Chapter 9: BICYCLE PATHS AND BRIDGES

9.1 BIKE PATHS AND TRANSPORTATION ISSUES

9.1.1 Terminology

The HDM uses the terms “Class 1 Bikeway” and “Bike Path” to describe a bikeway that “Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with cross flow minimized”. AASHTO adopted the term “Shared Use Path” in 1999, in recognition that virtually all bike paths are also used by pedestrians of all shapes and sizes and other modes legally defined as pedestrians: joggers, roller-bladers, parents with baby strollers, people walking their dogs, non-motorized scooters and skateboards and of course the disabled. Terms such as “trail”, “off-street bikeway”, “greenway”, “multiuse trail” or combinations of these and other words also refer to bike paths in some if not most cases. This chapter uses the terms “trail” and “path” interchangeably, and assumes that multiple user-types are to be accommodated.

9.1.2 Pertinent Design Manuals

The primary design standards for bike paths in California are HDM Chapter 1000 and AASHTO Guide. In addition, two local references will be very useful to designers:

• Countywide Trails Master Plan Update and the Uniform Interjurisdictional Trail Design, Use, and Management Guidelines (TDMG) Santa Clara County Parks and Recreation Department, 1995.

• Trail Planning for California Communities Julie Bondurant and Laura Thompson, to be published by Summer 2008 by Solano Press.

The designer is encouraged to reference the aforementioned manuals for most design details. Two typical cross sections are presented in this chapter in order to incorporate the best practices of several manuals in one illustration. See also Section 1.3.3. See Table 4-1 on page 4-3 for recommended frequencies of various trail maintenance activities.

9.1.3 Bike Path Hours and Lighting

Bike Path Hours

Bike paths that are used for transportation, (i.e. virtually all paved trails and many unpaved trails) should be open 24 hours a day just as roads are.

Bike Path Lighting

Optimally, bike paths should be lit at night year-round to increase safety and to maximize the number of trips made by bicycle. For some bike paths or trail segments, however, lighting may not be appropriate or allowed within sensitive wildlife habitat areas. Cost and other inhibiting factors may place limits on the feasibility of trail lighting. See discussion in inset “Issues Facing Bike Path Operators and Bike Path Users”.

Federal, state and local design manuals (see Section 9.1.2) contain lighting guidance for commuter bike paths during the winter months when commuter bike paths would be dark during the hours before sunrise and after sunset. If used, special consideration should be given to the placement of lighting on bike paths located within environmentally sensitive areas and near residential areas. Lighting is considered an important safety measure to provide at the intersections of bike paths with surface streets; at night; and in underpasses and tunnels in the daytime as well as after dark. See appropriate design manuals for intersections and underpasses.

VTA Best Practice

Where used, lighting should be pedestrian and bicycle-scale and should meet the following criteria:

• No uplighting from any light fixture.

• All light fixtures should include shrouds (either fixed or adjustable), louvers, other shielding, or be directed in such a way as to block direct light from all sensitive receptors (e.g. residences, wildlife habitat areas) adjacent or in close proximity to the trail.

• Stray light should be controlled through use of low-brightness fixtures with optical lens or reflector controls.

NOTE

VTA views bike paths as part of an integrated, multimodal, countywide and regional transportation system consistent with the TEA-21 federal mandate “to develop transportation facilities that will function as an intermodal transportation system”.

The responsible department for maintaining and operating a bike path varies from Public Works to Parks and Recreation to special districts. The issues faced by the various trail operators in keeping trails open 24 hours a day are discussed in the inset on Page 9-4.

Caltrans Standard

HDM- Chapter 1000 Lighting 1003.1 (16) Lighting. Fixed-source lighting reduces conflicts along paths and at intersections. In addition, lighting allows the bicyclist to see the bicycle path direction, surface conditions, and obstacles. Lighting for bicycle paths is important and should be considered where riding at night is expected, such as bicycle paths serving college students or commuters, and at highway intersections. Lighting should also be considered through underpasses or tunnels, and when nighttime security could be a problem.

Depending on the location, average maintained horizontal illumination levels of 5 lux to 22 lux should be considered. Where special security problems exist, higher illumination levels may be considered. Light standards (poles) should meet the recommended horizontal and vertical clearances. Luminaires and standards should be at a scale appropriate for a pedestrian or bicycle path.

AASHTO Standard

AASHTO Bike Guide

Lighting Fixed-source lighting improves visibility along paths and at intersections. In addition, lighting allows the bicyclist to see the path direction, surface conditions and obstacles. Lighting for shared use paths is important and should be considered where night usage is expected, such as paths serving college students or commuters, and at highway

intersections. Lighting should also be considered through underpasses or tunnels, and when nighttime security could be an issue. Depending on the location, average maintained horizontal illumination levels of 5 lux to 22 lux should be considered. Where special security problems exist, higher illumination levels may be considered. Light standards (poles) should meet the recommended horizontal and vertical clearances. Luminaires and standards should be at a scale appropriate for a pedestrian.

NOTE

The CVC requires “every bicycle operated upon any highway during darkness to be equipped: (1) with a lamp emitting a white light which, while the bicycle is in motion, illuminates the highway in front of the bicyclist and is visible from a distance of 300 feet in front and from the sides of the bicycle; (2) with a red reflector on the rear” or tail light. The state legislature is considering a law to also require bicycles to use headlights on bike paths.

Source: California Vehicle Code-Division 11, Chapter 1, Article 4, Section 21201 (d)

Potential Issues Related to 24 hour Access on Bike Paths

The information presented below is intended to outline the concerns and potential issues that bike path users and operators may face by allowing or not allowing extended access to bike paths for the full 24-hour day. VTA hopes that by identifying these issues and concerns and by opening a dialog, Member Agencies, VTA and other interested agencies, advocates and stakeholders can work together to resolve the concerns regarding 24-hour use of bike paths.

The BTG, as guidelines, does not require changes to existing bike paths or to the policies of a respective department or agency. However, VTA and the at-large bicycle community maintain that more bicycle trips will occur if bike paths are more fully integrated with the on-street bicycle and roadway system and are accessible at all times as are roadways and sidewalks. The concomitant benefits of more bicycle trips include improved air quality and public health, and reductions in green house gasses, global warming, and roadway congestion. Moreover, there are social justice and economic equity issues related to access to affordable transportation that argue for 24-hour access to bike paths, especially considering that many lower-income members of the community use bicycles as their primary mode of transportation, and temporal exclusion of access to key transportation corridors may have significant safety or quality of life implications and cause hardships to these groups.

Trail Manager Issues Related to Providing 24-Hour Access to Bike Paths

• Environmental and Regulatory Setting: There may be legal, environmental, regulatory, permitting or other issues related to the development of a particular bike path, bike path segment, or bike path extent that create conditions where 24-hour access may not be feasible or desirable. One intended purpose of the Bicycle Technical Guidelines (BTG) is to provide information and tools to both users and operators that may allow the conditions to be addressed and improved over time.

• Policies and Guidelines: It is understood that some jurisdictions have policies and/or guidelines that limit access to bicycle trails that reside within parks or at certain locations. These policies and/or guidelines should undergo periodic review and reconsideration as local agencies develop and revise plans and ordinances.

• Availability of Resources: There are staffing costs associated with patrolling bike paths both if they are open and if they are closed at night. However having the trail open for 24-hour access may involve the need for additional staff and/or operating and maintenance funds. Several jurisdictions in Santa Clara County have expressed a desire to continue this dialog

internally and with neighboring jurisdictions and VTA; the BTG is intended to function as a reference tool and a technical resource document in these discussions. In addition, there may be opportunities for partnerships to share resources. For example, some cities have created win-win situations by allowing police officers either in patrol cars, motorcycle, or bicycles - or a combination of all three - to use bike paths and bike bridges as a way to increase the range and response time of the police officers to calls in all areas, as well as to provide patrols of the trail itself.

• Potential Liability: Potential liability may exist whether a bike path is open or closed at night. VTA encourages each jurisdiction to work with its residential and business community, and with bicycle advocacy groups to identify and work to resolve bike-path-related liability issues in order to provide access and maximize use.

Issues Related to Closing Bike Paths at Night

• Inconsistent Hours: A bike path that travels through many jurisdictions is potentially subject to several different sets of "hours" such that a bike commuter could cross the city limit(s) on the way home from work and could enter another jurisdiction after its park had closed and thus be in violation of that jurisdiction's ordinances.

• Multimodal access: Bicyclists who also use transit may expect trails to be open after dark in coordination with the hours of service offered by buses or light rail. (Most VTA lines operate 13 to 18 hours per day).

• Direct Routing and Safety: The trails system can, and often does, provide a more direct and safer route than the roadway network. Restrictions on hours of operation would direct cyclists and pedestrians onto alternative routes of travel at night that could result in additional travel time or less safe conditions.

• Connectivity: Ideally, the trails system would be seamlessly interconnected with the rest of the valley's transportation system. The BTG is designed to facilitate movement toward this goal by providing best practices on planning, design, and operation of these facilities.

• Potential Liability: As discussed above, potential liability may exist whether a bike path is open or closed at night.

• Availability of Resources: As discussed above, there are staffing costs associated with patrolling bike paths both if they are open and if they are closed at night. Closing trails also involves staff time if an agency expects to successfully enforce any such ordinance.

Issues Related to Lighting Bike Paths at Night

While appreciated by most bicyclists who must bicycle after-dark, lighting bike paths is not always feasible. State and Federal environmental laws prohibit lighting of riparian corridors as it can impact many nocturnal species. Addressing this issue is beyond the control of one local agency, and as a result, may be a long-term challenge for installation of lighting. The provision of lighting in any form (i.e., type, intensity, hours of lighting, etc.) should be carefully evaluated for each location. For example, some trails may pass through sensitive habitat areas that should remain dark at night; or the funds to construct and/or operate lighting may simply not be available.

Trail Safety

All of the issues above have some bearing on the issue of trail safety. Ordinances requiring bicyclists (and even pedestrians) to use lights at night, restricting use of the trail to transportation purposes or to commuters with lights, implementing teen curfews, prohibiting loitering or vagrancy, and/or providing call-boxes have all been used by Member Agencies and other agencies in California to address safety issues. Moreover, a "closed" facility, with no eyes-on-the-trail may be more attractive to vagrants and loiterers than one that is open and used by cyclists (and/or pedestrians). Although most bicyclists and pedestrians,

including wheelchair bound pedestrians, and pedestrians using mobility devices, would feel safer traveling on trails with adequate lighting, the ultimate decision in where to travel is up to the individual.

9.1.4 Typical Cross-Section For a Transportation Bike Path

For transportation bicycling, the key is to accommodate the variety of users on a typical bike path; the variety of users essentially boils down to 4 types: fast bicyclists, slow bicyclists, fast pedestrians and slow pedestrians. A one-size-fits-all approach will not work; site constraints and right-of-way constraints often dictate less than optimal cross-sections.

Typically 25 feet of right-of-way is required to accommodate the trail tread, and the required graded shoulders, signage, landscaping and offsets. The typical allocation of widths for the various components are illustrated in Figure 9-1.

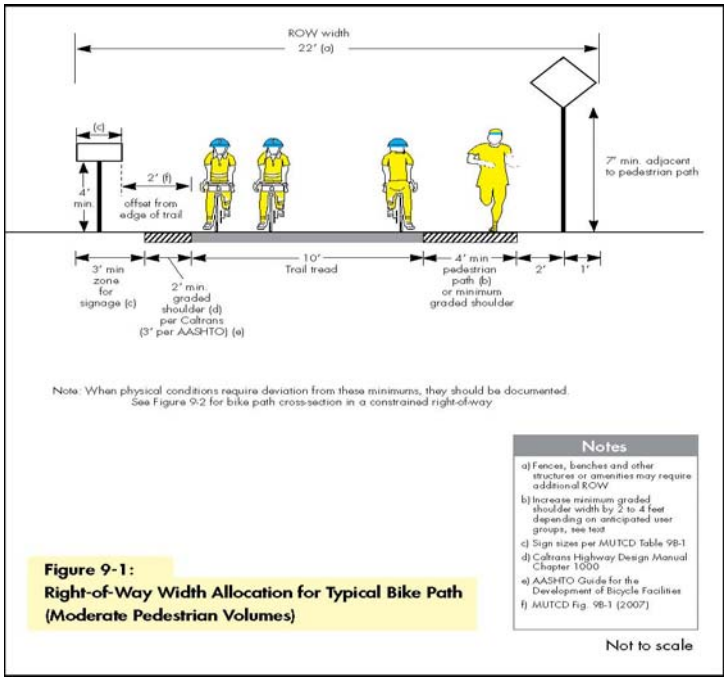


Figure 9-1: Right-of-Way Width Allocation for Typical Bike Path (Moderate Pedestrian Volumes)

Note:

When physical conditions require deviation from these minimums, they should be dcumented.

See Figure 9-2 for bike path cross-section in a constrained right-of-way

a) Fences, benches and other structures or amenities may require additional ROW

b) Increase minimum graded shoulder width by 2 to 4 feet depending on anticipated user groups, see text

c) Sign sizes per MUTCD Table 9B-1

d) Caltrans Highway Design Manual Chapter 1000

e) AASHTO Guide for the Development of Bicycle Facilities

f) MUTCD Fig. 9B-1 (2007)

Americans with Disability Act (ADA) Note:

Compliance for the Physically Handicapped Exception. When the grade differential of the walking surface of a pedestrian grade separation exceeds 14 feet due to required height clearance and grade conditions, and the enforcing agency finds that because of right-of-way restrictions, topography or other natural barriers, wheelchair accessibility or equivalent facilitation would create an unreasonable hardship, such accessibility need not be provided.

Source: Pedestrian Grade Separations, Memo to Designers, Caltrans June 1989

Cross-Section In Constrained Right-of-Way

Occasionally a bike path is forced to be contained within a restricted right-of-way. This situation is illustrated in Figure 9-2.

Figure 9-2: Bike Path Width Allocation in Constrained Right-of-Way

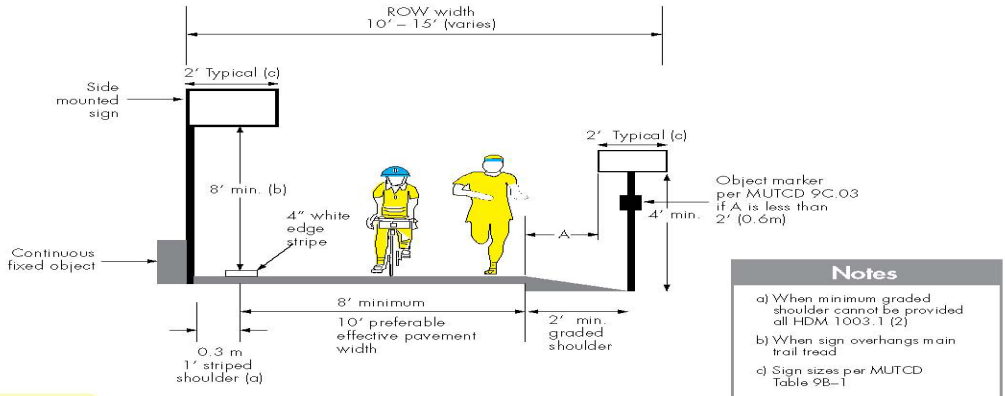


Figure 9-2:
Bike Path Width Allocation in Constrained Right-of-Way

Not to scale

Notes

a) When minimum graded shoulder cannot be provided all HDM 1003.1 (2)

b) When sign overhangs main trail tread

c) Sign sizes per MUTCD Table 9B–1

9.2 TRAIL/ROADWAY INTERSECTIONS

9.2.1 Intersection Design Issues

Many design elements contribute to creating a safe intersection of a trail and a roadway; See Tech Tip.

The inventory checklist presented in Appendix E can help evaluate how to improve an existing intersection. Traffic control and right-of-way are discussed in more detail below in Section 9.2.2. See also TDMG Policy UD-4.17; and Figures T-12A, T-12B, T-13A and T-14.

TECH TIP

The following elements should be included at the intersection of a bike path with a roadway:

- Lighting
- Ramp design
- Signage (including street name signs)
- Pavement markings
- Crossroad width and posted speed
- Traffic control and right-of-way

9.2.2 Traffic Control and Right-of-Way at Trail Intersections.

The type of traffic control device to use at the intersection of a trail with a roadway depends on the total and relative volumes on the roadway and on the trail. Generally speaking, when a trail intersects another trail, the best way to design the intersection is with a mini roundabout.

Figure 9-3 depicts the various ways of assigning right-of-way at an intersection of a trail and a roadway. Figure 9-4 is an illustration of which method is appropriate given the relative volumes on a road and a trail.

In general, when a trail intersects a driveway, a private road or a low volume road, if sight distance is adequate, a YIELD control can be appropriate. If sight distance is not adequate, a STOP sign should be installed. If the trail volume is higher than the cross-traffic, the trail is given the right-of-way.

When a trail intersects a typical local or collector street, the right-ofway typically goes to the roadway. If, however, the trail has the higher volumes, consider assigning right-of-way to the trail as if it were the intersection of two roads. If sight distance is adequate, a YIELD sign can be used in lieu of a STOP sign as described in the MUTCD and the California Supplement. As the volume on the roadway increases and becomes more difficult to cross, consider a median refuge and/or inpavement flashing lights.

When a trail intersects an arterial, the pedestrian signal warrants in the MUTCD can help to assess the need for a signal. All trail users are included in the pedestrian volume.

An overcrossing/undercrossing of the arterial should be considered if trail volumes are very high and/or the arterial volumes are high enough that trail users benefit from reduced delay and so that progression is maintained on the arterial. When trails have no or few at-grade crossings with roads, they function almost as bicycle freeways where travel is uninterrupted by stop signs and traffic signals.

TECH TIP

Roundabouts have been successfully used at trail intersections on the UC Davis campus for decades. The number of collisions between cyclists and pedestrians significantly decreased upon switching from stop sign controls to a modern roundabout.

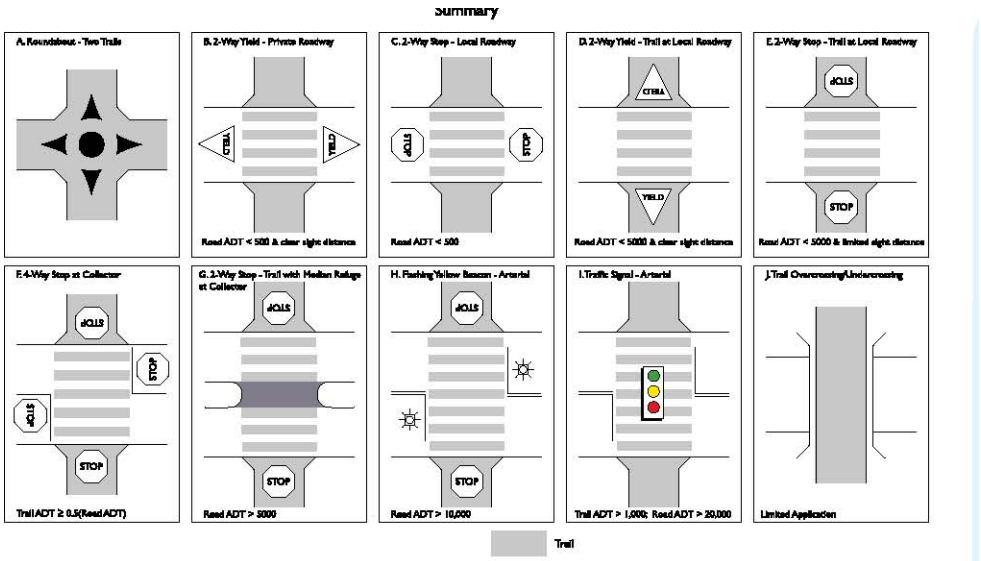


Figure 9-3: Traffic Control Options at Trail Intersections

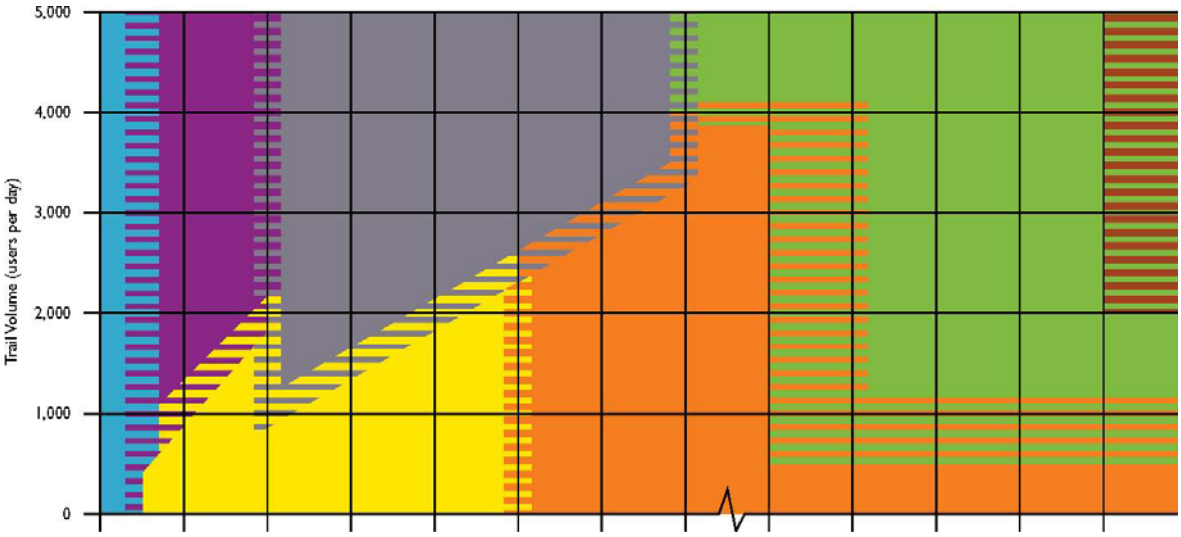


Figure 9-4: Guidelines for Traffic Control Devices at Trail Intersections

9.3 BICYCLE/PEDESTRIAN ACROSS BARRIER CONNECTIONS (ABC'S) (BRIDGES/UNDERPASSES)

9.3.1 Terminology

When a bike path or roadway crosses over a freeway, railroad, creek or river, it is referred to as a bridge or overpass; when it goes under, it is referred to as a tunnel or underpass. In the case of a railroad right-ofway, the crossing can also be an at-grade crossing. To refer collectively to these three types of crossings-overpass, underpass or railroad at-grade crossing, and also to future crossings where it is unknown what the facility will be, the term Across Barrier Connection (ABC) will be used.

9.3.2 Pertinent Design Manuals

The primary design standards for bike bridges and tunnels in California are Caltrans HDM Section 208, Caltrans Bridge Design Specifications, and AASHTO Guide Specifications for Design of Pedestrian Bridges, August 1997. Additional guidance is found in HDM Chapter 1000 and AASHTO Bike Guide.

9.3.3 Clear Width

Caltrans Standard

HDM 1003.1(2) The clear width on structures shall not be less than 8 feet and should be equal to the minimum clear width of the approach path, typically 12ft for an 8 ft path with 2 foot shoulders. See Figure 9-5 for a typical cross section of a bike bridge.

VTA Best Practice

In practice it is acknowledged that pedestrian and bike ABC's fill a variety of functions within the transportation system, thus will vary immensely in the number of users and mix of users. A one-size-fits-all approach is not recommended. A bridge over a small creek serving as a neighborhood connection like Adobe Creek in Los Altos can be narrower than an underpass of the railroad tracks that serves regional attractors and is the only way for bicyclists and

pedestrians to cross safely for miles, e.g. Lawrence Ave Caltrain station undercrossing at 22' wide and the future Santa Clara Station Caltrain undercrossing.

NOTE

On bridges in scenic locations, belvederes can increase capacity as well as enhance the recreational experience.

9.3.4 Bridge Railing Height

A bicycle railing on a bridge should be 54 inches in height. It should be noted that the primary design manuals differ (see side bar). To resolve this inconsistency, Caltrans is conducting a study to determine the appropriate rail height for bicycles on bridges. The study will develop a computer model for various types of bicycles, e.g. road, hybrid, mountain, as well as various loads a bicyclist might be carrying, e.g. backpack, front and rear panniers. See also discussion on page 9-12.

Bicycle Railing–Other Applications

A bicycle railing can be used on a bike path as physical barrier as an alternative to dense shrubs or a fence. Rails should be placed on the outside of the graded shoulder, otherwise the effective width of the path is reduced. Typical locations where a railing might be used are:

• Bike path adjacent to parallel highways less than five feet from edge of shoulder; (HDM §1003.1(5)).

• On highway bridges, with a two-way bike path on one side of bridge: railing height between traffic lane and bikeways should be 46 inches min. (HDM §1003.6(1)b).

• Between the edge of pavement and top of a slope, depending on the height of the embankment and the conditions at the bottom of the slope.

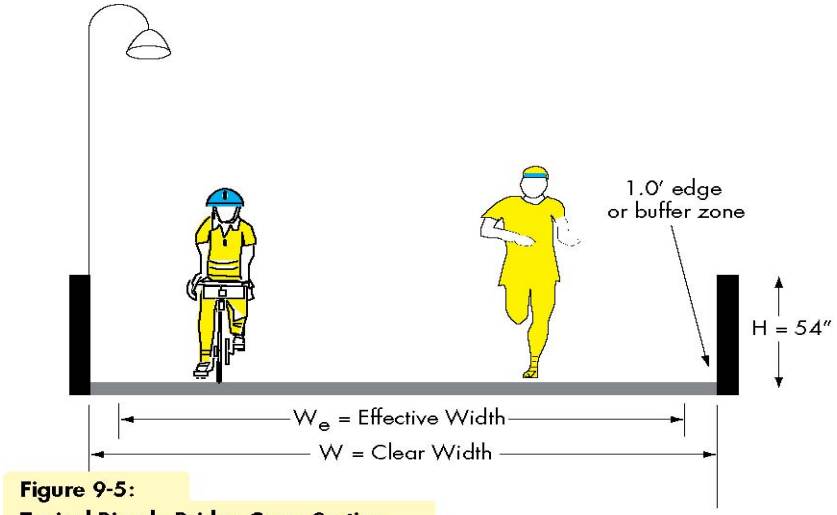


Figure 9-5:
Typical Bicycle Bridge Cross Section

Figure 9-5: Typical Bicycle Bridge Cross Section

Notes

H = 54" minimum - bicycle rail

(Pedestrian Rail Height = 42 inches, see discussion in Section 9.2.4)

W = 12' for an effective width (We) of 10 feet.

W = 16-20' optimum if bridge has extremely high use by pedestrians and bicyclists; Consider design cues to separate users as depicted in Photo 1 and Photo 2.

W = 8'- 12' if used as a local neighborhood connector bridge and/or there are site constraints.

V = vertical clearance of an overpass over the lower facility depends on the category of facility e.g. railroad, freeway, arterial, local road, waterway. See HDM Section 208 for further guidance.

V = 8'min. for a bicycle underpass

Discussion on Railing Height

The rail height of the bicyclist will affect center of gravity and therefore adequate rail height to prevent vaulting or falling over the railing. Locations with high wind-prone ridges on curves where bicyclists can attain high speeds need higher railings than locations where bicyclists are always traveling parallel to the rail and would not be traveling fast. Other considerations are the degree of hazard faced when falling over the edge, i.e. a precipitous drop versus falling onto a grassy slope.

The NCHRP study "Determination of Appropriate Railing Heights for Bicyclists", July 2004 recommended 48 inches at locations where bicyclists should be protected from a severe hazard, such as:

• On the outside edge of a highway bridge

• Between a bike path and travel lanes on a highway bridge where the biker may fall into the path of vehicular traffic (as opposed to a shoulder)

• A bikeway bridge with a drop of 2 feet or greater

• Along a pathway where the railing protects from cliff, water body or other such hazard

The NCHRP study recommended 54 inches at locations where bicyclists should be protected from a severe hazard as described above and have a potential to vault over the railing as a result of a high speed angular collision, e.g.:

• Where the radius of curvature is not adequate for the design speed or attained speed and falling over the rail would subject biker to a severe hazard (cliff, water body, etc.)

• Where sight distance is inadequate and a biker could take evasive action and collide with a railing at a sharp angle.

• At the end of a long descent where speeds of bicyclists are higher.

TECH TIP

Bicycle Railing Height

• Caltrans HDM § 208.10(6) - 54 inches

• Caltrans Bridge Design Specifications§2.7.2.2 54 inches min

• AASHTO Bike Guide - 42 inches

• NCHRP Project 20-7(168), July 2004 - 48 inches

Pedestrian Railing Height

• Caltrans Bridge Design Specifications § 2.7.3.2 42 inches min

• AASHTO Pedestrian Guide- 42 inches

• AASHTO Standard Specifications for Highway Bridges–42 inches

• AASHTO Guide Specifications for the Design of Pedestrian Bridges, August 1997

Section 9.3.5 Bridge Ramps and Stairs

Ramps leading to bridges are the most cost-effective way to provide ADA access to the over or undercrossing. ADA criteria govern the slope. Ramp widths should have a minimum width of 8 to 10 feet, given the variety of users expected. Stair channels on stairs are very useful for bicyclists to aid them in carrying bicycles up the stairs.

9.3.6 Bridge Live Load

Bike bridges live loads should allow for the passage of an occasional maintenance/service vehicle. Also, depending on the emergency service providers' routes, a bike bridge might be designed to accommodate an occasional ambulance or other emergency vehicle.

9.3.7 Vibrations

Considering that all bike bridges will also be open to pedestrians, the bridge performance should consider the vibrations caused by runners and walkers. See Guide Specifications for the Design of Pedestrian Bridges, Section 1.3.2, August 1997.

Chapter 10: BIKE PARKING

10.1 DEFINITIONS

Class 1

A method of bicycle parking that protects the entire bicycle and its components from theft, vandalism or inclement weather. Class I bicycle parking is appropriate for long-term (two hours to all day) bicycle parking such as at employment sites, schools and transit stations/stops. It is also important at sites where bicycles are left overnight for several days such as airports, train stations and of course, multi-family residential units. See Section 10.2 for a discussion on the various options for Class 1 bike parking.

Class 2

A bicycle rack to which the frame and at least one wheel can be secured with a user-provided U-lock or padlock and cable. Racks that provide two points of contact prevent bikes from pivoting and falling over. Bike racks are appropriate for short-term parking where the typical parking duration is less than two hours. They can be thought of as serving the customer or visitor parking demand for locations such as retail stores, libraries, dental and medical offices, office buildings and at apartments/ condominiums. See Section 10.3 for discussion on the various options for Class 2 bike parking.

Class 3

A bicycle rack designed such that only one wheel and not the frame can be locked to the rack. While still used in some situations like school yards, they are not secure. They are never recommended except in guarded areas or locked rooms where they are used in Class 1 situations.

10.2 CLASS 1 BIKE PARKING OPTIONS

Examples of Class 1 bike parking include bicycle lockers, rooms with key access for regular bicycle commuters, valet or check in parking and guarded parking areas. These and other variations should be discussed with the local jurisdiction's Bicycle Advisory Committee. Section 10.6 presents guidance on appropriate types of Class 1 bike parking for various land uses including transit stations, office buildings, schools, commercial sites, employment centers and residential complexes. Table 10-1 presents some of the variations of the options for Bike Lockers and their advantages and disadvantages.

TECH TIP

Detailed VTA Bike Locker Specifications are on file in the Service and Operations Planning Division.

1) Dimensions of approximately 42" wide by 75" deep by 54" high.

2) Must withstand minimum load of 200 lb. per square foot.

3) Opened door must withstand 500 lb. minimum vertical load.

Table10-1 Bike Locker Variations and Management Strategies

Option	Advantages	Disadvantages
Reserved Lockers: Assign one locker per person, typically by issuing a key and requiring a key deposit (Current VTA practice). Some agencies also charge a monthly, quarterly or annual fee (Current Caltrain and BART practice).	1. Regular bike commuters have a guarantee that they will have a safe and secure bike parking place.	1. Lockers are not available to those who want to ride on the spur of the moment or who do not take the time and effort (and sometimes money) necessary to reserve it in advance. 2. Space and cost-inefficient with one locker per one bicycle commuter because the locker is not available to anyone else even when the renter is not using it.
Distribute key to locker user on demand at site	1. Available to any user without having to sign up and pay a deposit. 2. Overall, accommodates more bicyclists with the same number of lockers	1. This requires someone such as a security guard or parking lot attendant to be available to sign the key in and out. 2. Due to constraint (1) listed above, this option may not be available 24 hours a day, 7 days a week.
Coin-operated Lockers	1. Available to any user without having to sign up in advance and pay a deposit 2. Overall, accommodates more bicyclists with the same number of lockers 3. Available 24 hours a day, 7 days a week	1. These have typically been removed due to continued vandalism, but they might be appropriate in certain controlled circumstances. 2. They could also work with a token distributed as in Option described above (distribute keys to locker users at site)
User provided lock – the bike locker is locked with a user-provided pad lock or U-lock	1. Available to any user without having to sign up in advance and pay a deposit. 2. Overall, accommodates more bicyclists with the same number of lockers. 3. Available 24 hours a day, 7 days a week.	1. BART experienced a problem with theft and vandalism. 2. They are easily misused for storage of property other than bicycles, requiring staff time for maintenance and property seizures. 3. Perception by bicyclists that they are not as secure.
Smart Card – practice for new VTA lockers	1. The locker is not monopolized by one person whether or not they use it. 2. Overall, accommodates more bicyclists with the same number of lockers. 3. The smart card can be used at any VTA locker systemwide, and also at lockers with similar technology Bay Areawide. 4. Can be easily monitored. Data is gathered on how many people and how often and/or how long lockers are rented. 5. Available 24 hours a day, 7 days a week.	1. Users will still have to sign up in advance in order to obtain a smart card (this will enable the user to use a locker at any location with an e-locker, not just one locker at one location). 2. Nominal charge for bike parking to pay for the smart card technology compared to current VTA policy of free lockers.

LOCAL PRACTICE

City of Sunnyvale has public lockers that use bicyclist provided locks at the library and at the Sunnyvale Caltrain station. In both locations, there are continuous issues to address and the biking public does not trust them. However the ones at City Hall for

Table 10-2 Bike Stations/Bike Room Management Strategies

Option	Advantages	Disadvantages
Bike Station: Valet (Attended) Bike Parking	The safest most secure bike parking.	Nominal charge for bike parking to pay for the smart card technology compared to current VTA policy of free lockers.
Bike Station: Smart-card Bike Room Parking	Provides a place to leave a bike where the general public does not have access. Can be open 24 hours a day, 7 days a week.	Theft of bike and bike components can still occur; although frequency is much less due to the video surveillance cameras and tracking name and time of entry through the smart card keys.
Fenced Compounds and Locked Rooms	Provides a place to leave a bike where passerby and/or strangers do not have access. If inside/covered then also protects bike from the elements.	Theft of bike and bike components can still occur although frequency is much less.

LOCAL PRACTICE

The Palo Alto Bike Station reopened on February 27, 2007 as a secure parking bike room with 24 hour access using a "smart" card key. Inside the secured building there are 96 bicycle racks which are also monitored by security cameras. Bicyclists must subscribe and can pay daily, monthly or annually.

10.3 CLASS 2 BIKE RACK OPTIONS

Typical bike rack dimensions are illustrated in Figure 10-1. 1 Acceptable design options are presented in Figure 10-2. Some designs are more suitable for smaller installations while others are more suitable for large quantities of bikes. These designs have the following elements in common:

• Schedule 40 steel pipe or stronger (see Tech Tip sidebar)

• Two points of contact to support the bike frame

• Able to secure frame and one wheel with a U-lock

The wave or ribbon rack, while popular with some bicyclists, only provides one point of contact. It is not recommended for new installations, but it is still functional with a U-lock. It is generally not worth replacing. Class 3 "wheel bender" racks, however, should be replaced. (However, in Class 1 situations they are acceptable as described in Section 10.1.) Guidance on where to place bike racks in specific settings is presented in Section 10.4 and illustrated in Figures 10-4 through 10-6.

TECH TIP

Bike Racks shall be:

• Steel or stainless steel (other metals such as brass are not recommended since they are softer and are also themselves a valuable target for thieves).

• If square tubing: 2 inch square tube, 0.188” min wall thickness.

• If round pipe: 2 inch schedule 40 pipe (OD 2.375, ID 2.067, wall thickness 0.154 inch) and rack must be designed such that bike cannot be stolen with only one cut.

• Finishes for steel: galvanized, polyester-powder coat paint, thermoplastic or PVC jacket.

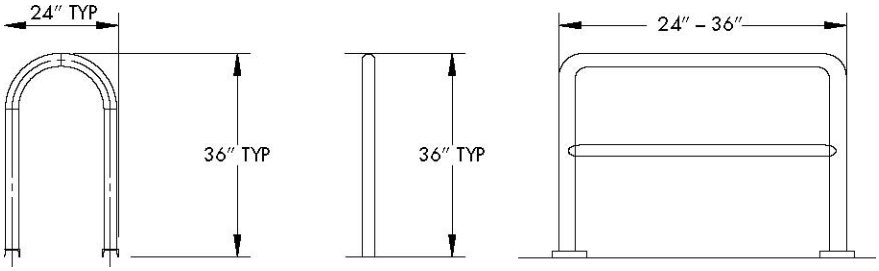


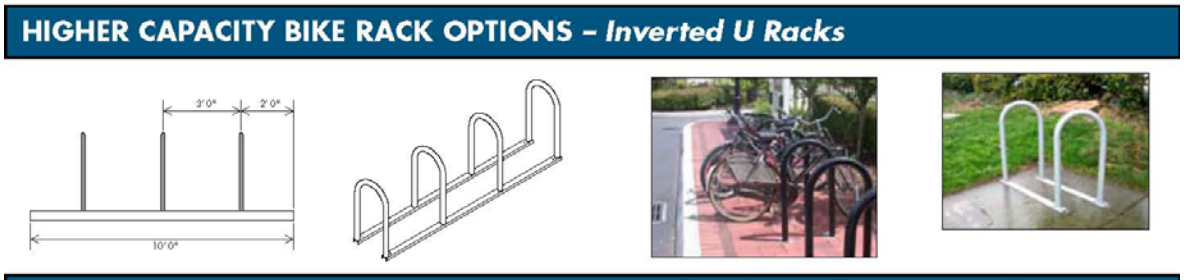
Figure 10-1: Typical Dimensions – Inverted u and variations

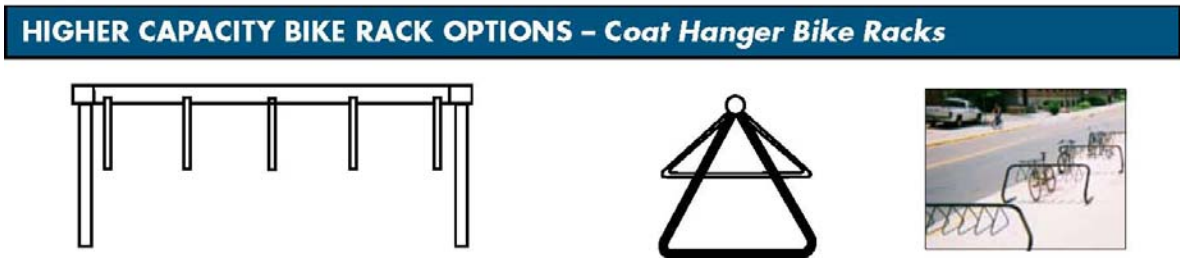
FIGURE 10-2 BIKE RACK DESIGN OPTIONS

INVERTED U RACKS AND VARIATIONS – *1 or 2 bikes per rack*

METER POST RACKS – *Typically 1 or 2 bikes per meter*

Meter Rack | Meter Retrofit | Meter Rack | Parking Meter





10.4 PLACEMENT DIMENSIONS AND CRITERIA

To be effective, bicycle racks and lockers must be placed such that:

1. Security is maximized (See Sections 10.4.1 and 10.4.2);

2. Pedestrian circulation is not adversely impacted (See Section 10.4.3); and

3. They can be used to their maximum design capacity. Guidelines for selecting and designing the optimum site for bicycle racks and lockers are presented below. Placement dimensions and guidelines for lockers are presented in Figure 10-3 and for bicycle racks in various locations are presented in Figures 10-4 through 10-6.

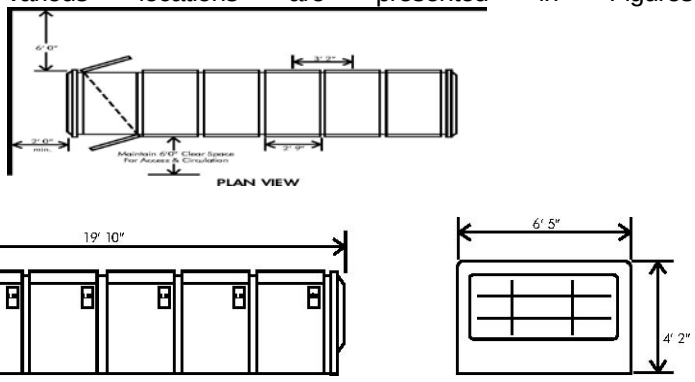


Figure 10-3: Bike Locker Placement Criteria

Figure 10-4: Bike Rack Placement Criteria (in Plazas or near Buildings)

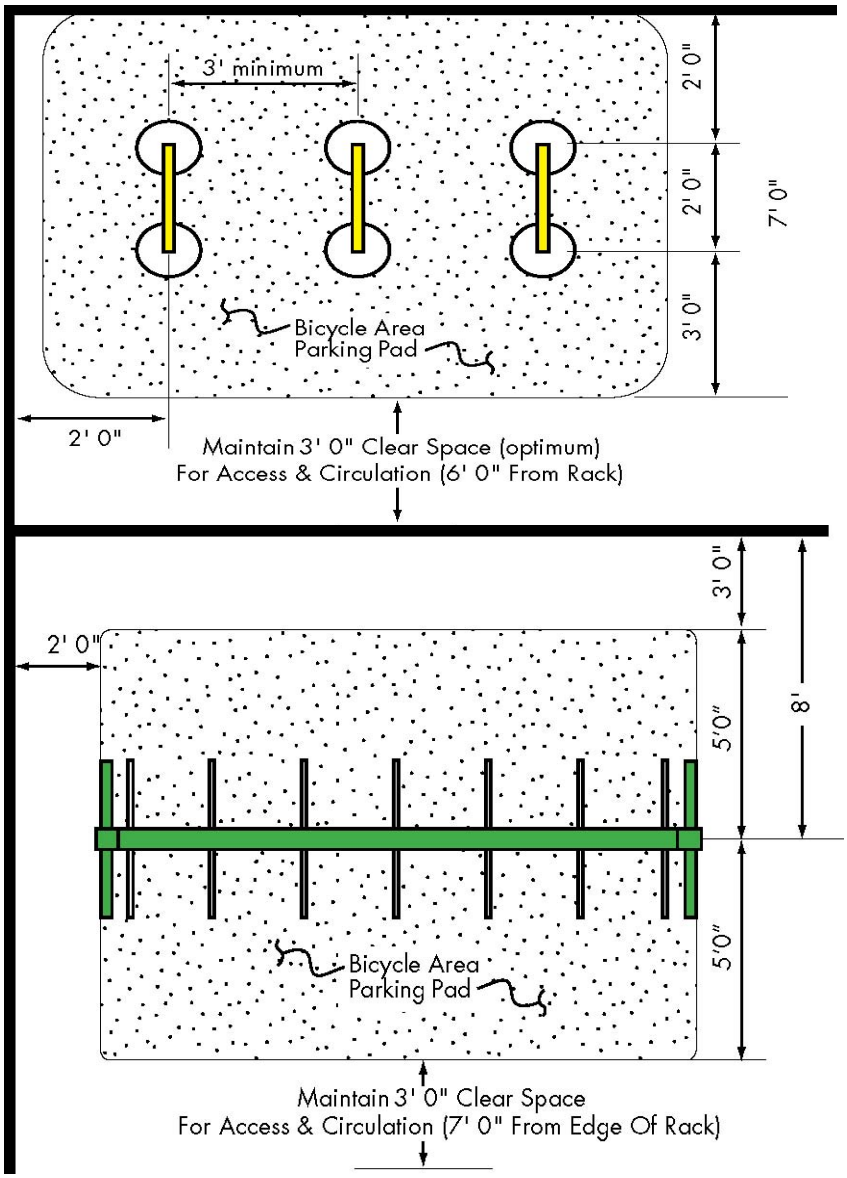
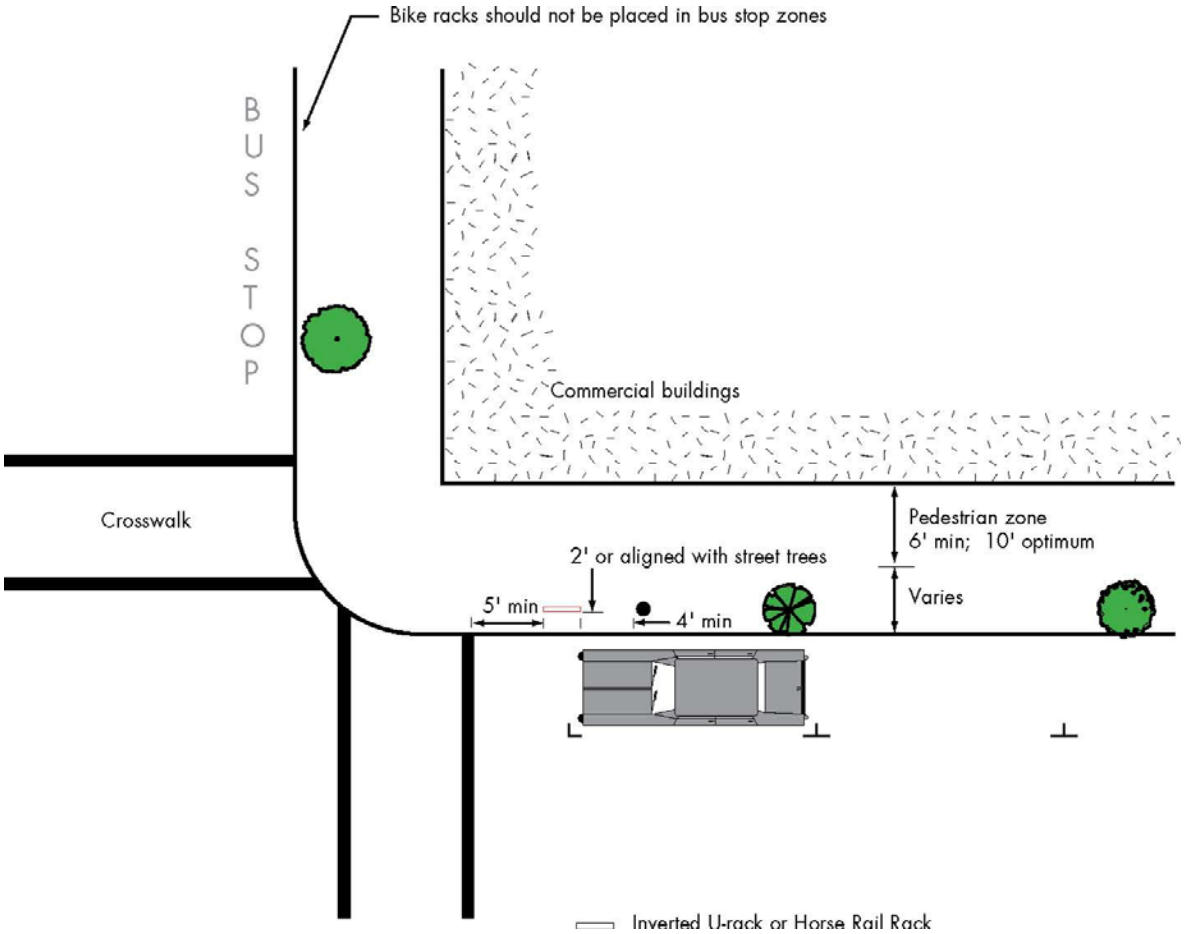


Figure: 10-5: Bike Rack Placement Criteria (Adjacent to Curb)

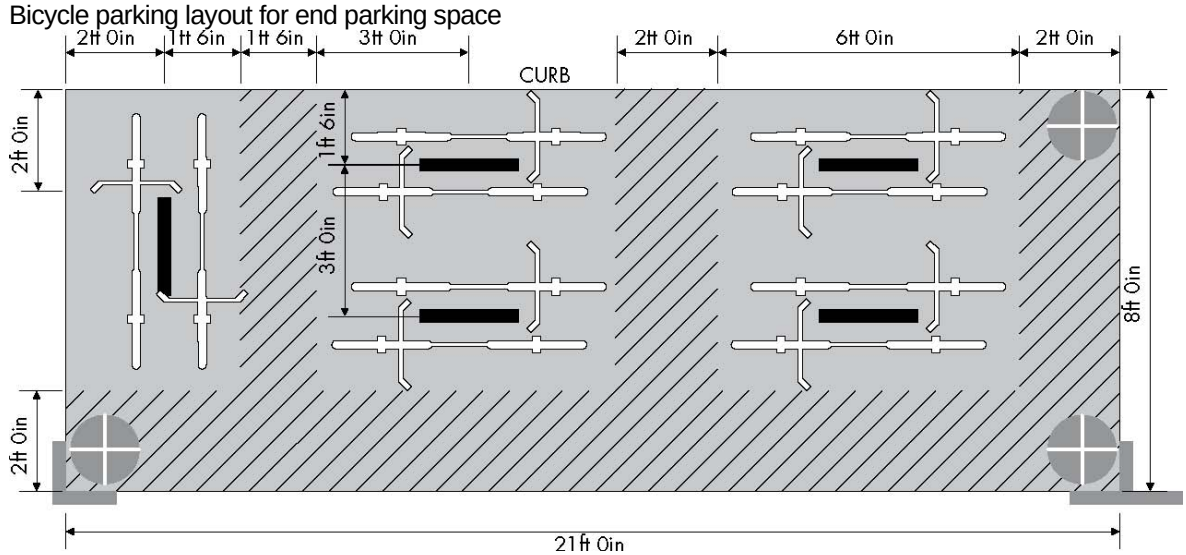


Note:

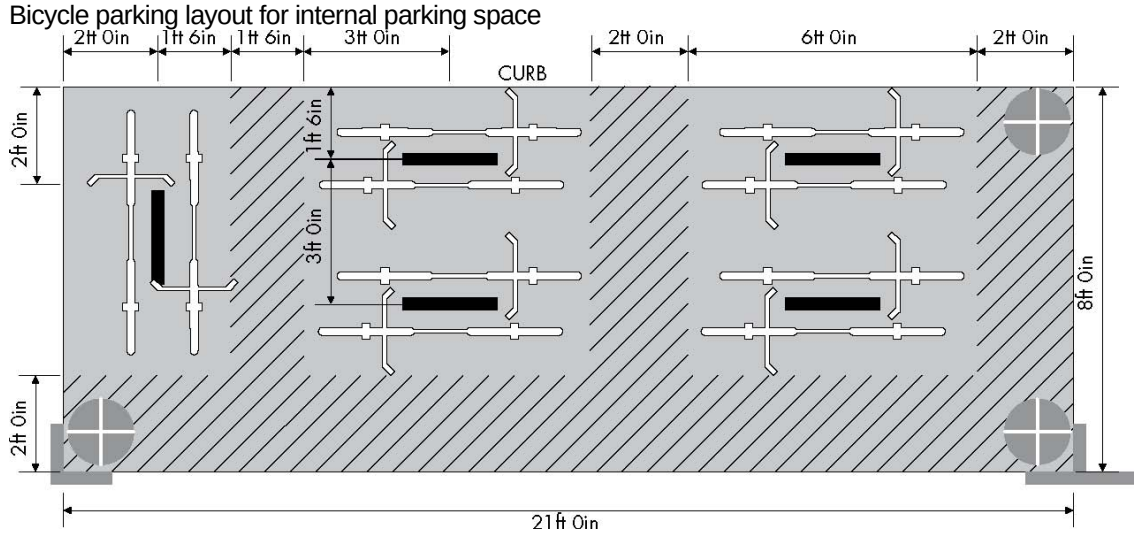
A minimum of 3 bike racks should be installed per block depending upon store frontages and bicycle demand, and no bike racks should be placed in bus stop zones.

Figure 10-6: Bike Rack Placement Criteria (On-Street Parking Space)

Bicycle parking layout for end parking space



Bicycle parking layout for internal parking space



10.4.1 Security and Theft From Vandalism

Racks should not be obscured by landscaping, fences, or other obstructions.

• Racks should be lit at night to protect both the bicycle and the user.

• Visibility to racks should be provided to at least one of the following: security guard, station agent, parking garage attendants, clerks, vendors, or passing pedestrians.

• Unguarded shared parking areas should issue keys only to those who share an affiliation. Locker placement is more flexible, but it should still be convenient for the bicyclist. A rule of thumb is that lockers should be located at least as close as the nearest motor vehicle parking, if any.

10.4.2 Utility and Convenience

Racks should be located within 50 feet of building entrance and should be clearly visible from the building entrance and its approaches. If this is not possible, signs should be posted to direct bicyclists to the bike parking. See Section 10.4.4.

• Protection from the weather should be provided for a portion of the rack supply.

• Ground surface of the bicycle parking area should be an all weather and drainable material such as asphalt or concrete; care should be taken when using brick, or other materials that can become slippery when wet.

• Lockers should also be placed on hard all-weather surface and locker users will appreciate a cover from the rain; lockers made of perforated metal should definitely be covered to protect the contents from the rain.

10.4.3 Pedestrian and Vehicle Conflicts

Racks shall be located outside the typical pedestrian travel path, with additional room for bicyclists to maneuver outside the pedestrian way.

• Racks shall be of minimum height so as to increase their visibility to pedestrians. See also Figure 10-1 and TDMG Figure T-7.

• Racks shall be located at a sufficient distance from motor vehicles to prevent damage to parked bicycles and motor vehicles. (See Figures 10-4, 10-5 and 10-6).

10.4.4 Signage to Bike Parking

• Signage should be posted to direct bicyclists to the locations of bicycle racks that may not be readily apparent such as in parking garages.

• Similarly, signs indicating the location of bicycle parking should be posted wherever a NO BICYCLE PARKING sign is posted.

10.5 BIKE PARKING QUANTITY

Recommendations for bicycle parking supply are presented in Table 10-3. Optimally, a mix of both Class 1 and Class 2 parking should be provided in virtually all locations. The parking rates in Table 10-3 are for communities with bicycle commute rates of less than 2% (the

countywide average). It is recommended that the amount of bicycle parking be increased proportionately for those cities or communities whose bicycle commute rates exceed the countywide average. The parking demand-to-capacity ratio should be monitored and additional parking should be provided as needed.

Table 10-3: Bicycle Parking Supply Recommendations

Use	Required Number of Bicycle Spaces
General, multi-dwelling residential	1 Class I per 3 units + 1 Class II per 15 units
Multi-dwelling residential -primarily for students & low-income families	1 Class I per 2 units + 1 Class II per 15 units
Multi-dwelling residential – primarily for residents 62 and older	1 Class I per 30 units + 1 Class II per 30 units
Elementary, middle, & high schools	1 Class I per 30 employees(3) + 1 spot per 12 students (50% Class I and 50% Class II)
Colleges - Student residences	1 Class I per 4.5 beds + 1 Class I per 30 employees
Academic buildings and other university facilities	1 Class I per 30 employees + 1 spot per 9 student seats (25% Class I and 75% Class II)
Park-and-Ride Lots/Parking Garages	7% of auto parking (75% Class I & 25% Class II)
Transit Centers	2% of daily home-based boardings (75% Class I and 25% Class II)
Cultural/Recreational (includes libraries, theaters, museums, & religious institutions)	Class I per 30 employees + (Class II 1,500 sq. ft. or Class II per 60 seats (whichever is greater)
Parks/Recreational Fields	1 Class I per 30 employees + Class II per 9 users During peak daylight times of peak season
Retail Sales/Shopping Center/Financial Institutions/Supermarkets	1 Class I per 30 employees + Class II per 6,000 sq. ft.
Office Buildings/Offices	1 per 6,000 sq. ft. (75% Class I & 25% Class II)
Hotels/Motels/Bed-&-Breakfasts	1 Class I per 30 rooms + Class I per 30 employees
Hospitals	1 Class I per 30 employees + 1 Class II per 45 beds
Restaurants	1 Class I per 30 employees + 1 Class II per 3,000 sq. ft.
Industrial	1 Class I per 30 employees or 1 Class I per 15,000 sq. ft.
Day Care Facilities	1 Class I per 30 employees + 1 Class II per 75 children
Auto-Oriented Services	1 Class I per 30 employees
Other Uses	Same as most similar use listed

Notes

(1) For cities with less than 2% bicycle commuter rate. Cities with different bicycle commute rates should pro-rate these accordingly.

(2) The minimum number of required Class II Bicycle parking spaces is 4, except when the code would require 1 or less, in which case

2 bicycle spaces must be provided.

(3) Employees = maximum number of employees on duty at any one time.

Source: League of American Bicyclists, 1994.

10.6 BIKE PARKING POLICIES AND GUIDELINES BY LAND USE TYPE

VTA Bike Parking Policy

1. Provide bike lockers at each Transit Center and Park & Ride lot. Work with cities to provide bike racks at each LRT station and major bus stops.

2. Existing fleet of VTA bike lockers are reserved in advance with a key deposit.

3. VTA will begin to retrofit its existing fleet of lockers to use Smart- Card technology so that lockers will be available on a first-come first-served basis, with a nominal fee.

4. Any new lockers purchased will use Smart Card technology.

Transit Station Guidelines

Class 1-The Class 1 parking should consist of either lockers (preferably first-come first-serve/day-use) or guarded bicycle parking. The exact quantity will be determined by initial survey and monitoring. The initial supply of Class 1 parking should be equal to 1.5% percent of daily homebased boardings. More should be added as demand increases. The lockers should be located convenient to the transit center entrance and within sight of passengers, to discourage vandalism.

Class 2-Bicycle racks ideally should be placed in an active area close to boarding platforms. They should not be placed in obscure areas out of public view. The quantity of bike racks will depend on how much of the demand is satisfied by Class 1 parking; the total of Class 1 and Class 2 parking supply initially should be 2% percent of daily home-based boardings. See Section 10.4 for more guidance

Office Buildings

Class 1-Typical Class 1 parking for office buildings should consist of either bicycle lockers or locked rooms within the parking garage or the building. Variations include allowing employees to bring their bicycles into their own office or work area. Where city ordinance permits, bicycle parking can often be carved out of unused spaces inside buildings, such as under stairwells. The exact quantity will need to be determined by monitoring use. The initial supply should be equal to 3% percent of the number of employees or as recommended in Table 10-3.

Class 2-Bicycle racks should be provided for visitors/deliveries near the front door of every building. A minimum of two to four racks should be provided, with additional capacity as recommended in Table 10-3.

Industrial Sites/Campus Employment Centers

Class 1-The Class I parking should consist of either bicycle lockers or locked compounds within the parking lots or the buildings. In addition, allowing employees to bring their bicycles into their own buildings is effective Class I parking.

Class 2-Bicycle racks located near all building entrances should be provided for visitors as well as employees who travel to various buildings within the worksite/campus during the work day.

Stand Alone Commercial Sites

Class 1-Class I parking should be provided for the employees of the businesses as recommended in Table 10-3.

Class 2-Racks near the building entrances should be provided at each stand-alone business. Land-uses such as grocery stores where bulky purchases are made should

provide a minimum of two stalls large enough to accommodate bicycles with trailers. The quantity should comply with Table 10-3.

Schools and Colleges

Class 1-Providing covered bicycle racks within a fenced locked area works well for both students and teachers at smaller campuses. These compounds at grade schools and junior high schools are typically locked during the school day by the janitor or other staff person. Depending on the number of bicycles, separate areas maybe needed for students and teachers. Where the risk of theft is particularly high, such as community colleges with large numbers of expensive bicycles, the compound should be watched by an attendant, as is the procedure at CSU Sacramento. Dormitories should provide Class 1 parking for all residents.

Class 2-Racks holding four to eight bicycles should be provided within view of the school office for visitors or those staying only a few hours or less. These racks would also be available for students who are late and are locked out of the compound. At colleges, racks should be provided at the main entrances to all classrooms, lecture halls, libraries and cafeterias.

Multi-Family Residential Units

Class 1-Individual garages serve as Class 1 parking for most singlefamily and for some multi-family dwelling units. Where multi-family units do not have individual garages, the following options are appropriate:

1. Traditional bike lockers located on the premises (either for each unit or as requested by tenant)

2. Locked large individual storage area for each unit

3. Bike cage with limited access within the locked parking garage (such as Option 2 on page 10-5.)

Class 2-Visitor Parking

Bike racks should be provided near the front door of a large unit with a single entrance or within a highly visible place in a development with multiple doors.