Appendix B – Bicycle Design Guidelines/Best Practices Manual

This chapter provides design guidelines gathered from local, state and national best practices. It is intended to serve as a guide for city planners, engineers, and designers when designing and constructing bicycle facilities in the San Diego region. The design guidelines presented in this appendix are a combination of minimum standards outlined by the *California Highway Design Manual's* Chapter 1000, recommended standards prescribed by the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* and the CA MUTCD. The minimum standards and guidelines presented by Chapter 1000 and AASHTO provide basic information about the design of bicycle facilities, such as bicycle lane dimensions, striping requirements and recommended signage and pavement markings. These guidelines also include recommendations for optional design treatments that are not intended to represent a minimum or maximum accommodation or to replace any existing adopted roadway design guidelines. Also included in these guidelines are experimental or nonstandard best practices with information about optional innovative bikeways and support facilities that have not been adopted by the *California Manual of Uniform Traffic Control Devices (California MUTCD)* or by the State of California for use in California and do not currently meet *Highway Design Manual, Chapter 1000* design requirements.

Final design of any bikeway should be conducted by a licensed engineer using sound engineering judgment and applicable standards and guidelines.

B.1 **Design References** lists the documents used to develop the San Diego region bicycle facility guidelines.

B.2 **Design Principles** describes the principles that should be used in implementing the San Diego region design guidelines.

B.3 **Standard Designs of Bicycle Facilities** provides general descriptions of California bikeway classifications, standard treatments, and standard signage.

B.4 **Innovative Treatments and Signage** presents treatments and signage that are intended to enhance safety but are not standard in California according to the *California MUTCD* or *Caltrans Highway Design Manual, Chapter 1000*.

B.5 **Bicycle Parking** describes guidelines for placing bicycle parking, and design guidelines for bicycle racks, bicycle lockers, and high-volume bicycle parking options such as bicycle corrals and bike stations.

B.1 Design References

The bikeway design principals outlined in this chapter are derived from the regional, state, and national documents listed below. Many of these documents are available online and provide a wealth of information and resources to the public.

- *Highway Design Manual, Chapter 1000: Bikeway Planning and Design* (California Department of Transportation, 2006).

  http://www.dot.ca.gov/hq/oppd/hdm/pdf/chp1000.pdf

- *California Manual of Uniform Traffic Control Devices for Streets and Highways, Part 9: Traffic Controls for Bicycle Facilities* (California Department of Transportation, 2006). http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd/CAMUTCD-Part9.pdf

- *Guidelines for the Development of Bicycle Facilities* (American Association of State Highway and Transportation Officials, 1999). http://www.transportation.org/

- Federal Highway Administration *Best Practices Design Guide Part 2, Designing Sidewalks and Trails for Access* (FHWA Pub# FHWA-EP-01-027, 1001)

- *AASHTO Green Book: Policy on Geometric Design of Streets and Highways* (American Association of State Highway and Transportation Officials, 2001). www.transportation.org

- *Bike Lane Design Guide* (City of Chicago and Pedestrian and Bicycle Information Center, 2002). http://www.bicyclinginfo.org/pdf/bike_lane.pdf

- *Bicycle Parking Design Guidelines* (Association of Pedestrian and Bicycle Professionals, 2002). http://www.bicyclinginfo.org/pdf/bikepark.pdf

- *Pedestrian and Bicycle Facilities in California: A Technical Reference and Technology Transfer Synthesis for Caltrans Planners and Engineers* (California Department of Transportation, 2005)

- *Innovative Bicycle Treatments* (Institute of Transportation Engineers, 2003)

- *Bicycle Boulevard Design Tools and Guidelines* (City of Berkeley, 2000)

- *Bicycle Boulevards Technical Memorandum* (Alta Planning + Design, 2007)

- *Cycle Tracks: Lessons Learned* (Alta Planning + Design; Burchfield, Robert, 2008)

All bikeway facilities are required at a minimum to meet the design guidelines outlined in the *Highway Design Manual, Chapter 1000* and in the *California MUTCD*. Jurisdictions in the San Diego region are encouraged to consider application of the innovative design treatments where appropriate. When using design treatments not approved by the *California MUTCD* and the *Highway Design Manual, Chapter 1000*, agencies in the San Diego region must follow the protocol for testing innovative treatments specified by the State.

B.2 Design Principles

The following key principles were followed in developing the San Diego regional bicycle network as proposed in this plan:

- The San Diego region will have a complete and interconnected network of on-street bicycling facilities and shared-use paths that will provide bicycle access across the region to a broad range of bicycle users.

- All roads in the San Diego region are legal for the use of bicyclists, (except those roads designated as limited access facilities which prohibit bicyclists). This means that most streets are bicycle facilities, and will be designed and maintained accordingly.

- The San Diego region should strive for 'complete streets' as called for by the California Complete Streets Act of 2008. Complete streets are designed to safely accommodate all users, including bicyclists, pedestrians, transit riders, children, older people, and disabled people, as well as motorists.

Design guidelines are intended to be flexible and should be applied with professional judgment by licensed engineers. In this manual, design guidelines approved by the *California MUTCD* and the *Highway Design Manual, Chapter 1000* are differentiated from innovative design treatments that are not yet approved. When using design treatments not approved by the standard regulatory documents, agencies in the San Diego region must follow the protocol for testing innovative treatments specified by the State.

B.3 Standard Designs of Bicycle Facilities

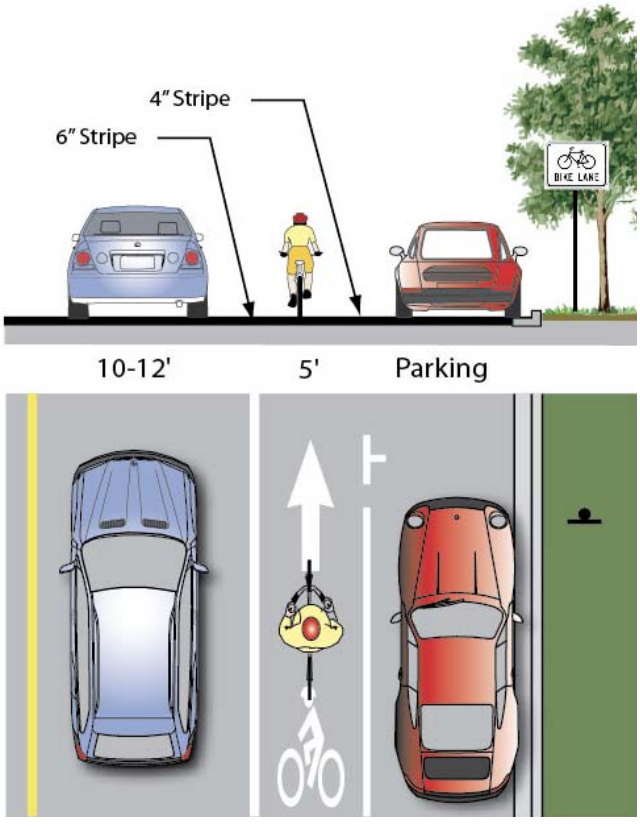
According to Caltrans, the term "bikeway" encompasses all facilities that provide primarily for bicycle travel. Caltrans has defined three types of bikeways in the *Highway Design Manual, Chapter 1000*: Class I, Class II, and Class III. For each type of bikeway facility both "Design Requirements" and "Additional Design Recommendations" are provided. "Design Requirements" contain requirements established by *Highway Design Manual, Chapter 1000,* including minimum dimensions, proper pavement markings, signage and other design treatments for bicycle facilities. "Additional Design Recommendations" are provided as guidelines to assist with design and implementation of facilities and include alternate treatments approved or recommended but not required by Caltrans. This section provides an overview of these standard bicycle facilities.

Class II Bike Lanes

Description

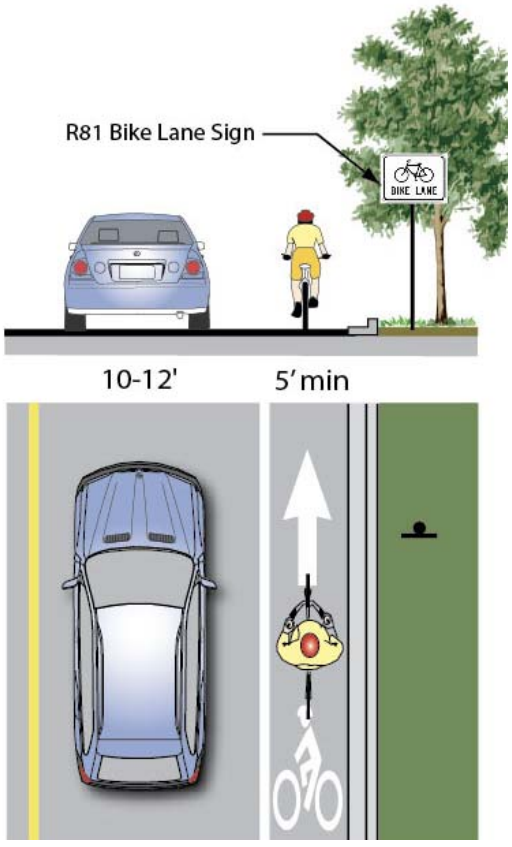
A bike lane or Class II bikeway is defined as a portion of the roadway that has been designated by striping, signage, and pavement markings for one-way bicycle travel on either side of a street or highway. The following graphics show examples of typical bike lane configurations, including standard signage and required lane striping.

Graphics



Bike Lane with On-Street Parallel Parking

Source: Alta Planning + Design, 2009



Bike Lane with No On-Street Parking

Source: Alta Planning + Design, 2009

General Guidelines

The width of the bike lanes vary according to parking and street conditions. Note that these dimensions are for reference only, and are subject to engineering design review.

- 4 feet (1.2 m) minimum width if no gutter exists, measured from edge of pavement;
- 5 feet (1.5 m) minimum width with normal gutter, measured from curb face; or 3' (0.9 m) measured from the gutter pan seam;
- 5 feet (1.5 m) minimum width when parking stalls are marked; and
- 11 feet (3.4 m) minimum width for a shared bike/parking lane where parking is permitted but not marked on streets without curbs; or 12 feet (3.7 m) for a shared lane adjacent to a curb face.
- Bicycle lanes shall be comprised of a 6 inch solid white stripe on the outside of the lane, and a 4 inch solid white stripe on the inside of the lane.
- Where on-street parking is allowed, bicycle lanes must be striped between the parking area and the travel lanes.
- In cases where there is insufficient space for a bike lane, cities may recommend removing a traffic lane, narrowing traffic lanes, or prohibiting parking.
- The R81 (CA) bicycle lane sign shall be placed at the beginning of all bicycle lanes, on the far side of arterial street intersections, at all changes in direction and at a maximum of .6 mile intervals. All standard signage is shown in Chapter 9 of the 2006 *California MUTCD*.

Additional Discussion

Intersections represent a primary collision point for bicyclists. Small intersections with few lanes are relatively easy to manage. Large, multi-lane intersections are more difficult for bicyclists to travel through than smaller, two-lane intersections. Road striping and signage can be used to accommodate bicyclists at critical locations. Figures 9C1 and 9C3 of the *California MUTCD* provide standard treatment options for intersections with right-turn only and left-turn only lanes.

Challenges for bicyclists at large signalized intersections include:

- Signals may not be timed to allow slower-moving bicyclists to travel across the intersection;
- Loop detectors or video detection that is used to actuate the signal may not be calibrated to detect bicyclists;
- Bicyclists may not know how to actuate the signal using loop detectors, even if it is calibrated;
- Bicyclists who wish to turn left may be required to travel across several motor vehicle lanes to reach the left hand turn lane;
- Bicyclists who wish to turn left like a pedestrian may experience long delays as they wait through several light cycles;
- Bicyclists who are traveling straight may have to merge across motor vehicle traffic that is turning right from a right-turn lane;
- Motorists may be less likely to be aware of bicyclists at large, multi-lane intersections due to higher traffic volumes, more lanes of traffic and the complexity of large intersections; and
- Large intersections without bicycle facilities are very auto-centric, leading motorists to assume that bicyclists are not supposed to be on the roadway.

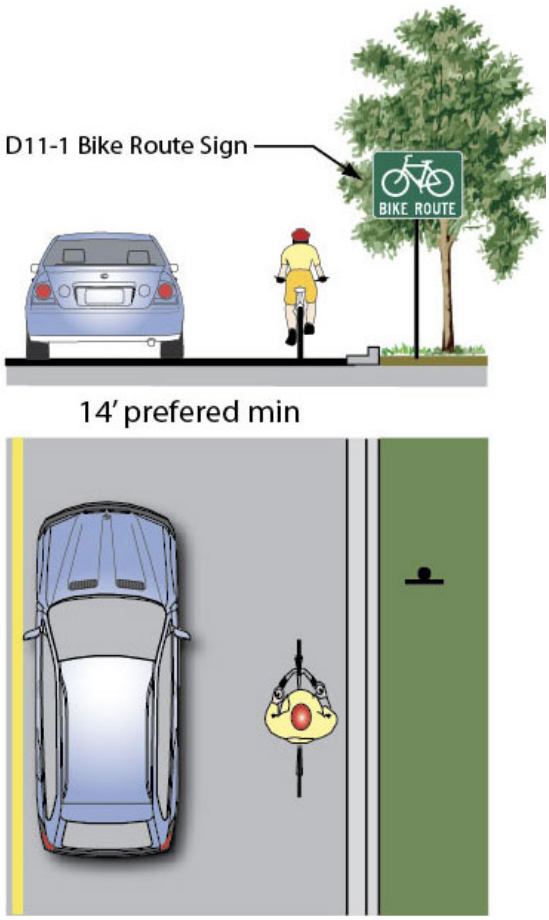
Design treatments can help bicyclists travel through intersections and alert motorists of bicyclists' presence. Good intersection design alerts motorist to bicyclists, indicates to motorists and bicyclists where bicyclists may ride, and guides bicyclists through intersections.

Typical Class III Bike Routes

Description

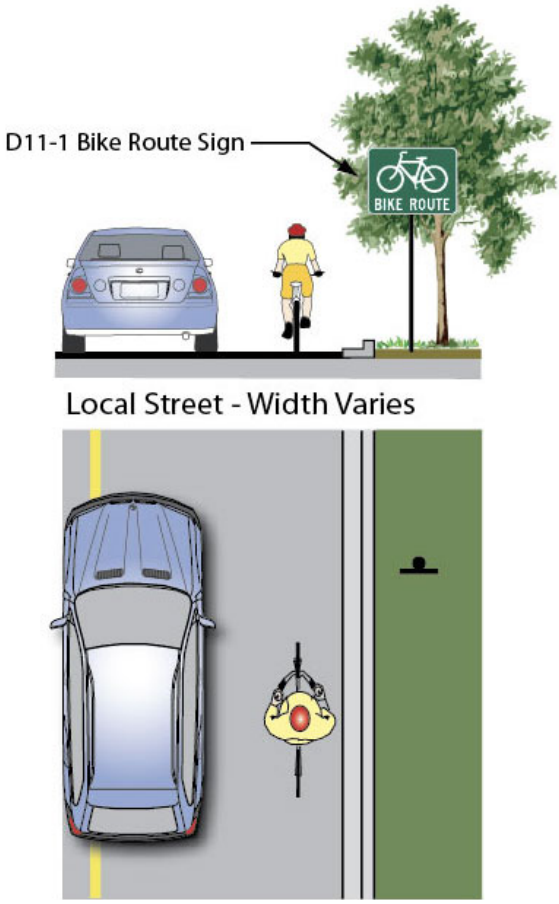
A bike route or Class III bikeway provides routes through areas not served by Class I or II facilities or to connect discontinuous segments of a bikeway. Class III facilities can be shared with either motorists on roadways or pedestrians on a sidewalk (strongly discouraged) and is identified only by signing. There are no recommended minimum widths for Class III facilities, but when encouraging bicyclists to travel along selected routes, traffic speed and volume, parking, traffic control devices, and surface quality should be acceptable for bicycle travel. Although it is not a requirement, a wide outside traffic lane (14 feet) is typically preferable to enable cars to safely pass bicyclists without crossing the centerline. *Highway Design Manual, Chapter 1000* provides details regarding the design requirements for placement and spacing of bicycle route signage.

Graphics



Bike Route with Wide Outside Lane

Source: Alta Planning + Design, 2009



Bike Route on Minor Roadway

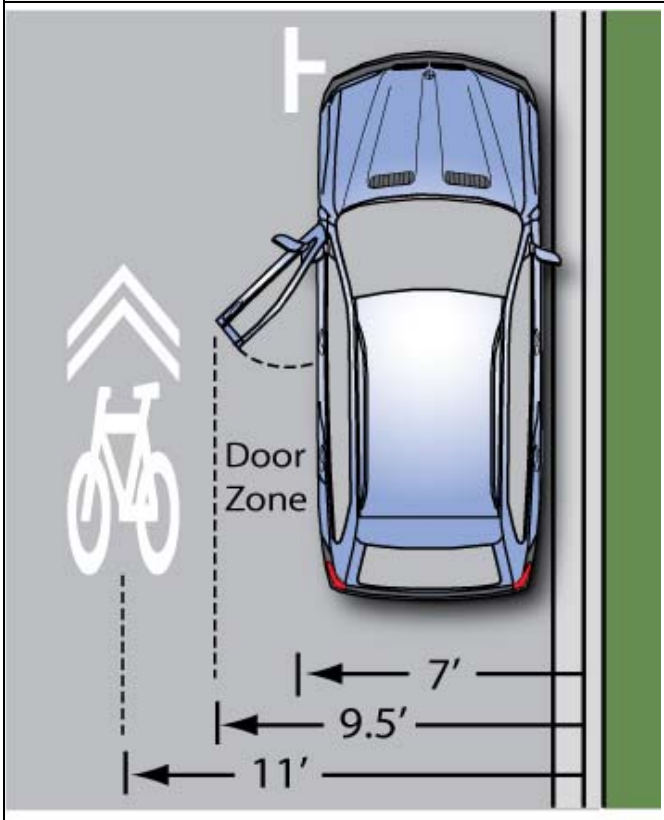
Source: Alta Planning + Design, 2009

Shared Lane Arrow Markings (SLMs)

Description

In September 2005, the "shared lane marking" was approved by the California Traffic Control Devices committee for use by California jurisdictions.[1] The primary purpose of the shared lane marking (sometimes referred to as "sharrows") is to provide positional guidance to bicyclists on roadways that are too narrow to be striped with bicycle lanes and to alert motorists of the location a cyclist may occupy on the roadway. Shared lane markings are intended to reduce the chance of a cyclist colliding with an open car door of a vehicle parked on-street, parallel to the roadway. The *California MUTCD* only allows shared lane markings to be used on urban roadways with on-street parallel parking. The next version of the national *MUTCD* will include shared lane markings, and will allow them to be included at all locations, not just next to parked cars.

Graphics



Recommended Sharrow Placement

Source: Alta Planning + Design, 2009

Sharrow on a residential street

[1] Policy Directive 05-10 "Shared Roadway Bicycle Marking", passed on September 12, 2005, outlines implementation guidelines for placing Shared Lane Markings. <http://www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm>

General Guidelines

Shared lane markings are appropriate on bicycle network streets that are:

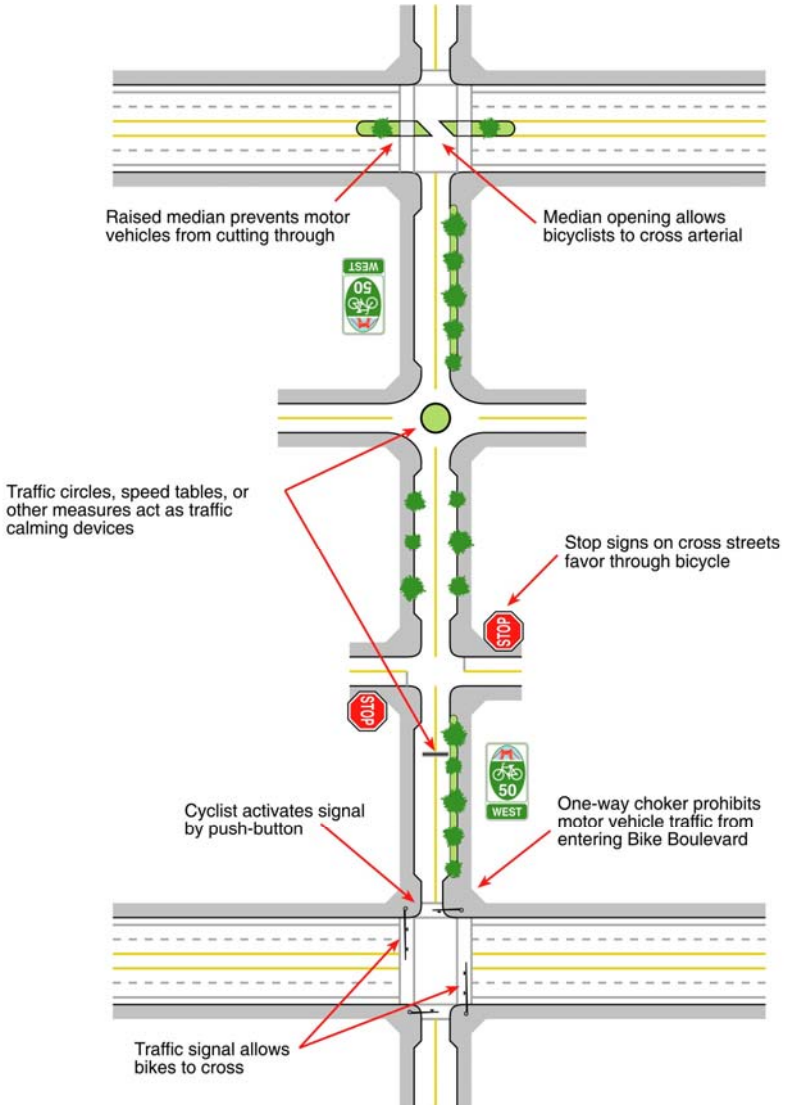
- Too narrow for standard striped bicycle lanes;
- Areas that experience a high level of "wrong-way" riding; or
- Streets that have moderate to high parking turnover, typically in commercial areas.
- There is increasing interest in applying sharrows in conjunction with bike lanes on steeper slope roadways. Bike lanes are placed on the uphill side of the roadway and sharrows are placed on the downhill side of the roadway to encourage fast moving bicyclists to position themselves away from parked cars.
- Shared lane arrow markings should be installed in conjunction with "share the road" signs
- Arrows should be spaced approximately 200' center to center, with the first arrow on each block or roadway segment placed no further than 100' from the nearest intersection.

Bicycle Boulevards

Description

Bicycle boulevards are local roads or residential streets that have been enhanced with treatments to facilitate safe and convenient bicycle travel. These facilities accommodate bicyclists and motorists in the same travel lanes, typically without specific vehicle or bicycle lane delineation. Bicycle boulevards prioritize bicycle travel above vehicular travel. The treatments applied to create a bike boulevard heighten motorists' awareness of bicyclists and slow vehicle traffic, making the boulevard more conducive to safe bicycle and pedestrian activity. Bicycle boulevards have been implemented in a variety of locations including Berkeley, Palo Alto and Davis California, and Portland, Oregon.

Graphic



Bicycle Boulevard Lane Configuration

Source: Alta Planning + Design, 2007

General Guidelines

Bicycle boulevards typically include the following design features:

- Traffic calming devices such as traffic circles and curb bulbouts;
- Bicycle destination signage;
- Pavement stencils indicating status as a bicycle boulevard;
- Crossing improvements at major arterials such as traffic signals with bicycle-detection, four-way stops and high-visibility crosswalks;
- Bicycle-friendly signal preemption at high-volume signalized intersections;
- Stop signs on streets crossing the bicycle boulevard; and
- Some jurisdictions have implemented bicycle boulevards by removing on-street parking in select locations.

Bicycle boulevards can be designed to accommodate the particular needs of the residents and businesses along the routes, and may be as simple as pavement markings with wayfinding signs or as complex as a street with traffic diverters and bicycle signals. Bike boulevards with signage only typically require extensive public education to be effective.

To further identify a street as a preferred bicycle route, lower volume roadways may be modified to function as a through street for bicycles, while maintaining only local access for automobiles. Traffic calming devices can lower traffic speeds and through trips, limiting conflicts between motorists and bicyclists and providing priority to through bicycle movement.

For more information, see:

- City of Berkeley Bicycle Boulevard Design Tools and Guidelines: http://www.ci.berkeley.ca.us/transportation/Bicycling/BB/Guidelines/linkpag.htm;
- Bicycle Transportation Alliance Bicycle Boulevards Campaign: http://www.bta4bikes.org/at_work/bikeboulevards.php
- Draft 2009 AASHTO Guide for the Development of Bicycle Facilities
- Bicycle Boulevard Design Guidebook (forthcoming publication of the Portland State University Initiative for Bicycle and Pedestrian Innovation (IBPI) and Alta Planning + Design.

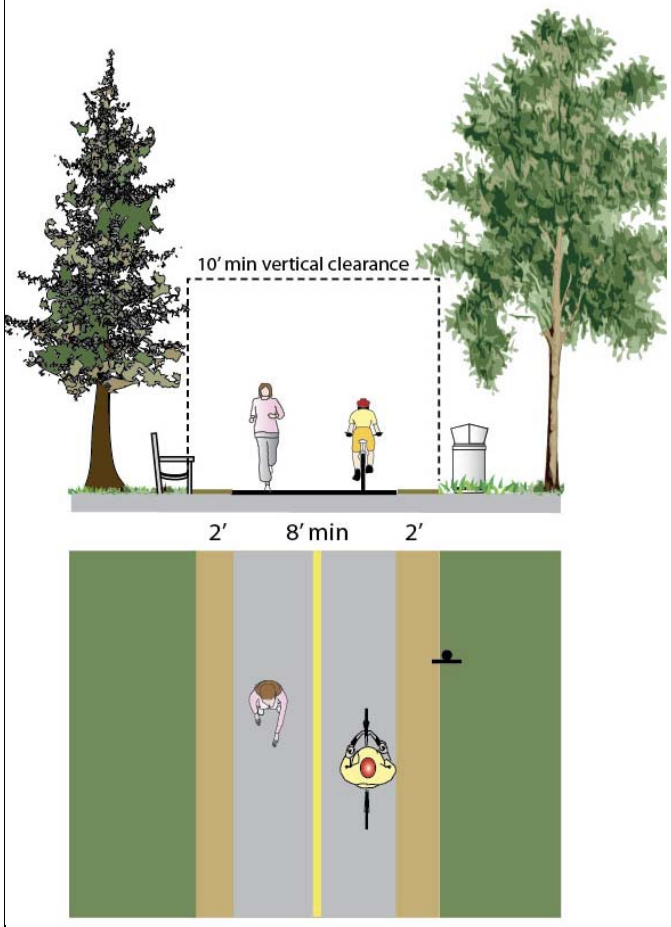
Traffic calming on bicycle boulevards

Class I Bike Path (Shared-Use Path)

Description

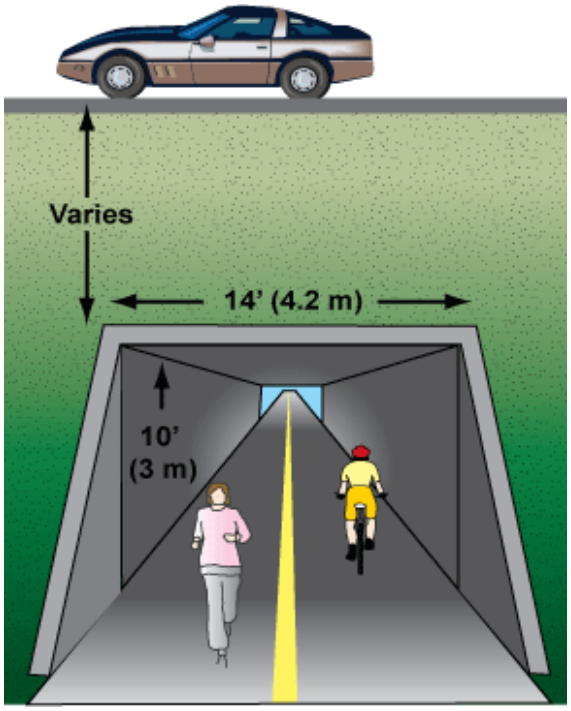
Typically called a "bike path" or "shared-use path," a Class I bikeway provides bicycle travel on a paved right-of-way completely separated from any street or highway. In locations with high use, or on curves with limited sight distance, a yellow centerline should be used to separate travel in opposite directions. High use areas of the trail should also provide additional width of up to 12 feet. Lighting should be provided in locations where evening use is anticipated or where paths cross below structures.

Graphics



Shared-Use Path Example

Source: Alta Planning + Design, 2009



Shared-Use Path Undercrossing

Source: Alta Planning + Design, 2009

General Guidelines

The recommended width of a shared-use path is dependent upon anticipated usage:

- 8 feet (2.4 m) is the minimum width for Class I facilities.
- 8 feet (2.4 m) may be used for short neighborhood connector paths (generally less than one

mile in length) due to low anticipated volumes of use.

- 10 feet (3.0 m) is the recommended minimum width for a typical two-way shared-use path.
- 12 feet (3.7 m) is the preferred minimum width if more than 300 users per peak hour are anticipated, and/or if there is heavy mixed bicycle and pedestrian use.
- A minimum 2' (0.6 m) wide graded area must be provided adjacent to the path to provide clearance from trees, poles, walls, guardrails, etc.
- Paths should be constructed with adequate sub grade compaction to minimize cracking and sinking, and should be designed to accommodate appropriate loadings, including emergency vehicles.
- A 2% cross slope shall be provided to ensure proper drainage.
- 8 feet (2.4 m) is the required minimum clearance from overhead obstructions, with 10 feet (3.0 m) recommended.

Grade Intersection:

When shared-use paths cross streets, proper design should be developed on the pathway as well as on the roadway to alert bicyclists and motorists of the crossing. Sometimes on larger streets, at mid-block pathway crossing locations, an actuated signal is necessary. A signal allows bicyclists a clear crossing of a multi-lane roadway. If a signal is or is not needed, appropriate signage and pavement markings should be installed, including stop signs and bike crossing pavement markings.

Overcrossings:

Overcrossings are also an important component of bikeway design. Barriers to bicycling often include freeways, complex interchanges, and rivers. When a route is not available to cross these barriers a bicycle overcrossing is necessary.

Some design considerations for overcrossings include:

- Pathways must be a minimum 6 feet (1.8 m) wide, with a preferred width of 8 feet (2.4 m) or 10 feet (3.0 m) wide;
- Slope of any ramps must comply with ADA Guidelines; and
- Screens are often a necessary buffer between vehicle traffic and the bicycle overcrossing.

Undercrossings:

Undercrossings are an important component of Class I bikeway design. Some considerations for undercrossings include:

- Must have adequate lighting and sight distance for safety;
- Must have adequate over-head clearance of at least 10 feet (3.0 m);
- Tunnels should be a minimum width of 14 feet (4.3 m) for several users to pass one another safely; a 10 feet x 20 feet (3.0 m x 6.1 m) arch is the recommended standard;
- "Channeling" with fences and walls into the tunnel should be avoided for safety reasons; and
- May require drainage if the sag point is lower than the surrounding terrain.

Bicycle Signals & Adaptive Signal Timing

Description

Making intersections more "friendly" to bicyclists, involves modifying how they operate. Improved signal timing, calibrating loop detectors to detect bicyclists, and camera detection makes intersections easier for bicyclists to cross intersections.

Bicycle loop detectors activate traffic signals at intersections, similar to standard loop detectors used for auto traffic. Where bicycle loop detectors are not present, bicyclists are forced to wait for a motor vehicle to trigger a signal; where motor vehicle traffic is infrequent, they may cross against a red signal. Bicycle loop detectors should be identified with pavement markings that show cyclists where to position themselves to trigger the traffic signal.

A bicycle signal provides an exclusive signal phase for bicyclists traveling through an intersection. 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 became an approved traffic control device in the state of California after the technology was studied after years of service in the City of Davis. Part 4 of the *California MUTCD* covers bicycle signals.

Graphics

Bicycle signal

Bicycle loop detector stencil

General Guidelines

Bicycle signals are typically considered in locations with heavy bicycle traffic combined with significant conflicts with motor vehicles, at intersections with unique geometry or at the interface between busy roads and off-street bicycle facilities. Specific situations where bicycle signals have had a demonstrated positive effect include:

- Locations with high volume of bicyclists at peak hours;
- Locations with high numbers of bicycle/motor vehicle crashes, especially those caused by crossing paths;
- At T-intersections with major bicycle movement along the top of the T;
- At the confluence of an off-street bike path and a roadway intersection; and

- Where separated bike paths run parallel to arterial streets.

While bicycle signals are approved for use in California, local municipal code should be checked or modified to clarify that at intersections with bicycle signals, bicycles should only obey the bicycle signal heads.

On-Street Bikeway Signage

Description

Standard signage for on-street bikeways includes standard BIKE LANE and BIKE ROUTE signage, as well as supplemental signage such as SHARE THE ROAD and warning signage for constrained bike lane conditions. Engineers should consult the *California MUTCD* for the full spectrum and applicability of signage options.

Graphics

Potential Signage Options for Bike Routes/Bicycle Boulevards

(not comprehensive)

Source: California MUTCD

Berkeley, CA bike boulevard signage

San Francisco, CA route identification signage

Additional Discussion

Wayfinding signage is an important part of the bicycle network. Implementing a well-planned and attractive system of signage can greatly enhance bikeway facilities, making their presence aware to motorists, as well as existing and potential bicyclists. By leading people to city bikeways that offer safe and efficient transportation, effective signage can encourage residents and visitors to bicycle. Way-finding can include mile-markers, route identification, and informational kiosks.

Destination signage helps bicyclists use the bikeway network as an effective transportation system. These signs typically display distance, direction and in some cases, estimated travel time information to various destinations and activity centers. In the San Diego region, destination signage would be helpful for destinations such as downtown, Balboa Park, UCSD, and beaches. Signage can also assist users to navigate towards major bikeways, transit hubs, or greenway trails. Finally, way-finding can help bicyclists avoid difficult and potentially hazardous road scenarios, like steep terrain, dangerous intersections, highway and river crossings, or deteriorating road conditions.

Wayfinding and bike route network signage is recommended for the San Diego region. *California MUTCD* defines standards for these route network signs. Most commonly, they show the route number and the corresponding direction. Route naming and numbering should be coordinated between neighboring jurisdictions where bikeways cross cities' boundaries so that the regional signage system is seamless.

For bike route signs, *California MUTCD* requires a green background and white lettering. The top third portion of the sign is customizable for the city or region where it is located. For example, the City of San Francisco shows the Golden Gate Bridge on its bike route signs.

The multi-use path network should be integrated with on-street bike facility signage to encourage use of paths for recreational as well as utilitarian bicycling; helping bicyclists of all ages and abilities reach destinations more easily.

Informational kiosks, complete with maps of the surrounding area, can help provide initial orientation and bearings for bicyclists beginning their journeys at major transit hubs, or transitioning from off-street to on-street facilities.

B.4 Innovative Treatments and Signage

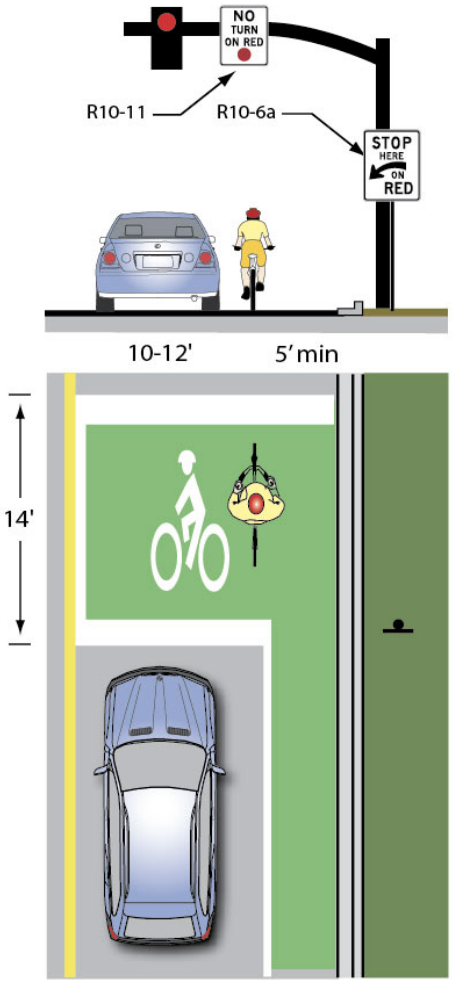
The following section describes facilities and treatments that are intended to enhance safety but are not adopted as standard treatments by the *California MUTCD* or *Caltrans Highway Design Manual*.

Bike Boxes

Description

A bike box is a relatively simple innovation to improve turning movements for bicyclists without requiring cyclists to merge into traffic to reach the turn lane or use crosswalks as a pedestrian. The bike box is formed by pulling the stop line for vehicles back from the intersection, and adding a stop line for bicyclists immediately behind the crosswalk. When a traffic signal is red, bicyclists can move into this "box" ahead of the cars to make themselves more visible, or to move into a more comfortable position to make a turn. **Bike Boxes are not included in the *California MUTCD*.**

Graphic



Possible Bike Box Configuration

Source: Alta Planning + Design, 2009

Examples of bike boxes

General Guidelines

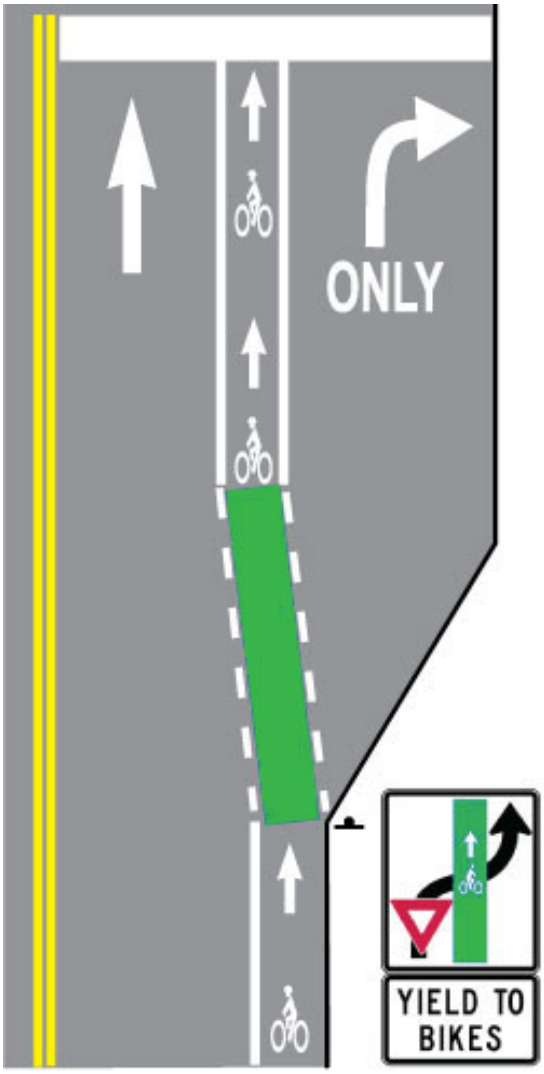
- Apply at intersections with a high volume of bicycles and motor vehicles.
- Apply where there are frequent turning conflicts and/or intersections with a high percentage of turning movements by both bicyclists and motorists.
- California MUTCD signage should be present to prevent 'right turn on red' and to indicate where the motorist must stop.
- In the US, bicycle boxes have been used in Cambridge, MA, Portland, OR and Eugene, OR. They have been used in a variety of locations throughout Europe.

Colored Bike Lanes in Conflict Areas

Description

European countries have used colored pavement – red, blue, yellow, and green—for bike lanes where this is a higher probability of vehicle conflicts. Examples of such locations are freeway on- and off-ramps where motorists move into a right turn pocket. In the United States cities such as Portland and Seattle have experimented with colored bike lanes and supportive signage with favorable results. Studies conducted in Portland showed that more motorists were using their turn signals and slowing or stopping at the blue lanes. **Colored Bike Lanes are not included in the *California MUTCD*.**

Graphics



Colored Bike Lane Configuration

Source: Alta Planning + Design, 2009

Examples of colored bike lanes in U.S. cities

General Guidelines

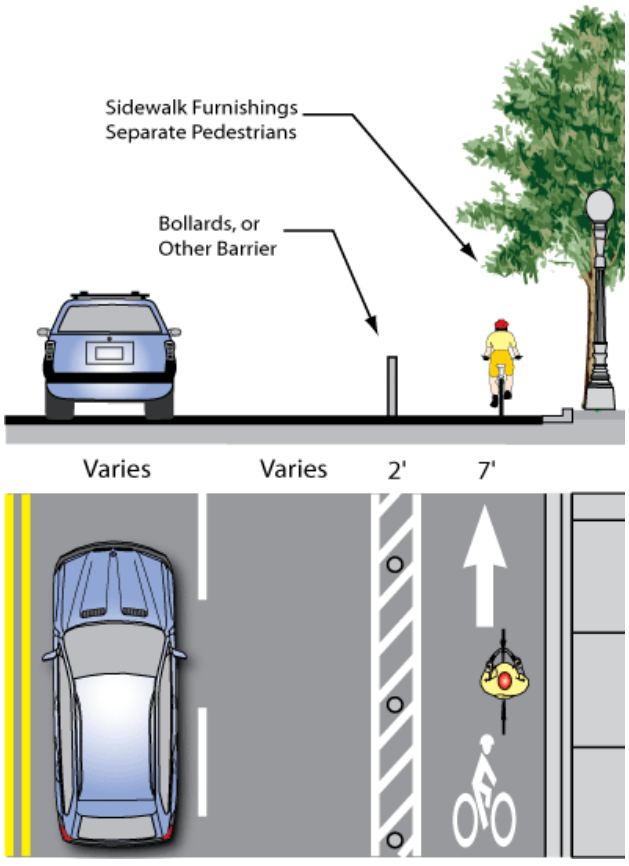
- This treatment is not currently present in any State or Federal design standards.
- Colored bike lanes are used to guide bicyclists through major vehicle/bicycle conflict points, especially at locations where the volume of conflicting vehicle traffic is high, and where the vehicle/bicycle conflict area is long.
- Colored bike lanes typically extend through the entire bicycle/vehicle conflict zone (e.g., through the entire intersection, or through the transition zone where motorists cross a bike lane to enter a dedicated right-turn lane.
- Portland's Blue Bike Lanes: http://www.portlandonline.com/shared/cfm/image.cfm?id=58842

Cycle Tracks

Description

Cycle tracks are receiving increasing levels of interest and attention from planners and engineers in the United States, although they are not currently considered a standard facility type. **The *Highway Design Manual, Chapter 1000* does not define cycle tracks as a bikeway or include provisions for cycle track designs.** Cycle tracks are physically separated one-way (or two-way) bike lanes in the roadway right-of-way. These bikeways are located between sidewalks and vehicle travel lanes or parking lanes and are a delineated area specifically for through bicycle traffic. Cycle tracks can be at the same plane as sidewalks but are usually separated by a low curb or barrier. There should be sidewalks adjacent to cycle tracks to prevent pedestrians from confusing cycle tracks with multi-use paths. When crossing cycle tracks, pedestrians should have the right-of-way. On the motor vehicle side of cycle tracks, if there is an on-street vehicle parking lane then there is normally a two to three foot buffer preventing car doors from entering the bikeway. If there is no on-street parking, a larger barrier is put in place to separate bicycles and automobile traffic.

Graphics



Cycle Track with No On-Street Parking

Source: Alta Planning + Design, 2008

Cycle track in New York City, NY

General Guidelines

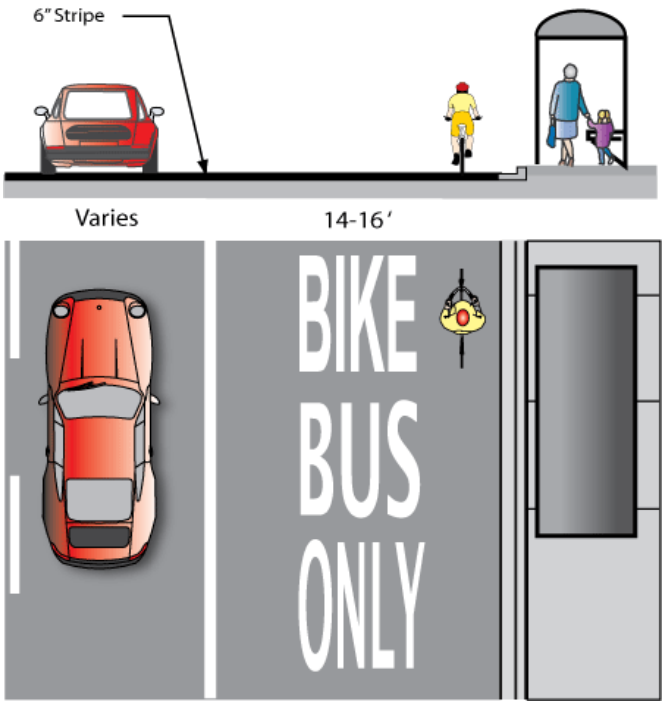
- Cycle tracks are useful along streets with minimal crossings.
- Intersections should be designed to include signage that alerts motorists of bicyclists crossing from the cycle track, and vegetation and parking should be limited near intersections so that bicyclists and motorists can see each other.
- If cycle tracks are two-way, motorists should be alerted to the fact that bicyclists will be approaching from both directions.
- To help decrease the number of wrong-way riding bicyclists on one-way cycle tracks, complimentary facilities should be provided on the opposite side of the street.
- While cycle tracks increase bicyclists' comfort on urban and suburban streets, intersection treatments are needed to mitigate turn movement conflicts. Protective measures include retrofitting signalized intersections to provide separate left and right turn movements, adding bicycle-only signals, requiring no right-turn-on-red, and warning signage and special markings at unsignalized intersections. Other innovative treatments, such as colored pavement, can complement these facilities and improve warnings to motorists.
- For additional discussion of cycle track designs, see the white paper on cycle tracks provided in **Appendix I**.

Shared Bike-Bus Lane

Description

Travel time for bikes and buses can be improved with a dedicated shared bicycle/bus lane, so that neither is hindered or endangered by congestion from other auto traffic. Shared bicycle/bus lanes are commonly used in central business districts where room for dedicated bicycle lanes is limited, and where motor vehicle congestion warrants a separate facility for buses.

Graphic



Shared Bike-Bus Configuration

Source: Alta Planning + Design, 2009

Shared Bike-Bus Signage

General Guidelines

- Potential locations for bicycle/bus lane implementation include congested streets with moderate or long bus headways, streets with moderate bus headways during peak hours, or places that provide no reasonable alternative routing alignment.
- Shared bicycle/bus lanes should be paved with colored asphalt and stenciled as a diamond lane with supporting signage and pavement legends to emphasize their designation.
- Lanes should be wide enough to allow bicyclists to comfortably pass stopped buses on the left. Twelve feet is the recommended minimum width of shared bicycle/bus lanes.
- Potential disadvantages of shared lanes include a leapfrogging between buses and bikes (when buses and bikes are continually passing one another in the lane). Leapfrogging creates a greater potential for conflicts. The second disadvantage is when vehicles are allowed to use the lane at intersections as a right turn lane. This slows and creates potential conflict points between bicycles and vehicles and slows buses and bicycles significantly.

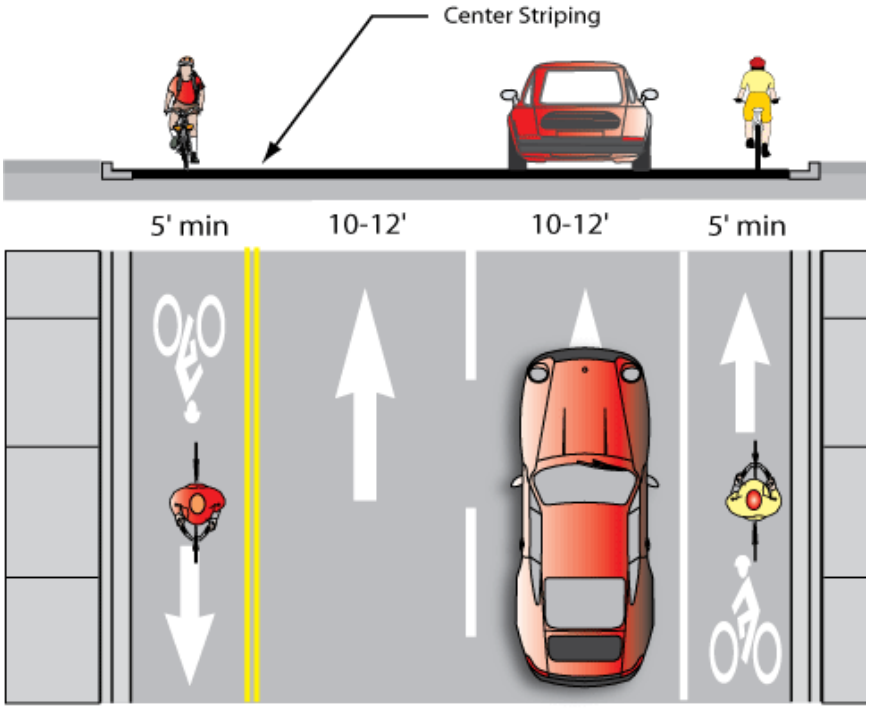
Contra-Flow Bicycle Lanes

Description

Contra-flow bicycle lanes entail a striped lane for bicycles going against the flow of automobile travel. The lanes should be separated by a double-yellow line. **Contra-flow bike lanes are not included in the *Highway Design Manual, Chapter 1000*.**

Contra-flow bike lanes are designated lanes that allow bicycles to move in the opposite direction of traffic on a one-way street. Functionally, streets with contra-flow bicycle lanes are set up so that motor vehicles can only move one way on the road, while bikes can move in both directions – with traffic or opposite traffic in the contra-flow lane.

Graphic



General Guidelines

Their implementation is controversial primarily because, contrary to standard road rules, they encourage cyclists to ride against motor-vehicle right of way, which can lead to increased bicycle/motor-vehicle crashes.

However, in some circumstances, they may offer substantial savings in out-of-direction travel, by providing more direct routes. For popular destinations and high-use bikeways, a contra-flow lane can increase safety by reducing the number of bicyclists, and the number of conflicts, along the longer indirect route.

Potential Applications:

- Provides direct access to key destination;
- Improves safety;
- Infrequent driveways on bike lane side;
- Bicyclists can safely and conveniently re-enter traffic at either end;
- Sufficient width to provide bike lane;
- No parking on side of street with bike lane;
- Existing high bicycle usage of street;
- Less than three blocks in length; or

No other reasonable route for bicyclist.

Contra-flow lanes are most successful on streets with few intersecting driveways, alleys or streets on the side of the lane; on streets where bicyclists can safely and conveniently re-enter the traffic stream at either end of the lane; on streets where a substantial number of bicyclists are already using the street; and on streets with sufficient width to accommodate a bike lane.

Special features to incorporate into contra-flow bike lane design include the following.

- The contra-flow bike lane must be placed on the right side of the street (to motorists' left) and must be separated from oncoming traffic by at least a double yellow line; vertical separation or grade separation is encouraged. This indicates that the bicyclists are riding on the street legally, in a dedicated travel lane.
- Any intersecting alleys, major driveways, and streets must have signs indicating to motorists that they should expect two-way bicycle traffic.
- Existing traffic signals should be fitted with actuators for bicyclists (i.e. loop detectors, video cameras, infrared or push buttons).
- Existing traffic signals should be modified (if necessary) so that bicyclists traveling in the contra-flow direction can see the signal head, and any conflicting turn phasing shall be eliminated.

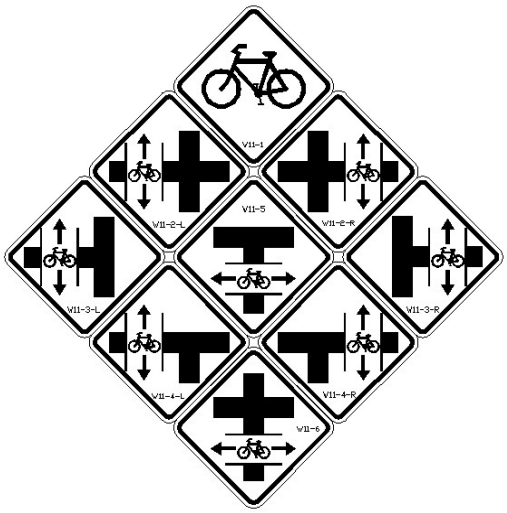
Innovative Signage

Description

Innovative signage can be developed for a number of reasons – as a standardized warning system, to assist with unique way-finding, or to help lend a sense of place to a community. Some innovative signage is developed to increase awareness that bicyclists may use the full travel lane and to alert motorists to the proper response. Any signs to be installed on public roadways in California must be approved by Caltrans.

New experimental designs can be utilized after approval. This continuing process of developing better way-finding or safety-warning signs is important for designing safer and more enjoyable bicycling facilities, as well as improving the overall transportation system.

Graphics



Experimental parallel path warning signage in Denver, CO

Experimental parallel path warning signage in Denver, CO

San Carlos, CA innovative sign

Innovative signage in Santa Cruz, CA

B.5 Bicycle Parking

As more bikeways are constructed and bicycle usage grows, the need for bike parking will increase. *Short-term parking at shopping centers and similar land uses can support bicycling as well as long*-term bicycle parking at transit stations, work sites and schools.

Bicycle parking should be installed on public property, or available to private entities on an at-cost basis. Bicycle parking facilities should be provided at other public destinations, including government buildings, community centers, parks, schools and shopping centers.

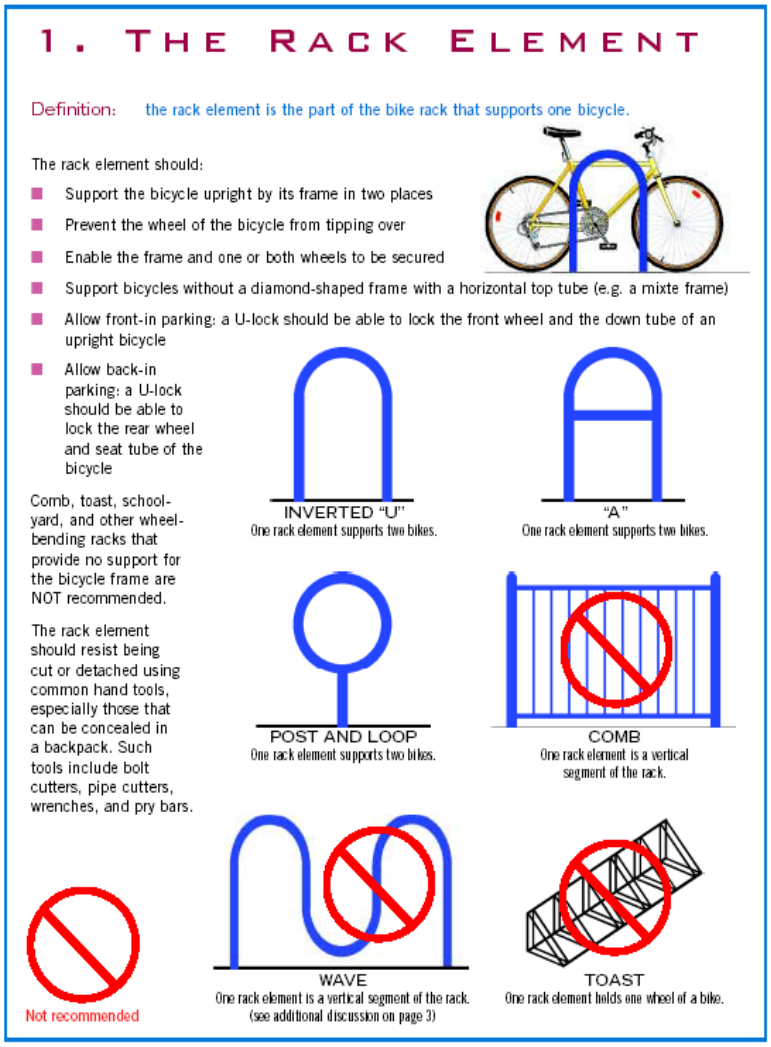
All bicycle parking should be in a safe, secure area visible to passersby. Commuter locations should provide secure indoor parking, covered bicycle corrals, or bicycle lockers. Bicycle parking on sidewalks in commercial areas should be provided according to specific design criteria, reviewed by merchants and the public, and installed as demand warrants.

Short Term Bicycle Parking

Description

Short term bicycle parking facilities are best used to accommodate visitors, customers, messengers and others expected to depart within two hours. Bicycle racks provide support for the bicycle but do not have locking mechanisms. Racks are relatively low-cost devices that typically hold between two and eight bicycles, allow bicyclists to securely lock their frames and wheels, are secured to the ground, and are located in highly visible areas. They are usually located at schools, commercial locations, and activity centers such as parks, libraries, retail locations, and civic centers.

Graphics



Bike Rack Recommendations

Source: Association of Pedestrian and Bicycle Professionals, 2002

Custom artistic racks

Simple post-and-ring style rack

General Guidelines

Bicycle racks should be installed with the following guidelines in mind.

- The rack element (part of the rack that supports the bike) should keep the bike upright, supporting the frame in two places and allowing one or both wheels to be secured.

- Install racks so there is enough room between adjacent parked bicycles. If it becomes too difficult for a bicyclist to easily lock their bicycle, they may park elsewhere. A row of inverted "U" racks should be installed with 15 inches minimum between racks.

- Empty racks should not pose a tripping hazard for visually impaired pedestrians. Position racks out of the walkway's clear zone.

When possible, racks should be in a covered area protected from the elements. Long-term parking should always be protected.

Generally, 'U' type racks bolted into the sidewalk are preferred and should be located intermittently or in front of key destinations. Bicycle racks should be installed to meet ADA standards and not block pedestrian through traffic.

Cities may want to consider custom racks that serve not only as bicycle parking, but also as public artwork or as advertising for a specific business. The "post and ring" style rack is an attractive alternative to the standard inverted-U, which requires only a single mounting point and can be customized to have the city name or emblem stamped into the rings. These racks can also be easily retrofitted onto existing street posts, such as parking meter posts. While custom racks can add a decorative element and relate to a neighborhood theme, the rack function should not be overlooked: all racks should adhere to the basic functional requirement of supporting the bicycle by the frame (not only the wheel) and accepting a U-lock.

U-locks with shelter installed near a building entrance.

Long Term Bicycle Parking

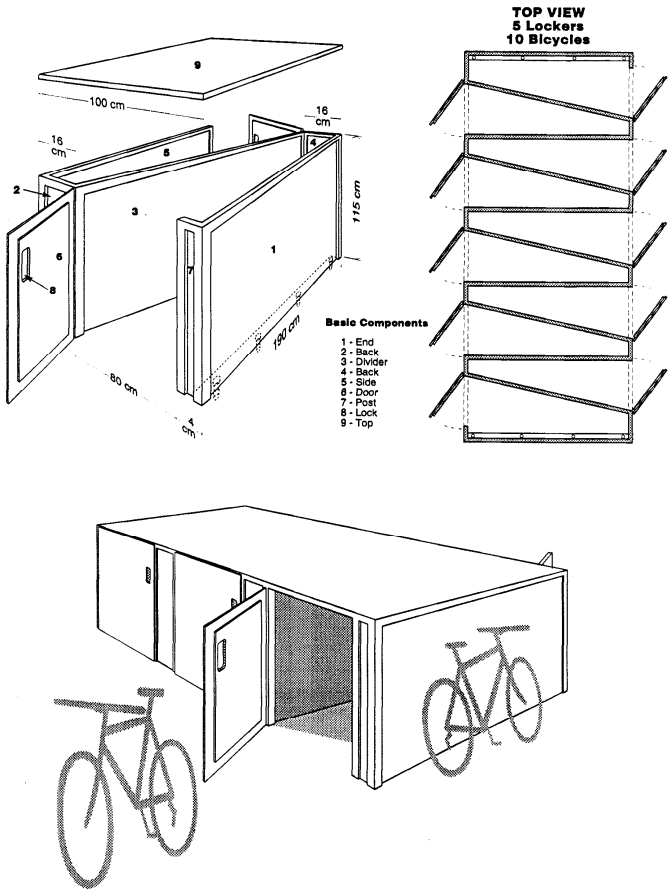
Description

For long-term parking, cities may want to consider bicycle lockers. Bicyclists are usually more comfortable storing their bicycles in lockers for long periods because they offer increased security and protection from natural elements. Although they may be more expensive to install, they can make the difference for commuters deciding whether or not to bicycle.

Lockers can be controlled with traditional key systems or through more elaborate subscription systems. Subscription locker programs, like e-lockers, or park-by-phone systems allow even more flexibility within locker use. Instead of restricting access for each patron to a single locker, subscribers can gain access to all lockers within a system, controlled by magnetic access cards, or caller ID. These programs typically have fewer administrative costs because they simplify or eliminate key management and locker assignment.

Long-term bicycle parking facilities accommodate employees, students, residents, commuters, and others expected to park more than two hours. This parking should be provided in a secure, weather-protected manner and location. Long-term bicycle parking will either be a bicycle locker, or a secure area like a 'bike corral' that may be accessed only by bicyclists.

Graphic



Bike Locker Configuration

Source: Alta Planning + Design, 2000

Innovative High Volume Bicycle Parking

Description

In many locations, individual U-racks located on the sidewalk can be sufficient to meet bicycle parking demand. Where bicycle parking demand is higher, more formal structures and larger facilities need to be provided. Several options for high-volume bicycle parking are outlined below.

Graphic

Bike Oasis

Bike Corral in Portland, OR

Bike Station in Chicago, IL

General Guidelines

On-Street Bike Parking Corral:

A relatively inexpensive solution to providing high-volume bicycle parking is to convert one or two on-street motor vehicle parking spaces into on-street bicycle parking. Bike racks are installed in the street and protected from motor vehicles with removable curbs and bollards. These Bike Parking Corrals move bicycles off the sidewalks, and leave space for sidewalk café tables or pedestrians. Bicycle parking does not block sightlines like motor vehicles do, so it may be possible to locate bicycle parking in no-parking zones near intersections and crosswalks.

Bike Oasis:

In 2008, the City of Portland, Oregon began installation of several "Bike Oases" in commercial districts. These signature bicycle parking facilities are installed on curb extensions and consist of attractive covered bike parking and an information panel. Portland's Bike Oases provide parking space for ten bikes. Bike and walking maps are installed on the information panel.

Bike Stations:

Bike stations serve as one-stop bicycle service centers for bicycle commuters. They include 24-hour secure bicycle parking and may provide additional amenities such as a store to purchase items (helmets, raingear, tubes, patch kits, bike lights, and locks), bicycle repair facilities, showers and changing facilities, bicycle rentals, and information about biking. Some bike stations provide free bike parking, while others charge a fee or require membership.

Bike stations have been installed in several cities in California, including Long Beach, San Francisco, Los Angeles and Berkeley, as well as Chicago, and Seattle.

Valet Bike Parking:

The San Diego County Bicycle Coalition (SDCBC) currently provides bike parking in a pavilion during Padres games and other community events. To expand bike parking options, indoor locations for storing bicycles should be designed into future venues that host sporting events, festivals, and other events where large numbers of people gather.

In San Francisco, attended bicycle parking is provided at the AT&T Stadium, home of the San Francisco Giants. The bicycle valet sees between 100 and 180 bicycles per game on average (the stadium's capacity is 41,503). In addition to providing bicycle valet parking, the City and stadium heavily promote using alternative modes to get to the stadium, emphasizing that "if you drive you will get stuck in traffic."

Their valet parking system works much like a coat check: the bicyclist gives their bicycle to the attendant, who tags the bicycle with a number and gives the bicyclist a claim stub. The valet also will take non-motorized devices such as rollerblades, baby strollers and push scooters. When the bicyclist returns to get their bicycle, they present the claim stub and the attendant retrieves their bicycle for them. Locks are not needed. The valet is open from two hours before the game to thirty minutes after.