State of California
**DEPARTMENT OF TRANSPORTATION**

California State Transportation Agency

# Memorandum

**To:** DEPUTY DIRECTORS
DISTRICT DIRECTORS
DIVISION CHIEFS

**Date:** February 7, 2022

**From:**

JANICE BENTON
Chief, Division of Design

**SUBJECT: DESIGN INFORMATION BULLETEN 89-02**

Effective immediately, the California Department of Transportation's separated bikeway guidance, DIB 89-01 "Class IV Bikeway Guidance", has been updated to version 89-02 and is now available on the Division of Design website. For projects on the State highway system that have begun the project development process, follow the procedures in the Highway Design Manual (HDM) Index 82.5 "Effective Date for Implementing Revisions to Design Standards."

**Summary of Significant Changes in DIB 89-02**

- Updated the Introduction with guidance on the role of the greater bike network in relation to separated bikeways.
- Expanded guidance for separated bikeway design considerations.
    - One-way separated bikeways
    - Two-way separated bikeways
    - Bikeway separation considerations
    - Intersections, alleys, and driveways
    - Loading zones, transit stops and passenger drop-off zones
    - Crossing points with pedestrians
- Updates and clarifications related to separated bikeway design criteria.

Project specific applicability and questions should be referred to the District Design Liaison.

c:
Duper Tong, Chief, Office of Standards and Procedures
Rebecca Mowry, Office of Standards and Procedures
Aaron Daniels, Office of Standards and Procedures
District Design Liaisons

# DESIGN INFORMATION BULLETIN NUMBER 89-02

**Department of Transportation**
**Division of Design**
**Office of Standards and Procedures**

# CLASS IV BIKEWAY GUIDANCE
# (Separated Bikeways / Cycle Tracks)

**APPROVED BY:**

**JANICE BENTON**
**DIVISION CHIEF**
**DIVISION OF DESIGN**

**February 7, 2022**

# Foreword

It is the goal of the State to increase the number of trips Californians take by bicycling, walking, and other forms of active transportation in order to help meet the State's greenhouse gas emissions reduction goals, and to provide the economic and public health benefits associated with active transportation. Bicycle facilities are a vital part of the transportation infrastructure that enable an alternative to driving trips and provide people the freedom to travel by bicycle to work, school, and other important destinations.

Class IV Bikeways, also referred to as separated bikeways, protected bike lanes, or cycle tracks, provide an alternative to other bikeways and may minimize interactions with other modes of travel by introducing a vertical element separation. The objective is to foster bicycling as a means of transportation, in a manner that improves safety for all users, including motorists, transit users, and pedestrians, including persons with disabilities.

The Protected Bikeways Act of 2014 (Assembly Bill 1193 - Ting, Chapter 495) established Class IV Bikeways for California and required the California Department of Transportation (Caltrans), in cooperation with local agencies and in consultation with the existing Caltrans advisory committee dedicated to improving access for persons with disabilities, to establish design criteria for separated bikeways. This Design Information Bulletin (DIB) was prepared to provide that design criteria and other general guidance on best practices related to separated bikeways to establish uniform guidance for the use of these facilities.

Additionally, this guidance supports the new Director's Policy 37 (DP-37), dated December 7th, 2021, which provides updated guidance regarding the inclusion of complete streets features in all projects funded or overseen by Caltrans. DP-37 establishes Caltrans' organizational priority to encourage and maximize walking, biking, transit, and passenger rail as a strategy to not only meet state climate, health, equity, and environmental goals but also to foster socially and economically vibrant, thriving, and resilient communities.

The design criteria and guidance in this DIB has been written to allow designers to exercise sound judgment when applying it, consistent with the Project Development philosophy (see Caltrans *Highway Design Manual* Index 81.1) when designing projects and has been written to allow for flexibility in applying the design criteria by taking into consideration the context of the project location, which enables the designer to tailor the design, as appropriate, for the specific circumstances while maintaining safety.

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## 1.0 INTRODUCTION

A Class IV bikeway (separated bikeway) is a bikeway for the exclusive use of bicycles and includes a separation required between the separated bikeway and the through vehicular traffic. The separation may include, but is not limited to, grade separation, flexible posts, inflexible posts, inflexible barriers, raised curb, or on-street parking.

Various separated bikeway/cycle track design criteria are in use around the world and the United States. California state and local laws and ordinances need to work together. This Design Information Bulletin (DIB) establishes design guidance and criteria to facilitate consistent user expectations. Best practices from cities, states and countries currently operating separated bikeways have been used to formulate this guidance and design criteria for the State of California. As with all guidance and design criteria, as engineers and practitioners gain more experience with the use of separated bikeways, this DIB will be updated, as necessary, to reflect the lessons learned.

The Federal Highway Administration (FHWA) publication Separated Bike Lane Planning and Design Guide (FHWA Guide) should be used to design separated bikeways. Where this DIB is inconsistent with the FHWA Guide, this DIB should govern. The FHWA Guide can be accessed at:

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm.

The FHWA Guide used the Urban Bikeway Design Guide, a National Association of City Transportation Officials (NACTO) publication, as part of its source material. The NACTO publication also provides additional guidance not covered in this DIB. However, where this DIB is inconsistent with the NACTO Guide, this DIB should govern. The use of that guidance, coupled with sound engineering judgment, can be used in collaboration with the guidance in this DIB.

This DIB provides additional design criteria and refers to traffic operations guidance (signing and markings) in accordance with existing California codes and the California Manual on Uniform Traffic Control Devices (CA MUTCD). In addition, this DIB is also referenced in the Caltrans Highway Design Manual (HDM). Design guidance in the HDM on various topics of highway design should also be utilized in combination with this DIB. In particular, bikeway design guidance for Class I Bikeways (bike paths) in Chapters 200 and 1000 for design speed, stopping sight distance, drainage, landscaping, etc., may be used as appropriate for the Class IV Bikeway design. For the State Highway System, DIB 82 is also applicable in all aspects of pedestrian design to comply with the Americans with Disabilities Act of 1990. Similarly, off the State Highway System the ADA applies to local agencies per Chapter 11 of the Caltrans Local Assistance Procedures Manual.

Some local jurisdictions may have published standards for facilities that they own and operate. When Caltrans projects impact adjacent transportation facilities, local standards should be used in conjunction with this DIB to encourage designs that are

sensitive to the local context and community values. Agreeing on which standards will be used needs to be decided early in the project development process. Chapter 5 of the FHWA Guide presents a Four Step Design Process to determine various features of the Class IV Bikeway design. These are important considerations for the project development process.

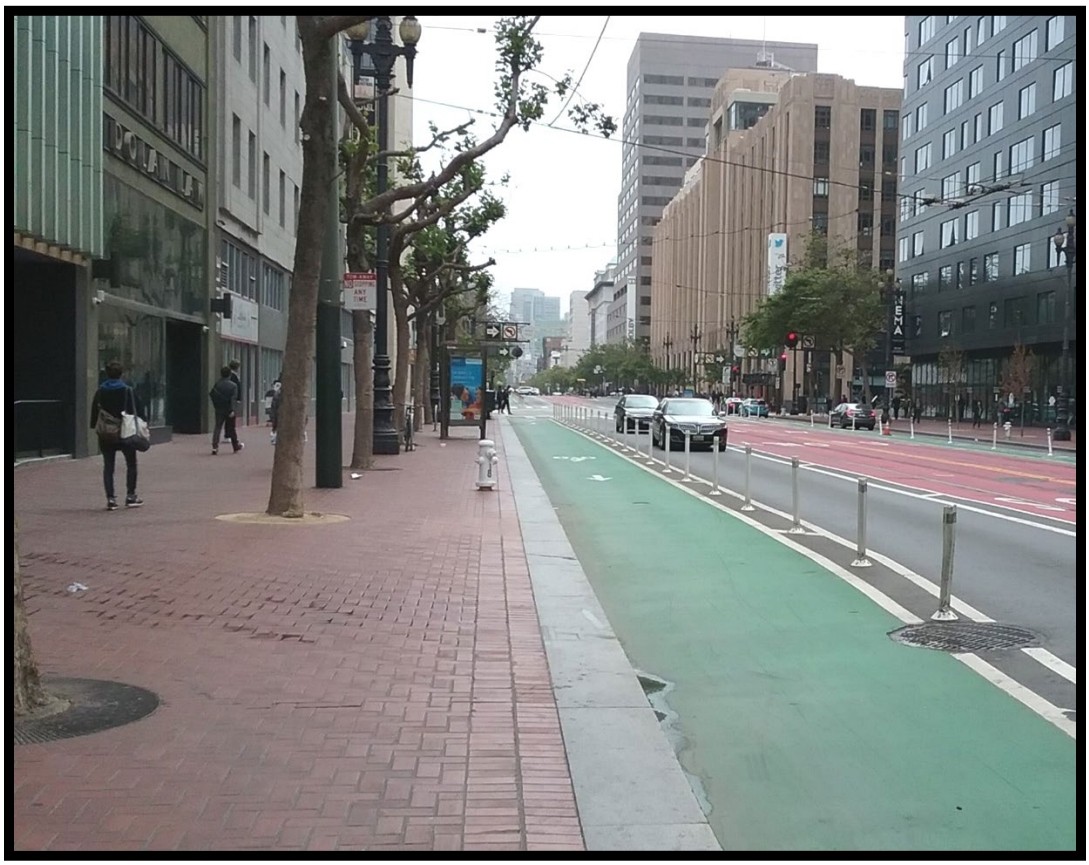


**Photo 1: Separated Bikeway in San Francisco**

## Planning Considerations

Local jurisdictions have the authority to establish bicycle transportation plans and bikeways. Adding a Class IV Bikeway into an already built-out street environment usually requires a reevaluation of service needs, such as a traffic operations analysis for capacity, because some transportation feature(s) may need to be reduced or eliminated, e.g., vehicular lanes, shoulder, on-street parking, or sidewalk. Local jurisdictions must be involved when analyzing these community impacts with the local residents, businesses, and advocacy groups and deciding what features are to be included in the street modification. Thus, community planning is necessary when local agencies are contemplating a Class IV Bikeway route. Moreover, effective public engagement is vital to the successful development of Class IV Bikeways. Additional planning considerations are discussed in Chapter 4 of the FHWA Guide, which provides guidance in deciding how the Class IV Bikeway will function within the local community context.

**Bike Network**

The following are types of bicycle facilities which can be part of a context sensitive, user friendly, and equitable bicycle network (see CA MUTCD Part 9 and HDM Index 1003.1 for more information):

- Class I Bikeway (Bike Path): A shared use (bicycle and pedestrian) facility in a completely separated right of way from the roadway with crossflow by motorists minimized. If there is a pedestrian facility immediately adjacent to or separate from the bike path, pedestrians are required to use the designated walking path and are not permitted on the bike path per CVC 21966. See the HDM Index 1003.1 for more information.
- Class II Bikeway (Bike Lane): A delineated lane for bicycles within the roadway which provides a restricted right of way. Through travel by motor vehicles and pedestrians are prohibited, however, crossflow for vehicle parking or by pedestrians and motorists are permitted.
    - Buffered Class II Bike Lane: A Class II Bike Lane that has a horizontal buffer, marked with pavement delineation, without a vertical separation element between the bike lane and the vehicular traffic lane. See the CA MUTCD Part 9 for more information.
    - Contraflow Class II Bike Lane: A Class II Bike Lane that is designed for travel in the opposite direction as vehicular traffic. However, contraflow bike lanes are not placed on two-way roadways. See HDM Index 301.2(1) and CA MUTCD Part 9 for more information.
- Class III Bikeway (Bike Route): A right of way on-street or off-street that is shared with motorists and pedestrians. A bike route is useful to provide continuity to other bicycle facilities. These routes are indicated by roadway markings such as Shared Lane Markings (SLMs or “sharrows”) and appropriate signage.
- Class IV Bikeway (Separated Bikeway): A bikeway for the exclusive use of bicycles and includes a separation required between the separated bikeway and the through vehicular traffic. The separation may include, but is not limited to, grade separation, flexible posts, inflexible posts, inflexible barriers, or on-street parking.

In many contexts, it may be appropriate to have the various bikeway classifications interconnect in an overall network. Also, it may not be appropriate or feasible to have a continuous separated bikeway through certain street environments, such as on the same side of a street with many driveways. A bike lane may perform better in this context.

The vertical element feature of Class IV Separated Bikeways affords some bicyclists a greater sense of comfort and usability, which could encourage increased bicycling. FHWA Bikeway Selection Guide Chapter 3 describes user types for whom bike facilities should be designed. When the design user is in the “Interested but Concerned”

category, the most appropriate recommendation may be a facility that provides bicyclists a greater degree of separation from motor vehicle traffic. This is in comparison to facilities that are more acceptable to bicyclists who can tolerate closer proximity to vehicles and are in the “Highly Confident” or “Somewhat Confident” rider categories. The development of a well-conceived bikeway network that includes separated bikeways can have a positive effect on bicyclist and motorist behavior and on the community. Providing an interconnected network of bikeways can improve safety and access for bicyclists. The decision as to which type of bikeway facility to use should be made in coordination with the appropriate local agencies, and should include evaluation of factors such as land use, existing and anticipated bicycle volumes, traffic speeds and volumes, right of way, maintenance and city services, and type of roadway users.

If there is width for a Class II buffered bike lane, a Class IV bikeway should be evaluated as an alternative with consideration for the design user, the context of the street, and the surrounding network. There is no minimum or maximum motorist speed required for consideration of Class IV bikeways. However, the separated bikeway should always be considered for multilane roadways, which are desired to be part of the bikeway network, where vehicle speeds are greater than 30 mph, next to parking lanes, or where vehicles volumes are greater than 6,000 ADT (FHWA Bikeway Selection Guide).

For additional information regarding the selection of the appropriate bicycle facility, refer to the Caltrans Memorandum, Bikeway Facility Selection Guidance, dated June 30, 2020, found here:
https://dot.ca.gov/-/media/dot-media/programs/design/documents/dod-bikeway-selection-memo_06302020_signed-a11y.pdf

## 2.0 CLASS IV BIKEWAY (SEPARATED BIKEWAY) DESIGN CONSIDERATIONS

A Class IV Bikeway (separated bikeway) can be either a one or two-way facility separated from vehicle travel lanes with a horizontal buffer and vertical element, and from pedestrian travel. The vertical separation may be provided by a grade separation, flexible posts, inflexible physical barriers, medians, landscaping elements, raised curb, or on-street parking. The pedestrian pathway can be separated by a grade separation, vertical element, or raised paving material (see Photos 1 and 2).

### One-Way Class IV Bikeways

Separated bikeways typically operate as one-way bikeway facilities in the same direction as vehicular traffic and on the same side of the roadway. Providing a one-way bikeway on each side of a two-way street achieves the goal of providing direct access to destinations on both sides of the roadway. On one-way streets, however, several factors should be considered when deciding which side of the roadway to locate the bikeway. To provide direct access for bicyclists, a major consideration is to locate the bikeway on the same side of the street with destinations. Another consideration is to minimize conflicts with vehicle turning movements if one side of the street has more driveways than the other. On transit corridors with frequent headways, the bikeways

are preferred on the left side of traffic to avoid conflicts at bus stops, unless the design accounts for these conflicts on the right side of vehicular traffic. Since driver and bicyclist expectation may assume bicycle traffic to be located to the right of vehicle traffic, maximizing the visibility of bicyclists and evaluation of vehicular turning volumes at intersections should also be considered when deciding which side of the roadway to place the bikeway.

On one-way streets with one Class IV bikeway in the same direction as vehicular travel, the inclusion of signage or pavement markings to discourage bicyclists from traveling in the wrong direction may be considered. An R5-1b ("wrong way bikes") sign can be placed at the downstream end of the block, where wrong-way riders would enter. A guide sign directing bicyclists to the preferred adjacent bike facility may also be considered. Refer to Part 9 of the CA MUTCD for guidance relating to use and placement of pavement markings and signs.

**Two-Way Class IV Bikeways**

Two-way separated bikeways can be used to concentrate bicyclists to one side of the road and may be used on one-way or two-way streets. Two-way bikeways may be considered on one-way roadways to provide the most efficient path to destinations which would otherwise not be directly accessible through a one-way bikeway. Other uses are to close a gap in the bikeway network and mitigate wrong-way riding. See FHWA Guide, Chapter 5, Two-Way Separated Bike Lane on Right-Side of One-Way Street (Page 80), for guidance for two-way separated bikeways on one-way streets.

Two-way bikeways on two-way streets may be preferred when a significant number of destinations or conflicts are on one side of the roadway. Since two-way separated bikeways require less space than two one-way bikeways, they may be a preferred alternative when there is limited right-of-way. However, when there are destinations or entry/exit points on both sides of the street, the two-way Class IV bikeway will not be the most direct route for some users. To determine which side of the roadway to place the two-way bikeway, considerations similar to those for the one-way bikeway should be investigated including the side of the street where destinations are located, the location of transit stops, maximizing the visibility of bicyclists, and turning traffic volumes for driveways and intersections. See FHWA Guide, Chapter 5, Two-Way Separated Bike Lane on Right-Side of Two-Way Street (Page 81), for guidance for two-way separated bikeways on two-way streets.

Since there is a potential for bicycles traveling simultaneously in two directions at intersections, and since drivers may not anticipate bicycle traffic from the opposite direction, traffic control devices should be included to minimize conflicts. For discussion on signalization, see Section 2.2, Crossing Points, of this document and CA MUTCD Section 4D.104(CA). For signing and striping requirements, follow Part 9 of the CA MUTCD.


**Photo 2: Two-Way Separated Bikeway in Redondo Beach**

## 2.1 Vehicle Travel Lane and Bikeway Separation Considerations

The horizontal buffer of the Class IV bikeway, which includes the vertical element, is one of the most important features of separated bikeway design. The buffer width, along with the selection and placement of the vertical elements are critical to the safety, comfort, and functionality provided by the bikeway. The horizonal buffer is typically striped and the vertical element may be a grade separation, flexible posts, inflexible physical barriers, raised medians, on-street parking, planters, or other elements in support of complete streets.

Wider buffers improve bicyclist comfort and safety on multi-lane, high speed roadways. When a wider buffer is used to accommodate protected intersection (see “Intersections” of Section 2.2 of this document for more information) elements or include striping and/or vertical elements to tighten turning radii, the wide buffer space can encourage reduced speeds of motorists turning across the bikeway, increase motorists’ reaction times, and increase opportunities for motorists to yield to bicyclists. Appropriate buffer widths provide the desired degree of separation necessary for the comfort of bicyclists, accommodate the widths of vertical elements, shy distances from vertical elements, clearance for door zones, and other types of structures or uses inside the buffer zone. Features that need to be seen or accessed from the street, like signage, bicycle racks, mailboxes, parking meters, street lighting, or pay stations, can be located in the buffer zone if consideration is given to visibility of bicyclists, and maintenance. When placing

vertical elements in the buffer zone it is necessary to consider the clear recovery zone and horizontal clearance requirements described in the HDM.

Selection and horizontal placement of the vertical element should provide for the desired comfort of intended users, the required shy distance, the door zone buffer from on-street parking, and maintenance. The linear spacing of elements should be designed for roadway speeds and number of lanes, level of safety provided for bicyclists, anticipated motorist encroachment into the bikeway as a travel or parking lane, cost effectiveness, and maintenance. A combination of vertical elements can be considered for context sensitivity, and to maximize the benefits and cost effectiveness of the facility.

Generally, the higher the speed and volume of a road, the more separation is needed for bicyclists. Flexible posts are popular due to their visibility, ease of installation, and low cost, and are appropriate for low to moderate speeds and may be considered on roadways with speeds of 30 mph or less. If flexible posts are to be used on a higher speed roadway, a wider horizontal buffer separation should be considered.

On roadways with higher vehicle volumes and speeds, rigid and permanent vertical separation should be considered. Curbed medians provide a permanent rigid physical barrier and are preferred on high volume street where speeds exceed 30 mph. Sloped curbs should be considered in constrained conditions to reduce the chance of pedal strike. Concrete barriers provide the highest level of protection for bicyclists.

**Street Parking**

Where there is on-street parking, the separated bikeway is typically between the parking and the raised sidewalk. See Photos 4, 5 and the FHWA Guide, Chapter 5, Forms of Separation (pg 87). If parking is provided adjacent to a sidewalk level separated bikeway, adequate buffer width behind the curb face is needed to account for vehicle doors, see Section 3.3 of this document. As is necessary, pedestrians will need to cross the separated bikeway from parked vehicles. Additionally, motorists may need to cross the separated bikeway to access driveways and alleys. As such, sight distance will also need to be considered at those driveway and alley crossing locations. Refer to Section 2.2 of this document for further discussion on crossing points and Figures 14 and 15 of the FHWA Guide for guidance on setback distances for sight triangles.

Where on-street accessible parking is proposed for the block, it may be better to avoid the side of the block face adjacent to the separated bikeway. The federal Accessibility Guidelines for Public Rights-of-Way contain the accessible parking provisions on a block perimeter basis. However, if accessible parking is required on the block face adjacent to the separated bikeway, the separated bikeway may need to be modified. This could include the addition of a marked crossing of the separated bikeway and a curb ramp in the adjacent sidewalk, as shown on Figure 19 of the FHWA Guide.

**Photo 3: Separated Bikeway with parking and flexible posts in Sacramento**

**Photo 4: Separated Bikeway with parking in Oakland**

### Vertical Element Placement

The horizontal placement of the vertical elements should be placed within the buffer zone with enough clearance to prevent contact between the bicycle handlebars and the vertical element. Preference should be given to locating the vertical element to maximize the width of the bicycle lane; however, if there is street parking, the clearance required for open car doors should also be considered. Additionally, it may be necessary to utilize more frequently spaced vertical elements where motor vehicle encroachment in the bike lane is observed or anticipated. Where on-street parking is located adjacent to the street buffer, it is not required to have additional vertical elements, except in locations where parking is absent, such as near intersections. However, the addition of supplemental vertical elements will help compliance and reduce the occurrences of parking in the bikeway. Supplemental vertical elements should be included in locations where on-street parking is prohibited for portions of the day, commercial areas where on-street parking turnover is high, or locations where parking demand is low. If the vertical element is less than the horizontal buffer width required, the horizontal buffer zone should be delineated with paint. Section 3.2, Vertical Element Linear Spacing, of this DIB, provides guidance for the spacing of various vertical elements.

For the separated bikeway in higher speed environments, using an inflexible physical barrier, see Section 3.1(3) of this DIB.

## 2.2 Crossing Points: Intersections, Driveways and Alleys

The FHWA Guide Chapter 5 provides a thorough discussion regarding the conflict points associated with intersection crossings and driveways. Intersection crossing points offer unique challenges to the design and operation of a separated bikeway. While grade separated crossings, such as overcrossings or undercrossings, are preferred to eliminate conflicts altogether, construction of these facilities is often infeasible for various reasons. In their absence, the usability and safety of the separated facility depends heavily on the manner in which intersections, driveways, and alleys, as well as pedestrian facilities, interact with and connect to the separated bikeway and bikeway network. The bikeway must provide adequate visibility at intersections, driveways, and alleys, to avoid right or left hook collisions in which vehicles turn in front of bicyclists traveling straight. As such, it is critical that careful thought and planning go into the design of all intersections, driveways, and alleys located along a bikeway.

The use of green colored pavement marking, typically green paint, is permitted by MUTCD Interim Approval IA-14 and approved for statewide use in California on all highways and all local jurisdictions. This approval for green colored pavement marking allows for the use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Refer to MUTCD Interim Approval IA-14 for permitted uses and applications. Also, refer to Interpretation Letter 9(09)-86(I), dated June 17, 2016, “Chromaticity Requirements for Green Colored Pavements,” which defines the approved green colorization of pavement.

Consideration should also be given to skid resistance, durability, weatherization, and maintenance needs when applying pavement colorization.


**Photo 5: Separated Bikeway with green pavement at driveways in Los Angeles.**

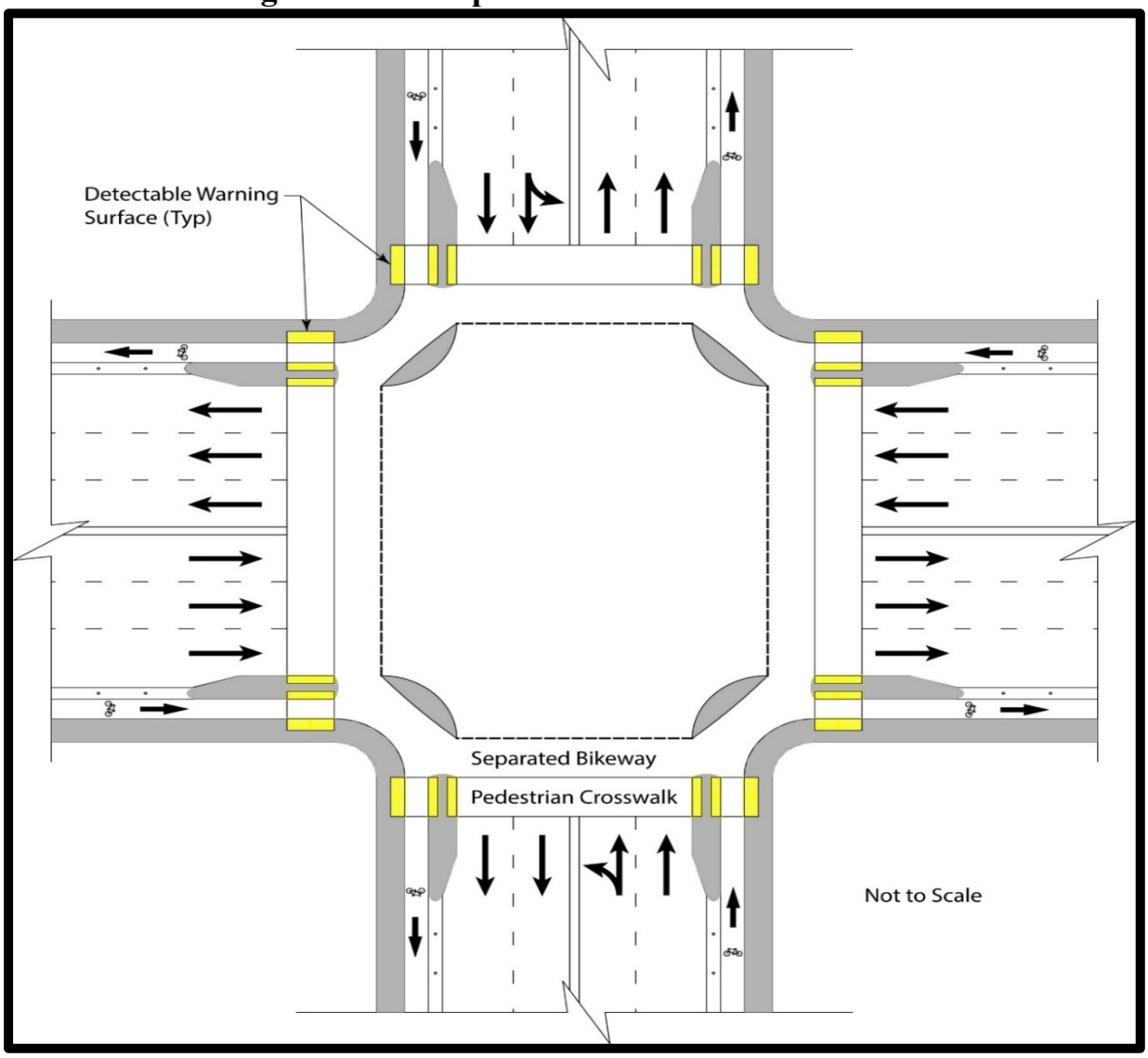
### Intersections

Intersection design should minimize the potential conflicts between the separated bikeway user and the crossing or turning of motorized traffic and pedestrians. Consideration should be given to: providing dedicated spaces for motorists to wait while yielding to bicyclists and pedestrians, separating bicycle crossings from pedestrian crossing, and providing space for turning and queuing bicyclists. Additionally, evaluation of whether the bike facility should bend in, bend out, or proceed straight approaching the intersection should be based on motorist speeds, vehicle volumes, and available right-of-way.

As shown in Figure 1, Protected Intersections provide physical separation between turning vehicles and bicyclists at intersections. This design uses corner islands to provide a buffer for waiting bicyclists and pedestrians, and a dedicated path through the intersection without requiring a merge with mixed traffic. A protected intersection has a bikeway crossing that is set back to improve sight lines and to provide a place for bicyclists and pedestrians to queue outside of the bikeway and sidewalk. Protected intersections also reduce vehicle turning speeds, which reduces the rate of serious injury in the event of collision with bicyclists or pedestrians. Refer to Topic 404 of the HDM regarding selection of the appropriate design vehicle when evaluating the corner

radii for the design of the protected intersection. For bicycle detection, see the CA MUTCD Part 4.

**Figure 1: Example of a Protected Intersection**




Sometimes it may be necessary to direct the bicyclist to cross the intersection similar to crossings for Class II Bikeways (bike lanes). To accomplish this, the separated bikeway would end prior to the intersection and become a bike lane and continue operating as a bike lane prior to and through the intersection. Typically, the vertical separation feature would terminate before the intersection and resume after the intersection (unless a separation is designed at the intersection). However, the pavement markings may extend through the intersection denoting the bikeway projection as dotted white lines, see the CA MUTCD Part 9.

If the vertical elements of the Class IV bikeway are dropped prior to the intersection approaches, these locations should be signed and designated with markings with

consideration given for the use of green pavement marking to alert users of potential conflict areas, indicate the right-of-way, and delineate the movements of motorists and bicyclists.

**Photo 6: Protected intersection in Davis**

Right-turn lanes may necessitate that the separated bikeway be modified or terminated. If terminated before the intersection, the approach markings can be the same as a bike lane positioned to the left side of the right-turn lane. See the CA MUTCD Part 9. If it is desired to maintain the separated bikeway path through the intersection, Figures 22, 23, 25 and 26 in the FHWA Guide may be considered.

Figure 22 of the FHWA Guide allows the separated bikeway to continue uninterrupted up to the intersection. When using the Figure 22 option at signalized intersections, the use of a separate bicycle signal will be needed in order to eliminate conflicts between turning vehicular traffic and bicycles proceeding straight through the intersection in the separated bikeway. Refer to CA MUTCD Part 4 for guidance related to the use of bicycle signals. If the Figure 22 configuration is utilized at intersections or driveways with an uncontrolled approach, consider the incorporation of signage or pavement markings. FHWA Guide Chapter 5 contains sign guidance (pg 127) which includes a modified version of Sign R10-15, indicating turning vehicles shall yield to bicycles. If a

modified R10-15 sign is proposed, the designer should consult with the California Traffic Control Devices Committee (CTCDC) secretary in the Caltrans Division of Safety Programs.

On the other hand, Figure 23 of the FHWA Guide will necessitate an interruption of the separation feature to allow a vehicle to cross the separated bikeway. Consider minimizing the weave length to encourage vehicles to make slower turning movements into the right turn lane. Review the FHWA Guide for additional details related to the Figure 23 configuration.

Figures 25 and 26 of the FHWA Guide provide guidance for layouts known as “Bend-In” and “Bend-Out”, respectively, and are without dedicated right-turn lanes. The Bend-In layout shifts bicyclists closer to the adjacent lanes to improve motorist visibility of the bicyclist. The Bend-Out layout shifts bicyclists downstream on the side street away from the intersection, allowing vehicles to complete turning movements before interacting with bicyclists.

Bikeway turns may be accomplished by utilizing the guidance in the FHWA Interim Approval for bike boxes and/or two-stage turn queue boxes per IA-18 and IA-20, respectively, see Figures 30 and 31 of the FHWA Guide.

**Photo 7: Separated Bikeway with a Bike Box**

Also, the separated bikeway may be discontinued on the approach to the intersection and may be designed as a bike lane, which provides for a designated space for the left turn movement, adjacent to the left-turn lane. Public involvement, typically in the planning process, should be used to make these types of major design decisions.

### Interchanges

Interchange locations pose unique challenges due to weaving and merging of entering and exiting vehicles on the local road. As such, in some situations it may be best to discontinue the separated bikeway so that it would function as a bike lane. Another alternative would be to provide a connection to or similar to a Class I Bikeway that provides grade separated crossings of the highway ramps. At locations with higher bicycle and pedestrian volumes, consider either a wider Class I Bikeway or separated bike and pedestrian paths similar to a sidewalk-level Class IV Bikeway. See Chapter 1000 of the HDM for Class I Bikeway guidance. See the CA MUTCD Part 9 for guidance on bike lanes at interchanges.

### Bicycle Signal Faces

Section 4D.104(CA), of the CA MUTCD, "Optional Use of Bicycle Signal Faces," permits the use of bicycle signal faces at signalized locations if deemed beneficial based on engineering judgement. Prior to using bicycle signal faces, alternative means of handling conflicts between bicycles and other users should be considered, including restriping of the intersection and bikeways.

If bicycle signal faces are used, signal phasing shall be such that while bicycles are moving on a green or yellow bicycle indication, they are not in conflict with any simultaneous motor vehicle or pedestrian movements at the signalized location, including right (or left) turns on red. Inclusion of signs R13A(CA) or R13B(CA) for no right/left turn on red may be required if vehicle turning movements are necessary. Refer to Section 2B.54 of the CA MUTCD for additional information. Additionally, automated bicycle detection should be considered to encourage proper use of the bicycle signal. Section 4D.105(CA) of the CA MUTCD provides guidance for bicycle detection.

An advantage of using bicycle signal faces is that it can permit separate and protected movements of bicycle traffic to avoid conflicts with other users, such as allowing bicycles to travel straight through an intersection while prohibiting right turn movements of vehicular traffic.

For additional information on the use of bicycle signal faces, refer to Section 4D.104(CA), of the CA MUTCD.

### Driveways and Alleys

Separated bikeways that must cross driveways and alleys should continue as a separated bikeway facility. The buffer width should be maintained, however, the vertical separation feature will be discontinued at driveway and alley locations. For examples, see Figures 14 and 15 of the FHWA Guide. Note the "Field of View" and sight distance guidance provided by "Driveways" section of Chapter 5 and Figures 14 and 15 of the FHWA guide (pg 89 – 91).

Marking the separated bikeway with green colored pavement marking may be used to raise the driver's and bicyclist's awareness of these potential conflict areas at driveways

and alleys, see Photo 5 and Section 2.1 of this DIB. Other traffic control devices may be used as well, see the CA MUTCD Part 9.

## 2.3 Loading Zones, Transit Stops and Passenger Drop-Off Zones

Loading and unloading zones, transit stops (e.g., bus stops) and passenger drop-off zones should take place within the standard parking area adjacent to the marked buffer separating the separated bikeway. Additionally, modifications to the separated bikeway or vehicle travel lanes may be necessary, e.g., narrowing vehicle lane width, narrowing the separated bikeway width and/or raising the separated bikeway. See Figures 20, 21 and the photo on page 101 within the “Loading Zones” section of Chapter 5 of the FHWA Guide for more information.

Another option, particularly for transit stops and passenger drop-off zones is the use of Island Platforms. The Island Platform, as shown on Figures 16 and 17 of the FHWA Guide, allow buses to load and unload passengers from a raised platform, similar to boarding a bus from a sidewalk, which can allow for easier boarding and disembarking of the bus passengers.

Island Platforms can be designed such that buses stop in the travel lane or within a bus pullout. These configurations are shown in Figures 2 and 3 of this document and are also shown on Figure 16 and 17 of the FHWA Guide. With either configuration, the vertical profile of the separated bikeway could be designed to rise up to meet the platform to allow for at grade pedestrian crossings from the island to the sidewalk and then lowered back down to the roadway elevation. Another option is for the separated bikeway to remain at the roadway grade (vertically separated from the island and sidewalk) and to provide ADA compliant curb ramps in both the island and the sidewalk for the pedestrian crossing. Additionally, all pedestrian crossings points should have a marked crosswalk.

When designing island platforms, if objects such as bus shelters are proposed, consider how such objects may affect the ability of bicyclists and pedestrians to see each other. For example, if a bus shelter is placed on the downstream end, near where pedestrians enter the front of the bus, consider placement of the bikeway crossing on the upstream end to allow for improved visibility for both bicyclists and pedestrians to see each other.

Where possible, relocate loading zones to other block faces, and place the bikeway facility on the other side of the road on one-way streets. However, on many streets, a division between loading uses, transit, and bicycles is not possible.

At locations without adequate width to accommodate transit stops in addition to a separated bikeway, an alternative is to discontinue the separated bikeway and transition to a different classification such as a Class II or Class III and then to resume the Class IV separated bikeway beyond the transit stop.

**Figure 2: Busbulb Island Platform**

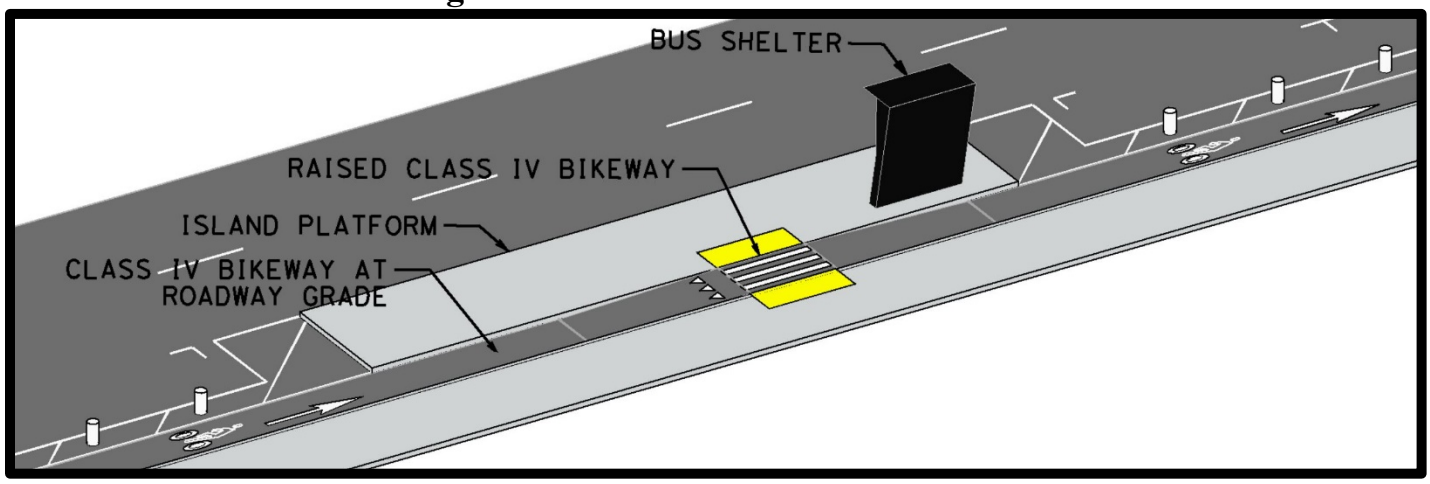
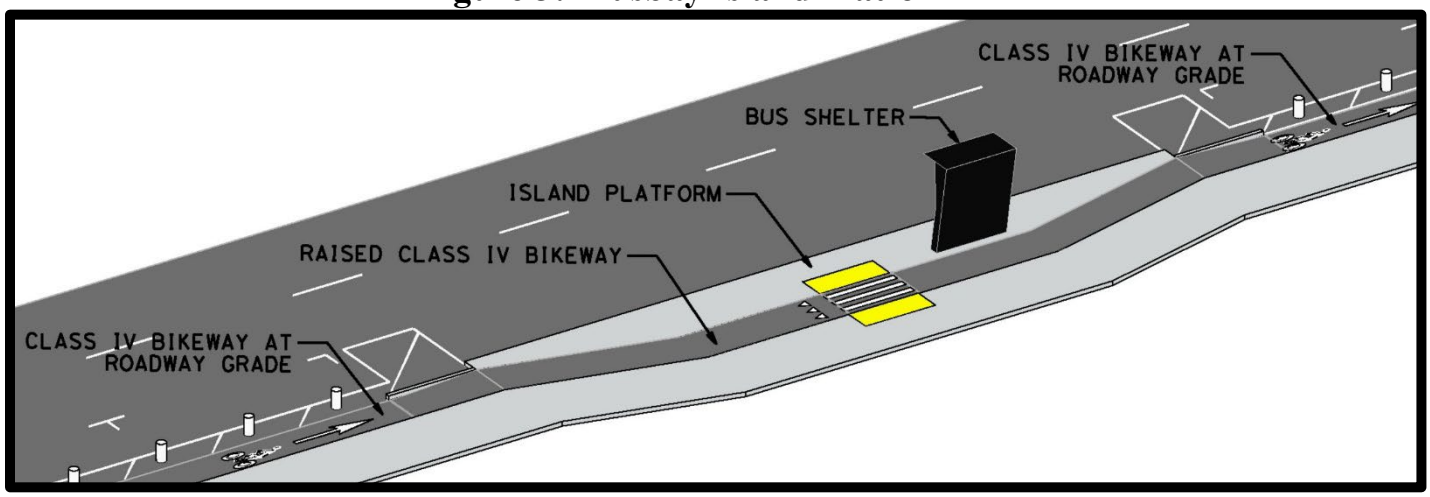



**Figure 3: Busbay Island Platform**




## 2.4 Crossing Points with Pedestrians

### Intersections

Separated bikeways should be separated from pedestrian crosswalks at intersections to discourage bicyclists from mixing with pedestrians, such that the separated bikeway path of travel will be adjacent to the crosswalk, see Photo 6, Figure 1, and the FHWA Guide Appendix page A-9. This example provides a concept of a protected intersection and can be adjusted for various features as needed. When the bikeway is on a sidewalk, bicyclists and pedestrians should be separated, which could be accomplished with separate push buttons along with appropriate signs and markings to accommodate all users for separated crossings, see Photo 8.


**Photo 8: Separate push button placement for bicyclists and pedestrians**

### Sidewalk-Level Bikeways

Sidewalk-level bikeways must be separated from the pedestrian facility because the bikeway is for the exclusive use of bicycles. Vertical elements such as curbs and planters can be used to separate pedestrians and bicyclists. Although vertical elements are not required between the sidewalk-level bikeway and the pedestrian path, an important consideration is the need for all users, particularly for visually impaired users, to detect the limits of the walking path. As such, the bikeway should be visually distinct and detectable. Consider using a rolled curb or other linear feature that would be detectable to visually impaired users. Per the FHWA Guide, different paving materials can be used to differentiate the bikeway from the walkway. However, if using different paving materials to differentiate the bikeway from the walkway, it is important that the material difference be detectable to those who are visually impaired. Detectable Warning Surfaces should be used at crossing locations but should not be used as a continuous detectable separation between the bikeway and walkway. The section

"Forms of Separation" (pg 86), of Chapter 5 of the FHWA Guide provides discussion on sidewalk level separated bikeways.

**Photo 9: Two-way Separated Bikeway with pedestrian path grade separation**

When vertical elements are used to separate the bicycle and pedestrian facilities, the requirements of those who need to access each path on demand should be considered. For example, bicyclists need to cross the vertical element to access the sidewalk or destinations fronting the street, and pedestrians who need to cross the bikeway to access on-street parking. Pedestrians retrieving or walking their bicycles on the walking path will need to access the bikeway. If a continuous vertical barrier is selected as an alternative, periodic openings with adequate space for bicyclists to cross should be provided.

### Mid-Block Crossings and Island Platforms

At locations where concentrated and uncontrolled pedestrian routes cross the separated bikeways, pavement markings such as crosswalk and yield markings as well as signage should be considered to encourage pedestrians to cross at designated locations and to alert bicyclists to yield to crossing pedestrians. Consider street or pedestrian lighting when locating uncontrolled pedestrian crossings at bikeways.

## 3.0 CLASS IV BIKEWAY (SEPARATED BIKEWAY) DESIGN CRITERIA

Documenting design decisions is recommended when employing these criteria. Documentation for the State Highway System is prescribed in HDM Index 82.2. Documentation on the local road system is per Chapter 11 of the Caltrans *Local Assistance Procedures Manual*. The documentation process must also comply with the provisions in the California Streets and Highways Code Section 891(b). The separated bikeway design criterion is provided herein along with a graphical representation in Figure 4, showing an example for one-way travel. The separated bikeway traffic control devices are prescribed in the CA MUTCD Part 9.

### 3.1 Vertical Element Separations

Multiple factors should be considered when evaluating the vertical element options including vehicle travel way geometry, vehicle speeds, vehicle volume, anticipated future bicycle volume, skill level of anticipated users, aesthetics, traffic calming, right-of-way constraints, drainage, and maintainability.

Sight distance should be evaluated at crossings of intersections, driveways, alleys, and pedestrian crossing locations to verify visibility for all users. When inflexible physical barriers are used, the compatibility of the barrier with clear recover zone and horizontal clearance requirements should be considered (see HDM Topic 309). For continuous barriers, access for emergency vehicles or access to fire hydrants should also be considered.

The bikeway vertical element separation shall be at least one of the following to discourage the intrusion of motor vehicles into the bikeway:

1) Grade Separation. A vertical separation that is on a different elevation from the adjacent roadway. The bikeway may either be raised to the sidewalk level, or to an intermediate grade. The horizontal alignment of the bikeway may also be separate from the roadway. Drainage design for runoff is also needed.
2) Flexible Bikeway Separator Posts. Flexible bikeway separator posts are MASH compliant, with retroreflective sheeting, and comply with the CA MUTCD Parts 3 and 9. Bikeway separator posts can be standard channelizers but can also have different heights, different widths and increased retroreflective sheeting.
3) Inflexible Physical Barrier. Barriers, railing, landscape planters or similar. These items should include signs/markers per the CA MUTCD Part 2. Drainage design for runoff is also needed.
4) On-Street Parking. Parking that is allowed all times of the day, except for maintenance. If continuous inflexible physical barriers, raised islands, or curb/dike are used in the buffer, an opening should be provided such that a 5-foot minimum clear width is provided for pedestrians to access their vehicle and the sidewalk. Also, this placement should be designed to accommodate drainage. In situations where the separated bikeway is on a hill with a grade greater than 3%, a curb or dike is required so that the wheels of parked vehicles can be turned against it to comply with CVC 22509. While on-street parking may be sufficient to serve as the vertical separation element, it may be necessary to provide additional vertical elements to

improve separation in locations where parking is absent, such as near intersections, locations where on-street parking is prohibited for portions of the day, commercial areas where on-street parking turnover is high, or locations where parking demand is low. Optional supplemental vertical elements may also be used to discourage parking in the bikeway.

5) Raised Island. Raised channelization islands may include landscaping and signs/markers per the CA MUTCD Part 2. Curb, dike or wheel stops (i.e., parking bumpers) may also be used. Drainage design for runoff is also needed.

The roadway drainage must be considered when selecting the vertical element to determine if additional drainage facilities are necessary to ensure proper drainage for the roadway, separated bikeway and sidewalk. Refer to Indexes 1003.1(16) and 1003.5 of the HDM for additional discussion regarding bicycle facilities and drainage.

## 3.2 Vertical Element Linear Spacing

The spacing of vertical elements along the roadway should be considered based on the skill level of anticipated users, motorists' speeds and volumes, street parking and overall network connectivity. The objective is to provide safety, comfort, access, and connectivity for bicyclists and to encourage use of the facility. Elements should be placed closer where vehicle encroachment is likely.

| Vertical Element | Recommended Spacing |
|---|---|
| Flexible Bikeway Separator Post | 10' – 40' on center |
| Inflexible Physical Barrier | 10' – 40' on center, or continuous inflexible physical barrier |
| Parking Stop/Bumper | 9' – 12' on center |
| Planter Boxes | Maintain consistent spacing |
| Curb/Raised island | Continuous or with openings for drainage |
| Concrete Barriers | Continuous, see Section 3.1 for considerations |

A closer spacing may be appropriate for slower speed environments to deter motorists from merging into the bikeway or pulling up to the curb. A wider spacing may be used in areas of higher speeds, in which the spacing will visually look tighter to the driver. The wider spacing may reduce the feeling of separation to the bicyclist, so the designer may need to consider a more frequent spacing to create a lower-stress environment for bicyclist and to increase traffic control guidance for motorists.

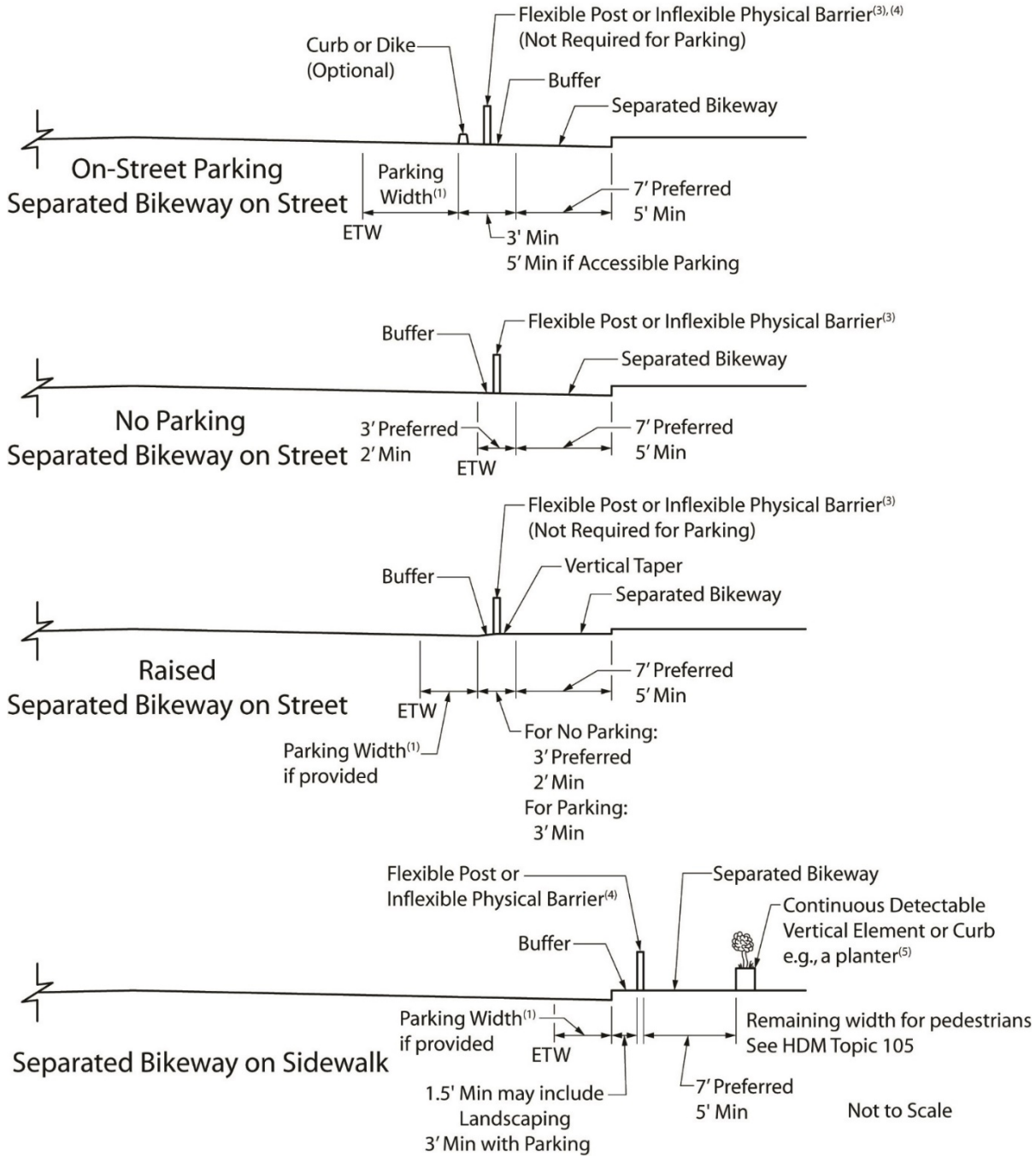
At locations with parking, if an inflexible barrier is used, such as planter boxes, a 5-foot minimum clear width should be provided for pedestrians to access their vehicle and the sidewalk. At locations with accessible parking, a 5-foot minimum clear width should be provided adjacent to the accessible parking.

## 3.3 Separation Width

The separation includes a width or buffer (refer to Figure 4):

1) Grade Separation.
   a. For a separated bikeway on the same grade as a sidewalk, the separated bikeway separation width should be 1.5 feet minimum, including the curb width (which may include landscaping), and 3 feet minimum with parking to account for vehicle doors. Note, this portion of the sidewalk can no longer be used by pedestrians.
   b. If the separated bikeway is in the roadbed and is raised, the vertical taper (See Figure 4) should be placed in the buffer between the separated bikeway and the vehicular traffic lanes. The vertical taper is included in the buffer width of 3 feet preferred, with 2 feet being the minimum where there is no parking. With parking this width should be 3 feet minimum and 5 feet with accessible parking. If there is no parking, the buffer includes either flexible bikeway separator posts, inflexible physical barrier or a raised island because the vertical taper itself may be too subtle to be recognized by drivers; these are not required with parking. See Section 3.6 of this DIB for raised separated bikeway and vertical taper guidance.
2) Flexible Bikeway Separator Posts. The flexible bikeway separator posts should be placed in the center of a marked buffer that is 3 feet wide preferred, with 2 feet being the minimum width. For the separated bikeway on a sidewalk, the separation may include the flexible bikeway separator posts 1.5 feet minimum from face of curb.
3) Inflexible Physical Barrier. An inflexible physical barrier should be used in lower speed environments (where the posted speed is 35 mph or less). An inflexible physical barrier should be placed in a marked buffer of 3 feet wide preferred, with 2 feet minimum width. In higher speed environments a concrete barrier should be used. On a sidewalk, the separation may include the inflexible physical barrier 1.5 feet minimum from face of curb.
4) On-Street Parking. A marked buffer between the on-street parking and the separated bikeway should be a minimum width of 3 feet. However, at on-street accessible parking the minimum width is 5 feet. The flexible bikeway separator posts, inflexible physical barrier or raised island may be included.
5) Raised Island. Raised islands may be between the separated bikeway and vehicular traffic or parking. These islands should be 3 feet wide, preferred, if no parking is allowed, with 2 feet being the minimum width; 1-foot if used with flexible bikeway separator posts. Three feet is the minimum width with parking; 5 feet with accessible parking.

## Figure 4: Typical One-Way Class IV Bikeway Cross Sections




NOTES:

1) See CA MUTCD Section 3B.19 for parking guidance.
2) For separated bikeway marking and signing guidance, see the CA MUTCD Part 9.
3) May be a raised island in lieu of flexible bikeway separator posts or inflexible physical barriers.
4) Flexible bikeway separator posts or inflexible physical barriers may be omitted.
5) Periodic openings should be provided for bicyclists to access buildings.
6) At locations with designated accessible parking, a minimum 5’ buffer is required.

### Clearance to Objects Adjacent to Bikeways

When designing bikeways, consideration should be made to prevent conflicts with bicyclists and objects adjacent to the bikeways. Where a curb separates the bikeway from the adjacent buffer zones, it is preferred there be a minimum 6-inch offset between the face of curb and the edge of the vertical object greater than or equal to 30 inches in height such as signage, parking meter, or street furniture. Where there is no curb, it is preferred there be a minimum 12-inch offset provided between the edge of the bikeway and the vertical object. A minimum 8-foot vertical clearance should be provided from the floor of the bikeway along the entire bikeway path.

## 3.4 Separated Bikeway Width

Separated bikeway width is designated by the clearance between markings, inflexible physical barriers, bridge barriers or railings, and curbs. Consideration for maintenance, such as street sweeping, snow removal, and debris removal from de-icing practices should be part of the decision for the clear width selected. Anticipated bicycle volume, need for passing, bicycle commuting route, and availability of right-of-way are some of the factors where the separated bikeway width may exceed the minimum or preferred stated below.

1) One-Way Separated Bikeway: The separated bikeway clear width should be 7 feet preferred, with 5 feet being the minimum when adjacent to a roadway.
2) Two-Way Separated Bikeway: The same width as a Class I Bikeway (bike path) should apply (HDM Index 1003.1). Where the two-way bikeway is at street-level adjacent to a gutter pan, a minimum paved width of 3 feet must be provided in the lane next to the gutter. To maximize the paved riding surface for the lane nearest the gutter, the centerline of the two-way bikeway may not necessarily be centered between the face of curb and the outer edge of the bikeway, but may be aligned towards the center of the asphalt riding surface. See Photo 10.
3) Temporary Reduction in Width: When located at accessible parking or a raised bus stop island, the separated bikeway minimum clear width should be 4 feet for a one-way bikeway and 8 feet for a two-way bikeway.

See the CA MUTCD Part 9 for additional guidance on longitudinal pavement markings and the symbol marking.

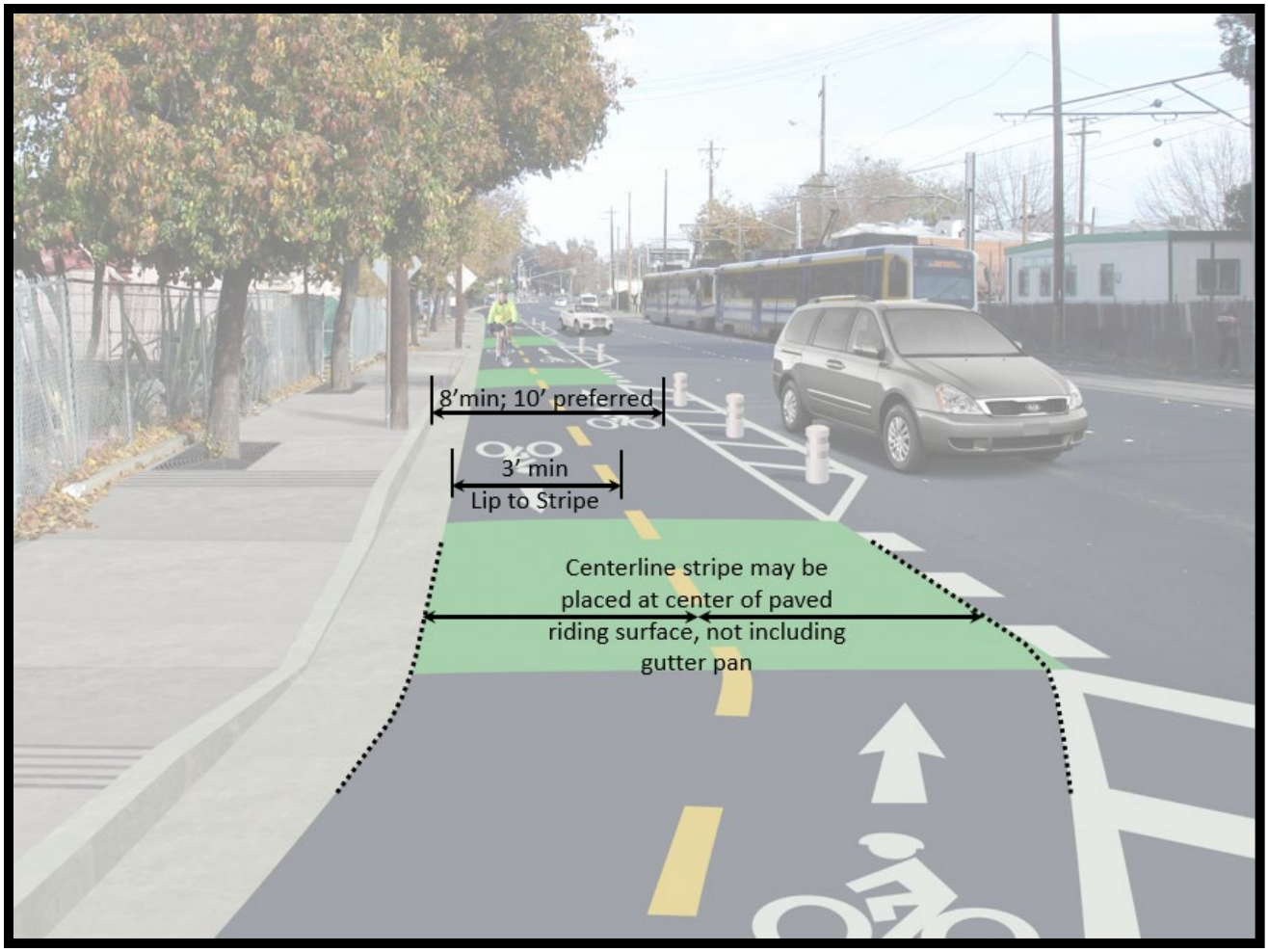



**Photo 10: Two-Way Class IV Bikeway Dimensions (Image Source: Psomas)**

## 3.5 Separated Bikeway Approach Tapers

Separated bikeway approach tapers will occur primarily at intersections, but may occur at other locations depending on the presence of traffic signal hardware, etc. For example, reducing the separated bikeway width may be required due to the presence of accessible parking, bus stops, or transit stations. Longer approach tapers can improve the bicyclists visibility of the bikeway ahead and allow for more comfortable maneuvers by bicyclists through the transition.

1) A separated bikeway approach taper transition between 10:1 to 5:1 is preferred, with 3:1 being the minimum for constrained locations.

## 3.6 Raised Separated Bikeway On Street

If the separated bikeway is to be raised, it should be designed to accommodate drainage. Also, the transition from the bikeway to the roadway may be designed to allow the bicyclist to enter the adjacent traffic lanes.

1) A raised separated bikeway should be elevated 3 inches minimum above the finished grade, but no higher than the adjacent curb in order to allow drainage towards the street unless some other drainage design is implemented.
2) A vertical tapered edge should be 4:1 or flatter occurring in the marked buffer.

## 3.7 Curb Selection

The use of lower height curbs may be considered when adjacent to the bikeway to prevent pedal strikes or sloped curbs may be employed to facilitate entering or exiting the bikeway.

Standard vertical curbs should be used where appropriate to prohibit encroachment by motor vehicles. Section 303 and Table 303.1 of the Highway Design Manual provides guidance for curb type selection. A standard 6 inch vertical curb is recommended next to vehicle travel lanes and parking to reduce encroachment into the bikeway.

Sloped curbs with a maximum 1V:1H slope reduce the risk of pedal strikes and provide easier access to the sidewalk. Sloped curbs with a maximum 1V:4H slope allow for bicyclists to enter or exit a raised separated bikeway.

# 4.0 CLASS IV BIKEWAY (SEPARATED BIKEWAY) MAINTENANCE

Separated bikeways require routine maintenance similar to other roadway facilities. However, because of their location near the edge of the roadway, they are more likely to accumulate debris. Since bicyclists are inhibited from entering and exiting separated bikeways at their discretion, maintaining the separated bikeway surface and removing debris in a manner similar to the adjacent roadway is recommended. Narrow street sweeping vehicles may be needed depending on the separated bikeway width and separation selected. See “Sweeper Selection for Separated Bike Lane Maintenance” (pg 65), Chapter 4, of the FHWA Guide.

In areas that receive significant snowfall, separated bikeway design may be influenced by the need to accommodate snow removal equipment, such as the type and width of separation used. Consider tapering front ends of curbs and providing vertical delineation at above-ground features to prevent snowplow blade contact. See the section “Maintenance” (pg 64), Chapter 4, of the FHWA Guide.

If using Caltrans equipment, the narrowest setting of the sweeper is 8 feet. The pickup plow blade can be rotated for a 6.5- or 7.5-foot plow width. The 7-foot preferred separated bikeway width in combination with the standard buffer width can accommodate the Caltrans equipment.

Some maintenance activities involving sweeping, pavement repairs, striping, and pavement markings may require a separate contract or project due to maintenance crews not having equipment designed for the maintenance of these facilities. All proposed facilities should be reviewed by maintenance to support the development of maintenance plans for these facilities. Maintenance plans should address routine maintenance and long-term maintenance needs, such as removing debris, maintaining

landscaping, repairing and replacing the vertical separation elements, maintaining the pavement, striping, pavement markings, and traffic control devices. These plans should also address if the facility will be maintained by Caltrans, a local agency through a Maintenance Agreement, or through a separate contract.

If planters are used as the vertical element, consideration should be given to delegating the maintenance of the planters to the local agency so that the plantings will conform to the local agency's preference.


**Photo 11: Separated Bikeway with planters (Image source: City of Bellevue, Washington)**

## 5.0 CLASS IV BIKEWAY (SEPARATED BIKEWAY) TEMPORARY WORK ZONES

Temporary traffic control zones can impact a wide range of State highway users, including bicyclists. During the design phase, a decision should be made regarding the traffic handling plans to accommodate bicyclists through construction zones. The CA MUTCD Part 6 contains examples of how to manage bicycles through work zones and recommends the traffic control devices to be used. Additionally, Design Information Bulletin 91, Guidelines on the Use of Positive Work zone Protection (PWP) & Mitigation Measures, provides guidance for the use of various barrier systems in work zones. For State highway projects, if plans and/or special provisions are provided for this purpose, the Caltrans *Transportation Management Plan Guidelines* should be followed.