

Federal Highway Administration University Course on Bicycle and Pedestrian Transportation

Lesson 17: Bicycle Parking and Storage

July 2006



U.S. Department of Transportation
Federal Highway Administration



Pedestrian and Bicycle Safety

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LESSON 17:

BICYCLE PARKING AND STORAGE

17.1 Introduction

Bicycle parking is an important supporting element in bicycle programs. Quite simply, bicyclists need a safe and convenient place to park or store their bicycles along or at the end of most trips. This lesson contains the following information on developing an effective bicycle parking program: basic bicycle parking strategies; bicycle rack designs, specifications, and costs; and bicycle parking ordinances. The major sections of this lesson are as follows:

- 17.1 Introduction.
- 17.2 Overview of the Problem.
- 17.3 Overview of Bicycle Parking Strategies.
- 17.4 Implementing Bicycle Parking Strategies.
- 17.5 Student Exercise.
- 17.6 References and Additional Resources.

This lesson on bicycle parking and storage has been primarily derived from the “Bicycle Parking” chapter of *Implementing Bicycle Improvements at the Local Level*.⁽¹⁾ Other sources of information are listed at the end of the lesson.

17.2 Overview of the Problem

Providing secure bicycle parking is a key ingredient in efforts to encourage bicycling at the local level (see figure 17-1). Many bicycle trips end somewhere other than the bicyclist’s home, and as a result, the bicyclist must park his or her bicycle. And for those who live in apartment complexes, college dormitories, or other high-density settings, the issue of where to leave a bike while at home is also a serious issue. In short, at one time or another, most bicyclists have experienced the frustration of finding no secure place to leave their bikes.

While providing secure bicycle parking is not the entire solution to the problem of theft, it certainly can help, and it can increase bicyclists’ comfort in leaving their bicycles unattended. As a result, many bicycle owners may be encouraged to make bicycle trips that they might otherwise forego.



Figure 17-1. Photo. Effective bicycle parking improves security and reduces theft.

17.3 Overview of Bicycle Parking Strategies

An effective bicycle parking program should include the following basic strategies:

- **Provide bicycle parking in public rights-of-way.** Provide well-located secure bicycle parking at popular destinations in business districts and at other public sites:
 - Install bicycle parking at public centers.
 - Install bicycle parking on public rights-of-way in neighborhood commercial and downtown business districts.
 - Encourage private businesses to provide bicycle parking for their customers.
 - Install bicycle parking at transit stops and in parking garages.
 - Encourage the installation of high-security bicycle parking at existing worksites, schools, and high-density residential developments.
- **Provide bicycle parking in private development.** Encourage bicycle parking at existing developments and require new commercial, public, and high-density residential developments to include plans for bicycle parking:
 - Encourage existing businesses to provide bicycle parking for their customers.
 - Add provisions to local zoning regulations requiring bicycle parking as part of new developments, particularly commercial, public, and high-density residential developments.
 - Make these requirements part of the process of getting a building permit.

Typically, the provision of bicycle parking at public facilities helps to convince business owners of the need for bicycle parking on private development. The use of zoning regulations or bicycle parking ordinances helps in the long-term to ensure bicycle parking in newly developed areas.

Bicycle parking can be provided for these strategies using three types of devices (see figure 17-2):

1. **Bicycle racks.** These are open-air devices to which a bicycle is locked and work well for short-term parking.
2. **Bicycle lockers.** These are stand-alone enclosures designed to hold one bicycle per unit and are a good choice at sites that require long-term parking for a variety of potential users.
3. **Bicycle lock-ups.** These are site-built secure enclosures that hold one or more bicycles and are often used for long-term parking for a limited number of regular and trustworthy users.

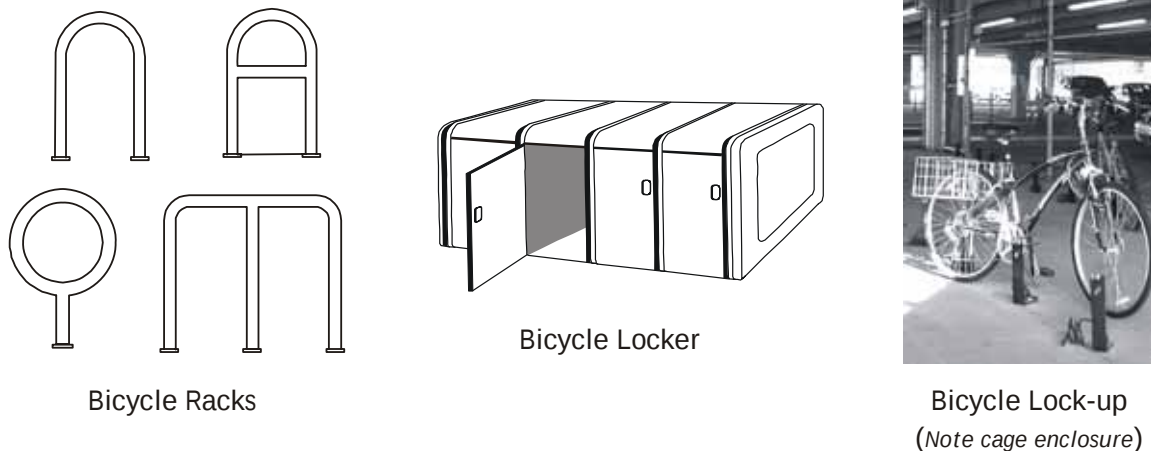


Figure 17-2. Illustrations and photo. Examples of common bicycle parking devices.

17.4 Implementing Bicycle Parking Strategies

This section describes one possible approach to implement bicycle parking. Other approaches are possible and encouraged, particularly if the bicycle parking program is managed by city or county government. This approach is organized chronologically by major steps.

Step 1—Identify Key Implementers

Each of the strategies described previously requires the cooperation of a different group of constituencies. Bicycle parking in public spaces requires the cooperation of public agencies who control or manage the property involved. Sidewalks are typically controlled by the streets or public works department, whereas a parks and recreation department typically has responsibility for open spaces and recreational areas. There may be an agency (similar to the Federal Government's General Services Administration) in charge of all public property. Or agencies that run specific services (e.g., libraries, public health clinics) may control their own sites.

Encouraging businesses to install bicycle parking may require the cooperation of such groups as the local chamber of commerce, downtown business association, or shopping center manager. In addition, agencies that routinely deal with businesses should be enlisted as outlets for any literature developed as part of the program.

Altering zoning regulations to require consideration of bicycle parking in new developments requires close cooperation with city planning and zoning agency staff, as well as assistance from appointed zoning boards and builders' associations. Typically, regulations are revised on a schedule; therefore, the time or opportunity to revisit bicycle parking requirements will need to be coordinated with these schedules.

Step 2—Structure the Program

In some communities, a reactive program that simply fills orders and answers questions can be successful. This success would be most likely in a bicycle-friendly community with a high degree of interest in bicycling matters. However, in many places, a reactive approach will result in little and disorganized response. Business owners and managers of large employment centers or residential complexes often see bicycles as clutter and a problem to be eliminated rather than as a solution to traffic congestion or air quality problems. As a result, a successful bicycle parking program should include elements of marketing and promotion.

With the help of the key implementers identified in step 1, one could create three ad hoc task groups to cover three primary thrusts. The groups should create the ground rules and materials necessary for the following tasks:

- Task Group 1: Public Bicycle Parking.
 - Install bicycle parking at public centers.
 - Install bicycle parking on public rights-of-way.
 - Install bicycle parking at transit stops and in parking garages.
- Task Group 2: Private Bicycle Parking.
 - Encourage private businesses to provide bicycle parking for their customers.
 - Encourage installation of high-security bicycle parking at worksites, schools, and high-density residential developments.
- Task Group 3: Zoning Regulation Revision.
 - Add provisions to local zoning regulations requiring bicycle parking.
 - Make these requirements part of the process of getting a building permit.

Step 3—Identify Priority Locations that Need Bicycle Parking

The International Bicycle Fund (IBF) provides the following information on identifying locations for bicycle parking:⁽²⁾

Various mechanisms can be used for determining where bicycle parking is needed. Almost all the ones that are sited with bicyclist input are in heavy use. It is more likely that those sited for political consideration will be underutilized. Siting bicycle parking doesn't have to be scientific. Some of the best deterrents for bicycle parking are:

- **Visual observation:** Look for where bikes are parked illegally due to lack of legal parking. The (car) parking patrol people can probably do this for you in a week.
- **User input:** Ask bicyclists (through clubs or advocacy groups) to create a list of most-needed spots for bike parking.
- **Land use criteria:** Target every coffee shop, bookstore, video arcade, teen/young adult clothing store.
- **Public-private partnership:** Have a grant program whereby businesses can request bike parking for customers and employees, paying for the installation themselves, but getting the racks paid for by the grant.
- **Building code:** Require all new development or change of business to install bike parking proportionate to car parking requirements.

More scientific criteria may be useful for determining exactly what kind of bicycle parking device to install and exactly where.

- **Visibility:** Cyclists should easily spot short-term parking when they arrive from the street. A highly visible location discourages theft and vandalism. Avoid locations “off on the side,” “around the corner” or in un-supervised parking structures or garages.
- **Access:** The parking area should be convenient to building entrances and street access, but away from normal pedestrian and auto traffic. Avoid locations that require bicycles to travel over stairs.
- **Security:** Surveillance is essential to reduce theft and vandalism. For security, locate parking within view of passersby, retail activity, or office windows. Better yet: officially assign building security, a parking lot attendant, or other personnel to watch for suspicious behavior.
- **Lighting:** Bicycle parking areas should be well lit for theft protection, personal security and accident prevention.
- **Weather protection:** Whenever possible, protect bicycle parking area from weather. An existing overhang or covered walkway is recommended.

Alternatively, construct a canopy or roof—either freestanding or attached to an existing building.

- **Avoid conflict with pedestrians:** Locate racks so that parked bicycles don't block the pedestrian path. Select a bike rack with no protruding bars that could trip or injure cyclists or pedestrians. Very low bar-type racks can be a hazard to pedestrians and are not recommended.
- **Avoid conflict with automobiles:** Separate bicycle parking, auto parking, and road areas with space and a physical barrier. This prevents motor vehicles from damaging parked bicycles and keeps some thieves at a distance. Most professional bike thieves use vans or similar vehicles to hide their activities and make a getaway with their loot concealed. The closer bicycle parking is to automobile parking, alleys, roads, etc., the better the opportunity for a bike thief.

The following location criteria have been gathered from guidelines used by the cities of Denver and Seattle for placing bicycle racks:

- Racks should be located within 15.2 meters (m) (50 feet (ft)) of building entrances (where bicyclists would naturally transition into pedestrian mode).
- Racks should be installed in a public area within easy viewing distance from the main pedestrian walkway, usually on a wide sidewalk with 1.5 m (5 ft) or more of clear sidewalk space remaining (a minimum of 61 centimeters (cm) (24 inches) of clear space from the parallel wall and 76 cm (30 inches) from the perpendicular wall).
- Racks are placed to avoid conflicts with pedestrians. They are usually installed near the curb and at a reasonable distance from building entrances and crosswalks.
- Racks can be installed at bus stops or loading zones only if they do not interfere with boarding or loading patterns and there are no alternative sites.

Step 4—Choose Appropriate Bicycle Parking Devices

As described earlier, bicycle parking can be accomplished with three basic devices: racks, lockers, or lock-ups (see figure 17-2). Packets of information should be assembled for available bicycle parking devices, along with the pros and cons of each device. In a joint meeting(s) with all three task groups, adopt a set of criteria and decide which devices are to be endorsed. Typical criteria used to evaluate bicycle parking devices are security (and how well the device works with common bicycle locks), durability and resistance to vandalism, ease of use, aesthetics, and cost.

The Association of Pedestrian and Bicycle Professionals (APBP) publication, *Bicycle Parking Guidelines*, suggest that bicycle racks should:⁽³⁾

- Support the bicycle upright by its frame in two places.
- Prevent the wheel of the bicycle from tipping over.
- Enable the frame and one or both wheels to be secured.
- Support bicycles without a diamond-shaped frame with a horizontal top tube (e.g., a women's or other 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 the seat tube of the bicycle.
- Resist being cut or detached using common hand tools.

The American Association of State Highway and Transportation Officials' (AASHTO) *Bicycle Guidelines* recommend that bicycle racks should:⁽⁴⁾

- Not bend wheels or damage other bicycle parts.
- Accommodate high-security U-shaped bike locks.
- Accommodate locks securing the frame and both wheels (preferably without removing the front wheel from the bicycle).
- Not impede or interfere with pedestrian traffic.
- Be easily accessed from the street and protected from motor vehicles.
- Be visible to passersby to promote usage and enhance security.
- Be covered where users will leave their bikes for a long time.
- Have as few moving parts as possible.
- Accommodate a wide range of bicycle shapes and sizes.
- Be simple to operate.

Figure 17-3 illustrates a variety of bicycle racks that meet these requirements, whereas figure 17-4 illustrates types of bicycle racks that are not recommended because they fail to meet one or more of these requirements. The average cost for typical bicycle racks ranges from \$75 to \$100 per rack; a single rack typically holds one or two bicycles. The cost for bicycle lockers ranges considerably more, from about \$500 to \$1,500 per bicycle.

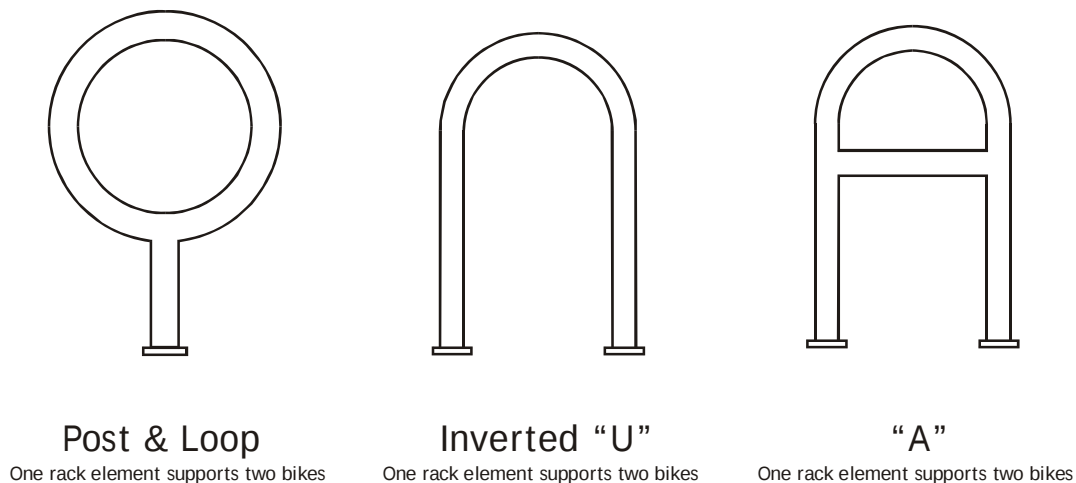
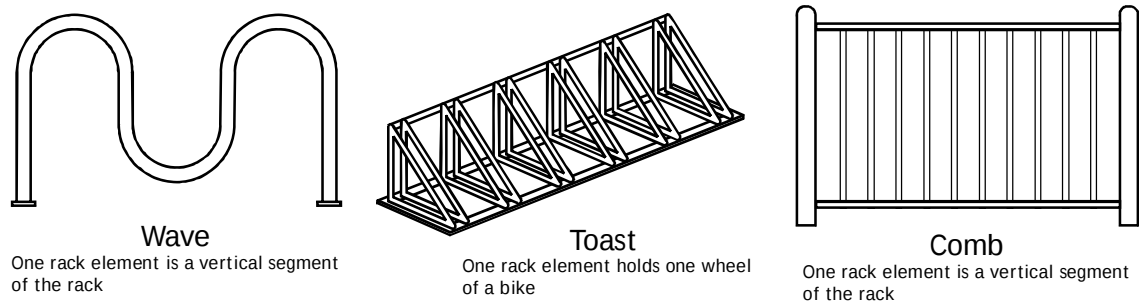


Figure 17-3. Illustrations. Recommended types of bicycle racks.

Source: *Bicycle Parking Guidelines*⁽³⁾



These bicycle racks are not recommended

Figure 17-4. Illustrations. Bicycle rack types that are not APBP-recommended.

Source: *Bicycle Parking Guidelines*⁽³⁾

In addition to the basic bicycle rack design, the layout of bicycle rack areas will need to be designed. The APBP *Bicycle Parking Guidelines* provides some minimum recommended dimensions for bicycle rack areas (see figure 17-5).⁽³⁾ Their guidelines also suggest that large rack areas with a high turnover rate have more than one entrance. If possible, the rack area should be protected from weather elements.

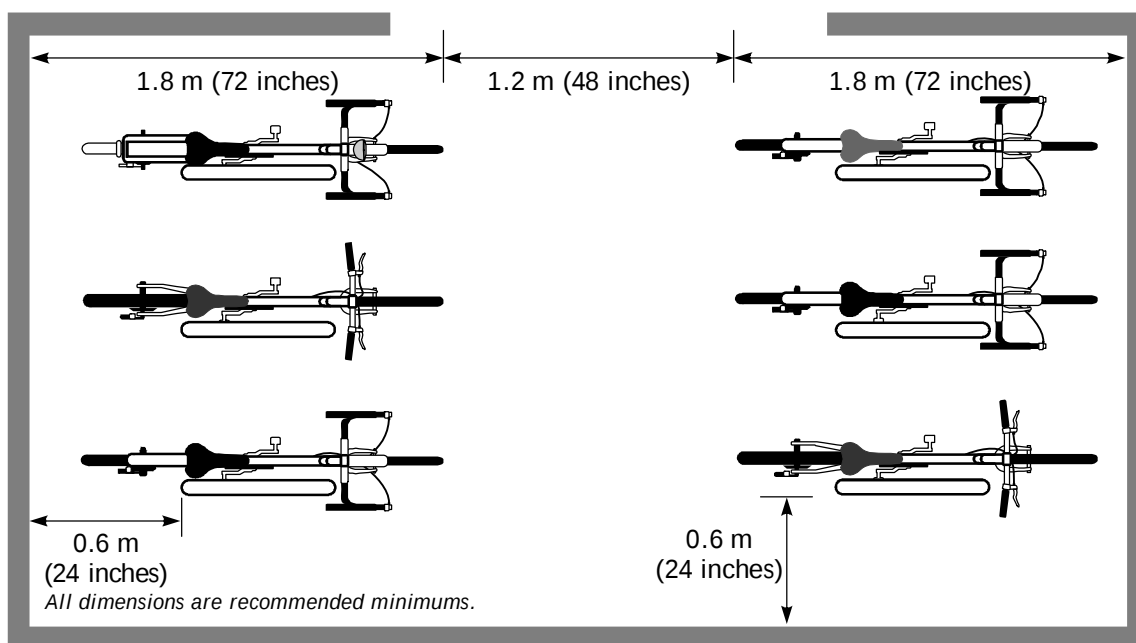


Figure 17-5. Illustration. APBP-recommended design dimensions for bicycle rack areas.

Source: *Bicycle Parking Guidelines*⁽³⁾

Step 5a—Tasks for Developing Public Bicycle Parking

The first task group should set criteria for installing bicycle parking on sidewalks as well as at public destinations. For sidewalks, criteria could include such items as minimum width of sidewalk, rack position on sidewalk and proximity to other street furniture and vegetation, and number per block or number per site. For public sites, they could include proximity to the main entrance, and minimum number of bicycle parking spaces per installation (i.e., based on the type of facility served).

Next, they should create a step-by-step procedure for planning and installation. This should include initial identification of the potential site, discussion with relevant agency personnel, determination of the specific site's needs (number of parking devices and location), cost analysis and budgeting, procurement, installation, and followup.

To support this activity, they should create a project sheet for rack installation that includes places for the source of the request (if any), signatures of any required agency personnel, a schematic diagram of the site, installation date, and any comments.

Next, they should estimate the total bicycle parking need for public places given a list of potential sites. Estimates can be conservative and based to some extent on existing bicycle traffic, as long as participants recognize that latent demand may be significant. For this reason, phased installation may be particularly appropriate.

For sidewalks, a base number of racks to be installed during a fiscal year (e.g., 100, 500, or 750) should be decided, along with a map showing priority areas. For instance, downtown might be a top-priority area, neighborhood commercial areas could be second, and strip development areas might be third.

Finally, the first task group should set an annual budget for the program and decide how the bicycle parking will be funded. Potential sources include a wide variety of Federal transportation programs, as well as local funding opportunities.

Step 5b—Tasks for Developing Private Bicycle Parking

The second task group should assemble a packet of information for potential private-sector bicycle parking providers. The packet should include a cover letter describing the importance of bicycle parking to businesses and giving any organizational endorsements for the program; a list of available parking devices, along with information on how to order them and which are best suited for which settings; tips on deciding how many bikes need to be accommodated; and tips on locating and installing the devices.

The second task group should also work out details of any promotional activities that will need to be planned. For instance, they should develop a list of groups to talk with, determine who should be responsible for reaching each one, and start making contacts. To this end, the task group should develop a standard presentation, possibly including slides and handouts.

Step 5c—Tasks for Revising Zoning Regulations

The third task group should start by identifying passages in the existing zoning codes where motor vehicle parking is discussed. They should find out when the regulations are going to be modified and use that in determining their schedule of work. They should then assemble sample bicycle parking laws from other communities. Based on the sample laws, they should create a draft revision to the regulations and circulate it for comment. Once comments have been received and considered, they should forward a final draft revision for action at the proper time.

Based upon examples from several locations (e.g., Ann Arbor, MI, Madison, WI, Denver, CO, and San Francisco, CA), bicycle parking ordinances should include these elements:

1. **Number of spaces required.** Bike parking ordinances should clearly indicate how many bicycle parking spaces are required, either as a function of the type of development (retail, office, residential, etc.) or as a standard percentage of the required off-street automobile parking. For

example, the City of Denver requires that off-street automobile parking facilities of 20 spaces or more provide bicycle parking equal to 5 percent of the automobile parking space requirement.

2. **Type(s) of permitted racks.** Bicycle racks that support the bike by the wheel should not be permitted.
3. **Location of bicycle racks.** Bicycle racks should be located at least as close to the building entrance as to the nearest parking space (excluding accessible parking spaces).
4. **Other elements.** The requirements can also address lighting of bicycle racks, requirements to retrofit existing public buildings, and protection from weather.

A growing number of communities have included bicycle parking requirements in their development regulations. By so doing, they ensure that bicycle parking is included in the normal course of development. Figure 17-6 contains excerpts about bicycle parking from the off-street parking ordinance in Madison, WI.⁽⁵⁾ Figure 17-7 illustrates the City of Philadelphia's standard for bicycle rack placement in business districts.⁽⁶⁾ Bicycle parking ordinances from numerous other cities can be found by searching a particular city's website for their planning, development, or land use ordinances.

Step 6—Implement the Program

With the program established, materials prepared, and initial funding identified, implementation of the program can begin. Routine responsibilities for the various tasks should be taken care of by the agencies identified through the previous steps. Oversight of the program may require the attention of a project coordinator. This may be a task delegated to a member of the planning department or public works staff.

Step 7—Evaluate Progress

As the work is proceeding, keep track of successes and failures. Early on, get the word out to the bicycling public that: (1) the program exists and (2) they should submit comments and ideas for potential parking sites. Keep a record of how many parking devices have been installed, how many comments have been received, how many information packets have been sent out, what proportion of public places has adequate bicycle parking, how well the parking is working (i.e., whether the public likes it, whether it holds up well to vandalism), and how successful the zoning regulations appear to be (once they are adopted). Use this feedback to fine-tune the program and determine future levels of funding.

Excerpts from “28.11 OFF-STREET PARKING AND LOADING FACILITIES”

(1) Statement of Purpose

...
(d) Providing adequate and safe facilities for the storage of bicycles.

(2) General Regulations

(a) Scope of Regulations

...
4. Bicycle parking facilities shall be provided as required for all new structures and uses established as provided in Sec. 28.11(2)(a)1. or for changes in use as provided in Secs. 28.11(2)(a)2. and 3; however, bicycle parking facilities shall not be required until the effective date of this paragraph. Notwithstanding Secs. 28.08(1)(i), 28.09(1)(i), and 28.09(5)(a), bicycle parking facilities shall be provided in all districts including districts in the Central Area.

(3) Off-Street Parking Facilities

(a) Utilization

1. In the residence district, accessory off-street parking facilities provided for uses listed herein shall be solely for the parking of passenger automobiles (including passenger trucks) and bicycles of patrons, occupants, or employees. Such vehicles are limited in size to less than one (1) ton in capacity.

...
(e) Size ... Required bicycle parking spaces shall be at least 0.6 m by 1.8 m (2 ft by 6 ft). An access aisle of at least 1.5 m (5 ft) shall be provided in each bicycle parking facility. Such space shall have a vertical clearance of at least 1.8 m (6 ft).

...
(h) Design and Maintenance. ... 2. d. Bicycle Parking Facilities. Accessory off-street parking for bicycle parking shall include provision for secure storage of bicycles. Such facilities shall provide lockable enclosed lockers or racks or equivalent structures in or upon which the bicycle may be locked by the user. Structures that require a user-supplied locking device shall be designed to accommodate U-shaped locking devices. All lockers and racks must be securely anchored to the ground or the building structure to prevent the racks and lockers from being removed from the location. The surfacing of such facilities shall be designed and maintained to be mud and dust free.

...
(i) Location. ... 3. Bicycle parking facilities shall be located in a clearly designated safe and convenient location. The design and location of such facility shall be harmonious with the surrounding environment. The facility location shall be at least as convenient as the majority of automobile parking spaces provided.

...
(l) Schedule of Required Off-Street Parking Facilities. ... 1. Bicycle parking facility spaces shall be provided in adequate number as determined by the Zoning Administrator. In making the determination, the Zoning Administrator shall consider when appropriate, the number of dwelling units or lodging rooms, the number of students, the number of employees, and the number of automobile parking spaces in accordance with the following guidelines:

(continued on next page)

Figure 17-6. Photo. Excerpts from off-street parking ordinance in Madison, WI.

Source: *Code of Ordinances*⁽⁵⁾

(l) <u>Schedule of Required Off-Street Parking Facilities</u> (continued)	
Off-Street Bicycle Parking Guidelines	
Land Use	Bike Space
Dwellings/lodging rooms	1 per dwelling unit or 3 lodging rooms
Clubs/lodges	1 per lodging room plus 3% of person capacity
Fraternities/sororities	1 per 3 rooms
Hotels/lodging houses	1 per 20 employees
Galleries/museums/libraries	1 per 10 automobile spaces
Colleges/universities/junior high and high schools	1 per 4 employees plus 1 per 4 students
Nursery/elementary schools	1 per 10 employees plus students above second grade
Convalescent and nursing homes/institutions	1 per 20 employees
Hospitals	1 per 20 employees
Places of assembly, recreation, entertainment, and amusement	1 per 10 automobile spaces
Commercial/manufacturing	1 per 10 automobile spaces
Miscellaneous/other	To be determined by the Zoning Administrator based on the guidelines for the most similar use listed above
(l) 1. a. In all cases where bicycle parking is required, no fewer than two spaces shall be required. b. After the first fifty (50) bicycle parking spaces are provided, additional bicycle parking spaces required are 0.5 (one-half) space per unit listed. c. Where the expected need for bicycle parking for a particular use is uncertain due to unknown or unusual operating characteristics of use, the Zoning Administrator may authorize that construction and provision of not more than 50 percent of the bicycle parking spaces be deferred. Land area required for provision of deferred bicycle parking spaces shall be maintained in reserve. ...	

Figure 17-6. Photo. Excerpts from off-street parking ordinance in Madison, WI—*Continued*
Source: Madison, WI, *Code of Ordinances*⁽⁵⁾

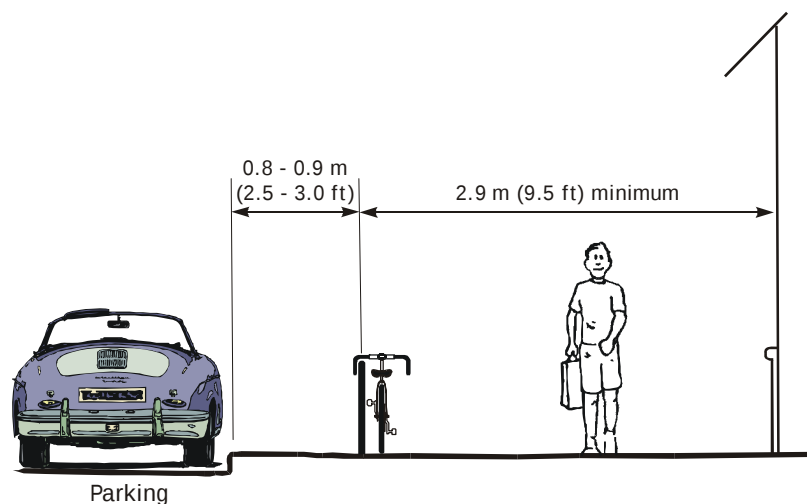


Figure 17-7. Illustration. Philadelphia's standard for bike rack placement in business districts.
Source: *City of Philadelphia Bicycle Parking Specifications*⁽⁶⁾

17.5 Student Exercise

Exercise A

Do an inventory of need for bicycle storage facilities and a preliminary site design for an activity center in your community.

Exercise B

Develop a bicycle parking ordinance for your local community. Have students consider the features discussed in this chapter.

17.6 References and Additional Resources

The references for this lesson are:

1. Williams, J., B. Burgess, and B. Wilkinson, *Implementing Bicycle Improvements at the Local Level*, Federal Highway Administration, Publication No. FHWA-RD-98-105, Washington, DC, 1998.
2. *Bicycle Parking Criteria, Bike Rack, Bicycle Locker, Cycle Stands & Bike Storage Systems*, International Bicycle Fund, 2004, available online at <http://www.ibike.org/engineering/parking.htm>, accessed March 9, 2004.
3. *Bicycle Parking Guidelines*, Association of Pedestrian and Bicycle Professionals, Spring 2002, available online at <http://www.apbp.org/pdfs/bikepark.pdf> or <http://www.bicyclinginfo.org/pdf/bikepark.pdf>, accessed March 23, 2004.
4. *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials, Washington, DC, 1999.
5. *Code of Ordinances*, City of Madison, WI.
6. *City of Philadelphia Bicycle Parking Specifications*, 1998.

Additional resources for this lesson include:

- *Bicycle Parking*, Bicycling Info Website, available online at <http://www.bicyclinginfo.org/de/park.htm>, accessed April 12, 2004.
- *Bicycle Parking Facility Guidelines*, City of Portland, OR, Office of Transportation, available online at <http://www.trans.ci.portland.or.us/bicycles/parkguide.htm>, accessed April 20, 2004.
- Fletcher, Ellen, *Bicycle Parking*, 1990.
- *Pro Bike News*, Bicycle Federation of America, April 1996.
- *Source Book of Designs, Manufacturers, and Representatives*, Bicycle Federation of America, 1992.

