Bicycle Parking Guidelines

2nd Edition

A Set of Recommendations from the
Association of Pedestrian and Bicycle Professionals (APBP)

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Photographs, Graphics, Specifications

The images and graphics shown in the Bicycle Parking Guidelines, 2nd Edition, are intended to depict generic examples of different bicycle parking types. APBP thanks the individuals, organizations and companies who provided visual illustrations to help convey concepts described in the text. The use of photos, graphics and specifications in this guide does not constitute a product endorsement.

Disclaimers and Disclosures

Use of trade, product, and manufacturers' names in this document does not constitute an endorsement by APBP. APBP member John Ciccarelli, through his company Bicycle Solutions, represents several bicycle rack and locker companies mentioned in this guide. Mr. Ciccarelli did not author the fixture sheets which compare various types of bicycle parking products.

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INTRODUCTION

In the spring of 2002, the Association of Pedestrian and Bicycle Professionals released *Bicycle Parking Guidelines*, a basic guide to the selection and placement of bicycle racks. Since then, the rapid growth of bicycling (particularly in urban areas) has led to numerous innovations in the field of bicycle parking. *Bicycle Parking Guidelines, Second Edition*, expands on the original guide and is intended as a comprehensive resource for practitioners. This guide includes:

- General bicycle parking principles
- Definitions of bicycle parking terms
- Elements of a good rack or locker, including specific performance criteria
- Site design and layout, including guidance by land use type
- Maintenance best practices
- Innovative practices such as sheltered parking and in-street bicycle corrals
- Sample bicycle parking policies and ordinances

APBP's 2002 *Bicycle Parking Guidelines* has been cited and included in many bicycle plans. This new edition of the guidelines is appropriate for adoption by local agencies as official bicycle parking policy.

WHY IS BICYCLE PARKING IMPORTANT?

One of the most common obstacles for bicyclists is the lack of bicycle parking at their destination. At the most basic level, bicycle parking encourages people to ride, but it also has some specific benefits, even for non-cyclists:

- *Bicycle parking is good for business.* Bicycle racks provide additional parking spaces which customers can use to patronize local businesses. Bicycle racks not only invite cyclists in, but they announce to potential cyclist and non-cyclist customers alike that the business supports sustainable values, an increasingly important factor for many consumers.
- *Designated, well-designed parking promotes a more orderly streetscape and preserves the pedestrian right of way:*
    - It presents a more orderly appearance for buildings.
    - It prevents damage to trees and street furniture.
    - It keeps bicycles from falling over and blocking the sidewalk.
- *Bicycle parking helps legitimize cycling as a transportation mode by providing parking opportunities equal to motorized modes.*

CORE CONCEPTS

All bicycle parking facilities fall into two categories: *short-term* and *long-term*. The following table describes the differences between short- and long-term bicycle parking.

Table 1-1: Criteria for short-term and long-term bicycle parking

Criteria	Short-term	Long-term
Parking duration	Less than two hours	More than two hours
Fixture types	Simple bicycle racks	Lockers, racks in secured area
Weather protection	Unsheltered	Sheltered or enclosed
		Secured, active surveillance
		Unsupervised:
		"Individual-secure" such as bicycle lockers
Security	Unsecured, passive surveillance (eyes on the street)	"Shared-secure" such as bicycle room or cage
		Supervised:
		Valet bicycle parking
		Paid area of transit station
Typical land uses	Commercial or retail, medical/ healthcare, parks and recreation areas, community centers	Residential, workplace, transit

The majority of bicycle parking is short-term parking. Even cities with a large amount of bicycle parking usually have mostly short-term facilities. In some cases, short-term parking can function as long-term, through strategies such as shelters and locating parking in areas with high pedestrian volumes (i.e., eyes on the street or passive surveillance). However, properly designed long-term parking almost always offers a superior level of security. Secure long-term parking should always prevent non-users from accessing the bicycle (e.g., lockers, user-restricted or valet parked bicycle rooms or cages) and ideally would prevent access to bicycle accessories, so that a cyclist does not have to remove them.

Figure 1-1: Short-term and long-term bicycle parking
(Graphic courtesy City of Portland, Ore.)

THE BICYCLE VERSUS THE RACK ELEMENT

The 2002 *APBP Bicycle Parking Guidelines* laid out a conceptual framework for thinking about bicycle parking which had three main components:

- The rack element: the part of the bicycle rack that holds one bicycle.
- The bicycle rack: rack elements assembled into fixtures that hold one or more bicycles.
- The rack area: the layout of the site where multiple bicycle racks are placed.

The second edition of this guide (2010) recommends the following terminology, which is used throughout the guide:

- The bicycle: the vehicle to be parked; it has specific design dimensions, characteristics, tolerances and requirements, detailed in Chapter 2 and Appendix A.
- The bicycle rack: the fixture which parks one or more bicycles.
- The rack area: a site layout of multiple bicycle racks.

Chapter 2 | Facilities

THE BICYCLE

The overall dimensional envelope (height, length, and width) of the modern bicycle (two inline wheels of equal or nearly equal diameter) has not changed much for over a century. The dimensions of most conventional bicycles fall within the range pictured below, and most acceptable bicycle racks and lockers accommodate these dimensions. This guide refers to the top tube, down tube, seat tube, and front and rear wheels in describing recommended bicycle parking paractices; these elements of a bicycle frame are shown in the diagram.

Figure 2-1: Typical bicycle dimensions

Modern bicycle parking fixture designs and site layouts should strive to accommodate other bicycle types such as recumbents, folding bicycles, adult tricycles, trail-a-bike child carriers, bicycle trailers, longtail cargo bikes, and any number of larger racks and baskets, which are more and more common on utility bicycles. There is often a connection between a particular land use and a certain bicycle type (i.e., cargo bikes or trailers at grocery stores or child trailers and trail-a-bike at schools). Appendix A provides additional details about bicycle dimensions and the effect of various bicycle types on bicycle rack design.

PERFORMANCE CRITERIA – WHAT MAKES A GOOD BICYCLE RACK OR LOCKER?

This section describes the elements of a bicycle rack or locker and identifies performance criteria to evaluate the utility of a given bicycle parking fixture. A bicycle rack or locker is only as good as its design, materials and installation.

APBP recommends selecting a bicycle rack that:

- Supports the bicycle in at least two places, preventing it from falling over.
- Allows locking of the frame and one or both wheels with a U-lock.
- Is securely anchored to ground.
- Resists cutting, rusting and bending or deformation.

Above all, bicycle racks must provide a way to lock the frame with a U-lock because cable locks and chains are easily cut. However, racks that do not offer this feature may be useful as bicycle stands in certain elementary school yards and in fenced, attended (guarded) bicycle parking corrals at event venues such as stadiums.

Other recommended rack features include:

- Racks that capture the front wheel in a well or cradle prevent the bicycle's front wheel from swiveling or flopping over, enabling the cyclist to use both hands for locking, loading or removing cargo.
- Racks with vertical staggering elevate every other bicycle's front end, typically 8 to 12 inches. This avoids handlebar conflicts while enabling closer bicycle spacing (typically 16 instead of 24 inches), which is an advantage in high capacity installations or where space is constrained.

APBP recommends selecting a bicycle locker that:

- Fully encloses the bicycle.
- Provides some weather protection.
- Anchors securely to the ground.
- Resists tampering and vandalism.

Use the following performance criteria to evaluate any bicycle rack or bicycle locker design.

Cost

Compared with automobile parking, bicycle parking is one of the most cost-effective transportation improvements. The level of expense involved with bicycle parking is directly related to the length of time which people are expected to park. The shortest-term parking such as unsheltered simple bicycle racks located in a utility or street furniture zone on an existing public sidewalk is usually the least expensive. Shelters, bicycle cages and lockers increase the cost of bicycle parking facilities. While long-term parking is typically much more expensive than short-term, this cost difference offers a dramatic increase in security. Use a per-bicycle cost to evaluate the level of expense per user when comparing bicycle parking options.

Space Efficiency

As with cost, evaluate space efficiency per bicycle in terms of how many bicycles can be parked within a given space. An efficient bicycle rack is one that is contained entirely within the footprint of the bicycle and does not extend to the side or front or back of the parked bicycle. Exceptions to this are racks which stagger bicycles vertically to allow them to be parked more closely together, such as double-decker or vertical wall-mounted racks. Fixtures such as bicycle lockers or sheltered, caged bicycle racks may have a less efficient footprint, yet provide critical amenities for bicycle transportation. Understand this trade-off in the context of increased security and weather protection.

Maintenance

Select bicycle parking fixtures constructed of durable materials with scratch- and vandal-proof finishes and few, if any, moving parts. Exceptions include racks designed or finished to match a particular architectural theme or streetscape. Generally, choose fixtures with moving parts requiring maintenance only if they improve security or user convenience. For example, two-tiered racks with spring or hydraulic-assist upper trays help riders who otherwise could not lift their bicycle to the second level of the rack.

Materials

The following section describes typical finishes, moving parts and materials of most bicycle parking racks and lockers.

Racks

Finishes

The surface finish of a bicycle rack affects its appearance, durability and maintenance requirements. Most bicycle racks feature one of five types of finish.

Table 2-1: Common bicycle rack finishes

<table>
<tr><th>Finish Type</th><th>Appearance</th><th>Choice of Color?</th><th>Notes</th></tr>
<tr><td>Galvanized</td><td>Silver; may have slight texture.</td><td>No</td><td>Least expensive, durable and maintenance-free; proper application reduces surface texture of finish.</td></tr>
<tr><td>Powder coat</td><td>Color, typically smooth, may be gloss or matte.</td><td>Yes*</td><td rowspan="2">Must be applied over a zinc-rich primer so rust cannot spread beneath the coating from nicks or abrasions that expose bare metal; both powder coating and vinyl may deteriorate quickly and will require ongoing maintenance.</td></tr>
<tr><td>Vinyl (PVC) jacket</td><td>Often black</td><td>Possibly</td></tr>
<tr><td>Thermoplastic</td><td>Color, typically fairly smooth, comparable in appearance to powder-coat</td><td>Yes*</td><td>Sprayed directly onto cleaned (sandblasted) and heated rack. High adhesion keeps rust from spreading beneath surface from nicks or abrasions. Technique is also used to weatherproof naval weaponry.</td></tr>
<tr><td>Stainless steel</td><td>Silver/chrome, typically smooth</td><td>No</td><td>High resistance to cutting. Most expensive finish.</td></tr>
</table>

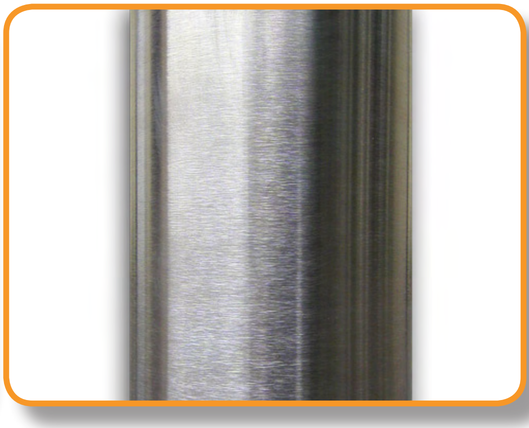
* Manufacturers that feature powder-coated or thermoplastic-coated racks typically offer a set of standard colors. Some can produce special orders using custom colors selected from a larger palette (color chart). Matte black is a standard color that hides dirt better than gloss black.

Figure 2-2: Galvanized (photos: Eric Anderson; Dero Bike Racks)

Figure 2-3: Powder coat (photos: Dero Bike Racks; Andrew J. Besold; figure: Dero Bike Racks)

Figure 2-4: Vinyl (PVC) jacket (photos: Andrew J. Besold; John Ciccarelli; Dero Bike Racks)

Figure 2-5: Stainless steel (photos: Heath Maddox; Dero Bike Racks)



Moving Parts

Most modern bicycle rack designs have few or no moving parts.

Table 2-2: Typical acceptable moving parts in bicycle rack designs

Moving Parts	Function	Notes
Permanently attached cable(s) with eyelets; chain	Locking: Enable securing one or both wheels to user's U-lock, without user having to bring a cable.	Many bicyclists carry their own braided cables for securing the wheels.
Swiveling locking arm with loop	Locking: Position a loop near the bicycle's frame/wheel locking point, yet stowed when not in use.	Heavy locking arm must be properly designed to not pose risk of injury to user.
Articulated upper tray	Storage and retrieval: Minimizes lifting distance to upper tier. May assist with metal or gas springs.	Includes a large handle so users can move the tray while keeping fingers away from pinch points; must be strong enough to resist bending by vandals.

Figure 2-6: Flexible locking cable and integrated locking chain (photos: John Cinatl; John Luton, Capital Bike & Walk)

Figure 2-7: Swiveling locking arm (photo: John Ciccarelli)

Figure 2-8: Articulated upper tray (photo: Heath Maddox)

Lockers

Construction

The following table describes the most common types of bicycle locker construction.

Table 2-3: Common bicycle locker construction

Type	Notes
All metal	Typically have flat tops, suitable for double stacking. On sunny days, can become very hot, especially if dark colored.
Molded plastic	May have flat or round tops.
Plastic panel on metal frame	Panels can separate from frame, increasing vulnerability to prying attacks.
Fiberglass panel on metal frame	Stiffness of fiberglass panels prevents prying vulnerability of plastic panels.

Figure 2-9: Perforated powdercoated steel locker (photo: Eric Anderson)

Figure 2-10: Molded polyvinyl or polyethylene lockers are susceptible to fire damage (photos: Laura Timothy, BART)

Figure 2-11: Fiberglass panel locker (photo: CycleSafe, Inc.)

Visibility / Inspection of Contents

Some manufacturers offer metal lockers with perforated panels, or unbreakable windows in the door, top, or side panels to allow security personnel to view the locker contents. This is useful for on-going locker administration and security, to ensure that bicycles are not abandoned and that lockers are serving their intended use.

Two-level Installations

Lockers with flat tops can form the lower tier of a two-level installation. To make it easier to store and retrieve bicycles from an upper locker, a wheel guide tray should be mounted to the floor of the locker at an angle relative to the side panels. The wheel guide tray enables the user to roll the bicycle and its handlebars in and out vertically. The user lifts the bicycle's front wheel onto the tray, which prevents the front wheel from turning while the user then employs both hands to lift and guide the rest of the bicycle into place.

Aesthetics

The appearance of the bicycle rack, although completely subjective, has become increasingly important in some communities. As the demand for bicycle parking and the number of racks increases, so do concerns that bicycle racks blend in as appealing street furniture in the existing streetscape design. Colored finishes and alternate shapes have become increasingly popular alternatives to meet this need. A number of manufacturers produce custom racks with a variety of distinctive designs such as café, restaurant and parks and open space. Some cities have sponsored bicycle rack design competitions or commissioned artists to design and produce racks as functional pieces of public art. Business districts, neighborhoods and historical areas may prefer a signature style of rack. When selecting or designing a rack it is essential to balance aesthetic concerns against critical functionality and safety issues. Innovative rack designs should fulfill the basic requirements of security (locking the bicycle frame and at least one wheel) and stability (supporting the bicycle in at least two places along a horizontal plane). Also, designers should be careful not to create obstacles or hazards for pedestrians or obstruct the accessible path of travel for persons with disabilities.

Security

Racks

A successful bicycle rack design enables proper locking. Enabling proper locking means the user must be able to secure a typical size U-lock around the frame and one wheel to the locking area of the rack. Racks that support the bicycle but either provide no way to lock the frame or require awkward lifting to enable locking are not acceptable unless security is provided by other means such as a locked enclosure or monitoring by attendants.

Vulnerabilities

Even if a rack meets the basic criteria of support and lockability, it must be securely constructed and anchored. Organized thieves will transport bicycles still locked to severed racks in vans or trucks to a location where they can remove the locks.

Disassembly and detachment

Racks are vulnerable to removal if they can be unfastened (for example, a wheel-holder attached only by simple bolts and nuts to angle-iron base rails) or if rust has weakened a weld such that the locking area can be easily broken. Rust intrusion can result from a separated paint or vinyl finish on a rack that was not primed before application of the final finish.

Figure 2-12: Cut round tubing rack (photo: Eric Anderson)

Cutting

The locking area of the rack must resist cutting by manual tools that a bicycle thief will commonly carry, including bolt cutters, hand saws, abrasive cutting cables, and pipe cutters. Although battery-powered cutters can detach bicycles, few thieves will risk the noise generated by such tools. No cost-effective bicycle rack can withstand a power saw for long, and most bicycle parking guidelines do not require this level of protection, instead relying on bicycle lockers and bicycle enclosures for higher security.

Locking area thickness, shape and hardness

A solid locking area or one with thick walls is preferable to a thin-walled area and will take longer to sever. The "Schedule" number of pipe and tubing indicates its wall thickness: Schedule 80 pipe has the same outside diameter as the standard Schedule 40 but has a thicker wall.

Regardless of wall thickness, round tubing – especially of relatively small diameter – is vulnerable to attack by inexpensive, silent hand-held pipe cutters. However, any non-round shape – even an ellipse – will defeat them, and several manufacturers now offer square-tubing versions of common rack designs.

Most bicycle racks are made of mild steel, which is moderately resistant to cutting. Stainless steel has a very hard surface that resists most cutters, however it is typically several times more expensive than mild steel.

Mounting / Anchoring

The method of mounting bicycle racks is a key determinant of rack security – poorly anchored fixtures can be removed by thieves. Horizontal bicycle racks used outdoors may be mounted on poured concrete surfaces such as sidewalks, on asphalt, or on unpaved ground.

Table 2-4: Horizontal bicycle rack mounting options

Surface	Rack Base	Anchoring Methods	Notes
Concrete (sidewalk, pad, poured footing, or non-post-tensioned floor)	Embedded leg	Embed (dig post hole, support rack temporarily, fill hole with concrete, allow to set, remove temporary support)	Suitable for new sidewalk construction. Permanent. Difficult to replace when damaged.
	Surface flange, flat-bar base, or base frame	Wedge anchor bolt Tamper-proof spike Industrial adhesive	Suitable for new or existing sidewalk. Easy to replace when damaged. Should not be installed over most vaulted sidewalks. Stainless steel flanges recommended to prevent rust stains on concrete.
Concrete post-tensioned floor	Flat-bar base	Industrial adhesive	Post-tensioned concrete floors should not be drilled.
Asphalt	Embedded leg	Provide a concrete footing, proceed as above	Do not anchor directly into asphalt.
	Surface flange		
	Base rail or frame	Landscape nails (6" to 12" long spikes, typically 1/4" to 3/8" in diameter)	Drill pilot hole through asphalt using hammer drill and masonry bit. Drive nails with sledgehammer.
Unpaved	Embedded leg	Provide a concrete footing, proceed as above	Do not anchor directly into ground.
	Surface flange		
	Base rail or frame	Landscape nails	Drive nails with sledgehammer.

Figure 2-13: Embedded rack footings in soil, concrete and asphalt (photos: Dero Bike Racks; Eric Anderson)

Figure 2-14: Flange concrete rack mounting (photo: Eric Anderson)

Figure 2-15: Rail mounted racks anchored to asphalt surface (photo: Heath Maddox)

Figure 2-16: Tamper-proof anchor for flange mounting or securing rail-mounted racks (photo: John Ciccarelli)

Warning: Wall-mounted racks should not be supported by walls constructed of metal studs; studs cannot resist heavy rotation forces. For this reason, wood studs are preferable to metal studs. As with concrete floors, post-tensioned concrete ceilings – such as many parking decks – should not be drilled.

Lockers

Bicycle lockers provide an individual-secured, enclosed space for each stored bicycle. The security of a bicycle locker depends on the security of the wall panels, door, frame and the locking mechanism.

Locking Mechanisms

User lock and hasp

The least secure and least desirable locking mechanism for a bicycle locker consists of a hasp that accepts a user-provided padlock. This setup is vulnerable to direct cutting and prying of the padlock and hasp. Even if a hasp shield prevents the lock from being cut or twisted off, a user-provided lock creates the need to have to break the lock if a user abandons the locker or fails to remove the lock as expected. Master keys cannot be used to inspect the contents of user-locked lockers. Whenever a user-lockable locker is vacant, its unlocked door invites misuse of the interior.

Integral mechanical

Most conventional bicycle lockers employ recessed internal mechanical lock mechanisms, often with pop-out T-handle latches, and non-duplicable keys owned and assigned by the locker management program.

Mechanical keys pose a system management challenge when users lose or fail to return keys. Charging a substantial key deposit can deter this, but system managers must be prepared to change out or re-key lock mechanisms if necessary.

Lockers with mechanical key-lock units are not easily shared, which limits their use to long-term (monthly) rentals. If a substantial number of users do not need their lockers every day, the locker bank is underutilized.

Integral smart

Lockers that employ digital "smart" locks instead of mechanical keys enable flexible usage, including on-demand reservations of lockers by one-time or infrequent users. Some systems employ user access devices such as magnetic-stripe cards, proximity cards, or proximity fobs. As more transit systems allow smart cards, those cards can also enable access to system bicycle lockers. Some smart lockers also provide keypads and small displays. In the simplest stand-alone digital access setups, each locker has a smart lock but the locker bank is not connected together either locally or to a broader network. If a locker bank with smart locks is also networked to a reservation system, users can determine locker availability before they begin their trip, and can reserve a locker before arrival.

Figure 2-17: Smartcard bicycle locker system (photos: Eric Anderson; John Luton, Capital Bike & Walk)

Locker Vulnerabilities

Bicycle lockers are vulnerable to several types of attack: cutting (of enclosure panels), prying (door and frame), door/frame failure (door sag), and fire (some plastic enclosures). As is the case with bicycle racks, most thieves will not employ power tools due to noise. Lockers also conceal or obscure their valuable contents, which may remove or reduce motive unless they have view windows or are made of perforated panels.

Cutting (plastic)

The plastics used for bicycle locker shells vary in their resistance to cutting with common tools. Some weak shells such as softer polyurethane can be cut can-opener style, while others will effectively resist blade intrusion.

Prying

Poorly engineered enclosure frames (panel joints) or door frames can be pried apart with crowbars. Lockers that do not incorporate an integral floor can sometimes be pried off their anchors with a pallet jack. More commonly, door frames provide excess space where a prying tool can be inserted.

High quality locker door mechanisms incorporate a locking mechanism that inserts two or more tabs into the internal frame to defeat door prying attacks. Lockers can also be retrofitted with metal channels that protect the door-frame gap.

Door sag

Low-quality bicycle lockers have doors consisting of panels attached to angle-iron or U-channel frames. The corners of these frames may break or bend with repeated use and weather cycles, causing the latch edge of the door to sag and possibly making it impossible to lock the unit. Repairing such doors is an expensive nuisance best avoided by initially requiring higher-quality door/frame construction.

Fire (plastic)

Plastic materials (e.g., some types of polyurethane) used for some bicycle locker shells will burn, such that the entire locker will burn if a vandal with a torch or lighter succeeds in igniting any part of it. Locker purchase specifications should disallow such materials.

Rack and Locker Safety

Detectability (ADA)

Bicycle rack areas on or adjacent to sidewalks and plazas should be detectable with the long cane used by people who are visually impared to detect obstacles and tripping hazards. Some rack designs have ground-mounted elements that are detectable. A detectable device should be added for racks that cannot be located outside the pedestrian path of travel.

Lockers - Special Concerns

Explosives and Weapon Storage

Security managers at sensitive locations such as airport terminals, major transit hubs, national and campus laboratories, financial institutions, and high-profile government buildings often consider bicycle lockers a risk because of their potential to conceal a bomb or weapons. Especially since September 11, 2001, locker manufacturers have responded by offering lockers that incorporate semi-transparent panels of perforated steel, and/or hardened windows into which a light can be shone for inspection.

Figure 2-18: Detectable footing around bicycle parking area (photo: Eric Anderson)

In airports, bicycle lockers are the appropriate solution, and they can be sited away from vulnerable terminals by locating them in parking lots with safe and convenient bicycle access from nearby streets. Because the lockers will be used at night as well as during daylight, they should be located adjacent to and in direct view of parking attendant booths. They should also be near an airport terminal shuttle stop minimizing the distance luggage needs to be carried.

Unwanted Contents

Any bicycle locker or shared bicycle enclosure can be an attractive place for some individuals to store personal belongings not related to bicycle trips. Locker management programs should include policies that do not allow inappropriate storage, reserve the staff's right to inspect contents without notice, and dispose of inappropriate items in a specified manner after sufficient notice. Requiring positive identification, a deposit, and optionally a personal check or a nominal charge against a credit card can deter unwanted use.

Unwanted Activities

Bicycle lockers that accept user-provided padlocks are unlocked when the units are unoccupied. This is an open invitation for misuse, and transit agency experience has demonstrated this problem.

Usability

Racks

A successful bicycle rack design provides proper support. For a horizontal bicycle rack, proper support means supporting the bicycle so that the user can lock and unlock it, and load and remove cargo, without the bicycle flopping over due to the front wheel turning. This can be accomplished either by supporting the bicycle's frame at two or more points on a horizontal plane, or by supporting the frame at one point while also preventing the front wheel from turning. All bicycle racks should meet the following usability criteria:

- Support the bicycle upright on a horizontal plane by its frame in two places.
- Prevent the wheel of the bicycle from tipping or flopping over.
- Enable the frame and one or both wheels to be secured.
- Support bicycles without a diamond-shaped frame or a horizontal top tube (e.g., a mixte women's or step-through frame).
- Allow front-in parking: a U-lock should be able to lock the front wheel and the down tube of an upright bicycle.
- Allow back-in parking: a U-lock should be able to lock the rear wheel and seat tube of the bicycle.
- NOT recommended: Wheelbending racks that provide no support for the bicycle frame.

For easier site planning and use, preferred racks are accessible and usable from both sides. The design of the rack should be intuitive to use: complex designs with a learning curve encourage incorrect use, which can result in reduced security or obstruction of the rack for other users. All bicycle rack designs should strive to accommodate both conventional bicycle types as well as non-traditional types like recumbents, adult tricycles, folding bicycles and others.

Lockers

There are a number of locker-specific design issues which can affect usability.

- Locker doors should open to at least 90 degrees to allow easy loading/unloading.
- Lockers should be clearly labeled as bicycle parking.
- Directions for use should be posted on or near the lockers.
- Information about how to sign up for lockers (leased or smartcard on-demand) should be posted on or near the locker.
- Stacked lockers should have a wheel track to guide the bicycle into the locker.

Capacity

Put simply, bicycle racks and lockers should hold the number of bicycles advertised by their manufacturers. This is a distinct issue from space efficiency, though it is related. For example, undulating racks are frequently advertised to hold two bicycles between each upright loop area, but the spacing between the loops may be inadequate, resulting in tangled handlebars because bicycles are parked too close together. Incorrect use of a rack may also limit capacity, as for example when a cyclist parks the bicycle parallel to an undulating rack in order to support the bike in two places and consequently blocks most, if not all, parking spots.

APBP makes two recommendations to manufacturers of bicycle parking: 1) Consider the spacing recommendations in this guide when designing racks, acknowledging that this may result in fixtures that hold fewer bicycles; 2) Consider the recommendation to support the bicycle upright in two places, as lack of support may inadvertently encourage incorrect use of the rack, thereby limiting actual capacity.

RECOMMENDED RACKS

The following racks meet all of the design criteria identified in this guide.

Inverted U	  Photos: Heath Maddox; Palmer Group's bikeparking.com
Cost	Low to medium cost per bicycle
Space Efficiency	Rack is within bicycle footprint, although incorrect use would expand footprint
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Variety of finishes available; alternate shapes such as circle expand options
Security	Easily allows locking of bicycle and at least one wheel when properly sited; allows removal of second wheel and locking with single lock; square tubing recommended because round tubing is more vulnerable to cutting
Safety and Detectability	Racks and parked bicycles are detectable and do not pose tripping hazard
Usability	Intuitive; supports bicycle at two points; easy to park when properly sited and spaced; accessible from both sides
Capacity	Two bicycles per inverted U

Post and Ring



Photos: Heath Maddox; Palmer Group's bikeparking.com

Cost	Low to medium cost per bicycle
Space Efficiency	Rack is within parked bicycle footprint, although incorrect use would expand footprint; may be retrofitted to unused meter posts during parking conversion
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Variety of customized finishes, designs and shapes possible
Security	Easily allows locking of bicycle and at least one wheel when properly sited; allows removal of second wheel and locking with single lock; square steel tubing recommended because round tubing is more vulnerable to cutting; cast metal rings vulnerable to prying
Safety and Detectability	Racks and parked bicycles are detectable and do not pose tripping hazard
Usability	Intuitive; supports bicycle at two points; easy to park when properly sited and spaced; accessible from both sides.
Capacity	Two bicycles per post and ring

Inverted U Series

Photos: Heath Maddox

Cost	Low to medium cost per bicycle
Space Efficiency	Rack is within parked bicycle footprint, although incorrect use would expand footprint
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Variety of finishes possible; alternate shapes expand options
Security	Easily allows locking of bicycle and at least one wheel when properly sited; allows removal of second wheel and locking with single lock; square steel tubing recommended because round tubing is more vulnerable to cutting
Safety and Detectability	Racks and parked bicycles are detectable and do not pose tripping hazard
Usability	Intuitive; supports bicycles at two points; easy to park when properly sited and spaced; accessible from both sides
Capacity	Two bicycles per inverted U

ACCEPTABLE RACKS

The following racks meet most of the design criteria identified in this guide but may not be suitable for all situations.

Wall-Mounted Racks

Photos: Creative Pipe, Inc.

Cost	Low cost per bicycle
Space Efficiency	Footprint smaller than floor-mounted rack; may be staggered vertically to increase overall capacity
Materials and Maintenance	Round steel bar stock; flat steel trays (may be less secure than other rack designs with thicker tubing); no moving parts (unless integrated cable); only anchors and finish may need maintenance
Aesthetics	Usually not in public space; appearance is not an issue
Security	Intended for secured areas unless locking loop or mechanism is provided; best if located in highly secured or attended location; may not be able to secure both wheels and frame unless integrated locking cable is provided; if located in unsecured area, may be bent or detached from wall
Safety and Detectability	Not detectable unless a detectable surface is installed around rack footprint
Usability	Supports bicycle adequately in hanging position; accessible from only one side; less intuitive; may be difficult to lift bicycle onto hook for some users; not compatible with recumbent and folding bicycles
Capacity	One bicycle

Wheelwell - Secured

Photos: Arthur Ross, City of Madison; Creative Pipe, Inc.; John Cinatl

Cost	Low to medium cost per bicycle
Space Efficiency	Rack is within parked bicycle footprint
Materials and Maintenance	Square or round bent steel tubing and steel plate; recommend hardened steel similar to U-lock shackle for locking loop; no moving parts; only anchors and finish may need maintenance
Aesthetics	Unique shape; variety of finishes possible
Security	Allows locking of bicycle and at least one wheel; difficult to lock both wheels with one lock by removing front wheel. Locking loop may be susceptible to cutting, should be hardened steel similar to U-lock shackle
Safety and Detectability	Racks may not be fully detectable without some additional detectable surface
Usability	Fairly intuitive; supports bicycle at two points; easy to park when properly sited and spaced; accessible from only one side
Capacity	One bicycle per wheelwell

Tree Guard Bicycle Racks


Photos: Eric Anderson; Jym Dyer/TIME'S UP!

Cost	Low to medium cost per bicycle
Space Efficiency	Rack is mostly within parked bicycle footprint; incorrect use would expand footprint
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Variety of finishes possible; alternate shapes expand options
Security	Easily allows locking of bicycle and at least one wheel when properly sited; allows removal of second wheel and locking with single lock; square steel tubing recommended because round tubing is more vulnerable to cutting
Safety and Detectability	Racks and parked bicycles are detectable and do not pose tripping hazard
Usability	Intuitive; supports bicycle at two points; easy to park when properly sited and spaced; not accessible from both sides
Capacity	One or more bicycles; does not have same capacity as equivalent inverted U racks

Modified Coathanger

Photos: Dero Bike Racks

Cost	Low to medium cost per bicycle
Space Efficiency	Rack is mostly within parked bicycle footprint
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Unique shape; variety of finishes possible
Security	Allows locking of bicycle and at least one wheel when properly designed and sited; cannot lock both wheels with one lock by removing front wheel; square steel tubing recommended because round tubing is more vulnerable to cutting
Safety and Detectability	Racks are detectable and visible
Usability	Proper spacing of locking loops improves usability; supports bicycle at two points; higher cross-member accommodates taller bicycles or those with large front baskets or rear racks; longer locking loops suitable for recumbents and folding bicycles; not accessible from both sides
Capacity	One bicycle per modified coathanger; advertised capacity depends on proper spacing of locking loops

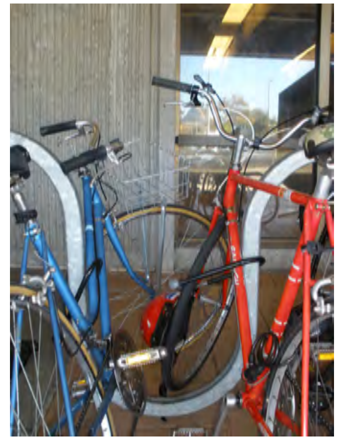
Two-Tier or Double Decker

Photos: Dero Bike Racks; Bikestation®

Cost	Medium to high cost per bicycle
Space Efficiency	Very space efficient when properly designed and used
Materials and Maintenance	Steel trays and locking mechanisms; low to medium maintenance; no moving parts (unless integrated locking mechanism)
Aesthetics	Usually not in public space; appearance is not an issue
Security	Intended for secured areas unless locking loop or mechanism is provided; best if located in highly secured or attended location; may not be able to secure both wheels and frame
Safety and Detectability	Cane detectable; users may drop bicycles, potentially causing injury
Usability	Supports bicycle adequately; many models include lift-assisted trays; accessible from only one side; not always intuitive; difficult to lift bicycle for some users if lift assist not provided; not compatible with recumbent and folding bicycles
Capacity	One bicycle per tray

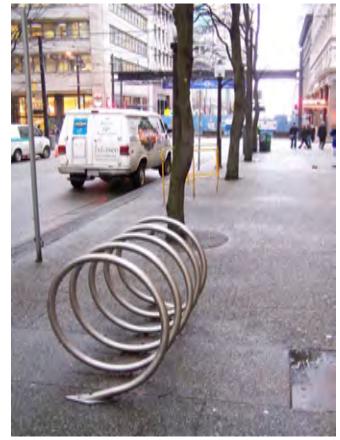
OTHER RACKS

The following racks do meet some of the critical design criteria identified in this guide. Some might be appropriate for specific purposes in limited situations.

Undulating	   Photos: John Ciccarelli; Eric Anderson
Cost	Low to medium cost per bicycle
Space Efficiency	Widely spaced upright loops improve space efficiency and ensure advertised capacity
Materials and Maintenance	Recommend square bent steel tubing; no moving parts; only anchors and finish may need maintenance
Aesthetics	Unique shape; variety of finishes possible
Security	Allows locking of bicycle and at least one wheel when properly designed and sited; cannot lock both wheels with one lock by removing front wheel; square steel tubing recommended because round tubing is more vulnerable to cutting
Safety and Detectability	Racks are detectable and visible
Usability	Does not support bicycle at two points; typical narrow spacing of parking spaces reduces usability; handlebar conflicts are typical
Capacity	Spacing of upright loops varies by manufacturer, therefore may not hold number of bicycles claimed; one bicycle parked parallel will reduce capacity to two bicycles

Schoolyard; Grid; Comb	  Photos: Eric Anderson; Mike Lydon, The Street Plans Collaborative
Cost	Low cost per bicycle
Space Efficiency	Parking spaces usually too close together, reducing efficiency
Materials and Maintenance	No moving parts
Aesthetics	Little opportunity for alternate finishes or shapes
Security	No means to secure bicycle unless locked sideways, which blocks entire rack; steel tubing and bars easily cut or vandalized
Safety and Detectability	Cane detectable, but may pose tripping hazard depending on height
Usability	Except for front wheel, does not support bicycle; handlebar conflicts common
Capacity	Typically does not hold advertised capacity, particularly for adult sized bicycles

Spiral



Photos: Dero Bike Racks; John Luton, Capital Bike & Walk

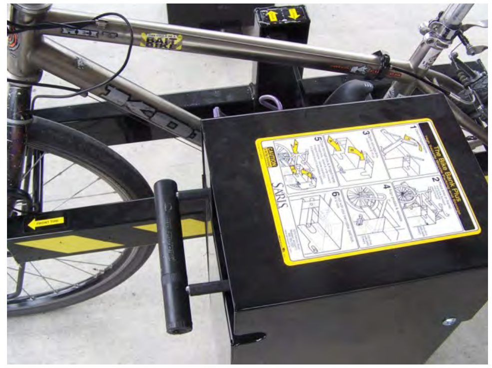
Cost	Low to medium cost per bicycle
Space Efficiency	Parking spaces usually too close together, reducing capacity and efficiency
Materials and Maintenance	No moving parts; only anchors and finish may need maintenance
Aesthetics	Unique shape; variety of finishes possible
Security	Round tubing susceptible to cutting, which makes all locked bicycles vulnerable to theft; allows locking of bicycle and at least one wheel when properly designed and sited but cannot lock both wheels with one lock by removing front wheel
Safety and Detectability	Racks are detectable and visible
Usability	Does not support bicycles at two points; spacing of parking spaces reduces usability; spiral causes bicycles to tip or handlebar conflicts
Capacity	May not hold advertised capacity

Wheelwell

Photos: Eric Anderson; R.J. Thomas Mfg. Co., Inc.

Cost	Low cost per bicycle
Space Efficiency	Rack footprint within bicycle footprint
Materials and Maintenance	Concrete or molded plastic; low maintenance (no moving parts)
Aesthetics	Little opportunity for streetscape incorporation or appearance modifications
Security	Typically no means to secure bicycle
Safety and Detectability	Cane detectable, but may pose tripping hazard
Usability	Except for front wheel, does not support bicycle
Capacity	One bicycle

Coathanger	   Photos: John Luton, Capital Bike & Walk
Cost	Low to medium cost per bicycle
Space Efficiency	Rack is mostly within parked bicycle footprint
Materials and Maintenance	Square or round bent steel tubing and bar stock; bar stock should be hardened steel similar to U-lock shackle to resist cutting; no moving parts; only anchors and finish may need maintenance
Aesthetics	Unique shape; variety of finishes possible
Security	Allows locking of bicycle and at least one wheel when properly designed and sited; cannot lock both wheels with one lock by removing front wheel; locking loops may not be as secure as racks with thicker tubing
Safety and Detectability	Racks are detectable and visible
Usability	Improper spacing of locking loops reduces usability, may cause bicycle or handlebar conflicts; some bicycles will not fit under rack; not suitable for recumbents, folding bicycles or front baskets/tall handlebars; supports bicycle at two points; accessible from both sides when sited correctly
Capacity	May not hold advertised capacity if locking loops are too closely spaced

Swing Arm Secured	   Photos: John Luton, Capital Bike & Walk; John Ciccarelli
Cost	Medium to high cost per bicycle
Space Efficiency	Rack footprint larger than bicycle footprint
Materials and Maintenance	Moving parts include a swing arm and possibly locker lid; may be high maintenance; some indication of failure of moving parts
Aesthetics	Utilitarian appearance, no options for alternate finishes or shapes
Security	Additional locking elements secure wheels automatically; however may be susceptible to cutting or prying
Safety and Detectability	Cane detectable, but low profile may pose tripping hazard
Usability	Not intuitive; racks include instructions; frequent misparking; users in a hurry will often not use as intended; supports bicycle in two places when properly used; may not work with recumbent and folding bicycles
Capacity	One bicycle per unit

SITE PLANNING

Site planning requirements for bicycle parking differ based on whether the use is to be short-term or long-term. Aside from the intrinsic difference between short-term and long-term site planning, the kinds of fixtures typically associated with these parking types also have unique site design requirements.

Dimensions for specific rack and locker layouts are provided later in this section.

Figure 2-19: MUTCD D4-3 bicycle parking sign (image: FHWA, 2009)

Short-term

Because short-term parking usually consists of simple bicycle racks located on the sidewalk in front of a building or destination, the site planning focus is on convenience, utility, and the attempt to improve security for the basic bicycle rack. Short-term parking racks should be:

- Convenient to the cyclist destination.
- Placed no more than 50’ from the door, otherwise cyclists may lock to other street furniture or trees.
- Visible from the destination to reassure cyclists about the security of the rack.
- Located in a high-traffic area with passive surveillance or eyes on the street.
- Identified by a sign at the visitor entrance; recommend sign D4-3 in the *Manual On Uniform Traffic Control Devices*.
- Located along the “desire line” from adjacent bikeways; the path that cyclists are most likely to travel.
- Weather-protected, by siting racks under existing structures or installing free-standing structures when possible.

Figure 2-20: Secure long-term parking and weather protection (photo: Eric Anderson)

Long-term

Long-term parking consists of a wider variety of fixture types and site plan layouts and includes both racks in cages and bicycle rooms, as well as lockers located in a variety of different settings, both indoors and outdoors. Because long-term parking areas are frequently located in low pedestrian traffic areas and may be in out-of-the-way locations, site design focus is on ensuring the safety of users while maintaining exclusive access to these areas. Long-term parking should have:

- Easy access via effective guide signage.
- Controlled access:
  - Leased (keyed or smartcard) lockers
  - On-demand (self-lock or smartcard) lockers
  - Keycard/code access garage cage or bicycle room
- Higher security from controlled access to cages, rooms or lockers.
- Safeguards for users such as effective lighting and visible surveillance cameras or security guards.
- Weather protection:
  - Free-standing shelter
  - Indoor cage or room

- Lockers and showers for longer commutes or extremely hot or inclement climates.
- Outreach to users to educate them about the presence of the facilities.

Bicycle Rack Site Layout

The layout of a bicycle parking area is critical to it being easily used by cyclists. Racks that are placed too close together or too close to nearby objects such as walls or trees may be completely unusable. Some key principles of bicycle rack site design are:

- Avoid handlebar/rack/basket conflicts; this can be accomplished through proper rack spacing or vertical staggering of bicycle racks.
- Allow two feet of clearance around the rack for users to be able to access and securely lock bicycle from the side.
- Ensure adequate end and side clearance for users to maneuver their bicycles around the parking area.
- Ensure adequate clearance from walls and other fixed objects to allow parking of bicycles; too close to a wall and the racks will be unusable.
- Aisle spacing should:
  - Allow for simultaneous users.
  - Consider entry and exit flow.
  - Accommodate lifting of bicycles where two-tiered racks are used.
- Consider access from all sides so that all parking spaces can be used.
- Not everyone will use racks as intended; thoughtful site design can anticipate and accommodate some incorrect use to minimize the impact of incorrect parking. For example, consider including extra spacing between racks or extra clearance between racks and adjacent obstructions.

Bicycle Locker Site Layout

To an even greater degree than with simple bicycle racks, the layout of a bicycle locker area is critical. Lockers that are placed too close together or too close to nearby objects such as walls or trees, may result in doors that cannot be opened or insufficient room to maneuver a bicycle. Some key principles of bicycle locker site design are:

- Ensure adequate end and side clearance for users to maneuver their bicycles around the parking area, given the increased size and obstruction of larger bicycle lockers.
- Aisle spacing should:
  - Allow for simultaneous users.
  - Consider entry and exit flow.
  - Take into account door swing from opening lockers, both to allow the door to open and to maneuver the bicycle into and out of the locker.
  - Accommodate lifting of bicycles where stacked lockers are used.
- Consider access from both sides where two-sided lockers are used.
- Accommodate special requirements of types such as wedge lockers which can be arranged in circles rather than rows.

Figure 2-21: Typical rack spacing

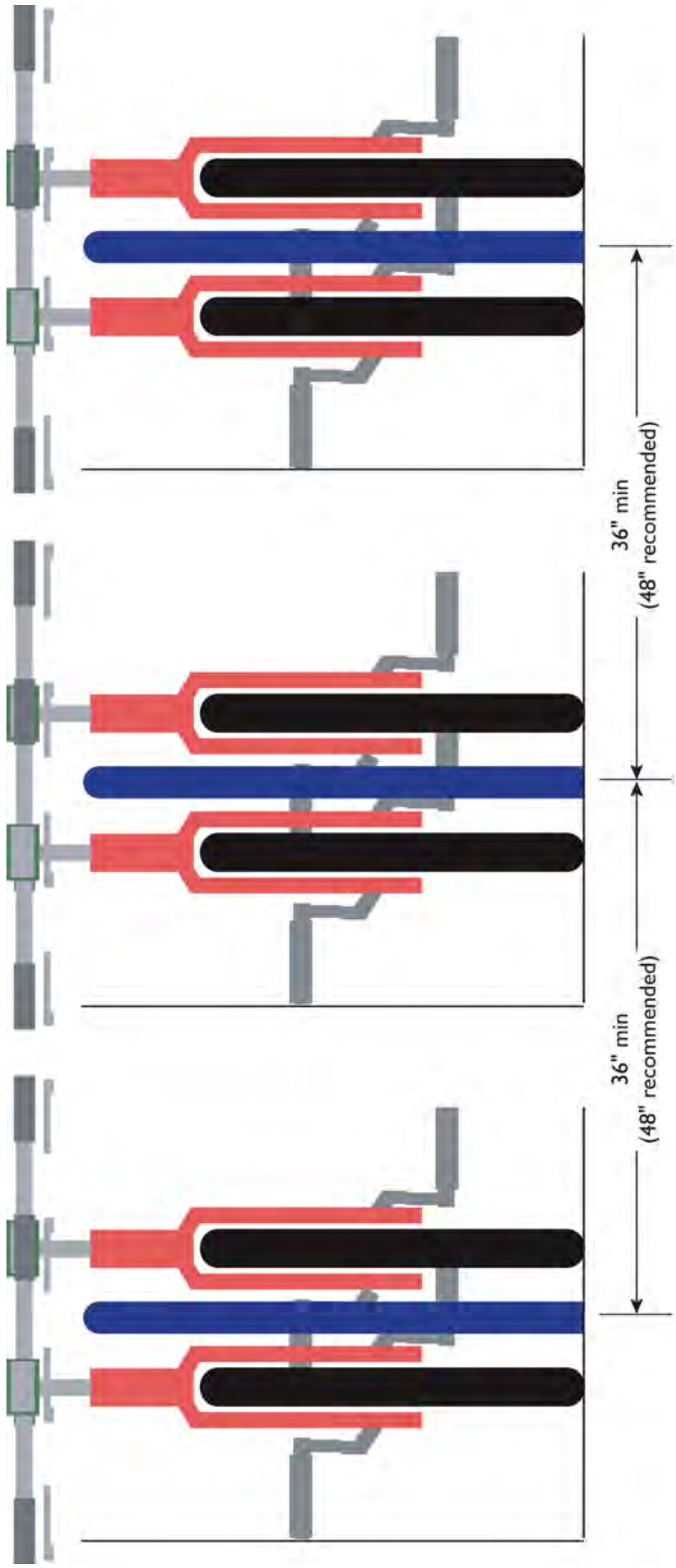


Figure 2-22: Sample layout, racks parallel to curb

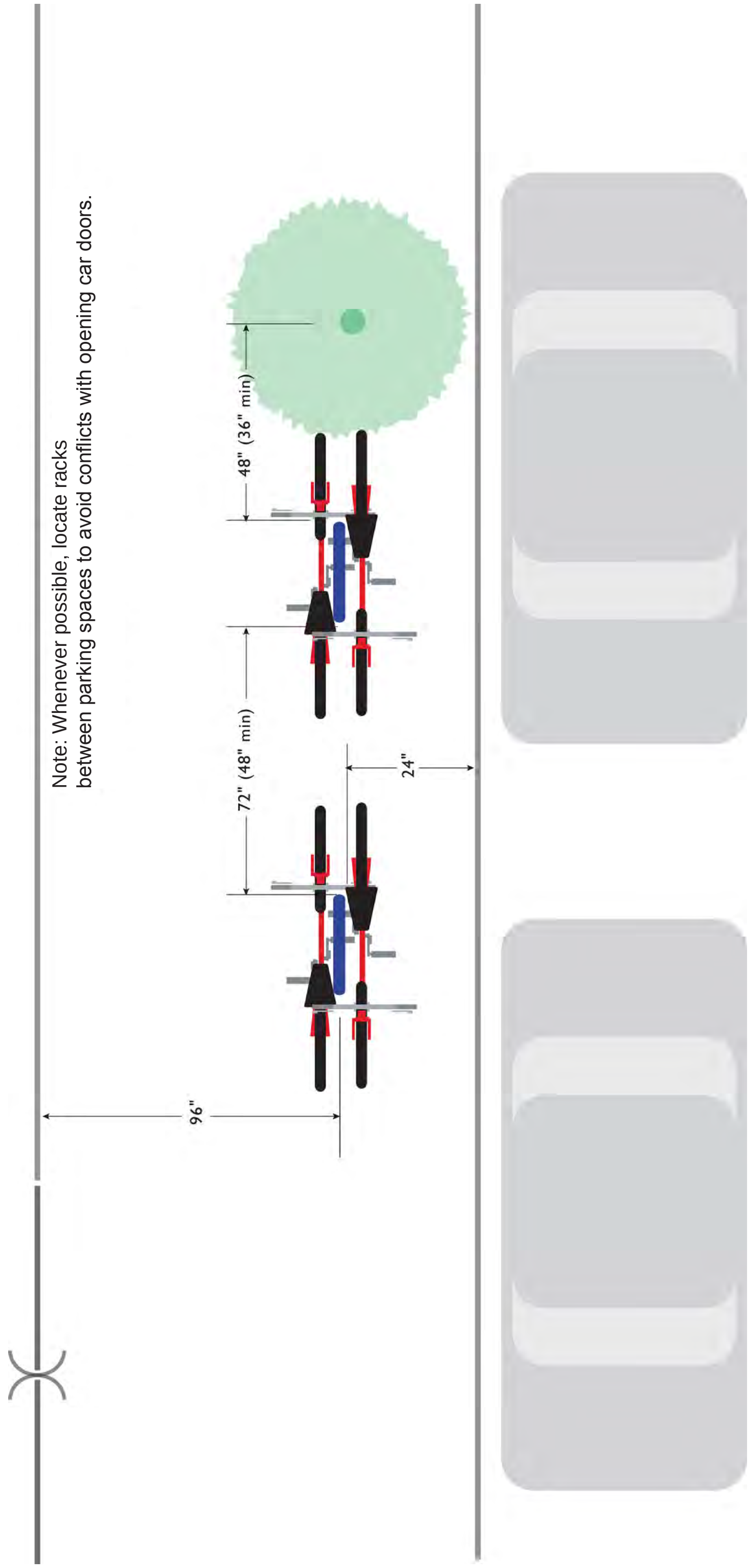


Figure 2-23: Sample layout, racks perpendicular to curb

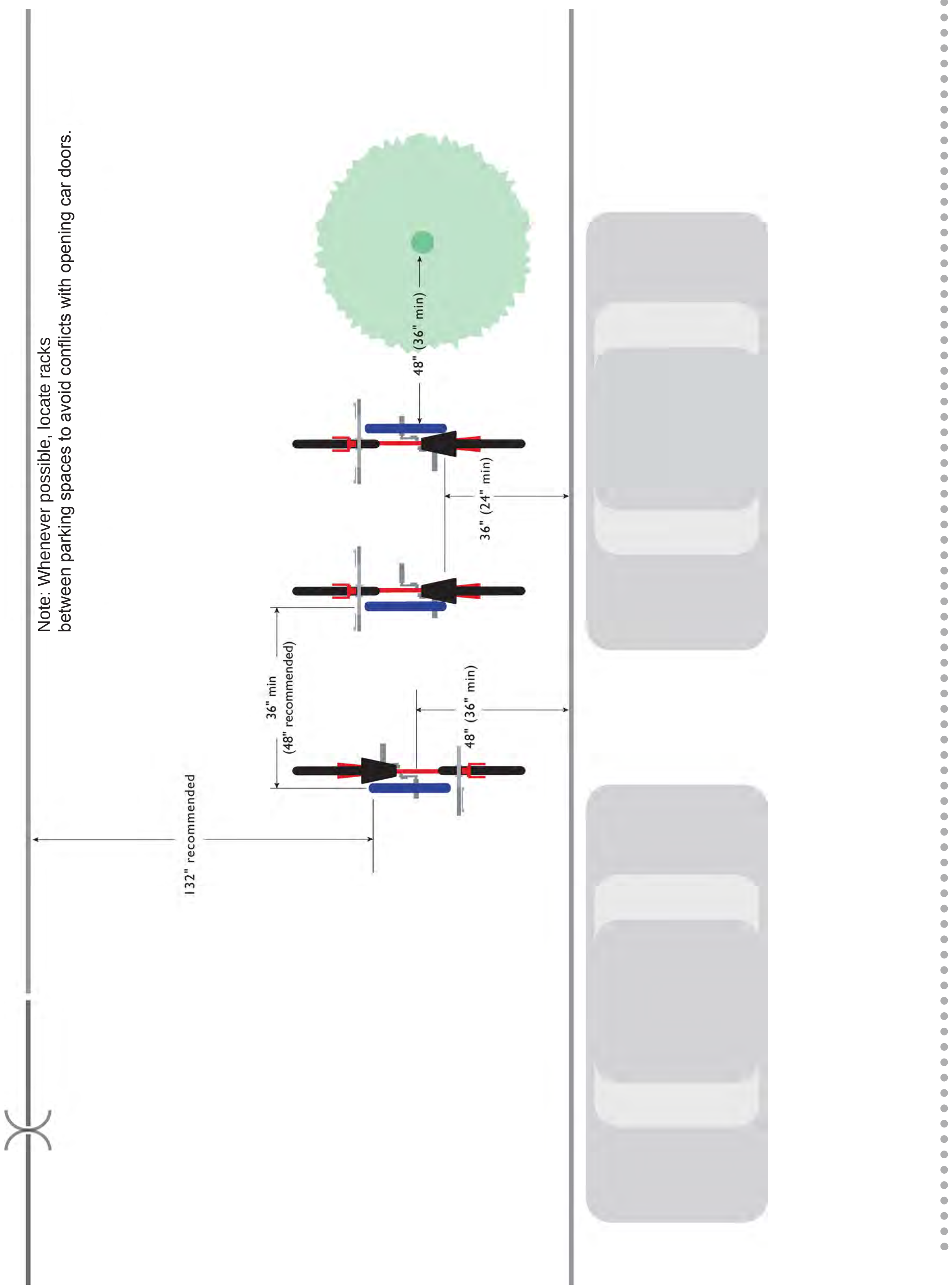


Figure 2-24: Sample ADA-compliant sidewalk rack site plan in bus stop area

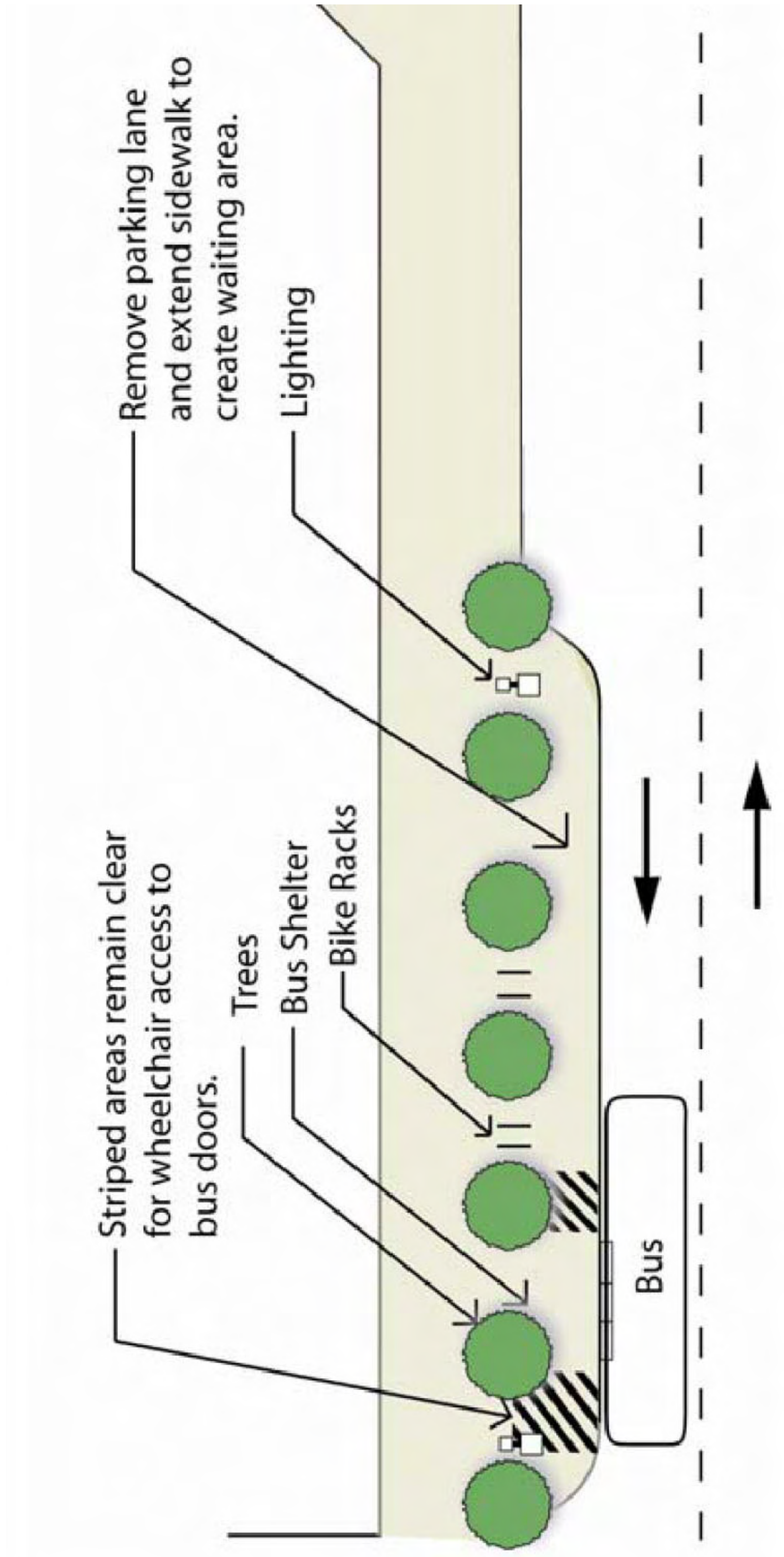


Figure 2-25: Sample bicycle parking lot layout

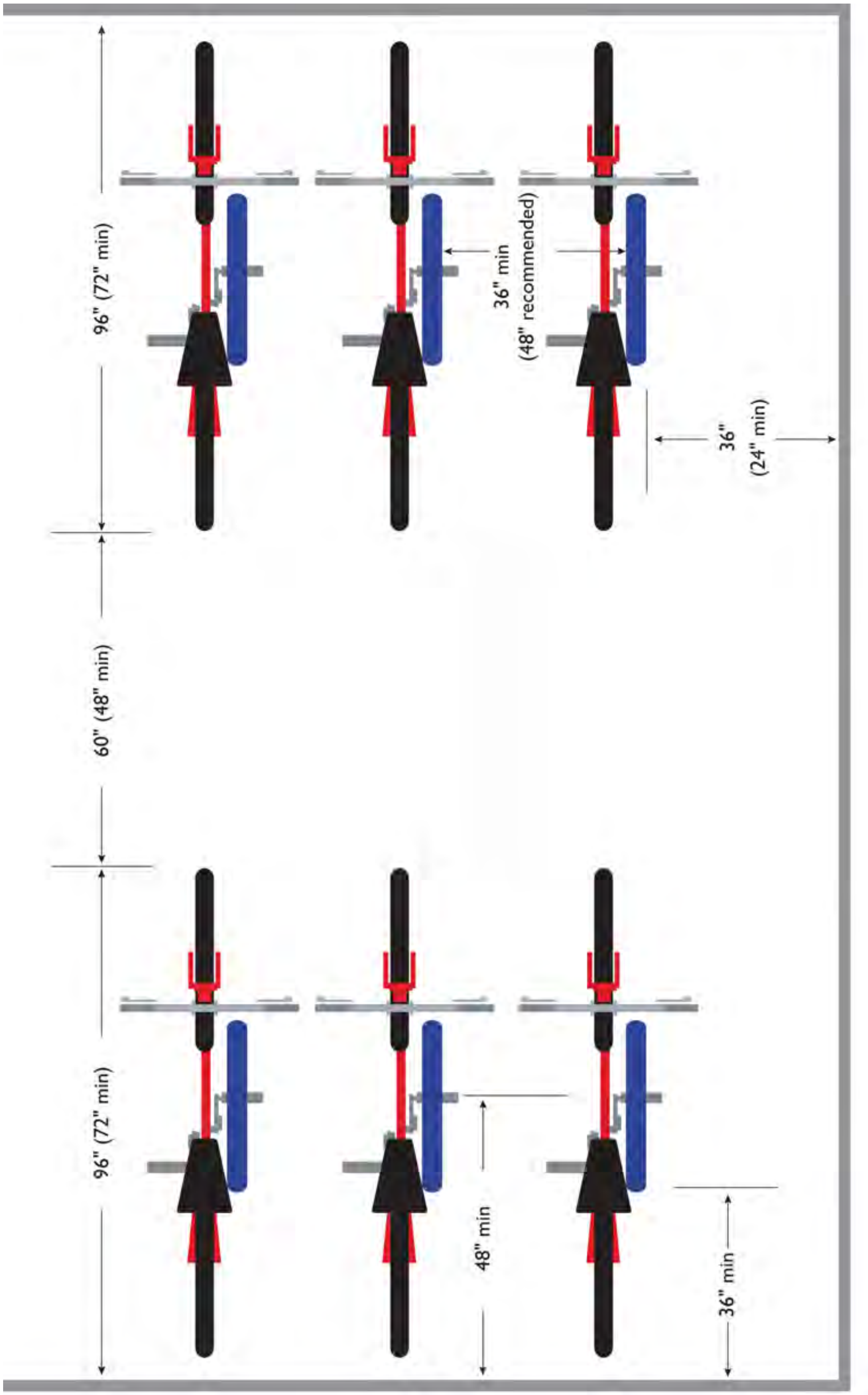


Figure 2-26: Sample transit station area rack layout

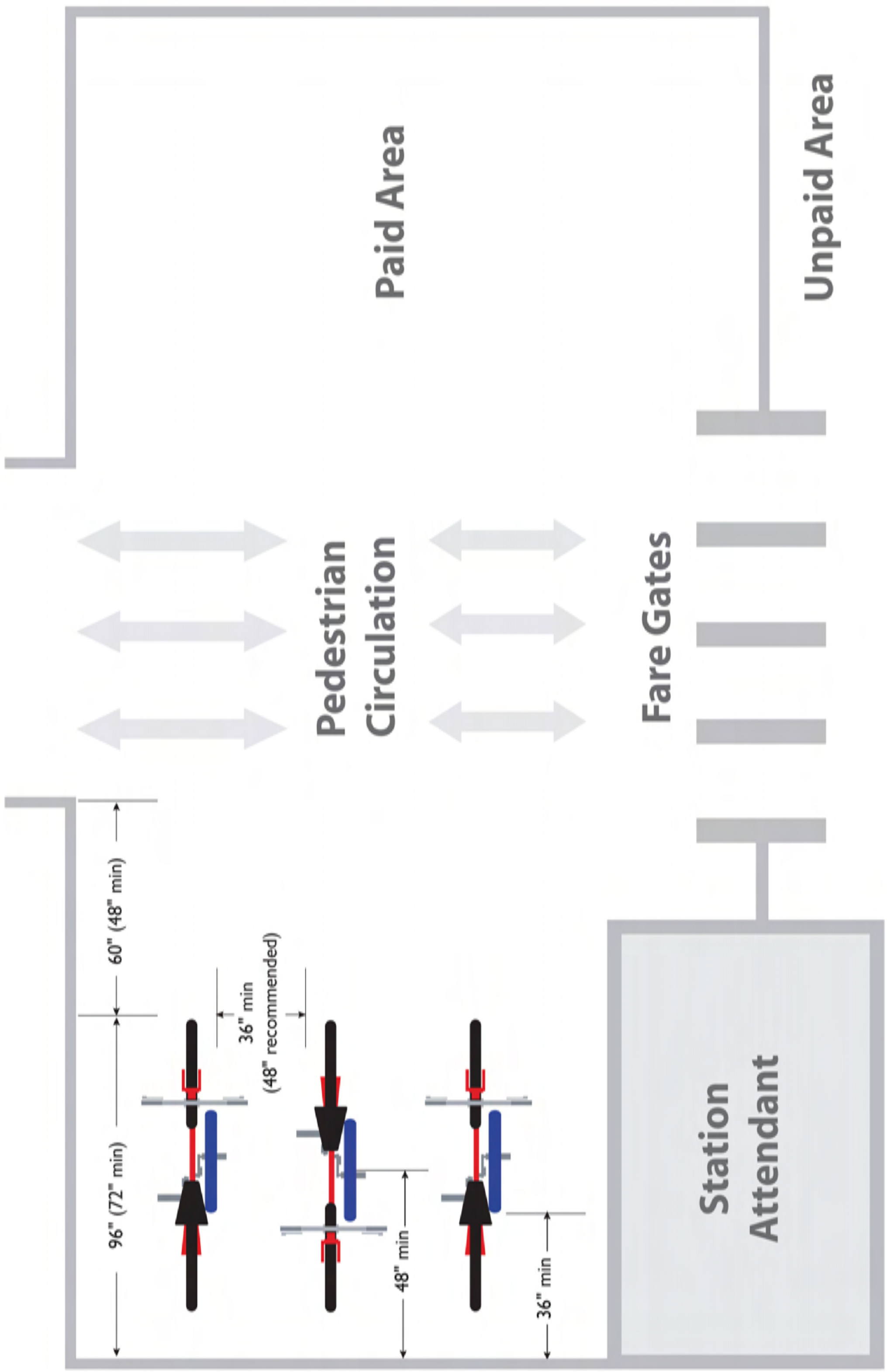
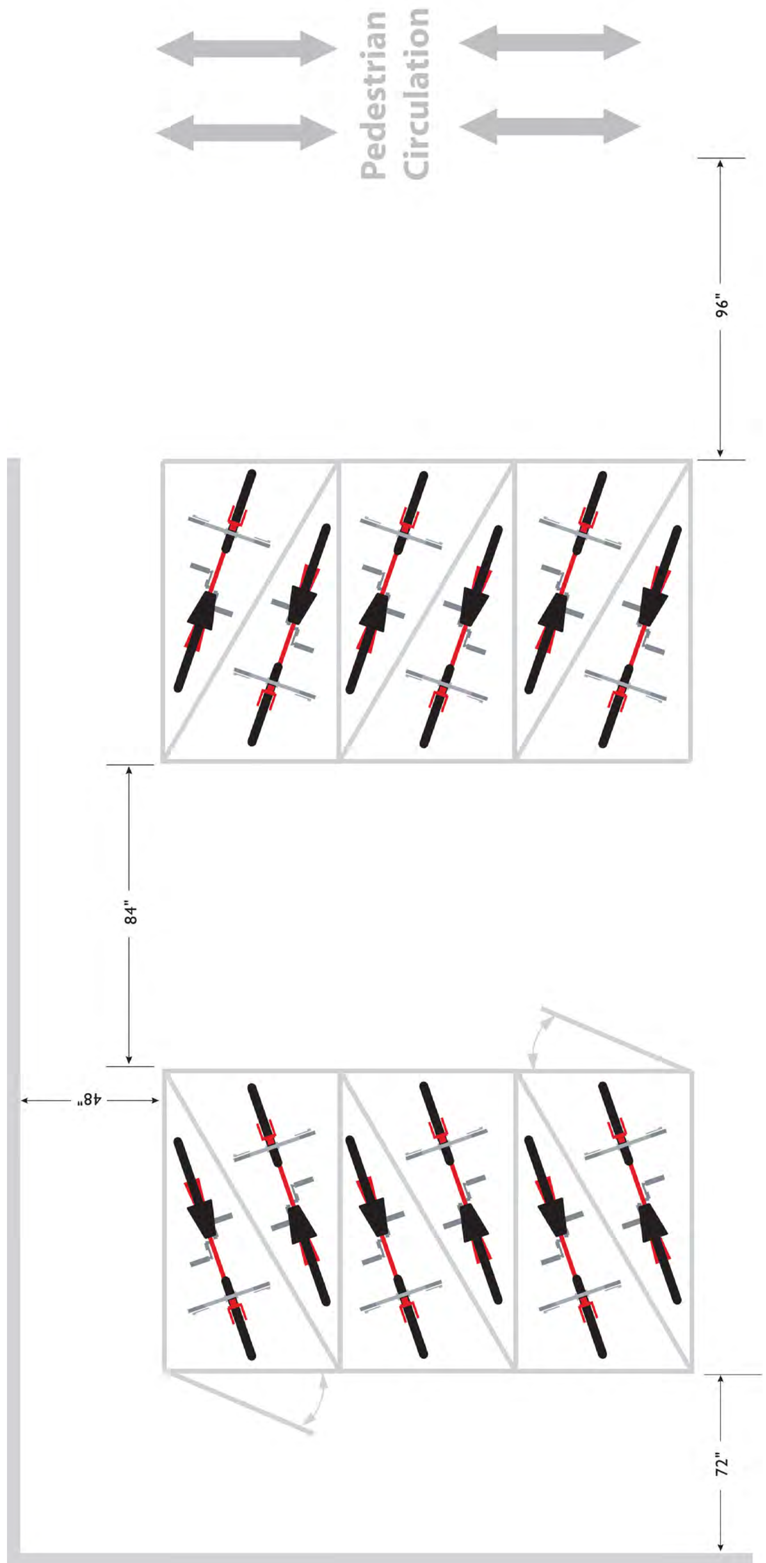


Figure 2-27: Sample bicycle locker site layout



SPECIAL CASES

Event Bicycle Parking

Providing attended or unattended temporary bicycle parking areas at events ranging from street fairs and inaugurations to major league sport games and Olympic competitions can benefit event operations and promotions in several ways. It can:

- Significantly reduce the number of motor vehicle trips generated by the event.
- Encourage individuals, couples and families to enjoy bicycling to the event, creating a community experience they will wish to repeat.
- Reduce random locking of bicycles around the venue.
- Reduce the number of bicycles being walked through crowded spaces such as street fairs.
- Raise the visibility and acceptance of bicycling for transportation.

Figure 2-28: Special event bicycle parking (photo: East Bay Bicycle Coalition)

There are three types of event bicycle parking operations, differentiated by whether the parked bicycles are monitored and whether the bicycle is parked and retrieved by the owner or an attendant:

Table 2-5: Types and characteristics of event bicycle parking operations

Operation	Parking and Retrieval	Monitoring	Bicycles Locked?	Suitable Racks
Valet	Attendants	Attendants	No	None (kickstands or lean-to). Collapsible stands (transportable by bicycle trailer, car, or truck). Otherwise obsolete metal racks that support bicycles but don't enable frame locking. Conventional outdoor racks that enable frame locking.
Attended (Self-park)	Owners	Attendants	Advisable (owner brings lock)	Otherwise obsolete metal racks that support bicycles but do not enable frame locking. Conventional outdoor racks that enable frame locking.
Unattended	Owners	None	Yes	Conventional outdoor racks

Valet

Valet and attended (self-park) operations use outdoor bicycle corrals with an enclosed perimeter or designated indoor rooms. The bicycle area has a single access point staffed by attendants, and a claim-check system using rolls of paired numbered tickets such as those used typically for raffle drawings. In valet operations only the attendants may enter the corral – the motto is "we park it, we watch it". Aisle width can be minimized if valets are adept at wheeling bicycles and accessing the racks.

Figure 2-29: Valet event bicycle parking (photo: John Ciccarelli)

Attended (Self-park)

In an attended (self-park) operation the bicycle owner parks the bicycle after attaching the bicycle half of the numbered ticket pair. Although attendants check claim tickets when bicyclists exit, bicyclists are encouraged to bring locks, and the racks in the corral, as a minimum, should enable cable locking. Aisle widths should be generous (five to six feet) to handle peak arrival and departure flows and to allow bicycles to be walked past users who are still parking or retrieving their bicycles. Attended parking can accommodate large numbers of bicycles. For example, at Stanford University's home football games, four large corrals each staffed by two attendants have stored as many as 1,500 bicycles.

Unattended

Unattended operations provide only a temporary bicycle rack area, often set up in a parking lot or on a temporarily closed street segment. Parked bicycles are not monitored except by other bicyclists. Bicyclists are expected to bring a standard lock and the racks should meet all the requirements for quality short-term bicycle parking except for anchoring. Enclosing the area with temporary fencing is encouraged, as this may deter bicycle and accessory theft by eliminating walk-throughs from random directions. If enclosed, the area should have a single access point, or perhaps two if there are high arrival and departure volumes.

Figure 2-30: Unattended event bicycle parking (photo: Carolyn Helmke)

Racks and Fixtures

Several bicycle advocacy organizations including the East Bay Bicycle Coalition and Sacramento Area Bicycle Advocates have fabricated lightweight multi-bicycle supports that ship knocked-down on large bicycle cargo trailers. In Portland, Ore., a local business has created a collapsible, truck-transportable rack and offers event bicycle parking services by arrangement.

Sheltered Bicycle Parking

On-sidewalk sheltered bicycle parking (sometimes called a bicycle oasis) has been installed in a number of North American cities as a win-win solution benefiting both cyclists and pedestrians. Such parking is typically installed on a curb extension, often at the corner. This location has the benefit of moving the bicycle racks out of the pedestrian path of travel and also functions as traffic calming, shortening the pedestrian crossing distance and improving pedestrian visibility. Kiosk shelters can provide information and resources such as bicycle route maps. Kiosks can also generate revenue through placement of bus shelter-type advertising.

Figure 2-31: Victoria, B.C. placed a standard bus shelter on a curb extension (photo: John Luton, Capital Bike & Walk)

Covered bicycle parking facilities are extremely attractive options for cyclists, particularly those in rainy climates. Unfortunately the cost and space requirements to install covered facilities have made them rarities in the urban landscape. Guidelines for identifying locations for covered parking follow the same rules of thumb as other sections in this chapter, but the addition of a roof requires additional considerations, such as roof span, setbacks and clearances, local and federal guidelines, and lighting and signage.

Roof Span

The shelter should be deep enough to provide sufficient shelter for the length of the bicycles, ideally a minimum of eight feet. This suggestion will vary depending on the height of the roof. The footings to support a roof generally require a purpose-built curb extension. Some vendors have introduced prefabricated shelters which store bicycles vertically and thus require a much smaller footprint.

Figure 2-32: New York City project to install 37 new covered bicycle shelters around the city using standard bus shelter design (photo: AllWaysNYC.com)

Figure 2-33: Portland, Ore. bicycle oasis (photos: Eric Anderson)

Setbacks and Clearances

Local setback requirements will vary by city. Locating a shelter will require considering the setback from the curbline, ensuring adequate pedestrian through way clearance, overhead clearances, and visibility clearances at intersections. Account for any visibility conflicts with adjacent stop signs in the facility design.

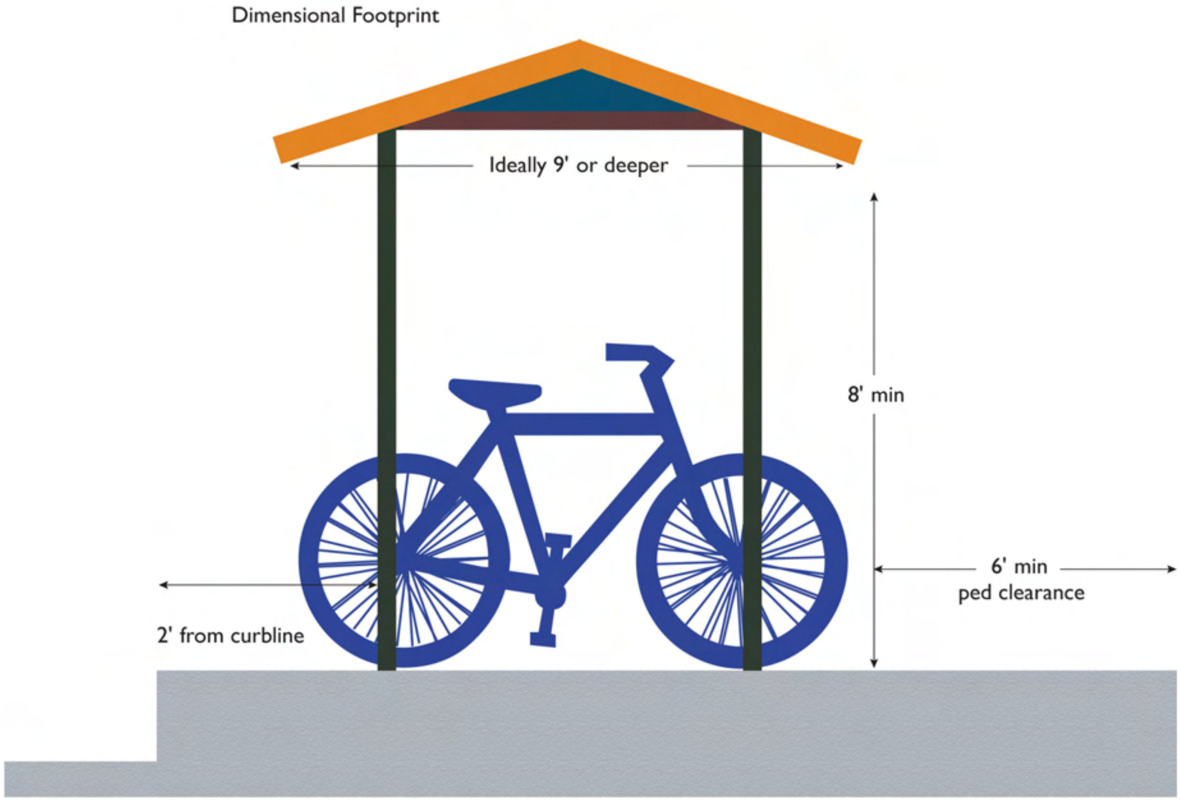
Local and Federal Guidelines

The installation of any shelter in the public right of way will need to comply with local building code requirements, require a detailed review by city structural engineers, compliance with federal Americans with Disabilities Act (ADA) guidelines, and possibly, take into consideration stormwater impacts.

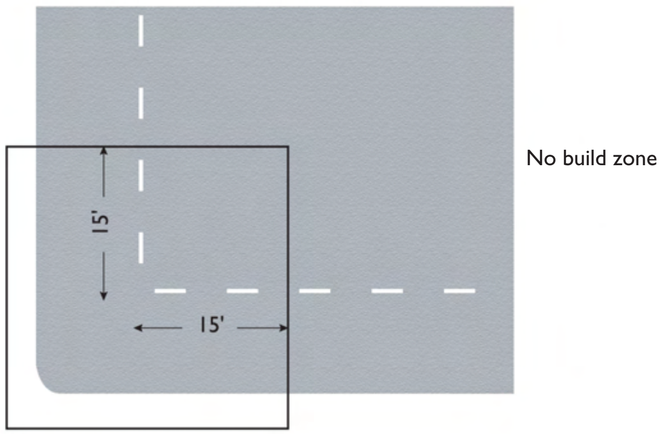
Lighting and Signage

Inadequate lighting of a shelter may be a safety concern, particularly at night. Some designs have installed glass roofs to allow overhead street lighting to illuminate the parking area. Many shelter designs take advantage of side or back panels to display local information, such as bicycle or pedestrian maps. If graffiti is a problem in the vicinity, the design may want to avoid broad, flat surfaces which could be a target.

Figure 2-34: Sample clearance guidelines, City of Portland, Ore.



For maximum visibility, do not build structure within 15 feet of corner property line.



In-street Bicycle Parking Facilities (Bicycle Corrals)

An alternative method for providing greater quantities of short-term bicycle parking is to consolidate the racks which would typically be placed on the sidewalk and locate them in the traditional auto on-street parking lane, along the curb. This approach is commonplace in European cities with high bicycle mode share and is rapidly gaining support in the United States.

Figure 2-35: Ace Hotel, Portland, Ore. (photo: City of Portland, Ore.)

Before deciding that in-street bicycle parking is an appropriate solution for a particular community, factors such as street sweeping and snow removal should be considered. While maintenance agreements can provide some level of street debris removal, snow belt communities should consider how in-street parking will fit into snow removal and storage plans before implementing this parking type.

The design of on-street bicycle parking, sometimes referred to as corrals, will vary widely between cities as each municipality accommodates their specific traffic engineering requirements, safety concerns, weather, and aesthetic goals.

Why? Articulating the Community Benefits

On-street bicycle parking is particularly attractive for commercial corridors where the high demand for bicycle parking begins to crowd available space within the sidewalk right-of-way. Depending on sidewalk width, this typically occurs when parking for 10 or more bicycles is desired.

The removal of bicycle racks from the sidewalk and consolidation of racks in a designated facility on the street provides many community benefits:

- For businesses: Corrals can provide on average a ratio of eight customers to one parking space and advertise their bicycle-friendliness. They also improve the outdoor café seating environment by removing locked bicycles from the sidewalk.
- For pedestrians: Corrals clear the sidewalks and serve as *de facto* curb extensions.
- For cyclists: Corrals increase the visibility of bicycling.
- For vehicle drivers: Corrals improve visibility at intersections by eliminating the opportunity for larger vehicles to park at street corners.

Figure 2-36: Inverted U racks are welded in clusters of three onto steel tracks in order to affix to an asphalt surface (photo: Jonathan Maus, BicyclePortland.org)

Where? Choosing the Right Location

Identifying the ideal location for a corral is a question of balancing various factors. Locations are identified through consultation with business associations when feasible. Maintenance agreements are signed between businesses and the city to ensure corrals are debris-free. Other elements to consider are convenience, street corners, main streets, and traffic operations and street amenities.

Convenience

The facility should be located as close as possible to the entrances of high demand locations. On dense commercial corridors it is likely that a corral will usually benefit a cluster of businesses, however in most cases customers are unlikely to park their bicycle more than 100 feet from their destination.

Street Corners

Locating corrals on corners will provide greater visibility benefits for pedestrians and improve cyclist access to the facility. Cyclists benefit from improved access to the corral, as mid-block locations can be difficult to enter with adjacent parallel parked cars. Exiting cyclists are also easier to see when the corral is not concealed between a row of parked cars.

Main Streets

It is tempting to recommend locating corrals on side streets, to move the corral away from higher traffic volumes and to avoid taking premium auto parking spaces away. However, when possible, bicycle parking should be situated on the main street. Locating corrals along the main street makes the corral easier to find for cyclists, generally reduces distance to main entrances, improves visibility of business facades, and creates the most benefits for pedestrians.

Traffic Operations and Street Amenities

Bus stops, fire hydrants, turning bus movements, location of manholes and sewer valves, parking meters, and even adjacent landscaping may be obstacles when identifying a location. Care must be taken not to locate corrals in street areas subject to flooding or deep water during rain storms.

How? Developing a Design

A corral is composed of the following elements: the bicycle racks, a method of demarcating the parking area, and signage.

Rack Choice

Single inverted-U racks bolted to an asphalt surface can be easily dislodged over time or by a persistent vandal. One successful method for installing racks to an asphalt surface is to use racks welded to steel rails in clusters of three or four.

Bicycle Orientation

Most on-street auto parking lanes are 7.5 to 8 feet wide. By angling bicycle racks at a 60 degree angle the depth of a 6-foot bicycle is reduced to 5 feet, providing a greater buffer between moving traffic and the bicycle's wheel. Orienting racks perpendicular to the curb provides less room between the edge of the bicycle and the travel lane; however this layout accommodates a slightly greater number of bicycles within the available space. In cities where longtails, trailers and cargo bicycles are more prevalent, consider orienting the bicycles parallel to the curbline.

Dimensions

Spacing racks at 36 inches on center allows greater convenience for cyclists parking their bicycles, particularly with the wide variety of handlebar styles and in areas where cyclists are using various types of panniers. When racks are placed on an angle, handlebar conflicts are minimized and spacing between racks can be reduced. A minimum of 36 inch spacing on center is also recommended for racks on a 60 degree angle. See figure 2-44.

A minimum of a 5-foot maneuvering zone on either end is recommended to give cyclists an entry or exit zone. This space can be used for cyclists to orient themselves before merging with traffic or wait for others in their riding party. It should be noted that maneuvering zones can be tempting for illegal motorcycle or scooter parking in congested areas.

Perpendicular and angled spaces can be successfully modified for on-street bicycle parking. Spaces at street corners are preferred to improve access and visibility.

Demarcation

Methods for delineating the bicycle parking area will vary based on conditions in each city. The appropriate solution will depend on the following considerations:

Flexibility versus Permanence

Pavement markings and prefabricated racks which bolt to the road surface are easy to remove for road maintenance or modifications such as incremental increases to meet increasing demand. Concrete pads and bollards provide greater protection from road dangers but are permanent road modifications that reduce ability to make future modifications.

Cyclist Access and Safety

Safety of users is a critical design component. Parking areas should be set back from travel lanes, occupying a maximum width equal to an 8-foot parking lane. Although main commercial streets are the preferred location, low roadway speed limits, low truck or bus traffic and low parking turnover are all factors which contribute to cyclist safety when accessing the parking area. The 5-foot maneuvering zone on either end of the parking area helps improve cyclist circulation and access by providing a safe dismount area.

Figure 2-37: Berkeley, Calif., has built accessible and attractive facilities with a concrete surface and stylized bollards. (photo: Heath Maddox)

Protection

Some corral designs emphasize a physical barrier between the travel lane and parked bicycles, such as poured concrete curbs or bollards. The necessity of a physical barrier such as a bollard will be based on traffic speeds and safety. In some cities introducing fixed objects in the right of way may not be permitted if they are viewed as a safety concern for drivers. Elements like bollards can be designed to be breakaway, thus providing a visual deterrent to drivers. Less costly but visually not as attractive, reflective flexible stanchions can also serve this purpose.

Figure 2-38: Concrete curbs are used to encourage entry from the sidewalk and protect bicycles (photo: City of Seattle, Wash.)

Consider the following costs when deciding on barriers:

	Min $	Mid $$	Max $$$
Minimum Barrier	Pavement markings	Rubber curbing, reflective wands	Concrete pad
Maximum Barrier	Prefabricated on-street racks	Poured concrete curbs	Concrete pad and bollards

For facilities that rely only on pavement markings to define the parking area, a physical barrier to discourage adjacent parallel parking vehicles from advancing too close is recommended. This could be a 4-foot rubber or cement parking block, reflective flexible stanchions, or bollards along the side adjacent to vehicle parking.

Visibility of Corral

Increasing the visibility of a corral is an important safety consideration as well as an aesthetic component. Various methods can provide day and night time visibility, including vertical elements, reflective material, bright colors, and placing corrals at street corners where adjacent auto parking does not conceal exiting cyclists. Visibility can either enhance or detract from the facilities' attractiveness.

Figure 2-39: Pavement legends designate the cyclist dismount area and circulation pattern. (photo: City of Portland, Ore.)

Figure 2-40: On-street bicycle parking sign, Bijou Café (photo: City of Portland, Ore.)

Figure 2-41: In-street bicycle parking with flexible bollards in Portland, Ore. (photo: Eric Anderson)

Making It Happen

Based on the successes in communities in North America, the following steps are key to developing a successful in-street parking program:

1. Adopt design guidelines (such as the best practices in this guide): Design guidelines should be officially adopted by the city council or another group of elected officials.
2. Create city policies (maintenance and liability): Consistent policies for maintenance and liability are an excellent tool when working with the community and local businesses and help to address concerns about adding to a city's maintenance burden or liability exposure.
3. Choose locations based on merchant requests. The most frequent objection to in-street parking is from merchants who perceive the loss of an automobile parking space as a threat to their livelihood. Seek out bicycle-friendly businesses.
4. Identify funding: Funding can be from local sources, project-by-project, or multiple sites can be bundled together for the purpose of larger grant applications.
5. Pilot locations which will succeed: Pick locations that are a guaranteed success, ones which have the strongest local support and will be the most heavily used. Picking sites with few if any design or installation challenges is also important to speed implementation.
6. Document outcomes: Before and after documentation should include bicycle parking utilization (bicycle counts) at the site as well as intercept or online surveys of cyclists, business patrons and business owners.

Figure 2-42: Sample bicycle parking corral layout, City of Portland, Ore.

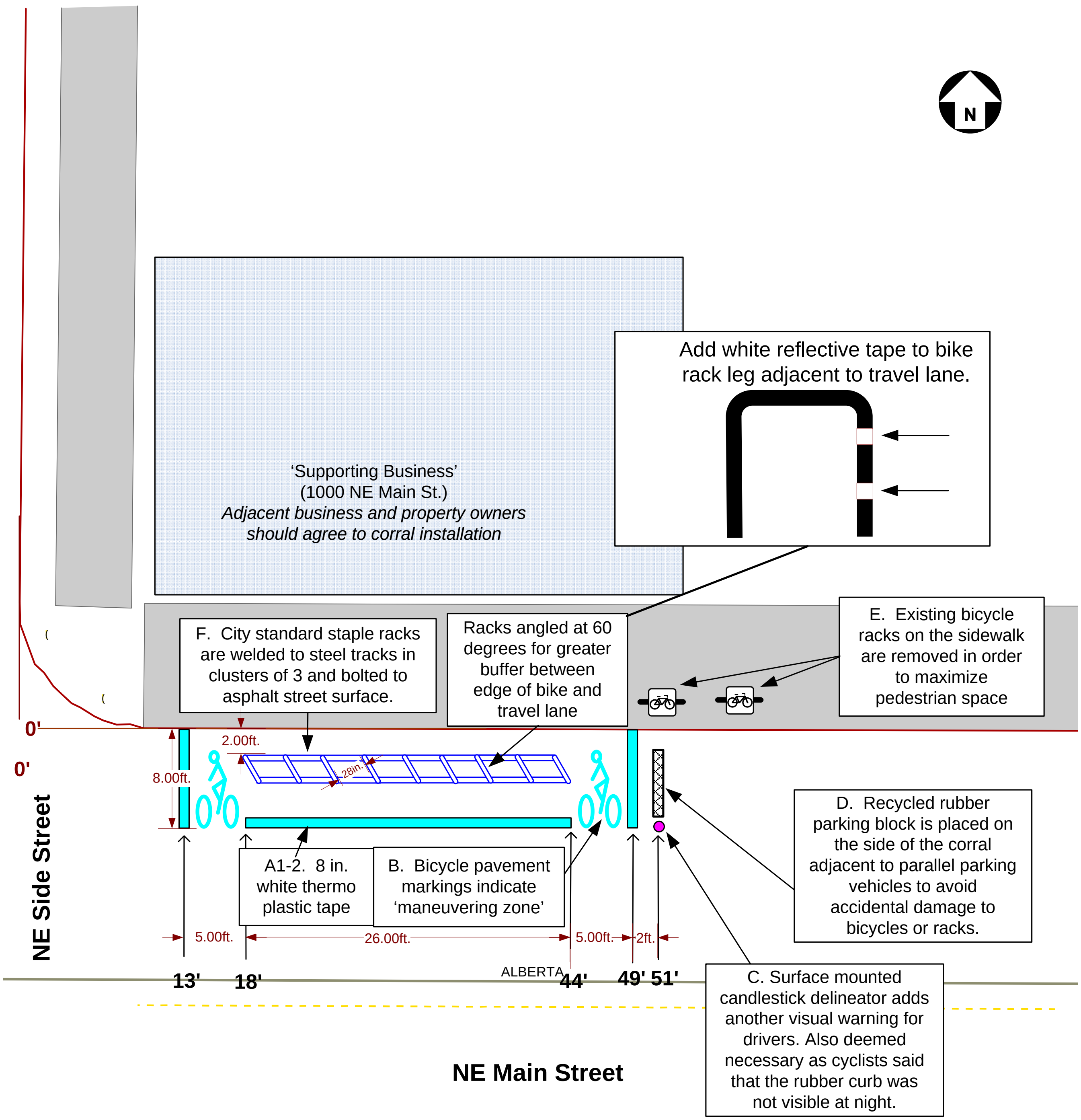


Figure 2-43: Sample perpendicular rack in-street parking layout

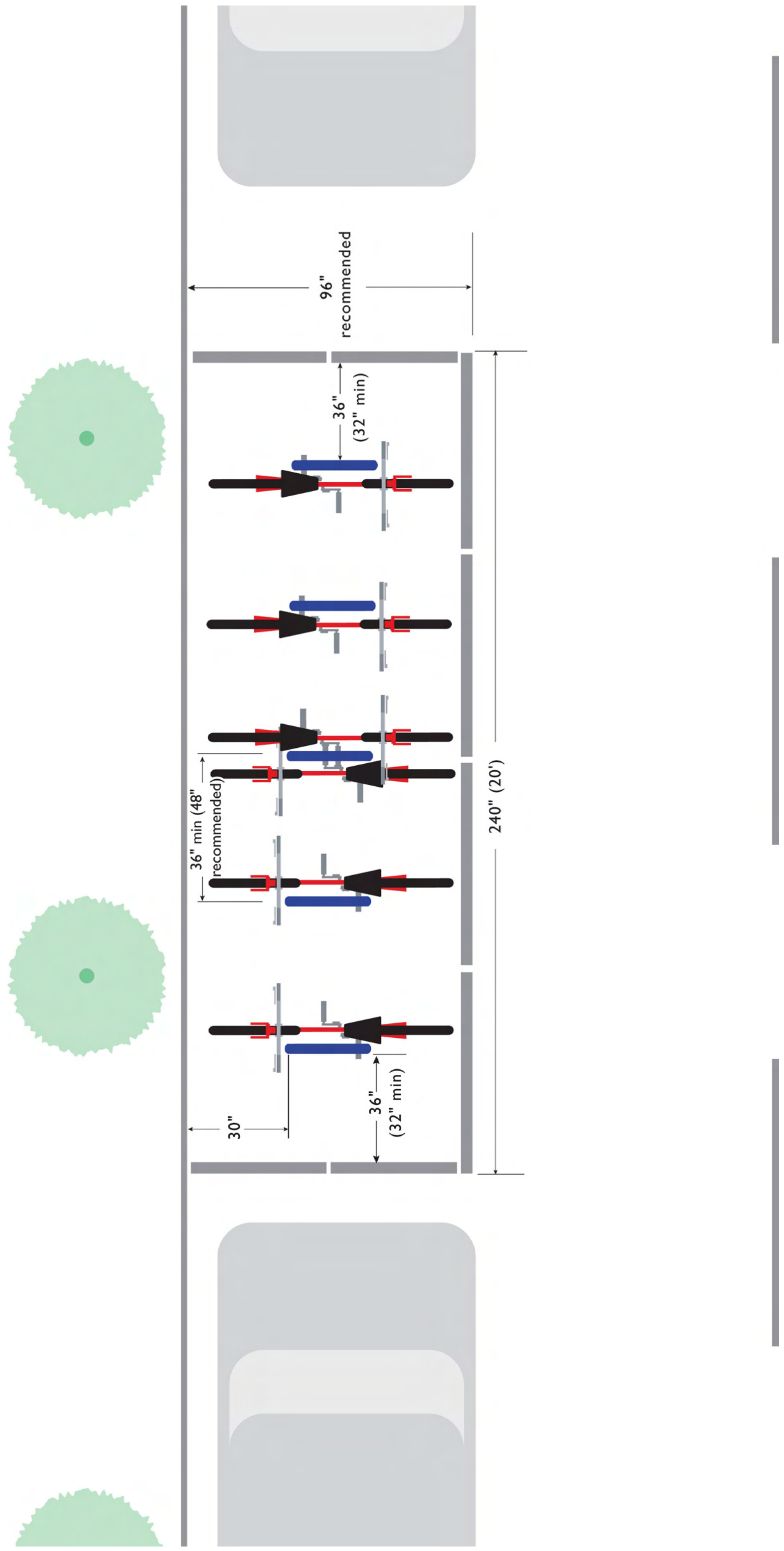


Figure 2-44: Sample diagonal rack in-street parking layout

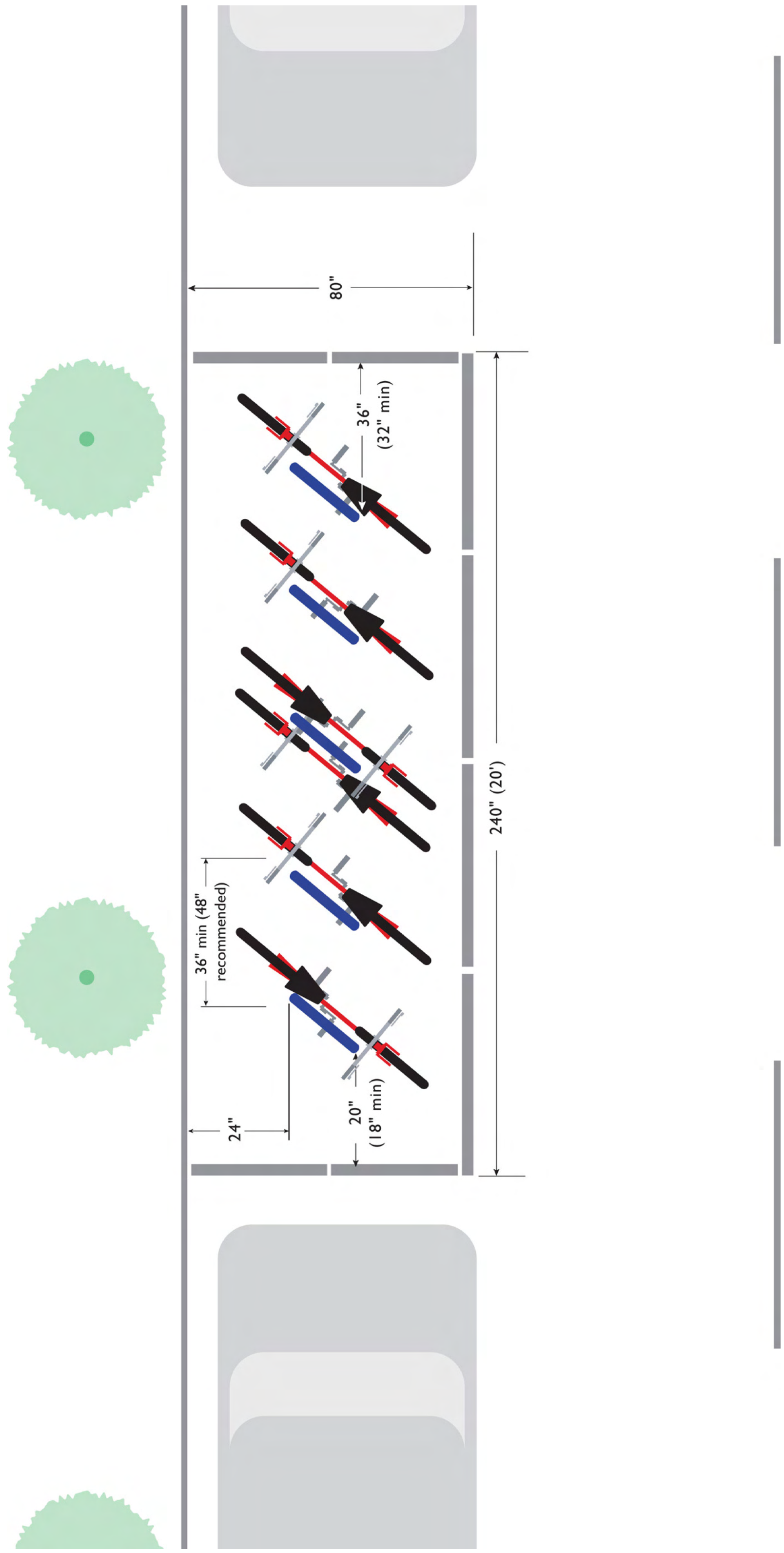
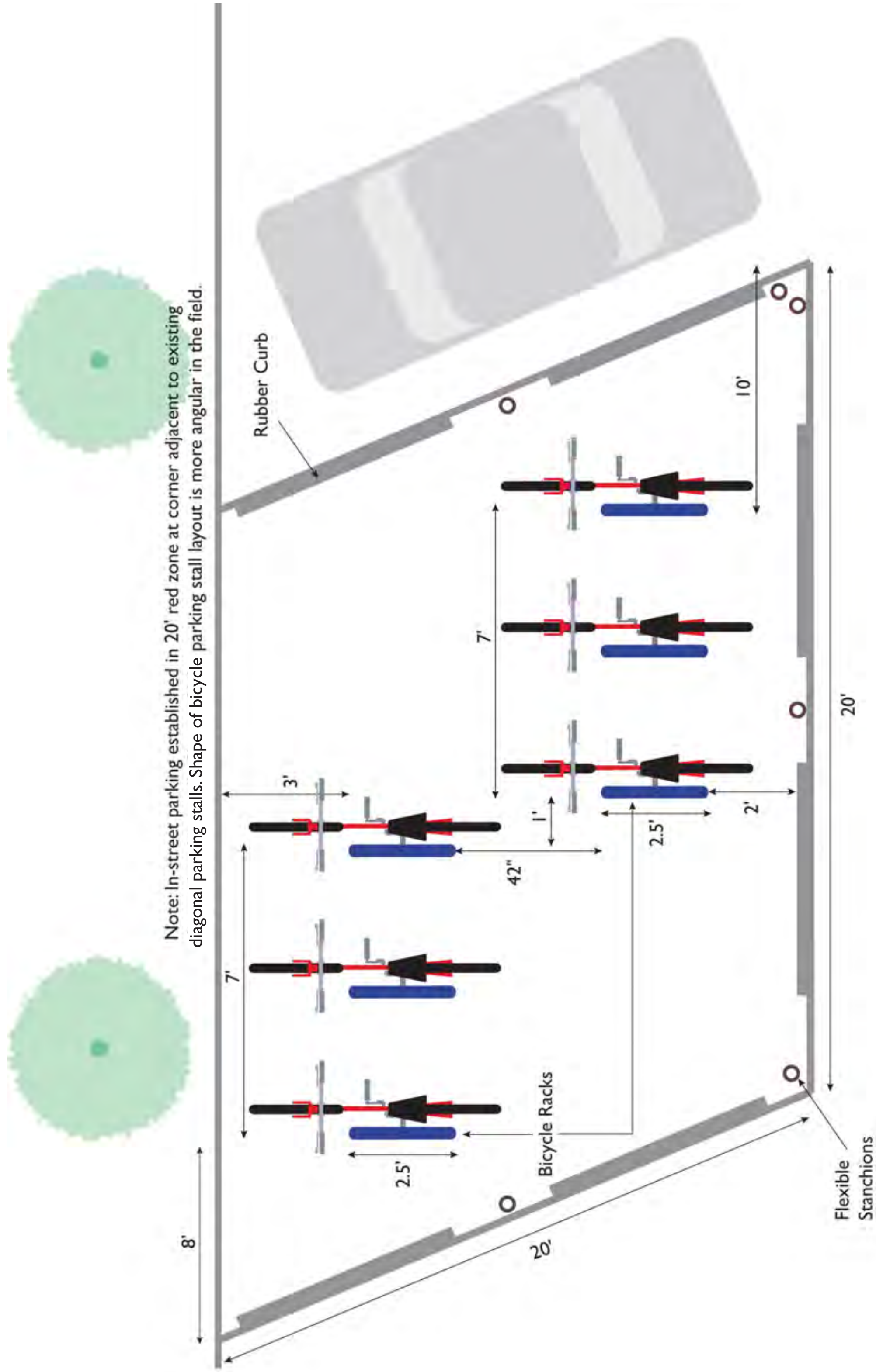


Figure 2-45: Sample in street diagonal parking stall layout, City of Berkeley, Calif.



Bicycle Transit Centers

Bicycle transit centers offer secure and weather-protected bicycle parking, typically located near major rail or bus hubs. Most bicycle transit centers offer free parking during their hours of operation, and paid memberships for 24-hour access to secure parking. In addition, each bicycle transit center location provides unique services and amenities. Bicycle transit centers sometimes offer:

- Shared-use bicycle rentals
- Staffed operating hours, often with valet parking
- Information to plan commute trips
- Bicycle repair
- Bicycle and commute sales and accessories
- Rental bicycles for local and tourist needs
- Shower/restroom/changing rooms
- Access to environmentally-clean vehicle-sharing.

Figure 2-46: This Seattle bicycle transit center offers secure bicycle parking as well as bicycle retail and repair services. (photo: John Luton, Capital Bike & Walk)

Bicycle transit centers have certain operating costs associated with leasing space and paying for staff time; therefore funding has been a challenge for some communities wishing to build such a facility. Some of the ways costs can be underwritten include automating parking through electronic access control, sharing operations costs with co-located, sometimes bicycle-related businesses (e.g. bicycle shops, cafes), and limiting staff hours or having staff perform multiple duties such as retails sales and bicycle repair, when not parking bicycles.

Read a case study at http://www.bicyclinginfo.org/library/details.cfm?id=3969

MAINTENANCE BEST PRACTICES

As with many bicycle parking practices, maintenance requirements vary according to the type of parking installed.

Short-term Parking

Short-term parking typically involves simple bicycle racks surface mounted on existing sidewalks or other concrete areas. As such, maintenance needs should be relatively minor. However, there are a few key maintenance activities which are important for local jurisdictions to observe.

Use Spike Anchors (tamper-proof)

Use of proper anchors will prevent vandalism and theft of the anchors themselves and help to ensure that racks cannot be removed by thieves or metal scrappers.

Inspect Racks and Anchors for Damage

Racks and anchors should be regularly inspected for damage. Damaged anchors can be replaced by grinding off the anchor head and pounding in a new anchor, pushing the old anchor shaft into the ground below the rack. Damage to racks is less common; however some thieves have been known to score or partially cut bicycle rack tubing, then wait for theft-worthy bicycles to be locked up. A partially cut section of bicycle rack tubing can be fairly easily knocked loose with a small hammer, which allows the bicycle to slide off the rack.

Method for Repainting and Touch-ups

Jurisdictions using painted or coated racks should plan to touch up the racks either regularly or as needed. In other cases, the contractor or street crews which install new bicycle racks carry touch-up paint and check all racks on the same block, touching up any damaged finishes. Some cities have accomplished this by repainting along with other street furniture such as metal benches, trash receptacle holders and light poles. However, it should be noted that finish maintenance requirements for colored bicycle racks are substantially greater than light poles and benches, as those items are not repeatedly bumped with metal objects such as bicycle frames and bicycle locks. Upkeep of some finishes on painted or colored bicycle racks can be a serious maintenance burden.

Figure 2-48: Round tubing bicycle racks are vulnerable to pipe cutters. (photo: Eric Anderson)

Figure 2-47: Damaged bicycle rack; Chicago, Ill. (photo: Eric Anderson)

Figure 2-49: Sample of an abandoned bicycle notice (photo: Eric Anderson)

Abandoned Bicycle Removal

Abandoned bicycles (those missing major parts or with flat tires and rusted chains) are a visual nuisance and discourage other cyclists from using the bicycle parking. A typical abandoned bicycle practice involves posting a notice on the bicycle at least two weeks in advance of removing the bicycle. The notice should state that the bicycle will be removed by a certain date and provide the name and contact information for the person to contact in case the bicycle is mistakenly identified as abandoned. Abandoned bicycles can often be donated to local nonprofits, many of which work with disadvantaged youth on after-school and skills training programs. Jurisdictions with a bicycle rack request process should also integrate requests for abandoned bicycle removal into that process.

Snow Removal

Special snow removal efforts may be needed to ensure the usability of bicycle racks during winter months. Many jurisdictions use the planting strip or buffer zone of the sidewalk as *de facto* snow storage areas. Educate snow removal crews about the importance of bicycle racks and to avoid burying racks whenever possible. As with sidewalk shoveling requirements, cities may consider making snow removal around bicycle racks a requirement for winter maintenance of commercial frontage.

Long-term Parking

Long-term parking typically involves bicycle racks located in secured areas or bicycle lockers. In addition to the maintenance needs of simple bicycle racks identified above, long-term parking areas have the following additional maintenance concerns.

Check Functioning of Moving Parts (locks, hasps and hinges)

Unlike simple racks, bicycle cages, bicycle rooms and lockers all involve moving parts which can fail over time or can be vandalized. It is recommended to regularly inspect such items. Jurisdictions installing bicycle lockers should consider the skills and materials necessary to make repairs when damage or failure occurs. Most locker manufacturers will provide replacement parts to customers and some will offer extended warranty maintenance agreements for an additional fee. In some cases the implementing agency will need to train maintenance staff to make repairs.

Change Keys or Codes Periodically

Parking cage and locker subscribers often lose keys and may pass along access codes to other unapproved users. This is undesirable for obvious reasons, but in particular because the security of shared-secure parking depends on limiting access to a consistent, reasonably trustworthy user group.

Check Condition of Enclosures

As with moving parts, many long-term parking areas employ fencing or shelters to provide security and weather-protection, respectively. Inspect fencing for damage, vandalism and cutting. Cut fencing which is not noticed can be used for easy access by thieves. Although it is not a security risk, damage to shelters can defeat the purpose of providing weather-protection and should be repaired when discovered.

Ensure Security Lighting and Cameras are Working

Many long-term bicycle parking areas are not in highly trafficked areas. Security cameras and lighting are used to improve safety for users and security for their bicycles. Proper functioning of this equipment is essential and can provide valuable evidence in case a crime is committed.

Chapter 3 | Policies, Requirements and Codes

Bicycle parking policies, requirements and codes should be based on best practices and a city's bicycling potential. The following sample policies were developed with a survey of best practices in the United States and Canada, a review of academic research, and based on professional experience. Requirements are discussed in units of measurement and rates of required parking.

APBP recommends that bicycle parking policies and codes:

- Specify number of bicycle spaces by land use.
- Require long-term parking for all workplaces, transit stations and multi-unit residential.
- Require adequate short-term parking for other land uses.
- Provide site planning requirements.
- Provide rack and locker design requirements.

A definition of the following words is offered at the end of this chapter: code, policy, regulation, and requirement. See Appendix B for a sample methodology for programming bicycle parking quantities for a building or cluster of buildings.

UNIT OF MEASUREMENT

To identify the rates of bicycle parking, cities can use several different units of measurement including a percentage of auto parking, unit count, proportion of building square footage, and building occupancy. Because most American cities have followed policies that increase the overall supply of car parking, simple policies linking bicycle parking requirements to automobile parking requirements have been reasonably effective in many cases. However, bicycle parking requirements based on auto parking can pose problems. Auto demand and parking rates are not necessarily an indicator of bicycle parking need and the relationship between the two is not clearly understood. Looking to the future, if a city adopts automobile parking maximums or reduces parking requirements in an attempt to encourage other modes of transport, the amount of bicycle parking is also reduced, which is counterintuitive to the goal of promoting other modes, particularly bicycling.

Rates of bicycle parking based directly on unit count, the proportion of building square footage, and building occupancy are better indictors of demand. Additionally, these units of measurement are commonly used during plan check and can therefore be easily integrated into the planning process.

SAMPLE RATES OF PARKING

Rates of bicycle parking should meet current demand at a minimum, and should also meet goals for future mode share. The following policies are based on best practices in North America. The requirements are appropriate for cities with a current bicycle commute mode share between one and five percent.

Recommended policies are based on the following factors:

1. North American best practices
2. Bicycle mode share goal of five percent (commute trips)
3. U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) credit levels for alternative transportation
4. Bicycle ownership rates

In most cases, the following requirements meet the U.S. Green Building Council's LEED standards for one credit towards alternative transportation. LEED is a program designed to act as a sustainability measurement for building design and construction.

The following rates are minimums. Cities with bicycle commute mode shares above five percent should consider higher rates of parking, provided later in this section.

Some additional considerations:

- Additional bicycle parking could be used as a condition of approval for projects requiring a conditional use permit.
- Consider developing bicycle parking plans for neighborhood commercial districts to meet need in the public right of way.
- Review rates in conjunction with bicycle master plan updates or at least every five years.
- Square feet can be measured in gross square feet, net square feet, or whatever measure of square feet the local planning department uses.
- Whether required or not, develpers, owners and managers of privately owned commercial properties can benefit financially by providing convenient and secure bicycle parking for tenants, employees and customers.

SAMPLE BASIC PARKING REQUIREMENTS

The following bicycle parking requirements are suitable for use in a variety of community sizes in North America with varying levels of bicycle use.

Residential

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Single Family Dwelling	No spaces required.	No spaces required.
Multifamily Dwelling		
a) With private garage for each unit*	No spaces required.	0.05 spaces for each bedroom. Minimum is 2 spaces.
b) Without private garage for each unit	0.5 spaces for each bedroom. Minimum is 2 spaces.	0.05 spaces for each bedroom. Minimum is 2 spaces.
c) Senior Housing	0.5 spaces for each bedroom. Minimum is 2 spaces.	0.05 spaces for each bedroom. Minimum is 2 spaces.

* A private locked storage unit may be considered as a private garage if a bicycle can fit into it.

Civic: Cultural/Recreational

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Non-assembly cultural (library, government buildings, etc.)	1 space for each 10 employees. Minimum requirement is 2 spaces.	1 space for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.
Assembly (Church, theaters, stadiums, parks, beaches, etc.)	1 space for each 20 employees. Minimum requirement is 2 spaces.	Spaces for 2% of maximum expected daily attendance.
Health care/hospitals	1 space for each 20 employees or one space for each 70,000 s.f. of floor area, whichever is greater. Minimum is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum is 2 spaces.
Education		
a) Public, parochial, and private day-care centers for 15 or more children	1 space for each 20 employees. Minimum is 2 spaces.	1 space for each 20 students of planned capacity. Minimum is 2 spaces.
b) Public parochial, and private nursery schools, kindergartens, and elementary schools (1-3)	1 space for each 10 employees. Minimum requirement is 2 spaces.	1 space for each 20 students of planned capacity. Minimum requirement is 2 spaces.
c) Public parochial, and elementary (4-6), junior high and high schools	1 space for each 10 employees plus 1 space for each 20 students of planned capacity. Minimum requirement is 2 spaces.	1 space for each 20 students of planned capacity. Minimum requirement is 2 spaces.
d) Colleges and universities	1 space for each 10 employees plus 1 space for each 10 students of planned capacity; or 1 space for each 20,000 s.f. of floor area, whichever is greater.	1 space for each 10 students of planned capacity. Minimum requirement is 2 spaces.
Rail/bus terminals and stations/airports	Spaces for 5% of projected a.m. peak period daily ridership.	Spaces for 1.5% of a.m. peak period daily ridership.

Commercial

Commercial Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Retail		
General food sales or groceries	1 space for each 12,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 2,000 s.f. of floor area. Minimum requirement is 2 spaces.
General retail	1 space for each 12,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 5,000 s.f. of floor area. Minimum requirement is 2 spaces.
Office	1 space for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum requirement is 2 spaces.
Auto Related		
Automotive sales, rental, and delivery Automotive servicing Automotive repair and cleaning	1 space for each 12,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum requirement is 2 spaces.
Off-street parking lots and garages available to the general public either without charge or on a fee basis	1 space for each 20 automobile spaces. Minimum requirement is 2 spaces. Unattended surface parking lots excepted.	Minimum of 6 spaces or 1 per 20 auto spaces. Unattended surface parking lots excepted.

Industrial/Manufacturing

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Manufacturing and production	1 space for each 15,000 s.f. of floor area. Minimum requirement is 2 spaces.	Number of spaces to be prescribed by the Director of City Planning. Consider minimum of 2 spaces at each public building entrance.

SAMPLE BICYCLE PARKING REQUIREMENTS – URBANIZED OR HIGH MODE SHARE AREAS

The following bicycle parking requirements have been scaled to reflect the increased bicycle parking requirements of communities which are densely developed, more urbanized, or which have higher levels of bicycle use.

Residential

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Single family dwelling	No spaces required.	No spaces required.
Multifamily dwelling		
a) With private garage for each unit*	No spaces required.	0.10 spaces for each bedroom. Minimum is 2 spaces.
b) Without private garage for each unit	0.5 spaces for each bedroom. Minimum is 2 spaces.	0.10 spaces for each bedroom. Minimum is 2 spaces.
c) Senior Housing	0.5 spaces for each bedroom. Minimum is 2 spaces.	0.10 spaces for each bedroom. Minimum is 2 spaces.

* A private locked storage unit may be considered as a private garage if a bicycle can fit into it.

Civic: Cultural/Recreational

Type of Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Non-assembly cultural (library, government buildings, etc.)	1.5 spaces for each 10 employees. Minimum requirement is 2 spaces.	1 space for each 8,000 s.f. of floor area. Minimum requirement is 2 spaces.
Assembly (church, theaters, stadiums, parks, beaches, etc.)	1.5 spaces for each 20 employees. Minimum requirement is 2 spaces.	Spaces for 5% of maximum expected daily attendance.
Health care/hospitals	1.5 spaces for each 20 employees or one space for each 50,000 s.f. of floor area, whichever is greater. Minimum is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum is 2 spaces.
Education		
a) Public, parochial, and private day-care centers for 15 or more children	1.5 spaces for each 20 employees. Minimum is 2 spaces.	1 space for each 20 students of planned capacity. Minimum is 2 spaces.
b) Public parochial, and private nursery schools, kindergartens, and elementary schools (1-3)	1.5 spaces for each 10 employees. Minimum requirement is 2 spaces.	1.5 spaces for each 20 students of planned capacity. Minimum requirement is 2 spaces.
c) Public parochial, and elementary (4-6), junior high and high schools	1.5 spaces for each 10 employees plus 1.5 spaces for each 20 students of planned capacity. Minimum requirement is 2 spaces.	1.5 spaces for each 20 students of planned capacity. Minimum requirement is 2 spaces.
d) Colleges and universities	1.5 spaces for each 10 employees plus 1 space for each 10 students of planned capacity; or 1 space for each 20,000 s.f. of floor area, whichever is greater.	1 space for each 10 students of planned capacity. Minimum requirement is 2 spaces.
Rail/bus terminals and stations/ airports	Spaces for 7% of projected a.m. peak period daily ridership.	Spaces for 2% of a.m. peak period daily ridership.

Commercial

Commercial Activity	Long-term Bicycle Parking Requirement	Short-term Bicycle Parking Requirement
Retail		
General food sales or groceries	1 space for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 2,000 s.f. of floor area. Minimum requirement is 2 spaces.
General retail	1 space for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 5,000 s.f. of floor area. Minimum requirement is 2 spaces.
Office	1.5 spaces for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum requirement is 2 spaces.
Auto Related		
Automotive sales, rental, and delivery Automotive servicing Automotive repair and cleaning	1 space for each 10,000 s.f. of floor area. Minimum requirement is 2 spaces.	1 space for each 20,000 s.f. of floor area. Minimum requirement is 2 spaces.
Off-street parking lots and garages available to the general public either without charge or on a fee basis	1 space for each 20 automobile spaces. Minimum requirement is 2 spaces. Unattended surface parking lots excepted.	Minimum of 6 spaces or 1 per 10 auto spaces. Unattended surface parking lots excepted.

Industrial/Manufacturing

Type of Activity	Long-Term Bicycle Parking Requirement	Short-Term Bicycle Parking Requirement
Manufacturing and production	1 space for each 12,000 s.f. of floor area. Minimum requirement is 2 spaces.	Number of spaces to be prescribed by the Director of City Planning. Consider minimum of 2 spaces at each public building entrance.

DEFINITIONS

Policy[1]: A specific statement of principle or of guiding actions that implies clear commitment but is not mandatory; a general direction that a governmental agency sets to follow in order to meet its goals and objectives before undertaking an action program [Source: *A Glossary of Zoning, Development, and Planning Terms*, American Planning Association, Planning Advisory Service Report Number 491/492]. Policies are the core principles which requirements, regulations and codes are designed to enforce.

Requirement: Something needed or necessary; a demand [Webster's Dictionary]. While some general requirements may be advisory in nature, they can be used more specifically by local agencies to enforce policy with regard to a particular project. In this case they would become mandatory.

Code[2]: Collection of laws [Webster's Dictionary]. As with other development requirements, codes governing bicycle parking are usually legislated by the local body of elected officials from a city, town or county. Codes contain regulations which are applied generally to enforce policy.

Regulation[3]: A rule or order prescribed for managing government [Source: *A Glossary of Zoning, Development, and Planning Terms*, American Planning Association, Planning Advisory Service Report Number 491/492]. Regulations are specific, legislated elements of a code, utilized to enforce policy.

[1] Advisory [2] Mandatory [3] Mandatory

APPENDICES

APPENDIX A

Dimensions of Bicycles

Table A-1: Dimensions of conventional bicycles

Dimension	Typical	Notes
Wheel diameter	24" - 29"	29", a.k.a. Twenty-Niner, is a recent fad. 27" or 700cm (700c) are common on road or hybrid types. 26" are common on mountain, comfort and cruiser types. 24" are found on bicycles for shorter adults. 20", 18", and 16" are common on adult folding bicycles and on children's bicycles. 12" and smaller wheels are found on some folders, and on children's bicycles.
Length	70" - 72"	For 26" or larger wheels. Length of smaller-wheel bicycles is typically shorter due to the smaller wheel diameter.
Handlebar width	18" - 30"	As narrow as 12" on some folding bicycles. 18" - 20" for road bicycles (dropped, ram's horn or racing bars). About 24" for mountain, hybrid and comfort bicycles. Up to 30" for extra wide bars on some cruisers. Before the advent of mountain bicycles in the early 1980s, road bicycle handlebars predominated in the U.S., and rack designs that predate the mountain bicycle have rack element spacing of about 18".
Height	42" - 48"	On an upright (hybrid or comfort) bicycle, handlebar ends may be higher than the seat. On a road bicycle, the seat is typically the highest point.
Pedal envelope	Extends 4" - 5" on either side	Can constrain rack designs that use vertical staggering, if the handlebars of one bicycle pass close to pedals of adjacent bicycles that are supported at a greater height.
Front basket	Extends up to 18" beyond handlebars	Typically neither wider than handlebars, nor taller (extending farther from the ground) than the handlebar ends.

Other Bicycle Types

Certain other bicycle types have lengths or widths that significantly exceed the above ranges, and may not fit in bicycle storage lockers intended for conventional bicycles.

Table A-2: Other bicycle types

Bicycle type	Notes
Tandem (two inline riders)	Length up to 100"; other specs similar to conventional bicycles. Will fit in most outdoor bicycle racks, but may extend into aisles.
Recumbent (feet-first, with a chair or sling-like seat)	Height of seat back similar to height of conventional bicycles. Front wheels frequently smaller than 26", sometimes also rear wheels. Pedals often elevated, sometimes as much as 18" above ground. Several subtypes: Short wheelbase (SWB): Length < conventional. Medium wheelbase (MWB) or Compact: Length like conventional. Long wheelbase (LWB): Length > conventional. If length does not exceed conventional length, a recumbent will typically fit in a bicycle locker. Even if overall length does not exceed conventional length, the distance between tire contact points may exceed the length of guide trays on certain two-level bicycle storage racks.
Adult tricycle	Two formats: Delta (single wheel in front) Tadpole (single wheel in rear) Two layouts in each format: Upright (similar to conventional comfort or hybrid bicycle) Recumbent (feet first, similar to two-wheel recumbent)
Cargo	Several subtypes: Longtail (extended length bicycle frames which carry cargo behind the rider) Cargo trailer (wheeled cart which attaches to the rear of the bicycle to carry cargo) Bakfiets (Northern European-style cargo bicycle which carries cargo in front of the rider, usually in a large basket or wooden cargo hold)

Implications of Bicycle Shapes on Bicycle Rack and Locker Design

The dimensions and spatial placement of bicycle elements (frame members, handlebars, seats, pedals, baskets, etc.) affect how well bicycle rack or locker designs will accommodate a broad range of bicycle types and sizes. Conversely, faulty or restrictive assumptions made by bicycle rack or locker designers can prevent certain types or sizes of bicycles from being secured by the frame, or may lead the users of those bicycles to lock in a way that compromises security – for example by only locking the front wheel.

Table A-3: How bicycle dimensions affect rack and locker design

Dimension	Design implication for racks and lockers
Wheel diameter	On racks and in lockers with wheel stops, may affect the bicycle's front-back positioning. May also affect vertical positioning, if the wheel support has a cutout or both front and back wheel stop elements, such that smaller wheels sit lower in the wheel holder.
Length	Interior depth (door to rear wall) is a basic property of a bicycle locker.
Handlebar width	For racks without vertical staggering, determines minimum practical spacing of rack elements. For racks with vertical staggering, determines minimum practical spacing of bicycles.
Height	Interior height is a basic property of a bicycle locker. On 2-level racks, bicycle height determines whether a bicycle can be parked on one or both rack levels.
Pedal envelope	Can constrain rack designs that use vertical staggering or multiple levels, if handlebars of one bicycle pass close to pedals of adjacent bicycles supported at a different height.
Front basket	Height of bottom of basket determines maximum height of any bicycle rack element that the bicycle is expected to glide over while being parked and removed. Some bicycle rack designs have elements directly in front of where a bicycle's handlebars will be positioned, precluding the use of front baskets with front-in parking.

Table A-4: One-level horizontal bicycle rack layouts

Layout	Examples	Enable locking of frame	Require large lift of front wheel to lock frame	Prevent front wheel flop	Large front baskets OK	Require small lift of front wheel over pipe to park	Vertical stagger, enabling 16" spacing
Wheel support only	PW Athletic "Loop Rack" Concrete wheel wells Lindcraft L-9	N	N/A	Y	Y	N	N
Planar loop	Inverted U, post-and-hoop	Y	N	N	Y	N	N
Hanging locking loop	Cora "Expo"	Y	N/A	N/A	N/A	N	N
Wheel well + support/locking loop	Creative Pipe "Lightning Bolt"	Y	N	Y	Y	N	N
Wheel support + locking loop	Peak "Campus Rack" Benno	Y	Y	Y	Y	N	Y

Table A-5: Two-level horizontal bicycle rack designs

Product	Supports bicycle in vertical plane	Vertical stagger (close spacing)	Articulated upper tray (easier loading)	Notes
Bicycle Security Racks Co. "Bicycle Double Decker Framework"	Y*	N	N	*Bicycle must be rolled in/out vertically, then leaned against an adjacent support bar.
Palmer "Double Decker"	Y	Y	N	
Dero	Y	N/A	N/A	
Josta "Double Parker"	Y	Y	Y	
Dero Decker	Y	Y	Y	

Table A-6: Vertical (hanging) bicycle rack designs

Product	Bicycle support	Loop for U-locking bicycle frame	Multiple-bicycle models	Wall-mount	Free-standing (floor-mount)
Simple hooks	Front wheel, at wall	N	N	Y	N
Creative Pipe Wall Hook 1	Front rim, top	Y	N	Y	N
Palmer VertiRack II	Front rim, top	Y	N	Y	N
Palmer VertiRack 4-bicycle unit	Front rim, top	Y	Y	Y	Y
Dero UltraSpaceSaver	Behind fork and below front tire	Y	Y	Y	Y

Maximizing Bicycle Parking Density

The storage density of a bicycle rack design depends primarily on the spacing between adjacent bicycles. Adjacent bicycle spacing is constrained by handlebar width, and most rack designs that do not vertically stagger bicycles work well with a 24 inch bicycle spacing that corresponds to the handlebar width of common mountain and hybrid bicycle types. Obsolete rack designs that predate the mountain bicycle (early 1980s) may have bicycle spacing of around 18 inches, corresponding to the handlebar width of then-popular road-bicycle (a.k.a. racer) handlebars.

For double-loaded areas, the density also depends on the extent of wheel overlap of opposing bicycles.

Maximum bicycle density is achieved by rack designs or installations that vertically stagger bicycles such that the now-common 24-inch handlebars overlap in space. Such designs typically space bicycles 14 to 16 inches apart. Horizontal vertical stagger designs include wheel support elements that raise every other bicycle, or its front (handlebar) end, 8 to 12 inches above adjacent bicycles. In vertical (hanging-bicycle) arrays, raising every other bicycle about 12 inches achieves the same density.

The highest bicycle storage density with independent insertion and removal is achieved by two-level horizontal designs that employ vertical staggering; the 14 to 16 inch bicycle spacing on each level produces a 7 to 8 inch per-bicycle spacing when both levels are counted.

Table A-7: Selected bicycle rack designs using vertical alternation

Product (Manufacturer)	Layout	Bicycle spacing per level	Bicycle spacing counting all levels
Campus Rack (Peak Racks)	Horizontal 1-level	16"	16"
Benno "Fahrradstander" (Behnisch Architects)	Horizontal 1-level	16"	16"
Ultra Space Saver (Dero Bike Racks)	Vertical floor-standing or wall-mount	16"	16"
VertiRack 4-bicycle unit (Palmer Group)	Vertical wall-mount	16"	16"
DoubleDecker (Palmer Group)	Horizontal 2-level	14"	7"

Clearances

Horizontal single-loaded racks

Depth

Many bicycle rack areas use horizontal single-loaded racks oriented perpendicularly or diagonally to a path, walkway or aisle. The total required depth of such areas is the sum of three depths, starting from the walkway.

Table A-8: Components of rack area depth

Area	Function	Dimension
Front	Access: Reduces conflicts between path or walkway users, and bicyclists accessing bicycles. If not provided, users and bicycles being accessed will obstruct path/walkway travel.	Minimum 12" unless the walkway serves only as an access aisle in a bicycle parking area. Along busy paths or walkways, provide at least 24".
Bicycle	Storage: Bicycle parking depth	For perpendicular layouts: 6' for conventional bicycles, 10' if tandem bicycles or single bicycles with child trailers are expected. For diagonal layouts, adjust above depths by the sine of the angle between the walkway and the bicycle frames.
Rear	Maintenance: Enables gardeners to trim shrubs or hedges behind bicycles.	If there are shrubs or hedges or something else behind the parked bicycles that requires maintenance, provide at least 12".

End Bicycles

For bicycles parked perpendicularly to a walkway or aisle, provide at least 24 inches between the frame of the leftmost and rightmost bicycle and the side walls or fences or other elements next to the rack area. This enables the users of the end bicycles to stand next to the bicycle in order to reach forward and access a front basket, items on the handlebars, or a front locking position.

Vertical (hanging) Racks

Vertical rack installations, whether wall-mounted or floor-mounted (freestanding), must provide sufficient overhead clearance that a bicycle can be lifted onto the support element (hook, cradle, or other). The required vertical clearance is the sum of three dimensions, starting from the floor or ground:

Table A-9: Components of required vertical clearance for vertical racks

Dimension	Function	Notes
Ground clearance	Distance from floor to rear tire of hanging bicycle.	For vertical-stagger designs, measure the upper (riser) position.
Bicycle length	Length of hanging bicycle	
Lifting clearance	Distance that a bicycle must be lifted beyond the support point in order to hang it or remove it.	Depth of hook or cradle that supports the bicycle.

If extended-frame bicycle types such as longtails or tandems are to be stored vertically on vertical-stagger racks, consider reserving the upper positions for them and ensuring that the support height is sufficient that the rear tire will not touch the floor.

APPENDIX B

Programming a Building or Cluster

This section defines how to program and distribute bicycle parking for a large building with several user groups, each of whose desire lines may favor different entrances. In some cases a small cluster of buildings may share a set of desire lines and may be able to be analyzed as a single large building.

- A user group is a set of building occupants or visitors that shares a common bicycle usage pattern that affects the need for security (expensive commuter bicycles vs. basic campus bicycles), the duration of storage (all-day or over-night vs. short-term), or the building entrance(s) likely to be favored.
- Depending on the building's function, user groups may include office occupants, residents, graduate students with office space, undergraduate students attending classes in auditoriums, visitors, and perhaps others. If a group is composed of subgroups whose bicycle usage patterns differ, it should be subdivided into two or more user groups accordingly. For example a faculty member may be a building occupant or a visitor.
- To program means calculating the needed quantities of short- and long-term bicycle parking from each user group's bicycle usage patterns.
- Compute each building's long-term and short-term parking needs from zoning or building code requirements, survey responses, estimates, or by relating occupant projections to surveys of other buildings.
- To distribute means dividing those quantities among the building entrances to best serve the arrival and departure patterns of the user groups.

The following worksheet and discussion is based on examples from Stanford University, a residential campus with high bicycle usage. However, the method is applicable to non-campus office, commercial, mixed use and multifamily housing regardless of bicycle usage rates.

Sample Bicycle Parking Programming Worksheet for Large Building:

University Computer Science Department (academic) building with 480 office occupants and 200 classroom seats.

Persons = Number of persons in this user group
% Bicycle = % of # persons in that user group expected to arrive by bicycle
# Bicycles = Number of bicycles for this user group (= # persons x % bicycle)
% Long term = % of # bicycles that need secure (enclosed) storage
# Long term = Number of bicycles to be enclosed (= # bicycles x % long term)
# Short term= Number of bicycles not needing enclosure (= # bicycles - # long term)

Table B-1: Bicycle parking programming worksheet example

User Group	#Persons	%Bicycle	#Bicycles	%Long term	#Long term	#Short term
Faculty with office	100	60%	60	50%	30	30
Staff with office	80	50%	40	50%	20	20
Grad students with desk	300	50%	150	30%	45	105
Classroom students	200	70%	140	0%	0	140
Visitors	50	50%	25	0%	0	25
Total	750		415		95	320

Two ratios are estimated for each user group:

%Bicycle **Percentage expected to arrive by bicycle (i.e. bicycle mode share).**

%Bicycle varies by job description, office culture and dress code. Stanford's surveys of occupants and building managers showed that science, engineering and medical faculty and staff had bicycle usage ratios of 50 percent or more, whereas most administrative and financial staff generally had ratios of 20 percent or less. These ratios were then applied to new buildings whose office culture would be similar to previously surveyed departments.

Some building occupants keep a work bicycle at the building for errand running, and some departments provide fleet bicycles for this purpose. Both practices increase the bicycle mode share of user groups that use those bicycles.

At Stanford about 70 percent of classroom attendees arrive by bicycle.

%Longterm **Percentage of bicycles expected to need secure (enclosed) storage, i.e, a bicycle locker or bicycle storage room space.**

%Long term is the fraction of parked bicycles for a given User Group that are expected to require protection from accessory theft. This depends on commute distance and culture. Longer-distance commuters are more likely to use higher-value bicycles, but some just-off-campus commuters may ride inexpensive bicycles which they don't mind parking at outdoor racks all day. Classroom students and visitors were assumed not to need secure storage at academic buildings.

For dormitory residents, Stanford began by programming an outdoor bicycle rack space per bed, i.e, %Bicycle = 100% and %Long term = 0%. Over time, some dormitories added secure bicycle courtyards (i.e, %Long term > 0).

For our example building, long- and short-term bicycle capacity was distributed as follows:

#Long term Provided by a shared bicycle storage room.

#Short term Distributed among three building entrances:

Main classroom entrance: Over half of the 320 spaces, to accommodate 140 classroom arrivals and a portion of visitors and graduate students expected to arrive along the same desire line from the center of campus.

Side (staff) entrance: Most of the remaining rack capacity.

Third (north) entrance (serving a minor desire line): A small amount.