Appendix C

Design Guidelines

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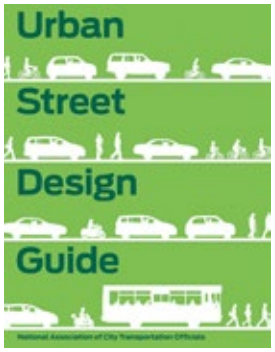
Section I

Context

Guidance Basis

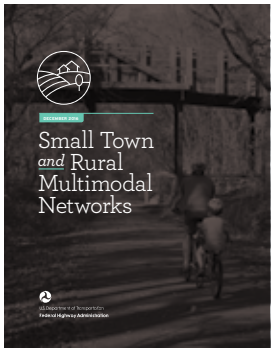
The sections that follow serve as an inventory of pedestrian and bicycle design policies and treatments and provides guidelines for their development. These treatments and design guidelines are important because they represent the tools for creating a pedestrian- and bicycle-friendly, accessible community. The guidelines are not, however, a comprehensive list nor a substitute for a more thorough evaluation by a professional engineer prior to implementation of facility improvements or a replacement for the City's Engineering Standards, Zoning Regulations or other standards. The following guidelines are referred to in this Facilities Design Guide.

NATIONAL GUIDANCE



The National Association of City Transportation Officials' **(NACTO) Urban Bikeway Design Guide (2012) and Urban Street Design Guide (2013)** *are collections of nationally recognized street design standards, and offers guidance on the current state of the practice designs.*

Separated Bike Lane Planning and Design Guide (2015) *is the latest national guidance on the planning and design of separated bike lane facilities released by the Federal Highway Administration (FHWA). The resource documents best practices as demonstrated around the U.S., and offers ideas on future areas of research, evaluation and design flexibility.*



The Federal Highway Administration's **Small Town and Rural Multimodal Networks Report (2016)** *offers resources and ideas to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities. It connects existing guidance to rural practice and includes examples of peer communities.*

Additional Guidance

- AASHTO Guide for the Development of Bicycle Facilities (FORTHCOMING 2020)
- AASHTO. Guide for the Planning, Design, and Operation of Pedestrian Facilities (2004)
- Alta White Paper on Advisory Bike Lanes and Protected Intersections
- MASSDOT Guide on Protected Intersections
- Access Board's ADA Standards

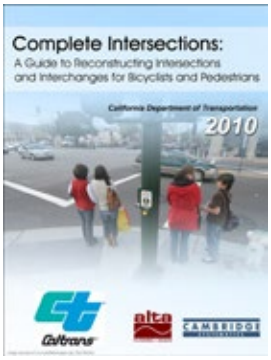
CALIFORNIA GUIDANCE

The **California Manual on Uniform Traffic Control Devices (CAMUTCD) (2014)** *is an amended version of the FHWA MUTCD 2009 edition modified for use in California. While standards presented in the CA MUTCD substantially conform to the FHWA MUTCD, the state of California follows local practices, laws and requirements with regards to signing, striping and other traffic control devices.*

Main Street, California: A Guide for Improving Community and Transportation Vitality (2013) *reflects California's current manuals and policies that improve multimodal access, livability and sustainability within the transportation system. The guide recognizes the overlapping and sometimes competing needs of main streets.*

The **California Highway Design Manual (HDM) (Updated 2015)** *establishes uniform policies and procedures to carry out highway design functions for the California Department of Transportation.*

The Caltrans Memo: **Design Flexibility in Multimodal Design (2014)** *encourages flexibility in highway design. The memo stated that "Publications such as the National Association of City Transportation Officials (NACTO) "Urban Street Design Guide" and "Urban Bikeway Design Guide," ... are resources that Caltrans and local entities can reference when making planning and design decisions on the State highway system and local streets and roads."*



Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians (2010) *presents information and concepts related to improving conditions for bicyclists and pedestrians at major intersections and interchanges. The guide can be used to inform minor signage and striping changes to intersections, as well as major changes and designs for new intersections.*

Additional Guidance

- City Engineering Standards
- Zoning Regulations
- Downtown Concept Plan
- Specific Plans
- The California Bicycle Coalition's Quick-Build Guide and other resources
- Caltrans DIB 82-06 "Pedestrian Accessibility Guidelines for Highway Projects"

Design Needs of Pedestrians

The CA MUTCD recommends a normal walking speed of 3.5 ft per second when calculating the pedestrian clearance interval at traffic signals. The walking speed can drop to 3 ft per second for areas with older populations and persons with mobility impairments. While the type and degree of mobility impairment varies greatly across the population, the transportation system should accommodate these users to the greatest reasonable extent.

TYPES OF PEDESTRIANS

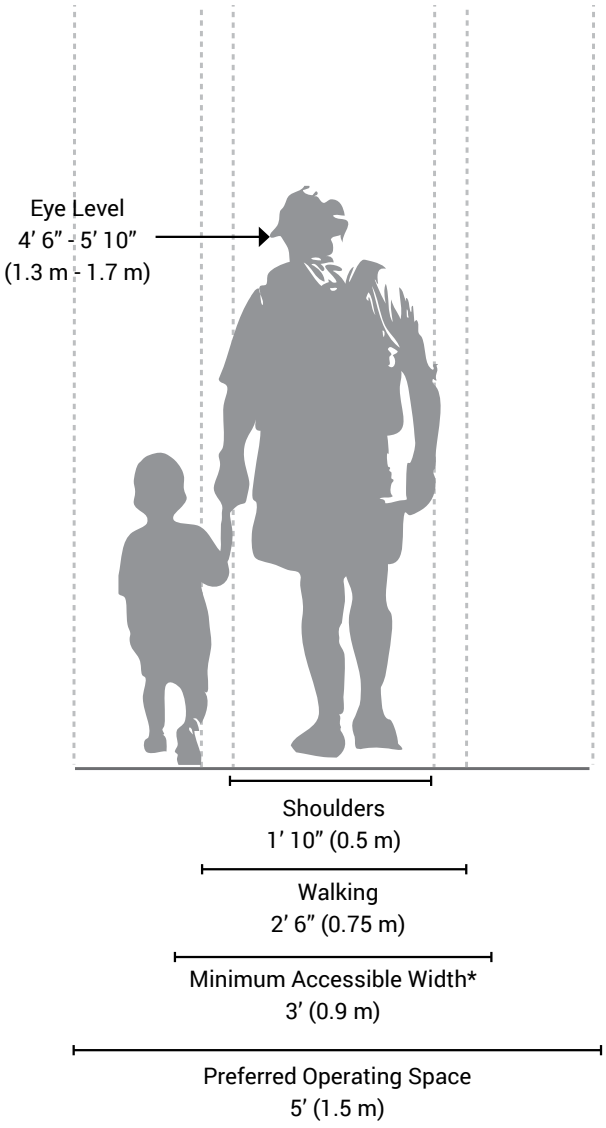
Pedestrians have a variety of characteristics and the transportation network should accommodate a variety of needs, abilities, and possible impairments. Age is one major factor that affects pedestrians' physical characteristics, walking speed, and environmental perception. Children have low eye height and walk at slower speeds than adults. They also perceive the environment differently at various stages of their cognitive development. Older adults walk more slowly and may require assistive devices for walking stability, sight, and hearing.

DISABLED PEDESTRIAN DESIGN CONSIDERATIONS

The table below summarizes common physical and cognitive impairments, how they affect personal mobility, and recommendations for improved pedestrian-friendly design. The designer should consider all types of disabilities when making design decisions. In addition, while specific design is necessary for disabled pedestrians, they are also beneficial amenities for other types of pedestrians as well.

Disabled Pedestrian Design Considerations

Impairment	Effect on Mobility	Design Solution
Physical Impairment Necessitating Wheelchair and Scooter Use	Difficulty propelling over uneven or soft surfaces.	Firm, stable surfaces and structures, including ramps or beveled edges.
	Cross-slopes cause wheelchairs to veer downhill or tip sideways.	Cross-slopes of less than two percent.
	Require wider path of travel.	Sufficient width and maneuvering space.
Physical Impairment Necessitating Walking Aid Use	Difficulty negotiating steep grades and cross slopes; decreased stability and tripping hazard.	Cross-slopes of less than two percent. Smooth, non-slippery travel surface.
	Slower walking speed and reduced endurance; reduced ability to react.	Longer pedestrian signal cycles, shorter crossing distances, median refuges, and street furniture.
Hearing Impairment	Less able to detect oncoming hazards at locations with limited sight lines (e.g. driveways, angled intersections, channelized right turn lanes) and complex intersections.	Longer pedestrian signal cycles, clear sight distances, highly visible pedestrian signals and markings.
Vision Impairment	Limited perception of path ahead and obstacles; reliance on memory; reliance on non-visual indicators (e.g. sound and texture).	Accessible text (larger print and raised text), accessible pedestrian signals (APS), guide strips and detectable warning surfaces, safety barriers, and lighting.
Cognitive Impairment	Varies greatly. Can affect ability to perceive, recognize, understand, interpret, and respond to information.	Signs with pictures, universal symbols, and colors, rather than text.



**At point of contact*

Pedestrian Characteristics by Age

Age	Characteristics
0-4	Learning to walk
	Requires constant adult supervision
	Developing peripheral vision and depth perception
5-8	Increasing independence, but still requires supervision
	Poor depth perception
9-13	Susceptible to "darting out" in roadways
	Insufficient judgment
	Sense of invulnerability
14-18	Improved awareness of traffic environment
	Insufficient judgment
19-40	Active, aware of traffic environment
41-65	Slowing of reflexes
65+	Difficulty crossing street
	Vision loss
	Difficulty hearing vehicles approaching from behind

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

DESIGN NEEDS OF RUNNERS

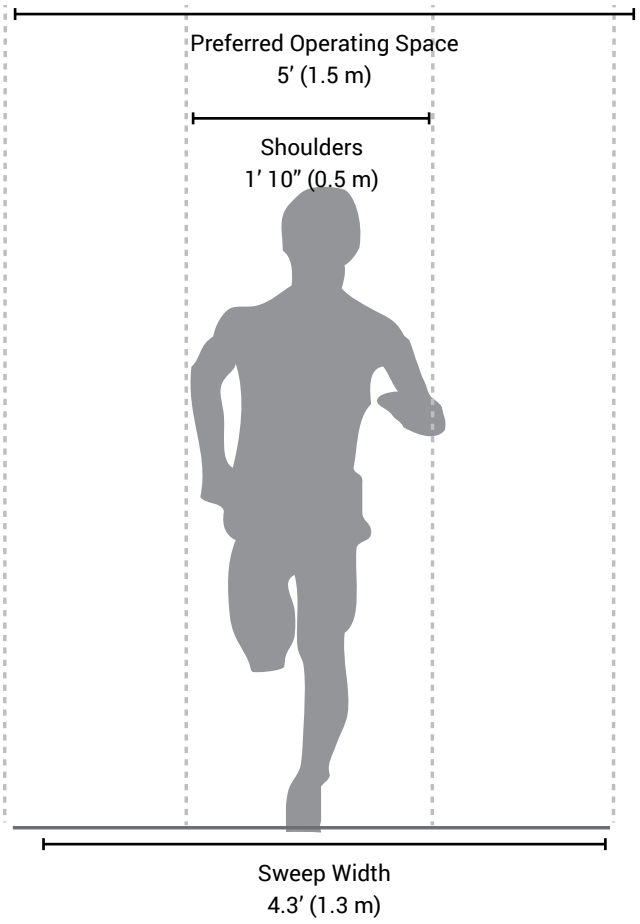
Running is an important recreation and fitness activity commonly performed on shared use paths. Many runners prefer softer surfaces (such as rubber, bare earth or crushed rock) to reduce impact. Runners can change their speed and direction frequently. If high volumes are expected, controlled interaction or separation of different types of users should be considered.

DESIGN NEEDS OF STROLLERS

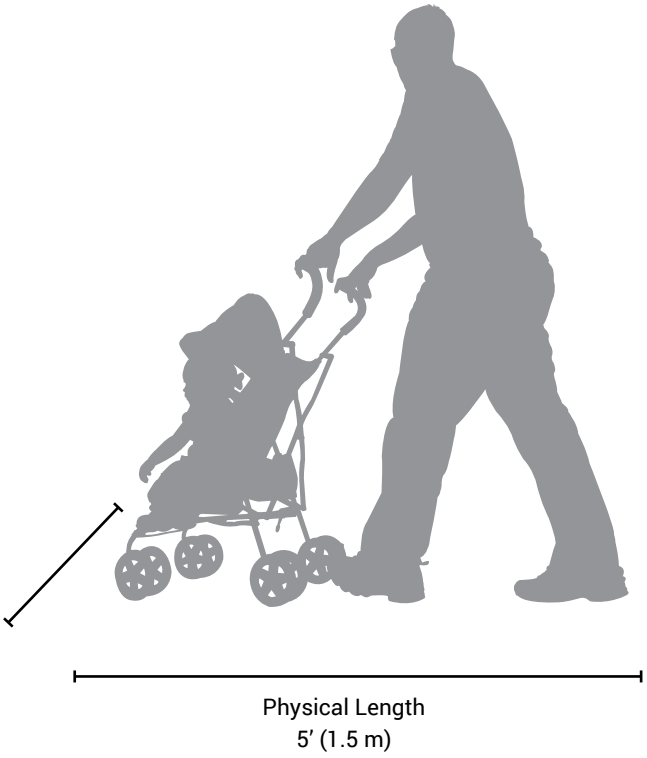
Strollers are wheeled devices pushed by pedestrians to transport babies or small children. Stroller models vary greatly in their design and capacity. Some strollers are designed to accommodate a single child, others can carry 3 or more. Design needs of strollers depend on the wheel size, geometry and ability of the adult who is pushing the stroller.

Strollers commonly have small pivoting front wheels for easy maneuverability, but these wheels may limit their use on unpaved surfaces or rough pavement. Curb ramps are valuable to these users. Lateral overturning is one main safety concern for stroller users.

Runner Dimensions



Stroller Dimensions



DESIGN NEEDS OF WHEELCHAIR USERS

As the American population ages, the age demographics in communities may also shift, and the number of people using mobility assistive devices (such as manual wheelchairs, powered wheelchairs) will increase.

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.

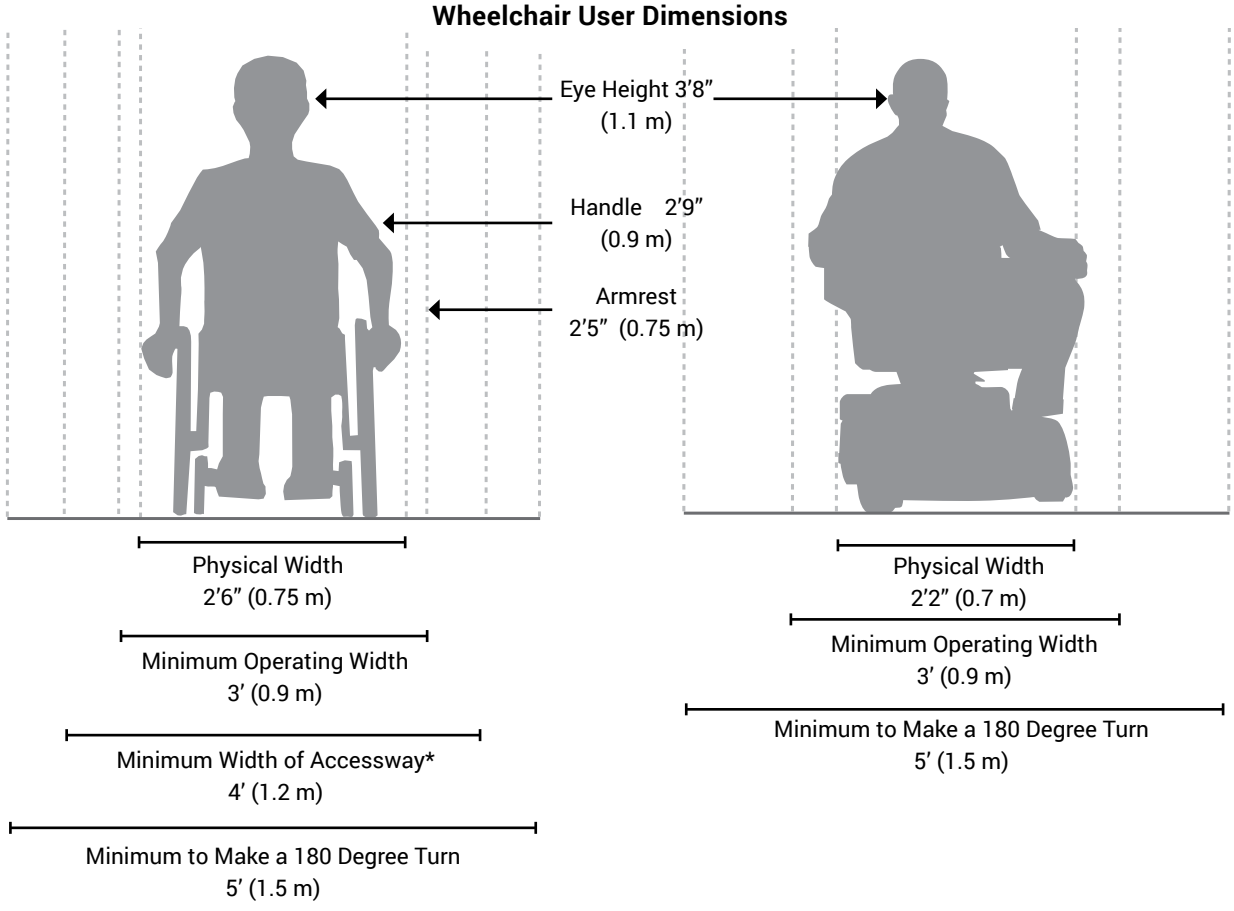
Power wheelchairs use battery power to move the wheelchair. The size and weight of power wheelchairs limit their ability to negotiate obstacles without a ramp. Various control units are available that enable users to control the wheelchair movement, based on their ability (e.g., joystick control, breath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

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 two percent.
Require wider path of travel.	Sufficient width and maneuvering space.

Wheelchair User Dimensions



**Provide 5' x 5' passing zone every 200' if travel way is at minimum width*

Design Needs of Bicyclists

The facility designer must have an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers.

By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk. The following details outline the typical physical parameters to consider when designing for bicyclists of different sizes, ages, and ability levels—these dimensions should not be interpreted as formal design specifications.

BICYCLE AS A DESIGN VEHICLE

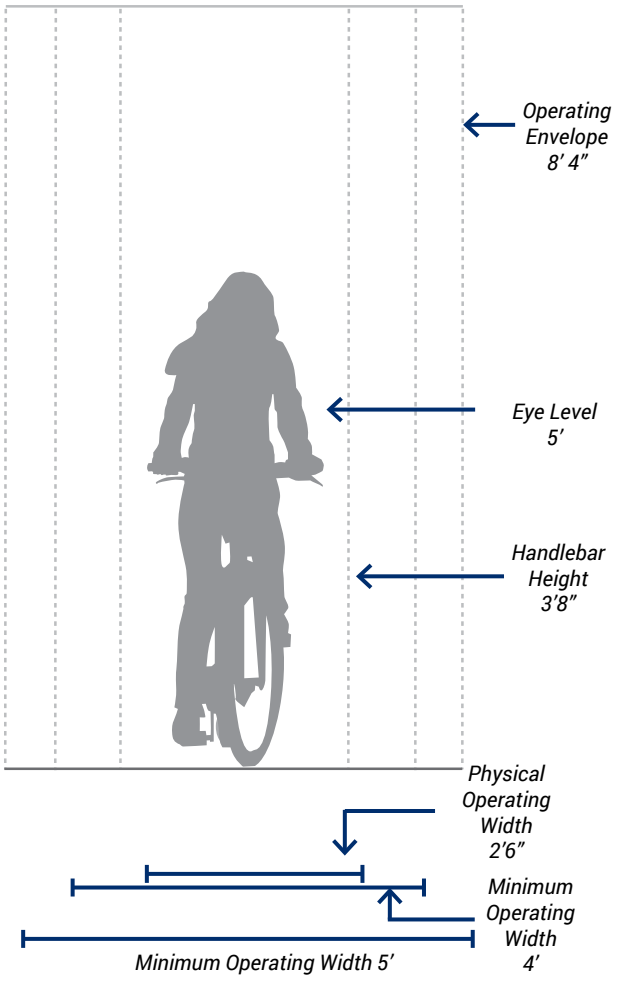
Similar to motor vehicles, bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a bikeway should consider reasonably expected bicycle types on the facility and utilize the appropriate dimensions.

The Bicycle Rider figure illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. Generally, bicyclists prefer a minimum operating width of five feet.

In addition to the design dimensions of a typical bicycle, there are many other commonly used pedal-driven cycles and accessories to consider when planning and designing bicycle facilities. The most common types include tandem bicycles, recumbent bicycles, and trailer accessories. Extra care should be given to account for wider tracking of these larger bicycle types.

A rapidly emerging bicycle type is the electric assist bicycle, which can increase the distance covered by bike and can help accommodate the "interested but concerned" bicyclist type. However, electric assist bicycles have the capability to travel at higher speeds than fully human-powered bicycles, which the designer should take into consideration especially regarding bikeway curves and widths.

Bicycle Rider - Typical Dimensions



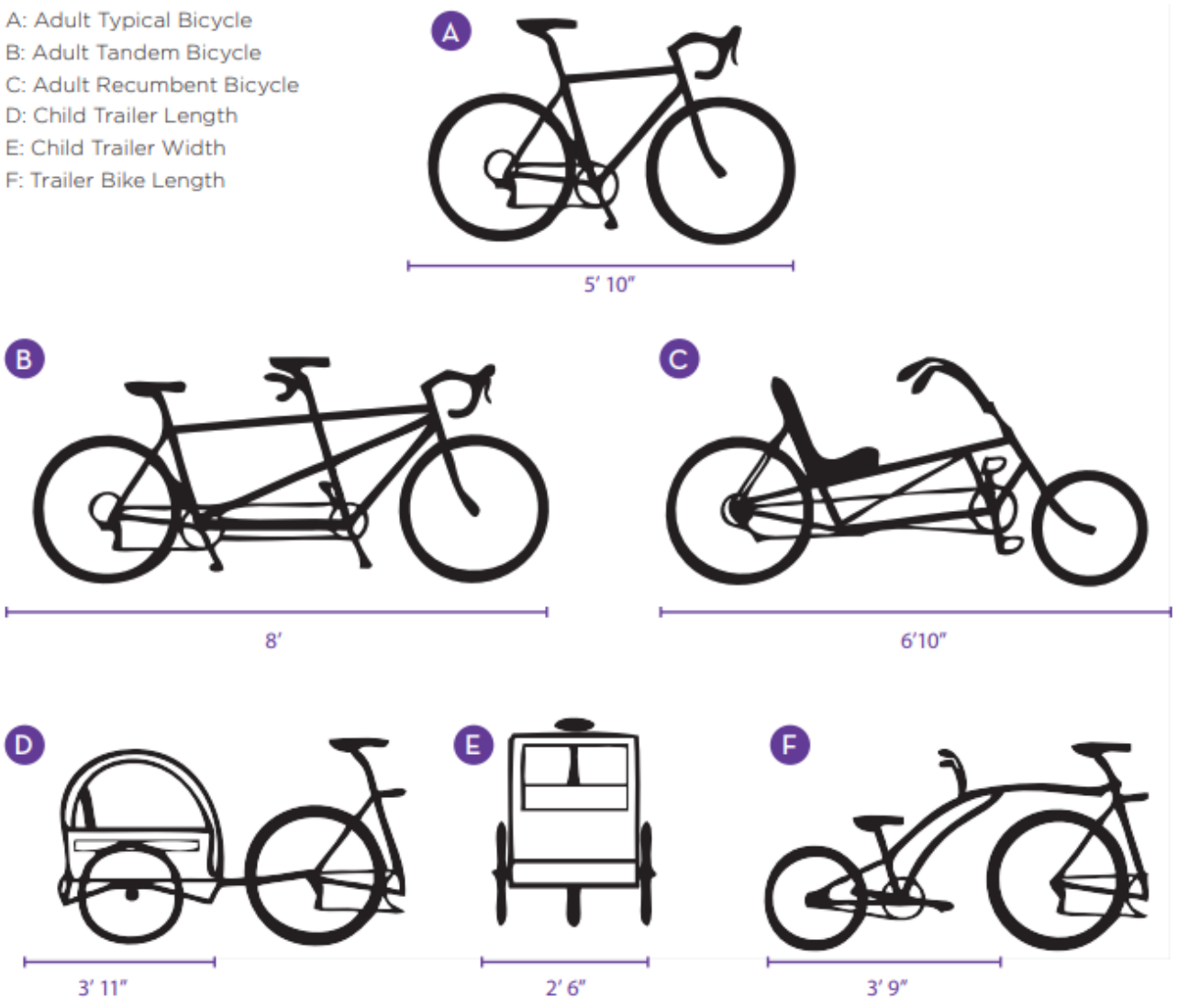
Bicycle as Design Vehicle - Design Speed Expectations

BICYCLE TYPE	FEATURE	TYPICAL SPEED
Upright Adult Bicyclist	Paved level surfacing	8-12 mph*
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph
Electric Assist Bicycle	Paved level surface	15-25 mph

** Typical speed for causal riders per AASHTO 2013.*

Bicycle Design Vehicle - Typical Dimensions

A: Adult Typical Bicycle
B: Adult Tandem Bicycle
C: Adult Recumbent Bicycle
D: Child Trailer Length
E: Child Trailer Width
F: Trailer Bike Length



Source: AASHTO *Guide for the Development of Bicycle Facilities*, 4th Edition

Section 2

Design Policies

Operations and Maintenance

2.1 The City shall identify opportunities to include improvements to bicycle and pedestrian facilities as prescribed by this Plan during other regular maintenance activities, such as roadway sealing and utility repair/replacement projects. Potential improvements that may be incorporated into other maintenance projects include, but are not limited to, upgrading older drainage inlets and intersection corner ramps to current City Standards, if funding is available to support this added work.

2.2 Sidewalks, shared-use paths and protected bike lanes should be swept regularly to clear debris and litter.

2.3 During scheduled and budgeted street resurfacing and maintenance work, the City should exhaust all reasonable efforts to maintain a pavement surface along designated bikeways that is smooth and free of potholes, cracks or other hazards. As funding and staffing resources allow, the City should endeavor to meet the following surface tolerances with installation of new bikeway facilities and following maintenance projects, such as roadway resurfacing and resealing.

Direction of Travel	Grooves[1]	Steps[2]
Parallel to travel	No more than 1/2" wide	No more than 3/8" high
Perpendicular to travel	--	No more than 1/2" high

(1) Groove—A narrow slot in the surface that could catch a bicycle wheel.

(2) Step—A ridge in the pavement, such as that which may exist between the pavement and a concrete gutter or manhole cover, or two pavement blankets.

2.4 Continue to require development and redevelopment projects to construct, improve or maintain existing pedestrian infrastructure adjacent to roadways. If construction of new pedestrian infrastructure at the time of development does not connect with existing pedestrian infrastructure, those pedestrian improvements may need to be deferred. Require deferred pedestrian improvements to be installed when those new improvements will connect to existing pedestrian infrastructure.

Construction Sequencing and Work Zone Safety

3.1 During the construction of new or upgraded intersections, roundabouts and roadways, the City shall strive to phase construction activities to minimize impacts to pedestrian and bicycling connectivity during construction where feasible, such as opening a road or intersection to motor vehicle traffic with incomplete sidewalks or lack of adequate connections for bicycling and walking for extended periods of time. The City may require installation of temporary bicycling or pedestrian pathways during construction to maintain connectivity until permanent facilities are completed.

3.2 Traffic control plans prepared for work within the public right of-way shall address bicycling and walking access needs during construction. Signage should warn bicyclists, pedestrians, and motorists in advance of any location where the bicycle lane or sidewalk is closed and identify alternative routes where available.

3.3 Where sidewalk closures are required for several weeks or more, or where there are no controlled pedestrian crossing opportunities (i.e. a signaled or stop-controlled crossing) within one block, temporary pedestrian pathways should be provided per City Engineering Standards to maintain pedestrian access during construction activities.

3.4 Where construction activities require closure of a bicycle lane on streets with speeds of 35 mph or more, a minimum four-foot wide temporary bicycle lane shall be maintained using traffic delineators or safety barricades. Where it is infeasible to maintain width for a temporary bicycle lane, construction traffic control plans shall be designed to reduce motor vehicle speeds to 25 mph or less through the work zone and appropriate signs shall be provided to convey that bicyclists may share the travel lane.

3.5 All reasonable efforts shall be taken to avoid placing traffic control signage within the bike lane or sidewalk where a clear width of at least four feet cannot be maintained. Alternate solutions may include installing signs on temporary sign posts during construction activities.

3.6 Bikeways and pedestrian facilities shall be inspected regularly before, during and after construction activities to identify damage caused by construction activities that may present concerns for active transportation users, such as increased road/sidewalk debris, cracks or potholes. Consistent with City Engineering Standards, the City should hold contractors responsible for repairing damage to public infrastructure caused by construction activities. Where possible, the City should also strive to include repairs to preexisting damaged roadway and sidewalk areas as part of planned construction activities.

Designing Intersections for Walking and Bicycling

ROUNDABOUTS

4.1 Consistent with the policies identified in the General Plan Circulation Element, roundabouts shall be the preferred intersection control device over signalized intersections. Where practicable, roundabouts or neighborhood traffic circles shall be provided where all-way stop control would otherwise be considered.

4.2 Where multi-lane roundabouts are proposed, additional crossing enhancements should be considered to improve the pedestrian crossing experience consistent with guidance from the U.S. Access Board, which may include consideration for pedestrian signals, Pedestrian Hybrid Beacons or grade-separated crossings.

4.3 Where roundabouts are installed, A) curb ramps should be designed using best practices for bike and pedestrian safety and convenience and B) separated facilities for bicycle and pedestrian travel should be provided in the roundabout design if high-volume bike lanes or protected bike lanes lead into the roundabout.

4.4 Roundabouts should be designed such that a bicycle can either traverse through it using either a separated shared-use path/protected bike lane or by sharing the roadway.

PROTECTED INTERSECTIONS

4.5 Where new signalized intersections are proposed or where existing signalized intersections are proposed for significant reconstruction, bicycle protected intersection design elements shall be incorporated.

4.6 Where protected intersections are infeasible, other bikeway intersection crossing treatments shall be prioritized at intersections to improve bicyclist safety and connectivity, including bike boxes, dedicated bicycle signal phases, and colored pavement.

PEDESTRIAN CROSSING TREATMENTS

4.7 Intersection designs should include elements that reduce pedestrian crossing exposure and minimize conflicts with higher-speed motor vehicle movements. Potential intersection design elements include, but are not limited to, curb extensions (“bulbouts”), median refuges, ADA-compliant curb ramps, reduced corner radii and mountable corner truck aprons, hi-visibility crosswalk markings, and hardened centerlines.

4.8 Uncontrolled pedestrian crossings should include enhancements to improve pedestrian visibility and crossing safety consistent with applicable engineering standards and best practices for quality pedestrian infrastructure design. Potential crossing elements include addition of hi-visibility warning signage and pavement markings, median

refuges, in-pavement yield signs, and active crossing devices such as Pedestrian Hybrid Beacons, Pedestrian Traffic Signals, and beacon systems, such as Rapid Rectangular Flashing Beacons.

4.9 Signalized intersections should provide pedestrian crossings at all legs, unless otherwise approved by the City Engineer for safety reasons. Signalized crossings shall include countdown signal heads accessible pedestrian signal (APS) pushbuttons and other features consistent with current ADA Standards.

4.10 Where practicable, all City-operated traffic signals should include Lead Pedestrian Intervals (LPIs) to provide a head-start for pedestrians to begin cross an intersection.

BICYCLE CHANNELIZATION AT RIGHT TURN LANES

4.11 On streets with speeds under 30 mph with striped bike lanes, bicycle channelization should be provided to the left of dedicated right-turn only lanes, where they exist.

4.12 On streets with speeds of 30 mph or greater with striped bike lanes, or where protected bicycle lanes are provided, bike channelization should generally be avoided at right-turn lanes. Instead, alternative treatments such as protected intersections (setback crossings) or dedicated bike signal phases should be implemented to facilitate more comfortable intersection crossings for riders of all ages and ability levels. The City shall encourage Caltrans and the County to apply a similar strategy for intersection improvements proposed within the vicinity of the City, but not under City jurisdiction.

FREEWAY CROSSINGS AND INTERCHANGES

4.13 The City shall work with Caltrans to encourage and advocate that freeway overcrossing/undercrossing and interchange projects incorporate the needs of bicycling and walking as part of the project design, avoiding conflict points where cyclists and pedestrians must cross the path concurrent with high speed/volume motor vehicle movements.

TRAFFIC SIGNAL DESIGN FOR BICYCLING

4.14 Traffic signal timings shall provide sufficient minimum green time for an average cyclist to enter and clear the intersection.

4.15 New or modified traffic signals shall include detection for bicycles at all approaches accessed by cyclists, with video detection being the preferred system. If in-pavement loop detection is used, pavement legends shall be applied to the road surface and maintained to identify the optimum location for bicyclists to position their bikes to trigger a signal change. Pushbutton actuation may be used, when appropriate, to avoid accidental detection by motor vehicles where cyclists approach an intersection from a shared-use path or curbside protected bike lane.

4.16 When used, pushbuttons for bicycles should be accessible so that bicyclists do not have to dismount or deviate from the bikeway to actuate a signal or flashing beacon system.

4.17 Bicycle signals should be considered where engineering judgement indicates that bicycle movements should be separated from motor vehicle or pedestrian movements with a dedicated signal phase.

Pedestrian Facilities

MARKED CROSSWALKS

5.1 Marked crosswalks should provide a direct alignment between curb ramps at either end of the crossing.

5.2 Where marked crosswalks are installed, high-visibility ladder style crosswalk markings should be applied at all uncontrolled crossings and at signalized crossings with high crossing demand, such as intersections within the Downtown Core. Pavers, stamped concrete, or other decorative treatments may be used at marked crosswalks within the Downtown Core in lieu of high-visibility ladder style markings.

5.3 To reinforce yielding to pedestrians and reduce vehicle incursion into the crosswalk, consider using an advanced stop bar in advance of the crosswalk and advance yield markings ahead of uncontrolled crosswalks.

SIDEWALK ZONES AND WIDTHS

5.4 Sidewalks shall be designed and installed per City Engineering Standards, with sidewalk widths determined as follows:

5.4.1 For new sidewalk installations, minimum widths should generally be based on pedestrian demand and level of service, with a target of LOS B and minimum of LOS C.

5.4.2 Sidewalk widths for commercial development outside the downtown may be required up to seven (7) feet detached, 12 feet integral.

5.4.3 Within the downtown planning area, new sidewalks should have a minimum of eight (8) feet clear width, with a total width of 12 to 20 feet to provide space for street trees, lighting, benches and other street furniture, public art installations, outdoor cafes and pedestrian traffic. Depending on the location, ultimate sidewalk widths may be limited by factors such as emergency response needs, presence of street parking, utility conflicts and other physical constraints.

5.4.4 Exceptions to minimum required sidewalk widths may be granted when the required sidewalk width is not consistent with neighborhood character and existing topography, street design, and density. Unless otherwise stated above, the standard minimum sidewalk width is five (5) for detached and six (6) feet when placed integral with curb and gutter.

CURB RAMPS

5.5 Curb ramps must be installed at all intersections and midblock locations where pedestrian crossings are allowed, as mandated by federal legislation. Curb ramps shall be installed per City Engineering Standards with construction of new intersections, reconstruction of existing intersections, as part of other qualifying roadway improvements or alterations, and with significant redevelopment of adjacent properties.

5.6 Where feasible, separate directional curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp radial at a corner for both crosswalks

CURB EXTENSIONS (BULBOUTS)

5.7 Curb extensions shall be designed per City Engineering Standards, with minimum radii that accommodate City street sweepers.

5.8 Curb extensions should be designed so they do not create conflicts with bicycle circulation or stormwater drainage.

STREET LIGHTING

5.9 Street lighting shall be provided at all intersections and along public streets consistent with City Engineering Standards.

5.10 Solar street lighting options should be considered where practicable.

5.11 Pedestrian-scale pedestrian lighting should be considered in commercial districts, such as the Downtown Core, and within other neighborhoods along routes with high pedestrian activity.

CREATE AN ENJOYABLE WALK

5.12 Where feasible, sidewalks should be buffered from the roadway by street trees, landscaped parkways, or other features that physically separate the pedestrian space from motor vehicle traffic.

5.13 The City should encourage urban design strategies that create an interesting, enjoyable walking environment and unique neighborhood character. Strategies include, but are not limited to, installing public art installations, painted bulbouts

and other street murals, installing wayfinding signage pointing pedestrians to popular destinations, and promoting outdoor cafes and pedestrian-oriented architectural elements along building frontages.

PARKLETS

Parklets are defined as public seating platforms that convert curbside parking spaces into vibrant community spaces. Parklets are often the product of a partnership between the city and local businesses, residents, or neighborhood associations. Most parklets have a distinctive design that incorporates seating, greenery, and/or bike racks and accommodate unmet demand for public space on thriving neighborhood retail streets or commercial areas.

5.14 If supported by the City Council, the City should create a formal parklet program to facilitate and encourage the development of parklets at appropriate locations to the satisfaction of the City Public Works and Community Development Departments.

5.15 The decision to install parklets shall consider the speed of the roadway and its impact on the safety of individuals using the parklet space. Parklets shall not be approved on roadways with vehicle speeds (posted speeds or measured 85th percentile speeds) that exceed 30 mph.

5.16 Parklets shall include appropriate barriers to prevent pedestrians from encroaching into the adjacent vehicular traveled way.

5.17 Parklet designs must be compliant with the Americans with Disabilities Act and should use a slip resistant surface. Parklets should have a flush transition at the sidewalk and curb to permit easy access and avoid tripping hazards.

5.18 Parklets shall not inhibit storm water drainage or block any utility access at drainage inlets, utility boxes, valves, or fire hydrants.

5.19 Parklets and bicycle racks shall not be placed so that either facility comes into conflict with another. However, opportunities should be explored to combine parklets with adjacent bike corrals, where possible.

5.20 Parking stops or other physical buffers shall be used to separate parklets from adjacent parking stalls. In addition, vertical separation, such as flex posts with retroreflective tape, shall be used along the edges of parklets to increase visibility and delineation between the parklet and adjacent vehicular travel lanes.

5.21 Parklet surfaces, barriers and other design elements shall not be physically bolted or anchored to the street or sidewalk without prior approval from the City Public Works Department.

Bicycle Facilities

BICYCLE ROUTES (CLASS III BIKEWAYS)

6.1 Bike routes shall only be designated on streets with prevailing speeds of ≤25 mph. Where existing speeds exceed these levels, traffic calming measures should be incorporated.

6.2 Advisory bike lanes may be considered as an alternative to bike routes or neighborhood greenways on streets where there is insufficient width to install standard Class II or IV bikeways.

BICYCLE RAMPS

6.3 Bike ramps should have a minimum width of 6 feet with flared transitions instead of vertical curbs where feasible. Bike ramp entry and exit angles shall be forgiving with angles of 30 degrees or less measured from the approach alignment. Entry angles shall be less than 15 degrees on downhill approaches where cyclists are likely to enter ramps at higher speeds. Where ramps exceed 6.5 feet, additional design considerations may be needed to minimize automobile encroachment.

6.4 Bike ramps should not include truncated domes that may be confused with pedestrian ramps. Other design elements, as recommended by the U.S. Access Board, should be considered to provide a visual and tactile warning for visually impaired users to distinguish bicycle ramps from pedestrian ramps.

6.5 Bicycle ramps should be flush with the gutter pan, avoiding vertical lips where feasible.

BICYCLE LANES (CLASS II BIKEWAYS) & PROTECTED BIKE LANES (CLASS IV BIKEWAYS)

6.6 Protected bike lanes are the preferred form of bikeway facility to provide a low-stress, comfortable environment for cyclists of all ages and abilities. Protected bike lanes should be installed on routes identified in this Plan, and where feasible along new streets constructed as part of future development projects.

6.7 Where feasible, the preferred design for protected bike lanes is to construct the bikeway at an elevated or sidewalk-level, vertically separated from motor vehicle traffic.

6.8 Directional bikeways (i.e. one-way facility on each side of the street) are the preferred configuration for new bike lane and protected bike lane installations. Two-way bicycle facilities may be considered in constrained locations, but should generally be avoided along streets with high vehicle speeds, frequent intersections and high traffic-volume driveways. Where proposed, two-way bicycle facility intersections should be controlled by dedicated bicycle signal phases.

6.9. Bike lanes shall run parallel to the motor vehicle lane, not the curb. Where on-street motor vehicle parking is allowed, bike lanes shall be located along the outside of parking bays next to the travel way (protected bike lanes excluded).

6.10 When a street with bike lanes or protected bike lanes is resurfaced, smooth surfaced material shall be used. New pavement surfaces and paveouts with installation of new curb and gutter shall be installed without seams or creases within the bike lane.

6.11 Before a street with bike lanes is sealed, pavement deficiencies such as severe cracking and potholes shall be repaired. Existing surface elevation differences between the edge of asphalt and the concrete gutter shall be made flush to the extent practicable. Streets with bikeways shall only receive slurry seals or microsurfacing, chip seals are not to be used on streets with bikeways.

6.12 Bike lanes shall be kept clear of all vegetation, including overhead (a minimum of 8 feet of vertical clearance). Landscaped medians and/or planter boxes may be placed within the buffer area in protected bike lane installations.

6.13 When installing new drainage inlets along bike lanes, side-opening inlets shall be used per City Engineering Standards to eliminate grates from the bikeway surface. When resurfacing roadways or performing other construction maintenance activities, inspection and assessment of drainage grates should be performed and corrected if deficient.

6.14 Angled Parking - The City shall avoid combining front-end angled parking with bike lanes given concerns for visibility, unless protected bike lanes are configured between the curb and angled parking stalls with an appropriate buffer to physically separate bicyclists from parking maneuvers.

6.15 Bikeways should be designed to avoid potential for incompatibility with motorized scooters or other micromobility devices that may be allowed to operate in the city in the future.

BIKEWAY WIDTH DESIGN STANDARDS

6.16 The following standards in the table below shall establish bike facility width within the City of San Luis Obispo and shall meet or exceed standards described in the California Highway Design Manual and the California Manual of Traffic Control Devices.

6.17 Existing bikeways that do not meet the standards shown are accepted as part of the City's bikeway network and may be upgraded if funding is available and significant environmental impacts can be avoided.

BIKEWAY FACILITY		CRITERIA				
Type	**Paved Width**	**Notes & Additional Guidance**				
Shared-Use Path (Class I Bikeway)	Min: 10' Pref: 12'	- 2 ft. shoulders shall also be included on either side of all Class I facilities				
Type	**Paved Width**	**Next to Parking**	**Vehicles per day**	**85% vehicle speeds**	**Downgrade**	**Notes & Additional Guidance**
Bike Lanes (Class II Bikeway)	Min: 5' (meet 1 criterion) Pref: 8'	No	< 10,000	< 35mph	< 4%	- Dimensions are inclusive of 18 in. gutter for curbside bikeways. Where 24 in. gutter pans exist, increase min. bikeway width by 6 in.
	Min: 6.5' (meet 1 criterion) Pref: 8'	Yes	≥ 10,000	≥ 35mph	≥ 4%	- Dimensions may also be applied to Advisory Bike Lane installations. - Dimensions exclude striped buffer.
	8' (meet 2 criterion)	Yes	≥ 10,000	≥ 45mph	> 4%	
Striped Bike Lane Buffer	Min: 1.5' Pref: 3'					- When a striped buffer is provided between a bike lane and traffic lane, 1 ft in width may be subtracted from the bike lane width as long as the combined bike lane and buffer width is no less than 7 ft.
Bike Lane Channelization (at right-turn lanes)	Min: 5' Pref: 6'					- Where channelization adjoins a right-turn lane used as a designated bus or truck route, increase width to 6 ft.
Type	**Paved Width**	**Notes & Additional Guidance**				
Protected Bike Lane (Class IV Bikeway)	Min: 8' Pref: 12' (two-way) Min: 5' Pref: 8' (on-street) Min: 5' Pref: 7' (elevated)	- Bike lane width does not include buffer area between bikeway and motor vehicle traffic and/or pedestrian sidewalk. - Dimensions are inclusive of 18 in. gutter pan for curbside bikeways. Where 24 in. gutters exists, increase minimum bikeway width by 6 in. - Width is measured from the centerline of stripe - Need at least 1' clearance to any obstacle and no objects or elevation changes at the edges like curbs- At pinchpoints, a minimum width of 5 ft. for one-way bikeways and 8 ft. for two-way bikeways may be allowed for limited segments.				
Protected Bike Lane Buffer Area	Min: 1.5' Pref: 3'	- When adjacent to street parking, a min. buffer of 3 ft. is required. - The buffer between the bikeway and pedestrian sidewalk may be eliminated where the bikeway and sidewalk are vertically separated. - If configured at a height flush with the sidewalk, color, pavement markings, textured surfaces, landscaping or other features should be used to discourage pedestrian use of the bikeway.				
General Notes						

1. Above dimensions apply to all new bikeway installations unless otherwise approved by the City Transportation Manager. Proposed widths below the "preferred paved width" listed above may require approval of an Infrastructure Design Exception by the Public Works Department.
2. Unless otherwise noted, all widths measured from centerline of leftmost stripe to centerline of rightmost stripe (or face of curb).

6.18 Construction of short segments of bikeway should generally be consistent with the design of adjoining bikeway segments, unless fully meeting these standards will provide significant improvement to the comfort or safety of bicycling.

BIKEWAY WIDTH DESIGN STANDARDS

General Provisions

7.1 As part of the goal to increase all trips in the City to 20% by bicycle, the City shall maintain bicycle parking requirements as part of the Zoning Chapter of its Municipal Code.

7.2 As stipulated by the Zoning Regulations, short- and long-term bicycle parking shall be provided whenever a new development is constructed or enlarged or whenever a new use is established.

7.3 The City shall explore areas in the downtown to add more in-street bike parking and bike corrals, including conversion of on-street parking stalls to bicycle parking and providing dedicated secure bicycle parking in parking structures.

7.4 The City shall look for opportunities to provide parking accommodations for larger-sized bicycles, such as cargo and recumbent bicycles, especially in the downtown. It shall also develop standards to accommodate the needs of these types of bicycles.

7.5 The City shall explore ways to accommodate the needs of electric bicycles such as their higher speeds as well as charging equipment with installation of public and private bicycle parking.

Bicycle Parking Design & Engineering

7.6 Development plans submitted for consideration by the City shall include dimensioned drawings that clearly describe and depict the location, orientation, number, type, and storage capacity of long and short-term bicycle parking facilities.

7.7 The City shall encourage existing development to upgrade their bicycle parking facilities to meet current City standards (e.g. type of rack, number of bicycles accommodated).

7.8 The City's Community Design Guidelines shall contain illustrations of how bicycle parking should be installed and oriented as part of new development projects. The City shall maintain and regularly update bicycle parking standards in its Engineering Standards.

7.9 In the Downtown Core, bicycle racks shall be colored forest green consistent with City Council Resolution # 9278 (2002 Series).

7.10 Where on-street parking areas are utilized for bicycle parking, bicycle racks should be mounted off the street to the extent possible, to allow for street sweeping and to minimize conflicts with drainage. Preferred locations shall include:

a. Low traffic speed and volume streets

b. Just prior to mid-block pedestrian crosswalks

c. Prior to driveway/street intersections outside of normal turning radii and where turning volumes are low

d. High visibility areas

e. High pedestrian volume

f. Known high bicycle parking demand areas

7.11 Bicycle parking shall be provided where direct connections between surface modes of transportation are made (e.g. train station, bus terminals, park-and-ride facilities, ride hailing pick up points), at public buildings, medical centers, public facilities serving disadvantaged communities, and at public parks, plazas or other recreation facilities.

7.12 City transit vehicles shall continue to provide racks for the transport of bicycles and increase capacity as demand increases and rack design improves. City transit vehicles shall also continue efforts to accommodate electric bikes on bus racks as much as possible.

7.13 Should grant funds become available, the City shall offer racks or lockers to businesses at high bicycle parking demand locations if they agree to install and maintain them.

7.14 The City shall continue to require enhanced bicycle parking services, such as Bike Valet, at planned and permitted community events such as Thursday night's Farmer's Market, or Concerts in the Plaza, when over 300 attendees are expected.

Short-Term Bicycle Parking (Typically used for 4 hours or less)

Bicycle Rack Siting and Design:
7.15 Install at highly visible locations that are as close to the main entrance of the destination as possible, at least as convenient as the most convenient automobile parking space available to the general public.

7.16 Short-term bicycle parking shall be visible from the interior of the destination.

7.17 Short-term bicycle parking shall be located where clear and safe pedestrian circulation is ensured.

7.18 Parked bicycles should neither be in jeopardy of damage by other area users, nor create unexpected hazards to those users.

7.19 Short-term bicycle parking shall be distributed to serve all tenants/visitors on sites that contain more than one structure or building entry.

7.20 Short-term bicycle parking shall avoid locations that require bicyclists to travel over stairs.

7.21 Short-term bicycle parking areas shall be illuminated during nighttime hours of use.

7.22 Whenever possible, protect bicycle parking areas from weather.

7.23 To the extent possible, accommodate cargo and other larger bicycles as well as electric bicycles and charging equipment

7.24 The City shall continue to promote and manage its Racks with Plaques bicycle rack donation program which provides short term public bicycle parking to serve public facilities and throughout the downtown area.

7.25 Peak Rack type racks, or other City approved design shall be used to meet the City's short-term parking requirements. While approved for use, "U-style" racks should be minimized to the extent possible since they do not provide for secure parking without a kickstand and can be more difficult to lock when other bikes are present. Wave, comb, and toast style racks are examples of racks not permitted by the above guidelines.

Long-term Bicycle Parking (Typically used for more than 4 hours)

7.26 Bicycle lockers, lockable rooms reserved for bicycle storage, and Bicycle Centrals (Stations) shall be used to satisfy the need for long-term bike parking.

7.27 Bicycle Centrals are defined as consolidated sheltered storage areas for employee or tenant bicycles, integrated into the design of work sites or developments, which may be combined with showers and bicycle repair and support facilities, with doors that can accommodate moving a bike in and out.

7.28 The City shall encourage the development of bicycle centrals at employment centers, mixed use developments, and locations where people gather.

7.29 Bicycle lockers shall:

a. Be located at least as conveniently as the most convenient automobile parking space and installed at highly visible locations that are as close to the main employee entrance as possible.

b. In the commercial core, be provided in parking structures, surface parking lots, or incorporated into new buildings and managed to enable safe and convenient access by downtown employees and residents.

c. To the greatest extent possible, be integrated into a project's overall architecture and site design themes.

d. Be constructed of durable materials and be waterproof. Fiberboard or high-density foam walls or dividers shall be avoided as construction materials.

e. Be installed on, and securely attached to a pad with a cross slope between one and two percent. Concrete is the preferred pad material.

f. Employ secure locking mechanisms that make it easy for the intended users to access them.

g. Encouraged to employ designs that prevent or discourage uses for anything other than bicycle storage.

h. To the extent possible, accommodate larger bicycles for cargo use or electric bicycles.

7.30 When interior locked rooms are used to provide long-term bicycle storage, these rooms shall:

a. Have a minimum dimension of 11 feet to accommodate a six-foot-long bike plus five feet of aisle space outside of the doorway area.

b. Include a means to organize bike storage with at least one wheel touching the ground.

c. Be located near or at the employee street level entry and arranged in a way that enables convenient ingress and egress for people with bicycles.

d. Exclude other routine indoor activities and be reserved for bicycle storage.

e. To the extent possible, accommodate cargo and other larger bicycles and electric bicycles and charging equipment.

f. Avoid use of vertical hanging bicycle racks, which do not accommodate the needs of users with limited lifting strength and/or those with larger vehicles, such as cargo or recumbent bicycles. No more than 50% of required long-term bicycle parking shall be provided via vertical hanging racks.

g. To the extent possible, interior bicycle storage areas should be on the ground floor, feature a wider door, and endeavor to have automatic door openers to accommodate better ingress and egress.

Long-Term Bicycle Parking Support Facilities

7.31 The City shall support programs where commuting or touring bicyclists can shower, change, and possibly store their bicycles at athletic and fitness clubs and gymnasiums in the San Luis Obispo area.

7.32 Consistent with the City Zoning Code, the City shall require for the provision of shower and locker facilities at new workplaces and their upkeep for original intended use. Work sites that are not required to provide showers and clothing lockers should be strongly encouraged to do so.

7.33 The City may require a particular land use to provide more than the minimum number of showers or locker facilities, as established by the City Zoning Regulations, when it determines that the land use will generate higher demand for these facilities.

7.34 Full-length and well-ventilated clothing lockers shall be the preferred type of facility for storing personal gear and bicycling equipment.

Mixed Use Facilities

SHARED USE PATHS (CLASS I BIKEWAYS)

Width

8.1 Shared-use paths shall have a standard width of 12 feet with two-foot shoulders (total width of 16 feet). A reduced path width of no less than eight (8) feet plus two-foot shoulders may be considered only in constrained locations where a full-width pathway is otherwise infeasible.

Intersections

8.2 Intersections of shared-use paths and roadways should align at 90 degrees, either at crossings where motorists can be expected to stop, or a location completely out of the influence of any other intersection. At crossings of roadways with high vehicle volumes or speeds, and at intersections not able to align at 90 degrees, traffic control devices such as traffic signals, Pedestrian Hybrid Beacons, or flashing beacon systems should be installed to convey crossing right-of-way.

8.3 At uncontrolled crossings, shared-use paths should be designed with raised crossings or "speed tables" to reduce motor vehicle speeds crossing the bicycle and pedestrian pathway.

8.4 Where shared-use paths are constructed parallel to a roadway, a minimum setback of five (5) feet should be provided, with a greater setback of 10-15 feet desired at driveway and minor street crossings. Where a minimum setback of five (5) feet cannot be provided, the buffer area between the pathway and street should include colored hardscape, landscape, railings/barriers, or other treatments to clearly convey the pathway as a separate facility from the roadway.

Adjoining Creeks

8.6 Shared-use paths shall be located outside of creek setbacks, except where otherwise allowed or as provided for in the City's Conservation and Open Space Element.

8.7 Where setback encroachments cannot be avoided, their extent shall be minimized, and existing riparian vegetation shall be reinforced with native plants to create landscaped buffers between the path and the riparian canopy. Pathway encroachments into the creek setback shall be subject to the exception process of the Creek Setback Regulations contained in the Municipal Code.

8.8 The number of bicycle-pedestrian bridges over creeks shall be minimized. Bridges shall:

a. Be of a "clear span" design.

b. To the greatest extent possible, be located to avoid removal of native trees and streamside habitat or impacts to important aquatic habitat areas.

c. Minimize grading of creek banks or changes to the channel alignment.

d. Include a smooth riding surface to minimize noise.

On Agricultural Land

8.9 Shared-use paths that cross or border agricultural land shall:

a. Use existing service roads where shared use is compatible with agricultural and bicycling operations.

b. Be fenced and signed to discourage trespassing onto adjoining areas.

c. Avoid dividing properties in a way that unduly complicates agricultural operations.

Near Laguna Lake

8.10 Shared-use paths located near Laguna Lake, should:

a. Be located beyond and adequately buffered from wetland habitat.

b. Not alter the hydrological dynamics of the wetland.

c. Be closed with proper public noticing when flood hazards exist.

d. Ensure construction is preceded by a census of bird life in adjoining areas. Bird populations should be periodically monitored, and remedial action taken, as needed.

On Flood Control Channels

8.11 Where an existing creek channel is widened to establish a new top of bank, multi-use paths shall be located outside of creek setbacks except where otherwise allowed or as provided for in the City's Conservation and Open Space Element.

8.12 Where parallel flood control channels are constructed, shared-use paths may be located within the riparian canopy established by the new flood control channel, parallel to the channel side that is farthest from the parent creek.

8.13 When existing creeks are widened or when new flood control channels are constructed, shared-use paths should be installed at the same time or, at a minimum, their rights-of-way shall be reserved and maintained as clear space to enable their eventual installation.

8.14 Along parallel flood control channels, shared-use paths and service roads may share the same alignment. The structural design of these facilities shall be sufficient to support maintenance vehicles.

Near the Railroad

8.15 Reconstruction of "at-grade" railroad crossings by the Union Pacific Railroad or others should be at right angles and shall include the installation of bicycle friendly panels on the approaches and between the tracks.

8.16 New bicycle and pedestrian bridges along the Railroad Safety Trail should generally be separated from existing railroad bridges.

8.17 Shared-use paths along the railroad should include appropriate setbacks and fencing to ensure safe and compatible operations with active rail lines.

Lighting

8.18 Vandal-resistant lighting shall be provided for all shared- use paths and shall be consistent with City plans, located overhead (including in under crossings), generally not more than 16 feet high, direct light downward, have bulbs well recessed to avoid direct glare, and comply with City regulations and engineering standards.

8.19 Solar path lighting options should be considered for new installations.

Access Control for Shared-Use Paths

8.20 Obstacle posts (bollards) and gates are fixed objects and placement within the path can cause them to be an obstruction to path users, especially bicycling. Obstacles such as posts or gates should be considered only when other measures have failed to stop unauthorized motor vehicle entry. Also, these obstacles may be considered only where safety and other issues posed by actual unauthorized vehicle entry are more serious than the safety and access issues posed to bicycling, walking, and other authorized path use.

The three-step approach to prevent unauthorized vehicle entry is:

a. Post signs identifying the entry as a shared use path with regulatory signs prohibiting motor vehicle entry where roads and pathways cross and at other path entry points.

b. Design the path entry so it does not look like a vehicle access and makes intentional access by unauthorized users more difficult. Dividing a path into two one-way paths prior to the intersection, separated by low plantings or other features not conducive to motor vehicle use, can discourage motorists from entering and reduce driver error.

c. Assess whether signing and path entry design prevents or minimizes unauthorized entry to tolerable levels.

PEDESTRIANIZED STREETS ("WOONERFS")

9.1 Pedestrianized streets, such as woonerfs, shall be designed to encourage vehicle speeds of 15 mph or less, giving special attention to the safety of pedestrians.

9.2 Pedestrianized streets should include pavers, stamped/colored concrete, street murals, or other unique surface treatments to convey that these streets are unique human-scaled environments where road space is prioritized for walking and slow bicycling.

NEIGHBORHOOD GREENWAYS

10.1 Neighborhood Greenways shall be constructed with traffic volume and speed management measures to provide for target speeds of 15-20 mph and traffic volumes preferably under 1,500 vehicles/day, but no greater than 3,000 vehicles/day. Diverters or other volume management strategies should be considered where volumes exceed 1,500 vehicles/day.

10.2 Neighborhood Greenways should include branded pavement markings, signage, high-visibility crosswalk markings, public artwork, green street elements, and other features to differentiate these routes from other streets and convey priority for bicycle and pedestrian travel.

10.3 Where consistent with the provisions of the California Manual on Uniform Traffic Control Devices (CA MUTCD), priority at side-street stop-controlled intersections should be given to bicyclists and pedestrians traveling along Neighborhood Greenway routes, with stop signs controlling cross traffic only.

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Section 3

Pedestrian Design Toolbox

Marked Crosswalks

A marked crosswalk signals to motorists that they must yield to pedestrians and encourages pedestrians to cross at designated locations. Installing crosswalks alone will not necessarily enhance the comfort level of crossings. At mid-block locations, crosswalks can be marked where there is a demand for crossing and there are no nearby marked crosswalks.

TYPICAL USE

Marked crosswalks at unsignalized intersections are only installed according to the City Engineering Standards. At unsignalized intersections, crosswalks may be marked under the following conditions:

- At a complex intersection, to orient pedestrians in finding their way across.
- At an offset intersection, to show pedestrians the shortest route across traffic with the least exposure to vehicular traffic and traffic conflicts.
- At an intersection with visibility constraints, to position pedestrians where they can best be seen by oncoming traffic.
- At an intersection within a school zone (yellow crosswalk) on a walking route.
- At an intersection or mid-block location with moderate-to-high crossing demand, high speed/volume motor vehicle traffic, and infrequent controlled crossings nearby.

DESIGN FEATURES

- The crosswalk should be located to align as closely as possible with the through pedestrian zone of the sidewalk corridor.
- Users should not have to leave the crosswalk or reorient themselves from the crosswalk when accessing the curb ramp onto the sidewalk.
- To reinforce yielding to pedestrians and reduce vehicle incursion into the crosswalk, include an advanced stop bar in advance of the crosswalk and advance yield markings ahead of uncontrolled crosswalks.
- Crosswalk installations and marking styles shall comply with the provisions of the California MUTCD.
- Marked crosswalks proposed at uncontrolled crossings with high traffic volumes/speeds will likely require additional crossing enhancements, such as median refuges, flashing beacons, pedestrian hybrid beacons, etc.

Marked crosswalks include standard parallel pavement markings as well as high-visibility ladder markings.

NOTE: Yellow crossings indicate school zone areas.

FURTHER CONSIDERATIONS

- Pedestrians are sensitive to out-of-direction travel, and reasonable accommodations should be made to make crossings convenient at locations with adequate visibility.
- High-visibility ladder crosswalk markings should be used at all marked crosswalks unless otherwise approved by the Public Works Director. Crosswalk details shall be consistent with City Engineering Standards and the CA MUTCD.
- Pavers, stamped concrete or other decorative crosswalk treatments may be used in lieu of ladder-style crosswalk markings in the downtown core to the satisfaction of the Public Works Director. Where decorative crosswalk treatments are used, retroreflective transverse lines shall still be installed on the boundaries of the crosswalk.
- Installation of a marked crosswalk alone is often not sufficient at uncontrolled crossings on higher-speed and multi-lane roadways. At these locations, additional design features should be considered consistent with guidance provided by NACTO, the Institute of Transportation Engineers, and the Federal Highway Administration.

MATERIALS AND MAINTENANCE

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Thermoplastic markings offer increased durability than conventional paint.

Raised Pedestrian Crossings

A raised crosswalk or intersection can eliminate grade changes from the pedestrian path and give pedestrians greater prominence as they cross the street. Raised crosswalks also function as speed tables and encourage motorists to slow down. As such, they should be used only in cases where a special emphasis on pedestrians is desired.

Raised crosswalks are typically implemented on low-speed streets, neighborhood greenways and other areas of very high pedestrian activity. They are often paired with other treatments such as curb extensions for greater traffic calming effect.

TYPICAL USE

Like a speed hump/table, raised crosswalks have a traffic slowing effect which may be unsuitable for high-speed streets, roadways with sharp curves, designated transit or freight routes, and in locations that would reduce access for emergency responders. Approaches to the raised crosswalk may be designed to be similar to speed humps/ tables.

DESIGN FEATURES

- Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.
- Approaches to the raised crosswalk may be designed similar to speed humps.
- Drainage improvements may be required depending on the grade of the roadway.
- Special paving materials can be used to increase conspicuity of the crossing, and alert drivers to the presence of pedestrians.
- Appropriate warning signs and pavement legends should be used to alert drivers to slow speeds approaching speed tables.

Raised pedestrian crossings help reduce vehicle speeds and give pedestrians greater prominence as they cross the street.

FURTHER CONSIDERATIONS

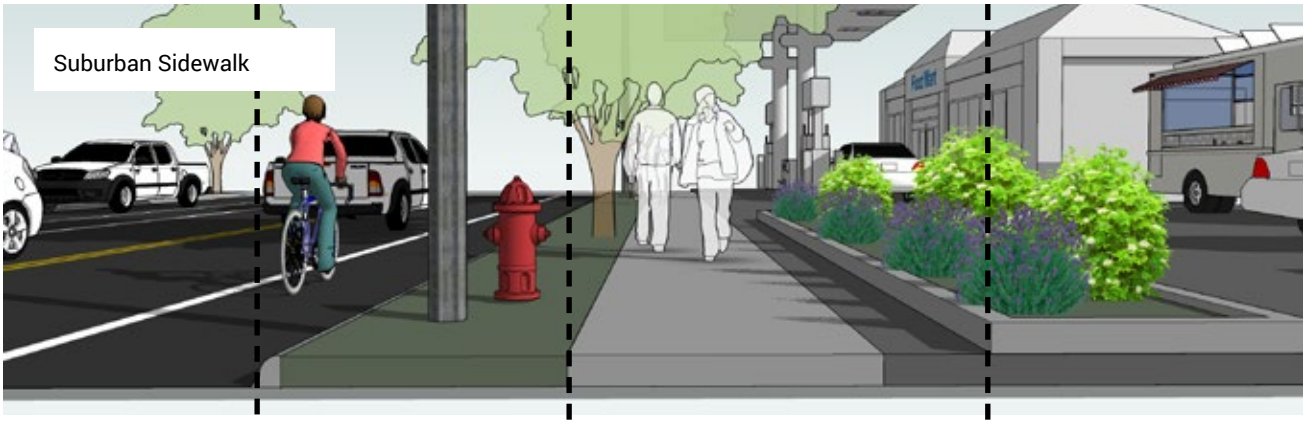
- The noise of vehicles traveling over raised crosswalks may be of concern to nearby residents and businesses.
- Refer to Americans with Disabilities Act (ADA) Standards for additional requirements.

MATERIALS AND MAINTENANCE

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Ensure drainage used to channel stormwater past the raised intersection is kept free of debris, to prevent stormwater from backing up and pooling.

Sidewalk Zones & Widths

Sidewalks are the most fundamental element of the walking network, as they provide an area for pedestrian travel separated from vehicle traffic. Providing adequate and accessible facilities can lead to increased numbers of people walking, improved accessibility, and the creation of social space.



Curbside Lane	Buffer Zone	Pedestrian Through Zone	Frontage Zone
The curbside lane can act as a flexible space to further buffer the sidewalk from moving traffic and may be used for a bike lane. Curb extensions and bike corrals may occupy this space where appropriate. In the edge zone there should be a 6 inch wide curb.	The buffer zone, also called the furnishing or landscaping zone, buffers pedestrians from the adjacent roadway, and is also the area where elements such as street trees, signal poles, signs, and other street furniture are properly located.	The through zone is the area intended for pedestrian travel. This zone should be entirely free of permanent and temporary objects. Wide through zones are needed in downtown areas or where pedestrian flows are high.	The frontage zone allows pedestrians a comfortable "shy" distance from the building fronts. It provides opportunities for window shopping, to place signs, planters, or chairs.

STREET CLASSIFICATION	CURBSIDE LANE	BUFFER ZONE	PEDESTRIAN THROUGH ZONE	FRONTAGE ZONE
Local Streets	Varies	Varies	5 ft (detached) 6 ft (when integral with curb and gutter)	Varies by zone
Downtown Commercial Core	Varies	Varies	8 ft minimum 12-16 ft preferred	None
Arterials and Collectors	Varies	Varies	5-7 ft (detached) 6-12 ft (when integral with curb and gutter)	Varies by zone

TYPICAL USES

- Wider sidewalks should be installed near schools, at transit stops, in downtown areas, or anywhere high concentrations of pedestrians exist.
- At transit stops, an 8 ft by 5 ft clear space is required for accessible passenger boarding/ alighting at the front door location per ADA requirements.
- Sidewalks should be continuous on both sides of urban commercial streets and should be required in areas of moderate residential density (1-4 dwelling units per acre).
- When retrofitting gaps in the sidewalk network, locations near transit stops, schools, parks, public buildings, and other areas with high concentrations of pedestrians should be the highest priority.
- Sidewalk widths above minimums may be required based on pedestrian Level of Service thresholds.

MATERIALS AND MAINTENANCE

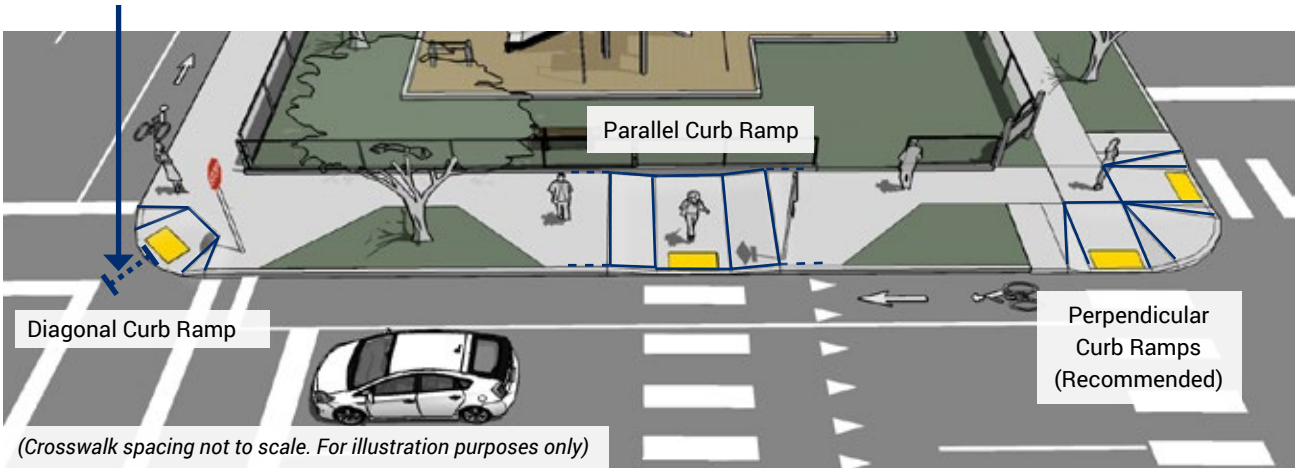
Sidewalks are typically constructed out of concrete and are separated from the roadway by a curb or gutter and sometimes a landscaped parkway. Less expensive walkways constructed of asphalt, crushed stone, or other stabilized surfaces may be approved as temporary installations only. Surfaces must be firm, stable, and slip resistant. Colored, patterned, or stamped concrete can add distinctive visual appeal, but must remain consistent with ADA Standards.

Curb Ramps

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.

Diagonal ramps shall include a clear space of at least 48" within the crosswalk for user maneuverability.

Curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Three configurations are illustrated below.



TYPICAL USE

- 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 curb ramps. In addition, existing facilities must be upgraded to current standards when appropriate.
- The edge of an ADA compliant curb ramp shall be marked with a tactile warning device (also known as truncated domes) to alert people with visual impairments to changes in the pedestrian environment. Contrast between the raised tactile device and the surrounding infrastructure is important so that the change is readily evident to partially sighted pedestrians. These devices are most effective when adjacent to smooth pavement so the difference is easily detected.

DESIGN FEATURES

- Caltrans Standards typically govern City design standards for curb ramp design with some specific exceptions based on City Engineering Standards.
- The level landing at the top of a ramp shall be at least 4'-4" feet long and at least the same width as the ramp itself. The slope of the ramp shall be compliant with current Caltrans Standards.
- If the ramp runs directly into a crosswalk, the landing at the bottom will be in the roadway.
- 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'-4" long (in the direction of the ramp run) and at least as wide as the ramp, although a width of 5'-0" is preferred.

Diagonal curb ramps only recommended when right-of-way does not allow directional ramps.

Curb ramps at a curb extension with landscaping

FURTHER CONSIDERATIONS

Unless otherwise approved by the Public Works Director, 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. Although diagonal curb ramps often cost less to construct, they orient pedestrians directly into the traffic zone, which can be challenging for wheelchair users and pedestrians with visual impairment. Diagonal curb ramp configurations are not recommended unless right of way constraints do not allow directional ramps.

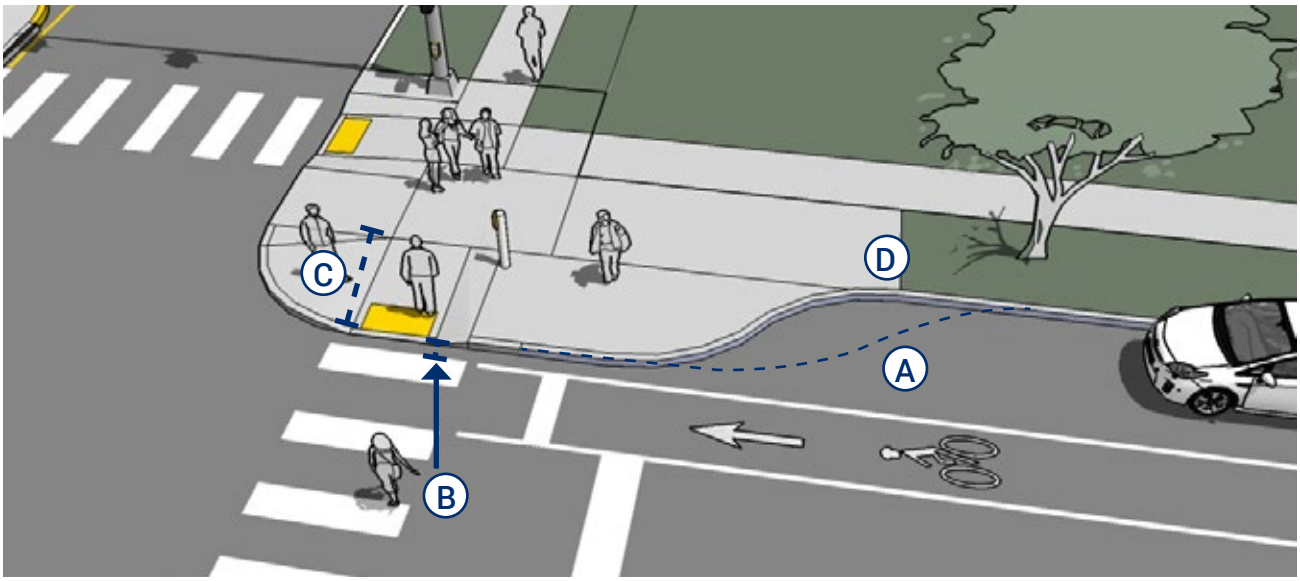
Curb return radii need to be considered when designing directional ramps. While curb ramps are needed for use on all types of streets, the highest priority locations are in downtown areas and on streets near transit stops, schools, parks, medical facilities, shopping areas.

MATERIALS AND MAINTENANCE

It is critical that the interface between a curb ramp and the street be maintained adequately. Asphalt street sections can develop potholes at the foot of the ramp, which can catch the front wheels of a wheelchair.

Curb Extensions (Bulbouts)

Curb extensions, also known as bulbouts, minimize pedestrian exposure during crossing by shortening crossing distance and giving pedestrians a better chance to see and be seen before committing to crossing.



TYPICAL USE

- Within parking lanes appropriate for any crosswalk where it is desirable to shorten the crossing distance and there is a parking lane adjacent to the curb.
- May be possible within non-travel areas on roadways with excess space.
- Particularly helpful at midblock crossing locations.
- Curb extensions should not impede bicycle travel in the absence of a bike lane.
- Curb extensions are often utilized as in-lane transit stops, allowing passengers to board and alight outside of the pedestrian through zone.

MATERIALS AND MAINTENANCE

Planted curb extensions may be designed as a bioswale, a vegetated system for stormwater management. To maintain proper stormwater drainage, curb extensions can be constructed as refuge islands offset by a drainage channel or feature a covered trench drain.

DESIGN FEATURES

(A) For purposes of efficient street sweeping, the minimum radius for the reverse curves of the transition is 10 ft and the two radii should be balanced to be nearly equal.

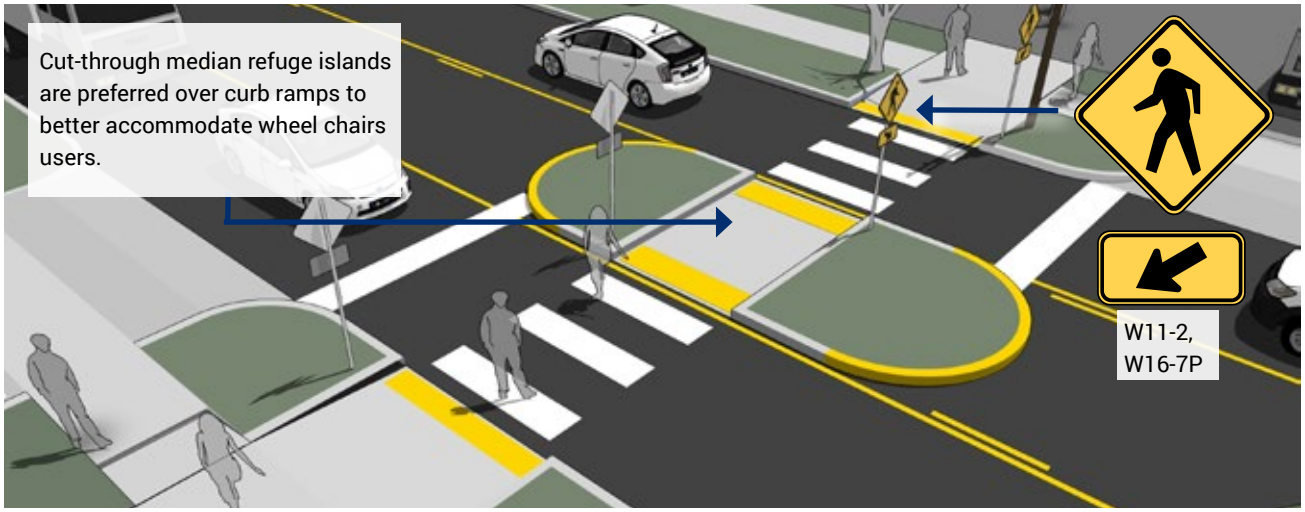
(B) When a bike lane is present, the curb extensions should terminate one foot short of the parking lane to enhance bicyclist access.

(C) Reduces pedestrian crossing distance by width of adjacent parking lane (6-8 ft. typical).

(D)
- Planted curb extensions may be designed as a bioswale for stormwater management.
- Potential for quick-build bulbouts using paint, flex posts, or other materials.

Median Refuge Islands

Median refuge islands are located at the mid-point of a marked crossing and help improve pedestrian access by increasing pedestrian visibility and allowing pedestrians to cross one direction of traffic at a time. Refuge islands minimize pedestrian exposure at mid-block crossings by shortening the crossing distance and increasing the number of available gaps for crossing.



TYPICAL USE

- Refuge islands can be applied on any roadway with a center left-turn lane or median that is at least 6' wide. Islands are appropriate at signalized or unsignalized crosswalks.
- The refuge island must be accessible, preferably with an at-grade passage through the island rather than ramps and landings.
- The island should be at least 6' wide between travel lanes and at least 20' long (40' minimum preferred).
- Provide double centerline marking, reflectors, and "KEEP RIGHT" signage (CA MUTCD R4-7a) in the island on streets with posted speeds above 25 mph.

MATERIALS AND MAINTENANCE

Refuge islands may require frequent maintenance of road debris. Trees and plantings in a landscaped median must be maintained so as not to impair visibility, with nothing higher than 36 in where sight lines need to be maintained.

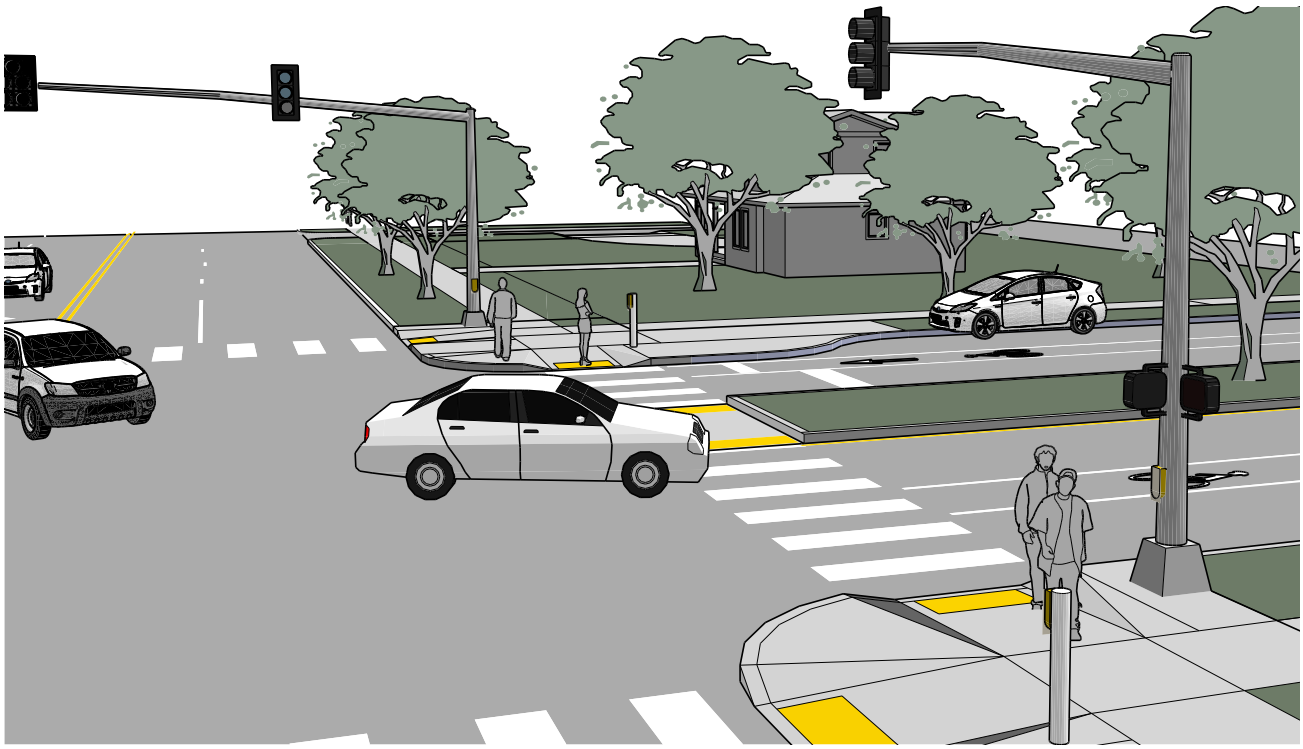
A Pedestrian Island in large intersections helps shorten crossing distances.

DESIGN FEATURES

- Median refuge islands can be installed on roadways with existing medians or on multi-lane roadways where adequate space exists.
- Median Refuge Islands should always be paired with crosswalks and should include advance pedestrian warning signage when installed at uncontrolled crossings.
- On multi-lane roadways, consider configuration with active warning beacons for improved yielding compliance.
- Consider whether pedestrian activation should be provided in the island.

Pedestrian Signalization Improvements

Pedestrian signal heads indicate to pedestrians when to cross at a signalized crosswalk. All traffic signals should be equipped with pedestrian signal indications except where pedestrian crossing is prohibited by signage. Pedestrian signals should be used at traffic signals wherever warranted, according to the CA MUTCD.



TYPICAL USE

- Countdown pedestrian signals are particularly valuable for pedestrians, as they indicate whether a pedestrian has time to cross the street before the signal phase ends. Countdown signals should be used at all new and rehabilitated signalized intersections.
- Adequate pedestrian crossing time is a critical element of the walking environment at signalized intersections. The length of a signal phase with parallel pedestrian movements should provide sufficient time for a pedestrian to safely cross the adjacent street.
- There are several types of signal timing for pedestrian signals, including concurrent, exclusive, "Leading pedestrian interval" (LPI), and all-red interval. In general, shorter cycle lengths and extended walk intervals provide better service to pedestrians and encourage better signal compliance. For optimal pedestrian service, fixed-time signal operation usually works best.
- Leading Pedestrian Intervals (LPI) are used to reduce right turn and permissive left turn vehicle and pedestrian conflicts. The through pedestrian interval is initiated first, in advance of the concurrent through/right/permissive left turn interval. The LPI minimizes vehicle-pedestrian conflicts because it gives pedestrians a 3-10 second head start into the intersection, thereby making them more visible, and reducing crossing exposure time. Accessible Pedestrian Signals (APS) are recommended with an LPI.
- Automated pedestrian phases are preferred to passive or active detection, particularly in areas of high pedestrian activity.

DESIGN FEATURES

- The CA MUTCD recommends that traffic signal timing assumes a pedestrian walking speed of 3.5 ft per second.
- At crossings where older pedestrians or pedestrians with disabilities are expected, crossing speeds as low as 3 ft per second should be assumed. Special pedestrian phases can be used to provide greater visibility or more crossing time for pedestrians at certain intersections.
- Pedestrian pushbuttons may be installed at locations where pedestrians are expected intermittently. Otherwise, pedestrian signals should be automated with traffic signals in areas with high crossing volumes. When used, pushbuttons should be well signed and within reach and operable from a flat surface for pedestrians in wheelchairs and with visual disabilities. They should be conveniently placed in the area where pedestrians wait to cross. Section 4E.09 within the CA MUTCD provides detailed guidance for the placement of pushbuttons to ensure accessibility.

FURTHER CONSIDERATIONS

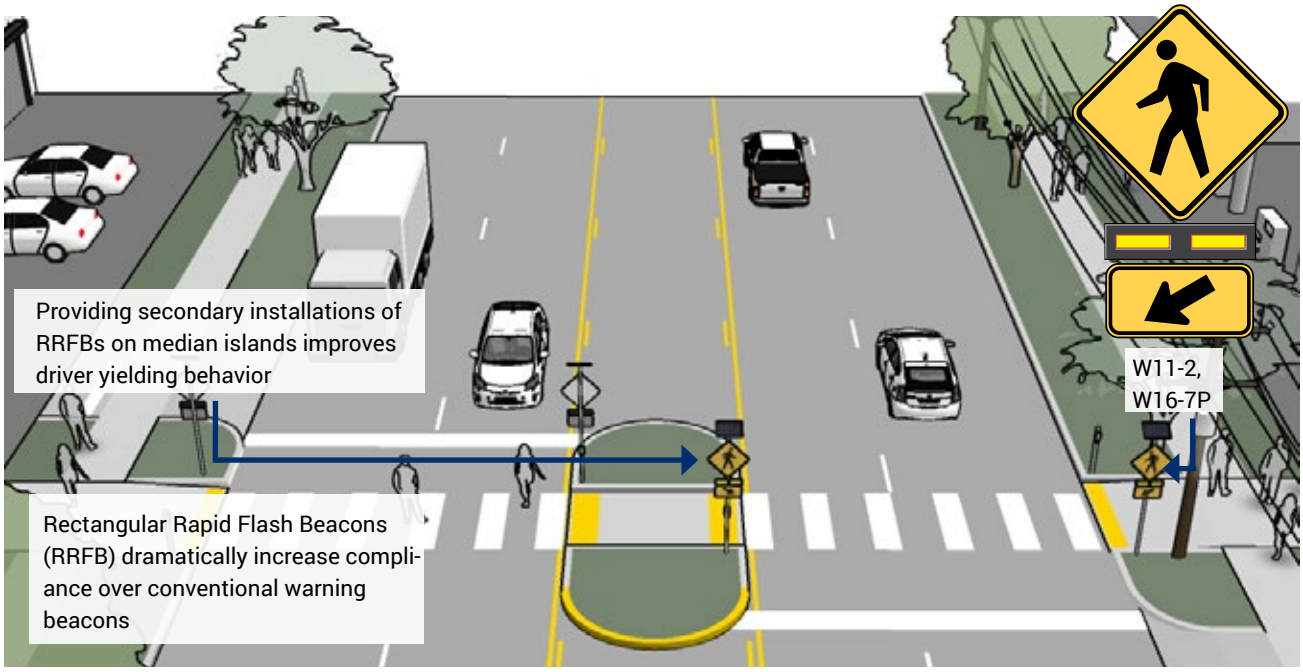
- When pushbuttons are used, they should be located consistent with ADA Standards so that someone in a wheelchair can reach the button from a level area of the sidewalk without deviating significantly from the natural line of travel into the crosswalk. Pushbuttons should be marked (for example, with arrows) so that it is clear which signal is affected.
- In areas with very heavy pedestrian traffic, consider an all-pedestrian signal phase to give pedestrians free passage in the intersection when all motor vehicle traffic movements are stopped. An exclusive pedestrian signal phase is also called a “Pedestrian Scramble,” and can be provided to reduce vehicle turning conflicts.

MATERIALS AND MAINTENANCE

It is important to perform ongoing maintenance of traffic control equipment. Consider semi-annual inspections of controller and signal equipment, intersection hardware, and detectors.

Rectangular Rapid Flashing Beacons (RRFB)

Rectangular Rapid Flash Beacons (RRFB) are a type of active warning beacon used at unsignalized crossings. They are designed to increase motor vehicle yielding compliance on multi-lane or high-volume roadways. Guidance for marked/unsignalized crossings applies.



TYPICAL USE

RRFBs are typically activated by pedestrians manually with a pushbutton or can be actuated automatically with passive detection systems.

RRFBs shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.

RRFBs shall initiate operation based on user actuation and shall cease operation at a predetermined time after the user actuation or, with passive detection, after the user clears the crosswalk.

MATERIALS AND MAINTENANCE

RRFBs should be regularly maintained to ensure that all lights and detection hardware are functional.

DESIGN FEATURES

Guidance for marked/unsignalized crossings applies.

- A study of the effectiveness of going from a no-beacon arrangement to a two-beacon RRFB installation increased yielding from 18 percent to 81 percent. A four-beacon arrangement raised compliance to 88%. Additional studies of long-term installations show little to no decrease in yielding behavior over time.
- See FHWA Interim Approval 21 (IA-21) for more information on device application standards.

Pedestrian Hybrid Beacon (PHB)

Hybrid beacons or High-Intensity Activated Crosswalk (HAWK) beacons are used to improve unsignalized intersections or midblock crossings of major streets. It consists of a signal head with two red lenses over a single yellow lens on the major street, and a pedestrian signal head for the crosswalk. The signal is only activated when a pedestrian and/or bicyclist is present, resulting in minimal delay for motor vehicle traffic.

TYPICAL USE

PHBs are only used at marked mid-block crossings or unsignalized intersections. They are typically activated with a pedestrian pushbutton at each end. If a median refuge island is used at the crossing, another pedestrian pushbutton can be located on the island to create a two-stage crossing.

DESIGN FEATURES

- PHBs must be installed by meeting traffic signal control warrants per the CA MUTCD if roadway speed and volumes are excessive for comfortable pedestrian crossings.
- If installed within a signal system, signal engineers should evaluate the need for the PHB to be coordinated with other signals and coordination should be avoided when long cycle lengths are in place to avoid potential users to cross illegally due to long wait times.
- PHBs should be designed to avoid side street turning movement conflicts to mitigate or temporarily prohibit during beacon activation through use of blank out signs.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk to provide adequate sight distance. (CA MUTCD 4F)

FURTHER CONSIDERATIONS

- PHBs may also be actuated by infrared, microwave, or video detectors.
- Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.
- The installation of PHBs should also include public education and enforcement campaigns to ensure proper use and compliance.

MATERIALS AND MAINTENANCE

PHBs are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

All Way Crossing

Also known as a "pedestrian scramble" or "barnes dance," intersections with this treatment allow for pedestrians to cross in any direction with no permitted vehicle conflicts. This treatment simplifies pedestrian crossings and can improve safety.

TYPICAL USE

All way crossings are typically used where pedestrian volumes are high (typically urban centers) or where a large percentage of crossing pedestrians have to cross two continuous crosswalks. No warrants exist by FHWA, though the City of Los Angeles uses:

- Pedestrian volumes meeting or exceeding 30% of vehicle volume, AND
- Turning traffic through any crosswalk exceeds 200 vehicle per hour, AND
- History of collisions involving turning-vehicles and pedestrians

DESIGN FEATURES

- Diagonal crosswalks and signage notifying pedestrians they can cross in any direction.
- Right turn on red restrictions for vehicles.
- Ample crossing time to enable all queued pedestrians to enter the intersection and sufficient clearance time to clear it.
- All-way crossing phase can be inserted multiple times per cycle.

FURTHER CONSIDERATIONS

- Pedestrians may still attempt to cross during concurrent vehicular phases. Pedestrians may be more compliant at larger intersections or where traffic volumes are steady.
- All-way crossings can increase overall delay for both vehicles and pedestrians at an intersection, especially where addition of a dedicated pedestrian crossing phase requires increasing the total signal cycle length. That said, delays may be reduced for some intersection users, including pedestrians wishing to cross diagonally and for motor vehicle drivers at heavy right turn movements that previously conflicted with crossings with high pedestrian volumes.
- Accessible Pedestrian Signals (APS) should be installed for visually impaired pedestrians so that they don't cross at the wrong time using traffic noise as cues.

MATERIALS AND MAINTENANCE

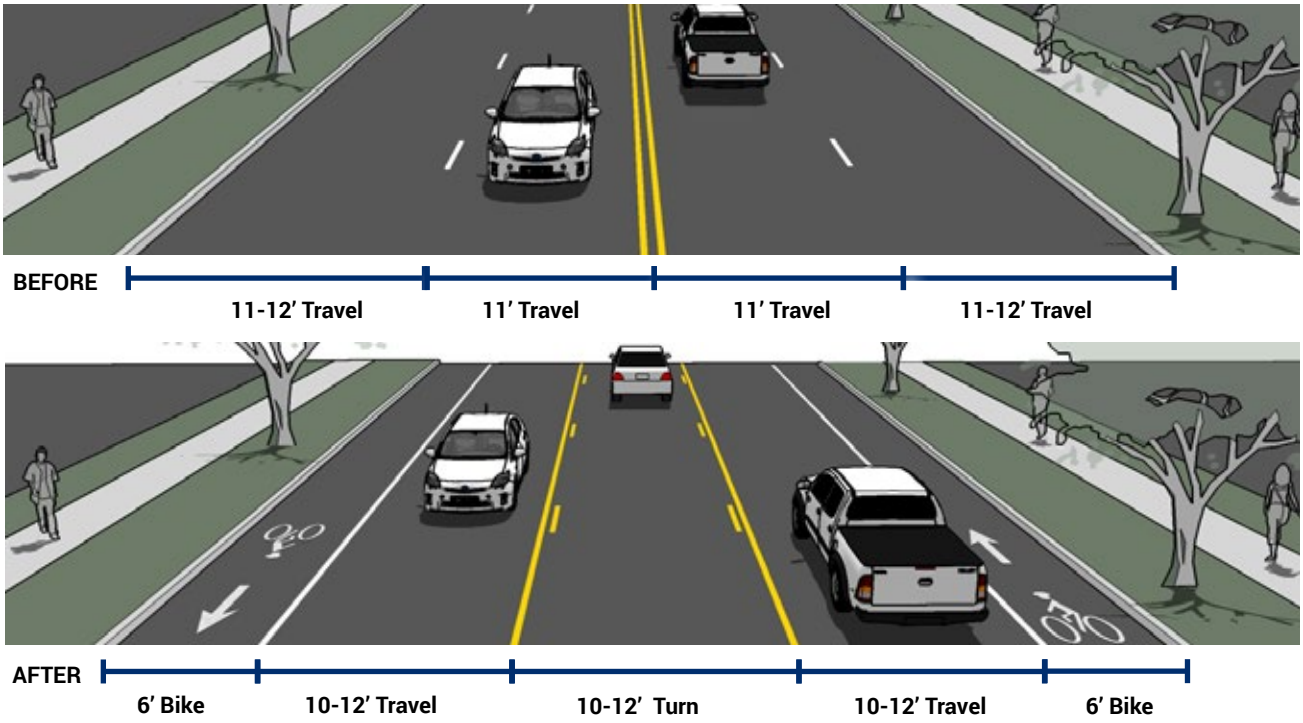
All Way Crossings are subject to the same maintenance needs as standard marked crosswalks and traffic signals.

Section 4

Bicycle Design Toolbox

Lane Reconfigurations and Road Diets

Streets with excess roadway capacity or wider lanes often make excellent candidates for lane reconfigurations, often called "road diets". The removal of a single travel lane will generally provide sufficient space for bike lanes or wider sidewalks on both sides of a street, corner bulbouts or median refuges to shorten pedestrian crossing distances. Even if the width of the sidewalk does not increase, pedestrians benefit from the buffer that new bike lanes create between the sidewalk and travel lanes. Although the actual roadway crossing distance has not been reduced, the addition of bike lanes reduces the number of vehicle travel lanes pedestrians must cross. Additional benefits of lane reconfiguration may include decreased speed while also improving roadway operations due to elimination of lane weaving.



TYPICAL USE

- Depending on a street's existing configuration, traffic operations, user needs, and comfort level, various lane reconfigurations may be appropriate.
- For instance, a four-lane street (with two travel lanes in each direction) could be modified to provide one travel lane in each direction, a center turn lane, and bike lanes.
- Prior to implementing this measure, a traffic analysis should identify potential short-term and long-term impacts, including diversion to other parallel neighborhood streets. Lane configurations should also consider school, city bus, emergency service access, and other truck volumes.

DESIGN FEATURES

- Narrower lanes generally encourage slower vehicle speeds, and higher comfort for people walking and biking.
- Vehicle lane width: Width depends on street context and types or road users. A lane width of 10 feet is generally appropriate on roadways with speeds of 40 mph or less. On roadways with higher speeds and/or frequent freight or transit service, 11-foot wide lanes may be desired.
- Number of Lanes: Generally, 3 lanes with a center turn lane can provide a capacity of 20,000 vehicles per day, with some examples carrying over 24,000 vehicles per day.

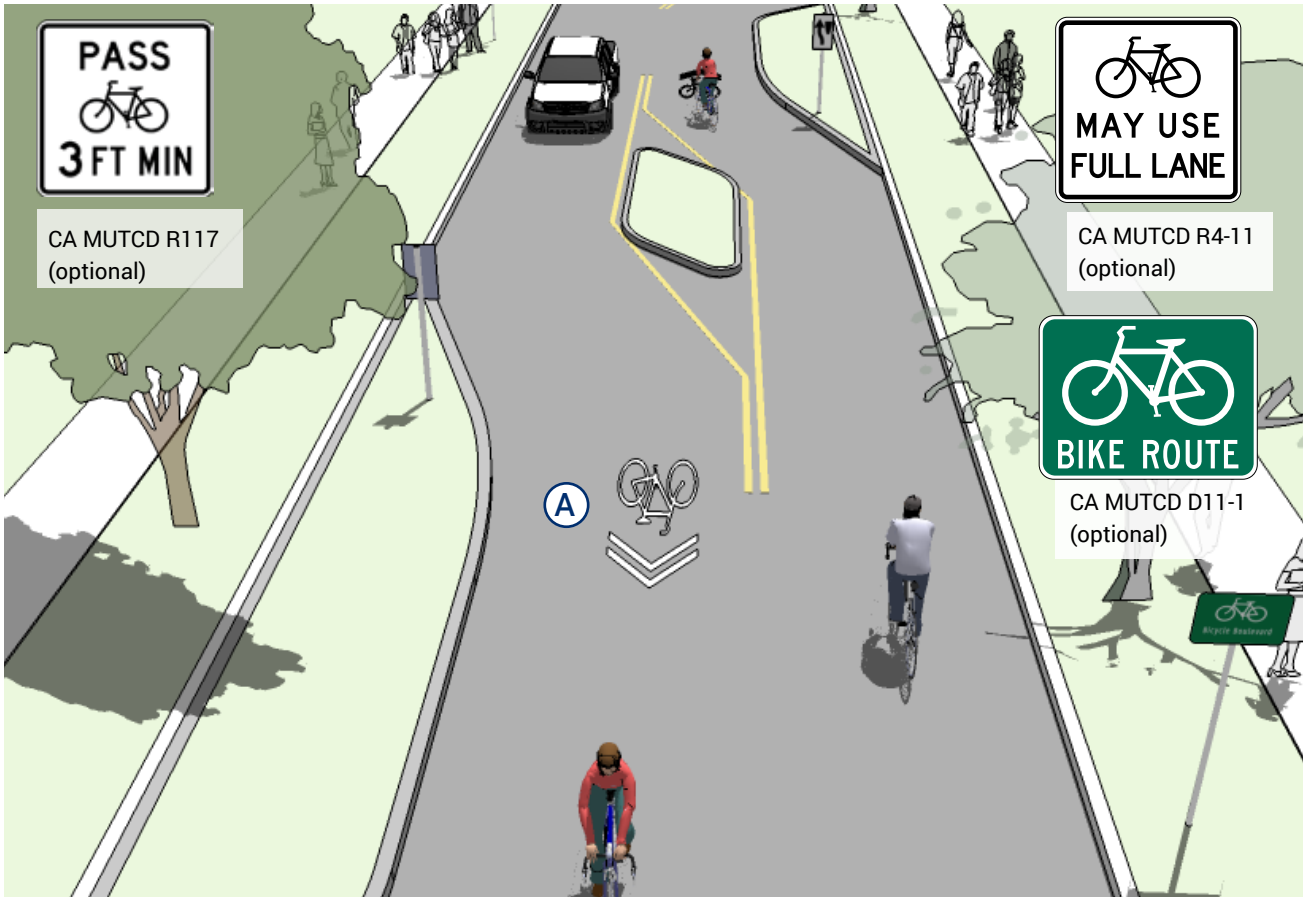
MATERIALS AND MAINTENANCE

Road re-configurations are often paired with the road repaving schedule to reduce costs, as paving projects already require removal and re-installation of roadway striping and markings. Ongoing maintenance needs would be the same as other signing and striping installations.

Before-and-after road reconfiguration on Laurel Lane in San Luis Obispo. General Flow lanes were narrowed to make way for a bike lane while retaining parking.

Shared Lane Markings

Shared Lane Marking (SLM) or "Sharrow" stencils are lane positioning stencils that can enhance shared roadways. The CA MUTCD approved pavement marking can serve a number of purposes, such as making motorists aware of the need to share the road with bicyclists, showing bicyclists the direction of travel, and, with proper placement, reminding bicyclists to bike further from parked cars to prevent collisions with drivers opening car doors.



TYPICAL USE

- Shared Lane Markings are not appropriate on paved shoulders or in bike lanes, and should not be used on roadways that have a posted speed greater than 25 mph.
- Shared Lane Markings should be implemented in conjunction with BIKES MAY USE FULL LANE signs.

DESIGN FEATURES

(A) Placement in the center of the travel lane is generally preferred. When placed adjacent to parking, markings should be 3-4 feet from the parking lane, outside of the "door zone". As a rule of thumb, minimum placement is centered 11-12 feet from the curb face with on-street parking and 4-5 feet from the curb with no parking.

- Markings should be placed immediately after intersections and spaced at 250-foot intervals thereafter.

Sharrows also serve as positional guidance and raise bicycle awareness where there isn't space to accommodate a full-width bike lane.

FURTHER CONSIDERATIONS

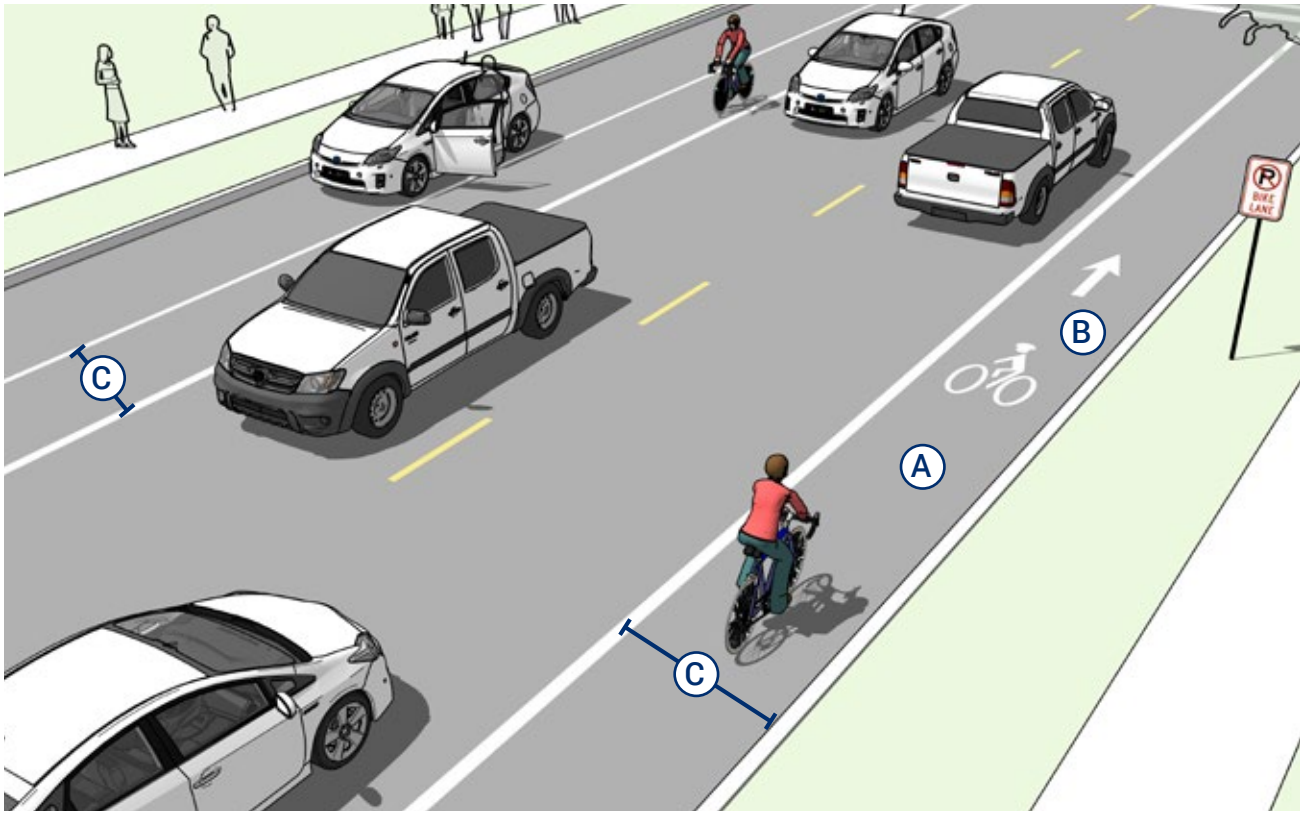
- Consider modifications to signal timing to induce a bicycle-friendly travel speed for all users.
- Though not always possible, placing the markings outside of vehicle tire tracks will increase the life of the markings and the long-term cost of the treatment. That said, bicyclist safety should be the primary factor when determining placement of shared lane markings.
- A green thermoplastic background can be applied to further increase the visibility of the shared lane marking.
- A "Pass Bicycle 3 FT MIN" sign (R117(CA)) can be installed to indicate to drivers the required passing distance per California Vehicle Code section 21760.
- A "BIKES MAY USE FULL LANE" sign (R4-11) should be installed to further educate all roadway users.

MATERIALS AND MAINTENANCE

- Shared lane markings should be inspected annually and maintained accordingly, especially if located on roadways that feature high vehicle turning movements, or bus, or truck traffic.

Bicycle Lanes

On-street bike lanes (Class II Bikeways) designate an exclusive space for bicyclists through the use of pavement markings and signs. The bike lane is located directly adjacent to motor vehicle travel lanes and is used in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge or parking lane.



TYPICAL USE

- Bike lanes may be used on any street with adequate space but are most effective on streets with moderate traffic volumes ≤ 6,000 ADT (≤ 3,000 preferred).
- Bike lanes are most appropriate on streets with lower to moderate speeds ≤ 25 mph.
- Appropriate for skilled adult riders on most streets.
- May be appropriate for children when configured as 6+ ft wide lanes on lower-speed, lower-volume streets with one lane in each direction.

DESIGN FEATURES

(A) Mark inside line with 6" stripe. **(CA MUTCD 9C.04)** Where parking lanes exist, mark 4" parking lane line or "Ts".[1]

(B) Include a bicycle lane marking **(CA MUTCD Figure 9C-3)** at the beginning of blocks and at regular intervals along the route. **(CA MUTCD 9C.04)**

(C) Bike lane widths range from 5-8 feet, depending on location. See page 19 for City Standard bike lane widths.

Include the "Bike Lane" (R81(CA)) sign at the beginning and along each bicycle lane at all major changes in direction.

1 Studies have shown that marking the parking lane encourages people to park closer to the curb. FHWA. Bicycle Countermeasure Selection System. 2006.

FURTHER CONSIDERATIONS

- It may be desirable to reduce the width of general-purpose travel lanes in order to add or widen bicycle lanes. (HDM 301.2 3)
- On multi-lane streets, the most appropriate bicycle facility to provide for user comfort may be buffered bicycle lanes or physically separated bicycle lanes.

MANHOLE COVERS AND GRATES:

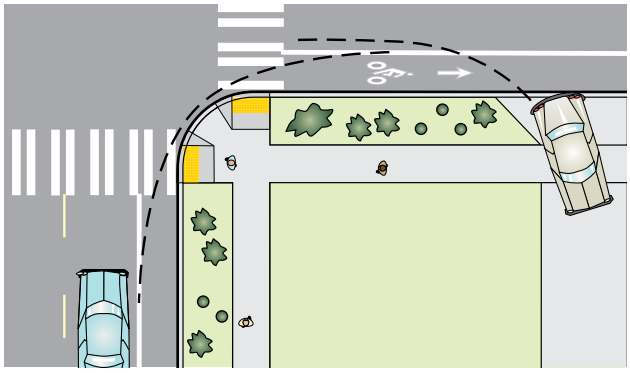
- Manhole surfaces should be manufactured with a shallow surface texture in the form of a tight, nonlinear pattern
- If manholes or other utility access boxes are to be located in bike lanes within 50 ft. of intersections or within 20 ft. of driveways or other bicycle access points, special manufactured permanent nonstick surfaces are required to ensure a controlled travel surface for cyclists breaking or turning.
- Manholes, drainage grates, or other obstacles should be set flush with the paved roadway. Roadway surface inconsistencies pose a threat to safe riding conditions for bicyclists. Construction of manholes, access panels or other drainage elements should be constructed with no variation in the surface.

MATERIALS AND MAINTENANCE

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should also be maintained so that there are no potholes, cracks, uneven surfaces or debris and are within roadway surface tolerances.

Standard Class II Bike Lane



Place Bike Lane Symbols to Reduce Wear

Bike lane word, symbol, and/or arrow markings **(MUTCD Figure 9C-3)** *shall be placed outside of the motor vehicle tread path in order to minimize wear from the motor vehicle path.* **(NACTO 2012)**

Buffered Bicycle Lanes

Buffered bike lanes are conventional bicycle lanes paired with a designated striped buffer space, separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane.

TYPICAL USE

- Anywhere a conventional bike lane is being considered.
- While conventional bike lanes are most appropriate on streets with lower to moderate speeds (≤ 25 mph), buffered bike lanes are appropriate on streets with higher speeds (+25mph) and high volumes or high truck volumes (up to 6,000 ADT).
- On streets with extra lanes or lane width.
- Appropriate for skilled adult riders on most streets.

DESIGN FEATURES

(A) Buffer may be included within the bike lane paved width for widths greater than 6.5 feet.

(B) Buffers should be at least 2 feet wide. If buffer area is 4 feet or wider, white chevron markings should be used. (CA MUTCD 9C-104)

- For clarity at driveways or minor street crossings, consider a dashed line.
- There is no standard for whether the buffer is configured on the parking side, the travel side, or a combination of both. The facility designer shall consider which sides of the facility to buffer based on context.

Buffered bike lanes transition into conflict markings. The use of additional pavement markings delineates space between vehicles and cyclists.

FURTHER CONSIDERATIONS

- Green pavement may be used within the lane to discourage motorists from entering the buffered lane.
- A study of buffered bicycle lanes found that, in order to make the facilities successful, there needs to also be driver education, improved signage and proper pavement markings.[1]
- On multi-lane streets with high vehicles speeds, the most appropriate bicycle facility to provide for user comfort may be physically separated bike lanes.
- NCHRP Report #766 recommends, when space is limited, installing a buffer space between the parking lane and bicycle lane where on-street parking is permitted rather than between the bicycle lane and vehicle travel lane. [2]

MATERIALS AND MAINTENANCE

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should be maintained so that there are no potholes, cracks, uneven surfaces or debris.

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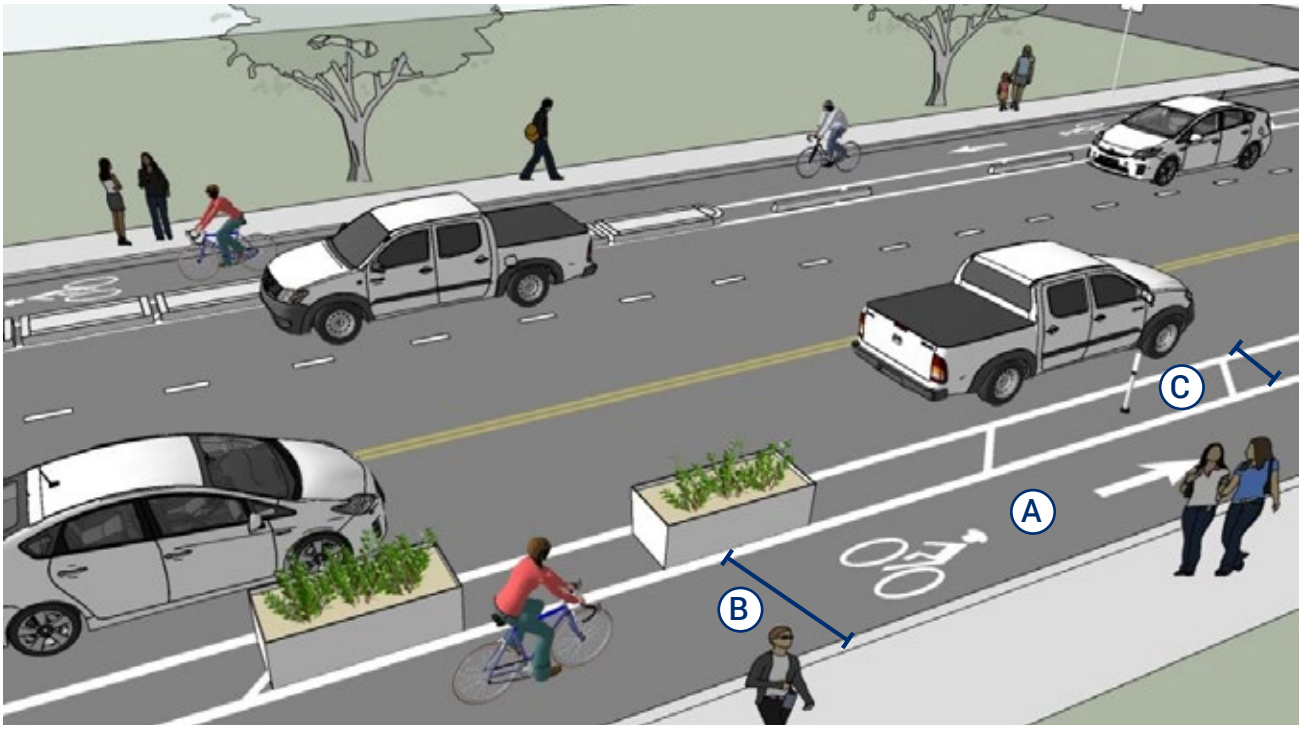
1 Monsere, C.; McNeil, N.; and Dill, J., "Evaluation of Innovative Bicycle Facilities: SW Broadway Cycle Track and SW Stark/Oak Street Buffered Bike Lanes. Final Report" (2011).Urban Studies and Planning Faculty Publications and Presentations.

2 National Cooperative Highway Research Program. Report #766: Recommended Bicycle Lane Widths for Various Roadway Characteristics.

Protected Bike Lanes

Protected bike lanes (Class IV Bikeways), also known as separated bikeways or cycle tracks, are on-street bikeway facilities that are separated from vehicle traffic. Physical separation is provided by a barrier between the bikeway and the vehicular travel lane. These barriers can include flexible posts, bollards, parking, planter strips, extruded curbs, or on-street parking. Separated bikeways using these barrier elements typically share the same elevation as adjacent travel lanes, but the bikeway could also be raised above street level, either below or equivalent to sidewalk level.



TYPICAL USE

- Along streets on which conventional bicycle lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high bicycle volumes, high motor traffic volumes (6,000-30,000 ADT), higher traffic speeds (25+ mph), high incidence of double parking, higher truck traffic (10% of total ADT) and high parking turnover.
- Considerations for mitigation of intersection conflicts.

DESIGN FEATURES

(A) Pavement markings, symbols and/or arrow markings must be placed at the beginning of the separated bikeway and at intervals along the facility based on engineering judgment to define the bike direction. (CA MUTCD 9C.04)

(B) 8-foot width preferred in areas with high bicycle volumes or uphill sections to facilitate safe passing behavior.

(C) 3-foot minimum buffer width adjacent to parking lines (2 foot minimum when adjacent to travel lanes), marked with 2 solid white (DIB 89, 2015). See page 19 for City Standard widths.

Parked cars serve as a barrier between bicyclists and the vehicle lane. Barriers could also include flexible posts, bollards, planters, or other design elements Source: Bike East Bay.

FURTHER CONSIDERATIONS

- Protected bike lane buffers and barriers are covered in the CAMUTCD as preferential lane markings (section 3D.01) and channelizing devices (section 3H.01). If the buffer area is 4 feet or wider, white chevron or diagonal markings should be used (section 9C.04). Curbs may be used as a channeling device, see the section on islands (section 3I.01). Grade-separation provides an enhanced level of separation in addition to buffers and other barrier types.
- Where possible, physical barriers such as removable curbs should be oriented towards the inside edge of the buffer to provide as much extra width as possible for bicycle use.
- A retrofit separated bikeway has a relatively low implementation cost compared to road reconstruction by making use of existing pavement and drainage and using a parking lane as a barrier.
- Gutters, drainage outlets and utility covers should be designed and configured as not to impact bicycle travel.
- For clarity at major or minor street crossings, consider a dotted line (CA MUTCD Detail 39A - Bike Lane Intersection Line) for the buffer boundary where cars are expected to cross.
- Special consideration should be given at transit stops to manage bicycle and pedestrian interactions.
- Protected bike lanes should be provided at locations recommended in this Plan and incorporated into new street construction where feasible.
- Special consideration should be given to smooth transitions to other types of bikeway facilities or non-bikeway facilities.

MATERIALS AND MAINTENANCE

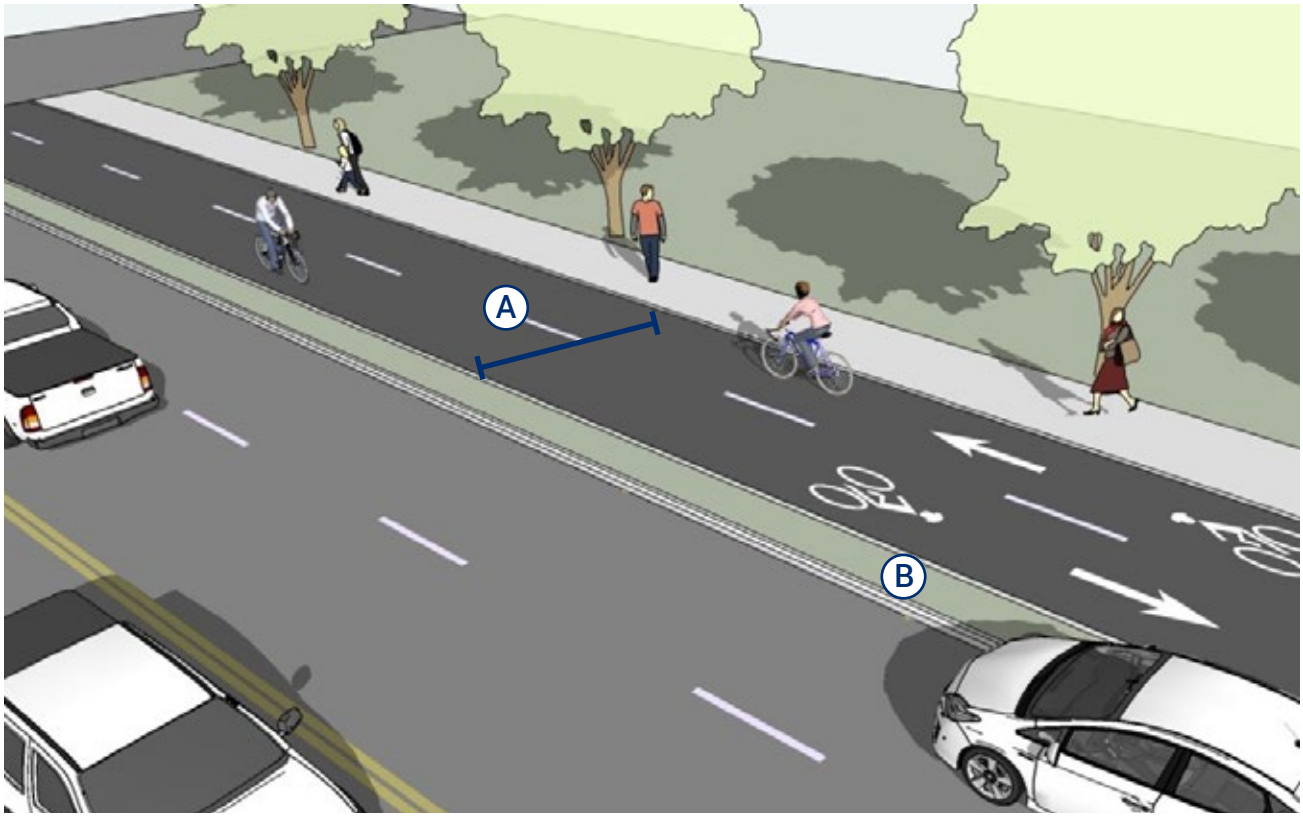
Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeways should be maintained so that there are no potholes, cracks, uneven surfaces or debris.

Access points along the facility should be provided for street sweeper vehicles to enter/exit the protected bike lane.

Protected Bike Lane (Two-Way)

Two-way protected bike lanes (Class IV Bikeways) are bicycle facilities that allow bicycle movement in both directions on one side of the road. Two-way protected bike lanes share some of the same design characteristics as one-way protected bike lanes, but often require additional considerations at driveway and side-street crossings, and intersections with other bikeways.



TYPICAL USE

- Works best on the left side of one-way streets.
- Streets with high motor vehicle volumes and/or speeds and insufficient width for one-way protected bike lanes on each side of the street.
- Streets with high bicycle volumes.
- Streets with a high incidence of wrong-way bicycle riding.
- Streets with few conflicts such as driveways or cross-streets on one side of the street.
- Streets that connect to shared use paths.

DESIGN FEATURES

(A) 12-foot operating width preferred (10 ft minimum) width for two-way facility.

- In constrained locations an 8-foot minimum operating width may be considered (HDM 1003.1(1)).

(B) Adjacent to on-street parking a 3-foot minimum width channelized buffer or island shall be provided to accommodate opening doors (NACTO, 2012) (CA MUTCD 3H.01, 3I.01).

- Additional signalization and signs may be necessary to manage conflicts.

Two-Way Protected Bikeway

A two-way facility can accommodate cyclists in two directions of travel.

FURTHER CONSIDERATIONS

- On-street bike lane buffers and barriers are covered in the CA MUTCD as preferential lane markings (section 3D.01) and channelizing devices, including flexible delineators (section 3H.01). Curbs may be used as a channeling device, see the section on islands (section 3I.01).
- A two-way protected bike lane on one-way street should be located on the left side.
- A two-way protected bike lane may be configured at street level or as a raised separated bikeway with vertical separation from the adjacent travel lane.
- Two-way protected bike lanes should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles.
- See Caltrans Design Information Bulletin No. 89 for more details.

MATERIALS AND MAINTENANCE

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Protected bike lanes should be maintained so that there are no potholes, cracks, uneven surfaces or debris.

Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

Advisory Bike Lanes

Roads with advisory bike lanes accommodate low to moderate volumes of two-way motor vehicle traffic and provide a prioritized space for bicyclists with little or no widening of the paved roadway surface. An approved Request to Experiment is required for implementation, called "dashed bicycle lanes" in the FHWA experimentation process.

TYPICAL USE

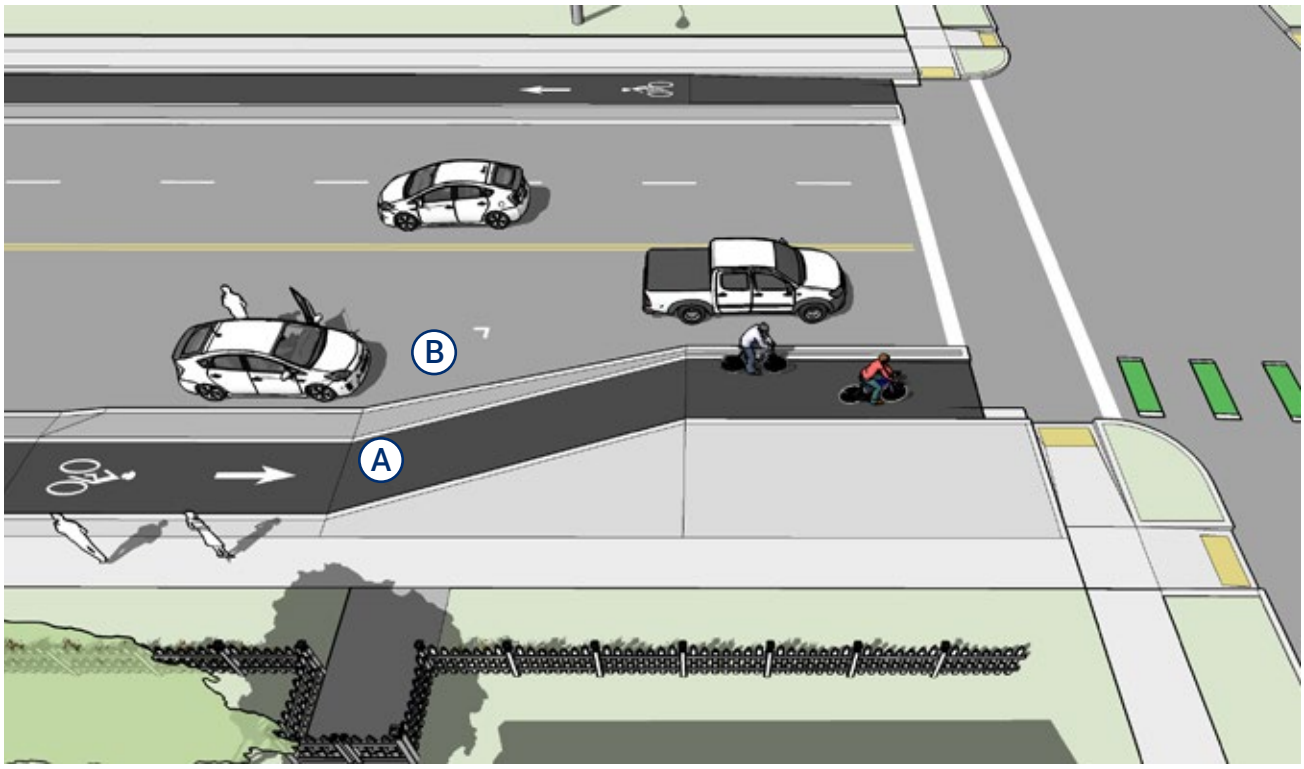
- Most appropriate on streets with low to moderate volumes and moderate speed motor vehicles where there is insufficient width for standard bike lanes.
- Roadways in built-up areas with constrained connections, bicycle and pedestrian demand, and limited available paved roadway space.
- Advisory bike lane designs work best on road segments without frequent stop or signal-controlled intersections.

DESIGN FEATURES

- The preferred width of the advisory bike lane space is 6 ft. See page 19 for City Standard widths.
- Consider using contrasting paving materials between the advisory bike lane and center travel lane to differentiate the advisory bike lane from the center two-way travel lane in order to minimize unnecessary encroachment and reduce regular straddling of the advisory bike lane striping.
- Preferred two-way center travel lane width is 13.5–16 ft although may function with widths of 10–18 ft. (Small and Rural Multimodal Networks Report, Table 2-2)

Bend-In

To increase the visibility of bicyclists for turning motorists, a "bend-in" intersection approach laterally shifts the separated bikeway immediately adjacent to the turning lane.



TYPICAL USE

- Bikeways separated by a visually intensive buffer or on-street parking.
- Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.
- Where space is not available to bend-out the bikeway prior to the intersection.

DESIGN FEATURES

(A) At least 20 ft prior to an intersection, provide between 20 – 40 ft of length to shift the bikeway closer to motor vehicle traffic.

(B) Where the separated bikeway uses parked cars within the buffer zone, parking must be prohibited at the start of the transition.

- Place a "Turning Vehicles Yield to Bikes" sign (modified MUTCD R10-15) prior to the intersection.
- Optional - Provide a narrow buffer with vertical delineators between the travel lane and bikeway to increase comfort for bicycle riders and slow driver turning speed.

Clear sight lines at intersections and driveways for people on bikes and people driving are an important aspect of this design.

The approach to an adjacent crossing intersection in Vancouver, BC.

FURTHER CONSIDERATIONS

- The design creates an opportunity for a curb extension, to reduce pedestrian crossing distance. This curb extension can also create public space which can be used bike parking corrals, bikeshare stations, parklets, public art exhibits, and/or stormwater features such as bioswales.
- Can be paired with intersection crossing markings such as green colored pavement to raise awareness of conflict points.
- Designers should consider that large shrubs, trees, or other items placed on the buffer may obstruct motor vehicle driver site-lines towards users of the bicycling facility, causing potential conflicts for right turning motor vehicle traffic.

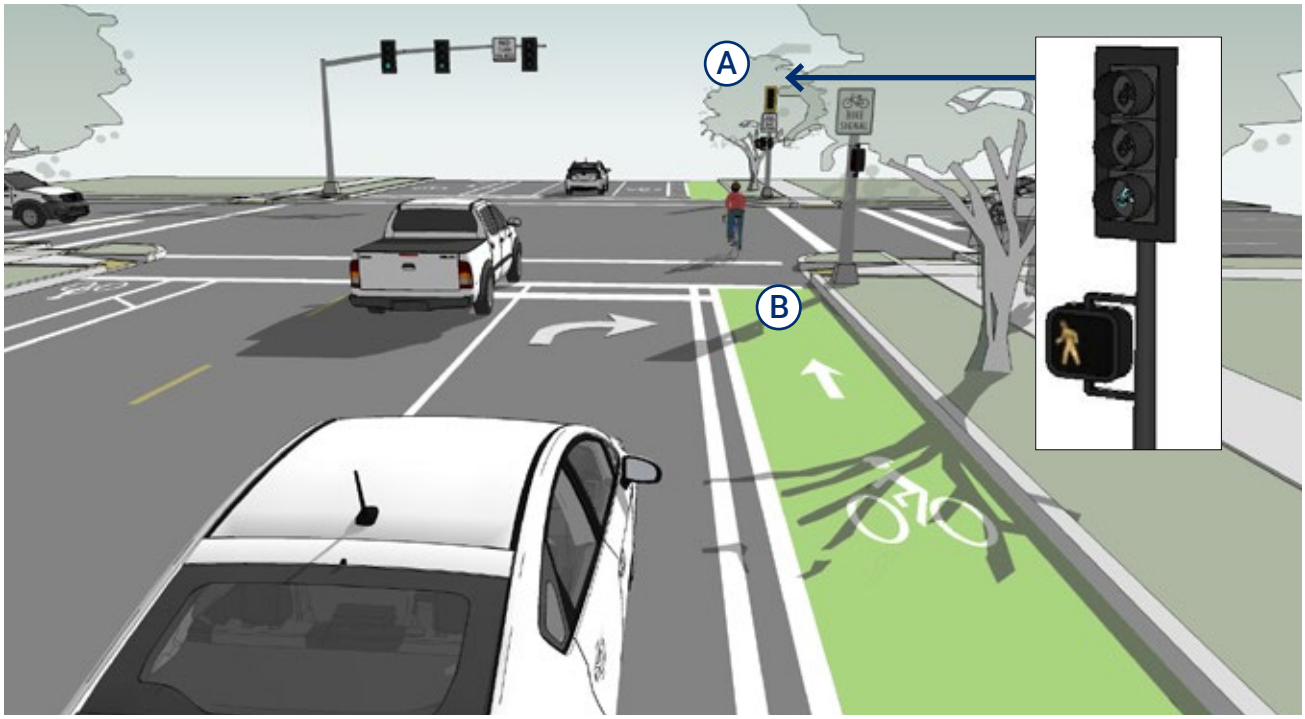
MATERIALS AND MAINTENANCE

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeway should be maintained so that there are no potholes, cracks, uneven surfaces or debris.

Separated Bicycle Signal Phase

Separated bicycle lane crossings of signalized intersections can be accomplished through the use of a bicycle signal phase which reduces conflicts with motor vehicles by separating bicycle movements from any conflicting motor vehicle movements. Bicycle signals are traditional three lens signal heads with green, yellow and red bicycle stenciled lenses.



TYPICAL USE

- Two-way protected bikeways where contraflow bicycle movement or increased conflict points warrant protected operation.
- Intersections with heavy right-turn volumes conflicting with bicycle crossings.
- Where shared-use pathways approach signalized intersections.

DESIGN FEATURES

(A) An additional "Bicycle Signal" sign should be installed below the bicycle signal head.

(B) Designs for bicycles at signalized crossings should allow bicyclists to trigger signals via pushbutton, loop detectors, or other passive detection, to navigate the crossing.

- On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists. (CA MUTCD 9D.02)

A bicycle signal head at a signalized crossing creates a protected phase for cyclists to safely navigate an intersection.

A bicycle detection system triggers a change in the traffic signal when a bicycle is detected.

FURTHER CONSIDERATIONS

- A bicycle signal should be considered for use only when the volume/collision or volume/geometric warrants have been met or based on engineering judgement. (CA MUTCD 4C.102)
- Bicycle scramble phases and bicycle signals are identified in NACTO guidance and used successfully in many cities in the USA.
- Right (or left) turns on red should be prohibited in locations where such operation would conflict with a green bicycle signal indication.
- Bicyclists moving on a green or yellow signal indication in a bicycle signal shall not be in conflict with any simultaneous motor vehicle movement at the signalized location.
- Bicyclists typically need more time to travel through an intersection than motor vehicles. Green light times should be determined using the bicycle crossing time for standing bicycles.
- Bicycle detection and actuation systems include user-activated buttons mounted on a pole, loop detectors that trigger a change in the traffic signal when a bicycle is detected and video detection cameras, that use digital image processing to detect a change in the image at a location.

MATERIALS AND MAINTENANCE

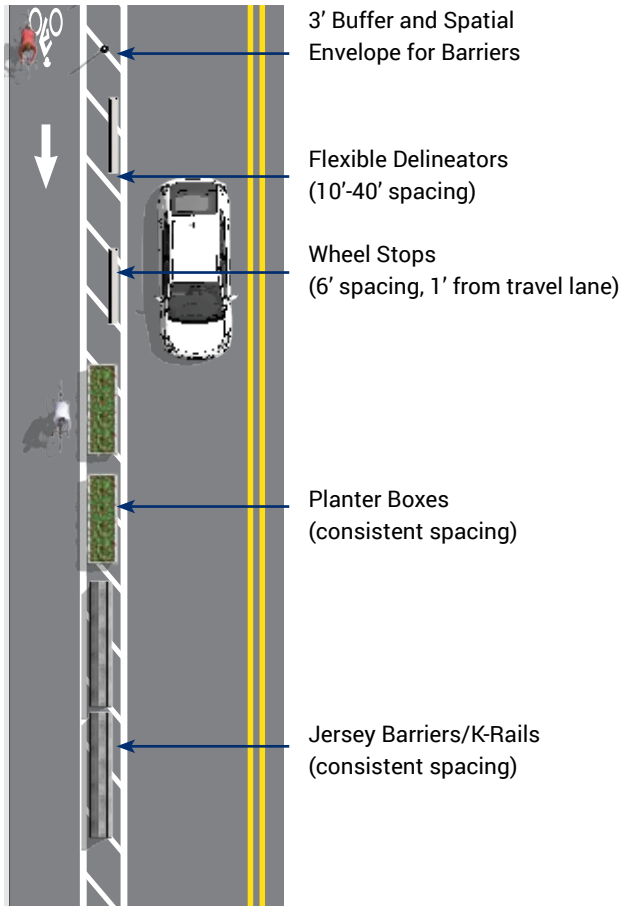
Bicycle signal detection equipment should be inspected and maintained regularly, especially if detection relies on manual actuation.

Pushbuttons and loop detectors will tend to have higher maintenance needs than other passive detection equipment.

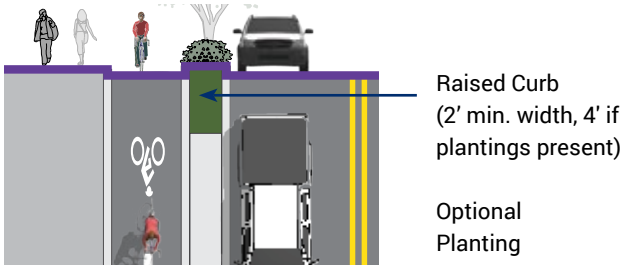
Protected Bikeway Barriers

Protected bikeways may use a variety of vertical elements to physically separate the bikeway from adjacent travel lanes. Barriers may be robust constructed elements such as curbs, or may be more interim in nature, such as flexible delineator posts.

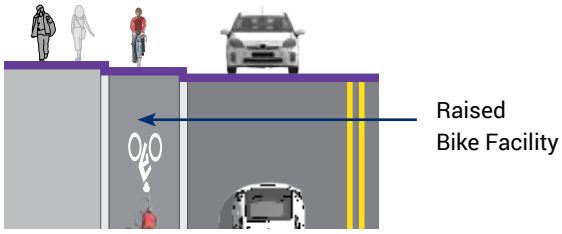
Barrier Protected



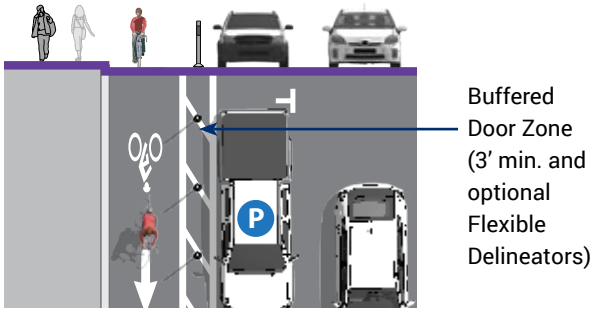
Median Protected



Grade Protected



Parking Protected



TYPICAL USE

Appropriate barriers for retrofit projects:

- Parked Cars
- Flexible delineators
- Bollards
- Planters
- Parking stops

Appropriate barriers for reconstruction projects:

- Curb separation
- Medians
- Landscaped Medians
- Raised protected bike lane with vertical or mountable curb
- Pedestrian Refuge Islands

Raised separated bikeways are bicycle facilities that are vertically separated from motor vehicle traffic.

DESIGN FEATURES

- Maximize effective operating space by placing curbs or delineator posts as far from the through bikeway space as practicable.
- Allow for adequate shy distance of 1 to 2 feet minimum from vertical elements to maximize useful space.
- When next to parking allow for 3 feet of space in the buffer space to allow for opening doors and passenger unloading.
- The presences of landscaping in medians, planters and safety islands increases comfort for users and enhances the streetscape environment.

FURTHER CONSIDERATIONS

- Separated bikeway buffers and barriers are covered in the CA MUTCD as preferential lane markings (section 3D.01) and channelizing devices (section 3H.01). Curbs may be used as a channeling device, see the section on islands (section 3I.01).
- With new roadway construction a raised separated bikeway can be less expensive to construct than a wide or buffered bicycle lane because of shallower trenching and sub-base requirements.
- Parking should be prohibited within 30 feet of the intersection to improve visibility.

MATERIALS AND MAINTENANCE

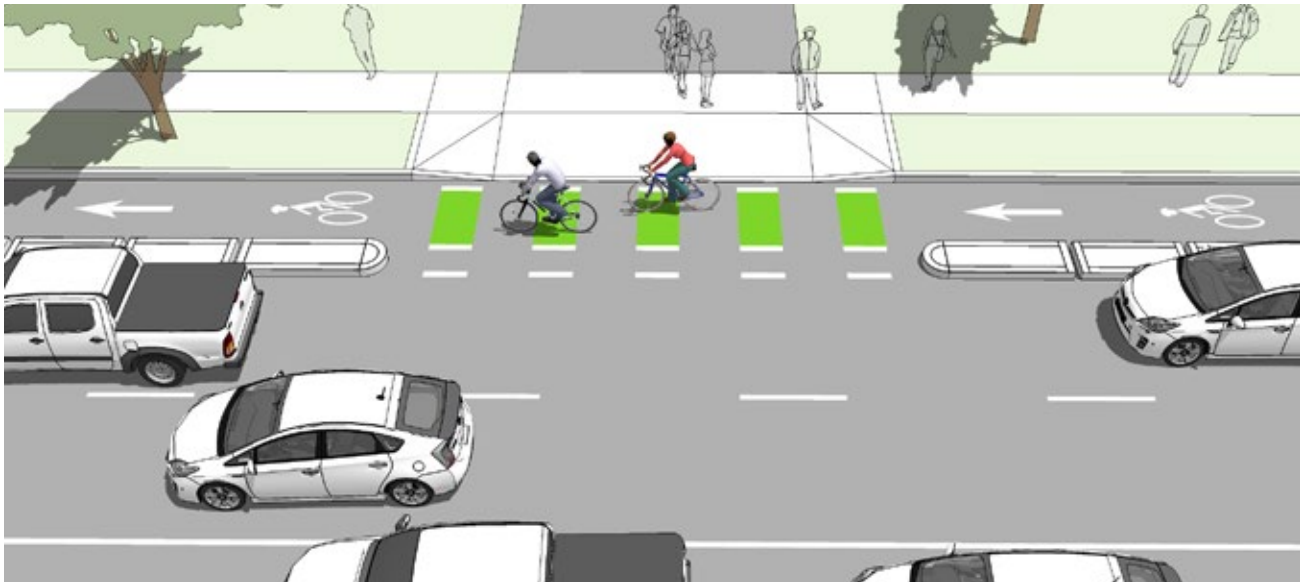
Separated bikeways protected by concrete islands or other permanent physical separation, can be swept by smaller street sweeper vehicles.

Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

Protected Bike Lanes at Driveways and Minor Streets

The added separation provided by protected bike lanes creates additional considerations at intersections and driveways when compared to conventional bicycle lanes. Special design guidelines are necessary to preserve sightlines and denote potential conflict areas between modes, especially when motorists turning into or out of driveways may not be expecting bicycle travel opposite to the main flow of traffic.

At driveways and crossings of minor streets, bicyclists should not be expected to stop if the major street traffic does not stop.



TYPICAL USE

- Along streets with protected bike lanes where there are intersections and driveways.
- Higher frequency driveways or crossings may require additional treatment such as conflict markings and signs.

DESIGN FEATURES

- Remove parking to allow for the appropriate clear sight distance before driveways or intersections to improve visibility. The desirable no-parking area is at least 30 feet from each side of the crossing.
- Use colored pavement markings and/or shared line markings through conflict areas at intersections.
- If a raised protected bike lane is used, the height of the lane should be maintained through the crossing, requiring automobiles to cross over.
- Motor vehicle traffic crossing the bike lane should be constrained or channelized to make turns at sharp angles to reduce travel speed prior to the crossing.
- Driveway crossings may be configured as raised crossings to slow turning cars and assert physical priority of travelling bicyclists.
- Motor vehicle stop bar on cross-streets and driveways is setback from the intersection to ensure that drivers slow down and scan for pedestrians and bicyclists before turning.

Intersection crossing markings can be used at high volume driveway and minor street crossings, as illustrated above.

FURTHER CONSIDERATIONS

- Removing obstructions and providing clear sight distance at crossings increases visibility of bicyclists.
- Treatments designed to constrain and slow turning motor vehicle traffic will slow drivers to bicycle-compatible travel speeds prior to crossing the protected bike lane.

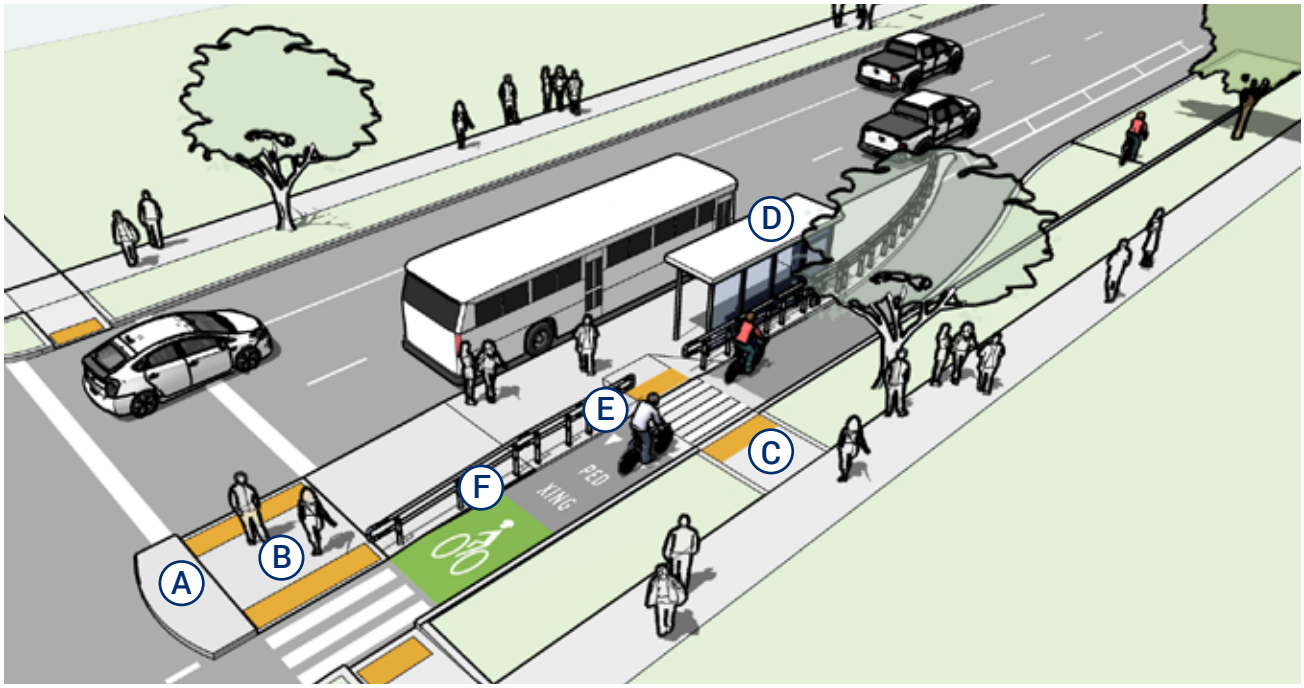
MATERIALS AND MAINTENANCE

Green conflict striping and markings, will require higher maintenance where vehicles frequently traverse over them at driveways and minor intersection. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Protected Bike Lanes at Transit Stops

A transit side boarding island is a channelized lane for bicyclists designed to provide a path for bicyclists to pass stopped transit vehicles, and clarify interactions between pedestrians, bicyclists, and passengers, boarding and alighting.

This is particularly helpful on corridors with high volumes of transit vehicles and bicyclists, where "leapfrogging" may occur, and on protected bike lane corridors where maintaining physical separation is important to maintain user comfort.



TYPICAL USE

- Routes where bike lanes or protected bike lanes and transit operations overlap.
- Provides an in-lane stop for buses, reducing delay at stops.
- Median refuge also provides a shorter crossing for pedestrians at intersections

DESIGN FEATURES

(A) Pedestrian median refuge island (optional) shortens the crossing distance at intersections.

(B) Pedestrian ramp into crosswalks should be ADA compliant with detectable warning surfaces.

(C) Direct pedestrians to crossing locations to minimize conflicts between modes.

(D) High volume stops should have room for appropriately sized shelters and transit amenities.

(E) Pavement markings and signage should clarify expectations among users. The bikeway could also ramp up to sidewalk level at this crossing to reduce bicycle speeds and enhance ADA access to the stop.

(F) Pavement markings on the bikeway should define the bicycle path of travel to minimize intrusion by pedestrians, except at designated crossings.

A transit side boarding island clarifies user spaces and minimizes conflict between bicyclists. pedestrians, transit passengers, buses, and vehicles.

FURTHER CONSIDERATIONS

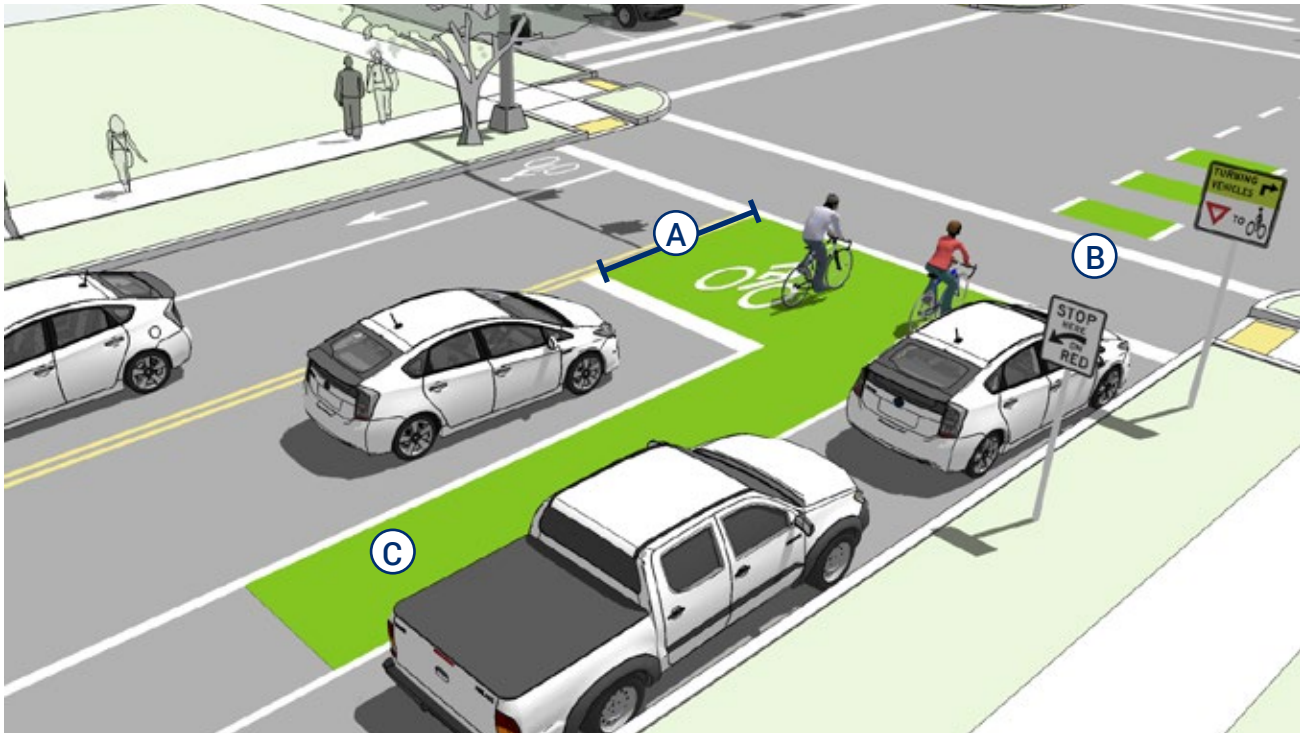
- Transit island should be wide enough to accommodate mobility devices. An 8'x5' accessible clear space is required at the front door per ADA requirements.
- Transit platforms should feature pedestrian scale lighting.
- Side boarding island will require detectable warning surfaces along full length of platform if greater than 6" high.

MATERIALS AND MAINTENANCE

Similar to median refuge islands, side boarding islands may require frequent maintenance of road debris. If at street grade, the bikeway can be swept by street sweeper vehicles with narrow widths.

Bicycle Box

A bicycle box is designed to provide bicyclists with a safe and visible space to get in front of queuing traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box. On a green signal, all bicyclists can quickly clear the intersection.



TYPICAL USE

- At potential areas of conflict between bicyclists and turning vehicles, such as a right or left turn locations.
- At signalized intersections with high bicycle volumes.
- At signalized intersections with high vehicle volumes.
- Not to be used on downhill approaches to minimize the right hook threat potential during the extended green signal phase.

DESIGN FEATURES

(A) 14 foot minimum depth from back of crosswalk to motor vehicle stop bar. **(NACTO, 2012)**

(B) A "No Turn on Red" **(CA MUTCD R10-11)** or "No Right Turn on Red" **(CA MUTCD R13A)** sign shall be installed overhead to prevent vehicles from entering the Bike Box. (Refer to CVC 22101 for the signage) A "Stop Here on Red" **(CA MUTCD R10-6)** sign should be post mounted at the stop line to reinforce observance of the stop line.

(C) A 50 foot ingress lane should be used to provide access to the box.

- Use of green colored pavement is recommended.

A bike box allows for cyclists to wait in front of queuing traffic, providing high visibility and a head start over motor vehicle traffic.

FURTHER CONSIDERATIONS

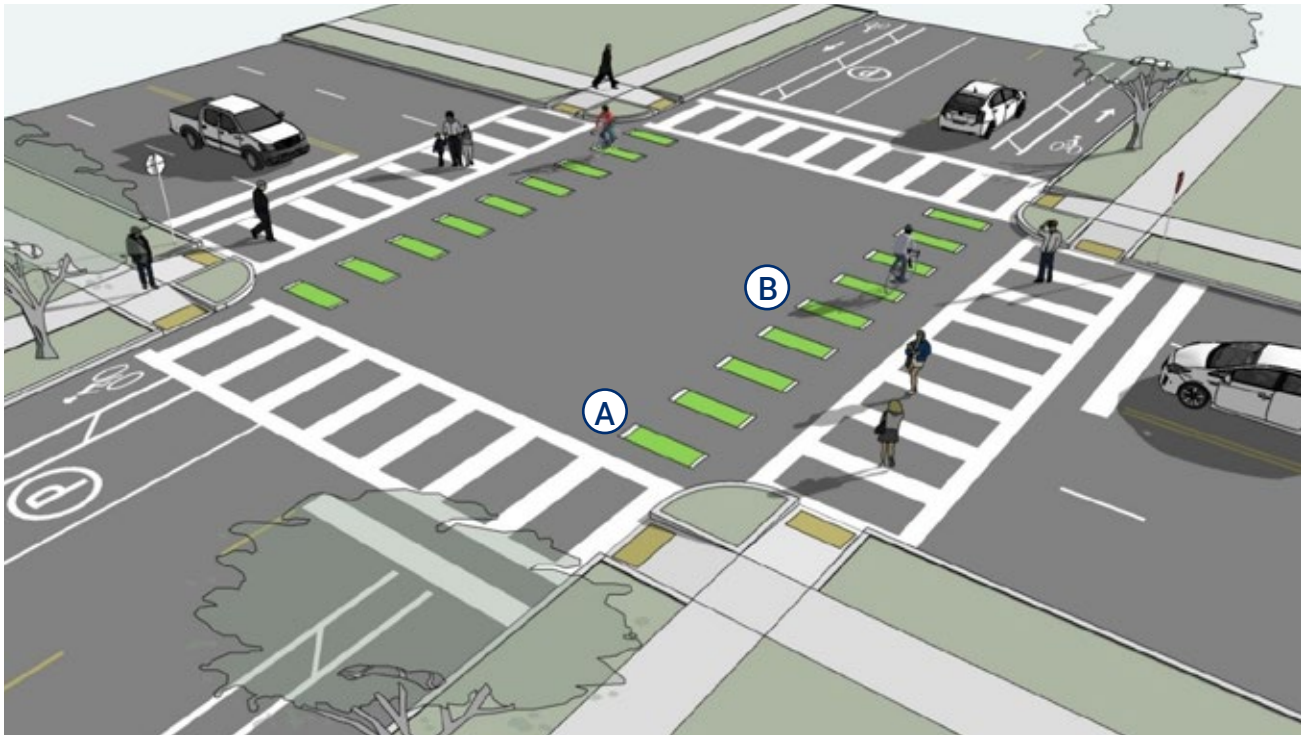
- This treatment positions bicycles together and on a green signal so all bicyclists can quickly clear the intersection, minimizing conflict and delay to transit or other traffic.
- Pedestrians also benefit from bike boxes, as they experience reduced vehicle encroachment into the crosswalk.
- Bike boxes are best used at minor street intersection approaches where users arrive at a red light more often than not. Bike boxes should not be used to accommodate bicyclist turns at intersections that have substantial parallel green time as bicyclists cannot safely occupy the box when arriving on green.

MATERIALS AND MAINTENANCE

Bike boxes are subject to high vehicle wear, especially turning passenger vehicles, buses, and heavy trucks. As a result, bike boxes with green coloring will require more frequent replacement over time. The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic is generally a more durable material than paint.

Colored Pavement Treatment

Colored pavement within a bicycle lane may be used to increase the visibility of the bicycle facility, raise awareness of the potential to encounter bicyclists, and reinforce priority of bicyclists in conflict areas.



TYPICAL USE

- Within a weaving or conflict area to identify the potential for bicyclist and motorist interactions and assert bicyclist priority.
- Across intersections, driveways and Stop or Yield-controlled cross-streets.
- At bike boxes and two-stage turn boxes.

DESIGN FEATURES

(A) Typical white bike lane striping (solid or dotted 6" stripe) is used to outline the green colored pavement.

(B) In weaving or turning conflict areas, preferred striping is dashed, to match the bicycle lane line extensions.

- The colored surface should be skid resistant and retro-reflective **(MUTCD 9C.02.02).**
- In exclusive use areas, such as bike boxes, color application should be solid green.

Green colored conflict striping indicates the typical path of travel of people on bicycles, and alerts people intending to turn across the bike lane to yield when bicyclists are present.

FURTHER CONSIDERATIONS

- Green colored pavement shall be used in compliance with FHWA Interim Approval (FHWA IA-14.10). [1]
- While other colors have been used (red, blue, yellow), green is the recommended color in the US.
- The application of green colored pavement within bicycle lanes is an emerging practice. The guidance recommended here is based on best practices in cities around the county.

MATERIALS AND MAINTENANCE

As intended, paint, thermoplastic, or other materials are placed in locations that are trafficked by vehicles and are subject to high vehicle wear. Colored pavement treatments will experience higher rates of wear at locations with higher turning vehicles, buses, and heavy trucks. At these locations, green coloring will require more frequent replacement over time.

The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic and Methyl Methacrylate (MMA) are more durable materials than paint.

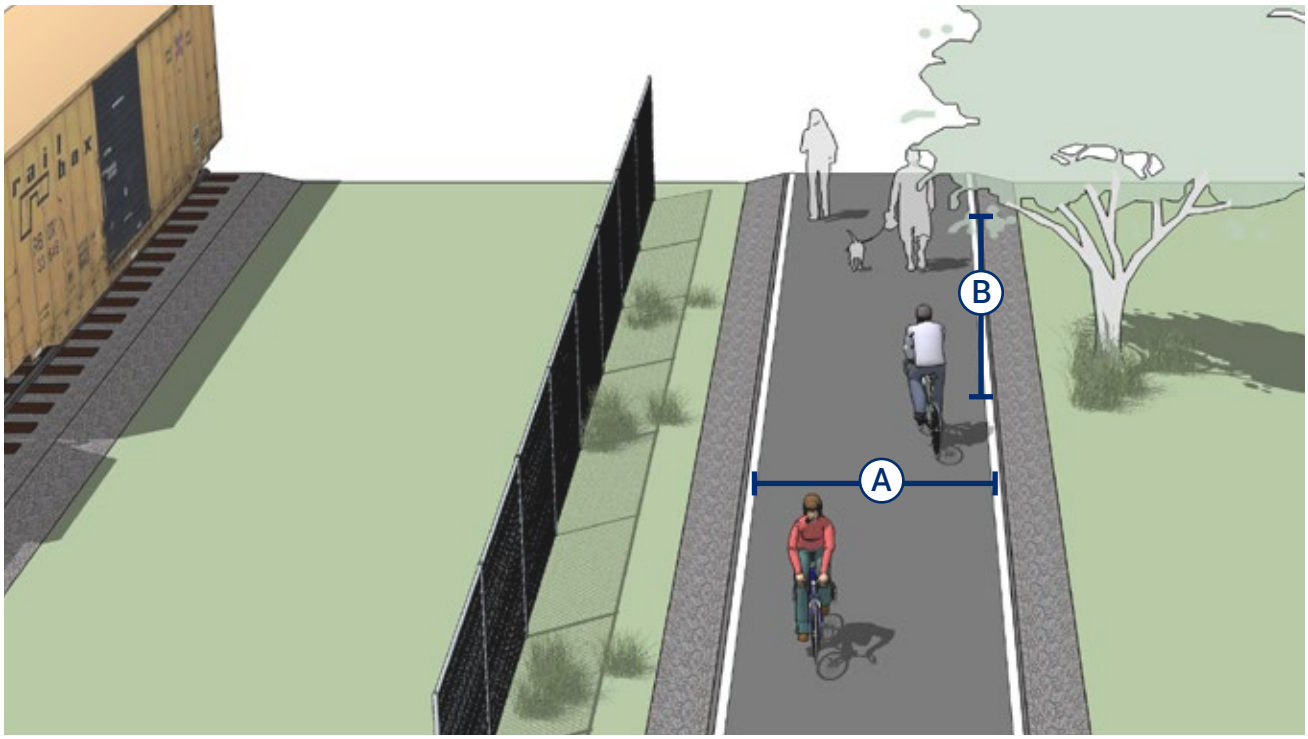
1 FHWA. Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14). 2011.

Section 5

Mixed Use Design Toolbox

Shared Use Path

Shared-Use Paths (Class I Bikeways) are off-street facilities that can provide a desirable transportation and recreation connection for users of all skill levels who prefer separation from traffic. They often provide low-stress connections to local and regional attractions that may be difficult, or not be possible on the street network.



TYPICAL USE

- In abandoned rail corridors (commonly referred to as Rails-to-Trails or Rail-Trails).
- In active rail corridors, trails can be built adjacent to active railroads (referred to as Rails-with-Trails).
- In utility corridors, such as powerline and sewer corridors.
- In waterway corridors, such as along canals, drainage ditches, rivers, and creeks.
- Along roadways.

DESIGN FEATURES

(A) 12 ft is the City Standard minimum width (with 2' ft shoulders) allowed for two-way bicycle and pedestrian use.

Lateral Clearance

(B) A 2 ft or greater shoulder on both sides of the path should be provided. An additional ft of lateral clearance (total of 3') is required by the MUTCD for the installation of signage or other furnishings.

Overhead Clearance

- Clearance to overhead obstructions should be 8 ft minimum, with 10 ft recommended.

Striping

- When striping is required, use a 4-inch dashed yellow centerline stripe with 4-inch solid white edge lines.
- Solid centerlines can be provided on tight or blind corners, and on the approaches to roadway crossings.

FURTHER CONSIDERATIONS

- The provision of a shared- use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes but may be considered in some locations in addition to on-road bicycle facilities.
- To reduce potential conflicts in some situations, it may be better to place one-way side paths on both sides of the street.
- The design of the trail should conform to Crime Prevention Through Environmental Design (CPTED) principles. CPTED is a framework that encourages intuitive visual cues to guide path users, increases the visibility of the corridor and adjacent landmarks and properties, indicates active use and upkeep, and manages conflicting uses, and regular maintenance to prevent improper or illegal uses.

Shared- Use Paths offer pedestrians and bicyclists space to be active away from vehicle traffic. Source: Peter Stetson.

MATERIALS AND MAINTENANCE

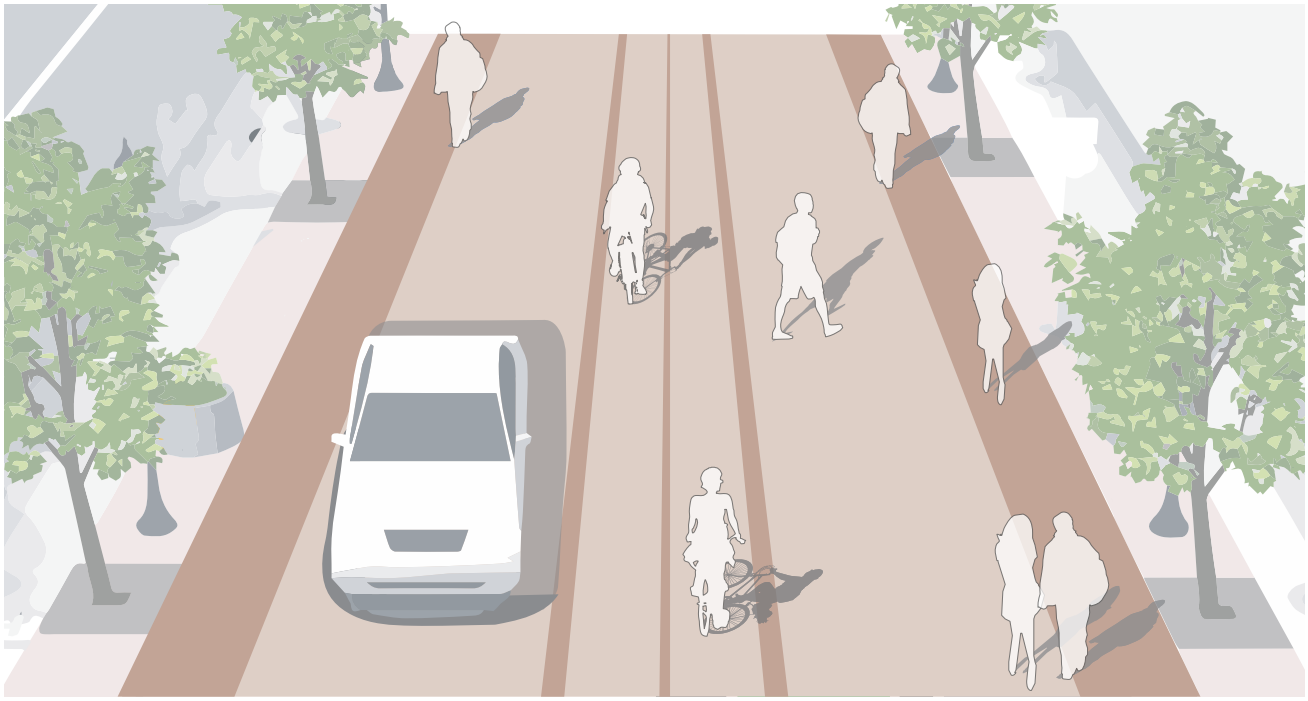
Shared-use paths may be constructed with concrete or asphalt surfaces. Design of path pavement sections should consider if the path must accommodate infrequent heavy vehicle use, such as maintenance or emergency response vehicles.

Shared- use paths must be regularly maintained so that they are free of potholes, cracks, root lift, and debris. Signage and lighting should also be regularly maintained to ensure shared- use path users feel comfortable, especially where visibility is limited.

Adjacent landscaping should be regularly pruned, to allow adequate sightlines, daylight, and pedestrian-scale lighting, and so as not to obstruct the path of travel of trail users.

Shared Street

A shared street, also referred to as a "woonerf", is a street with no designated space for bicyclists, pedestrians or vehicles, however, pedestrian and bicycle travel are prioritized. Shared streets are designed for the speed of pedestrians and bicyclists, and pavement materials, landscaping and amenities communicate that this is not a standard road. Vehicle volumes should be very low with only local vehicles (no through travel) using the street.



TYPICAL USE

- Utilized in areas with high pedestrian activity that need to maintain limited access for vehicles and loading / unloading delivery trucks at designated hours.
- In commercial areas, a shared street environment should be considered in places where pedestrian activity is high and vehicle volumes are either low or discouraged.
- In residential areas, a shared street should be considered in places where sidewalks are limited, pedestrian activity and use of streets as public space is high, and vehicle volumes are low.

DESIGN FEATURES

- Vehicle use should be limited to destinations along the shared street (residences, parking garages, maintenance and emergency access vehicles).
- Vehicle speeds should be no more than 15 mph giving special attention to the safety of pedestrians.
- The entrance to the shared street should be designed so that the shared street is clearly recognizable (through signage, surface material, amenities and landscaping).
- Amenities such as benches, cafe seating, and moveable landscaping elements should be included to communicate the prioritization of pedestrians and bicyclists, but should not restrict visibility.
- A clear width (void of vertical objects) should be provided to ensure emergency vehicle access.

Shared streets in active commercial areas become destinations themselves.

In residential areas, shared streets expand public space and create new places for people to play.

ADDITIONAL REFERENCES AND GUIDELINES

FHWA, Achieving Multimodal Networks: Applying Design Flexibility & Reducing Conflicts, "Shared Streets". 2016.

EXAMPLES

- Jack London Square, Oakland, CA
- Wall Street, Asheville, NC
- Bell Street Park, Seattle, WA
- Old Firehouse Alley, Fort Collins, CO
- Calle Guanajuato, Ashland, OR
- Winthrop Street, Cambridge, MA
- First Street North, Jacksonville Beach, FL

MATERIALS AND MAINTENANCE

Pavement materials should be similar to that of a pedestrian pathway or plaza using concrete, colored concrete, paving stones or similar materials. Pavement materials and depths should be designed to accommodate vehicular travel but should clearly signal to all roadway users that pedestrians have priority.

Neighborhood Greenways

A Neighborhood Greenway, also referred to as a "bicycle boulevard" in some cities, is a low-speed, low-volume roadway that is designed to enhance comfort and convenience for people bicycling and walking. It provides better conditions for bicycling and walking while improving the neighborhood character and maintaining emergency vehicle access. Neighborhood greenways are intended to serve as a low-stress bikeway network, providing direct, and convenient routes across communities. Key elements of neighborhood greenways are unique signage and pavement markings, traffic calming and diversion features to maintain low vehicle volumes, and convenient major street crossings.

TYPICAL USE

- Parallel with, and in close proximity to major thoroughfares (1/4 mile or less) on low-volume, low-speed streets.
- Follow a desire line for bicycle travel that is ideally long and relatively continuous (2-5 miles).
- Avoid alignments with excessive zigzag or circuitous routing. The bikeway should have less than 10% out of direction travel compared to shortest path of primary corridor.
- Local streets with traffic volumes of fewer than 3,000 vehicles per day and posted speed limits of 25 miles per hour. Utilize traffic calming to maintain or establish low volumes and discourage vehicle cut through / speeding.

DESIGN FEATURES

- Signs and pavement markings are the minimum treatments necessary to designate a street as a neighborhood greenway.
- Implement volume control treatments based on the context of the neighborhood greenway, using engineering judgment. While motor vehicle volumes should not exceed 3,000 vehicles per day, ideal conditions are 1,500 vehicles per day or less.
- Intersection crossings should be designed to enhance comfort and minimize delay for bicyclists of diverse skills and abilities

FURTHER CONSIDERATIONS

- Neighborhood greenways are established on streets that improve connectivity to key destinations and provide a direct, low-stress route for bicyclists and pedestrians, with low motorized traffic volumes and speeds, designated and designed to give bicycle and pedestrian travel priority.
- Neighborhood greenway retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists and pedestrians, these intersections can become major barriers along the neighborhood greenway.
- Traffic calming can deter motorists from driving on a street. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.
- The City may choose to use modified sharrow markings on neighborhood greenway routes to further convey priority for bicyclists.

MATERIALS AND MAINTENANCE

Neighborhood greenway require few additional maintenance requirements to local roadways. Signage, signals, and other traffic calming elements should be inspected and maintained according to local standards.

An example of a large pavement marking to reinforce that the street is a neighborhood greenway.

Chockers, planters, and curb extensions can also be used to restrict access to streets providing for slow-speed use instead of cut-through vehicle traffic.

Protected Intersection

A protected intersection, or "Bend Out" crossing, 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 as well as reduce the crossing distance for pedestrians. 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 USE

- Streets with protected bikeways protected by wide buffer or on-street parking.
- Where two protected 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

(A) Setback bicycle crossing of 15-25 feet (19.5 feet preferred) allows for one passenger car to queue while yielding. Smaller setback distance is possible in slow- speed, space constrained conditions.

(B) Corner 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 CONSIDERATIONS

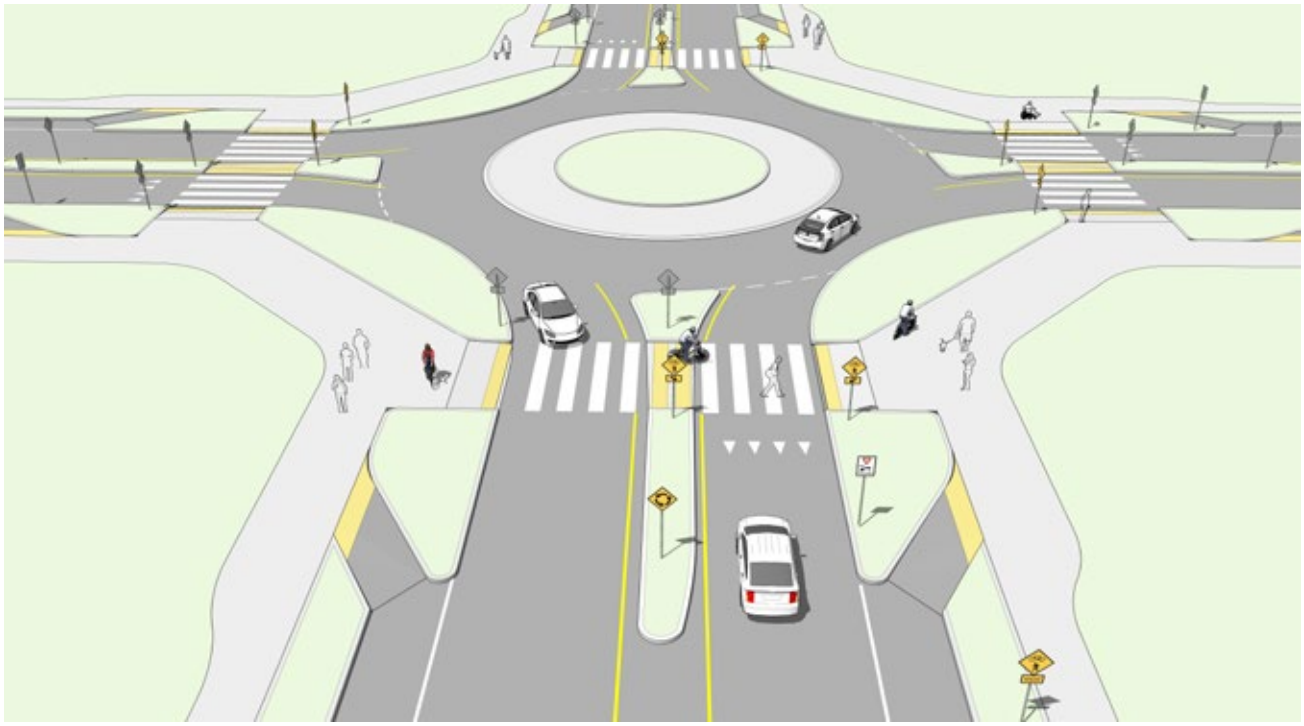
- Pedestrian crosswalks may need to be further set back from intersections in order to make room for two-stage turning queue boxes.
- Wayfinding and directional signage should be provided to help bicycle riders navigate through the intersection.
- Colored pavement may be used within the corner refuge area to clarify use by people bicycling and discourage use by people walking or driving.
- Intersection approaches with high volumes of right turning vehicles should provide a dedicated right turn only lane paired with a protected signal phase. Protected signal phasing may allow different design dimensions than are described here.

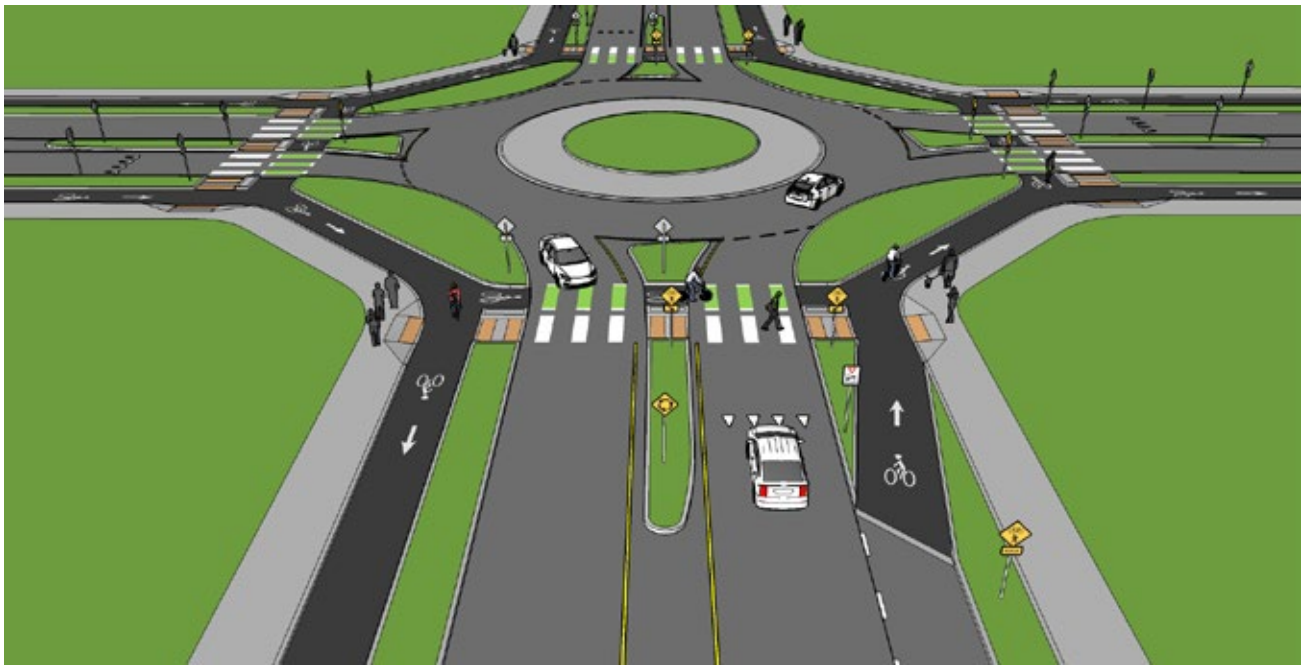
MATERIALS AND MAINTENANCE

- Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.
- Bikeways should be maintained so that there are no potholes, cracks, uneven surfaces or debris.
- Bikeways protected by concrete islands or other permanent physical separation, can be swept by street sweeper vehicles with narrow widths.

Roundabout

Roundabouts are circular intersections designed to eliminate left turns by requiring traffic to exit to the right of the circle. Roundabouts are installed to reduce vehicular speeds; improve safety at intersections through eliminating angle collisions; help traffic flow more efficiently and reduce operational costs when converting from signalized intersections; and help create gateway treatments to signify the entrance of a special district or area. Below are two types of roundabouts each for different roadway types and right-of-way constraints.





TYPICAL USE

Providing safe and comfortable bicycle and pedestrian facilities at roundabouts is important to the City of San Luis Obispo meeting its transportation goals. Where bike lanes approach a roundabout, continuing them through the intersection as separated Class IV bike lanes or terminating them into a Class I shared-use path using bicycle ramps are options.

DESIGN FEATURES

- Roundabouts should be designed for a maximum fastest path vehicle speed of 25mph with low exit speed being of particular importance.
- If separated Class IV bike lanes are used, additional right-of-way may be necessary. Bike lanes should meet design guidelines for that facility type. Sufficient space should be provided (at least 6.5 feet) between the edge of the bike lane and the crossing point to provide sufficient space for a bicyclist to leave the through lane and not block it while maneuvering to cross the roundabout. Signage and crossing markings should be provided to make vehicles aware of their obligation to yield.
- If a Class I shared use path is used, bicycle ramps should be provided at least 50 feet from the pedestrian crossing and should not inadvertently lead visually impaired pedestrians into the bike lane.

FURTHER CONSIDERATIONS

- Multi-lane roundabouts present additional challenges for bicycle and pedestrian safety and comfort as all crossings represent dual-threat conflict risks. PROWAG recommends hybrid beacons be used for pedestrian crossings of more than one lane. In general, multi-lane roundabouts should be discouraged at locations with moderate-to-high bicycle and pedestrian activity.
- Studies of roundabout yielding have shown higher vehicle speeds and much lower yielding when existing the roundabout. Additional consideration should be provided to mitigate this risk.
- Shared lane markings may be used within the circulating lane.