Bicycle Parking Rack Selection

**Background**

Madison’s zoning ordinance regarding bicycle parking [MGO 28.11, see esp. Subsections (3)(e) and (3)(h)2d] specifies some basic bicycle parking space and rack design criteria. These design criteria are based on the dimensions of standard adult sized bicycles, and the spacial needs for accessing each space. This is similar to the City’s car parking lot design requirements. The table below lists typical bicycle dimensions, and the resultant design criteria included in the ordinance.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Typical Dimension</th>
<th>Madison Zoning Ordinance Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td></td>
<td>2 feet</td>
</tr>
<tr>
<td>Drop Handlebars (road bike)</td>
<td>15 - 18 inches</td>
<td></td>
</tr>
<tr>
<td>Flat Handlebars (mountain bike / hybrid)</td>
<td>20 - 24 inches</td>
<td></td>
</tr>
<tr>
<td>Pedals</td>
<td>16 inches</td>
<td></td>
</tr>
<tr>
<td>Length of Bicycle</td>
<td>68 inches</td>
<td>6 feet</td>
</tr>
<tr>
<td>Access Aisle</td>
<td></td>
<td>5 feet</td>
</tr>
<tr>
<td>Vertical Clearance (adult height)</td>
<td></td>
<td>6 feet</td>
</tr>
</tbody>
</table>

In addition to meeting these spacial requirements, bicycle parking racks must also accommodate the use of all popular locking devices used by bicyclists. These include U-shaped locks such as Kryptonite, Citadel, the Bike Club and others that have similar designs. Most bicyclists use a U-lock to lock the front wheel and bicycle frame to something solid. Some bicyclists will lock the back wheel and frame, and a few will remove the front wheel and lock it along with the back wheel and frame to something solid.

It should be noted that these design criteria are not unique to Madison. Most other communities that require bicycle parking as part of their zoning ordinances (and there are many such communities) have similar design criteria. Despite the commonness of these design criteria, few manufacturers of bicycle parking racks build racks to meet them. Below is a discussion of (1) criteria for evaluating bicycle parking racks; (2) a few general rack types and some unique racks that meet these design criteria; (3) guidelines for installation of these racks; and (4) bicycle parking rack types to avoid.

Madison’s ordinance also specifies criteria for the location of bicycle parking racks on the property. “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 auto parking spaces provided.” Further, “All . . . racks shall be securely anchored to the ground or building structure . . . [and] . . . the surface of such facilities shall be designed and maintained to be mud and dust free.” [MGO 28.11(3)(I)3 and 28.11(3)(h)2d]

In general, bicycle parking should be located in a visible location, as close to the building entrance as possible. The area should also be lit at night. Bicycle parking located in areas where many people pass by decreases the chances that a bike thief will have time to steal a bike. Bike racks located in remote areas, behind fences or shrubs, or out back by the dumpster, for example, give bike thieves cover and time to steal bicycles. Poor rack locations will lead to the racks not being used as bicyclists will have a hard time finding them, or will find something closer the their
destination to lock up to.

**Criteria for Evaluating Bicycle Parking Racks**
The best racks have the following qualities:

- Spaces clearly at least 2 feet wide (2 feet from center of one space to center of adjacent spaces is another way to conceptualize this. See figure 1);
- Simple design that needs no explanation as to how the rack works (which direction does the bike go in, how is the lock attached, every space is useable for any standard bicycle with typical accessories such as lights and fenders, etc.) and that is difficult to mis-use, and will not cause problems for others (either other bicyclists using the rack, or pedestrians).
- Each space accommodates all types of user supplied locking mechanisms, including U-shaped locks, with the lock used to lock the bicycle frame and wheel(s) to the rack.
- Spaces that are clearly designated for each bicycle (it is obvious to the user where each space is) whether the rack is designed for single or double sided loading. For example, a rack designed for double sided loading with four bicycles on each side at two foot spacings is placed near a wall resulting in single sided use of the rack. Does the user see 8 one foot wide spaces or four two foot wide spaces? This type of confusion can lead to either fewer spaces being available as bicycles are loaded randomly into the spaces, or crowding and difficulty getting bicycles out if users try to squeeze more bikes in than the rack is designed to hold. Note that these problems will occur with this type of rack under double sided loading conditions as well.

**Special Considerations for Double-Sided Rack Design**
Racks that are intended for loading bicycles from both sides can park more bicycles in given width, but require additional length for both the second row of bicycles plus a second access aisle. Note, however, that the width savings will only occur as long as the handlebars of the bicycles parked on each side do not overlap. If the handlebars overlap, then the width space savings of double-sided loading racks is lost. Figures 2 - 4 illustrate this point. (See discussion below of wave racks and inverted-U racks for examples.)

**Figure 1**

**Figure 2** Double-sided rack, handlebars do not overlap the rack. Five bikes can be parked in the width of three, provided the location has adequate length (20 feet total: 10 feet for bicycles, assuming 1 foot of overlap, plus two 5-foot access aisles, one behind each row of bicycles).
Double-sided racks where the handlebars overlap the rack require a full 2 foot width for each bicycle regardless of which side the bicycle is loaded from, thus there is no width saving with this design.

Note also that the height of the rack should be below the handlebars so that the bicycles do not have to be lifted up and over the rack.

A single sided rack will save space lengthwise, or a double sided rack where the handlebars do not overlap the rack will better utilize the space, accommodating more bicycles.

**Acceptable Racks**

A. General Rack Types

"Inverted U" racks (figure 6) became popular in the 1980's, and remain one of the most preferred racks by bicyclists today. Inverted-U racks are a simple design, aesthetically pleasing, and can fit into limited spaces as well as large installations. They can be individually mounted (preferred) or ganged together on runners. The inverted-U rack is designed to park two bicycles, facing in opposite directions, parallel to the rack. Racks in a parallel series need to be 4 feet apart to provide adequate access to each bicycle (see figure 5). Most manufacturers of these racks will recommend spacing as little as two feet apart. Spacing them less than 4 feet apart will result in difficulty loading & removing bikes from racks when bikes are parked adjacent to each other. If adjacent racks are spaced is less than 4 feet, count each rack as one space, not two.

Adjacent inverted-U racks need to be spaced 4 feet apart in order to have sufficient room to fully load these racks and to be able to remove bicycles from the racks. If spaced less than 4 feet apart, then count each rack as parking only one bicycle, not two.

Note that while adjacent bicycles are parked in alternating directions, similar to double sided loading racks, there is no width savings from using these these racks since the handlebars overlap. Adequate width must be maintained to easily maneuver bicycles in and out of the spaces.
The major design concern with this type of rack is the length of the rack (the distance between the two verticals, see figure 6). Most inverted-U racks are only 18 - 24 inches long. This is too short to effectively park two bicycles due to the seat and handlebars of the two bikes lining up against each other making access to the verticals for attaching a U-lock difficult. Inverted-U racks that are 18 - 24 inches long should be considered as accommodating one bicycle, not two. Acceptable inverted-U racks are a minimum of 30 inches long, with a 36 inch length preferred. At this length, two bicycles parked on opposite sides facing in opposite directions will not interfere with each other. A nice design addition is a horizontal bar across the inverted-U about 18 inches off the ground. This provides additional stability, especially for smaller bicycles, as well as additional flexibility in locking a bicycle to the rack (figure 6). Height of the rack can be of concern as well. An overall height of about 30-32” works well. A height of 36” or more can cause interference with handlebars, limiting how bicycles may be parked and locked.

The "post and ring" rack (figure 7) was originally designed as an attachment to a parking meter for bicycle parking. Now these are used in a similar fashion as Inverted-U racks. The ring is typically 18 inches in diameter. The bottom of the ring should be about 12” off the ground. As with short inverted-U racks, the post and ring rack should be considered a one bicycle rack, especially when in multiple rack installations.

B. Acceptable Specific/Unique Racks

Some specific unique racks (racks that are proprietary to a specific manufacturer) that meet the above criteria are pictured below. Contact information for these manufacturers is included at the end.

Figure 8: Lightning Bolt rack from Creative Pipe

Figure 9: “Bike” bike rack from Dero Racks

Figure 10: UW rack

Figure 11: Campus Rack from Dero Racks

Figure 12: One and Two Post Key racks (aesthetic inverted-U’s) from MADRAX.
Marginal Racks

Racks with moving parts were popular during the 1970's bike boom. Typically, these enclosed the bicycle frame and wheels in some fashion with the user locking the rack, but not necessarily the bicycle. Generally speaking, the more complicated the rack, the more problems there are likely to be both in terms of maintenance (especially in Madison's climate) and in terms of the rack not fitting certain bicycles or bicycles with different accessories. If you are interested in a bicycle parking rack with moving parts, first check that the spaces are 2 feet wide (2 feet apart center to center), then make sure that the bicycle and its wheel(s) can be locked to the rack with a U-lock, not just the rack being locked to itself. Also test the rack with different types of bicycles equipped with different common accessories (water bottles, pump, fenders, lights, etc.) To make sure that the rack is suitable for all common bicycle designs and that there is no interference with accessories.

Angled continuous loop racks. These racks area intended to be essentially attractive ganged together inverted-U racks. Unfortunately, there are two general problems with these racks. First, the spacing of the inverted-U sections is too narrow for double sided loading (both in terms of the length of the individual U's, less than 30 - 36 inches; and the distance between U's, less than four feet). Secondly, users are often confused as to how to use them, particularly which angle to load from. This can drastically reduce the number of spaces actually available for use. For these reasons, these racks are not generally recommended. If the use of this type of rack is desired, there must be at least two feet between adjacent inverted-U sections, and the number of spaces provided shall be determined as one space per inverted-U section.

Racks That Are Unacceptable

The "fence" or "grid" style rack depicted in Figure 14, is one of the most commonly seen racks. These racks are unacceptable due to typically narrow spaces, 16 - 18 inches wide, and due to the fact that U-locks cannot be used effectively without mis-using the rack. Thus, this rack type is unacceptable even if the spaces are 24 inches wide. Bicyclists given no other option will often use these racks by lifting the front wheel over the rack in order to use a U-lock. This can damage the bicycle frame and fork. Another common mis-use of this rack is for a bicycle to be parked parallel to the rack, instead of perpendicular, turning it into a one bike rack. This style of rack is also known for a tendency to bend wheels when a bicycle falls over or is forcefully knocked over.

The "wheel holder" depicted in Figure 15 is another common unacceptable rack type. This rack has many of the shortcomings of the fence style racks: typically narrow spacing and an inability to use U-locks. Some people will use this rack backwards in order to use a U-lock, but this will not work with some fatter mountain bike tires, or if the bicycle has fenders or if the rack is located in an area where it is accessible from only one side. This rack can also bend wheels when a bicycle falls or is knocked over.
“Wave” or “loop” racks (Figure 16) are just pretty fence racks, although bent wheels are no longer a problem. Wave racks are designed for double sided loading (loading bicycle from both sides), and a manufacturer's advertised number of spaces is based on double sided loading. Most wave racks have spaces 18 - 20 inches wide (verticals 9-10 inches apart), a few have 24 inch wide spaces (verticals 12 inches apart) based on double sided loading and spaces staggered on opposite sides. U-locks can be used for bicycles parked in the open top spaces, but not in the closed top spaces. If the rack is against a wall, fewer spaces will be available (see comments above on evaluating racks). Even in an open area, these racks are difficult to fill to capacity. The handlebars of each bicycle in the open top spaces are on the other side of the rack from the rest of the bicycle, exasperating the narrow space problem and making it difficult to load a bicycle next to it from the opposite side. Bicyclists can, and will, park parallel to this rack, as with the fence style rack. Note that manufacturer's advertised number of spaces is almost always exaggerated. At most, count one bicycle per vertical. An even more realistic count of spaces is one per open top space plus one on each outside end. The number of spaces is a moot point, however, since this rack style is not recommended.

“Pedestal” style racks were developed in the 1970's during the bike boom that coincided with gasoline shortages. These designs support the bicycle below its center of gravity, making bicycles prone to falling over. Many of these allow the rack to be locked, but not the bicycle. They may have holes large enough to fit a U-lock through, but the bicycle wheel and frame often cannot be locked directly to the rack with the U-lock.

Also unacceptable is any rack that does not have spaces clearly 2 feet wide for each bicycle, or any rack for which each space does not allow the frame and wheel(s) to be locked directly to the rack with a U-shaped lock.

A list of bicycle parking rack manufacturers and their models which meet the City of Madison’s design guidelines is currently under development. If you know of manufacturers with racks that you think meet the City of Madison's design guidelines, please contact Arthur Ross, Pedestrian-Bicycle Coordinator (608/266-6225 or aross@ci.madison.wi.us) for rack evaluation for inclusion in this list.