07 | Design toolkit

Overview

This chapter contains a design toolkit of pedestrian and bicycle facilities and treatments. While the previous chapter presents location-specific design concepts, the toolkit gives general design guidance on facilities that may be applicable to multiple locations. The toolkit is intended to help Daly City staff plan and design appropriate pedestrian and bicycle improvements for a range of locations and roadway characteristics. In a number of cases, the City's design standards, policies and specifications might need to be updated. The facilities and treatments presented here are based on criteria established in published literature, best practices and national guidance.

The chapter is divided into five sections:

1. Guidelines and standards for sidewalks, crosswalks and other common types of **pedestrian facilities.**
2. Design treatments for some of the types of **pedestrian facilities** outlined in the section above.
3. Guidelines and standards for common types of bikeways and other **bicycle facilities.**
4. Design treatments for **bicycle facilities.**
5. Facilities and treatments for **pedestrian- and bicycle-friendly roadways.**

For each facility or treatment, the toolkit generally outlines more-flexible design guideline and lists documents containing firmer, more established design standards. Standards documents cited in the guidelines are referenced using superscript numbers. Unless noted, all the images used in this chapter are by Parisi Transportation Consulting.

1 Pedestrian facilities

1.1 Sidewalks

Sidewalks are the most fundamental public space in a city. Extending sidewalks where they currently do not exist provides access to important pedestrian destinations and amenities, including transit stops. Sidewalk widening enables pedestrians to walk side-by-side or wheelchair users to pass each other.

Newly constructed sidewalk (Fairfax, CA).

Design guidelines

Sidewalks have a desired minimum through zone of 6 feet and an absolute minimum of 5.5 feet, including the curb top. In commercial areas (for example, Mission Street, Southgate Avenue near Westlake Shopping Center and the area around Junipero Serra Boulevard and 87th Avenue), sidewalks should be at least 8 feet wide[1]; however, this standard might need to be reduced in areas with constricted right-of-way width. Also, where a sidewalk is directly adjacent to moving traffic, the desired minimum is 8 feet, providing a minimum 2-foot buffer for street furniture and utilities.[2,3]

Daly City's "Standard Detail S-2" provides that "Where a new sidewalk is to be constructed, the sidewalk shall be extended up to an additional 35 feet or 25%, whichever is greater to connect with an existing sidewalk." This toolkit recommends increasing this to "150 feet or 25%, whichever is greater" and incorporating the 8-foot minimum sidewalk width, except in areas of constrained right-of-way width.

Similarly, the toolkit recommends revising the city's "Standard Detail S-3" to reduce commercial driveway widths from "Commercial garage 8-30' with 3' flares" to "Commercial garage 8-24' with 1.5' flares." The detail should note that driveway curb cuts for two-way traffic should generally not be wider than 18', except in industrial locations requiring frequent access for large trucks or semi-tractor trailers.

Design standards

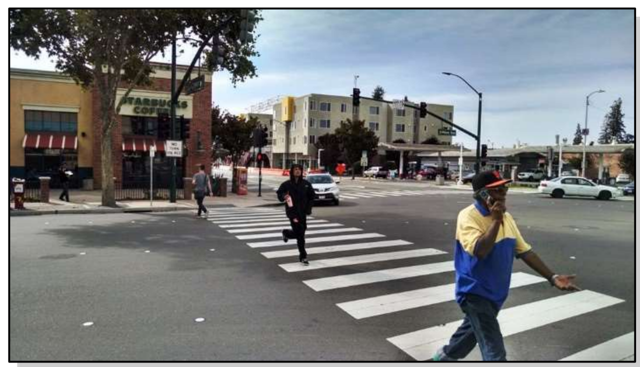
1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/street-design-elements/sidewalks/ .
2. Federal Highway Administration, Designing Sidewalks and Trails for Access (2001), Chapter 4.
3. United States Access Board, Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (2011), Section R302.3.

1.2 Crosswalks (general)

Crosswalk markings provide crossing guidance for pedestrians by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops. In conjunction with signs and other measures, crosswalk markings help to alert road users of a designated pedestrian crossing point across roadways at locations that are not controlled by traffic control signals or "stop" or "yield" signs.[1]

Some four-way intersections have just two or three pedestrian crossings instead of the standard four, which requires people walking to take circuitous routes. A single missing crosswalk at a large, signalized intersection triples the distance that a person walks to reach an opposing corner, which increases the likelihood that a person will cross outside a marked crosswalk.

Crosswalks should be striped across all legs of the intersection unless there is an unusual safety concern to consider, such as roadway geometry or grade that reduces a driver's visibility of the crosswalk. Inconvenience and access for pedestrians should be considered and evaluated against potential delay incurred by drivers within the context of other city policies.



Continental crosswalk (Hayward, CA).

High-visibility crosswalks (such as the continental crosswalk shown in the image above) should be the standard for all crosswalk striping. High-visibility crosswalks are preferable to traditional crosswalks, which consist of two transverse lines. High-visibility crosswalks are more visible to approaching vehicles and have been shown to improve yielding behavior.

Design guidelines

Crosswalks should be at least 10' wide or the width of the approaching sidewalk if it is greater. In areas of heavy pedestrian volumes, crosswalks can be up to 25' wide. Crosswalks should be aligned with the approaching sidewalk.[1,2] All legs of signalized intersections should have marked crosswalks unless pedestrians are prohibited from the roadway or section thereof, or if there is physically no pedestrian access on either corner and no likelihood that access can be provided. Pedestrians are unlikely to comply with a 3-stage crossing and may place themselves in a dangerous situation as a result.[1]

The intersection of Serramonte and Gellert Boulevards is an example of a location that should *not* have crosswalks striped at all four legs. At present, only two legs are striped with crosswalks because there is no sidewalk on the northeast corner. The existing striping treatment is appropriate given the current lack of pedestrian facilities, but in the future the City should consider constructing a sidewalk and striping crosswalks here. The intersection of Serramonte and Junipero Serra Boulevards is another example of a location that should not have marked crosswalks on all four legs, since the freeway entrance ramps here present a safety concern.

Traditional crosswalks (two transverse lines) are significantly less visible to drivers than high-visibility continental, ladder, or zebra crosswalks. As such, they should be used only on low-speed residential streets and other cases when engineering judgement determines that such markings are adequate.[3]

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/ .
2. California Manual on Uniform Traffic Control Devices (2014), Section 3B.18.
3. Federal Highway Administration, Crosswalk Marking Field Visibility Study (FHWA-HRT-10-068); https://www.fhwa.dot.gov/publications/research/safety/pedbike/10067/ .

1.3 Uncontrolled crosswalks

Crosswalk signage and advanced signage help announce designated pedestrian crossing points at uncontrolled locations. The pedestrian crossing sign and related supplemental plaques may have fluorescent yellow-green color for added visibility.[1]

Yield lines, sometimes called shark's teeth, consist of a row of solid white triangles pointing toward approaching vehicles. They are used in advance of crosswalks to indicate where drivers are required to yield in compliance with a "Yield Here to Pedestrians" sign.[2]

"Shark's teeth" yield line.

Image credit: Rapid City Journal.

In-street pedestrian crossing signs are low-cost treatments that can be effective in increasing the proportion of motor vehicles yielding to pedestrians. In-street pedestrian crossing signs can be placed between travel lanes or in conjunction with a refuge island or raised median.

Rectangular rapid-flashing beacons (RRFBs) are user-actuated LEDs that supplement warning signs at uncontrolled crossings.[3] They can be activated by a pushbutton or by a pedestrian detection system. RRFBs help alert oncoming drivers of pedestrians in the crosswalk and have been shown to increase yield compliance at uncontrolled crossings. RRFBs are not present in the current edition of the CAMUTCD, and as such, detailed warrants are not currently available. However, individual cities in California have developed their own criteria for installation. Generally, these policies suggest that streets with more than 9,000 vehicles per day and speeds of 30 mph or more may be candidates for RRFB installation. Additional consideration is often given to adjacent land uses, such as schools.[1,2,3,4,6,7]

Rectangular rapid-flashing beacons (Berkeley, CA).

Pedestrian hybrid beacons are used to control traffic when conditions require more than warning signs but do not justify a full traffic signal.[5] They are installed at intersections having a history of traffic collisions involving pedestrians and in areas with high pedestrian volumes. The California MUTCD provides guidelines for the installation of pedestrian hybrid beacons based on vehicle and pedestrian volumes.[1,2,4]

Pedestrian hybrid beacons (Berkeley, CA).

Corridors should also be assessed to determine if there are adequate safe opportunities for non-drivers to cross and if a pedestrian signal or a hybrid beacon is needed to provide an active warning to drivers when a pedestrian is in the crosswalk.

Design standards

1. California Manual on Uniform Traffic Control Devices (2014), Section 2B.11.
2. California Manual on Uniform Traffic Control Devices (2014), Section 3B.20.
3. FHWA Interim Approval 21: Rectangular Rapid-Flashing Beacons at Crosswalks (2018).
4. FHWA Field Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations (2018).
5. California Manual on Uniform Traffic Control Devices (2014), Chapter 4F.
6. Gadiel, George, "An Analysis of The Safety Effects of Crosswalks with In-pavement Warning Lights" (2007).
7. Boyce, P. R., and John Van Derlofske, "Pedestrian Crosswalk Safety: Evaluating in-Pavement, Flashing Warning Lights" (New Jersey Department of Transportation; 2002).

1.4 Curb ramps

When installing new curb ramps, directional (dual) curb ramps should be used wherever possible, especially at areas of high pedestrian traffic. Diagonal curb ramps, while less expensive to build than dual ramps, cause users (such as wheelchair riders and people with strollers) to enter the intersection at an angle misaligned from the crosswalk; this places them at greater exposure and risk to vehicle traffic.

Directional (dual) curb ramps (San Francisco, CA).

Design guidelines

Curb ramps shall provide turning space, running slope, transition, width, grade break, cross slope, counter slope, clear space, and other requirements in keeping with Americans with Disabilities Act standards.[1,2]

Design standards

1. United States Access Board, Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (2011).

2. Caltrans Revised Standard Plan RSP A88A (2016); http://ppmoe.dot.ca.gov/hq/esc/oe/project_plans/highway_plans/2010-RSP-and-NSP/rspa88a.pdf .

1.5 Accessible pedestrian signals / pedestrian push buttons

Image credit: Strong Towns.

Accessible pedestrian signals can actuate the pedestrian phase at traffic signals and assist people with vision disabilities. Push buttons may feature tactile arrows for vision-impaired users and audible beaconing, such that blind pedestrians can home in on the signal coming from the target corner as they cross the street.

In general, fixed-time signals are the rule in urban areas for reasons of regularity, network organization, predictability and reducing unnecessary delay. In less-trafficked areas, actuated signals such as push buttons and loop detectors may be appropriate; however, these must be programmed to minimize delay so as to increase compliance.[1] Push buttons should be separated by direction when possible—that is, they should not be mounted on the same pole.[2]

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/fixed-vs-actuated-signalization/ .
2. California Manual on Uniform Traffic Control Devices (2014), Section 4E.08.

1.6 Stairs and ramps

Staircases can help people walking up steep slopes and connect segments of a disconnected street grid. Adding a staircase connection is especially appropriate near schools, transit stations, retail or services, and other trip-generating activity centers.

Staircase with bicycle trough.

Design guidelines

Stairways have tread, riser, nosing, handrail, surface, clearance, and other accessibility requirements.[1] All stairways should include a bicycle trough (also called a "runnel") on at least one side, which allows persons with bicycles to push them up or down the stairway without lifting them (see image above).

Potential locations in Daly City for staircases are from Hickey Boulevard and Callan Boulevard to the playing fields at Gellert Park. Staircases installed as shown in yellow in the image below would allow nearby residents to take a shorter, more direct route to the park facilities.

Potential staircase locations at Gellert Park.

Design standards

1. United States Access Board, Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (2011), Section R408.

2 Design treatments for pedestrian facilities

2.1 Pedestrian sight lines at intersections (daylighting)

Parking should be prohibited with red curb markings at intersections and crosswalks where parked vehicles would obstruct the visibility of people entering a crosswalk; this practice is referred to as "daylighting." Daylighting also improves the view of drivers approaching an intersection and allows them to see if a pedestrian is waiting to cross. In the longer term, curb extensions (also known as bulb-outs) can be installed in the space made available. Implementation of this measure should take into account the scarcity of on-street parking in Daly City.

"Daylighting" with the use of red curb markings.

Design guidelines

Parking should be prohibited, and a red curb be striped, within 20 feet of a crosswalk at an intersection, or within 30 feet in advance of the approach to any flashing signal, stop sign, yield sign or traffic-control signal, where determined necessary by engineering judgement. The parking restriction area should be greater on higher-speed streets, since drivers' stopping sight distance increases with speed. For 35–45 mph streets, it is recommended that parking be restricted to 50 feet from the crosswalk; for streets with faster traffic, parking should be restricted to 100 feet from the crosswalk.[1,2]

Design standards

1. Federal Highway Administration, Crash Group/General Countermeasure Matrix; https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/56.htm .
2. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/visibility-sight-distance/ .

2.2 Corner curb radii

Smaller, or tighter, corner curb radii tend to reduce pedestrian crossing distances at intersections and slow vehicles when turning. Larger curb radii create longer crosswalks that increase pedestrian exposure to vehicle traffic and higher turning speeds, which are directly related to injury severity. When designing an intersection, the full width of the receiving vehicle lanes should be considered, to allow for corner designs with small curb radii.

Example in Daly City of a large corner curb radius.

Design guidelines

Curb radii should be designed based on the wheel path of a typical, but not necessarily the largest possible, design vehicle.[1] When using turning templates to consider changes to curb radii, the vehicle should be assumed to be turning from the rightmost lane on the sending street to any lane traveling in the desired direction on the receiving street. Since emergency vehicles have sirens and flashing lights and other vehicles must pull over, emergency vehicles can typically use the full right-of-way without encountering opposing vehicles; however, on busier streets, the ability of emergency vehicles to swing wide may be limited by queued traffic which might not be able to pull over.[2]

Daly City's curb radii standards are currently "Local/Alley: R = 20 feet and Collector/Local: R = 35 feet" (Standard Detail S-1), with a note that "Curb radius provided are for reference only. Curb radius 'R' shall be reduced where practical." The toolkit recommends updating this standard to a 15- or 10-foot radius, with an allowance that the radius be increased where necessary. The effective turning radius should consider how on-street parking will affect the turning path, and the design vehicle evaluated should be appropriate for the roadway under consideration (for example, whether the roadway is a truck or bus route).

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/corner-radii/ .
2. San Francisco Better Streets Plan, Chapter 5.

2.3 Curb extensions / bulb-outs

Curb extensions, also called bulb-outs, extend the sidewalk into the parking lane or shoulder to narrow the roadway and provide additional pedestrian space at corners. Bulb-outs increase pedestrian visibility by creating a waiting area in front of parked vehicles and decrease pedestrian exposure to vehicles by reducing crosswalk length. They also reduce vehicle turn speeds.

Corner curb extension, or bulb-out.

Curb extensions are not limited to use at corners. They may also be used to shorten existing mid-block crossings or create public space near popular destinations. Curb extensions need not be expensive or permanent: they can be designed with inexpensive materials such as paint and plastic traffic bollards to improve safety quickly.

Design guidelines

Corner curb extensions will vary in design according to the context. Curb extensions are not to extend into Class II Bikeways. The corner curb radii should be the minimum needed to accommodate the design vehicle.

Design standards

- Caltrans, Highway Design Manual (2014), Chapter 303.4.
- AC Transit Design Standards and Guidelines Manual for Safe and Efficient Multimodal Transit Stops (2018).
- National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/ .

2.4 Pedestrian refuge islands

Refuge islands are protected areas where pedestrians, especially those who are less able to cross the street in one stage, may safely pause or wait while crossing a street. Refuge island increase safety by reducing the exposure time experienced by a pedestrian in the intersection. They are recommended where a pedestrian must cross more than two lanes of traffic traveling in one direction (whether on a one-way or two-way street) but may be implemented on smaller cross-sections where space permits.

Pedestrian refuge island.

Design guidelines

The recommended width of pedestrian refuge islands is 8-10 feet[1] and at least 6 feet in constrained locations.[2] All medians at intersections should have a “nose” which extends past the crosswalk to protect people waiting on the median and slow turning drivers.

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/pedestrian-safety-islands/ .
2. Caltrans, Highway Design Manual (2014), Chapter 405.4.

2.5 Intersection lighting

Intersection lighting is appropriate at all intersections and is of particular benefit to non-motorized users. Lighting not only helps people walking and bicycling navigate the intersection, but also helps make them visible to oncoming drivers.

Image credit: City and County of San Francisco, SF Better Streets Plan.

Pedestrian-scale lighting should be prioritized on streets with high pedestrian volumes; key civic, downtown and commercial streets; underpasses and other streets with particular safety concerns; and small streets such as alleys and multi-use paths.

Design guidelines

Smaller, pedestrian-scale lighting, closer to the ground, creates a much more inviting, comfortable atmosphere for pedestrians than roadway-scale lighting. Daly City’s current standards for lighting include only large roadway-scale lighting, at a height of 30 feet (Standard Details S-6 and S-7). This toolkit recommends that S-6 and S-7 be updated to include pedestrian-scale lighting at a height of 12–15 feet, sharing poles with the more conventional streetlights. The cities of San Francisco, San Jose and Los Angeles all have detailed guidelines for ped-oriented street lighting that could serve as reference guides for Daly City.

Design standards

1. San Francisco Better Streets Plan, Chapter 6.
2. National Lighting Product Information Program, Streetlights for Local Roads (2011).
3. Project for Public Spaces, Lighting Use and Design (https://www.pps.org/article/streetlights).

2.6 Raised crosswalks

Raised crosswalks are best suited on lower-speed local and collector streets that do not involve significant vehicular traffic and are not frequently used as emergency access routes. Raised crosswalks improve accessibility and safety by allowing pedestrians to cross at a nearly constant grade without the need for a curb ramp and by making pedestrians more visible to approaching drivers. Raised crosswalks may be added as a complement to standard crossing elements. An example of candidate locations for raised crosswalks are intersections along Chester Street near Susan B. Anthony Elementary School.

Raised crosswalk (Albany, CA).

Design guidelines

Raised crosswalks should be flush with the height of the sidewalk. They should be at least 10 feet wide and designed to allow the front and rear wheels of a car to be on top of the table at the same time.[1,2]

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/ .
2. Safe Transportation for Every Pedestrian Countermeasure Tech Sheet: Raised Crosswalk; https://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_RaisedCW_508compliant.pdf .

2.7 Pedestrian countdown signals

Pedestrian countdown timers alert pedestrians to the time remaining to cross. Pedestrians may use the countdown signal to decide when to begin crossing the street.

Design guidelines

Pedestrian signal heads at crosswalks where the pedestrian change interval is more than seven seconds should include a pedestrian change interval countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.[1] Pedestrian signal heads are recommended at all signalized intersections.

Design standards

1. California Manual on Uniform Traffic Control Devices (2014), Section 4E.07.

2.8 Leading pedestrian interval

A leading pedestrian interval provides pedestrians with walk time before turning vehicles have green time as opposed to simultaneous walk and green indications. Pedestrians have priority and turning vehicles must yield to pedestrians already in the crosswalk.

Pedestrians about to cross (Berkeley, CA).

Design guidelines

At intersections with high volumes of pedestrians and of conflicting turning vehicles, a brief leading pedestrian interval may be used to reduce conflicts. During such intervals, an advance "walking person" indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic.

Design standards

- California Manual on Uniform Traffic Control Devices (2014); Section 4E.06.

2.9 Protected left-turn phasing

A common conflict at signalized intersections involves vehicles turning left permissively (that is, without a left-turn signal) and pedestrians crossing during the concurrent pedestrian signal phase. Drivers typically focus on on-coming traffic to identify gaps for left turns and often do not pay enough attention to pedestrians approaching or in the crosswalk. Permissive left turns at congested intersections cause drivers to accept smaller gaps in traffic, turn at higher speeds and sneak through the intersection during the yellow or red signal phases. (This happens at, for example, the intersection of Hillside Boulevard and E. Market Street, where left-turning drivers on all approaches must yield to both oncoming traffic and pedestrians in the crosswalk.) Implementing protected left-turn phasing can reduce conflicts with pedestrians crossing parallel to vehicle traffic.

Design standards

- California Manual on Uniform Traffic Control Devices (2014), Section 4D.17.

3 Bicycle facilities

3.1 Multi-use paths (Class I bikeways)

Multi-use paths and shared-use paths are facilities with exclusive right of way for bicyclists and pedestrians, away from the roadway and with cross flows by motor traffic minimized. This treatment is especially appropriate near schools, transit stations and other important pedestrian and bicycle attractors. In cities, due to the lack of free, available space, multi-use paths are typically found in parks, through other open spaces, along creeks and on abandoned rail corridors and other rights-of-way and easements. In Daly City, one opportunity is to improve the path on the south side of John Daly Boulevard and complete the missing segment in front of Westlake Shopping Center.

Multi-use path (San Luis Obispo, CA).

Design guidelines

The recommended width for multi-use paths is 12–14 feet[1] and as little as 8 feet in constrained locations. This narrower dimension is too narrow for pedestrians and bicyclists to share the space comfortably, so should be used only for short connections through physically constrained areas.[2]

Design standards

1. Caltrans, Highway Design Manual (2014), Section 1003.1.
2. AASHTO Guide for the Development of Bicycle Facilities (2012), Chapter 5.2.1.

3.2 Bike lanes (Class II bikeways)

These are conventional bike lanes, defined by pavement striping and signage to delineate a portion of a roadway for bicycle travel. They are one-way facilities, typically striped adjacent to car traffic traveling in the same direction. Bike lanes can provide a comfortable riding experience for all ages and abilities on streets with a single lane in each direction, car speeds at 25 mph or less, volumes less than 6,000 vehicles per day and low curbside activity.[1] For streets not fitting this profile, separated bikeways (Class IV; see section 3.5) should be considered.[2] When space allows, additional striping, cross hatching and/or a raised curb should be added to provide extra separation, in the form of a buffer, between cyclists and vehicles.

Bike lanes incorporating green-painted segments near an intersection (Tiburon, CA).

Design guidelines

The recommended width for bike lanes next to the curb face is 6–8 feet wide[2] and at least 5 feet in constrained locations; of this width, 1.5–3 feet can consist of a striped buffer. When the bike lane is next to a parking lane, the desirable distance from the curb face to the edge of the bike lane (including the parking lane, bike lane and optional buffer) is 14.5 feet (for example, a 6.5-foot bike lane and an 8-foot parking area), with a minimum distance of 12 feet in constrained locations (for example, a 5-foot bike lane and a 7-foot parking area).[2]

Design standards

1. National Association of City Transportation Officials, Contextual Guidance for Selecting All Ages & Abilities Bikeways; https://nacto.org/

publication/urban-bikeway-design-guide/designing-ages-abilities-new/choosing-ages-abilities-bicycle-facility/ .

2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bike-lanes/ .

3.3 Bike routes (Class III bikeways)

Bike routes are established by placing bike route signs and optional shared-roadway markings known as sharrows. Bike routes designate a preferred route for bicyclists on streets shared with car traffic. Bike routes are useful to establish connections between more comfortable bikeways. If they are designed to the standard of a bicycle boulevard (see section 3.4), bike routes can be comfortable for users of all ages and abilities.

Traffic-calmed bike route (Bekeley, CA).

Design guidelines

Bike routes are recommended on roadways with less than 1,500 vehicles per day (vpd), with up to 3,000 vpd allowed for short segments of the route. Bicycle refuge islands should be provided at intersections with high-volume cross-streets, allowing cyclists to cross one direction of traffic at a time when gaps in traffic allow. Also, signage should be provided indicating that the street segment is a designated bike route.[1] "Bicycle Boulevard" stencils may be installed on streets meeting the standard for such facilities.[2]

Design standards

1. Caltrans, Highway Design Manual (2014), Section 1003.3.
2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/ .

3.4 Bicycle boulevards (Class III bikeways)

Bicycle boulevards are specially designated bike routes with design features that seek to accommodate cyclists of all ages and abilities. Bicycle boulevards should have a maximum posted speed limit of 25 mph; these slower speeds improve the bicycling environment by reducing overtaking events, enhancing drivers' ability to see and react, and diminishing the severity of crashes, if they occur.

Image credit: National Association of City Transportation Officials.

Design guidelines

Like bike routes, bike boulevards should be designed for motor vehicle volumes under 1,500 vehicles per day (vpd), with up to 3,000 vpd allowed in limited sections. To create opportunities for bike boulevards, traffic volumes can be reduced by forcing turns, providing partial intersection closures such as diagonal diverters. "Bicycle boulevard" stencils should be provided, and also bicycle refuge islands at intersections with high-volume cross-streets.[1] A potential candidate in Daly City for bicycle boulevard treatment is Brunswick Street: it is a residential street that provides a lower-volume alternative to Mission Street, connecting the Crocker neighborhood to the Daly City BART station.

Design standards

1. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/ .

3.5 Separated bikeways or cycle tracks (Class IV bikeways)

Separated bikeways, or cycle tracks, are for the exclusive use of bicycles, being physically separated from motor traffic with a vertical feature such as flexible posts, curb or on-street parking. Separated bikeways are needed to encourage riders of all ages and abilities on fast, busy streets (higher than 25 mph and 6,000 vehicles per day or greater) with multiple lanes or with high curbside activity.[1] The Caltrans District 4 Bicycle Plan identifies the full length of Skyline Boulevard (Highway 35) and Mission Street (Highway 82) as candidates for separated bikeways on their list of "top-tier" projects in San Mateo County. Other potential candidates in Daly City include John Daly Boulevard, Junipero Serra Boulevard and Serramonte Boulevard.

Separated bikeway (Sacramento, CA).

Design guidelines

The recommended width for separated bikeways is generally 7–8 feet wide and 5 feet wide in constrained locations.[1,2,3] When located at disabled-accessible parking or a bus stop, the separated bikeway can be as narrow as 4 feet to bypass these features.[4] Separated bike lanes may be designed as raised facilities, either at sidewalk grade or at an intermediate grade. If designed at the sidewalk level, the use of different pavement types, markings or buffers may be necessary to keep bicyclists and pedestrians separated. If placed at an intermediate level, a 3-inch mountable curb may be used to permit access of sweeping equipment.

Design standards

1. National Association of City Transportation Officials, Contextual Guidance for Selecting All Ages & Abilities Bikeways; https://nacto.org/publication/urban-bikeway-design-guide/designing-ages-abilities-new/choosing-ages-abilities-bicycle-facility/.
2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/cycle-tracks/ .
3. Massachusetts Department of Transportation, Separated Bike Lane Planning and Design Guide (2015); https://www.mass.gov/lists/separated-bike-lane-planning-design-guide .
4. Caltrans Design Information Bulletin Number 89-01, Class IV Bikeway Guidance (Separated Bikeways/Cycle Tracks); http://www.dot.ca.gov/hq/LocalPrograms/bike/2018/Apr/DRAFT-DIB-89-01_013018_yllwhghlt.pdf.

3.6 Pedestrian/bicycle underpasses and overpasses

A dedicated pedestrian/bicycle bridge or underpass may be appropriate at locations that are grade-separated or that present frequent conflicts with motor vehicles. Possible sites include areas bisected by a freeway or railroad, and at-grade crossings across wide, high-speed and high-volume arterial streets. Between the two, bridges are generally preferred to underpasses because they have security advantages and are less likely to have drainage problems.

Bridges and underpasses are long-term projects that take a considerable amount of funding to implement. They are the result of a strong need to connect areas currently divided by major physical barriers to pedestrian and bicycle travel, such as freeways and railroad tracks. While not a particularly high community priority, a potential location in Daly City for a pedestrian/bicycle bridge is between W. Market Street and 92nd Street, across I-280 and the BART tracks.

Design guidelines

The recommended clear width for pedestrian/bicycle bridges and underpasses is 14–16 feet, and at least 10 feet in physically constrained locations.[1] A single-level surface should generally be used, with pedestrian and bicycle space delineated by paving color, striping or other surface treatment. Grade separation for the pedestrian and bicycle space may be considered for facilities wider than 16 feet.

Design standards

1. American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities (2012).

4 Design treatments for bicycle facilities

4.1 Filling bikeway gaps

The city should study opportunities to continue bike lane striping where it currently discontinues at intersections, and bike route designation where it currently ends. Striping bike lanes to and through intersections leads to more predictable travel movements by both bicyclists and drivers. Techniques to fill bikeway gaps can involve removing turn lanes or curbside parking, or constructing an adjacent raised bikeway in the form of a protected intersection for cyclists (see section 4.14). Locations where these treatments might be applicable include: (i) Skyline Boulevard, on which the right edge lines taper to and from the corners of intersections; these edge lines are considered and used as bike lanes, even though they begin and end mid-block; and (ii) Westmoor Avenue, where the bike lanes ends just before Skyline Boulevard, where it is perhaps needed most.

Bike lane markings and stencils (San Francisco, CA).

Design standards

- National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/through-bike-lanes .

4.2 Paving or widening roadway shoulders

On roadways where the shoulder is used as a bike lane, paving narrow shoulder sections allows bicyclists greater separation from adjacent vehicle traffic. Shoulder widening may allow for the bike lane to be upgraded with a striped buffer (see section 4.3) or to be upgraded to a separated bikeway (section 3.3). This treatment might apply to Skyline Boulevard and the western portion of John Daly Boulevard.

Image credit: Google Street View.

Design standards

- Caltrans, Highway Design Manual (2018), Topic 302.

4.3 Buffered bike lanes

Buffered bike lanes provide greater separation between cyclists and moving cars, as well as space for bicyclists to pass each other without encroaching into the adjacent car lane. Buffered bike lanes are considered Class II facilities because—unlike separated bikeways, which are considered Class IV facilities—they do not provide a physical barrier between cyclists and cars. Like other Class II bike lanes, buffered lanes can provide a comfortable experience for most users on streets with a single lane in each direction, car speeds equal to or less than 25 mph and volumes less than 6,000 per day, and low curbside activity.

Design guidelines

Painted buffers are generally 18 to 36 inches wide.[1] They should be painted between moving vehicles and the bicycle lane. One potential location for buffered bike lanes in Daly City is Southgate Avenue. Much of the street is 52 feet wide with conventional bike lanes. Given these dimensions, the travel lanes can be narrowed to 11 feet, the parking lanes can be made 8 feet wide, and five-foot-wide bike lanes can be given a 2-foot striped buffer.

Buffered bike lane (Fremont, CA).

Design standards

1. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bike-lanes/buffered-bike-lanes/ .

4.4 Green bike lanes

Installing green bike lanes increases the visibility of bike facilities and identifies potential areas of conflict, particularly at intersections and driveways. Color also reduces the road width visually, encouraging drivers to drive at slower speeds. The Class II bike lanes on John Daly Boulevard between De Long Street and Mission Street could be improved by adding green-color treatments in conflict areas.

Green-painted bike lane.

Design standards

- FHWA Interim Approval 14 (2011).
- National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/colored-bike-facilities/ .

4.5 Shared-lane markings (sharrows)

Shared-lane markings, better known as “sharrows,” are useful for wayfinding and help to clarify where bicyclists are expected to ride. They assist bicyclists with lateral positioning in a shared travel lane, and alert road users to the position that bicyclists are likely to occupy.[1] Sharrows are not a facility type and should not be considered a substitute for bike lanes, separated bike lanes (cycletracks) or other separation treatments where dedicated bikeway facilities are warranted.[1,2] One location in Daly City where sharrows could be added is St. Charles Avenue, from the Daly City BART station to the city limits (where they would meet sharrows in adjacent San Francisco).

Sharrow stencil (image credit: Google Street View).

Sharrows might be appropriate:
1. On Bicycle Boulevards or similar low-volume, traffic-calmed shared streets with a design speed of less than 25 mph.
2. On downhill segments, preferably paired with an uphill bike lane.
3. On streets where the traffic signals are timed for the travel speed of a bicyclist (12–15 mph).
4. Along front-in angled parking, where a bike lane is undesirable.
5. To transition bicyclists across traffic lanes or from conventional bike lanes or cycle tracks to a shared lane.
6. To designate movement and positioning of bicycles through intersections.

Sharrows should not be applied on roadways with traffic speeds above 25 mph, where bike lanes or a protected bikeway would be the more appropriate bicycle facility.[1] It is worth noting that some studies show that sharrows might not improve bicyclist safety.[3,4] However, on multilane streets with on-street parking, sharrows might marginally shift bicyclists' lateral position closer to the center of the lane and away from parked cars.[5]

Design guidelines

Sharrows should be positioned so that bicyclists' preferred path of travel aligns with the center of the sharrow marking. In most cases, this will be in the center of the right-most through travel lane, to discourage unsafe passing and encourage bicyclists to position themselves outside of the door zone of parked cars.

Design standards

1. California Manual on Uniform Traffic Control Devices (2014); www.dot.ca.gov/trafficops/camutcd/docs/2014r3/CAMUTCD2014-Chap9C_rev3.pdf .
2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/shared-lane-markings/ .
3. Nicholas Ferenchak and Wesley Marshall, "The Relative (In)Effectiveness of Bicycle Sharrows on Ridership and Safety Outcomes," 2015; https://trid.trb.org/view/1393928 .
4. Federal Highway Administration, "Evaluation of Shared Lane Markings" (Publication no. FHWA-HRT-10-041; 2010); https://nacto.org/wp-content/uploads/2011/01/Evaluation-of-Shared-Lane-Markings.pdf .
5. Brady, John et al, "Effects of Shared Lane Markings on Bicyclist and Motorist Behavior Along Multi-Lane Facilities (The Center for Transportation Research, University of Texas at Austin, 2010); https://nacto.org/wp-content/uploads/2011/02/Effects-of-Shared-Lane-Markings-on-Bicyclist-and-Motorist-Behavior-along-Multi-Lane-Facilities.pdf .

4.6 Green-backed sharrows and intersection crossing markings

Sharrows painted with green-colored backing can improve their visibility to drivers and bicyclists and also their durability. Green-backed sharrows and green-colored blocking are also typically used as intersection crossing markings to raise driver awareness of potential conflict areas and to reinforce bicyclist priority over vehicles entering the roadway.[1]

Green-backed sharrow stencil (Daly City, CA).

If used to delineate a bicycle route, green-backed sharrows should be applied on low-volume and low-speed roads, and are not recommended on roads with traffic speeds greater than 35 mph (see section 4.5). The installation of green-backed sharrows should be prioritized at intersections and where bicycle routes end or change direction. One location where green-backed sharrows could be installed is Southgate Avenue between Crestwood Drive and Park Plaza Drive.

Design guidelines

See section 4.5.

Design standards

1. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/intersection-crossing-markings/ .
2. California Manual on Uniform Traffic Control Devices (2014); www.dot.ca.gov/trafficops/camutcd/docs/2014r3/CAMUTCD2014-Chap9C_rev3.pdf .

4.7 Uphill bike lane with downhill sharrows

On steep grades, bicyclists traveling uphill move considerably slower than bicyclists traveling downhill; at the same time, climbing bicyclists typically need wider bikeways to maneuver compared to a roadway on a level grade. On the other hand, bicyclists going downhill are better able to match vehicle speeds but need space to maneuver around roadway obstacles, including the door zone of parked cars.

When space is constrained on streets with steep grades, it is generally better to provide a wider facility for uphill travel and a shared roadway in the downhill direction than to split the space available between two narrow bike lanes. (For example, if 10 feet of space is available on a steep roadway, it is better to provide a protected bike lane in the uphill direction than two five-foot-wide bike lanes. A five-foot bike lane is too narrow for a cyclist traveling downhill at, say, 20 mph; this is especially true if the bike lane is next to a lane of parked cars since this would expose cyclists to the risk of being hit by an opening car door.) In this case, the bike route would be considered a hybrid Class II/Class III route.

Hybrid bike route (image credit: Google Street View).

Design standards

- National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/shared-lane-markings/ .

4.8 Contraflow bike lane

Contraflow bicycle lanes are lanes designed to allow bicyclists to ride in the opposite direction of car traffic. Contraflow lanes convert a one-way traffic street into a two-way street: one direction for motor vehicles and bicycles, and the other for bicycles only. Often their installation normalizes movements that are already taking place. A potential location for this treatment is W. Market Street between Mission Street and Station Avenue.

Design guidelines

Contraflow lanes should be separated at least with yellow center lane striping, a painted median island or a raised median island.[1,2]

Contra-flow bike lane (image credit: Google Street View).

Design standards

1. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bike-lanes/contra-flow-bike-lanes/ .
2. California Manual on Uniform Traffic Control Devices (2014); www.dot.ca.gov/trafficops/camutcd/docs/2014r3/CAMUTCD2014-Chap9C_rev3.pdf .

4.9 Combined transit/bike facilities

Transit boarding islands and bus bulbs allow passengers to enter and exit without making the transit vehicle leave the travel lane. In some cases, the bicycle lane can be routed between the boarding island and the sidewalk, eliminating conflicts between buses and bicycles, as pictured below.

Bike lane and bus boarding island (Berkeley, CA).

In constrained locations, bike lanes can be combined with a bus bulb. In such shared situations, the bike lane rises to the level of the sidewalk and runs along the boarding area, rather than wrapping behind the boarding area (see photo below). Bicyclists can ride through the boarding area when no transit vehicle is present, but when a bus is stopped, cyclists must yield the space to boarding or exiting passengers. This plan proposes to install a shared cycletrack/bus stop on Serramonte Boulevard at Kent Court (see the last conceptual design, in Chapter 5). This is a particularly appropriate location for this treatment given that it's a steep uphill slope, where bicyclists will be riding slowly.

Image credit: Seattle Department of Transportation.

Design guidelines

An accessible boarding area, typically 8 feet wide by 5 feet long, must be provided to permit boarding by a person in a wheelchair.[1,2] Transit boarding islands and bus bulbs should be long enough to accommodate the size of the bus that serves the stop (for example, a 40-foot-long island for a 40-foot bus).[2]

Design standards

1. National Association of City Transportation Officials, Transit Street Design Guide (2016); https://nacto.org/publication/transit-street-design-guide/stations-stops/stop-configurations/side-boarding-island-stop/ .
2. AC Transit Multimodal Corridor Guidelines (2018); http://www.actransit.org/wpcontent/uploads/AC_Transit_Multimodal_Corridor_Guideline Final.pdf .

4.10 Bicycle wayfinding signs

Bicycle wayfinding signs indicate to cyclists that they are on a designated bikeway, and alert drivers that they are on a bikeway. Signs should provide at a minimum the name of the bikeway and may also include the direction, distance or time to other nearby bikeways. In particular, bicycle wayfinding signs could be used in Daly City to direct cyclists to the Daly City and Colma BART stations, to neighboring jurisdictions and to San Francisco State University, in cooperation with the City and County of San Francisco.

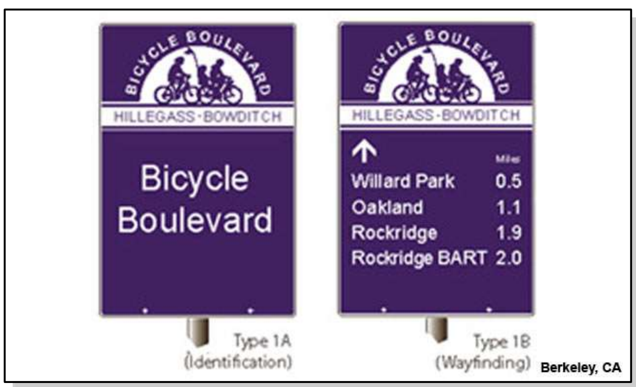


Image credit: City of Berkeley.

Design standards

- National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/bike-route-wayfinding-signage-and-markings-system/ .

4.11 Separated bikeways (Class IV)

Separated bikeways are considered Class IV bikeways. They separate cyclists from moving cars using any of various vertical barriers mentioned further below. Separated bikeways are needed to provide access to cyclists of all ages and abilities when streets have multiple lanes, fast and heavy traffic or high curbside activity. Note that separated bikeways must generally have at least 8 feet of clear width to be swept with standard street-sweeping equipment; however, narrow-profile sweepers exist and some cities are now investing in them to maintain their separated bikeways and multi-use pathways.

Flexible bollards (pictured below) are one option for a barrier. Because these may suffer from maintenance issues if they are repeatedly hit by drivers, bollards are most appropriate as an interim design solution until funding allows for more durable alternatives.

Separated bikeway (San Francisco, CA).

"Armadillos" (see photo below) are an alternative to bollards. They are more durable than bollards but are not appropriate for bikeways next to parked cars, as they can be a tripping hazard for people exiting vehicles.

Image credit: Inhabitat.

Building the bikeway at sidewalk grade or providing a curb (as in the example pictured below) are both best practices for the construction of separated bikeways.[1,2,3] Curb-separated bikeways are especially useful in commercial areas, where they prevent drivers from parking in them.[4]

Curb-separated bikeway (Salt Lake City, UT).

Planters and planter boxes (see below) can be either a temporary or permanent barrier option. Planters allow for subsequent design changes to the bikeway. Also, if special events require the street to be cleared, planters provide the flexibility to do so.

Bikeway separated by planters (Long Beach, CA).

Design standards

1. Massachusetts Department of Transportation, Separated Bike Lane Planning and Design Guide (2015), Chapter 3.4.2.
2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/cycle-tracks/ .
3. Caltrans Design Information Bulletin Number 89, Class IV Bikeway Guidance; http://cal.streetsblog.org/wp-content/uploads/sites/13/2016/01/dib89.pdf .
4. New York City Department of Transportation, The Economic Benefits of Sustainable Streets (2013); http://www.nyc.gov/html/dot/downloads/pdf/dot-economic-benefits-of-sustainable-streets.pdf .

4.12 Bike boxes

A bike box is a designated area at a signalized intersection that provides bicyclists with a queuing area in advance of stopped traffic during the red signal phase. Bike boxes are primarily used to eliminate conflicts between bicyclists and drivers on streets with high volumes of right-turning cars. Bike boxes also facilitate bicyclist left-turn positioning at intersections during red-signal indication if the box is extended across all lanes of travel. Bike boxes can be used where bicycle facilities end to allow for bicyclists to transition from a bicycle lane to a shared lane, so that lane changes do not take place within the intersection.

A potential location in Daly City for a bike box is Sheffield Drive at John Daly Boulevard, should a bike lane be installed on John Daly from Sheffield to De Long Avenue based on the conceptual designs presented in this plan. In that case, bicyclists will need a way to transition from the Class IV/Class II bike lane to the existing Class I path on the south side of John Daly at Sheffield Drive/Poncetta Drive. Due to the presence there of a bus bay, there is no space for a two-stage bicycle left-turn box (see section 4.13). Also, a two-stage turn box would place cyclists immediately next to fast traffic. In this case, a bike box might be a better solution.

Image credit: Google Street View.

Design guidelines

Bike boxes should be 10–16 feet deep measured from the crosswalk or stop bar. “No right turn on red” signage should be used to indicate that such turns are prohibited from the lane where the bicycle box is installed. A short length of bike lane approaching the bike box is required to provide a clear and predictable path for cyclists to enter the bike box.[1,2]

Design standards

1. FHWA Interim Approval 18; https://mutcd.fhwa.dot.gov/resources/interim_approval/ia18/index.htm .
2. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/ .

4.13 Two-stage bicycle left-turn boxes

Two-stage turn boxes allow a bicyclist to make a left turn movement by crossing a signalized intersection in two stages rather than merging with vehicle traffic into a left-turn lane. The design of two-stage turn boxes is similar to that of bicycle boxes, except that turn boxes are positioned at the far side of a signalized intersection. Two-stage turn boxes are essential in the case of separated bikeways because the design of such bikeways generally prevents bicyclists from merging into the left-hand turn lane.

Bike turn box.

Design guidelines

Two-stage turn should be painted green for high visibility. Pavement markings should include a bicycle stencil and a turn arrow to clearly indicate proper bicycle direction and positioning. The queue box should be placed in a protected area, typically within and on-street parking lane or between the bicycle lane and the pedestrian crossing. On streets where a constrained roadway prevents the creation of a dedicated two-stage turn queue box, the pedestrian crosswalk may be adjusted or realigned to create the space. A bike box may be provided behind the pedestrian crossing to serve the same purpose, but only where pedestrian volumes are relatively low, so as not to create conflict between pedestrians and cyclists.[1,2]

Design standards

1. National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/two-stage-turn-queue-boxes/ .

2. FHWA Interim Approval 20; https://mutcd.fhwa.dot.gov/resources/interim_approval/ia20/index.htm .

4.14 Protected intersections

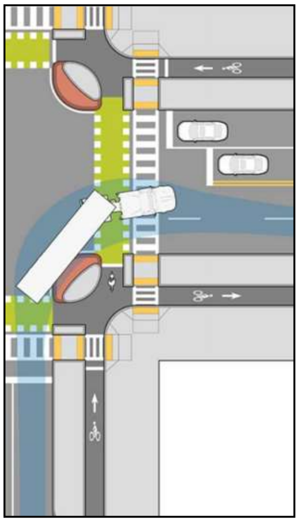


Image credit: Mass. Dept. of Transportation.

A protected intersection maintains the physical separation of bicyclists through the intersection, thereby eliminating the merging and weaving movements inherent in conventional bike lane and shared lane designs. This reduces the conflicts to a single location where turning traffic crosses the bike lane. This single conflict point can be eliminated by providing a separate signal phase for turning traffic.

On many streets, large turning radii and wide lanes encourage drivers to make sweeping, fast turns. Protected intersections reduce vehicle turning speeds, make bicyclists more visible, and give priority to through bicyclists over turning vehicles. A potential location in Daly City for this treatment is the intersection of Skyline Boulevard and John Daly Boulevard.

Design standards

- National Association of City Transportation Officials, Don't Give Up at the Intersection—Designing All Ages and Abilities Bicycle Crossings (2019); https://nacto.org/wp-content/uploads/2019/05/NACTO_Dont-Give-Up-at-the-Intersection.pdf .
- Massachusetts Department of Transportation, Separated Bike Lane Planning and Design Guide (2015), Chapter 4; https://www.mass.gov/files/documents/2017/10/26/SeparatedBikeLaneChapter4_Intersections.pdf .
- AASHTO Guide for the Development of Bicycle Facilities, 2019 (draft).

5 Pedestrian- and bicycle-friendly roadway design

5.1 Vehicle lane widths

Narrower travel lanes encourage motorists to drive more slowly while freeing up space for other uses. Space gained by narrowing existing lanes can be redistributed to bike lanes, sidewalks, landscaping or parking lanes.

Design guidelines

The standard lane width should generally be 10 feet. On designated truck and transit routes, one travel lane of 11 feet—ideally the right-most lane—may be used in each direction.[1] If the truck or transit route does not include on-street parking or is only a single lane in either direction, a 12-foot lane would provide the space to ensure adequate clearance for truck or bus mirrors.[2]

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/street-design-elements/lane-width/ .
2. San Francisco Municipal Transportation Agency Memorandum, "Lane widths for streets with Muni vehicles and bicycle facilities" (2013).

- Karim, Dewan (2015). Narrower Lanes, Safer Streets; https://www.researchgate.net/publication/277590178_Narrower_Lanes_Safer_Streets .

5.2 Irregularly shaped intersections

Intersections with irregularly geometries present safety hazards for all road users by reducing visibility for drivers at approaches intersecting at less than 90 degrees and by allowing for high-speed turns at approaches intersecting at greater than 90 degrees; skewed intersections also create long pedestrian crossings. Roadway approaches at irregularly angled intersections should be considered for realignment, to be perpendicular with the intersecting street, in order to shorten crossing distances and simplify intersection movements.

Image credit: Google Earth.

Design guidelines

One approach to correcting irregularly shaped intersections is to remove right-turn channelized lanes, known as slip lanes, at intersections; this would improve pedestrian visibility and slow down turning vehicles. For example, the slip lane serving the southbound right-turn from Sullivan Avenue to Eastmoor Avenue could potentially be removed, as could many of the slip lanes on Skyline Boulevard. The double slip lane from Serramonte Boulevard to Gellert Boulevard could potentially be removed, and adding a pedestrian crossing and sidewalk could be considered. Another possibility is to remove right-turn pockets to shorten pedestrian crossing distances and to fill bikeway gaps at intersections where right-turn queues would not create a traffic hazard.

Making changes to irregular intersections need not be expensive or permanent. For example, curb extensions can be designed with inexpensive materials such as paint and plastic traffic bollards to improve safety quickly. Such treatments may be used to reconfigure the intersection of San Pedro Road, Mission Street and Market Street (shown in Figure 6-5, in the "Conceptual Designs" chapter), for example, to reduce crossing distances for pedestrians. Consideration should be given to repurposing excess road space for wider sidewalks, pedestrian plazas, protected bike lanes and green infrastructure such as bioswales.

Image credit: Google Street View.

Design standards

- National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersections/complex-intersections/complex-intersection-analysis/ .

5.3 Road diets

Typical road diets involve reconfiguring four-lane roads into three-lane roads (two through lanes and a center left-turn lane) with bike lanes on both sides. Road diet studies have suggested that two through lanes and one center left-turn lane can accommodate up to approximately 23,000 vehicles per day (vpd)[1], though some four-to-three-lane conversion road diets have been successful with volumes as high as 30,000 vpd.[2] A potential candidate for such a road diet project might be East Market Street.

Design standards

1. Stamatiadis, Nikiforos; Kirk, Adam; Wang, Chen; Cull, Andrea; and Agarwal, Nithin, "Guidelines for Road Diet Conversions" (2011). Kentucky Transportation Center (Research Report KTC-11-19/SPR415-11-1F; https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1017&context=ktc_researchreports .
2. Thomas, Libby, Road Diet Conversion: A Synthesis of Safety Research (2013); http://www.pedbikeinfo.org/cms/downloads/WhitePaper_RoadDiets_PBIC.pdf .

- FHWA Road Diet Information Guide; https://safety.fhwa.dot.gov/road_diets/guidance/info_guide/ .

5.4 Street conversions: from two-way to one-way with bike lanes

An option for accommodating bike lanes on an otherwise too-narrow street is to eliminate a lane of through traffic by converting a two-way street to one-way with bike lanes. This might be desirable on bike corridors where alternate routes would require excessive out-of-direction travel for cyclists. Such a treatment might be appropriate, for example, on St. Charles Avenue between the BART station and Niantic Avenue. One-way southbound vehicle travel would not affect buses, since vehicles would be able to enter the station from St. Charles Avenue but they would need to leave via John Daly Boulevard.

One-way street with contra-flow bike lane.

Design standards

- National Association of City Transportation Officials, Urban Bikeway Design Guide (2011); https://nacto.org/publication/urban-bikeway-design-guide/bike-lanes/contra-flow-bike-lanes/ .

5.5 Parking-lane widths

The minimum width for a parking lane should be 7 feet, with 8 feet recommended for most streets[1,2] and 9 feet recommended for streets with Class II bike lanes next to the parking lane.[1,2,3]

Typical parking lane (image credit: Google Earth).

Design standards

1. American Association of State Highway and Transportation Officials, “A Policy on Geometric Design of Highways and Streets, 7th Edition (2018), Chapter 4.20.
2. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/street-design-elements/lane-width/ .
3. San Francisco Municipal Transportation Agency memorandum, “Lane widths for streets with Muni vehicles and bicycle facilities” (2013).

5.6 Edge-line striping

Edge lines delineate the right or left edges of a roadway. They narrow the traffic lanes visually, which encourages slower driving speeds. Edge lines are appropriate when there is additional space in a roadway cross-section that cannot be allocated to other uses, such as bike lanes or parking lanes.

Edge-line striping (image credit: Google Street View).

Design guidelines

A right-side edge line on urban streets should consist of a minimum four-inch-wide solid white line, while a six-inch-wide stripe is the standard for highways. Except for dotted extensions, edge line markings should not continue through intersections or major driveways.[1]

Design standards

1. California Manual on Uniform Traffic Control Devices (2014), Section 3B.06.

5.7 Speed humps / speed cushions

Speed humps, also known as speed cushions, may be used to decrease traffic speeds selectively along a corridor to 15–20 mph. (These devices should not be confused with speed bumps, which are designed for even lower speeds, causing cars to almost need to stop.) Emergency-access personnel should be consulted prior to the installation of speed humps on any street.

Image credit: National Association of City Transportation Officials.

Design guidelines

Speed humps should be 3–4 inches high and 12–14 feet wide, with a ramp length of 3–6 feet, depending on the target speed.[1]

Design standards

1. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/street-design-elements/vertical-speed-control-elements/speed-hump/ .

5.8 Mini-roundabouts / neighborhood traffic circles

Mini-roundabouts, also known as neighborhood traffic circles, are raised circular islands with wayfinding signs and optional landscaping, designed to lower speeds at minor stop-controlled intersections. These devices offer most of the benefits of conventional roundabouts but in the context of residential streets. Occasional large vehicles like fire trucks may be allowed to make turns against the signed counter-clockwise direction of traffic.[1,2] Emergency responders should be consulted prior to the installation of mini-roundabouts, to ensure adequate access for large vehicles. Brunswick Street, Vista Grande Avenue, Belleview Avenue and De Long Street all have intersections that could potentially benefit from the installation of mini-roundabouts/neighborhood traffic circles.

Mini-roundabout (Oakland, CA).

Design standards

1. FHWA, "Mini Roundabouts" (FHWA-SA-10-007); https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/fhwasa10007/fhwasa10007.pdf .
2. National Association of City Transportation Officials, Urban Street Design Guide (2013); https://nacto.org/publication/urban-street-design-guide/intersections/minor-intersections/mini-roundabout/ .