

B . Design Guidelines

This chapter identifies guidelines for the design of bikeways and bicycle parking facilities in the City of Richmond. The appropriate design of bicycle facilities is an integral component of encouraging the public to bicycle for commuting and recreational purposes. Good design affects the experience, enjoyment and comfort for bicyclists, and should ultimately provide the highest level of safety possible for all road and shared-use path users. The Richmond Bike Plan envisions a two-part bike network, a one that accommodates utilitarian trips, such as those between home and work, and one that accommodates recreational trips.

Bikeway planning and design in California typically relies on the guidelines and design standards established by Caltrans and documented in “Chapter 1000: Bikeway Planning and Design” of the Highway Design Manual (California Department of Transportation, 2006). Chapter 1000 follows standards developed by the American

Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) and identifies specific design standards for various conditions and bikeway-to-roadway relationships. These standards provide a good framework for future implementation, but depending on the circumstances may not always be feasible given specific constraints. Likewise, these standards can often be expanded. Whatever the case may be, local jurisdictions must be protected from liability concerns so most agencies adopt the Caltrans or AASHTO standards as a minimum. Caltrans standards provide for three distinct types of bikeway facilities, as generally described below.

This chapter presents design guidelines for the following topics:

Class I Shared-Use Path

- Shared-Use Path Structures
- Crossing Treatments
- Rails-with-Trails
- Path Amenities

Class II Bike Lanes

- Bike lanes next to Parallel Parking
- Bike lanes next to Angled Parking
- Bike lanes Without Parking
- Bike lanes on Hills
- Bike lanes at Intersections
- Bike Lane Markings
- Treatments at Interchanges, Bridges and Tunnels
- Bike Loops and Detectors

Class III Bike Routes

- Bike Boulevards
- Share the Road Markings or “Sharrows”
- “Super Sharrow Lanes”

Bike Parking

- In-Street/Sidewalk Parking
- Bicycle Lockers
- Enclosed Facilities

Bicycle Signage

- Wayfinding/Destination Signage
- Signs for Shared Roadways

Maintenance Standards

- Utility Covers and Construction Plates

Types of Bicycle Facilities

Class I: Bike Path/Shared Use Path

These facilities provide a completely separate right-of-way and are designated for the exclusive use of bicycles and pedestrians with vehicles cross-flow minimized.

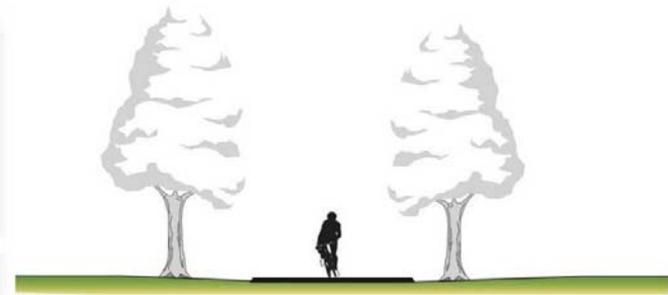
Class II: Bike Lane

Bike lanes provide a restricted right-of-way and are designated for the use of bicycles with a striped lane on a street or highway. Bicycle lanes are generally five feet wide. Vehicle parking and vehicle/pedestrian cross-flow are permitted.

Class III: Bike Route

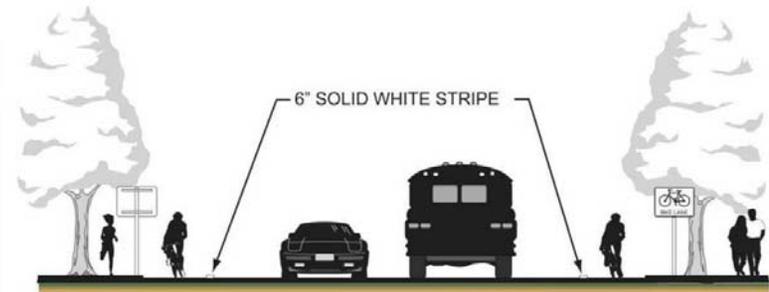
These bikeways provide a right-of-way designated by signs or pavement markings for shared use with pedestrians or motor vehicles.

Figure B-1 | Bikeway facility types



CLASS I BIKEWAY (Bike Path)

Provides a completely separated right-of-way for the exclusive use of bicycles and pedestrians with crossflow minimized.



CLASS II BIKEWAY (Bike Lane)

Provides a striped lane for one-way bike travel on a street or highway.



CLASS III BIKEWAY (Bike Route)

Provides for shared use with pedestrian or motor vehicle traffic.

CLASS I SHARED-USE PATH

Class I bikeways are typically called bike paths, multi-use or shared use paths and are completely separated from roads by a buffers (five feet or more) or barriers. Cross traffic by motor vehicles should be minimized along bike paths to avoid conflicts. Bike paths can offer opportunities not provided by the road system by serving as both recreational areas and/or desirable commuter routes.

According to the AASHTO standards, two-way bicycle paths should be ten feet wide under most conditions, with a minimum two-foot wide graded area on both sides. In constrained areas, an eight-foot wide path may be adequate. Bike paths are usually shared with pedestrians and if pedestrian use is expected to be significant, the path should be greater than ten feet, preferably twelve feet wide.

Where possible, bike paths should have an adjacent four-foot wide unpaved area to accommodate joggers. This jogging path should be placed on the side with the best view, such as adjacent to the waterfront or other vista (see figure on the next page). Where equestrians are expected a separate facility should be provided.

Decomposed granite, which is a better running surface for preventing injuries, is the preferred surface type for side areas and jogging path, while asphaltic concrete or Portland cement concrete should be used for the bike path. A yellow centerline stripe may be used to separate opposite directions of travel. A centerline strip is particularly beneficial to bicycle commuters who may use unlighted bike paths after dark.

Sidewalks and meandering paths are usually not appropriate to serve as bike paths because they are primarily intended to serve pedestrians, generally do not meet Caltrans' design standards, and do not minim-

ize motor vehicle cross flows. Where a shared use path is parallel and adjacent to a roadway, there should be a 5-foot or greater width separating the path from the edge of roadway, or a physical barrier of sufficient height should be installed.

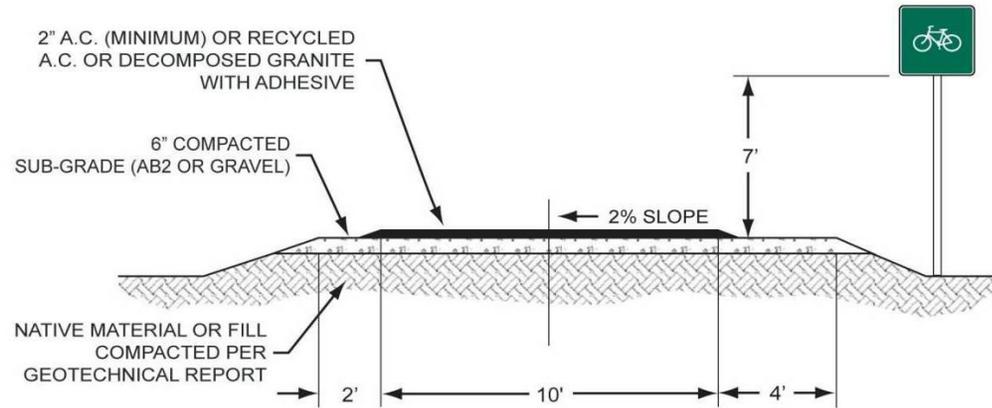
Table B-2 | Standards for Class I Facilities

	AASHTO Standards	Preferred Standards**
Minimum Width	8.0'	10.0'
Vertical Clearance	8.0'	8.0'
Horizontal Clearance	2.0'	3.0'
Maximum Cross Slope	2.0%	2.0%

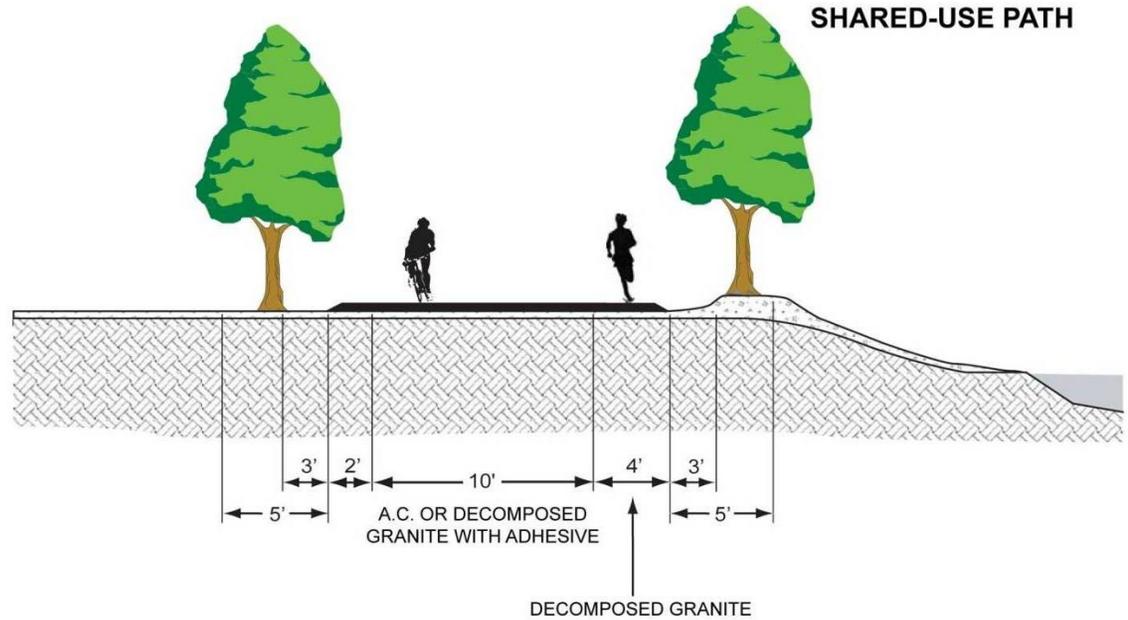
**The City of Richmond should decide what their preferred minimum standards are, and if they should exceed AASHTO standards.

Figure B-2 | Typical Class I path

BIKE PATH



SHARED-USE PATH



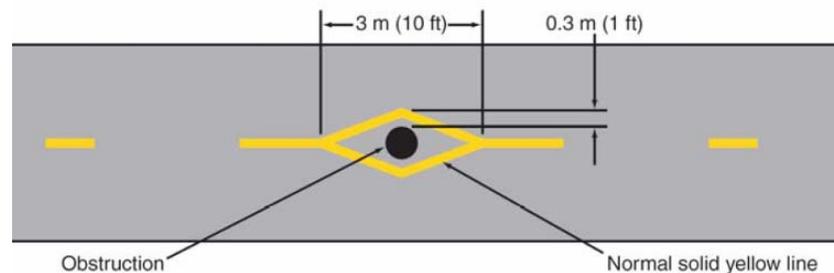
Shared Use Path Structures

The following sections present typical design features found on Class I facilities.

Bollards

Bollards can be placed at bike path access points to separate the path from motor vehicles and to warn and slow bicyclists as they approach street crossings. The diagonal layout of bollards will make the space between the bollards appear narrower, slowing bicyclists and deterring motorcyclists from entering the trail. The bollards are spaced to provide access by people using wheelchairs (generally 5' apart). A trail sign post can be incorporated into the bollard layout. The image below shows the recommended striping and placement for bollards on shared use paths. Careful consideration should be taken before installing bollards as they can become obstacles for bicycles and result in fixed-object collisions. Where need for bollards is a possibility, but uncertain, install bollard-ready infrastructure, but delay installation of the bollard until a need is demonstrated.

Figure B-3 | Typical Bollard Design



Split Trailway

New 2009 California MUTCD standards discourage the use of bollards if other options are practical. If feasible, the path should be split by direction to go around a small center landscape feature. Rather than one 8' or 10' trail, the trail would be split into two 4' or 5' paths. This feature not only narrows the trail and prevent vehicles from entering, but also introduces a lateral shift for cyclists, encouraging slower speeds in conflict zones.

Bridges

Bridges will be required wherever bike paths cross creeks and drainages. Crossings can utilize pre-fabricated bridges made from self-weathering steel with wood decks. Bridges should be a minimum of 8' wide (between handrails) and preferably as wide as the approaching trails. Openings between railings should be 4" maximum. Railing height should be a minimum of 42" high.

Fencing

Fencing may be necessary on some bike paths to prevent path users from trespassing on adjacent lands, or to protect the user from dangerous areas. In areas near railway lines, safety may be a concern. Fencing should maintain safety without compromising security. They should be tall enough to prevent trespassing, but they should maintain clear sight lights from the trail to the adjacent land uses. In areas where private residences are passed, privacy may be a concern. Screen fences should be used to maintain privacy of residents. Screen fences can be made of wood, concrete block or chain link if combined with vine planting. However, if fencing is used, there must be at least 2' of lateral clearance from the edge of the bike path.

Curb ramps

Where curbs are present, curb ramps should be provided and be as wide as the entire path.

Crossing Treatments

The following guidance is derived from the AASHTO *Guide to the Development of Bicycle Facilities*, the City of Seattle's *Bicycle Master Plan*, and the City of San Francisco's *Supplemental Bicycle Design Guidelines*.

Signs on Paths

Some jurisdictions have used STOP signs and BIKES MUST DISMOUNT signs to regulate bike traffic on shared-use paths. These signs are generally ineffective and result in frequent violations and disregard for other types of path signage.

Shared-use path crossings come in many configurations, with many variables: the number of roadway lanes to be crossed, divided or undivided roadways, number of approach legs, the speeds and volumes of traffic, and traffic controls that range from uncontrolled to yield, stop or signal controlled. Each intersection is unique and requires

engineering judgment to determine the appropriate intersection treatment. The safe and convenient passage of all modes through the intersection is the primary design objective. Regardless of whether a pathway crosses a roadway at an existing roadway intersection, or at a new midblock location, the principles that apply to general pedestrian safety at crossings (controlled and uncontrolled) are transferable to pathway intersection design.

When shared use paths cross roadways at intersections, the path should generally be assigned the same traffic control as the parallel

roadway (i.e., if the adjacent roadway has a green signal, the path should also have a green/walk signal or if the parallel roadway is assigned the right-of-way with a stop or yield sign for the intersecting street, the path should also be given priority). At signalized intersections, if the parallel roadway has signals that are set to recall to green every cycle, the pedestrian signal heads for the path should generally be set to recall to walk. Countdown pedestrian signals should be installed at all signalized path crossings as signal heads are replaced. As required by the Manual on Uniform Traffic Control Devices, the walk signal for any path shall not conflict with a protected left- or right-turn interval. Bicyclists benefit from the safe passage that pedestrian signals provide by having a dedicated time during which to cross a roadway without having to yield to on-coming vehicle traffic.

Consideration should be given to providing a leading pedestrian interval at path crossings (i.e., three seconds of green/walk signal time are given to path users before any potentially-conflicting motor vehicle movements are given a green signal). This allows pedestrians and bicyclists to have a head start into the roadway to become more visible to turning traffic.

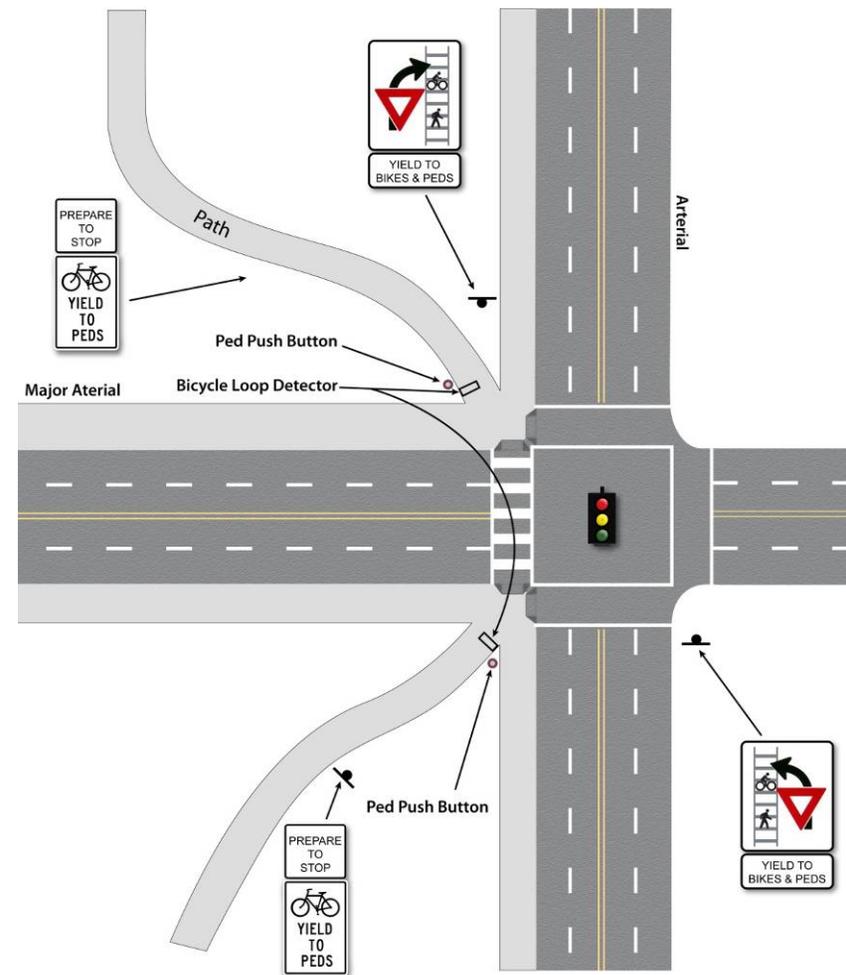


Where the signals for the parallel roadway are actuated, the path crossing will also need to be actuated. For shared-use path crossings, the minimum WALK interval may be 9-12 seconds to accommodate increased flow. The USE PED SIGNAL sign should be used at shared-use path crossings at signalized intersections. Pedestrian pushbuttons should be located within easy reach of both pedestrians and bicyclists, who should not have to dis-

mount to reach the pushbutton.

The figure on this page illustrates the preferred approach for a shared use path at a controlled intersection. Paths should cross at the intersection to encourage use of the intersection crossing and have path users in the location where they are most anticipated. In many cases, a path will be separated from a roadway by between 20 and 50 feet. Locating path crossings along these alignments (that is 20 to 50 feet away from the intersection) creates a condition where vehicles do not expect to encounter a path crossing and vehicles leaving the intersection are accelerating away from it when they cross the path crossing. For signalized trail crossing, an advance loop detector within 100 feet of the intersection should be considered, so bicyclists can approach the intersection slowly but without having to stop.

Figure B-4 | Shared Use Path Approach to at a Signalized Intersection



Unsignalized Intersections

At unsignalized or stop controlled locations, an engineering study should be conducted to determine an appropriate way to control cross bike and pedestrian traffic. The following are general guidelines that can be used for these locations:

- If paths cross at intersections with all way stops, stop signs should be placed at each path approach.
- Consideration should be given to removing stop signs along continuous paths and their parallel roadways and controlling intersecting roadways with stop signs. An engineering study should be conducted before removing or adding any stop signs.
- At intersections with STOP signs controlling only one of the approaches, the trail should be assigned the same right-of-way as the parallel street. Stop signs should not be placed on the path approaches to the intersecting roadway if the parallel street has no stop signs.
- If the two streets have the same roadway classification, and the stop signs face the intersecting street that is parallel to the path, consideration should be given to reversing the stop sign placement, giving the right-of-way to the path and the parallel street. An engineering study should be conducted before reversing the stop sign placement.
- The decision of whether to use a traffic signal at a mid-block crossing should be primarily based on the latest version of the MUTCD Pedestrian Signal warrants.

At mid-block crossings, all path users (including bicyclists) should be included in calculating the “pedestrian volume” for the warrant procedure. While the CA MUTCD has not yet been updated with revised pedestrian-related signal warrants, the 2009 national MUTCD contains these revised warrants and should be used. When a path crossing

meets the warrants, there may be other reasons why a signal is not necessary at the crossing. Where a decision has been made not to install a traffic signal at a mid-block path crossing, STOP or YIELD signs should be used to assign the right-of-way to the path or the roadway. The assignment of priority at a shared-use path/roadway intersection should be assigned with consideration of the relative importance of the path and the roadway; the relative volumes of path and roadway traffic; and the relative speeds of path and roadway users.

Bicycle Signal Heads



Image: Bike Signal Head Adjacent to Traffic Signal Head

Bicycle signal heads permit an exclusive bicycle-only signal phase and movement at signalized intersections. This takes the form of a new signal head installed with red, amber and green bicycle indications. Bicycle signals can be actuated with bicycle sensitive loop detectors, video detection or push buttons. Bicycle signals are an approved traffic control device in California, described in Part 4 and 9 of the CA-MUTCD. The City of Richmond may install bike signals at intersections with heavy bike

volumes, on bike paths adjacent to intersections where heavy bike traffic in the crosswalk may conflict with turning vehicles, or at three-legged intersections where bikes may enter or exit a bike path at the intersection. Bike signal warrants could be considered when bike vo-

lumes exceed 50 per hour and vehicle volumes are greater than 1,000 vehicles per hour, or in locations that have a history of bicycle vehicle collisions (>2 in one calendar year), or in locations where a multi-use path intersects a roadway.

Rails with Trails



Rail-with-Trail right-of-way adjacent to light-rail lines in Minneapolis, Minnesota. (source: Stuart Macdonald, 2003-06)

ing guidelines are based on the best practices identified in the U.S. Department of Transportation Federal Highway Administration's *Rails-With-Trails: Lessons Learned* (2002) report and AASHTO. Path designers should work closely with railroad operations and maintenance staff to achieve a suitable trail design.

Setback

Setback refers to the distance between the paved edge of a path and the centerline of the active railroad track. According to the FHWA's

Rail corridors provide opportunities for pathways, especially in dense urban settings where it may be difficult to find land for new paths or roadways that provide safe and efficient commuter bike corridors. Successful rail-with-trail projects have been implemented in over 60 communities throughout the US. The follow-

Rails-with-Trail: Best Practices Report (2001), setback should be based on type, speed and frequency of trains; the separation technique; topography; sight distance and maintenance requirements. Paths adjacent



Rail-with-trail section of the Great Allegheny Passage between Washington, DC and Pittsburgh, Pennsylvania.

to low frequency and slow moving trains could be located as close as 10' from the track centerline; paths adjacent to higher-speed trains or more frequent trains may require setbacks up to 50'. Vertical separation, such as fencing, walls, or landscaping, as well as natural features such as grades, thickets, and/or bodies of water, may allow for reduced setbacks. The absolute minimum setback must keep rail-path users outside of the "dynamic envelope," or operating space, of the path. According to the MUTCD, the dynamic envelope is "the clearance required for the train and its cargo to overhang due to any combination of loading, lateral motion or suspension failure, and includes the area swept by a turning train.

Separation

Typical barriers include fencing, vegetation, vertical grades, and drainage ditches. Depending on the safety and trespassing risk, typical fence separation can range in height from 3' to over 10'. In general, any separation should impede unnecessary access to rail lines and channel users to legal crossings. Fence design should also consider issues with crime, and it may be important to choose fencing or other

as well as natural features such as grades, thickets, and/or bodies

physical separators that maintain sightlines between the adjacent land uses and the rail lines and pathway. Vegetation, grades and ditches may be used as a barrier between the rail-trail and an active rail when:

- The rail-path (not including shoulder) is located farther than 25' from the nearest rail line, or
- The vertical separation between the surface of the rail-path and the track is greater than 10'.

The development of a rail-path may affect adjacent rail operation; therefore, the barrier type, material and location should be determined jointly by interested parties and should use the FHWA *Rails-with-Trail: Lessons Learned* (2002) as guidance. The table below summarizes the recommended separation for various facility types.

Table B-2 | Recommended separation from active rail lines

	Setting	Minimum	Recommended**
High-Density/High-Speed Lines (11 or more trains per day with speeds exceeding 45 mph)	Typical Conditions	15'	25'
	Constrained areas (e.g., bridges, trestles, cut/fill)	15' with vertical or other separation	15'
	With vertical separation of at least 10'	20'	25'
Medium-Density/Medium-Speed Lines (fewer than 11 trains per day with speeds not to exceed 45 mph)	Typical Conditions	15'	25'
	Constrained areas (e.g., bridges, trestles, cut/fill)	11' with vertical or other separation	25'
	In areas with extensive trespassing history (>100 persons per day)	11' with vertical or other separation	25'
Low-Density/Low-Speed Lines (less than one train per day; maximum speed of 35 mph)	Typical Conditions	11'	25'
	Constrained areas (e.g., bridges, trestles, cut/fill)	11' with vertical or other separation	25'

Source: *Rail-with-Trails: Lessons Learned; Table 5.2 Minimum Setbacks*; Vermont Department of Transportation Pedestrian and Bicycle Facility Planning and Design Manual

**The City of Richmond should decide what their preferred minimum standards are based after discussing potential path designs with rail operators.

Crossings



Rail-with-Trail crossing adjacent to light-rail lines in Minneapolis, Minnesota. (source: Stuart Macdonald, 2003-06)

Path crossings at active rail tracks should follow the same recommendations for shared use paths at roadway crossings. The appropriate design depends in part on expected train operations, and should consider train speed, frequency, type, number of tracks, stopping distance and

number of tracks. The following elements should be considered in the design of the crossing:

- When an at-grade rail-trail crossing intersects a roadway near a roadway intersection, consideration should be given to diverting the crossing to the roadway intersection and treat it as a parallel crossing or pedestrian crossing.
- Sight distance: The pedestrian or bicyclist should have an unobstructed view down the track to determine if sufficient time exists to cross the rail lines. In site distance is limited, additional passive and active devices should be included in the design of the crossing, including, but not limited to, exit swing gates, barriers, pavement markings and texture, message signs, flashing signals, audible devices, or signals. Even in locations with additional treatments, site distance should be maximized based on the FHWA's Guidance on Traffic Control Devices at Highway-Rail Grade Crossings. Site distance calculations should include considerations for deci-

sion/reaction distance of the pedestrian or cyclist, clearance from the track, distance between different tracks, and clearance on the opposite side of the track.

- Track Angle: As shown in the figure on the following page, the design of the crossing should obtain a perpendicular approach to the track to maximize site distance and minimize the potential for narrow wheeled vehicles to be trapped in the track rails.
- Width: The minimum width of the path should be 48 inches; however, typical railroad crossings with curb-mounted gates and warning devices, the minimum distance from the face of the curb to the centerline of the device is 51 inches. Therefore, crossings may need to be up to 11' 2" wide at rail crossings.
- Channelization: Crossings should be well marked to reduce the potential for illegal track crossings. Barriers may be recommended to assist in channelization; however, they many need to be sized to maintain appropriate site distance of approaching trains.
- Other treatments, such as swing gates, edge lines, and detectible surfaces are also desirable to improve crossing safety.

Figure B-5 | At-grade rail crossings

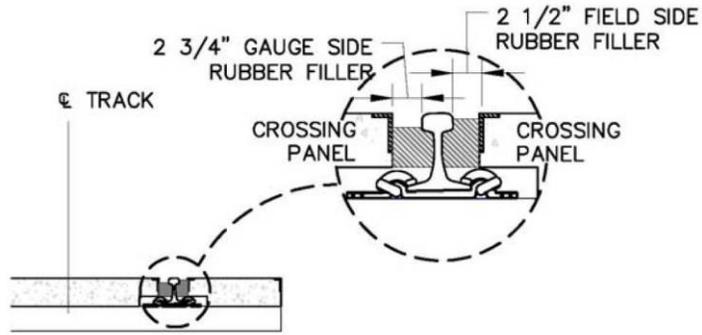
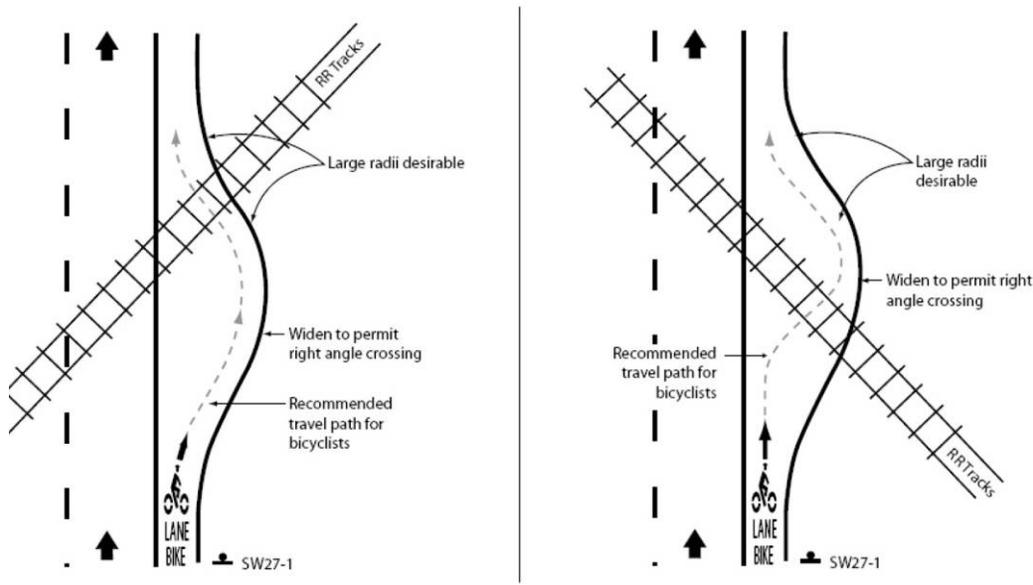
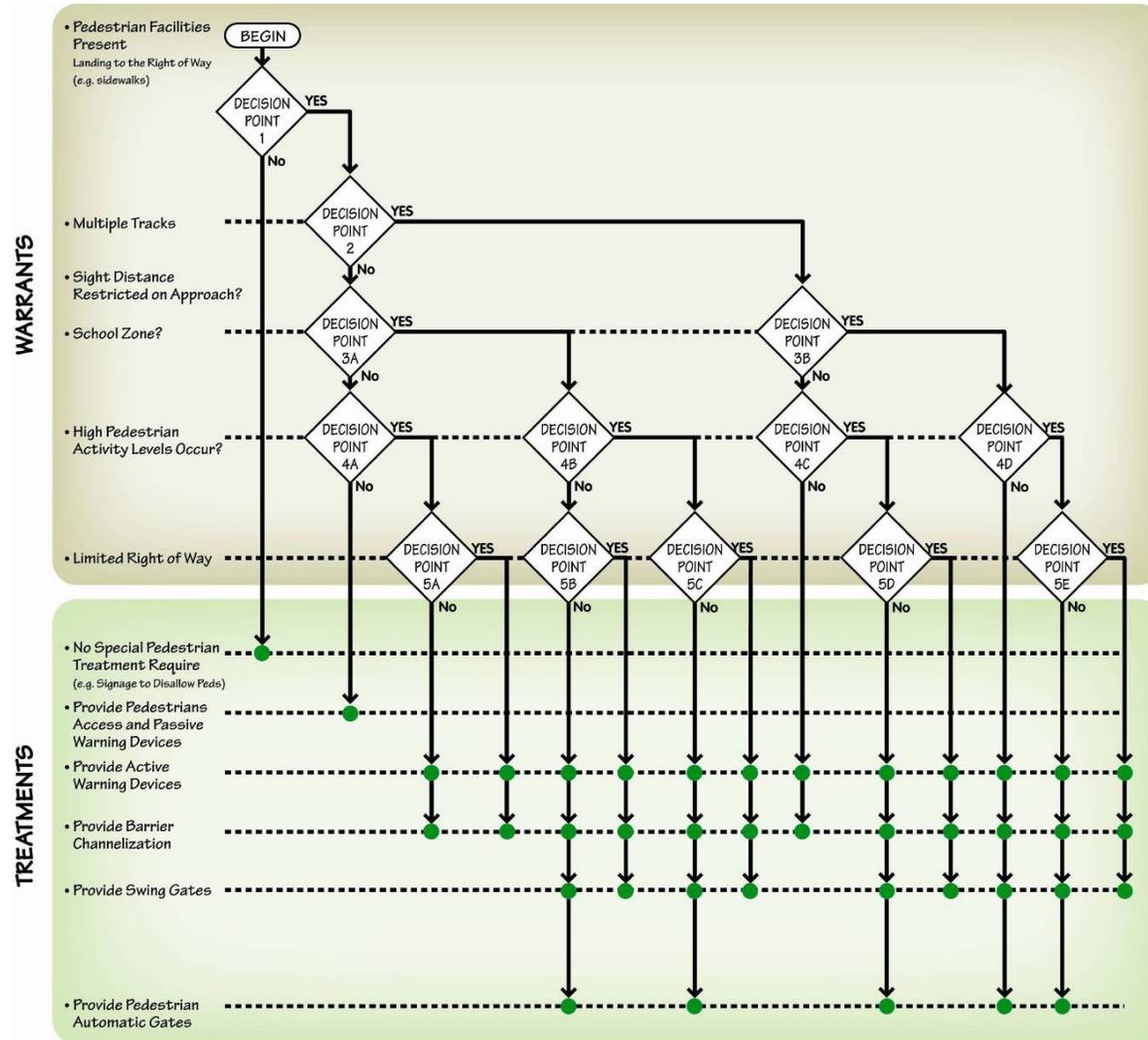


Figure C-5: Rubberized railroad crossing
(Caltrain Standard Drawing 2151)



The following decision tree was developed by the California Public Utilities Commission as standard guidance for treatments at rail crossings.

Figure B-6 | Decision tree for treatments at rail crossings



Source: California Utilities Commission, 2008

Shared-Use Path Amenities

Furnishings along a shared-use path should be concentrated at specific points to form gathering nodes. These nodes occur at intersections between different path types, special viewpoints, or at distinctive landscape features. Shared-use path support facilities consist of staging areas, seating and tables, weather-protection structures, drinking fountains, waste receptacles, fencing, bike racks, interpretive and directional signage and restrooms.

Staging Areas

Staging areas should be provided at path entrances. These areas should include basic information such as directional information and signage, bicycle parking, seating and waste receptacles. Restrooms, water fountains, weather structures should be provided where practical and feasible. At path entrances where a substantial number of users are likely to drive, a parking lot should be provided; however, vehicle parking should be minimized to encourage non-motorized access to recreational facilities.

Rest Areas

Rest areas are portions of paths that are wide enough to provide wheelchair users and others a place to rest while on trails without blocking continuing traffic. Rest areas are more effective when placed at intermediate points, scenic lookouts, or near other trail amenities. Most rest areas will have seating, shade, a place to rest bicycles, and waste receptacles. On longer paths, restrooms and/or water fountains may be desirable where feasible. The California State Parks Guidelines calls for rest areas every 200' on outdoor recreational routes with grades of no steeper than 8.3%. Accessible paths at steeper grades may require resting areas at greater frequency.

Seating

Benches provide people of all ages and abilities a place to sit and rest along trails. Seating should be placed away from the path, at least 3' from the trail edge, to allow room for people to sit with outstretched legs. An area adjacent to the bench should be able to accommodate a wheelchair.

Waste

Trash receptacles should be installed along bike paths at regular intervals, as well as at rest areas, path entrances, and seating areas, to encourage proper waste disposal and discourage littering.

CLASS II BIKE LANES



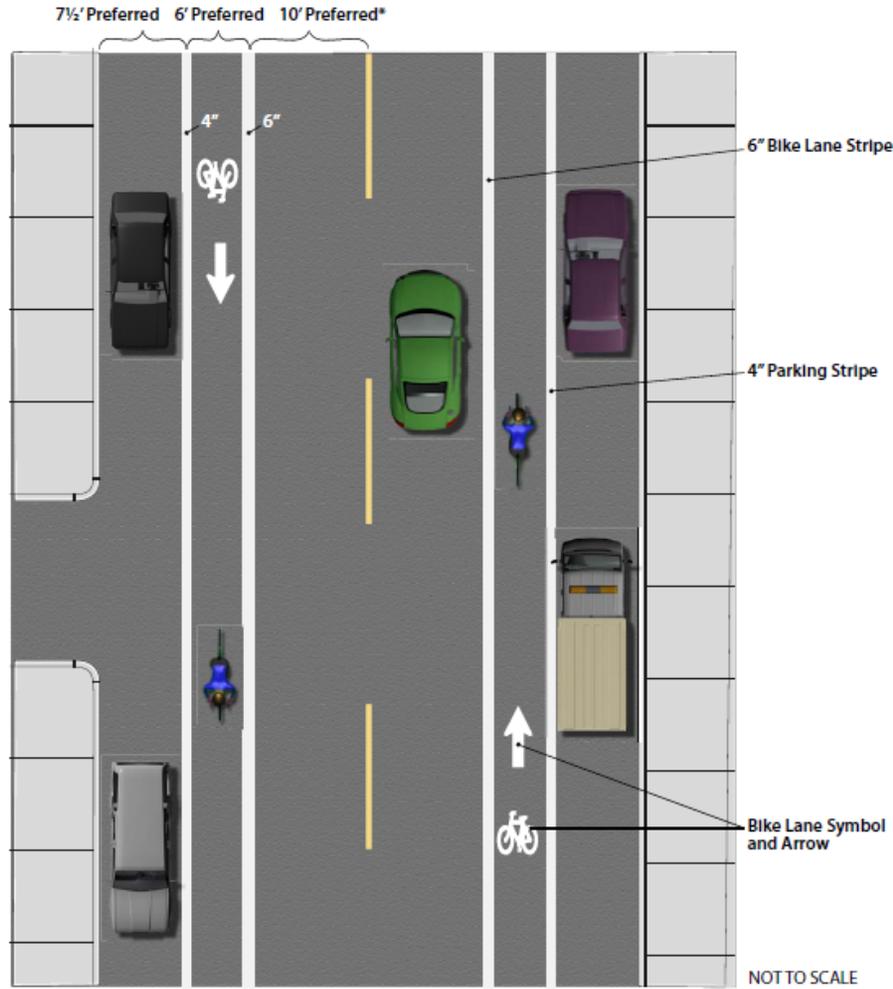
This section includes guidelines for Class II bicycle lanes along roadways and at intersections. Most riders benefit by having a lane that is separate from motor vehicle traffic, and bicycle lanes are typically used on streets with higher traffic volumes or greater speeds.

Standards for Class II Facilities

The figures on the following pages illustrate the preferred widths for bicycle lanes in the following situations:

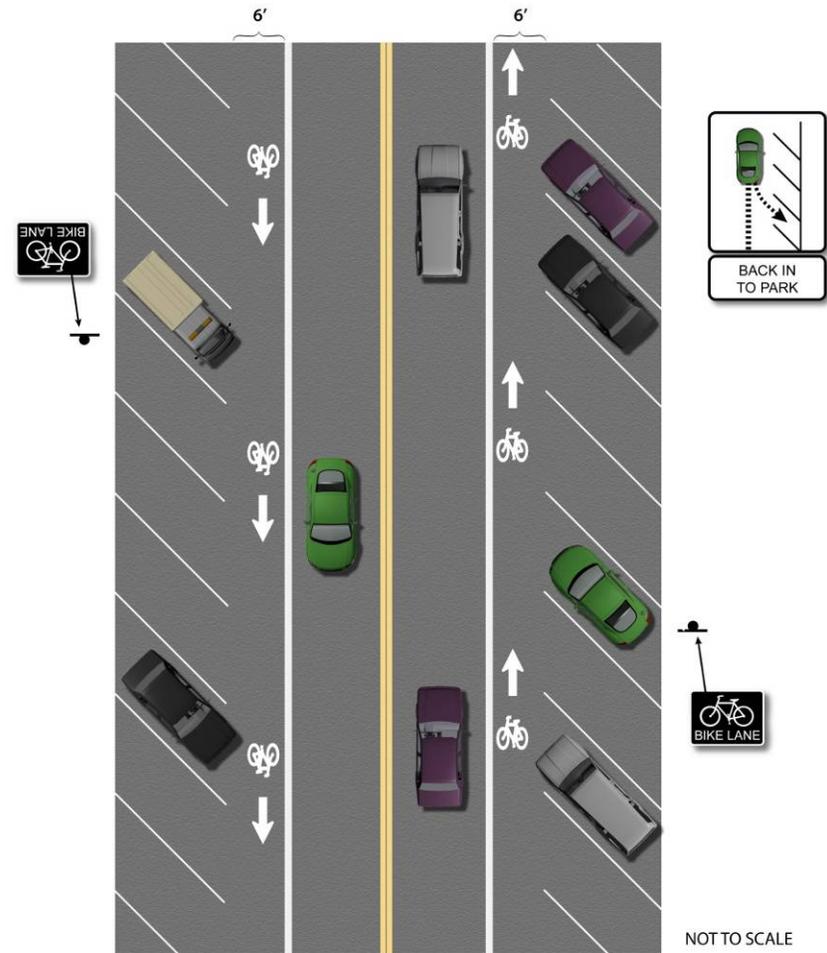
- Next to Parallel Parking
- Next to Back In Angled Parking*
- Without Parking
- Buffered Bike Lane

Figure B-7 | Bike Lanes Adjacent to Parallel Parking



*11' minimum width for outside travel lanes along bus routes

Figure B-8 | Bicycle Lanes Adjacent to Back-In Angled Parking



* The City of Richmond uses conventional front-in angled parking as a standard practice. Back-in angled parking may be considered in a pilot location where appropriate.

Figure B-9 | Bicycle Lanes without Parking

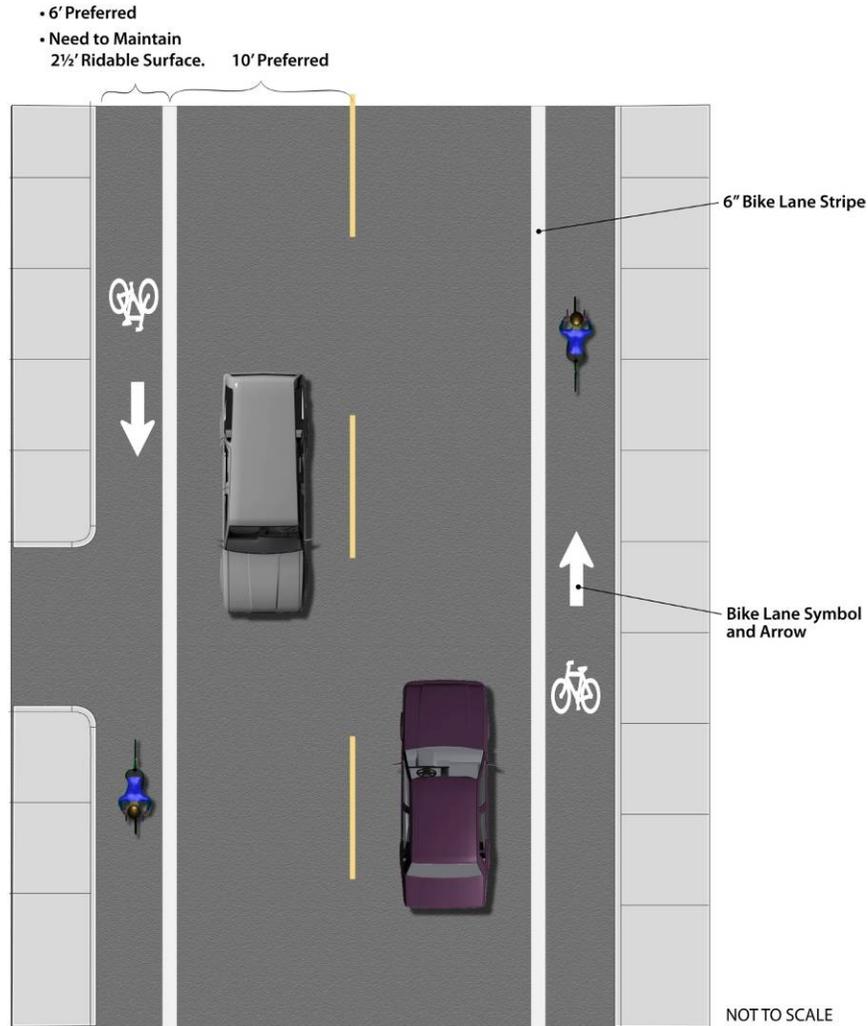
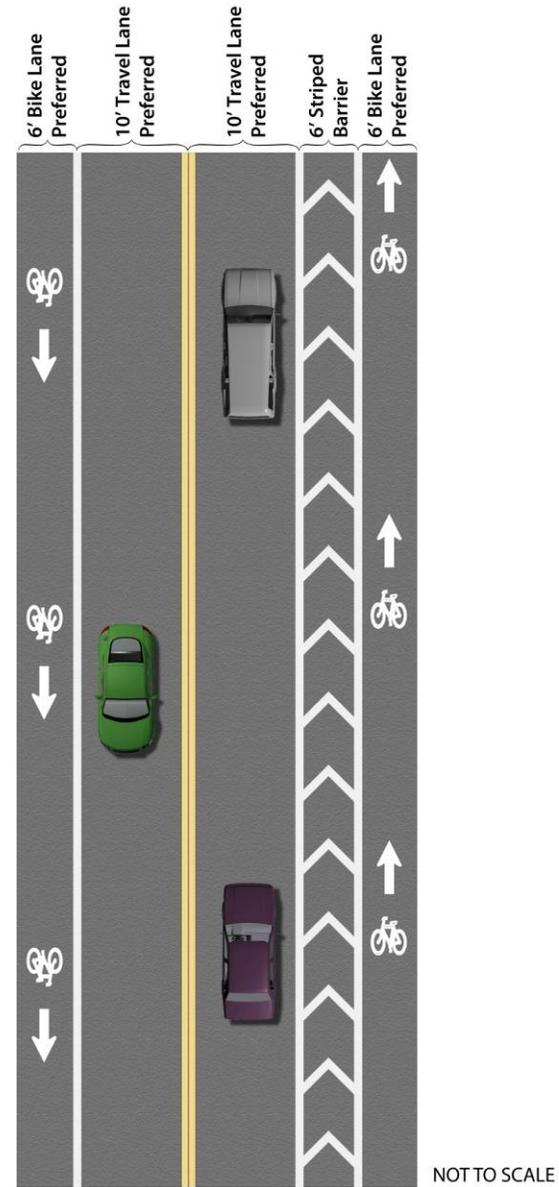


Figure B-10 | Buffered Bike Lanes



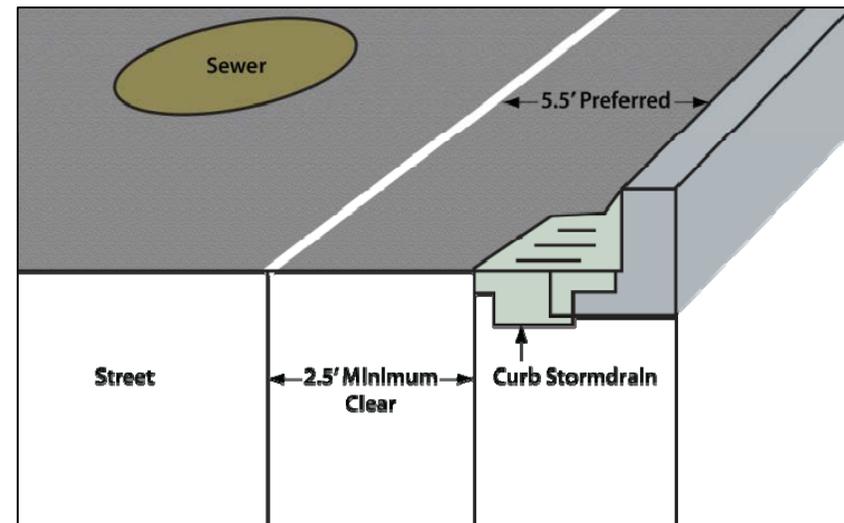
Standard Bike Lane: Bike lanes should be designed to meet Caltrans standards, which require a minimum width of five feet. The preferred bike lane width is 6 feet. The preferred vehicle travel lane width is 10 feet; however, AC Transit prefers that any roadway with bus routes have 11 foot travel lanes. Signs that say BIKES WRONG WAY may be used on the back of bike lane signs or on separate posts to discourage wrong way riding.

Shared Bike/Parking Lane: If a bike lane is shared with a parking lane, the combined lane should be a minimum of 12.5 feet, with 13 feet desirable. This minimum combined lane should be striped with a 6 foot bicycle lane and 7 foot parking lane. The optimum combined lane should be a 6 bike lane and a seven-foot parking lane.

Bike Lane without Parking: In places where there is no on-street parking, the six foot preferred width applies. In exceptional circumstances where no other reasonable options exist or retrofit situations, a 4 foot minimum is allowed as long as there is no on-street parking.

Gutter Pans & Bike Lanes: Where drainage or other obstructions constrict clearance between the vehicle travel lane and stormdrains, designers should take care to maintain a 2.5 foot clear longitudinal surface, free from drainage grates and other obstructions in order to give the cyclist adequate width to ride. It is preferable not to consider the gutter pan as clear surface.

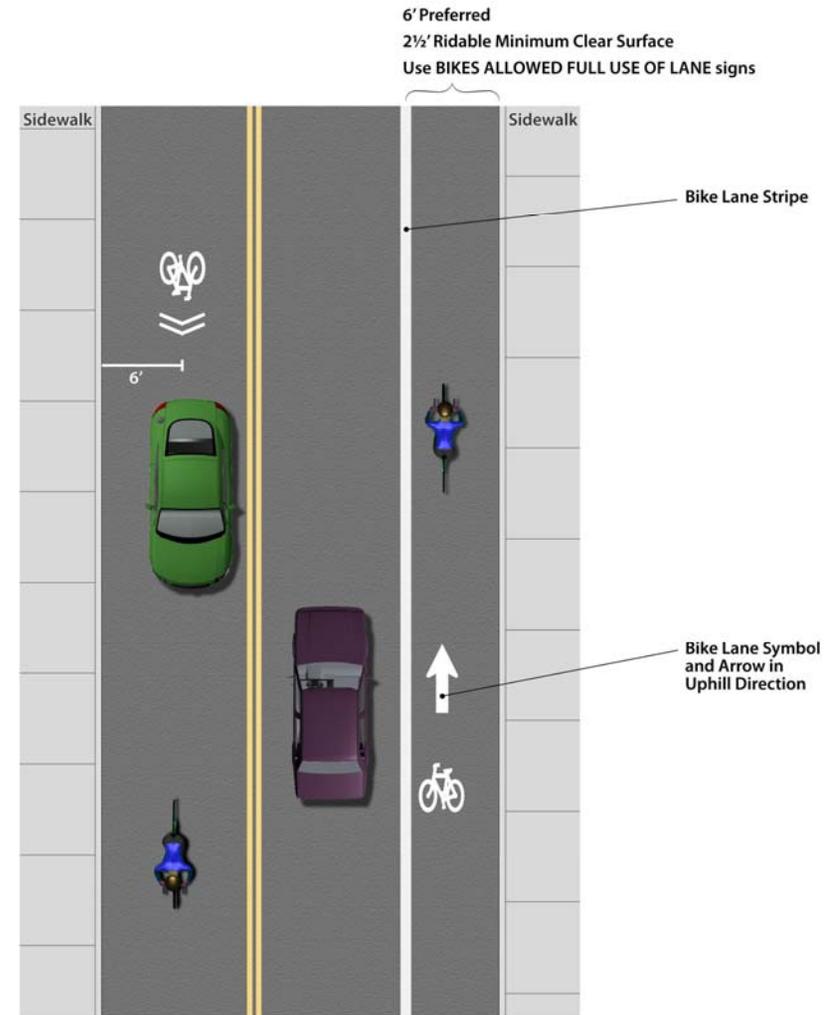
Figure B-11 | Location of Bike Lane with Curb and Gutter



Bike Lanes on Hills

In most cases, bike lanes should be provided on both sides of a two-way street; however, in cases where roadways have steep grades, a bike lane in the uphill direction and shared lane markings (sharrows) in the downhill direction would be considered acceptable (AASHTO, 2010). On narrower roadways, sharrows may be placed in the center of the lane to discourage vehicles from passing cyclists. BIKES ALLOWED FULL USE OF LANE signage may be appropriate on downhill segments. Posted speed limits of 25 mph or lower are preferred.

Figure B-12 | Climbing Lanes



NOT TO SCALE

Bike Lanes at Intersections

Nationally, the majority of collisions between motorists and bicyclists occur at intersections. While design guidance for bike lanes acknowledges that intersections are often constrained by the desire for addition turn lanes for autos and allows engineers to drop bike lanes at intersections, this practice is not recommended. There are several engineering treatments to significantly reduce conflicts at intersections.

Caltrans provides recommended intersection treatments in Chapter 1000 of the Highway Design Manual including bike lane “pockets” and loop detectors. Bike lane pockets between right-turn lanes and through lanes should be provided where available lane width allows. Where there is inadequate space for a separate bicycle lane and right-turn lane, the designer should consider the use of a combined lane, shown in the figure on the following page. The City of Eugene, Oregon evaluated this design and concluded that it was easy for cyclists to use. A majority of the cyclists using the facility felt that it was no different from a standard right-turn lane and bicycle lane.¹ An alternate treatment is a sharrow, or “shared right of way” marking, in the through lane adjacent to the right-turn lane.

The figure on the following page shows the appropriate location and use of loop detector stencils at intersections and typical striping and lane configurations for bike lanes and loop detectors at a multi-lane intersection. Figure B-14 presents several options for the treatment of Class II lanes approaching intersections with right-turn lanes.

¹ *Evaluation of a Combined Bicycle Lane/Right Turn Lane in Eugene, Oregon*, Federal Highway Administration, 2000

On the Horizon: Bike Boxes

Bicycle boxes are used at signalized intersections to create a dedicated space for cyclists while waiting for a green light. They offer the cyclist a “head start” and allow cyclists to position themselves for various movements (left turns, for instance). They also allow cyclists to avoid conflicts with right-turning vehicles.

Bike boxes have been used in New York, Tuscon (AZ), Portland, Eugene, and recently in San Francisco. Bike boxes work best at locations where they are self-enforced, that is, where there is a cyclist in the bike box during the red phase for a majority of the time. Therefore, a good baseline for a bike box would be a location with 90-120 bicycles or more per hour.



Bike Lane Markings

Pavement stencils should be reflectorized and be capable of maintaining an appropriate skid resistance under rainy or wet conditions to maximize safety for bicyclists. The minimum coefficient of friction should be 0.30. Thermoplastic can meet all of these requirements. It is optimized when the composition has been modified with crushed glass to increase the coefficient of friction and the maximum thickness is no larger than 100 mils (2.5 mm).

The Caltrans standard for placement of bicycle lane stencils states that markings should be on the far side of each intersection and at other locations as desired. Generally, bicycle lane markings should be provided at transition points, particularly where the bicycle lane disappears and reappears, as it transitions from curb side to the left side of the right-turn lane. Otherwise, place them at least every 500 feet or once per block. Symbols shown in the figures are for illustration purposes and should not be used as spacing or placement guidelines.

Figure B-13 | Bike Lanes Adjacent to Parallel Parking

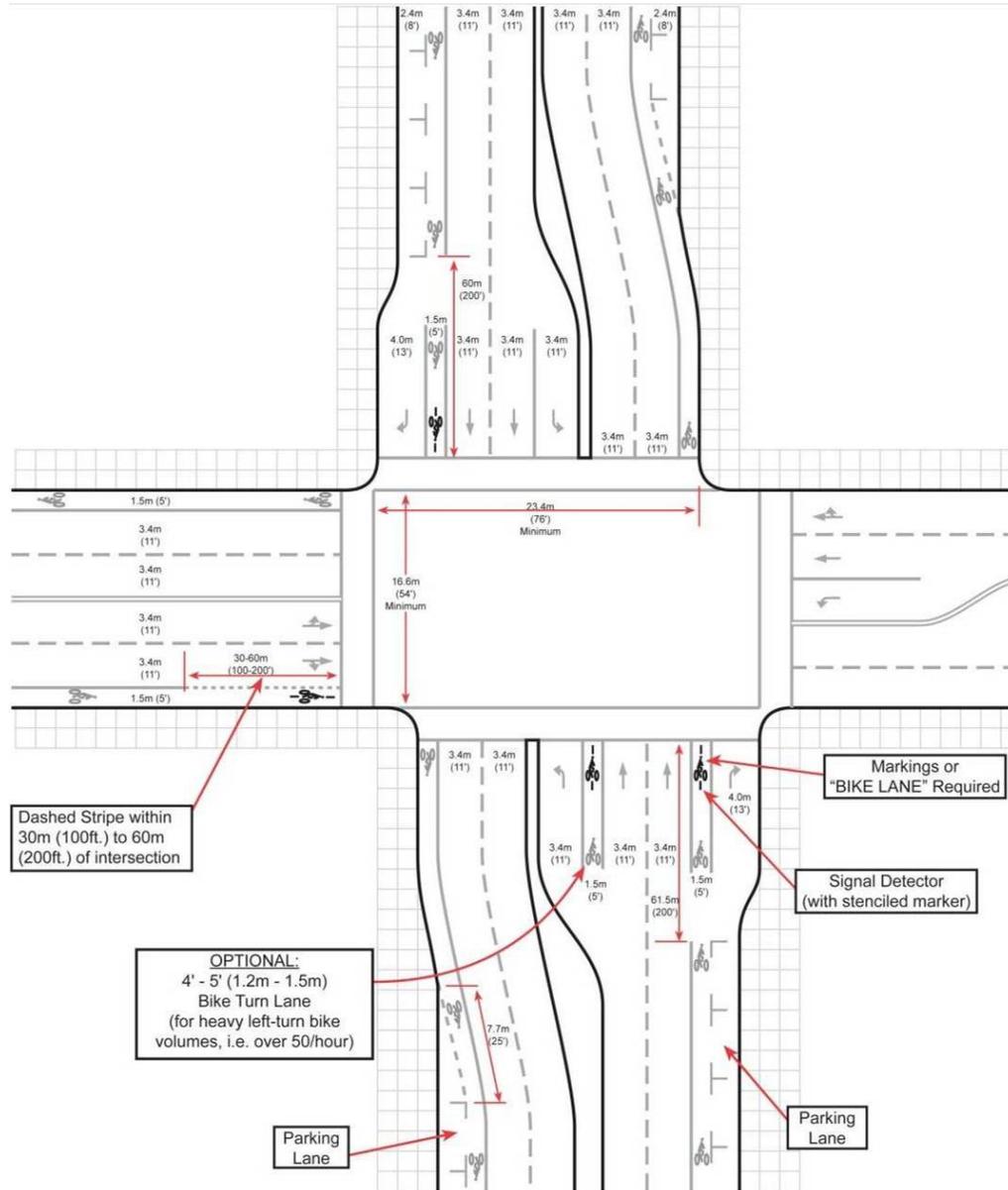
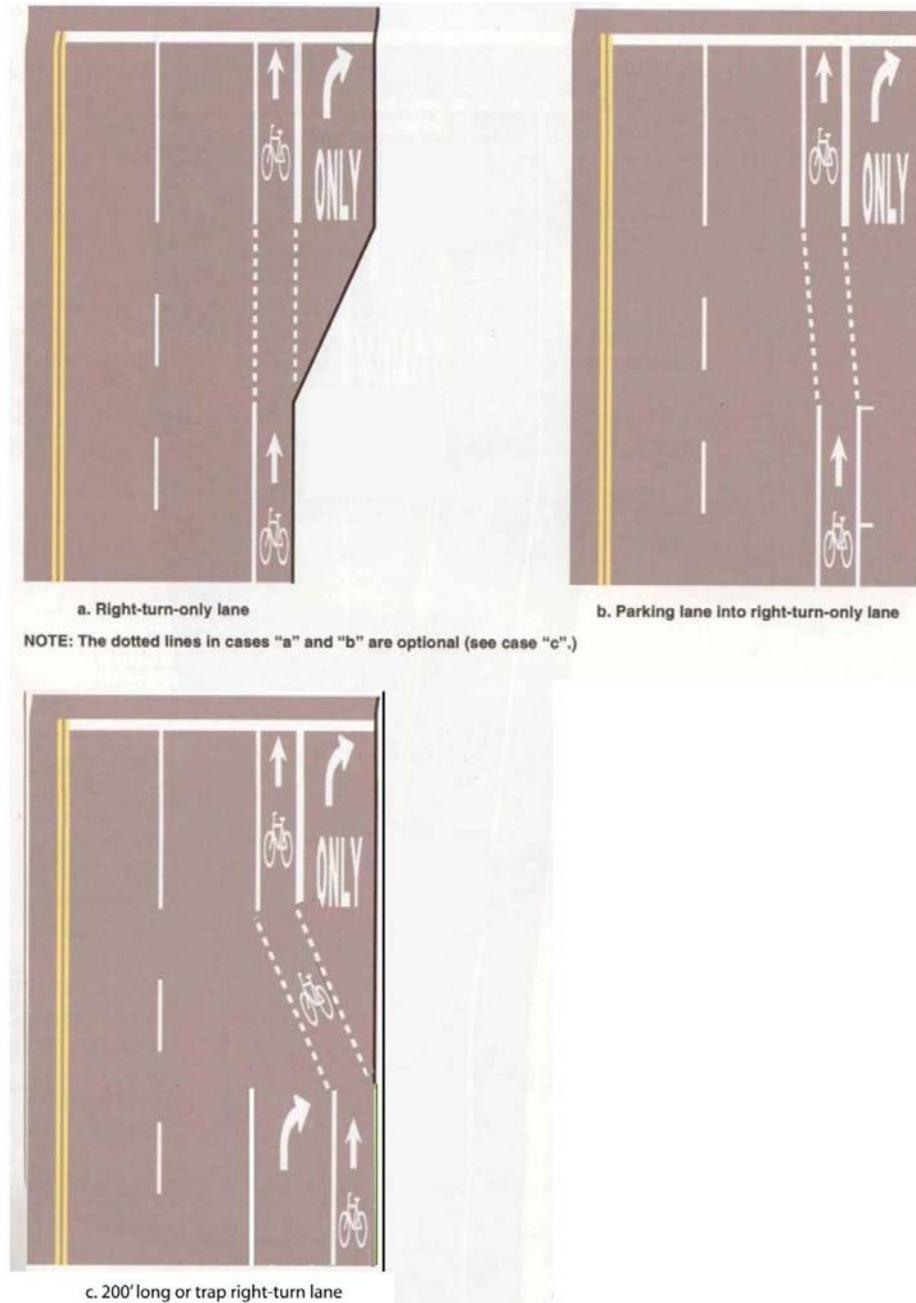


Figure B-14 | Bike Lanes at Right Turn



Colored Bicycle Lanes: Colored bike lanes can be used in high-conflict areas to alert motorists to the presence of bicyclists and bike lanes. Cities including Portland, Oregon and New York City have successfully experimented with colored bike lanes at highway interchanges and locations where drivers have otherwise encroached on bicycle lanes. These lanes can be painted or treated with thermoplastic. The City of Richmond may consider installing a trial colored bike lane before expanding the use of the treatment throughout the City.



*Image: Green bike lane at intersection.
Also shown: Bike-only left turn pocket.*

Skip-Stripe: At intersections with moderate to high bicycle volumes, or at intersections where bicyclists may need to reposition themselves to continue on the bike lane, it may be advisable to stripe the bike lane through the intersection using dashed lines. This “skip-striping” directs cyclists to the bike lane and increases the visibility of cyclists to motorists traveling through the intersection. To identify that the markings are for bicyclists, the City of Richmond may consider striping chevrons or sharrows through the intersection as well.



On the Horizon: Cycle Tracks

Cycle tracks, also known as separated on-street bike lanes, provide a buffer between bikes and cars. These facilities are useful along streets with moderate to high bicycle volumes and relatively few driveways or intersections. New York City has recently and extensively used separated on-street bikeways to improve bicycling conditions on several key corridors.

The New York Department of Transportation has experimented with two forms of separated bikeways. The first physically separates the bike lane from vehicle traffic and the bike lane is positioned between the sidewalk and the parking lane. At intersections, bikes receive a signal that allows cyclists to proceed without conflicting with turning vehicles. The second treatment positions the bike lane between the travel lane and the parking lane; however, a striped painted median separates the travel lane from the bike lane. The New York Street Design Manual recommends allowing at least 8' of space to accommodate the separated bike lane and the adjacent separation marking or structure.



Images: (left) 9th Avenue, New York City (RL Layman); (right) Greenwich Street (L Alter)

Treatments at Highway Interchanges

Bicycle and pedestrian routes at highway interchanges require special treatment to ensure the safety and comfort for all road users. Fast moving traffic, highway on and off-ramps and wide travel lanes make interchanges difficult areas for bicyclists and pedestrians to navigate. The guidance below can be used for retrofit projects or new interchange designs.

Travel lanes should be reduced from 12 feet to 10 or 11 feet to slow motor vehicle speeds and provide additional space for bicycle lanes and sidewalks

- Class II bike lanes should be striped continuously across overpasses and underpasses wherever feasible
- Minimize distances in which bicyclists are required to travel between two moving traffic lanes
- Use skip stripes to delineate bicycle path travel through conflict zones
- Consider colored bike lanes in conflict areas
- Avoid High-speed, Uncontrolled Movements. A tight diamond configuration with square off and on-ramps to encourage slower motor vehicle speeds and is recommended
- Avoid Multiple Right-turn lanes on Cross-street. Dedicate right turn lanes create a conflict for cyclists traveling through an intersection that must cross the right turn lane to continue to ride straight. Where possible, retain single right-turn lanes, even if greater than 200 feet. Where possible, avoid right-turn lanes greater than 200 feet

Treatments at Bridges and Tunnels

Bicycle connections to bridges and tunnels require special treatment to ensure the safety and comfort for all road users. Fast moving traffic, transitions between the roadway and the structure and wide travel lanes often make approaches to bridges and tunnels difficult areas for bicyclists and pedestrians to navigate. Appropriate measures to improve bicycle safety at bridge and tunnel approaches include:

- Reduce travel lanes from 12 feet to 10 or 11 feet to slow motor vehicle speeds and provide additional space for bicycle lanes and sidewalks
- Stripe Class II bike lanes continuously across bridges and through tunnels wherever feasible
- Minimize distances in which bicyclists are required to travel between two moving traffic lanes
- Use skip stripes to delineate bicycle path travel through conflict zones
- Consider colored bike lanes in conflict areas

Bike Loop Detectors and Push Buttons



As new signals are installed or major updates occur to existing signalized locations, bicycle loop detectors should be installed on the bikeway system at the stop bar for all actuated movements of the signal. It is suggested that loop detectors be installed in the approach bike lane 100 feet in advance of the intersection as well as at the intersection itself. The upstream loop should not be used when it would be triggered by right-turning vehicles. When the

upstream loop is triggered, the green time should be extended for the cyclist to reach the loop at the stop bar, at which point the signal should allow the cyclist to clear the intersection. The time that a bicycle needs to cross an intersection is longer than the time needed for vehicles, but shorter than the time needed for pedestrians. The AASHTO Guide for the Development of Bicycle Facilities includes detailed equations for bicycle signal timing. In general, while the normal yellow interval is usually adequate for bikes, an adjustment to the minimum green should be considered.



Image: Bicycle pushbutton in Menlo Park, CA

Stencils indicating the loop detector should be marked on the roadway at the intersection where a bicyclist may not be positioned correctly over a loop. Figure B-15 shows the appropriate location and use of loop detector stencils at intersections.

Push buttons are appropriate when other methods of detection are not feasible, particularly at narrow tunnels or where multi-use paths cross signalized intersections. A bicycle push button/pad/bar is similar

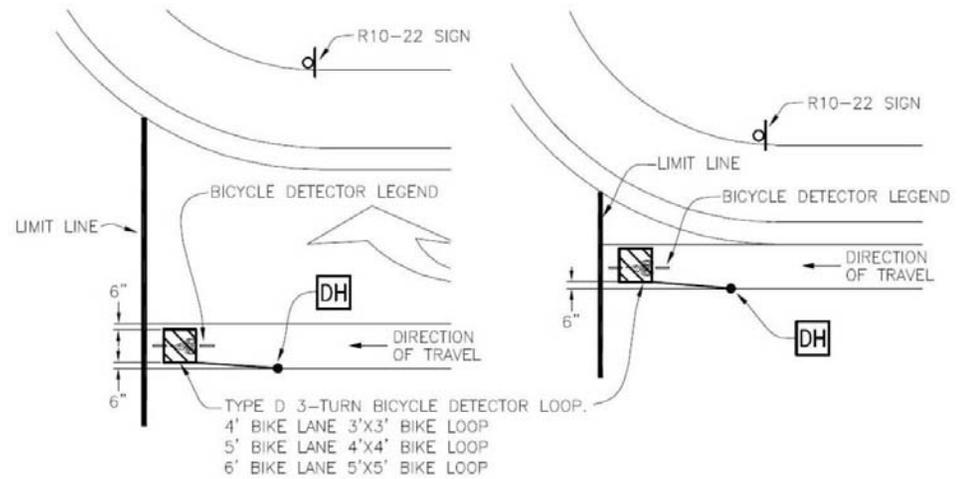
to those used for pedestrians, but installed in a location most convenient for bicycles and actuates a signal timing most appropriate for bicyclists. The sign plate located above the push button/pad/bar indicates that it is for use by bicyclists. The larger the surface of the button, the easier it is for cyclists to use, thus a push pad is preferential to a

push button, and a push bar is preferential to a push pad, as it can be actuated without removing one's hands from the handlebars. Advantages of the push button are that it is typically less expensive than other means of detection, and it allows for different signal timing for different user needs. The disadvantages of the pushbutton are that the location of the pushbutton usually does not allow the cyclist to prepare for through or left-turning movements at the intersection, and that it forces the bicyclist to stop completely in order to actuate the signal.

Caltrans Policy Directive 09-06

Caltrans recently modified its policy on bicycle detection at new and modified approaches to traffic-actuated signals. The California MUTCD was amended to require that in-pavement bike detectors or push buttons be placed on approaches to signalized intersections. If more than 50 percent of limit line vehicle detectors need to be replaced, then an entire intersection should be upgraded so that every lane has limit line detection. The signal timing guidance was also updated to reflect a bike speed of 10 mph (14.7 ft/sec) with 6 seconds of startup time based on current research.

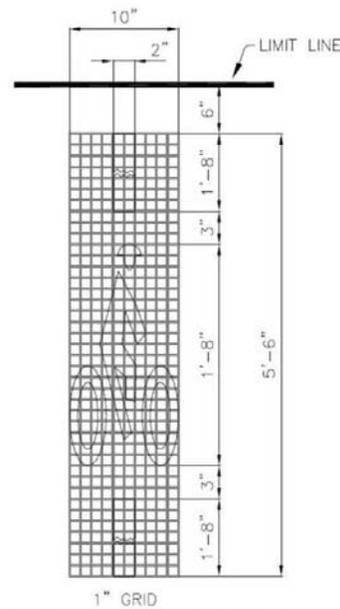
Figure B-15 | Bike Loop Detector



NOTE: CENTER OF BICYCLE DETECTOR LOOP SHALL BE 3' BACK FROM THE LIMIT LINE.

TYPICAL BICYCLE DETECTOR LOOP AND LEGEND PLACEMENTS

(NO SCALE)



BICYCLE DETECTOR LEGEND

(NO SCALE)



R10-22 SIGN

(NO SCALE)

CLASS III BIKE ROUTES

Class III bike routes are intended to provide continuity throughout a bikeway network and are primarily identified with signage. Bike routes can be used to connect discontinuous segments of a Class I or Class II bikeway. Bike routes are shared facilities either with motorists on roadways or with pedestrians on sidewalks (not desirable).

Minimum widths for bike routes are not presented in the Highway Design Manual, as the acceptable width is dependent on many factors. The following table presents recommended average daily traffic (ADT) and speed thresholds for bike routes.

Table B-3 | Recommended Guidelines for Class III Facilities

Curb Lane Width (in feet)	Average Daily Traffic (ADT)	Travel Speed
12' (arterial); 11' (collector); no minimum on local street	Under 5,000 vehicles	Under 25 mph
14'	5,000 – 20,000	25 – 35 mph
15'	Over 20,000	Over 35 mph

Source: Fehr & Peers

Share the Road Markings

Share the Road Markings, or “sharrows” are a newer design application used in California, and have been tentatively approved for the 2009 update to the CA MUTCD Standards. Sharrows are on-street stencils that reinforce that bicyclists are legitimate road users, and are helpful connectors between Class I or Class II facilities when roadway

widths are too narrow for a bike lane. Sharrows are suitable for streets with posted speeds below 35 mph, preferably with on-street parking.

Another potential application for sharrows is in high-conflict zones. Some cities are experimenting with colored bicycle lanes for this purpose; however, Sharrows are more immediately understood by motorists and cyclists as a bicycle facility. New York is the latest American city to use Sharrows this way, although they have long been used in Paris to raise the visibility of cyclists through complex intersections and to clearly indicate the best path of travel for cyclists.

Guidance for Sharrow Placement

(from Section 9C.07 of the 2009 MUTCD)

If used in a shared lane with on-street parallel parking, Shared Lane Markings should be placed so that the centers of the markings are at least 11 feet from the face of the curb, or from the edge of the pavement where there is no curb.

If used on a street without on-street parking that has an outside travel lane that is less than 14 feet wide, the centers of the Shared Lane Markings should be at least 4 feet from the face of the curb, or from the edge of the pavement where there is no curb.

If used, the Shared Lane Marking should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter.

Option: A “BICYCLES MAY USE FULL LANE” sign that may be used in addition to the Shared Lane Marking to inform road users that bicyclists might occupy the travel lane.

Figure B-16 | 2009 MUTCD Shared Roadway Marking Guidance for Installation

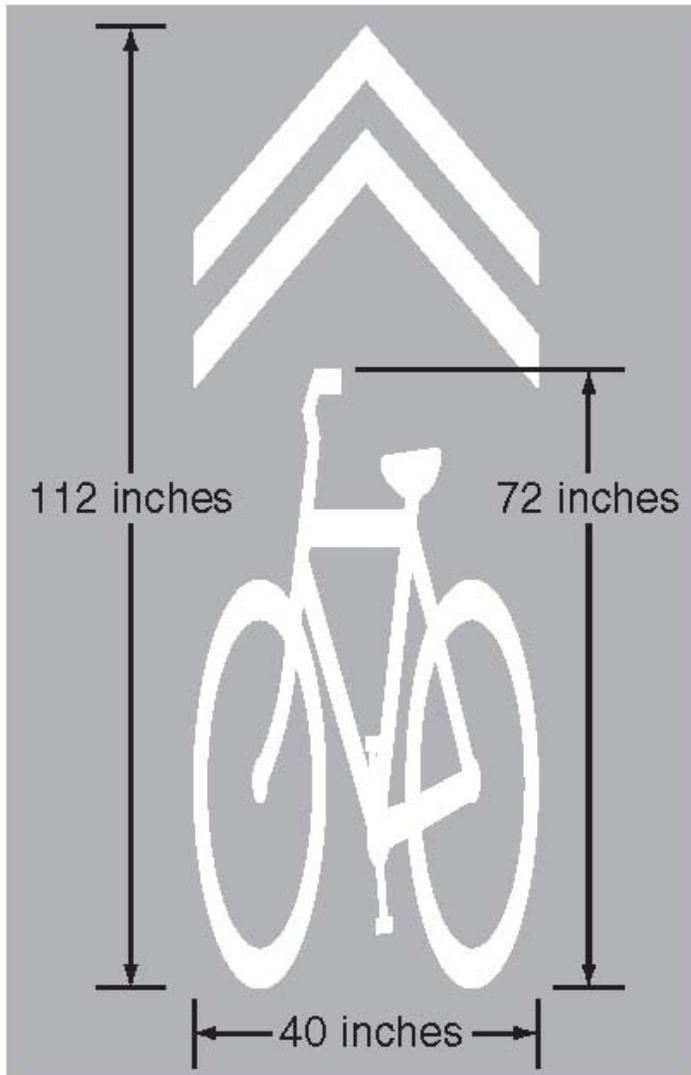


Figure B-17 | Caltrans Shared Roadway Marking Guidance

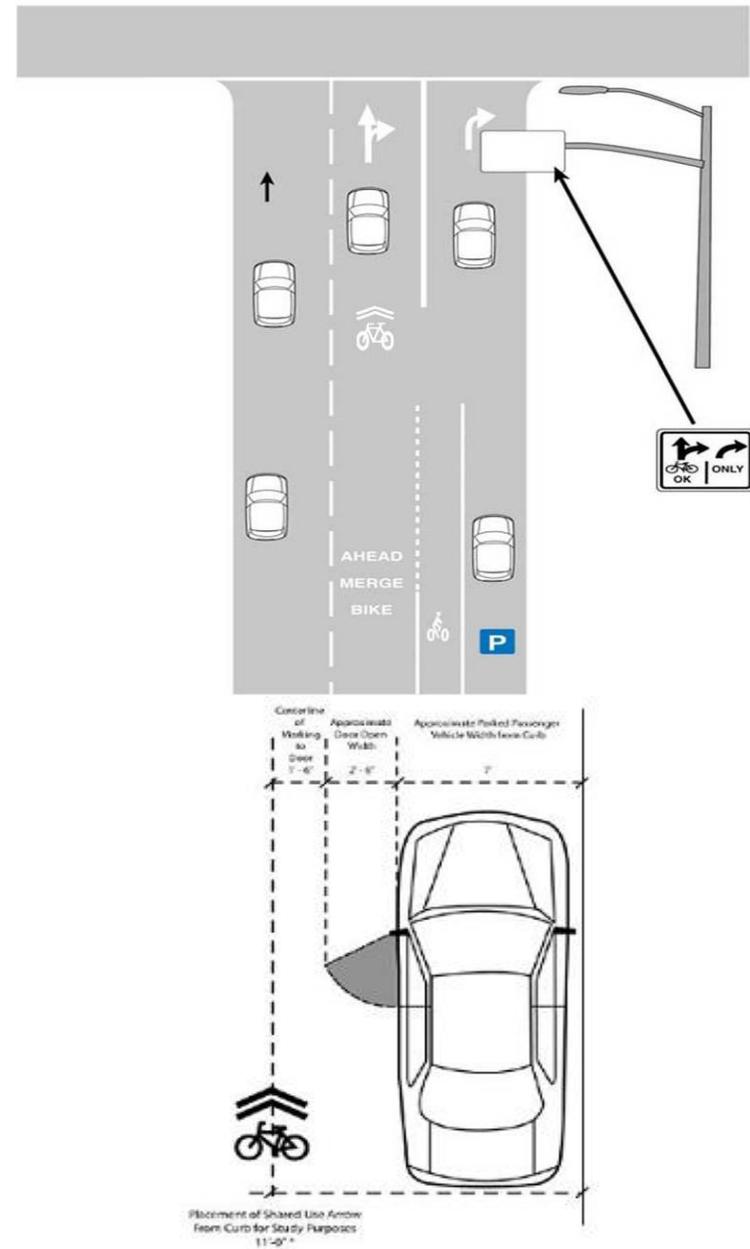
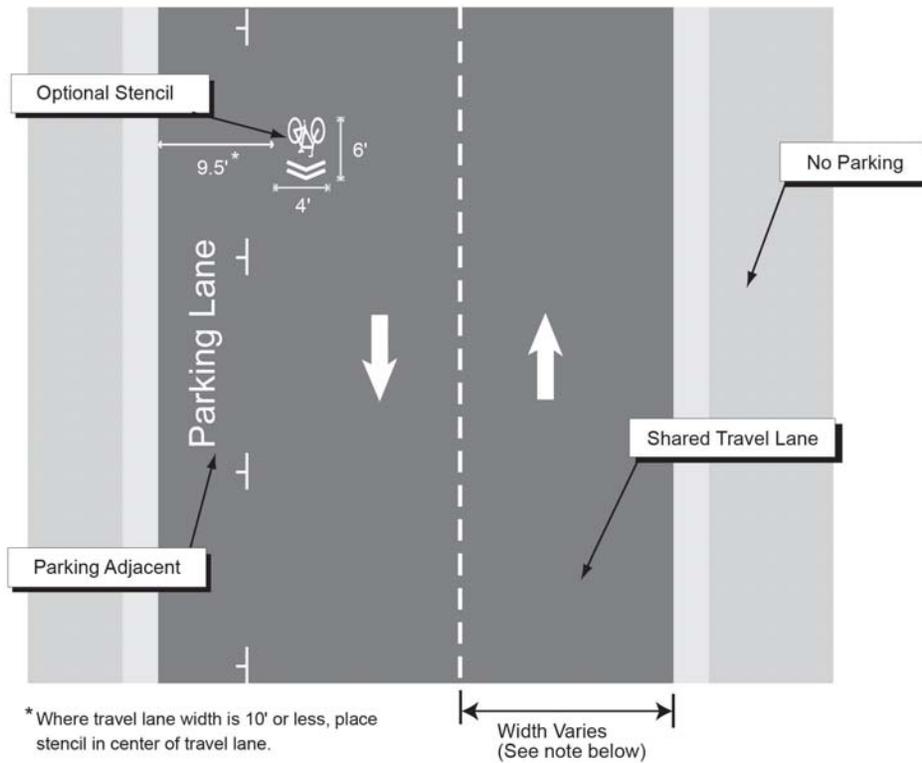


Figure B-18 | Typical Class III Bike Routes



* Where travel lane width is 10' or less, place stencil in center of travel lane.

TYPICAL SIGNING



NOTE:
Bike route width varies. 14' is desirable for a shared lane.

Bike Boulevards

An additional type of Class III facility is the Bicycle Boulevard. Typically, bike boulevards are on low-volume streets adjacent to higher volume arterials where bicycles have priority and have a relatively stop-free, low conflict route to their destinations. Traffic calming treatments such as traffic circles, chokers and medians are often used on bicycle boulevards to calm traffic.



Bike Boulevard in Berkeley, California

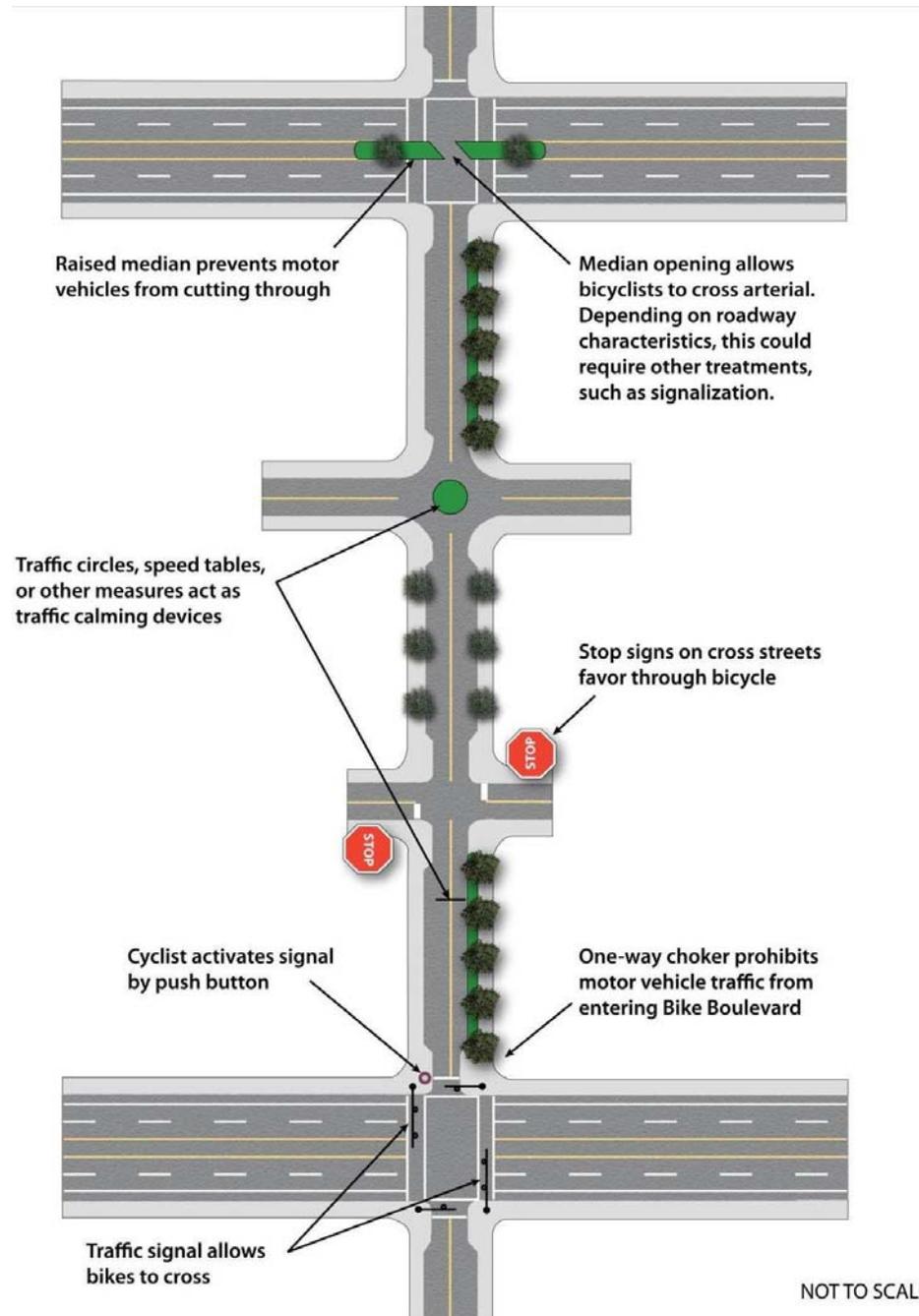
There are six general issues to address during bike boulevard implementation, as shown in the following table. These issues relate to bicycle and pedestrian safety and traffic circulation. There are two categories of tools that can help address these issues. The first category is called Basic Tools. These strategies are appropriate for all bicycle boulevards. The second category is called Site Specific Tools. These are used to varying degrees on a bicycle boulevard to respond to a specific issue, and they require more analysis and stakeholder involvement.

Table B-4 | Considerations and Tools for Bike Boulevards

Issue	Basic Tool	Site Specific Tools
<ul style="list-style-type: none"> • Create the look and feel of a bicycle boulevard • Slow traffic and discourage diversion of traffic to the bike boulevard when unwarranted STOP signs are removed. Unwarranted STOP signs cause excessive stopping and delay for cyclists. They also increase noise and air pollution, increase fuel consumption, and non compliance compromises safety for all. They often increase speeds mid-block as well. • Address school or pedestrian safety issues • Help bicyclists cross major streets • Reduce motor vehicle traffic speeds • Prevent diversion of motor vehicle traffic onto adjacent neighborhood streets 	<ul style="list-style-type: none"> • Signage • Unique pavement stencils • Pavement legends • Landscaping and street trees 	<ul style="list-style-type: none"> • Traffic circles • Curb extensions • Traffic signals • High-visibility crosswalks

Source: Berkeley Bicycle Boulevard Tools and Design Guidelines

Figure B-19 | Bike Boulevards



SUPER SHARROW LANES

On some collector or arterial streets a bike lane may be the preferred facility, but may not be feasible due to constrained roadway width or high vehicle volumes. Such streets are often designated as bike routes instead, but do not necessarily provide a sufficient level of comfort for everyone because bicyclists must ride between traffic with high speeds and volumes and on-street parking.

To address this issue, the City of Long Beach, California, received permission from the Federal Highway Administration to experiment with “Super Sharrow Lanes” along a key commercial district. The lanes have a typical Sharrow treatment with a six-foot strip of green paint down the center of the outer travel lanes to further indicate the appropriate position for bicyclists using the roadway, and to emphasize the expected location for bicyclists to general traffic.



Image: A Super Sharrow Lane on Second Street, Long Beach CA

Source: Dan Burden and Paul Zykovsky

Installation of Super Sharrow Lanes should be evaluated through an initial pilot phase, and in close coordination with AC Transit and other local transit providers to ensure that bus operations and safety are not affected. Macdonald and San Pablo Avenue may be good candidates for this experimental treatment.

BICYCLE PARKING

Every bicycle trip has two main components: the route selected by the bicyclist and the “end-of-trip” facilities at the destinations, such as safe and secure bicycle parking. This section provides guidance on the provision and placement of bicycle parking facilities.

As the Richmond bicycle network grows, so will the population that chooses to ride a bike. The availability of secure and convenient parking is as critical to bicyclists as it is for motorists. The availability of short and long-term bicycle parking at key destinations such as parks, schools, community facilities, transit stations, shopping areas and downtown is a vital part of a complete bicycle network.

Parking should be highly visible, accessible and easy to use. Facilities should be located in well-lit areas and covered where possible. Installation is equally important; for example a rack that is too close to a wall or other obstruction will not be effectively utilized. See the figures on the following pages for design specifications.

There are different types of parking facilities just as there are different levels of bikeway facilities. Parking facilities fall into one of three main categories:

In-Street / Sidewalk Parking		
<ul style="list-style-type: none"> Inverted U-Rack In-Street Bicycle Corral Covered Bicycle Parking Facilities Surface Parking Lot Conversion 	<p>Appropriate in areas with pedestrian activity and commercial areas. In-street facilities are ideal for areas with constrained sidewalk space.</p>	<p>Ideal for short-term parking needs (2-3 hours)</p>

Lockers		
<ul style="list-style-type: none"> Key Lockers Electronic Lockers 	<p>Appropriate for areas with low street activity or isolated areas.</p>	<p>Provides a high level of security, useful for long-term parking needs (>3 hours)</p>
Enclosed Facilities		
<ul style="list-style-type: none"> Bicycle Cage Bicycle Room Bicycle Station 	<p>Ideal for major transit hubs and areas with high bike volumes. Enclosed facilities can also be located in residential, commercial or employment centers with indoor space.</p>	<p>Provides the highest level of security, particularly when parking is attended. Ideal for long-term and over-night parking needs.</p>

In-Street/Sidewalk Parking

This section describes several types of typical in-street and sidewalk parking techniques.

Inverted U-Racks

Bicycle Racks are low-cost devices that provide a location to secure a bicycle. Ideally, bicyclists can lock both their frame and wheels. The bicycle rack should be in a highly visible location secured to the ground, preferably within 50 feet of a main entrance to a building or facility. Whenever possible, the racks should be visible from the doorways and/or windows of buildings, and not in an out of the way location, such as an alley. Short-term bicycle parking is commonly used for short trips, when cyclists are planning to leave their bicycles for a few hours.

The most common mistake in installing bike racks is placing them too close to a wall or fence, or orienting them the wrong way, rendering the rack unusable; nor should they impede pedestrians. In addition, in order to accommodate a range of bicycle styles and sizes, racks must be installed to allow sufficient space between bicycles and between racks.

Bicycle Rack Materials & Coatings

There are a variety of materials and coatings available for steel bicycle racks. Individual choices may vary depending on the available budget and aesthetic preferences, but the main options include the following:

Stainless Steel is the recommended choice because it is attractive and relatively maintenance free, but it is also typically the most expensive.

Galvanized Coatings are durable and much cheaper than stainless steel, but galvanized racks are not typically considered as attractive as other options. The low price and easy maintenance makes galvanized racks one of the mostly popular options.

Vinyl Coating is a good option when aesthetics and durability are considered. Vinyl requires minimal maintenance. More importantly, vinyl coatings are the most user-friendly of all the options because they will not scratch bicycles the way harder coatings will.

Powder Coating provides the best color coating option and is highly durable. It is more resistant to wear than regular paint and can easily be touched up if needed. Powder coating is usually the same cost as galvanized.

Paint is not as durable as some of the other options. This is a major issue in an area like Alameda where metal surfaces are subjected to alternating cycles of large amounts of rain in the winter months and searing heat in the summer. Paint chips, wears off quickly and requires regular repainting and maintenance to keep a reasonable appearance.

If there is space for two or more bikes on a single rack, there must be a minimum of 30 inches center to center between bicycle tires when bicycles are locked side to side; otherwise, the handlebars of one bicycle can prevent another bicycle from parking in the adjacent space.

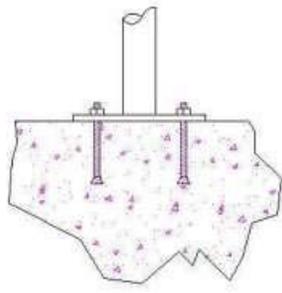


Image: Covered bike racks protect bicycles from rain and other elements.

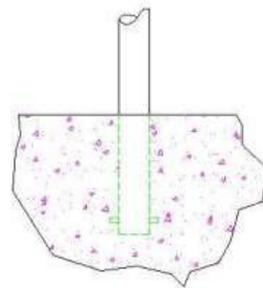
In addition to optimizing space by situating adjacent bicycles a sufficient distance apart, bicycle racks must be installed to allow sufficient space for bicyclists and their bicycles to move about between racks. In most cases, a standard bicycle footprint is six feet long. Aisles between rows of racks must be a minimum of four feet wide.

Other Considerations

- There are two primary types of rack installation: surface mount and cast-in place. Surface mount is preferred, however racks are designed for only one or the other installation type. In all cases, racks should be installed in concrete, never in soil and rarely in asphalt. There are issues to consider with each type of installation, detailed below:
- **Surface mount:** for installation after the substrate is in place (e.g. concrete slabs). For many rack types, this is the only option, but care should be taken in choosing the installation hardware. A technique among bicycle thieves is to steal a whole rack and load it into a truck, so only anti-tampering bolts and other hardware should be used. Surface mounted bicycle racks should only be mounted in concrete – asphalt will not securely hold the mounting hardware. If an asphalt substrate is all that is available, concrete footings should be poured. Multiple loop racks on flanges may be installed in asphalt, which can be useful for in-street bike corrals. For a more secure rack installation, perpendicular bars could be installed under the surface to prevent the rack from being pulled directly from the concrete. See illustration, below.



Surface mount bicycle rack installation



Embedded bicycle rack installation, also known as "cast-in-place" (courtesy of Creative Metalworks)

Embedded or cast-in-place: consider whether the location where the rack needs to be installed may already have a slab poured, or the chosen rack type may not provide a cast-in-place option. Also, embedded racks are expensive to relocate in the future if needed. Cast-in-place installation is appropriate for asphalt or concrete. See illustration, left.

- **Bicycle Spacing:** The basic footprint of bicycle parking design, whether parked horizontal or vertical, is 6 feet long, 2 feet wide, and 4 feet high. There are also spatial parameters to consider, and some rack makers do not allow enough space between the racks to allow for handlebar widths. The following specifications for inverted U-racks provide guidance on the minimum space needed. Where possible, provide additional spacing.

Poor rack design



This design is too low and poses a tripping hazard, and its small parts may scratch bikes. (Source: Sacramento Area Bicycle Advocates)

"Wheel bender" bicycle rack



When full, bicycles in the middle only have one source of support. (Source: Sacramento Area Bicycle Advocates)

- **Spacing between Bicycles:** If there are two or more rack spaces joined together, there must be a minimum of 30 inches center-to-center between bicycle tires when bicycles are locked side to side, and more if space is available. Otherwise, handlebars can get tangled up – a situation that is especially critical when dealing with large volumes of bicycles with relatively high turn-over of parking.
- **Spacing between Racks:** Aside from the physical space requirements between bicycles on the racks, space must be made for bicycles to move about between racks. If an aisle must be made between bicycle racks, a minimum of two feet wide and six feet long with a three foot aisle must be set aside to allow room for bicycles to move in and out of the racks. Spacing between racks or between a rack and other fixed objects can still be an issue. For most types of bicycles, six feet is considered a standard footprint. The graphics on the right show typical dimensions and placement requirements for bicycle parking racks. This type of rack can be installed in multiples to provide additional bicycle parking.



An old bike rack at Richmond City Hall demonstrates the need for proper bike rack design

Figure B-20 | Recommended Bike Rack Spacing (Association of Pedestrian and Bicycle Professionals)

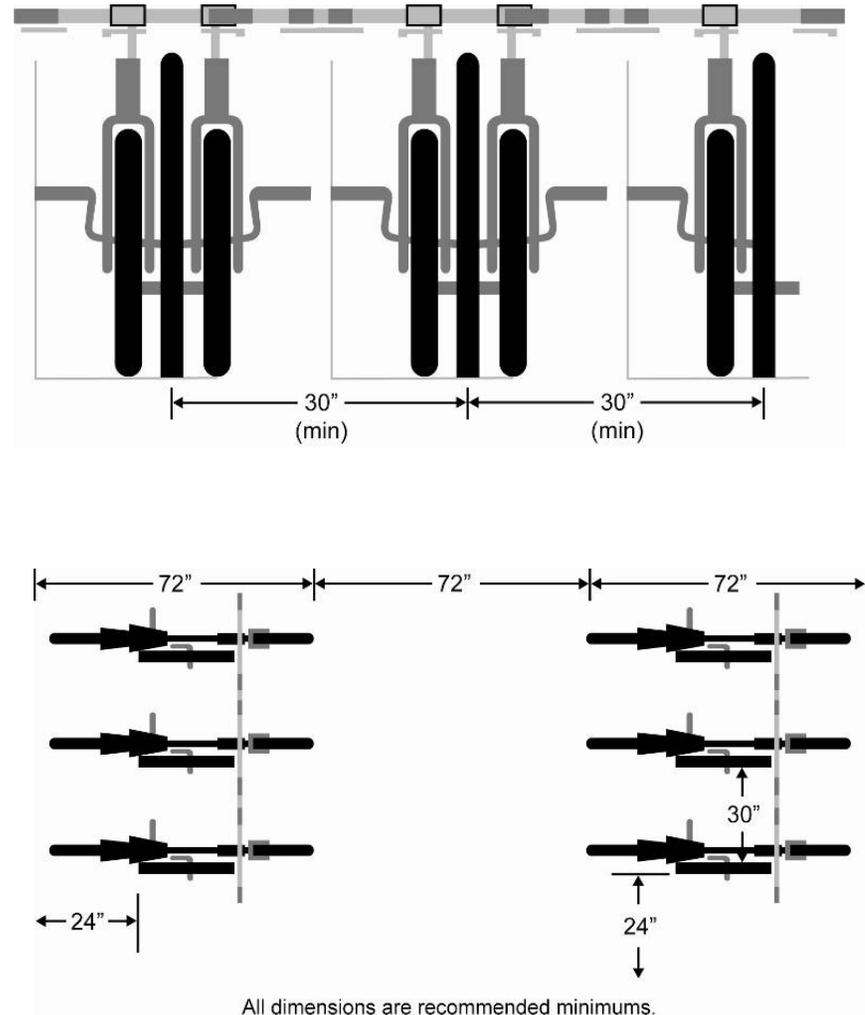
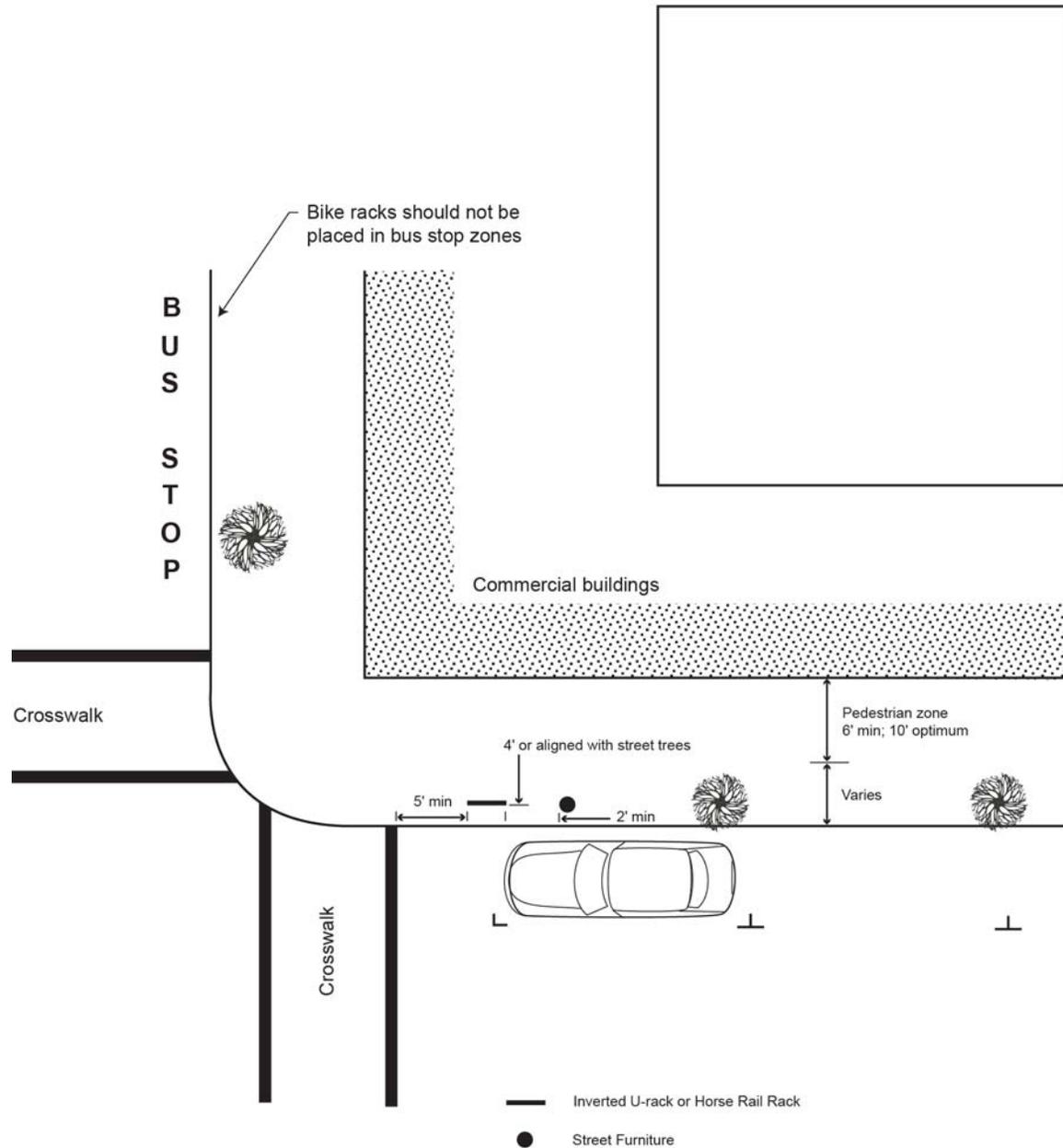


Figure B-21 | Bike Parking on Sidewalks



In-Street Bicycle Corral



This option is ideal for locations with a high parking demand and insufficient sidewalk space. Bike corrals have been used in Portland, San Francisco and Berkeley and involve replacement of parking spaces

with inverted U-racks. Bollard installation is recommended to protect cyclists and bicycles from adjacent vehicles. Two vehicle parking spaces can accommodate a corral with 10-12 racks for 20-24 bikes. Costs vary depending on the choice of materials, but can range from \$3,000 for a multiple loop rack and flexible bollards, to \$45,000 for a poured concrete pad, stainless steel bollards and custom racks. Corrals are a relatively low-cost option that reduce sidewalk clutter and do not obstruct the public right-of-way. Corrals can be placed in red zones, but frequently vehicle parking may be removed. If parking is a priority in a given area, local jurisdictions should decide whether bike corrals are appropriate.

Candidate locations for in-street bike corrals include:

- Pt. Richmond, adjacent to Starbucks
- Catahoula Coffee and Williams Health Foods on San Pablo Avenue
- Adjacent to the Mira Vista Post Office
- Nichol Park adjacent to the skate park

Covered Facilities



Covered bicycle racks, also referred to as a “bicycle oasis” provide shelter from weather conditions, constant rain in the winter takes its toll on bicycles causing a bike’s metal frames to rust, but constant sunlight all summer can be worse with ultraviolet rays deteriorating seats and tires. Covered bicycle parking has also been proven to increase cyclists’ willingness to park their bicycles for longer periods of time. In order to provide secure coverage from rainfall

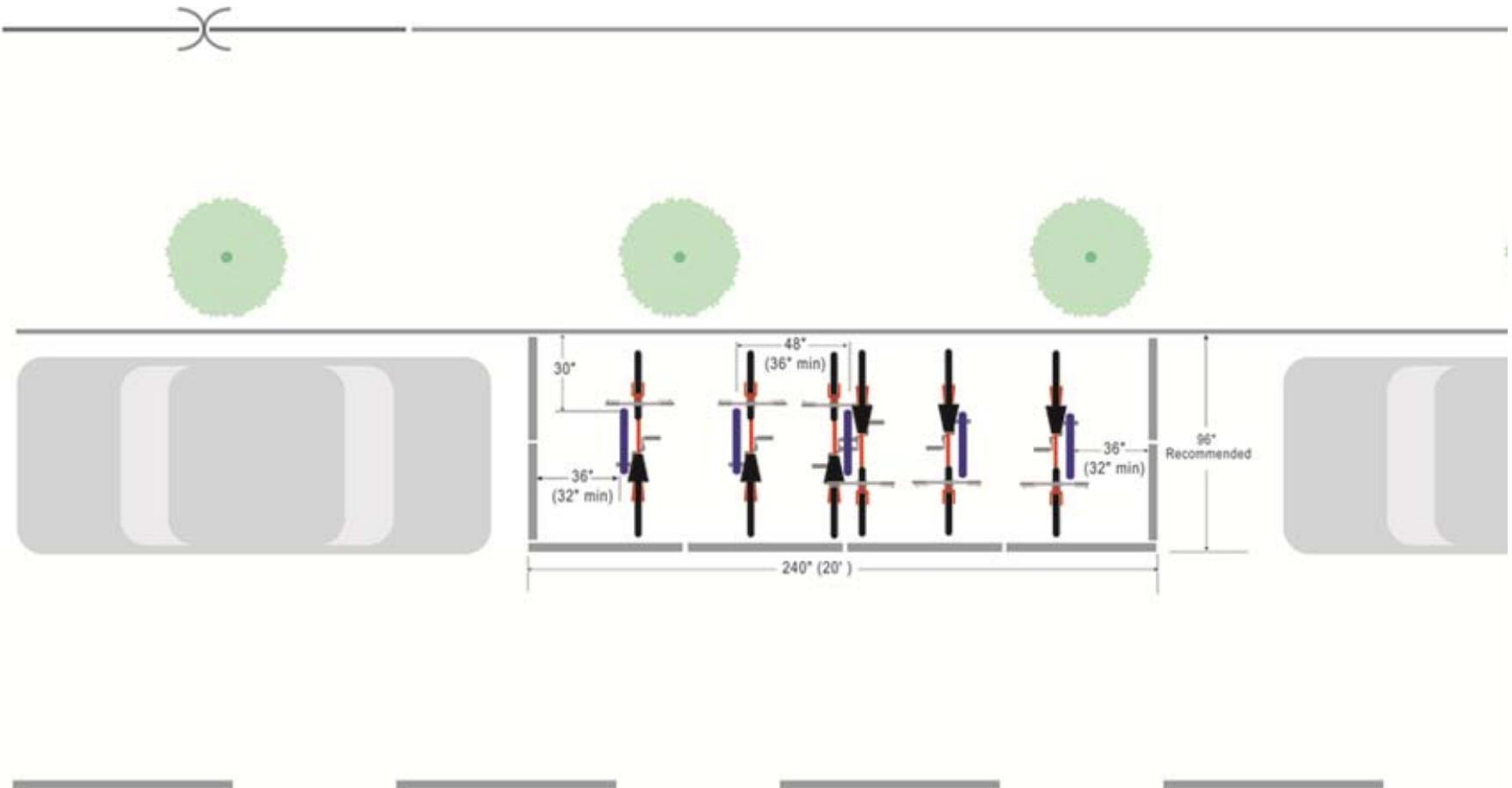
and clearance for cyclists, the cover should be at least seven feet above the ground. Existing covers such as overhangs or awnings are a low cost way of incorporating covered parking.

New York City and Portland have begun to implement covered bicycle parking. These designs provide shelter, map and advertisement capabilities (see photo, right). Covered racks do not necessarily deter theft any more than uncovered racks, and partial cover or cover that is too high does not protect against weather conditions and thus defeats the purpose.

Surface Parking Lot Conversion

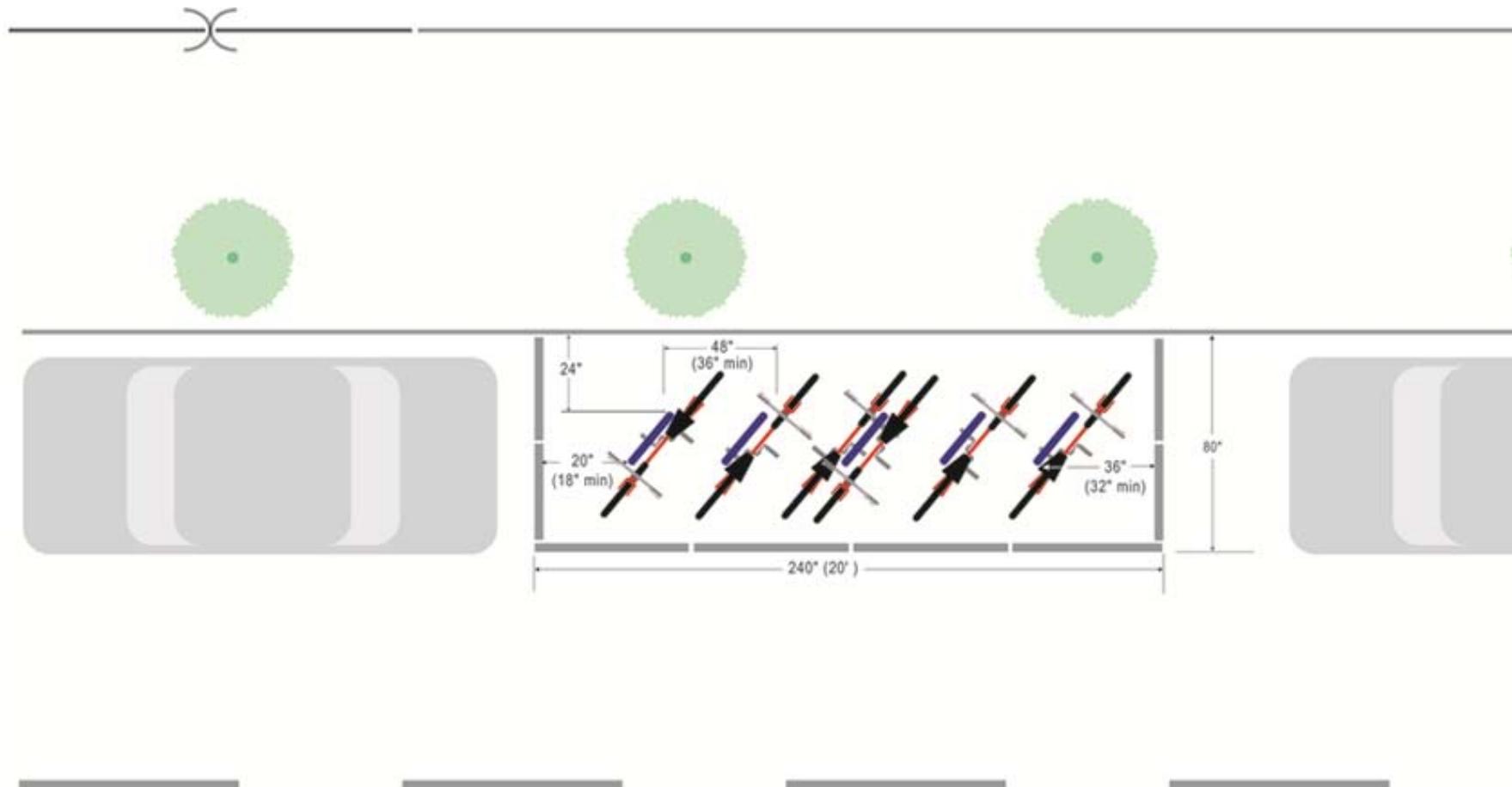
Parking lots near key destinations are ideal places for converting a few parking spaces into short term or long-term bicycle parking. Six racks can fit into the space occupied by one car. Adding U-racks with bollards and a covered or fenced area designates bicycle parking from vehicle parking. Bike cages can also be used in parking lots and provide security access through electric pass key systems. Simpler, less expensive modifications of surface lot parking spaces, such as a bike corral may be considered.

Figure B-22 | Bicycle Parking Layout for an In-street Parking Space (Perpendicular)



(Image source: The Association of Pedestrian and Bicycle Professionals)

Figure B-23 | Bicycle Parking Lay-out for an In-street Parking Space (Diagonal)



(image source: The Association of Pedestrian and Bicycle Professionals)

Bicycle Lockers

Bicycle Lockers are covered storage units that can be locked individually, providing secure parking for one bicycle. Bicycle cages are secure areas with limited-access doors. Occasionally, they are attended. Each of these means is designed to provide bicyclists with a high level of security so that they feel comfortable leaving their bicycles for long periods of time. They are appropriate for employees of large buildings and at transit stations. Lockers provide a secure place for bicyclists to store their helmets or other riding gear. Showers are important for bicycle commuters with a rigorous commute and/or formal office attire.

Bicycle Locker Materials

Stainless Steel is the best material because it is the strongest and most durable, it reflects sunlight well, and requires the least amount of maintenance because stainless steel never needs painting. Increasingly, perforated panels are being used for security purposes to make the contents of the locker visible. Perforated panels reduce the weather protection of the locker, and the top of the locker should always be solid. Also, consider placing perforated lockers in areas less exposed to the elements.

Powder Coated Steel is the second best option. Although not as durable as stainless steel, powder coat will last many years and gives the purchaser a broad range of color options (note: dark colors should be avoided due to heat absorption in the summer.)

Composite Materials such as resin based materials, chip-board, and particle board should be avoided. These materials photo-oxidize and break down quickly, and are easier to break into than steel lockers. However, lockers made of non-metallic sheet molding composites, such as the Cycle-Safe brand, are achieving new levels of quality, performance and cost-effectiveness.

Electronic Lockers



19th Street & Broadway Downtown Oakland BART
(Photo by Jason Patton, City of Oakland)

Electronic bike lockers provide secure individualized parking that can be accessed with an electronic card. Unlike standard key lockers, which provide one key for one renter, a single e-locker can be rented by multiple cyclists each week

by using smart card technology. The improved efficiency translates into greater availability, and is a popular option at transit stations throughout the Bay Area.

Bicycle lockers come in a variety of shapes and sizes depending on the need and the amount of space available. The most common bicycle locker size is approximately 40" wide by 48" high by 72" long. These typically have a diagonal divider inside the locker so that they will accommodate two bikes. Lockers with diagonal dividers are designed to open from two sides, so there should be adequate room on both sides of the locker to comfortably open the door and slide the bicycle in and out, which equates to six feet of clearance from both doors (see graphic below.)

Wedge-shaped locker units accommodate one bicycle, and are a useful design for corner areas. They can also be placed against walls in areas with a constrained public right-of-way.

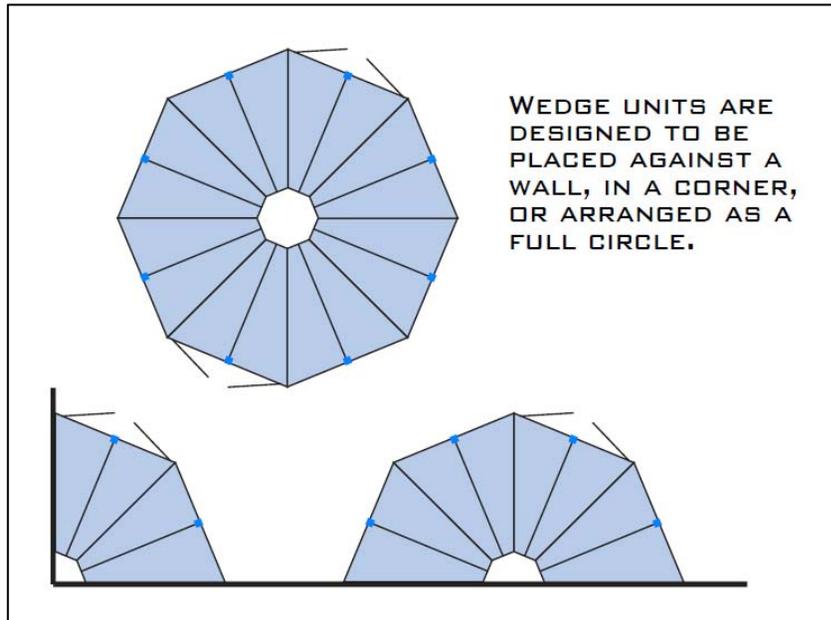
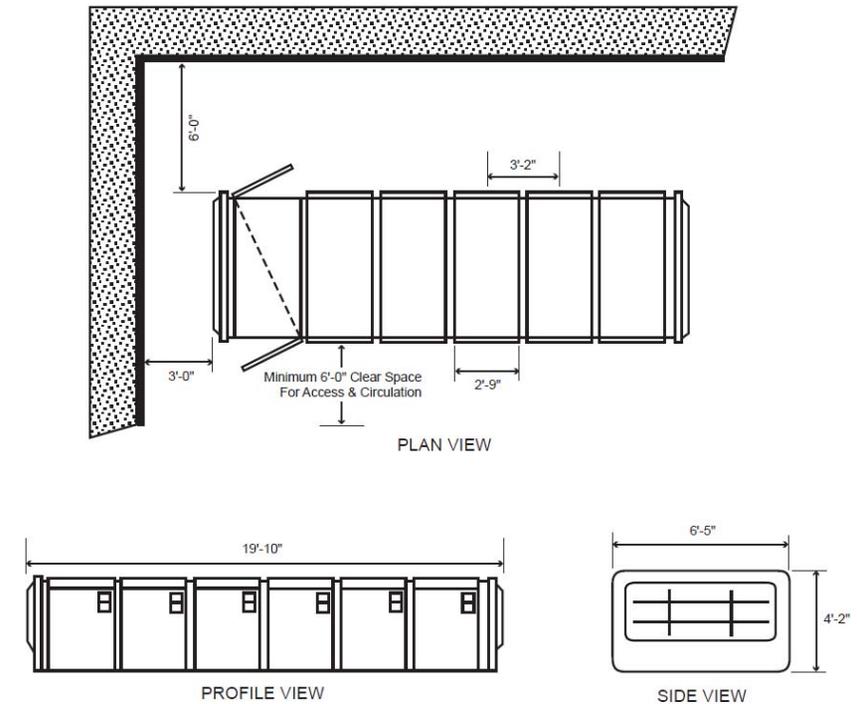


Image courtesy of BikeLink eLock-

Figure B-24 | Bike Locker Placement Guidance



Enclosed Facilities

This section describes several types of typical off-street and enclosed parking facilities.

Bicycle Cage

Bike cages are shared access storage areas in which cyclists lock their own bikes. Bike cages are often used by transit centers and large employers or universities to provide an extra layer of security for long-

term bike parking. Cages are a popular option for bike commuters because they provide a high degree of security and they protect bikes. Bike cages can be accessed by registered users at any time, and with unlimited ins and outs.



High security bike cages
Photo sources: J. Luton & J. Stanley

cages have used conventional lock-and-key systems, but these have proved cumbersome from an administrative standpoint. Magnetic pass keys also allow parking managers to monitor who goes in and out of the bike cages. Local jurisdictions or local non-profit organizations are typically responsible for implementing and maintaining this type of facility.

While cages provide additional security over U-racks or other on-street parking facilities, many people may have access to the facility. Small cages are preferred to limit the number of people with access to any single cage. Security may be bolstered by surveillance cameras and monitoring. A single cage of 18' by 20' occupies the same footprint as two standard parking stalls (or 9' by 20' each.)

Cyclists gain access to the bike cage by signing up in advance for a key or a key code. Historically, bike

Bicycle Rooms

Bike rooms provide enclosed and sheltered parking and protection from theft. A bike room is an excellent option for a transit terminal, but any available building floor space can be converted into a bike room. Bike rooms may have wall racks or floor racks, and should allow easy access by elevator or ramp to the ground level. Adding self-serve features such as bike pumps, bike stand and basic tools creates extra amenities to cyclists. They also require little maintenance and an attendant is not needed because users are provided with an access code to enter facility.

Bike rooms are ideal in business parks or apartment or condominium complexes. Individual businesses or apartment complexes would be responsible for providing bike room facilities.

Bicycle Station

The ultimate safety and security option for bike commuters and their bikes is the bike station, which combines all the safety features of good racks, the security of a bike cage, and attended parking; typically only the staff person may check bikes in and out. Users may or may not have to pre-register. In addition to high security bike parking, most bike stations also sell basic bike accessories, some sell bikes, and the majority provide basic bike repair while the cyclist is at work. These extra repair and retail services generate revenue to offset staffing costs and provide additional services for users. All of these options provide further incentives for cyclists to leave their bikes at the station. However, the hours of operation can be limited by funding constraints. Cyclists who want to retrieve their parked bike after hours can only do so by prior arrangement with the staff operator. There is usually no charge for regular day or overnight parking in the first few years of operation, since there are usually grant subsidies for operations. Bike

stations would be appropriate at major transit hubs such as a ferry terminal.



Bicycle Station at 4th & King Caltrain Station, San Francisco
 Photo Source: Jim Dyer

Bicycle stations have high capital and operating costs and may not be feasible unless co-located with other attractors such as major transit hubs, high-density housing and retail. A short- to medium-range improvement for bicycle parking would be an unstaffed high capacity bicycle cage(s). The Richmond Intermodal Transit Village would be an ideal location for a bicycle station.

BICYCLE SIGNAGE

Several new bicycle guide signs, along with information on their use, will be added to the 2009 CA MUTCD guidelines. These signs provide flexibility and may reduce costs for signing bicycle routes in urban areas where multiple routes intersect or overlap.

Wayfinding and Destination Signage



Among these signs are a new Alternative Bike Route guide sign and new Bicycle Destination signs, which indicate direction, distance in miles and destinations along bicycle routes.

In July 2009, the City of Oakland adopted a new system for bicycle wayfinding signage² based on these new MUTCD sign standards, with the addition of the City of Oakland logo (see image, right). The City of Richmond should consider adopting a similar system, and should consider a logo or City seal that reflects local qualities.

The green sign system includes three sign types:

- **Confirmation Signs:** Confirm that a cyclist is on a designated bikeway. Confirmation signs are located mid-block or on the far side of intersections, and include destinations and distances
- **Turn Signs:** Indicate where a bikeway turns from one street on to another street. Turn signs are located on the near side of intersections, and include directional arrows.

² The City of Oakland's Design Guidelines for Bicycle Wayfinding Signage can be found at <http://www.oaklandpw.com/AssetFactory.aspx?did=3528>

- **Decision Signs:** Mark the junction of two or more bikeways. Decision signs are located on the near-side of intersections, and include destinations and directional arrows.

Destination symbols, such as to the Richmond BART Station, shoreline access, bridge approaches and community destinations may be used. The figure on the next page illustrates these sign types.

Signs for Shared Roadways



Share the Road Signage: A “Share the Road” sign assembly (W11-1 + W16-1P) is intended to alert motorists that bicyclists may be encountered and that they should be mindful and respectful of them. However, the sign is not a substitute for appropriate geometric design measures that are needed to accommodate bicyclists. The sign should not be used to address reported operational issues, as the addition of this warning sign will not significantly improve

bicycling conditions. The sign may be useful under certain limited conditions, such as at the end of a bike lane, or where a shared use path ends and bicyclists must share a lane with traffic. The sign may also be useful during construction operations, when bicyclists may need to share a narrower space than usual on a travelway. This sign should not be used to indicate a bike route. A fluorescent yellow-green background can be used for this sign.

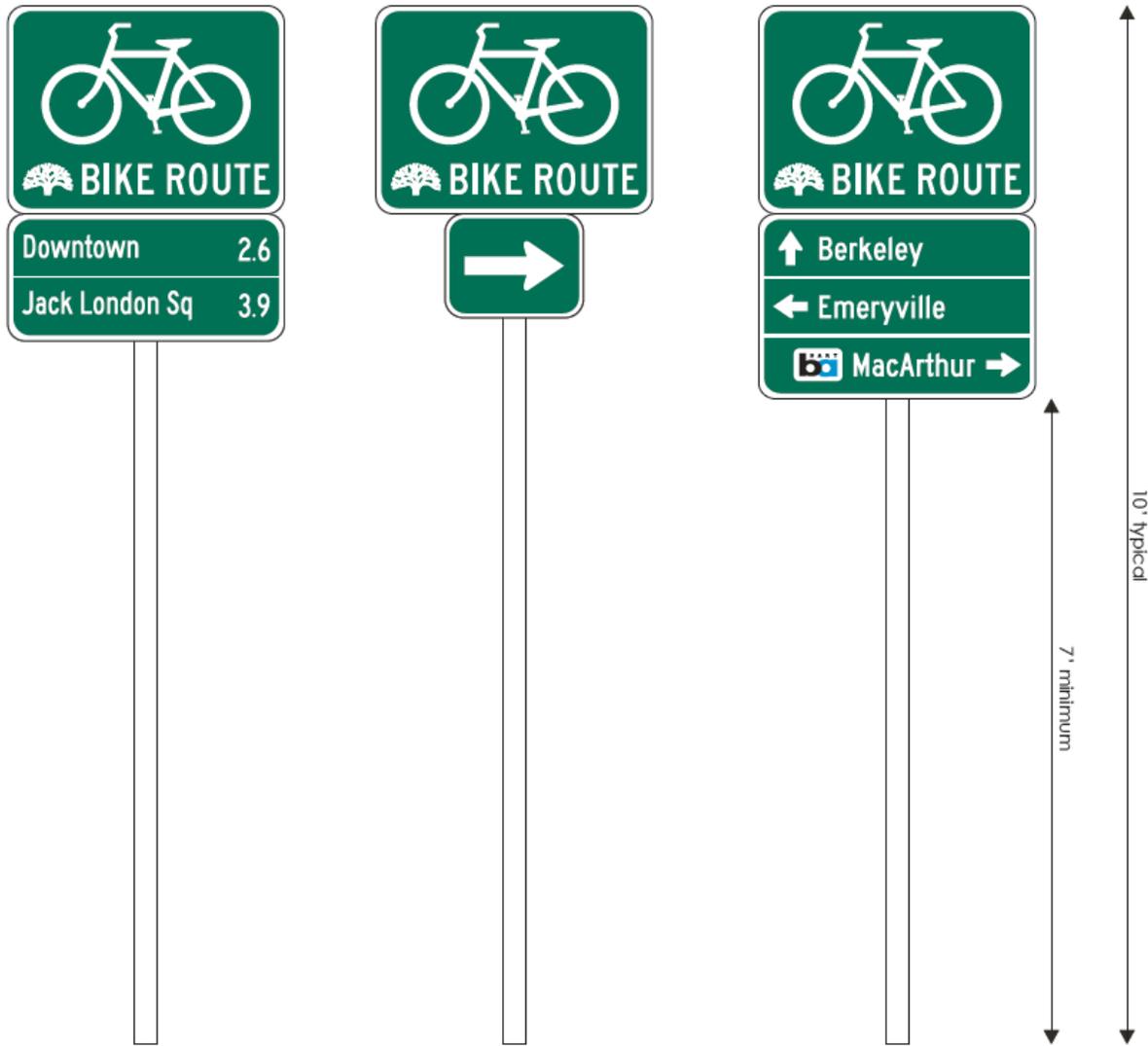
Another sign that may be used in shared lane conditions is the BICYCLES MAY USE FULL LANE sign (R4-31 11). This sign may be used on roadways without bike lanes or usable shoulders where travel lanes are too narrow for cyclists and motorists to operate side by side within a lane.



Wrong Way Riding: Where wrong-way riding by cyclists is a frequent problem, the MUTCD provides a bicycle WRONG WAY sign and RIDE WITH TRAFFIC plaque (R5-1b and R9-3cP) that can be mounted back-to-back with other roadway signs (such as parking signs) to reduce sign clutter and minimize visibility to other traffic. This sign assembly can be used in shared lane situations, as well as on streets with bike lanes and paved shoulders.

Figure B-25 | Bicycle Sign Types for the City of Oakland

(source: City of Oakland Design Guidelines for Bicycle Wayfinding Signage, July, 2009)



Confirmation Sign

Turn Sign

Decision Sign

MAINTENANCE STANDARDS

Since most cycling occurs on public roads, roadway maintenance is an important part of accommodating cycling. Below are some types of targeted maintenance.³

Surface Repairs: Inspect bikeways and road shoulders regularly for surface irregularities, such as potholes, pavement gaps or ridges. Such hazards should be repaired quickly.

Sweeping: Prioritize bike routes when establishing a street sweeping schedule. Sweeping road shoulders of accumulated sand and gravel in the springtime, and fallen leaves in the autumn where they accumulate. Sweepings should be picked up rather than just pushed aside in areas with curbs. Driveway approaches may be paved to reduce loose gravel on paved roadway shoulders. Off-street bike facilities should have an established maintenance schedule that includes routine sweeping.

Pavement Overlays: Where new pavement is installed, extend the overlay to the edge of the roadway. If this is not possible, ensure that no ridge remains at the edge of the road shoulder or bike lane. Do not leave a ridge within the bike travel area. Drain grates should be within 6 millimeters of the pavement height to create a smooth travel surface. Special attention should be given to ensure that utility covers and other road hardware are flush with new pavement.

³ Todd Litman, Robin Blair, Bill Demopoulos, Nils Eddy, Anne Fritzel, Danelle Laidlaw, Heath Maddox, and Katherine Forster. *Pedestrian and Bicycle Planning: A Guide to Best Practices*. Victoria Transport Policy Institute (2010)

Rail Crossings: Rail crossings can be hazardous to cyclists, particularly if they are at an oblique angle. Warning signs and extra space at the road shoulder can allow cyclists to cross at a 90° angle. A special smooth concrete apron or rubber flange may be justified at some crossings.

Vegetation: Vegetation may impede sight lines, or roots may break up the travel surface. Vegetation should be cut back to ensure adequate sight lines, and invasive tree roots may be cut back to preserve the travel surface.

Street Markings: Bike lane markings signal loop indicators may become hard to see over time. These should be inspected regularly and retraced when necessary.

Markings: Whenever roadway markings are used, traction or non-skid paint should be used to avoid the markings becoming slippery in wet weather.

Utility Covers and Construction Plates

Utility covers and construction plates present obstacles to bicyclists due to their slipperiness and change in surface elevation with the surrounding pavement. While covers and plates can be replaced with less slippery designs, as discussed below, to minimize their adverse impacts on bicyclists, it is best to design the roadway so that they are not located within the typical path of bicyclists riding on the roadway. Therefore, new construction should endeavor not place manhole and other utility plates and covers where bicyclists typically ride (i.e. within the six feet adjacent to the curb, or between 7 and 12.5 feet from curb if parking is permitted). These guidelines require a minimum of 2.5 feet straight and clear.

Wet utility covers and construction plate materials can be slippery. Plain steel plates are slippery and should not be used for permanent installation on the roadway. Temporary installations of construction plates on the roadway should endeavor to avoid using plain steel plates if possible. The placement of construction plates should consider bicycles and if possible, be located to provide a clear zone for cyclists to avoid the plates. An example of an effective method for covers and plates (both steel and concrete) to have acceptable skid resistance is for the manufacturer to imprint waffle shaped patterns or right-angle undulations on the surface. The maximum vertical deviation within the pattern should be 0.25 inch (6 mm).⁴

⁴ *Santa Clara Valley Transportation Authority Bicycle Technical Guidelines*