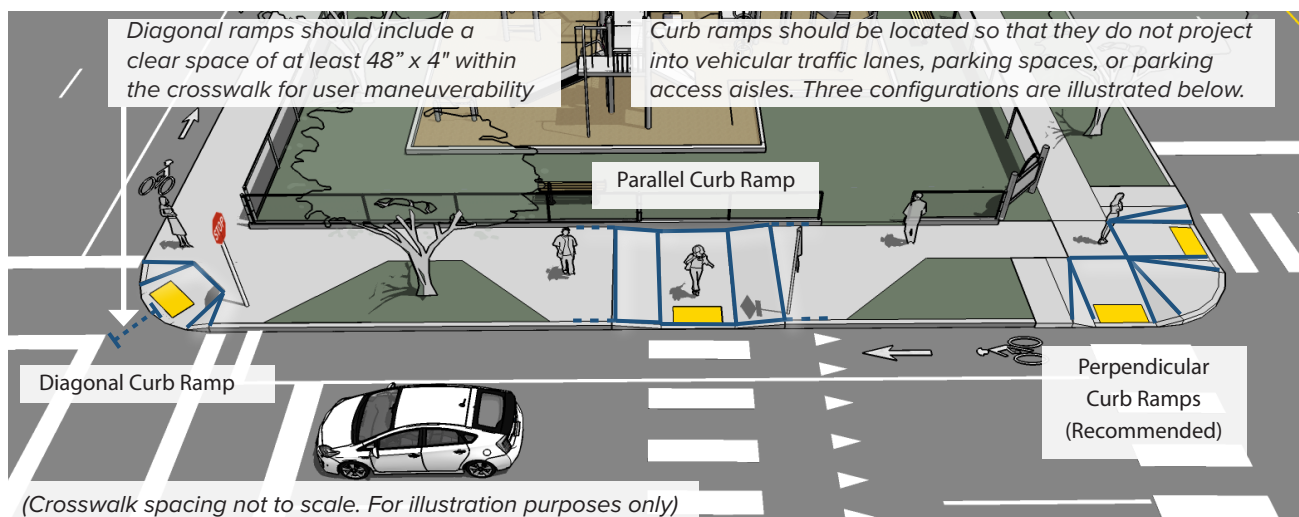
Design Features:

- » The level landing at the top of a ramp should be at least 4 feet long and at least the same width as the ramp itself. The slope of the ramp should be compliant to current standards.



ADA compliant curb ramp with tactile warning strip in Anchorage, AK

- » If the top landing is within the sidewalk or corner area where someone in a wheelchair may have to change direction, the landing must be a minimum of 4'-0" long (in the direction of the ramp run) and at least as wide as the ramp, although a width of 5'-0" is preferred.
- » Where feasible, separate directional curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks.



Note: The next Manual on Uniform Traffic Control Devices (MUTCD) will standardize the use of green pavement markings, which would confer interim approval to implement bicycle boxes and two-stage turn boxes.

Upon adoption of this plan, AMATS may identify examples of appropriate intersections for implementing crossbikes.

CROSSBIKE

A crossbike is an intersection marking which indicates the intended path of bicyclists through an intersection or across a driveway or ramp. Crossbikes guide bicyclists on a direct path through the intersection and provide clear boundaries between the path of bicyclists and motor vehicles in the adjacent lane.

Colored pavement can be overlaid several different ways: paint, durable liquid pavement markings (DLPM) including epoxy and Methyl Methacrylate (MMA), thermoplastic, or colored asphalt. Paint is easily worn down during winter months and often needs to be replaced annually, but is the least expensive overlay option, while the other applications are more expensive to apply, but last longer (NACTO Urban Bikeway Design Guide, 125 - 131)

Design Features:

- » Crossbikes are typically painted green to add visibility to the facility and to distinguish it from a crosswalk (NACTO Urban Bikeway Design Guide, 58-59).



Green crossbike markings continue a bicycle lane across an intersection in Minneapolis, MN

BICYCLE BOX

A bicycle box is a designated area located at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get in front of queuing traffic during the red signal phase. Motor vehicles should wait behind the white stop bar line at the rear of the bicycle box. This treatment reduces right hook collisions and allows bicyclists to quickly clear the intersection on a green signal. Large area markings do present a skid issue and therefore skid-resistant materials should be considered (e.g., colored concrete, inlaid MMA). This treatment is most appropriate on streets where there is high bicycle demand.

Design Features:

- » Boxes for queuing bicyclists are typically 10 to 16 feet deep (NACTO Urban Bikeway Design Guide, 53).
- » No turn on red signs should be installed to prevent vehicles from entering the bicycle box.



The green bicycle box allows bicycles to wait for a signal change in front of motor vehicles to prevent “right hook” collisions in Minneapolis, MN

TWO-STAGE TURN BOX

Two-stage turn boxes offer bicyclists a safe way to make turns at multi-lane signalized intersections by separating the turn movement into two stages. This intersection treatment results in providing more predictability for all modes. In order to make a left turn, bicyclists will travel straight into the bicycle facility on the far side of the intersection, then stop in a protected area called a turn box. This turn box then allows bicyclists to shift into the direction they want to travel. Bicyclists will wait to proceed straight until the signal turns green for the new direction of travel. Two stage turn boxes may prohibit turn on red signs and require enforcement to create a safer overall intersection for all users of the roadway.

Design Features:

- » Typically, two stage turn boxes are painted green for high visibility and to clearly denote to bicyclists and motor vehicles it is a bicycle facility (NACTO Urban Bikeway Design Guide, 52-53).



A two stage turn box near street car tracks in Charlotte, NC

MOUNTABLE TRUCK APRON

A mountable truck apron is a roadway design treatment that consists of a mountable (rollover) curb and colored or textured pavement to delineate the roadway and the apron. Often installed at signalized intersections, mountable aprons visually narrow an intersection to help calm traffic and reduce motor vehicle turning speeds. Similar to a mountable curb around a roundabout, mountable aprons provide additional space for freight, emergency, and other large vehicles to safely complete the turn, and discourage smaller vehicles (the majority of motorized road users) from taking sweeping, high-speed turns. Mountable truck aprons may be installed as retrofits to existing intersections.

Design Features:

- » In a typical application, there is a 3 inch rolled curb to allow counting by trucks and large vehicles, and a six-inch standard curb that form the waiting area for pedestrians.
- » There may be striping to indicate where motorists should yield to pedestrians and avoid driving on the apron.



Mountable curb

Crossing Types

RAIL CROSSINGS

Locations where shared use pathways cross railroad tracks are a challenge for pedestrians and bicyclists, particularly for those with mobility or vision impairments. Wheelchair casters and bicycle wheels can easily get caught in the flange-way gap, and slippery surfaces, degraded rough materials, or elevated track height can cause tripping hazards for all users. In terms of visibility, sight triangles provide a person approaching an intersection an unobstructed view. Per NACTO, these triangular areas should be large enough that a person can see approaching vehicles and pedestrians in sufficient time to slow or stop and avoid a crash. Angled track crossings are also problematic because they limit sight triangles, impacting the ability to see oncoming trains.

Bells or other audible warning devices may be included in the flashing-light signal assembly to provide additional warning for pedestrians and bicyclists. In areas with frequent train movements, pedestrian automatic gate arms or manually operated swing gates may help control non-motorized user movements when a train is approaching.

Adding new crossings increases crash risk and crash prediction. The 1988 Joint ARRC-DOTPF Policy for Rail-Highway Crossings requires new risks be mitigated by reducing overall risk – possibly by making improvements nearby to other facilities to offset increased risks. The ARRC Technical Design Standards apply as well.

Crossing design and implementation is a collaboration between the railroad company and the roadway agency. The railroad company is responsible for the cross-bucks, flashing lights and gate mechanisms, and the highway agency is responsible for advance warning markings and signs. Warning devices should be recommended for each specific situation by a qualified engineer based on various factors including train frequency and speed, path usage, and sight distances.

Design Features:

- » The crossing should be as close as practical to perpendicular with tracks (Rails-with-Trails: Lessons Learned, 73).
- » Ensure clear lines of sight and good visibility so that trail users can see approaching trains (Rails-with-Trails: Lessons Learned, 72).
- » The crossing should be level and flush with the top of the rail at the outer edge and between the rails (Rails-with-Trails: Lessons Learned, 73-74).
- » Flange-way gaps should not exceed two and a half inches (three inches for tracks that carry freight.) Concrete or rubber is the best material for pedestrian railroad crossings (Rails-with-Trails: Lessons Learned, 73).

INTERCHANGE ENTRANCE RAMP CROSSING

Arterials may contain high speed freeway-style designs such as merge lanes which can create difficulties for people on bicycles. The entrance lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles.

Design Features

- » Even with signage and striping improvements, free-flow ramps present significant challenges for people walking, biking, rolling; reconfiguring the intersection is the preferred treatment (Caltrans Complete Intersections, 2010).
- » Design strategies differ for low-speed and high-speed configurations.
- » Low speed ramp designs are preferred for bicycle comfort.
- » High speed designs will necessitate a more perpendicular crossing for visibility and gap detection.

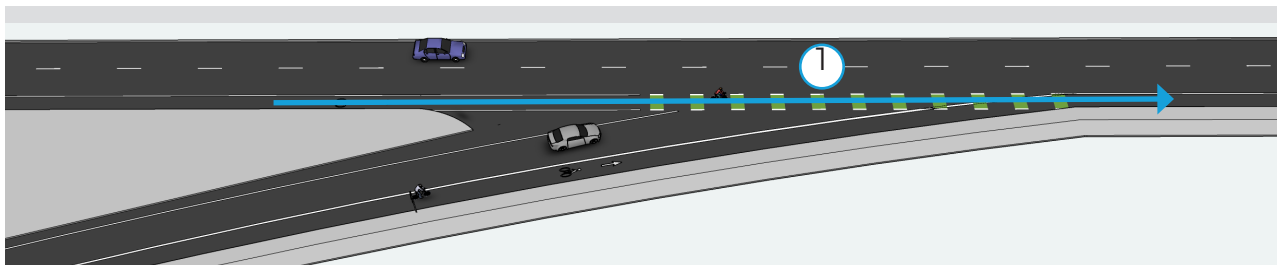
1 LOW SPEED ENTRANCE RAMPS (≤ 40 MPH)

Bicycle lane should travel straight through the merge area. Use dotted lines, colored pavement and signs to define bicyclist priority over merging traffic.

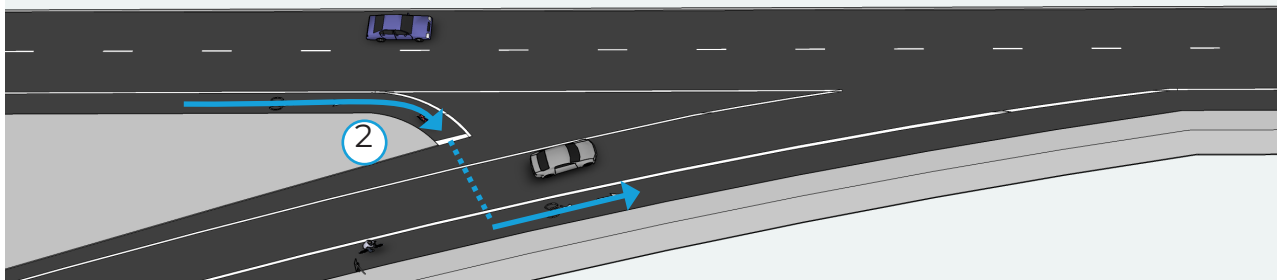
2 HIGH SPEED ENTRANCE RAMPS (≥ 45 mph)

Where there are dedicated receiving lanes, bicyclists should be encouraged to yield to merging traffic and cross when safe. Angle the bicycle lane to increase the approach angle with entering traffic and position crossing a before drivers' attention is focus on the upcoming merge.

LOW SPEED ENTRANCE RAMP (BICYCLE PRIORITY)



HIGH SPEED ENTRANCE RAMP (MOTOR VEHICLE PRIORITY)



INTERCHANGE EXIT RAMP CROSSING

Arterials with freeway-style exit ramps can create difficulties for bicyclists. Exit lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles.

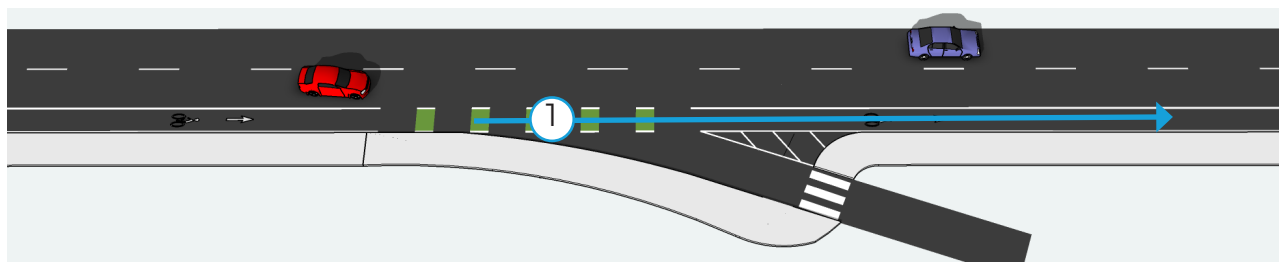
Design Features

- » Low speed designs improve bicycle comfort and priority.
- » High speed designs improve comfort and safety at the expense of bicyclist delay
- » Grade separated crossings are preferred over at-grade crossings to offer low-stress crossings of high-speed interchange ramps.
- » Grade separation designs utilizing a bicycle path could be used if the approach ramp elevations are appropriate, and if bicycle volumes are fairly high and motor traffic volumes are high. Standard bicycle

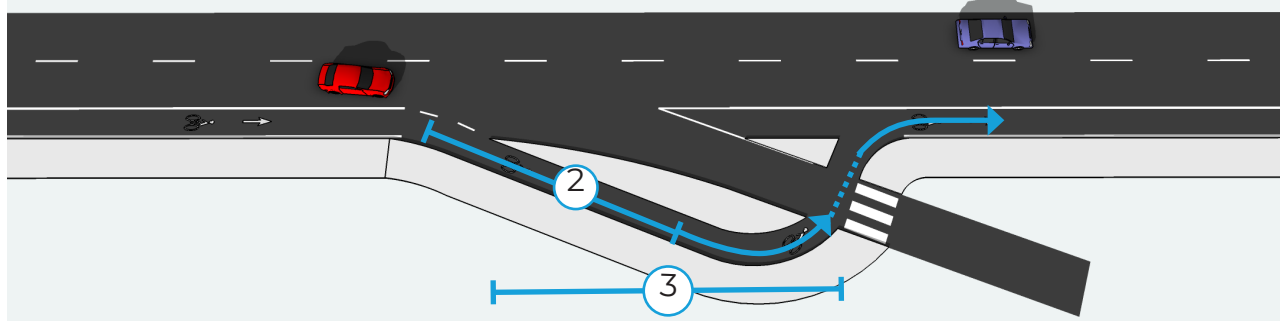
path geometric guidelines would be applied to the approaches to a grade separated crossing for a bikeway.

- 1 LOW SPEED EXIT RAMPMS (≤ 40 MPH)**
Bicycle lane should travel straight through the merge area. Use dotted lines, colored pavement and signs to define bicyclist priority.
- 2 HIGH SPEED EXIT RAMPMS (≥ 45 mph)**
Use a jug handle turn to bring bicyclists to a visible location with exiting traffic. Design a 45 foot (35 foot minimum) taper from roadway.
- 3** Where the bicycle lane crosses the ramp, there should also be a 45 foot (35 foot minimum) jughandle turn .

LOW SPEED EXIT RAMP (BICYCLE PRIORITY)



LOW SPEED EXIT RAMP (MOTOR VEHICLE PRIORITY)



PROTECTED INTERSECTION

A protected intersection, or “Bend Out” uses a collection of intersection design elements to maximize user comfort within the intersection and promote a high rate of motorists yielding to people bicycling. The design maintains a physical separation within the intersection to define the turning paths of motor vehicles, slow vehicle turning speed, and offer a comfortable place for people bicycling to wait at a red signal.

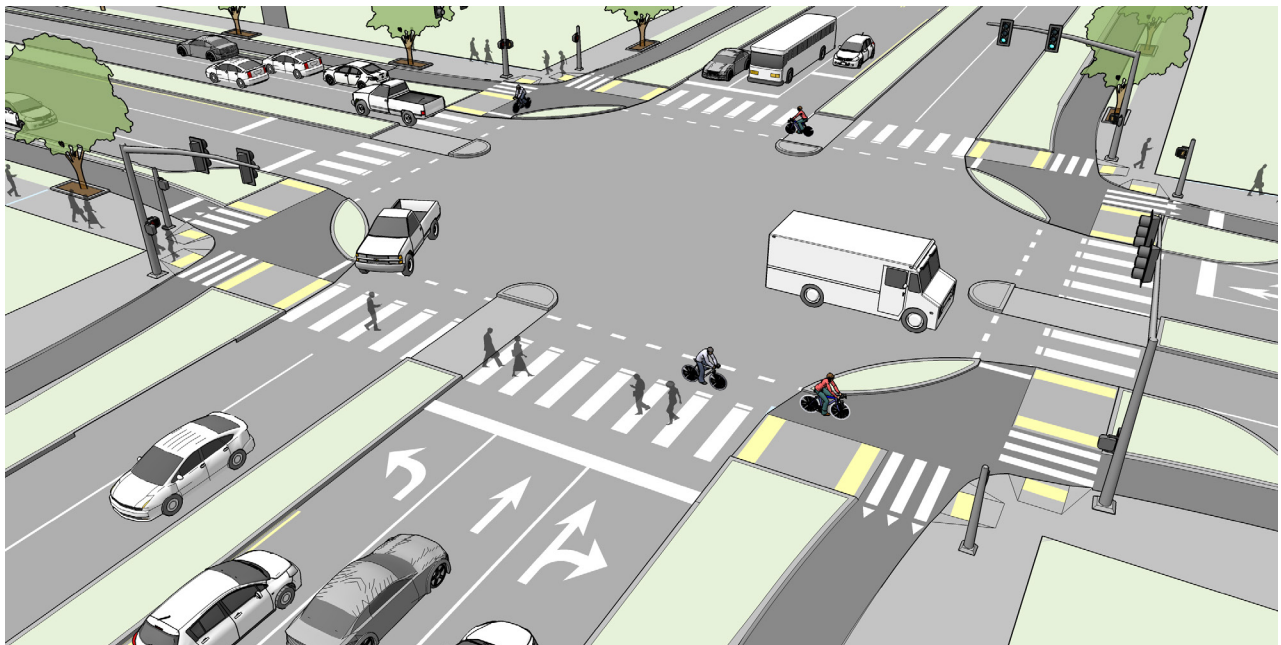
Typical Application:

- » Streets with separated bikeways protected by wide buffer or on-street parking.
- » Where two separated bikeways intersect and two-stage left-turn movements can be provided for bicycle riders.
- » Helps reduce conflicts between right-turning motorists and bicycle riders by reducing turning speeds and providing a forward stop bar for bicycles.

- » Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.

Design Features:

- » Setback bicycle crossing of 16.5 feet allows for one passenger car to queue while yielding. Smaller setback distance is possible in slow speed, space constrained conditions.
- » Corner safety island with a 15-20 foot corner radius slows motor vehicle speeds. Larger radius designs may be possible when paired with a deeper setback or a protected signal phase, or small mountable aprons. Two-stage turning boxes are provided for queuing bicyclists adjacent to corner islands.
- » Use intersection crossing markings.
- » Further guidance on protected intersections is available through the National Association of City Transportation Officials' (NACTO) [website](#) and design guidance publications.



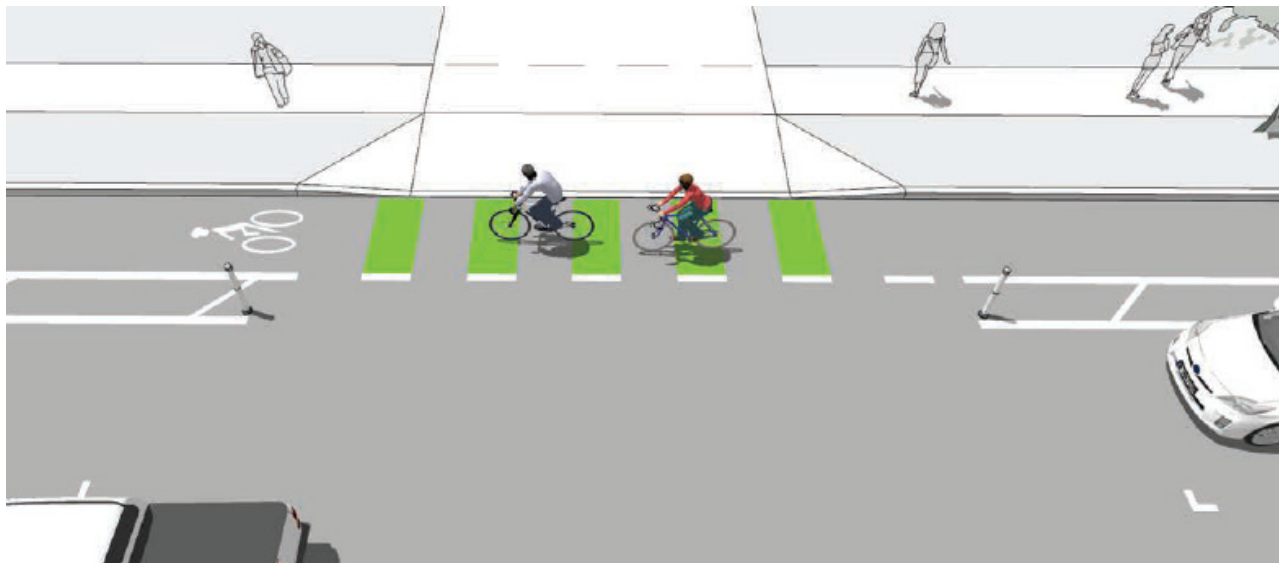
Protected intersection

DRIVEWAY CROSSING

Ideally, bikeways and sidepaths are along corridors with few driveway or side street crossings to minimize the number of potential conflicts between bicycle facility users and motor vehicle drivers. However, safety at driveway crossings can be increased by providing clear sightlines for motor vehicle drivers and bicyclists, pavement markings, and signage. The use of green pavement markings as shown is to alert both motorists and the non-motorized user of a potential conflict zone. Design details illustrating proper use and placement is shown in the NACTO Urban Bikeway Design Guide. These experimental treatments are recommended for major conflict areas.

Design Features:

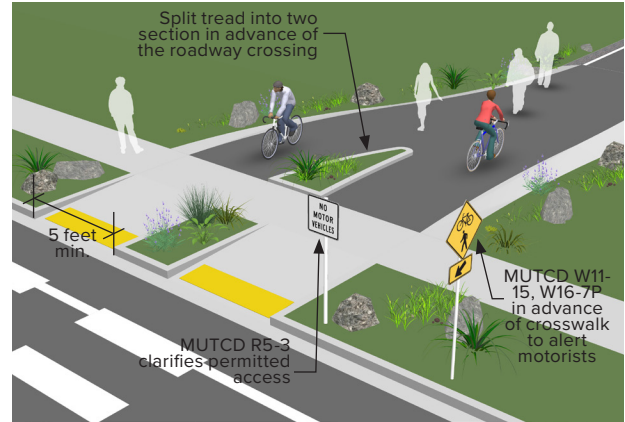
- » Provide ample stopping sight distance for vehicles (AASHTO Policy on Geometric Design of Highways and Streets, Table 9-21).
- » Driveway crossing can be raised to give priority to bicycle users and slow vehicles approaching the driveway.
- » The width of driveways can be narrowed to reduce vehicle speeds and reduce the driveway crossing distance for bicycles and pedestrians.
- » Turning radii can be decreased to slow vehicle speeds.
- » Provide crossing markings across entire length of driveway.



On street protected bicycle lane with crossing markings at driveway crossing to raise conspicuity.



Shared use pathway entry in Anchorage, AK



Multi-use entry control

SHARED USE ENTRY CONTROL

A variety of physical barriers and design strategies are employed to restrict motor vehicle access to non-motorized areas. While the bollard post is a common treatment, it presents numerous safety hazards to users. Potential hazards include inconsistent and unpredictable placement, broken fold-down posts that often do not fold back up, removable posts lacking flush sleeves, or removable posts with theft preventing chains that dangle onto the trail surface. If bollards are used at intersections and access points, they should be adequately spaced and brightly colored and/or supplemented with permanent reflective materials to be visible at night. Removable barriers should leave a flush surface to prevent tripping hazards.

Design Features:

- » Physical barriers should only be considered when other measures do not adequately control unauthorized vehicles, or where the danger posed by unauthorized vehicles exceeds the safety risks to trail users by the barriers themselves.
- » Alternative design strategies to control shared-use path entry include signage indicating “No Motor Vehicles” (MUTCD R5-3) placed at the path access point, separating the non-motorized path into two treads in advance of the crossing so that the curb cuts are not conducive to motor vehicle access, and including a landscaped median to act as an access barrier.
- » Note that there should be a minimum of five feet clearance for each tread for path user access.

Signalization

PEDESTRIAN SIGNAL

Pedestrian signals can be actuated by manually using a push button or automatically timed into each signal cycle. When possible, crossing signals may include audible information, because pedestrians with vision impairments cannot rely on the sound of vehicular traffic to identify the start of the WALK phase. Automatic timing of pedestrian walk phases is appropriate where sidewalks are present along with a high volume of pedestrian crossings, such as in urban areas. Manual activation can be more appropriate when pedestrian crossings are less predictable or more infrequent. This allows a pedestrian walk phase to be skipped when it is not necessary.

Design Features:

- » Manual activation of pedestrian signals require the user to locate and press a push button to actuate the pedestrian signal phase. Push buttons should be accessible per ADA standards. A push button outfitted with a pilot or indicator light with audible or vibrotactile feedback acknowledges that the pedestrian call has been placed and reassures the pedestrian they have been detected.
- » Automatic timing of a pedestrian walk phase into a signal cycle makes pedestrian crossings predictable, minimizes pedestrian delay, and does not create uncertainty whether a pedestrian has been detected.
- » Additional features to consider include a pedestrian-only crossing phase while all vehicles have a red light and No Turn on Red for vehicles to prioritize safe pedestrian crossing. Also, ensuring that the pedestrian crossing time allows sufficient time for safe crossing (3.5 ft/sec max per MUTCD or 3 ft/sec in areas with seniors or disabled population).
- » Pedestrian-scaled lighting is an important feature at pedestrian signals (as well as unsignalized crossings)



Pedestrian push button in Anchorage, AK

BICYCLE DETECTION AT TRAFFIC SIGNALS

Bicycle Detection and Actuation is used to alert the signal controller of bicycle crossing demand on a particular approach. Proper bicycle detection should meet two primary criteria: accurately detects bicyclists and provides clear guidance to bicyclists on how to actuate detection (i.e. what button to push and where to stand). When actuated, the traffic signal should be programmed to allow sufficient time for bicyclists to clear the intersection before cross-traffic receives a green light.

Design Features:

Radar detection is the preferred method of bicycle detection in the AMATS planning area. This method is used to detect bicyclists at or approaching signals and should register the presence or passing of cyclists in the anticipated path of travel.

Other methods of detection include push button activation and loop detectors. These methods are not preferred and are gradually being replaced by radar detection.

- » Signals that require push button for activation should not require bicyclists to dismount or require mounting the sidewalk to push the button. The push button should be mounted on a pole and face the street to easily reach from a curb side bicycle lane. Push buttons should also be paired with a sign such as MUTCD R10-24 or R10-26 to indicate to bicyclists to use the push button.
- » Loop detectors are embedded within the roadway and trigger the signal when a metal object passes over them. This allows a bicyclist to stay within their lane of travel without having to maneuver to the side of the road to reach a push button. A pavement marking should be placed on the optimum detection area of the loop detector to indicate to bicyclists where to position themselves to activate the signal.



MUTCD Figure 9C-7 pavement marking for bicycle loop detectors



Bicycle push button paired with a MUTCD R10-26 sign

RECTANGULAR RAPID FLASHING BEACONS

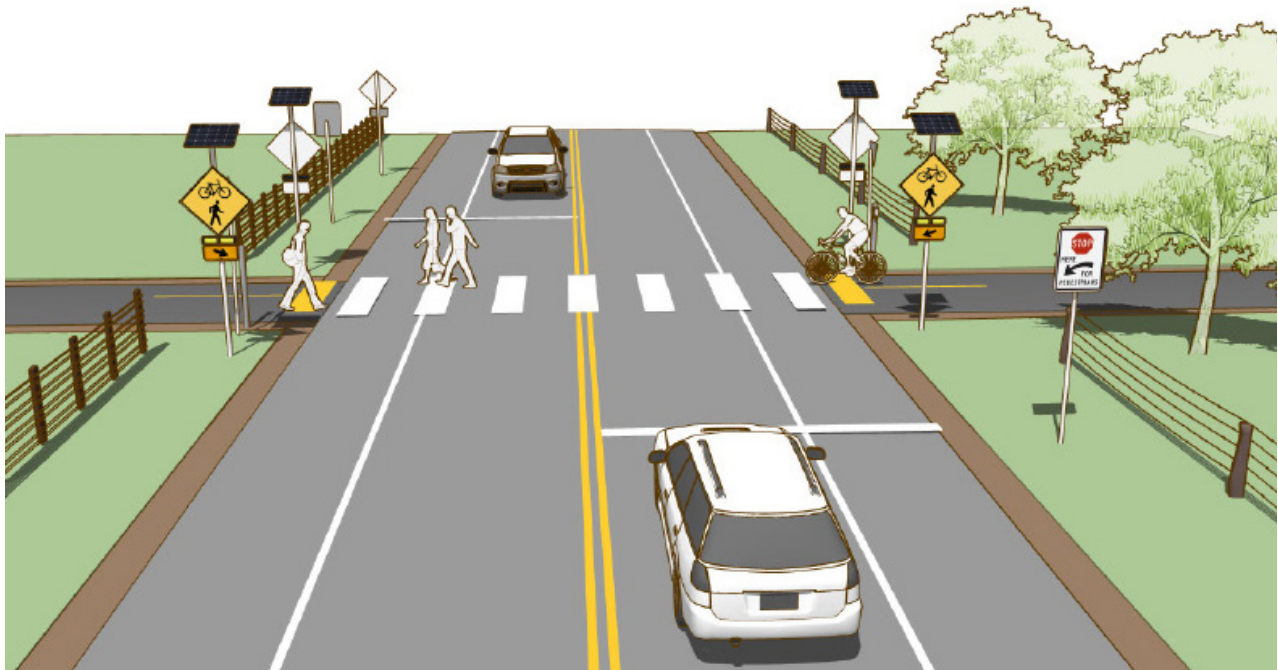
Rectangular Rapid Flashing Beacons (RRFB) are amber flashing lights that supplement warning signs at unsignalized intersections or midblock crosswalks. Beacons are actuated by either manually pushing a button or passively through loop detection. RRFBs use an irregular flash pattern similar to emergency vehicle flashing patterns. RRFBs can be used to enhance driver yielding for bicyclists and pedestrians in the crosswalk (NACTO Urban Street Design Guide, 114-115).

The selection and placement of RRFBs are based upon an engineering review of visibility, gaps, speed, crossing length, and traffic and pedestrian volumes.

Design Features:

- » Location of beacon poles should not conflict with pedestrian or bicycle crossing movements.
- » Passive detection technology or active push buttons can activate warning beacons.
- » Refer to ATMS 4A.100 and 4L.100 for more guidance on selection and use of various treatments

Note: The Alaska Department of Transportation has received Interim Approval from FHWA for the use of RRFBs.



RRFB

Grade-separated intersection treatments

UNDERCROSSINGS

Undercrossings can provide critical links in areas separated by barriers such as railroads and highway corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist. There are no minimum roadway characteristics for considering grade separation.

The undercrossing should have a centerline stripe, even if the rest of the path does not have one, to discourage passing movements. Safety is a major concern with undercrossings as path users may be temporarily out of sight from public view and may experience poor visibility. To mitigate safety concerns, an undercrossing should be designed to be spacious, well-lit, and completely visible for its entire length from end to end. Potential problems of undercrossings include conflicts with utilities, drainage, flood control, wildlife, limited sightlines, and vandalism.

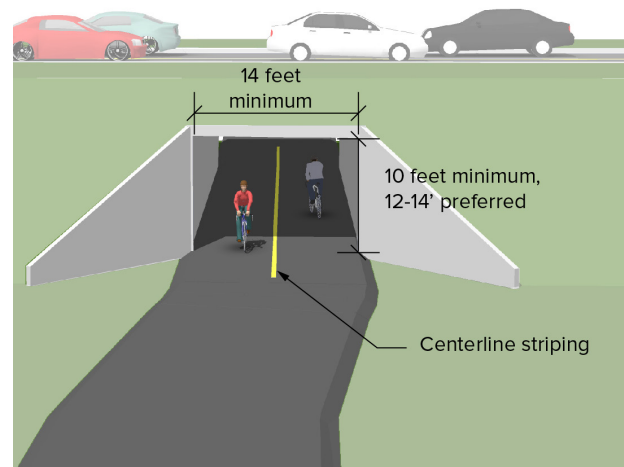


Undercrossing in Anchorage, AK

Undercrossings on shared use pathways that are used in the winter require that snow be hauled in for activities such as skiing.

Design Features:

- » Undercrossings should be a minimum of 14 feet wide, and greater widths are preferred for undercrossing lengths of over 60 feet.
- » For maintenance vehicles, there should be a 10 foot minimum vertical clearance.
- » Any grade-separated treatments should be implemented in accordance with the DOT P&F Highway Preconstruction Manual Section 1130.7 - Separation Structures for Pedestrian Crossings. Consideration should be given to relaxing the standards specified in Section 1130.7 to prioritize greenbelt crossings and school crossings based on walking route plans at less than the 150 peds/hr listed.



Undercrossing with typical dimensions



Overcrossing with typical dimensions

OVERCROSSINGS

Bicycle and pedestrian overcrossings can be used to continue pedestrian and bicycle facilities over large barriers such as deep canyons, waterways, or major roadways or rail yards. Overcrossings pose potential concerns regarding visual impact and functional appeal, as well as space requirements for approach ramps.

Design Features:

- » The recommended minimum vertical clearance for pedestrian structures over local roads and state highways is 17 feet 6 inches (Alaska Highway Preconstruction Manual, 1130-5).
- » The recommended minimum vertical clearance for pedestrian structures over railroads is 23 feet.
- » Access ramps to overcrossings are limited to five percent slopes per ADA. Level resting landings must be provided at four hundred foot intervals. Steeper grades will require more frequent landings.



7.5 Bicycle Parking

Bicycle parking should be convenient, highly visible, and easily accessible. Bicycle parking is categorized as either short term, which is storage for two hours or less, or long term parking, which is storage for two hours or more.

- » **Short term parking**— bicycle racks, on-street corrals
- » **Long term parking** – bicycle lockers, secure parking areas
- » **Bicycle repair** – a kiosk for basic bicycle service, including a tire pump and basic tools

Short Term Bicycle Parking

BICYCLE RACKS

Bicycle racks provide short-term bicycle parking and are meant to accommodate visitors, customers, and others expected to arrive and depart a location in a brief time period. Per APBP standards, a bicycle rack should support a bicycle in at least two places to prevent it from falling over, and the rack should allow locking of the bicycle frame and one or both wheels with a U-lock. Bicycle racks should be constructed of durable, weather resistant materials to prevent rusting, bending, and deformation. A “staple” rack is an ideal rack type as it is easily recognizable as bicycle parking, can accommodate bicycles of all sizes, and allows secure locking techniques (APBP Essentials of Bike Parking, 6).

AMATS should consider reviewing the development code and updating to reflect best practices regarding required bicycle parking (See APBP Essentials of Bike Parking for best practices).



Bicycle Parking, Portland, OR; NACTO Guide

Design Features:

- » Three feet minimum from the curb to avoid the door zone of parked cars (APBP Essentials of Bike Parking, 10).
- » Three feet perpendicular between racks to provide handlebar space and maneuvering room (APBP Essentials of Bike Parking, 10).
- » Six feet parallel space between racks to allow for the length of a bicycle and wheels (APBP Essentials of Bike Parking, 10).
- » Located close to destinations: place bicycle parking no further from the primary entrance than the closest vehicle parking space (Title 21). 50 feet maximum distance from a main building entrance (APBP Essentials of Bike Parking, 2).
- » Lighting is an important consideration for bicycle parking in order for users to feel safe outside of daylight hours and to deter theft.



Bicycle racks in Anchorage, AK



Bicycle Parking, Portland, OR

ON-STREET BICYCLE CORRALS

On-street bicycle corrals (also known as on-street bicycle parking) consist of staple racks grouped together in set spacing. Corrals may be located in an on-street parking space or in a particularly wide area of a sidewalk. Note that each motor vehicle parking space can be replaced with approximately 8-10 bicycle parking spaces. Bicycle corrals are reserved exclusively for bicycle parking and provide a relatively inexpensive solution to providing bicycle parking in areas of high demand.

Design Features:

- » Bicyclists should have an entrance width to the corral from the roadway of five to six feet.
- » Can be used with parallel or angled parking.
- » Parking stalls adjacent to curb extensions are good candidates for bicycle corrals.
- » On-street bicycle corrals should be seasonal and removed during winter months. For example the City of Minneapolis removes their bicycle corrals between November 1 and April 15 each year (City of Minneapolis On-Street Bicycle Corral Program, 3).

Long Term Bicycle Parking

Long term bicycle parking provides additional security and weather protection for a bicycle by an enclosed structure and managed access. It is a good option where users are expected to store their bicycles for more than two hours, especially for a full day or longer. While uncommon, users may use long term secure bicycle parking for shorter periods of time if they prefer the added security.

BICYCLE LOCKERS

Bicycle lockers provide long-term bicycle storage for an individual bicycle in a rectangular enclosure. Lockers may be accessed electronically on-demand, or they may be assigned to an individual. Lockers are more expensive and take up a larger amount of space, but it is common for cities or transit agencies to charge a fee for use of bicycle lockers.

Design Features:

- » Labeled as a bicycle locker on the exterior.
- » Minimum dimensions: width (opening) two and a half feet; height - four feet; depth six feet.
- » Four-foot side clearance and six-foot opening end clearance.
- » Seven-foot minimum distance between facing lockers.

SECURE PARKING AREA (SPA)

A Secure parking Area for bicycles, also known as a Bicycle SPA or Bicycle & Ride (when located at transit stations), is an enclosed space that houses a group of bicycle racks. Accessible via key-card, combination locks, or keys, Bicycle SPAs provide shared secure parking for 10 to 100 or more bicycles. To gain access to a bicycle SPA, typically users must pre-register with the city or transit agency managing the bicycle parking.

Design Features:

- » Closed-circuit television monitoring with secure access for users.
- » Double high racks & designated spaces for larger bicycles such as cargo bicycles.
- » Added features such as a bicycle repair station, bench, and bicycle tube and maintenance item vending machine.
- » Signage may be desired to direct users to designated bicycle SPAs.



Long term bus then bicycle shelter in Boulder, CO

BICYCLE REPAIR

Bicycle repair stations are small kiosks designed to offer a complete set of tools necessary for routine bicycle maintenance and minor repairs. Popular locations for placement include transit stations, major trailheads, or other popular destinations with high volumes of bicycles. Bicycle repair station tools are secured by high security cables, but will still be an attractive target for theft. Kiosks should be placed in areas of high activity to reduce potential vandalism. Consider grouping repair stations together with other added features such as seating, bicycle parking, and drinking fountains.



Bicycle repair station in Anchorage, AK



7.6 Signage and Wayfinding

A comprehensive and consistent system of signage ensures that information regarding the safe and appropriate use of all facilities is visible. Wayfinding signage can boost community branding, create a sense of place, promote economic development, and safely communicate how to navigate to regional and local destinations. Successful wayfinding connects places, promotes active transportation, allows users to maintain motion while navigating the environment, is predictable, and keeps information simple. Directional signing and wayfinding is used to enhance the travel experience and is not a required design treatment.

- » **Pedestrian** - Map kiosk, directional signs
- » **Bicycle** - Decision signs, confirmation signs, and turn signs
- » **Winter Signage Options** - Projected images, recessed pavement markings

Pedestrian Wayfinding Elements

Pedestrian wayfinding defines neighborhood or district boundaries, directs people walking to destinations, and provides detailed information such as maps, transit routes, and local business lists. Pedestrian wayfinding is designed at a human scale with directional posts, information kiosks, and map panels positioned at eye level and scaled at smaller font sizes than vehicular signage. Pedestrian wayfinding elements include kiosks with detailed orientation maps and information, and directional signs with nearby destinations and directional arrows.

MAP KIOSK

Kiosks with area and/or citywide orientation maps can provide helpful navigational information for pedestrians as well as for bicyclists, particularly in locations where bicyclists may be stopping long enough to digest more information (i.e. transit stations or stops, busy intersections, or trailheads). Map kiosks should include circles illustrating the walking and bicycling time and/or distances to encourage exploration. Additionally, orienting signs with respect to the audience's view (or, a heads up orientation) is more intuitive than maps where north is at the top. High contrast simple graphics or icons and the use of color coded areas or districts help make maps legible to a wide audience.

For shared use pathway settings, map kiosks should contain shared use pathway information such as rules and regulations including allowed uses and emergency contact information. Interpretive or educational information may also be integrated into kiosks (ATMS 2D.50).



Anchorage interpretive sign

DIRECTIONAL SIGNS

Pedestrian directional signs include a list of major attractions and local destinations with directional arrows. Walking distances are included adjacent to the directional arrow. Pedestrian directional signs may be single panels, or may be configured as individual blades mounted in different directions on a post. Pedestrian directional signs may also incorporate colors or brand marks distinct to the identity of a particular neighborhood or district.



Directional sign in Anchorage, AK



Pedestrian map kiosk with an orientation map in Bellevue, WA



Directional sign in Vancouver, WA

Bicycle Wayfinding Elements

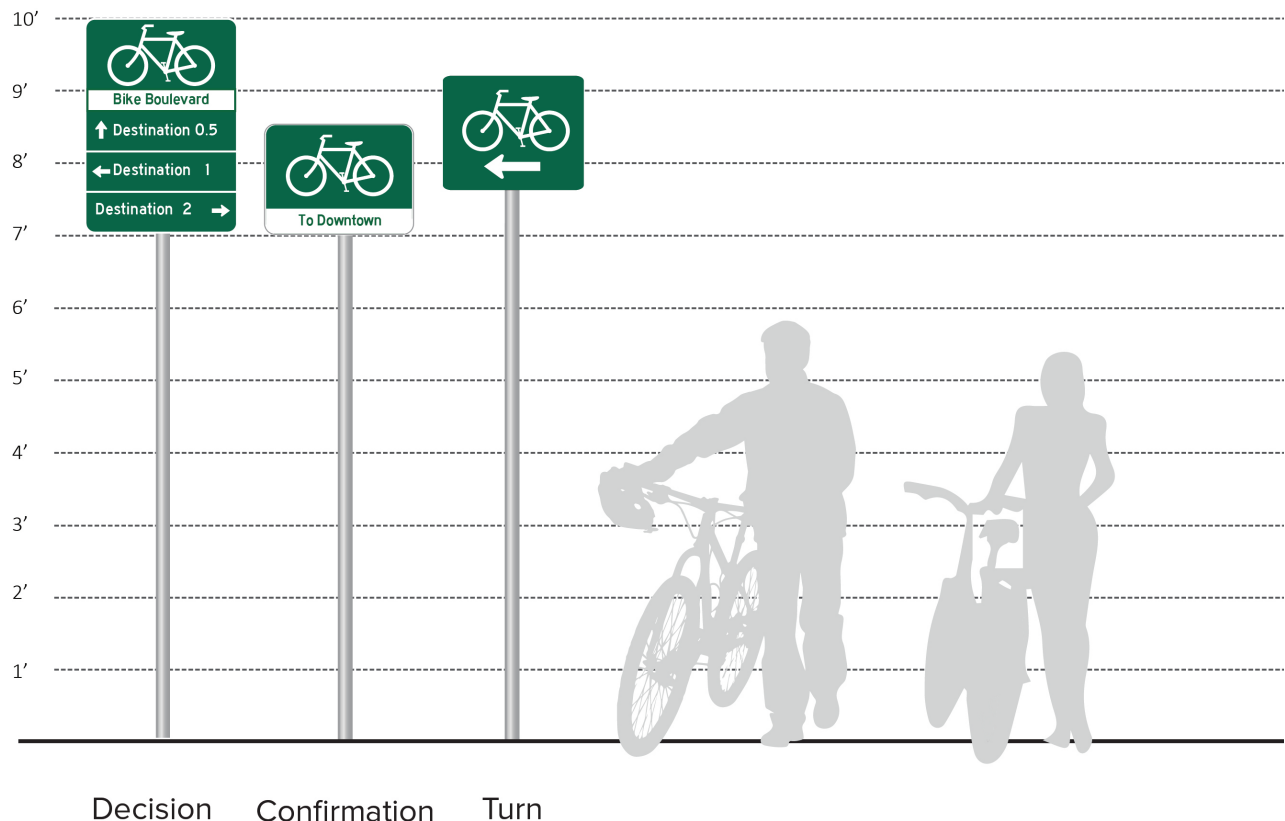
Bicycle wayfinding confirms orientation and directs bicyclists to local and regional destinations. Bicycle wayfinding is typically placed along shared use pathways and on-street bicycle facilities. These types of signs are designed so that bicyclists can easily read signs while moving, quickly comprehend the information, and adjust direction of travel in advance of turns. The fundamental family of bicycle wayfinding elements include decision, confirmation, and turn signs. Each proposed sign location should be evaluated based on the complexity of the location and decisions to be made with attention drawn to the overall number of signs within a given area. When non-motorized signage is added to motorized signage at a given location, there is the potential for too many signs to be installed thereby reducing the effectiveness of any of the given signs. In the case of the

sign family, the guidelines presented for each category are recommendations to be evaluated at the time of sign placement development

DECISION SIGNS

Decision signs clarify route options when more than one potential route is available. Signs typically consist of a system brand mark, space for up to three destinations, distance in miles and/or time (based on 10mph or a six-minute per mile travel speed). Decision signs may include a specific route or path name.

Decision signs should be placed before decision making points or intersections with routes having bicycle facilities. Sufficient distance prior to the intersection should be provided to allow for safe recognition and



response to information provided. Based on guidance from the AASHTO Guide for the Development of Bicycle Facilities, decision signs for bicycle travel typically are placed 50 - 150 feet in advance of a turn to allow a bicyclist enough time to slow, change lanes, and prepare for any turns that may be necessary. Care should be taken so that the turn or options the sign refers to are obvious. Decision signs should not be placed near side or access paths that could be confused with the primary route.

CONFIRMATION SIGNS

Confirmation signs should be placed after a turn movement or intersection to reassure cyclists that they are on the correct route. This signage can indicate a single regional destination and distance/time, but does not include arrows or a full list of destinations. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

Signs should be placed 50 – 100 feet after turns. Confirmation signs need not occur after every intersection. They should be prioritized at locations where a designated route is not linear as well as after complex intersections. Complex intersections include those having more than four approaches at greater or less than 90 degrees, roundabouts, or indirect routing.

TURN SIGNS

Turn signs are placed in advance of turns to give cyclists adequate time to slow down or, if necessary, change lanes to prepare for a turn. Turn signs may be used in conjunction with a decision sign at complex intersections warranting additional information. System brand mark (e.g. logo or city name), route or pathway name, bicycle symbol and directional arrow are included on the sign. Standard MUTCD DI-1 series signs may be used to indicate turns. Standard turn arrow signs (M5 and M6 series) may also be used in conjunction with bike route signs to clarify turn movements.

GUIDELINES

Section 1A.12 of the MUTCD establishes the general meaning for sign colors. Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US. Note that signage on off-street facilities, such as shared use pathways, can have more flexibility in sign design.

Winter Signage Options

In cities with similar winter conditions, agencies have displayed signage by projecting images on roadway surfaces, to ensure visibility in dark and snowy environments. This approach can be paired with traditional signage, which is still useful during warmer months. Light-projected signage is a preferred strategy to overhead signage, which can be difficult for roadway users to see while snow is falling or if not properly lit.

Pavement markings can also be enhanced for higher visibility, especially for daytime conditions. On concrete surfaces, black stripes in advance of white and yellow striping increase contrast and visibility during the winter months especially if salt is being used and the concrete is light in color. To enhance overall visibility in all weather conditions, a recessed pavement marking may be recommended. These pavement markings use colored ceramic elements, mixed with various sized glass beads applied onto a recessed epoxy base, to provide high reflectivity at night. Due to the recessed placement of the striping, they are protected from plow damage during winter months, increasing the longevity of the pavement marking. A limitation to their application may be cost and the need for placement on new facilities.

It is important curbing and other roadway infrastructure is visibly marked for plowing. This can be done by placing snowplow markers to delineate paths and crosswalks at entrances, notifying plow operators where to the edge of the plow path is.



Light-projected signage indicating bike lane and pedestrian path, Oulu, Finland. Photo courtesy of [reddit.com](https://www.reddit.com)



Snowplow markers increase visibility of driveways, sidewalks, and other roadway features. Photo courtesy of [homedepot.com](https://www.homedepot.com)

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7.7 Added Features

There is an array of site furnishings that enhance the user experience. Some of these, such as seating aid facility usage. Others, such as art and trash receptacles make the experience more desirable. When designing facilities, all these added features should be considered in order to create a complete user experience; however, these amenities and enhancements are suggested only and are not required.

- » **Lighting** - improves safety and ease of use, while extending the use of infrastructure at the beginning and end of the day
- » **Gathering area** - seating, trash receptacles, art

PEDESTRIAN LIGHTING

There are many considerations for lighting, from the size, brightness and location, to the maintenance commitment lighting requires. Lighting can improve visibility for day time use in tunnels and underpasses, and night-time use along sidewalk and intersection crossings. Lighting can extend the hours of safe use, which should be considered particularly during winter months when trips to and from work are often made before sunrise and after sunset. Lighting spacing along shared use pathways depends on the type and intensity of lights, though thirty to fifty feet spacing is common for pedestrian scale lighting. Lighting is generally not appropriate for shared use pathways in remote areas, pathways with low use, or where there is little to no development.

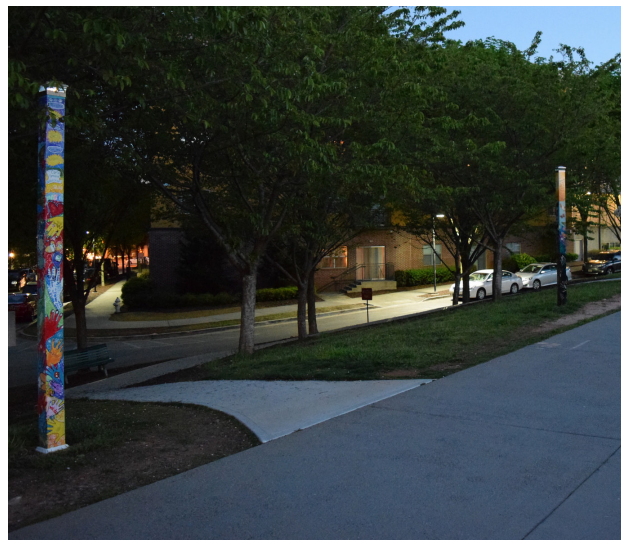
Lighting should respond to the conditions of the site and meet the minimum standards set forth by the Illuminating Engineering Society of North America (IESNA). Full cut-off fixtures, or luminaries with no direct uplight, should be used to reduce light pollution. These fixtures also limit direct glare or excessive illumination on to adjacent properties, streets, or sidewalks.

Shared use pathway lighting should be at pedestrian scale, but avoid light fixtures at eye level that could impair visibility. Pedestrian scale lighting is typically about 15 feet tall, has lower levels of illumination, and closer spacing to avoid dark zones between lights. Pedestrian scale light fixtures should use LED lighting. LEDs are the preferred lighting bulb as they offer a wide range of light levels and can reduce long term utility costs. Average horizontal illumination levels are 0.5 to two foot candles or five to 22 lux (AASHTO, 5.2.12).

GATHERING AREAS

Seating

Seating provides a place for users to rest, congregate, contemplate, or enjoy art. Benches can be designed to create identity or be strictly utilitarian. Picnic tables provide places for users to congregate for meals or to relax. To prevent vandalism, seating should be securely anchored to hardened surfaces such as concrete or asphalt. Orienting seating to maximize sunlight and offer wind protection can help make seating more comfortable during winter months (Winter Design Guidelines Transforming Edmonton into a Great Winter City, 77).



Effective lighting on sidewalks allows people to see 20 yards ahead

Trash Receptacles

Placement of trash receptacles will depend upon the location of concessions, facilities and areas of group activities. Receptacles should be selected for the expected trash/recycling amount, maintenance and collection program requirements, durability, and animal-resistance. Consider snow removal when placing trash receptacles or other street furniture and allow for a clear edge that can be easily cleared of snow (Winter Design Guidelines Transforming Edmonton into a Great Winter City, 43).

Art

Public art can be aesthetic or functional, doubling as seating or shelter; and depending on the scale and form, an activity in itself to serve as a public attraction. Public art can also be used as an interpretive device for telling a compelling story about the area history.

Bus Stops

Bus stops can provide information to riders through maps and signage making trips easier and provide comfortable areas to wait for buses. Stop elements could include shelters, seating, passenger information and wayfinding, and bicycle parking. Where possible consider headed shelters for winter months (Winter Design Guidelines Transforming Edmonton into a Great Winter City, 54).



Trash receptacle in Anchorage, AK



Art installation in Anchorage, AK



Seating and art in Anchorage, AK



7.8 Maintenance

Regular, routine maintenance on a year-round basis will ensure the safety and use of pedestrian and non-motorized vehicle facilities. Maintenance activities required for continuous, safe facility operations should always receive top priority. Maintenance of some pedestrian and bicycle facilities may require additional staffing and costs, especially during winter months. This should be considered when selecting facility types. This section discusses:

- » **Maintenance matrix** – summer and winter maintenance facility matrix
- » **Winter maintenance** – snow storage and roadway design, strategies for facilitating winter riding including planning, design, snow removal, prioritization for snow removal
- » **Alternative Treatments** – Options to enhance or replace traditional winter maintenance

Maintenance Matrix

One of the most efficient ways to facilitate timely snow removal is to plan, budget, and design for snow storage. For existing corridors, this may require additional right-of-way from adjacent landowners. Given both public and private owners are responsible for snow removal next to the road, the associated delays in hauling and pushing of snow onto each other's work areas are inevitable. A larger public right of way space with agreement for a singular public responsibility could make snow storage and removal more efficient and remove burdens from

the private landowner. Designing and building separated bicycle lanes with winter and seasonal maintenance in mind provides high-quality, comfortable facilities for year-round use.

The table below shows example facility dimensions to allow for snow clearance. Preferred widths allow for plowed snow to fit within boulevard space. This maintains facility width after snow clearance.

Table 7.6: Maintenance Matrix

SIDEWALK	ONE-WAY PROTECTED BICYCLE LANE	SIDEPATH/TWO-WAY PROTECTED BICYCLE LANE
		
Preferred Sidewalk Width: 11.5 to 12 feet in the central business district. Five to six feet along arterials and collectors. Six feet enables two pedestrians (including wheelchair users) to walk side-by-side or to pass each other comfortably.	Preferred Bicycle Lane Width: Six feet (allows for bicycle lane narrowing due to snow events). Five feet may be used in constrained conditions.	Preferred Pathway Width: Ten feet to 12 feet is preferred.
Preferred Buffer Width: Five feet or greater preferred. Three feet minimum recommended. Two feet allowable in constrained conditions.	Preferred Buffer Width: Five feet or greater preferred. Three feet minimum recommended. Two feet allowable in constrained conditions.	Preferred Buffer Width: Five feet or greater preferred. Three feet minimum recommended. Two feet allowable in constrained conditions.
Summer Maintenance: Pavement sweeping/blowing as budgeted	Summer Maintenance: Pavement sweeping/blowing as budgeted	Summer Maintenance: Pavement sweeping/blowing as budgeted
Winter Maintenance Equipment: This cell intentionally blank	Winter Maintenance Equipment: This cell intentionally blank	Winter Maintenance Equipment: This cell intentionally blank

Snow Storage and Roadway Design

There are several roadway planning and design considerations that should be factored to avoid a lack of snow storage options, which can lead to snow being stored in the sidewalk and in bicycle facilities. This makes these otherwise dedicated facilities difficult to use, at best, or altogether unuseable, forcing people walking, biking, and rolling to share the street with vehicles, or travel long distances out of direction to complete their trips.

PLAN ROADWAYS WITH SUFFICIENT ROW

On new roadways or in roadway reconstruction projects that include bicycle facilities (or may include them in the future), provide enough ROW for snow storage space. Ensure that the snow storage space is of adequate width to accommodate typical snowfall accumulations, allows plows to clear the roadway and bicycle facilities of snow, and allows sidewalks to be kept clear for travel and property access.

Best practice for bicycle lanes or buffered bicycle lanes is to plow snow onto the parking strip, or sidewalk furnishing zone, as this practice most closely matches that of typical snow plowing operations. The width of the furnishing/landscaping/utility zone, should be calculated according to the space required for vehicle, bicycle, and pedestrian facilities, plus typical snowfall conditions and equipment capabilities. Additionally, a standardized curb and gutter edge treatment along the furnishing zone can help to better define the snow storage space as opposed to a a rolled curb edge.

When ROW is restricted to such an extent that only curb-tight sidewalk without snow storage space is available, alternative techniques may be required for snow storage within that segment of the corridor.



Example of snow storage between a separated bike lane and the vehicular travel lane

SNOW STORAGE IN THE BICYCLE LANE BUFFER

By providing a wide, painted bicycle lane buffer, snow plow operations maybe able to store snow in the buffer between motor vehicle lane and the bicycle lane. This requires the roadway plow to plow snow to the right, and the bicycle lane plow to plow snow to the left. It is important to consider snow melt and proper drainage. During the day, the stored snow can melt and sheet flow across the bicycle facility, resulting in a very icy bikeway surface conditions. This issue needs to be addressed proactively with de-icing operations.

Where a parking protected bicycle lane is present, it is also possible to designate snow storage areas in the parking row in locations where parking is underutilized, or severe space constraints exist.



Snow removal operations

PROVIDE ENOUGH WIDTH FOR SMALL SNOW PLOW EQUIPMENT

Smaller, more specialized snow plow vehicles are available where typical snow plows are too wide to fit in the bicycle facility. These specialized plows are becoming much more common and are particularly important for bikeways that have confined travelways, such as separated bikeways and paths.

Cities with harsh winter climates may have a fleet of these specialized vehicles and ATV-mounted snow plows primarily for the purpose of clearing sidewalks and bicycle facilities. While many separated bicycle lanes can be cleared with typical truck-mounted snow plows, ATV-mounted snow plows and Bombardier snow plows are utilized more easily along key separated bicycle lanes that may be too narrow for trucks, or where physical barriers may be too difficult to navigate. Where bicycle facility widths permit, utilizing existing maintenance vehicles can prove to be much more cost-effective and time-efficient than the smaller vehicles which operate at slower speeds and have smaller plow blades.

Access for snow removal vehicles equipment should be a key consideration when designing separated bicycle lanes and shared use paths.

RECESSED THERMOPLASTIC PAVEMENT MARKINGS

Milling the area of pavement 3 mm in depth where thermoplastic pavement markings are applied has shown to be effective in reducing damage as a result of snow plows in a 2010 study¹. Minneapolis MN mills the area of pavement where thermoplastic bicycle lane indicators are placed to help reduce damage as result of snowplows. While this method increases the cost of installation, it may save in long-term maintenance costs (and help preserve safety conditions along the roadway).

EDGE-OF-ROADWAY VISUAL CUES

Pavement markings, striping, sidewalk curbs, and other types of delineators installed at ground-level serve as good indicators of the bicycle travel way when the ground is clear, but after a snow event, these lose their utility, and in some cases can become hazards, making the travelway difficult to navigate.

For this reason, it is important to provide other visual cues to indicate the bikeway for those riding as well as for snow plow equipment. Snow storage in the buffer area in separated bicycle lanes, in the place of parked cars in parking protected bikeways, and along the furnishing zone can help to visually define the facility and path of travel and help snow plows to identify curblines. This becomes especially critical when the bicycle facility bends in or around curb extensions, median islands, or other transitions.

Vertical, flexible delineators used in separated bikeways can be located far enough from the curb to allow a small truck-mounted plow to clear the bikeway. Curb extensions can be designed with tapered front ends and vertical delineators to prevent plow blade collisions along these facilities.

¹. Development of Recessed Pavement Markings that Incorporate Rumble Strips. http://www.easts.info/publications/journal_proceedings/journal2010/100292.pdf

Strategies for snow removal

SNOW REMOVAL TIMING

AMATS should adopt an internal policy to remove snow from non-motorized facilities within seventy-two hours after the end of a snow or freezing rain event. In addition, snow should be removed from separated bicycle lanes after the adjacent street is plowed. A maintenance worker will likely need to shovel these locations after the bicycle lane is cleared to reduce the likelihood of snow accumulating on curb ramps and crosswalks.

SEASONAL PREPARATION

Apply anti-icing treatment to non-motorized facilities up to twenty-four hours before snow or freezing rain events to reduce the amount of snow clearing required during or after a snow event. Following the snow, non-motorized facilities should be cleared and additional anti-icing material should be added as necessary. This approach saves anti-icing material and time spent plowing.

FUNDING OPPORTUNITIES

Snow removal is an annual cost to be factored into the overall planning process for any new non-motorized facilities. Designing facilities to be easily maintained by existing equipment is a strategy that will lead to the successful use and implementation of the proposed facility. Should this not be possible, utilizing funding sources such as the Federal CHIPS program to purchase specialty equipment for both summer and winter maintenance can greatly increase the success of the non-motorized facility. At a minimum, funding for any new facility should be included as an item in the City budget, and funding for the maintenance of these new facilities must also be anticipated and budgeted for.

Identifying new sources of funding for winter maintenance should be a top priority. Dedicated funding should also be identified to establish and continue coordination and communication between MOA and State DOT regarding snow removal of non-motorized facilities, as well as for improving coordination of facility design and maintenance requirements.

ANTI-ICING MATERIAL

AMATS should use beet juice and salt brine for most anti-icing scenarios. Salt brine is a better option than dry salt because it allows for quicker reaction times, less material used, and improved application accuracy. State DOT is currently using a salt brine mixture, which limits snow from bonding with asphalt, can cover more area than sand, does not blow away like sand can, and comes at a lower cost. State DOT is adding liquid calcium to the salt brine mixture in winter to make it usable below 15 degrees Fahrenheit. (AMATS Winter Maintenance Forum: Meeting Summary). Beet juice is an inexpensive additive to an anti-icing solution that improves the adherence of salt and sand to the roadway and also lowers the freezing temperature of the ice. The advantages of beet juice are that it is inexpensive, it adheres well to the roadway, and it is more environmentally friendly than using plain road salt (<http://time.com/5761/salt-shortage-triggers-beet-juice-cheese-brine-alternatives/>). Calcium magnesium



Anti-icing operations

**Snow removal brush**

acetate can be used in places with sensitive plantings (e.g., sidepaths and shared use pathways).

EQUIPMENT CONSIDERATIONS

Equipment can be mounted on pick-up (alley) trucks to plow bicycle lanes after plowing a street from its centerline. This equipment can also be used in two-way separated bicycle lanes

RECOMMENDED EQUIPMENT INVESTMENT

Small, snow removal vehicles are available from a number of different manufactures. Many small utility vehicles such as tractors, ATVs, bombardiers, and "skid steers" can be equipped with snow removal devices. Typically small vehicles are either equipped with snow plows, snow brushes (effective for removing light snow), or snow blowers (effective for relocating heavy snow). Many small snow removal vehicles can also be equipped with anti-icing applicators. AMATS should purchase this equipment for use in non-motorized facilities, as needed.

**Snow blower attachment**

INTERAGENCY COORDINATION

Review AMATS departmental guidelines regarding snow clearance, and also review procedures for snow clearance on off-street shared use pathways. Agencies may find it mutually beneficial to coordinate clearing of snow. Currently, the Alaska Department of Transportation and Public Facilities (ADOT&PF) tries to clear all sidewalks and shared use pathways within 48 hours. MOA and ADOT&PF have little overlap with shared plowing areas (AMATS Winter Maintenance Forum: Meeting Summary). These agencies should coordinate to prioritize non-motorized routes that should be cleared.

Agencies may choose to coordinate timing so that separated bicycle lanes are plowed immediately following travel lane plowing. This coordination helps keep separated bicycle lanes cleared of snow so that snow storage piles do not encroach on the bicycle lane. In terms of advance planning, maintenance agreements may be developed when separated bicycle lanes are installed on roads in Anchorage under the jurisdiction of another agency.

GEOGRAPHIC CONSIDERATIONS

Consider staging winter maintenance equipment at multiple storage facilities, located near high-priority separated bicycle lanes. This will facilitate efficient response following a snow event.

ORDINANCES AND COMMUNICATION

Create a service code for residents to report non-motorized facility maintenance needs to Street Maintenance (MOA). Train staff within Street Maintenance (MOA) to respond to service requests regarding non-motorized facilities. Afterwards, publicize residents' ability to request maintenance for pedestrian, bicycle, and multi-use facilities.

Communicate winter weather information through email, opt-in calls and text messages, mailers, and social media campaigns. Work with other departments to cross-promote winter-related messaging.

Regularly meet with transportation advocates and members of the public to discuss winter maintenance practices and areas for improvements.

After beginning construction on high-priority non-motorized facilities, consider working with advocates, private-sector firms, and members of the public to create a crowd-sourced, interactive map to monitor snow clearance quality along non-motorized facilities.

Prioritization for snow removal

Prioritization and scheduling is a key component of a successful winter non-motorized facility program. For most jurisdictions, keeping all non-motorized facilities completely clear during or immediately after a heavy snow event is infeasible. Primary routes should be cleared first, providing the best access to the greatest number of people possible following a heavy storm event. Destinations should be taken into consideration as well. If roadway clearing and anti-icing begins first thing in the morning, primary routes leading to schools and business districts should be cleared first.

Currently, the Municipality of Anchorage, Park Operations utilizes a GIS-based tracking program to organize and prioritize plowing tasks and coordinate with roadway snow removal efforts (AMATS Winter Maintenance Forum: Meeting Summary).

During the AMATS Winter Maintenance Forum it was also identified that citizens should be involved in snow removal route prioritization.

Alternative Treatments

In some areas with consistently cold winter conditions, cities have invested in grooming equipment to maintain hard-pack snow, rather than battling to completely clear surfaces. Hard pack is already used on some multi-use trails in Anchorage, and the practice could be expanded. Properly maintained hard-pack can be walked and biked on without special equipment, as it is not slippery. Surfaces like this are akin to snowy areas at the base of ski resorts, outside of lodges, where visitors can walk without skis.

In addition to hard-pack surfaces for pedestrians and cyclists, some cities maintain surfaces ideal for cross country skiing. While cross country skis are most often used today for recreation, they were historically used for transportation and are a practical way of getting around, as long as conditions allow. For cross country skiing to be a feasible method of transportation, there must be few areas where skiers need to cross paved areas where there is no snow coverage.

Maintaining pathways of hard-pack snow and groomed trails for cross country skiing can be done with snowmobiles with sled attachments in tow. Different regions and conditions require different maintenance strategies, but most successful networks use snowmobiles at 12-15 mph at least once a day. Passes in the evening or early morning can help reduce ice build up.

For further details, visit:

» <https://www.skinnyyski.com/trails/display.asp?id=3685>

» <https://www.snowgroomers.net/laying-cross-country-ski-tracks/>

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